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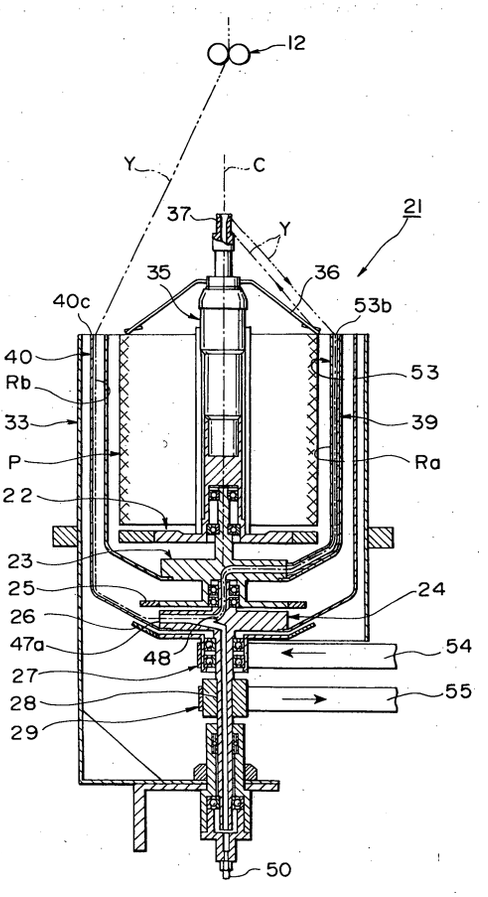
(54) Four-for one twister

(57) The present invention relates to a four-for-one twister provided with a package supporting member which supports a supply package (P) in a stationary position on a center line, an inner yarn path (Ra) formed in a vertical direction outside of the supply package, an outer yarn path (Rb) formed in a vertical direction outside of the inner yarn path. In order to regulate the increase in tension of the yarn rotating at high speeds and to protect against yarn entanglement and to reduce, therefore, a yarn breakage the inner yarn path (Ra) is formed in an inner guiding member (39) revolving around the center line (Fig. 1).

FIG. 1



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Description

[0001] The present invention relates to a four-for-one twister according to the preamble of claim 1 and is a divisional application of EP 97 122 447.2.

[0002] A conventional four-for-one twister has been officially published in the. Japanese patent publication No. Showa 44-6685. This four-for-one twister 1, as shown in Figure 6, is comprised of a package supporting member 2 which supports a supply package P on vertically extending center line C in a stationary position, an upper disk 3 and a lower disk 4 which revolve around the center line C, a pulley 7 which drives the upper disk 3 and is provided with permanent magnets 6 that attract permanent magnets 5 provided on the upper disk 3, and a pulley 9 which drives the lower disk 4, and is attached through a spindle 8 to the lower disk 4. The four-for-one twister 1 is constructed so as to form long an inner yarn path A and an outer yarn path B vertically around the supply package P. Drive providing the pulleys 7 and 9 are driven by drive belts 10 and 11, which are attached between motors (not shown in the drawing), and rotated in mutually opposed directions.

[0003] The four-for-one twister 1 guides a yarn Y, which is first pulled in an upward direction from the supply package P, in a downward direction along the inner yarn path A, and through a yarn guide hole 3a of the upper disk 3. It then guides the yarn through a yarn path 8a of the spindle 8, and further passes it through a yarn guide hole 4a of the lower disk 4 which revolves in an opposed direction from the upper disk 3. It then guides the yarn Y drawn out of the guide hole 4a to take-up rollers 12 through the outer yarn path B. With each rotation of the upper disk 3 and lower disk 4 rotating in mutually opposed directions, four additional twists are imparted to the yarn Y.

[0004] Thus, it takes a long time for the yarn to pass through the yarn path comprised of the yarn guide hole 3a of the upper disk 3, the yarn path 8a of the spindle 8, and the yarn guide hole 4a of the lower disk 4. Hence, it is a problem of the conventional four-for-one twister is that it takes a long time to pass the yarn and clear a new supply package, bringing down the operational efficiency of the twister.

[0005] Further, since the four-for-one twister 1 creates a curved, bow-shaped balloon along the outer yarn path B and inner yarn path A from the yarn Y revolving at high speeds around the center line C, the balloon tension is higher than in a two-for-one twister which only creates one balloon. This creates another problem, which is that with the four-for-one twister 1, increasing the speed of the rotation of the upper disk 3 and lower disk 4, by severely increasing the tension of the balloon, creates hairiness in the yarn and can lead to yarn breakage. Also, due to changes in the yarn tension, the inner balloon may expand into the outer balloon, and the two balloons may become entangled causing the yarn to break. Furthermore, the outer balloon, due to changes in the tension of the yarn, may come into contact with a permanent magnet 13 which keeps the package supporting member 2 stationary, and this may cause the yarn to break.

[0006] The problem underlying the present invention is to propose a four-for-one twisting machine that by regulating the increase in tension of the yarn rotating at high speeds and protecting against yarn entanglement, can reduce yarn breakage.

[0007] In order to solve the first mentioned problem the parent application proposes to use a four-for-one twister in which the twisting of the yarn occurs by means of an upper disk provided with a yarn guide hole and a lower disk provided with a yarn guide hole, said disks rotating concentrically in mutually opposed directions, air to pass yarn in a forwardly moving direction in each of the yarn guide holes. The yarn that is let out of each of the yarn guide holes is pulled by air in a forwardly moving direction, and is passed through the yarn guide holes.

[0008] Furthermore, it is proposed to sequentially connect the yarn guide holes of the upper disk and the lower disk. The yarn that is let out is pulled by the air, and is passed through the two connected yarn guide holes in a forwardly moving direction.

[0009] An ejecting nozzle is provided that injects air to pass the yarn which opens into an appropriate place inside the yarn guide holes. When the yarn guide holes eject air from the ejecting nozzle, outside air is sucked in from the upstream side by means of upstream suction force created by the nozzle openings. The air sucked in and the air ejected by the nozzle join, and by flowing towards the downstream end inside the hole, create a flow of air that passes the yarn in a forward moving direction through the length of the hole. When the yarn that is let out is made to enter the hole from the upper end of the yarn entry hole, it is automatically passed through the hole and pulled out from the outer downstream end by means of the air suction flowing along the yarn passage through the hole.

[0010] The problem- of the present invention is solved by the features defined in the characterizing portion of claim 1. The four-for-one twister provided with a package supporting member to support the supply package on the center line in a stationary position, an inner yarn path formed in a vertical direction outside of the supply package, and an outer yarn path formed in a vertical direction outside of the inner yarn path, has, therefore, the inner yarn path formed in the inner guiding member which revolves around the center line. Even if the rotational speed of the inner guiding member is increased in order to impart additional twist to the yarn, the yarn led along the inner yarn path formed in the inner guiding member does not form a balloon. Because of this, the yarn tension can be regulated, and the yarn passing along the inner yarn path does not become entangled with the yarn passing along the outer yarn path, and yarn breakage can be reduced. Since the yarn rotates around

the center line along with the inner guiding member, no slip occurs between the yarn and the inner guiding member, and frictional heating can be regulated.

