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(71) Applicant:
MURATA KIKAI KABUSHIKI KAISHA
Kisshoin, Minami-ku Kyoto-shi 601 (JP)

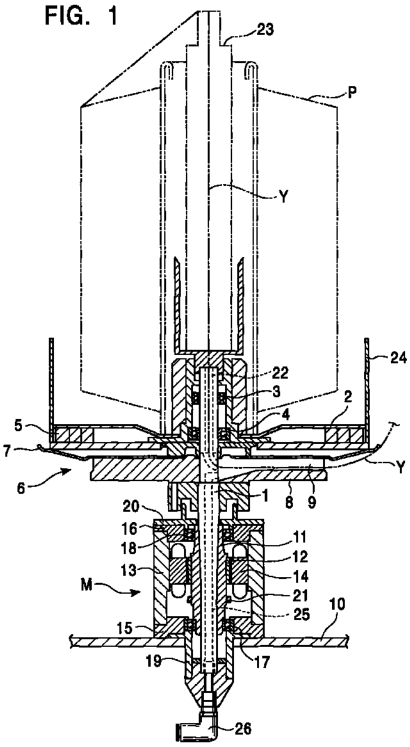
(72) Inventors:
- **Kimura, Tatsuo**
  Nara-shi, Nara (JP)
- **Kino, Yoshihiro**
  Uji-shi, Kyoto (JP)

(74) Representative:
Liedl, Christine, Dipl.-Chem. et al
Albert-Rosshaupter-Strasse 65
81369 München (DE)

(54) Twisting unit

(57) The present invention relates to a twisting unit comprising a drive motor M provided coaxially with a spindle shaft 1 to drive this shaft, the spindle shaft 1 being rotated to twist a yarn, comprising a sleeve 11 configured separately from the spindle shaft 1 and having a rotor 12 of the drive motor M secured to its outer-circumferential surface, a motor housing having a stator 14 of the drive motor M secured to its inner circumferential surface, bearings 18, 17 for rotatably supporting the sleeve both above and below the rotor 12 relative to the motor housing. By allowing the spindle shaft 1 to be inserted into or removed from the sleeve 11, the spindle motor 1 can be inserted or removed separately from the rotor 12 of the drive motor M and various inconveniences associated with attachment and detachment of a rotor integrally with a spindle shaft can be eliminated.

FIG. 1



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Description

Field of the Invention

[0001] The present invention relates to a twisting unit comprising a drive motor provided coaxially with a spindle shaft to drive this shaft, the spindle shaft being rotated to twist a yarn, for example, to a twisting unit in an individual-spindle-driven type twister comprising a plurality of twisting units installed in a line and a drive motor provided for each spindle shaft, and in particular, to a twisting unit that enables a drive motor for each spindle to be configured without the need to install a spindle shaft and that enables the spindle motor to be inserted into or removed from the drive motor irrespective of a rotor of the drive motor.

Background of the Invention

[0002] An individual-spindle-driven type multiple twister is conventionally known that comprises a drive motor provided coaxially with each spindle shaft and that rotates the spindle shaft to twist a yarn while ballooning it around a supply package. As such a multiple twister, for example, an individual-spindle-driven type double twister is known that rotates a spindle shaft once to twists a yarn twice. A new double twister has been developed wherein a drive motor is configured by mounting a motor housing on spindle rails acting as a support, and inserting a spindle shaft with a rotor directly secured to its outer circumferential surface, into a stator secured to the inner circumferential surface of the motor housing.

[0003] As an example in which a rotor is directly secured to a spindle shaft so that the spindle shaft can be inserted into or removed from a stator of a drive motor, a twisting spindle is known that comprises a spindle shaft that is not fixed to a support so as to be attached to or detached from the support and a stator fixed to the support (Unexamined Japanese Patent Application Publication (Tokkai-Hei) Number 3-14636). Specifically, the spindle shaft is rotationally movably supported on a sleeve attached to the support by directly fixing the rotor to the spindle shaft, removably providing a bush inside the sleeve, and placing a bearing between the bush and the spindle shaft. In such a configuration, since the spindle shaft is not fixed to the support, it can be easily installed and removed together with the bush by attaching or detaching the bush to or from the sleeve.