[0011] Preferably an outer guiding member rotates in an opposed direction to the inner guiding member around the center line wherein in the outer yarn guiding member the outer yarn path is formed and the outer yarn guiding member and the inner yarn guiding member each are formed as a tube with a bottom and yarn guide linked in the outer yarn guiding member and inner yarn guiding member at the bottom of each of the tubes are connected and extend to the center line. Even if the rotational speed of the inner guiding member is increased in order to impart additional twist to the yarn, the yarn led along the inner yarn path formed in the inner yarn guiding member and the yarn led along the outer yarn path formed in the outer yarn guiding member do not form a balloon. Because of this the yarn tension can be regulated and the yarn passing along the inner and outer yarn paths do not become entangled, and yarn breakage is reduced. The yarn rotates around the center line with the inner and outer guiding members, so there is no slip created in the rotational path between the inner and outer guiding, members, and frictional heating can be regulated. The rotating inner and outer guiding members are formed with tube bottoms, so air flows conically along the surface of the inner and outer tubes, and wind resistance and noise can be reduced.

[0012] In addition, the bottom of the outer guiding member is preferably formed slanting upwards and facing out, and permanent magnets are placed above and below the bottom of the outer guiding member such that the vertically positioned magnets are slanted at least partially upwards along the bottom of the outer guiding member in order to cause the inner guiding member to rotate. By guiding the yarn along the upward slant of the bottom of the outer guiding member and changing the direction of the yarn in a standing conic shape, hairiness and yarn breakage can be prevented. Furthermore, by slanting at least one side of the permanent magnets upwards, the vertically aligned permanent magnets are made to attract each other and can impart rotational force.

Brief Description of the Accompanying Drawing

[0013] Figure 1 shows a vertical cross-section of a four-for-one twister according to a first embodiment of the present invention.

[0014] Figure 2 is an enlarged front view of a cross-section of the upper half of a first embodiment of the present invention as shown in Figure 1.

[0015] Figure 3 is an enlarged front view of a cross-section of the lower half of a first embodiment of the present invention as shown in Figure 1.

[0016] Figure 4 shows a vertical cross-section of a four-for-one twister according to a second embodiment of the present invention.

[0017] Figure 5 shows a complete vertical cross-section of a third embodiment of the present invention.

[0018] Figure 6 shows a vertical cross-section of a conventional four-for-one twister.

Detailed Description of the Preferred Embodiments

[0019] Figure 1 to Figure 3 show an embodiment of a four-for-one twister according to the present invention. Figure 1 is a front diagram showing an entire vertical section, Figure 2 is an enlarged front diagram of a cross-section of the upper half, and Figure 3 is an enlarged front diagram of a cross-section of the lower half.

[0020] A four-for-one twister 21, as shown in Figure 1, is comprised of an inner yarn path Ra which extends vertically along an inner guiding member 39 which revolves around a center line C, and an outer yarn path Rb which extends vertically along an outer guiding member 40 which revolves around the center line C. The inner guiding member 39 and outer guiding member 40 together form a tube with a bottom that guides a yarn Y. Furthermore, the four-for-one twister 21 is provided with a package supporting member 22 which supports a supply package P along the center line C in a stationary condition, an upper disk 23 and a lower disk 24 which rotate around an axis of the center line C, a pulley 27 which drives the upper disk 23 which is provided with permanent magnets 26 that mutually attract permanent magnets 25 which is attached to the upper disk 23, and a pulley 29 which drives the lower disk 24 which is attached through a spindle 28 to the lower disk 24.

[0021] The package supporting member 22, as shown in Figure 3, fits into a boss portion 22a through bearings 31 and 31 on a standing center spindle 23a of the rotating upper disk 23. The package supporting member 22 is made stationary by the mutual attraction of fixed permanent magnets 32 which are affixed to a disk base 22b and fixed permanent magnets 34 which are affixed to the outside of a fixed hood 33. The package supporting member 22 is set up so that a cylindrical guide supporting member 35 can be freely attached and removed at the boss portion 22a. The guide supporting member 35, as shown in Figure 2, is provided with freely rotating guides 36 and 37 which guide the yarn Y taken off from the package P.

[0022] The upper disk 23, as shown in Figure 3, fits into a boss portion 23b through bearings 38 and 38 on a standing center spindle 24a. The upper disk 23 is affixed to the inner guiding member 39 comprised of a tube with a bottom with something like a screw fastened to a base portion 23c. The lower disk 24 is affixed to the outer guiding member 40 comprised of a tube with a bottom with something like a screw fastened to a base portion 24c. The inner guiding member 39 and outer guiding member 40 are made from non-magnetically conductive materials like aluminum, synthetic resin, stainless steel, or titanium, for example, so as not to interfere with the magnetic attraction between the permanent magnets 32

and 34, and 25 and 26. Since the inner guiding member 39 and outer guiding member 40 are formed of a non-magnetically conductive material, when they revolve, even though the magnetic power of the attraction of the permanent magnets 32 and 34 is present, the electric power consumption used in driving the rotation does not create an overcurrent or produce heat, so it does not have to be increased. The spindle 28 is allowed to freely rotate through bearings 44 and 45 on a bearing tool 43. The bearing tool 43 is fixed to fixed frame 41 by something like a nut member 42.

[0023] The upper disk 23 and lower disk 24 are provided with yarn guide holes 47 that form a yarn path R. The yarn guide holes 47 are sequentially comprised of an upper hole 47a and a lower hole 47b, the upper hole 47a opening into the base portion 23c of the upper disk 23, and the lower hole 47b opening into the base portion 24c and the standing center spindle 24a of the lower disk 24. The upper hole 47a and lower hole 47b, are connected through an air-tight passage 23d, and are positioned, as described below, so as not to leak, and thereby allow the air to flow through the holes 47a, 47b smoothly while passing the yarn Y along the yarn path R. The upper hole 47a consists of a radial portion extending towards the center line C from the outer surface of the base portion 23c, and a curved portion which continues at a right angle from said radial portion. The lower hole 47b consists of a standing portion in the same plane as the center line C, a curved portion at a right angle connecting to this standing portion, and a radial portion extending from this curved portion towards the outer surface of the base portion 24c.

[0024] The upper hole 47a of the upper disk 23 is connected to a yarn guide hole 53a of a yarn guide pipe 53 attached to the inner surface of the inner guide member 39. The yarn guide pipe 53 forms inside the pipe the inner yarn path Ra extending vertically to the inside of the inner guide member 39. The yarn guide pipe 53 is formed either from a combination of or a single non-magnetically conductive material such as aluminum, synthetic resin, ceramics, stainless steel, or titanium, so as not to interfere with the magnetic attraction of permanent magnets 32 and 34, to make the inner surface chafe-resistant, and decrease the frictional resistance. The upper end 53b (in reference to Figure 2) of the yarn guide pipe 53 opens in almost the same place as an open end 39b of the inner guiding member 39, permitting the thread to pass easily.

[0025] The lower hole 47b of the lower disk 24 opens into an ejecting nozzle 48 at the border area between the radial portion and the curved portion, and the ejecting nozzle 48 jets air to pass the string in the direction of the outer surface of the base 24. The ejecting nozzle 48 is connected to an air passage 49 opening vertically in the spindle 28, and receives a supply of pressurized air. In other words, the pressurized air supplied from an air supply pipe 50 which is attached to the bearing tool 43 is led in the air passage 49 by means of an air chamber 51 formed inside the bearing tool 43, and jetted from the ejecting nozzle 48.

[0026] The jetted air creates suction power in the yarn guide hole 47 from the ejecting nozzle 48 towards the upstream portion, and sucks in outside air from the upper end 53b of the yarn guide pipe 53 which connects to the yarn guide hole 47. In this way, the ejecting nozzle 48 can flow air used to pass the yarn Y in a forwardly moving direction along the yarn path R comprised of the yarn guide pipe 53 and yarn guide hole 47. Moreover, the air supply pipe 50 is fitted with an open/close valve (not shown in the drawings), and the supply of air pressure can be selectively stopped.

[0027] The outer guiding member 40 is formed like a bowl, with a rounded topless shape slanting up from the outer surface of a bottom portion 40b, and forms the outer yarn path Rb which extends vertically along an inner surface 40a and the inner surface of the bottom portion 40b, and from which yarn fed out an exit 47c of the yarn guide hole 47 is smoothly directed into a standing vertical position thereby preventing hairiness and yarn breakage.

[0028] The permanent magnets 25 and 26 placed above and below the bottom of the outer guiding member 40 impart rotational force to the upper disk 23 from the pulley driving the upper disk 23. The lower permanent magnets 26 are slanted upwards along the upper incline of the bottom portion 40b of the outer guiding member 40, and cause the upper permanent magnets 25 to draw near, imparting rotational force. Further, although not shown in the drawings, the upper permanent magnets 25 on the upper disk 23, while maintaining the yarn path R, are slanted upwards along the rising incline of the bottom portion 40b of the outer guiding member 40 while drawing the lower permanent magnets 26 closer and imparting rotational force.

[0029] The fixed hood 33 is fixed to the fixed frame 41 and the like, and is provided with a tube portion 33a which engages revolving the outer guiding member 40 and a notch 33b past which drive belts 54 and 55 travel. The fixed hood 33 has the permanent magnet 34 permanently attached on the outside, and maintains the package supporting member 22 in a stationary position. Between pulleys 27, 29 and the drive mechanism (not shown in the drawings), drive the belts 54, 55 are attached, and cause the pulleys 27, 29 to rotate in mutually opposed directions at the same rotation speed.

[0030] Next, operation of the four-for-one twister 21 is explained.

[0031] First, with the belt drives stopped, the operator inserts a new supply package P into the package supporting member 22 along with the previously removed the guide supporting member 35, as shown in Figure 1.

[0032] Next, the operator passes the yarn Y from the supply package P through the guides 36 and 37, and inserts it into the end opening 53b of the yarn guide pipe 53. At this time, if pressurized air is supplied from the air supply pipe 50, the yarn Y is sucked into the yarn

guide hole 53a of the yarn guide pipe 53 where air suction is created from the ejecting nozzle 48 as shown in Figure 3, guided along its passage with the air flow to the yarn guide hole 47, and comes out from the exit 47c facing the bottom portion 40b of the inclined inner guiding surface of the outer guiding member 40.

[0033] At this time; the air passing the yarn Y jetted from the exit (down-stream end) 47c of the yarn guide hole 47 flows up along the bottom portion 40b of the inclined inner guiding surface of the outer guiding member 40 and up the vertical inner surface 40a, and is further blown out vertically from an end opening 40c of the outer guiding member 40 (as shown Figure 1 and Figure 2). Thus, the yarn coming out from the exit 47c of the yarn guide hole 47 is ejected from the exit 47c and is passed with the air flow along surface 40a of the outer guiding member 40 vertically with the air flow, and passes vertically from the end opening 40c of the outer guiding member 40.

[0034] Next, the operator guides the yarn Y that has risen out of the end opening 40c into the take-up roller 12 (as shown in Figure 1), completing the yarn path. When the yarn passage is completed, drive is engaged by means of the drive belts 54 and 55, the upper disk 23 and inner guiding member 39 are made to rotate as the lower disk 24 and outer guiding member 40 are rotated in the opposite direction, and the four-for-one twister's twisting process is initiated. The supply of pressurized air from the air supply pipe 50 is, at a suitable time either after the yarn passage has been completed or immediately before the twisting process is begun, cut off by closing the open/close valve (not shown in the drawings).

[0035] Depending on the type of the yarn Y, pressurized air with pressure adjusted from the air supply pipe 50 can be supplied during the twisting process, and air can be flowed to the yarn guide hole 53a of the yarn guide pipe 53 and yarn guide hole 47, thereby easing the friction created between the yarn Y and yarn guide holes 53a and 47, and cooling the yarn Y, thus enabling control over the heating of the yarn Y.

[0036] Since the yarn Y, guided by the inner guiding member 39 and outer guiding member 40, does not form a balloon even when the rotational velocity of the inner guiding member 39 and outer guiding member 40 is increased to impart additional twist to the yarn Y, the four-for-one twister 21 can reduce yarn breakage, eliminate entanglement of the yarn Y, and regulate yarn tension.

[0037] Since the yarn Y revolves around the circumference of the center line C with the inner guiding member 39 and outer guiding member 40, there is no slip in the rotational course of the inner yarn guide 39 and outer yarn guide 40 and the four-for-one twister 21 can regulate the frictional heating caused by the yarn Y.

[0038] Furthermore, since rotating the inner guiding member 39 and outer guiding member 40 are formed as tubes with bottoms, and the fixed hood 33 acts as a stable cover, the four-for-one twister 21 can reduce wind resistance and wind noise.

[0039] Further still, since the permanent magnets 34 are attached to the outside of the fixed hood 33, it is possible to bring the fixed hood 33 and the outer guiding member 40 close together, enabling the four-for-one twister 21 to be compact.

[0040] Moreover, since thread tension can be regulated with only the inner guiding member 39, the four-for-one twister 23 allows the outer guiding member 40 and fixed hood 33 to be removed to accommodate different kinds of yarn.

[0041] Additionally, the yarn guide pipe 53 which is attached to the inner guiding member 39 can be removed from the four-for-one twister 21, and when the yarn is passed through, the tip of the yarn is then sucked towards the entrance of the yarn guide hole 47.

[0042] Further, the inner guiding member 39 and outer guiding member 40 can be formed without the tube with a bottom, with only the upper disk 23 and lower disk 24 comprising the standing pipes, and with the inner yarn path Ra and outer yarn path Rb allowing for the yarn to be passed by the air flow.

[0043] Further, it is possible to form the standing member as a hollowed out section standing from the upper disk 23 and lower disk 24, the inside of the concave groove facing the center line C to make the yarn path.

[0044] Further, although not shown in the drawings it is possible for the yarn path Rb, extending in the yarn guide pipe to the end opening 40c along the inner surface of the inner guiding member 40 from the exit 47c of the yarn guide hole 47, to be comprised of a single pipe hole, and further, for the yarn path R formed between the inner guiding member 39 and outer guiding member 40 to be comprised of a single hole. In this case, the ejecting nozzle 48 can be placed either at the entrance of the yarn path R (the upper end 53a of yarn guide pipe 53) or at the exit of the yarn path R (the yarn guide pipe exit forming yarn path Rb). In this case, the air hole. supplying pressurized air from the ejecting nozzle 48 is provided with a coupler at the air hole entrance, and while the rotation of the inner guiding member 39 and outer guiding member 40 are stopped, and the yarn Y is passed through, it is possible to attach a high-pressure hose to the coupler.

[0045] Figure 4 describes a second embodiment of the present invention.

[0046] A four-for-one twister 61 does a four-for-one twisting with a single drive belt 72, and is provided with a lower disk 64 which freely revolves on a fixed frame 74 through a bearing 81, a middle disk 75 which is attached on the lower disk 64. through a bearing 82, an upper disk 63 which freely revolves on the middle disk 75 through a bearing 83, and a package supporting member 62 which is attached on the upper disk 63□@through a bearing 84. Further, the four-for-one twister 61 is provided with a fixed hood 73 which is attached to the fixed frame 74, a outer guiding member 70 which is attached with something like a screw to the

lower disk 64, a stationary cap 76 which is fixed to the middle disk 75, and an inner guiding member 69 which is attached to the upper disk 63 with something like a screw.

[0047] The inner guiding member 69 and outer guiding member 70 are made of tubular shaped non-magnetically conductive materials, and on their inner' surface are provided with yarn guide pipes 91 and 92 made from non-magnetically conductive materials, these pipes 91 and 92 forming an inner yarn path Ra and an outer yarn path Rb. The lower end of the yarn guide pipe 91 is connected to a yarn guide hole 65 of the upper disk 63, and the lower end of the yarn guide pipe 92 is connected to a yarn guide hole 68 of the upper disk 64. Further, it is possible to omit the yarn guide pipes 91 and 92.

[0048] The four-for-one twister 61, after guiding the yarn drawn from stationary yarn supply package P in a downward direction to the yarn guide hole 65 on the upper disk 63 through a primary tensor 66, guides it upwards through the yarn guide pipe 91 of the inner guiding member 69 which revolves entirely with the upper disk 63. Then, after the yarn Y is guided in a downward direction to the yarn guide pipe 92 of the outer guiding member 70 through a secondary tensor 67, it is brought to a take-up device 71, having been guided through the yarn guide hole 68 of the lower disk 64 which rotates entirely with the outer guiding member 70. With each revolution of the upper disk 63 and lower disk 64 rotating in mutually opposed directions with drive from the belt 72, yarn Y is provided with four twists.

[0049] The package supporting member 62 supports the package by means of the mutual attraction of a permanent magnet 77 attached to the package supporting member 62 and a permanent magnet 78 attached to the stationary cap 76, along with the mutual attraction of a permanent magnet 80 attached to the fixed hood 73 and permanent a magnet 79 attached to the middle disk 75. Between the lower disk 64 and upper disk 63, an intermediate conveyor device 86 is set up in order to reverse the rotational drive force from the lower disk 64 to the upper disk 63. The intermediate conveyor device 86 is provided with a pulley 89 and a friction driven wheel 88 at the end of a rotating spindle 87. A belt 90 is attached between the pulley 89 and the boss member 63a of the upper disk 63, and frictional force is applied to the friction-driven wheel 88 from the upper boss member 64a on the lower disk 64.

[0050] Further, the structure of the intermediate conveyor device 86 can, in addition to the organization described above, be constructed as described in Japanese utility model publication No. Showa 48-1393, Japanese patent publication No. Showa 47-40100, and Japanese utility model publication No. Showa 50-16097.

[0051] The tips of ejecting nozzles 93 and 94 are opened at the appropriate place in the yarn guide hole 65 of the upper disk 63 and yarn guide hole 68 of the lower disk 64, and air for passing the yarn Y in a forwardly moving direction is flowed through. An air passage 95 (shown in the drawing by the dotted line) which supplies pressurized air to the ejecting nozzles 93 and 94 is comprised sequentially of an air hole 95a opened in the fixed frame 74, a sealed chamber 95b formed between the fixed frame 74 and lower disk 64, an air; hole 95c opened in the lower disk 64, a sealed chamber 95d formed between the lower disk 64 and middle disk 75, the air hole 95e opened in the middle disk 75, and a sealed chamber 95f formed between the middle disk 75 and upper disk 63, and is connected to the air supply pipe 50 in the air hole 95a.

[0052] Figure 5 describes a third embodiment of the present invention.

[0053] A four-for-one twister T is provided in order from the outside with an outer rotating tube 110 (the outer guiding member), an inner rotating tube 120 (the inner guiding member) and a package cover 130 positioned around the center axis, and a supply package P is provided inside the package cover 130. A yarn guide mechanism portion 150 is provided between the outer rotating. tube 110 and inner rotating tube 120. A hood H is provided on the outside of the outer rotating tube 110. The inner yarn path is formed from the inside of the inner rotating tube 120 vertically facing the outside of the supply package P, and the outer yarn path is formed inside the outer rotating tube 110 vertically facing the outside of the inner yarn path.

[0054] The inner and outer rotating tubes 120, 110 and the package cover 130 are each uncovered tubes with bottoms. The inner and outer rotating tubes 120, 110 are preferably made out of material that can endure high speed rotation, and even if friction is created with the yarn they will not wear away, and further, it is important that the material be light and non-magnetically conductive. Use of non-magnetically conductive metals such as aluminum, stainless steel synthetic compounds like ceramics and other non-electrically conductive materials are preferable. This is to prevent an overcurrent from arising in the tubes when the magnetic field between magnets M, m and N, n is rotated at high speeds, and to prevent heating or reverse torque from arising.

[0055] Moreover, in consideration of cost and processability, synthetic resin is thought preferable, particularly heat resistant phenolic plastic, urea resin, polyester resin and the like are good for machine processing. Buffing can reduce the frictional coefficient of the yarn, by a polish of an abrasion treatment on the surface, making the surface smooth and easy to pass. Further, because of the rise in intensity, when core fibers used to make glass cloth and other fabrics, or when mixing glass fibers with resin materials, a rotating tube made from FRP can be used.

[0056] At the center of the bottom of the outer rotating tube 110, a disk portion 111 in which a yarn guide passage 112 is formed is provided, and at the bottom of the disk portion 111, and a pulley portion 113 and a hollow spindle portion 114 are provided. The spindle portion

114, by means of a bearing tool 160 which is fixed to a frame F and the like with a nut 161, is allowed to rotate freely by means of a bearing, and by means of rotation drive supplied by a belt B on the pulley portion 113, the outer rotating tube 110 rotates. Pressurized air from a lower end opening portion 162 on the bearing tool 160 is supplied to an air passage 115 inside the spindle portion 114, and the said air passage 115 is formed so as to be connected to the yarn guide passage 112.

[0057] The inner rotating tube 120 is provided on the upper surface of the center of the bottom of the tube with a shaft portion 121 in which a yarn guide passage 122, and on the lower surface of the center of the bottom of the tube with the disk portion 123. The yarn guide passage 122 is formed extending uniformly from the shaft portion 121 to the disk portion 123. At the disk portion 123, the later-described yarn guide mechanism contracts, and a magnets Q attached to the disk portion 111 of the outer rotating tube 110 and which attracts magnets q are provided.

[0058] In the middle of the package cover 130 which is positioned inside the inner rotating tube 120, a bobbin holder 131 which holds a bobbin 133 of the supply package P is erected, the upper half of a yarn guide path 132 and the lower concave reception portion 134 are provided along the center axis of the bobbin holder 131. The package cover 130, by means of the shaft portion 121 of the inner rotating tube 120 inserted into the concave reception portion 134, is permitted to freely rotate in conjunction with the inner rotating tube 120 through a bearing. The magnet m which attracts the magnet M affixed to the hood H is attached to the outer surface of the bottom of the package cover 130, and the attraction of these magnets M and m keep the package cover 130 in a stationary position. The upper end of the bobbin holder 131 is equipped with a tenser cap 140 and a tension ring 141, and these impart the proper amount of tension to a yarn X drawn from the supply package P. A yarn guide path 142 which is connected to the yarn guide path 132 on the inside of the bobbin holder 131 is formed inside the tension cap 140.

[0059] The yarn guide mechanism portion 150 is comprised of a hollow pipe portion 151 which extends from a guide A on the upper part of the supply package P, between the outer rotating tube 110 and inner rotating tube 120, to the gap between the disk portions of the rotating tubes, a hollow shaft portion 152 which crosses between the disk portions 111 and 123, and an arm portion 153 which extends outwards from the shaft portion 152. Further, the guide A and the pipe portion 151 can be formed as a single unit. The shaft portion 152 enables both the outer and inner rotating tubes 110, 120 to rotate independently in the same direction by means of bearings inside concave portions 116 and 124 formed in the disk portions 111 and 123 of vertically positioned the outer and inner rotating tubes 110, 120, respectively. The hollow section inside the pipe portion 151 and shaft portion 152 is connected with the yarn guide path 112 formed in the disk portion 111 of the outer rotating tube 110. The magnet n which attracts the magnet N affixed to the hood H is attached to the end of the arm portion 153, and through the attraction of the magnets N and n, the yarn guide mechanism portion 150 is kept in a stationary position.

[0060] Further, since the magnetic field created by magnets Q and q move as inner and outer rotating tubes 120, 110 rotate at high speeds, the magnetic flux crosses over the pipe portion 151 and arm portion 153. Consequentially, in order to impede the creation of an overcurrent, it is desirable that the pipe portion 151 and arm portion 153 be formed from non-electroconductive materials.

[0061] As described above the four-for-one twister is organized such that the yarn guide mechanism is supported in the shaft portion 152 by the outer rotating tube 110, the inner rotating tube 120 is supported by the shaft portion 152 of the yarn guide mechanism, the package cover 130 is supported by the shaft portion 121 of the outer rotating tube 110, and supply the package P is supported by the bobbin holder 131 of the package cover 130. Therefore, the four-for-one twister keeps the yarn guide mechanism portion 150 in a stable position in line with the package cover 130 and supply package P by means of the magnetic force of the magnets M, m and N, n. In contrast, the outer rotating tube 110 and inner rotating tube 120 rotate freely, and by means of the magnetic force of the magnets Q and q, rotate at the same speed and in the same direction.

[0062] The twisting process that takes place takes place as follows.

[0063] The yarn X drawn from the supply package P is passed between the tension cap 140 and tension ring 141, and imparted appropriate tension. Then it passes through the yarn guide path 142 of the tension cap 140 and the yarn guide path 132 of the bobbin holder 131, and after being routed through the yarn guide path 122 of the shaft portion 121 in the inner rotating tube 120, is guided towards the guide A rising along the inner surface of the inner rotating tube 120. From the guide A yarn X, which has been passed inside the shaft portion 152 and the pipe portion 151 of the yarn guide mechanism portion 150 is passed through the yarn guide path 112 of the outer rotating tube 110, and after rising along the inner surface of the outer rotating tube 110 is guided towards rising guide D and supplied to take-up winders or the like.

[0064] The yarn passing process of the yarn X that reaches the yarn guide path 112 of the disk portion 111 at the outer rotating tube 110 from the pipe portion 151 and the shaft portion 152 of the yarn guide mechanism portion 150 can happen easily by the blowing of pressurized air through the inside of the air passage 115 of the spindle portion 114 at the lower end of the bearing tool 160. The air passage 115 is connected in the place where air moves from the curved area in the yarn guide hole 112 of the disk portion 111 to the straight radial sec-

tion so that the direction of the jetted air flows from the center portion to the outside of the disk portion 111. Consequentially, by blowing high pressured air from the air passage 115 to the yarn guide path 112, a pressure gap is created between the upstream and downstream sides of the yarn guide path 112. As a result, negative pressure builds up inside the shaft portion 152 and pipe portion 151, and air flow to pass the yarn along the yarn path from the upper end of the yarn guide mechanism portion 150 to the end point of the yarn guide path 112 of the disk portion 111 can be created.

[0065] Further, the supply of pressurized air to the air passage 115 of the spindle portion 114 is normally stopped after the yarn passage has been completed and before the twisting process is begun, however, depending on the type of the yarn X and other conditions, air of a suitable pressure may be supplied during the twisting process, and along with reducing frictional heating created by the passage of the yarn X, the cooling and control of the heating of the yarn is not obstructed.

[0066] When rotational drive is provided to the outer rotating tube 110 through the running of the belt B, the inner rotating tube 120 rotates at the same speed in the same direction by means of the attraction of the magnets Q and q. However, since the supply package P and the yarn guide mechanism portion 150 are kept in a stationary position, each rotation of the outer and inner rotating tubes 110, 120 yields four twists of the yarn.

[0067] Since the inner and outer rotating tubes 120 and 110 rotate at the same speed in the same direction, the air flowing between them flows in a uniform direction, and thus wind resistance and noise can be reduced.

[0068] As described above, the present invention achieves the following results.

[0069] Since, as proposed in the parent application, the yarn drawn out of each yarn guide hole is passed with air, the passage of yarn can be quick and easy instead of difficult, and the operational efficiency can be greatly increased.

[0070] Furthermore, the passage of yarn between two connected yarn guide holes is quick and easy.

[0071] Because of the simple structure with air flowing through the entire length of the yarn guide holes, the four-for-one twister is compact and easy to take care of.

[0072] By flowing air to pass yarn along vertical, radial or diametrical directions through the inside of the yarn guide holes where yarn passage is normally difficult, yarn passage is simpler and faster, and the operational efficiency can be greatly increased.

[0073] According to the present invention, the yarn tension can be regulated and yarn entanglement can be prevented, reducing yarn breakage, and further, the cause of friction heating of the yarn can be controlled, and heat effects on the yarn can be minimized.

[0074] Since there are the inner guiding member and the outer guiding member, the yarn tension and the frictional heating can be controlled, and since the rotating inner guiding member and outer guiding member are formed with tubular bottoms, wind resistance and wind noise can be reduced.

[0075] By preventing hairiness and yarn breakage by smoothly changing the direction of the yarn at the inclined bottom of the outer guiding member, it is possible to obtain high-quality twisted yarn. Also, by having the upper and lower permanent magnets in close proximity, rotational force can be reliably imparted and cause high speed rotation, thereby permitting twisting capability to be increased.

[0076] If the inner rotating tube and the outer rotating tube are rotated in the same direction, the wind resistance is reduced, and high-speed rotation is enabled. Further, by reducing wind resistance, stress on the bearings supporting the rotating guiding members is reduced, thereby increasing lifetime of the machine. Furthermore, energy efficiency is increased, and noise is reduced.

[0077] The rotation drive mechanism of the rotating guiding members can drive rotation of either the inner or outer guiding members, said rotation driven guiding member imparting rotational drive force to the other by use of magnets, thereby allowing the rotational drive force transfer mechanism to be made simple. Further, either the inner or outer guiding member can be provided with rotational drive, so a construction with only one rotational drive belt being used is possible. Further, this allows for the machine to become simpler, using a bearing to support the freely rotating guiding member, for example.

[0078] The inner guiding member and the outer guiding member are both formed as tubes with bottoms, so that rotating the guiding members enables wind resistance to be minimized.

[0079] In the case where a yarn guide mechanism supported in a stationary position between the inner guiding member and the outer guiding member is provided, it is possible to eliminate the flyer that employs the yarn guide that had been indispensable in a four-for-one twister where the rotational direction of the inner and outer tubes are different. Further, the yarn guide mechanism is not caused to rotate, so it is easier to stabilize the balance of the four-for-one twister.

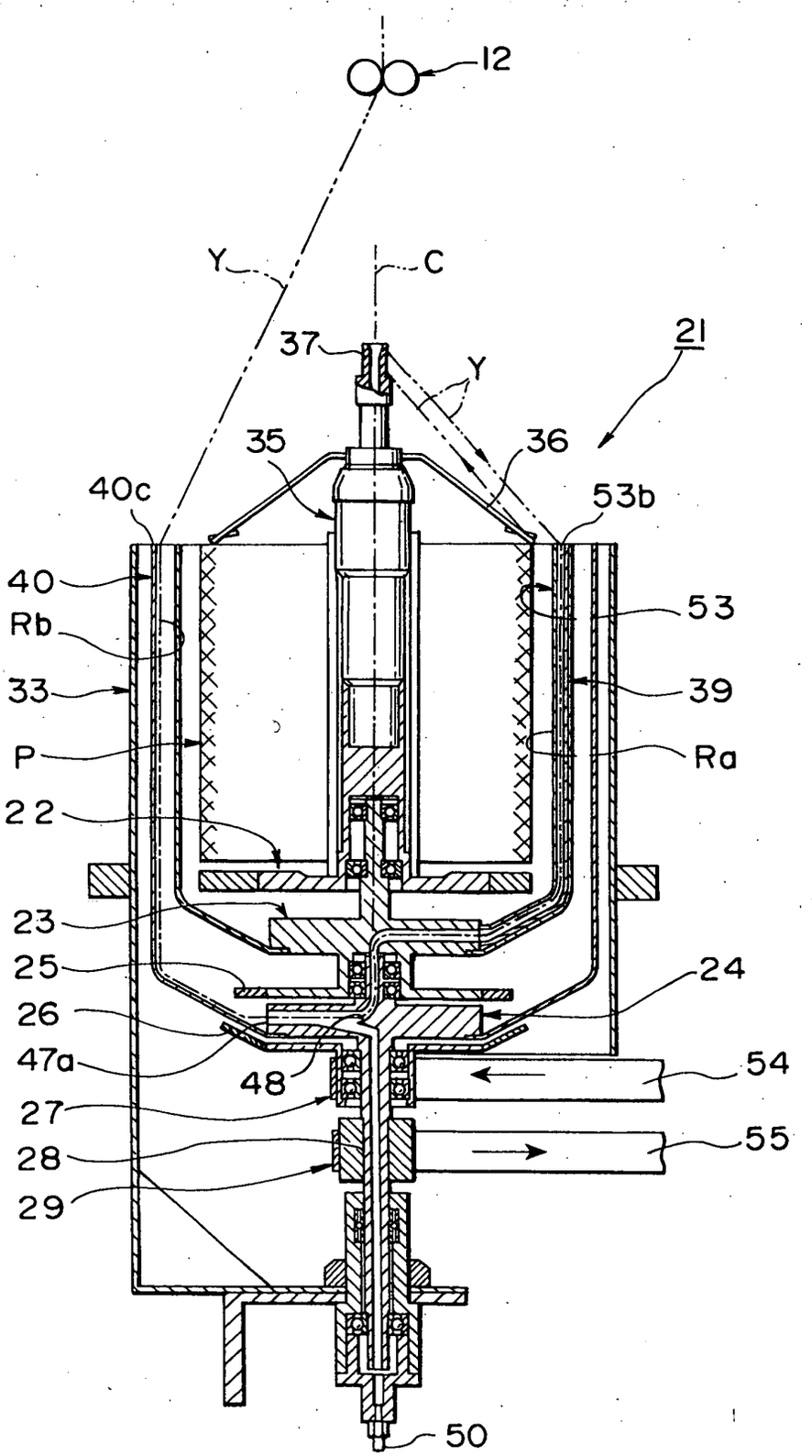
Claims

1. A four-for-one twister provided with a package supporting member which supports a supply package (P) in a stationary position on a center line, an inner yarn path (Ra) formed in a vertical direction outside of the supply package, an outer yarn path (Rb) formed in a vertical direction outside of the inner yarn path
   characterized in that
   the inner yarn path (Ra) is formed in an inner guiding member (39) revolving around the center line.

2. A four-for-one twister according to claim 1 **characterized in that** an outer guiding member (40) rotates in an opposed direction to the inner guiding member (39) around the center line that the outer yarn path (Rb) is formed in said outer yarn guiding member (40), that the outer yarn guiding member (40) and inner yarn guiding member (39) are each formed as a tube with a bottom, and **in that** yarn guide holes in the outer guiding member and the inner guiding member are connected at the bottom of each of the tubes and extend facing the center line.

3. A four-for-one twister according to claim 2 **characterized in that** the bottom of the outer guiding member (40) is slanting upwards and is vertically above and below provided with permanent magnets (25, 26) in order to rotate the inner guiding member (39).

FIG. 1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C
37
Y
21
35
36
40c
53b
40
Rb
53
33
39
P
Ra
22
23
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24
26
47a
48
54
27
55
28
29
50

FIG. 2

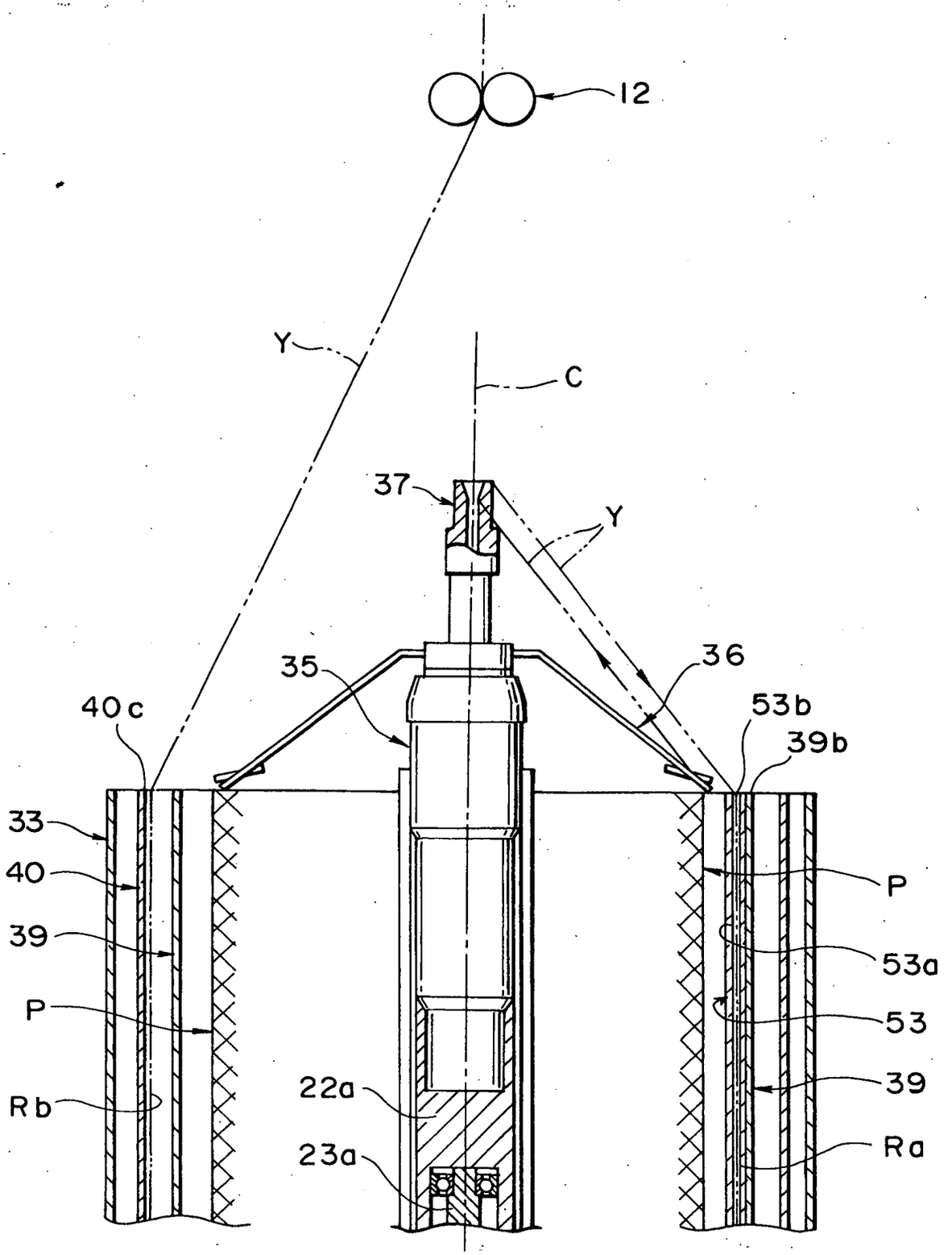
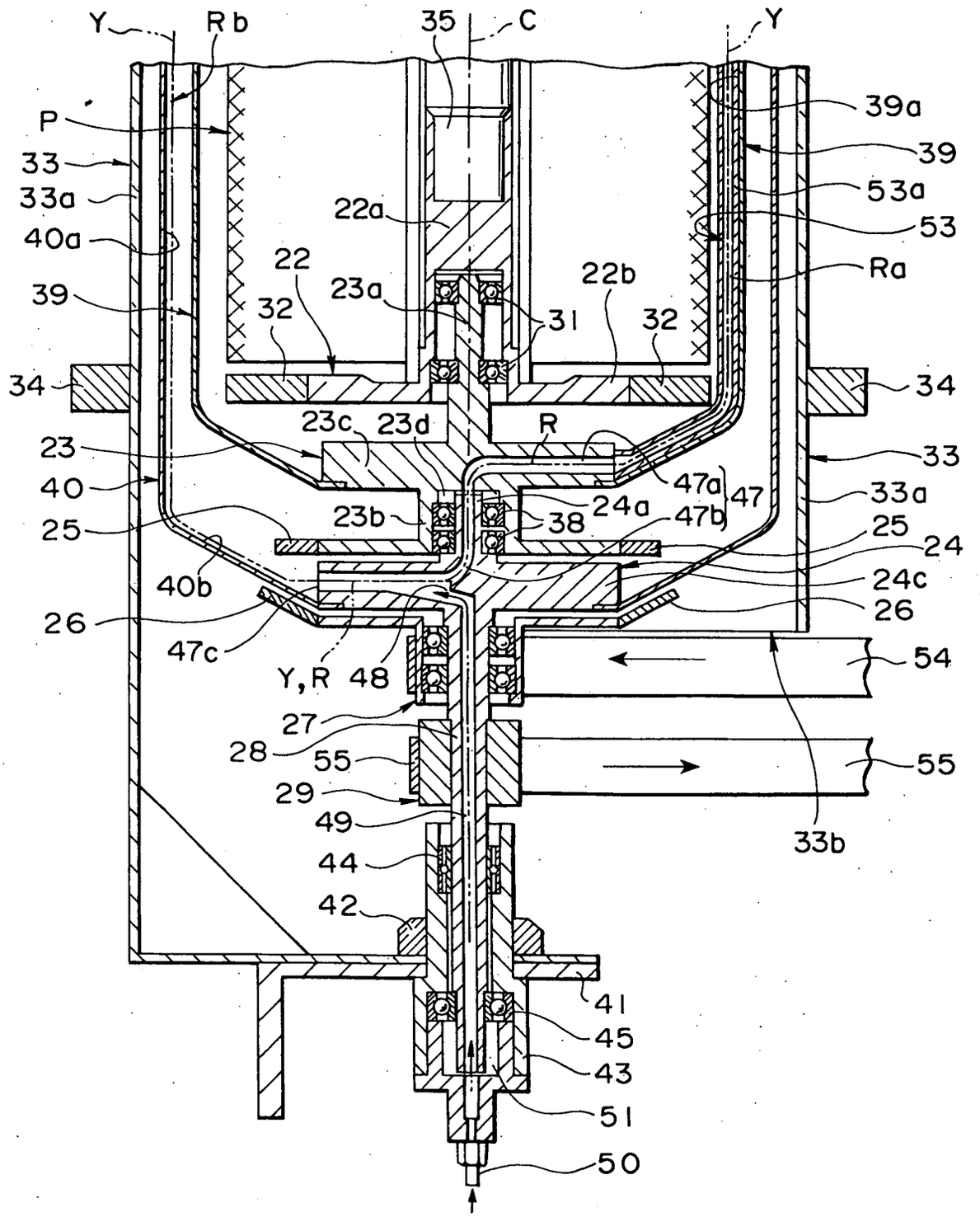


FIG. 3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C
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P
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53
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22a
Ra
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22b
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23a
31
32
32
34
34
23c
23d
R
23
33
47a
40
47
33a
24a
23b
38
47b
25
25
24
40b
24c
26
26
47c
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55
29
49
33b
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41
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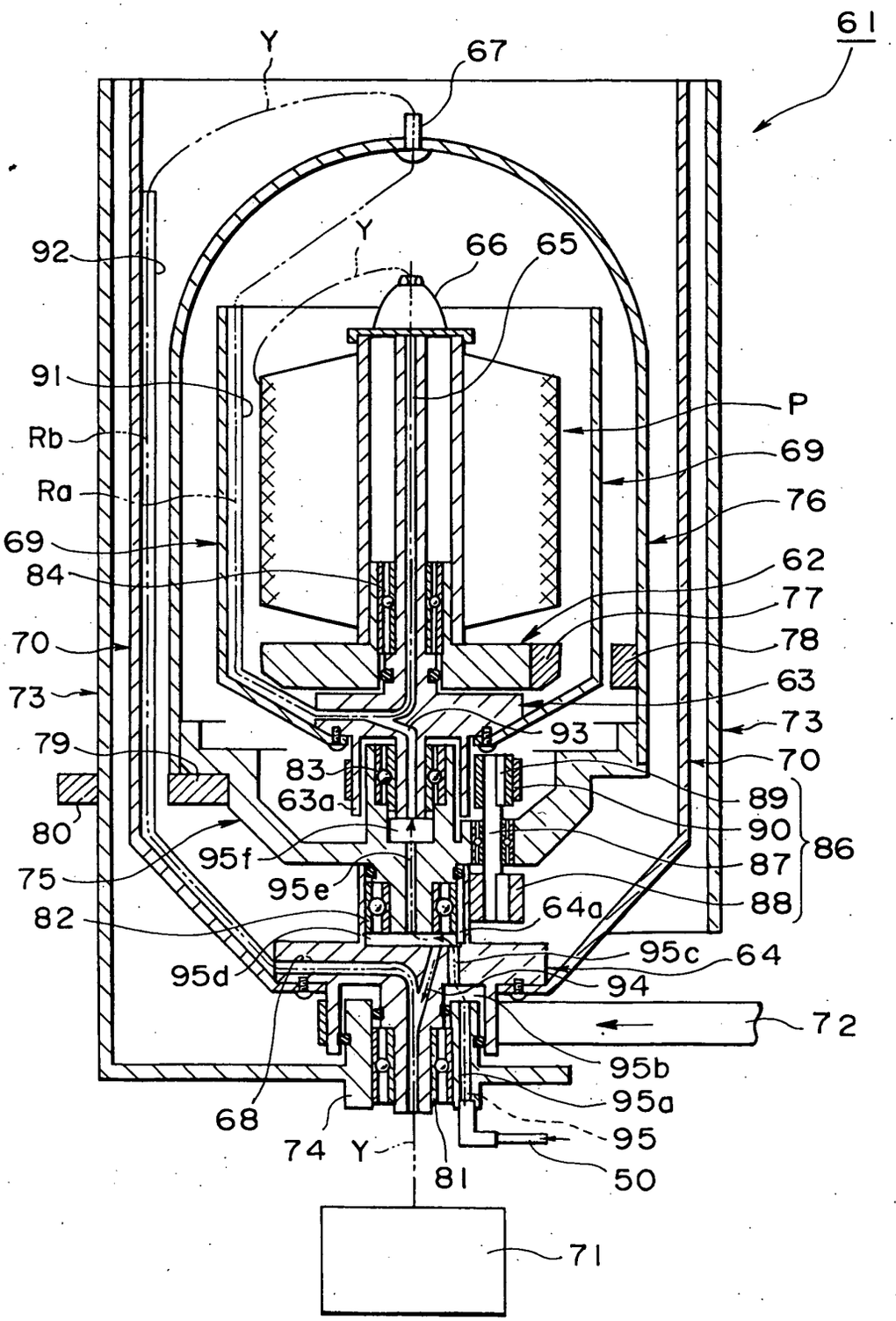
43
51
50

FIG. 4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78
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73
93
79
70
83
89
63a
90
80
86
95f
87
75
95e
88
82
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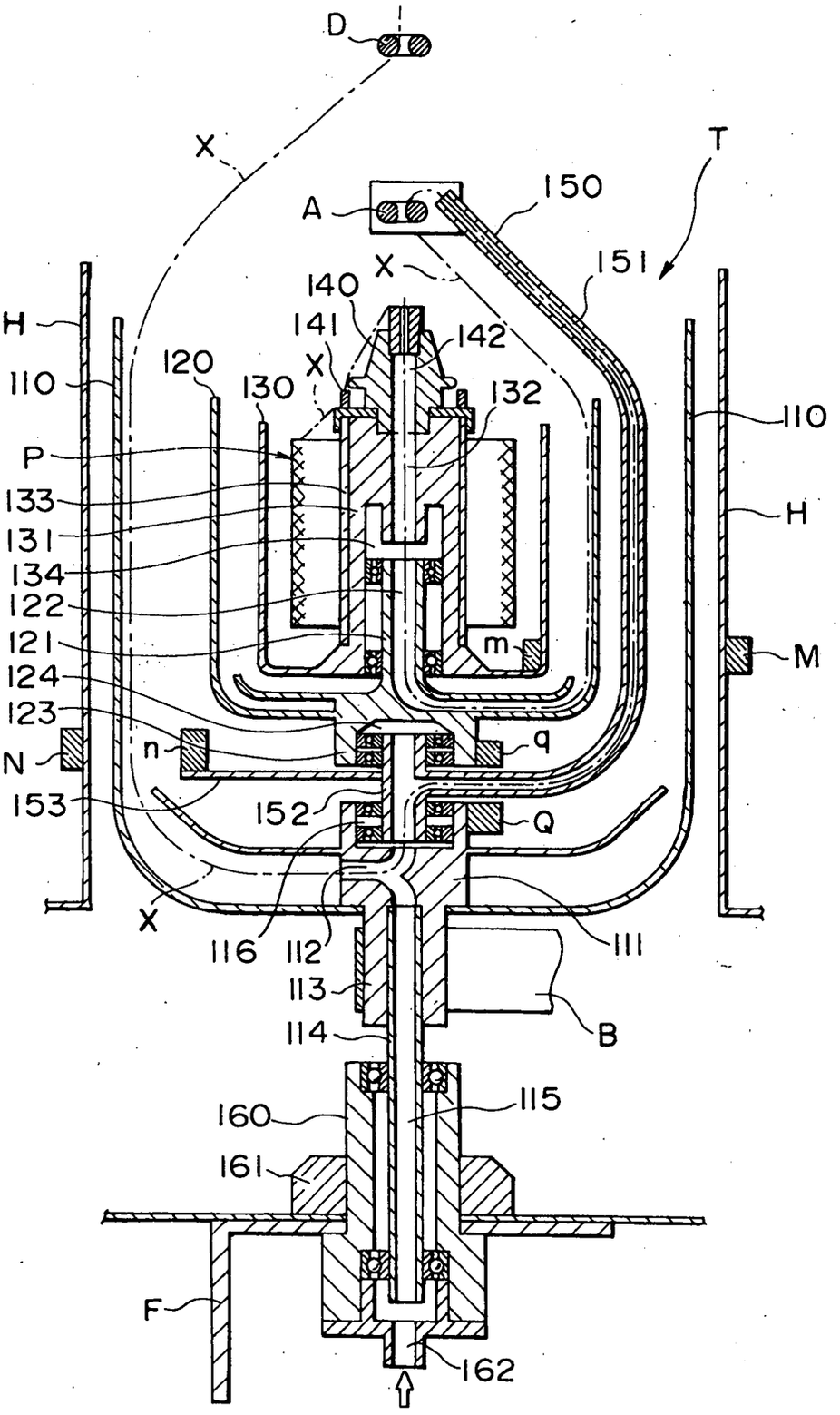
95c
64
95d
94
72
95b
95a
68
74
Y
81
95
50
71

FIG. 5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N
153
H
M
m
n
q
152
Q
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116
112
111
113
114
B
115
160
161
F
162

FIG. 6