[0004] Since the rotation speed of the spindle shaft directly affects the number of twists applied to the yarn, the rotation speed of the drive motor must be accurately maintained at a desired value during twisting in order to obtain high-quality twisted yarns. Thus, for the individual-spindle-driven type twister comprising a drive motor for each of a large number of spindle shafts, a large number of drive motors must be individually inspected for quality in order to prevent the quality of twisted yams from varying for each spindle. In the quality inspection of the drive motor, the motor is actually rotationally driven to measure the intensity of magnetic fields, a voltage value, and a current value. If, for example, a permanent magnet is used for a rotor, the drive motor can be configured by securing the rotor to the spindle shaft by means of adhesion, magnetizing the rotor, and then inserting an inserted body (including the rotor) including the spindle shaft.

Problems to Be Solved by the Invention

[0005] If, however, the rotor is directly secured to the spindle shaft, the drive motor cannot be configured without inserting the spindle shaft, so the drive motor cannot be inspected for quality before installing the spindle shaft. That is, the balance of a rotating body including the spindle body must first be completed, and the spindle shaft must then be installed in the drive motor before the drive motor is actually rotationally driven for quality inspections.

[0006] Consequently, the balance adjustment operation and the quality inspection cannot be simultaneously carried out, and this is very inconvenient particularly if a large number of drive motors must be handled.

[0007] In addition, if the rotor is directly secured to the spindle shaft, the spindle shaft and the rotor are integrally attached and detached, so the rotor may come in contact with the periphery to damage it when the spindle shaft is inserted or removed to replace a bearing or change a condition.

[0008] Furthermore, if the inserted body including the spindle shaft is to be replaced to change a condition, for example, if, in a double twister, the diameter of a rotating disc is to be changed to provide a different supply diameter, the rotor directly secured to the spindle shaft requires the rotor to be replaced together with the spindle shaft. This is wasteful particularly if an expensive rotor is used, and requires the drive motor to be inspected for quality again after the replacement. Furthermore, in order that the bearing to be replaced may be removed without interference from the rotor secured to the spindle shaft, the inner diameter of the bearing nuist be made larger than the outer diameter of the rotor and the bearing diameter is limited. The increased bearing diameter reduces the fast-rotation durability.

[0009] The present invention has been provided in view of these problems, and its first object is to eliminate the above various disadvantages occurring if the rotor is directly secured to the spindle shaft so as to be attached or detached integrally with the spindle shaft.

[0010] In addition, in a configuration for using a motor to directly drive a spindle shaft as in an individual-spindle-driven type multiple twister, the spindle shaft is rotatably supported via a bearing to a support table fixedly installed on a frame. Thus, during maintenance for supplying a lubricant to the bearing supporting the spindle, the spindle shaft must be removed upward from the support table prior to the supply.

[0011] Conventional concurrently-driven type multiple twisters engage a spindle shaft removing jig with part of the lower end of a wharve formed integrally with a spindle shaft and use this jig to push the spindle shaft up in order to remove the spindle shaft. Thus, the removal operation is complicated and the spindle shaft removing jig most be specially provided.

[0012] In addition, since the jig is engaged with part of the lower end of the wharve to push the spindle shaft up, an excessive force may be applied to the spindle shaft to shift the axis of the shaft. Consequently, a rotor secured to the spindle shaft may interfere with a stator secured to a housing to damage the motor.

[0013] Thus, a second object of the present invention is to provide a device that enables an easy removal operation while enabling the spindle shaft to be actually pushed up in the axial direction, without the need to specially provide the spindle shaft removing jig.

[0014] In addition, in individual-spindle-driven type multiple twisters adapted to directly drive a spindle shaft using a motor, a power line for supplying power to the motor is wired in a support table and the spindle shaft, and if this wiring is located below a lubricant supply port, a lubricant may spill and attach to the wiring during a lubricant supply, adversely affecting the wiring.

[0015] Thus, a third object of the present invention is to provide a device that precludes a spilled lubricant from attaching to the wiring passing through a wiring port of the motor for driving the spindle shaft, in order to prevent the wiring from being adversely affected by the lubricant.

Summary of the Invention

[0016] To achieve the first object as described above, the aspect of the present invention is a twisting unit comprising a drive motor provided coaxially with a spindle shaft to drive this shaft, the spindle shaft being rotated to twist a yarn, characterized in that the unit is configured so that the spindle shaft can be inserted into or removed from the drive motor separately from a rotor of the drive motor. The twisting unit is, for example, one in an individual-spindle-driven type multiple twister comprising a multiple twister for rotating a spindle shaft to twist a yarn while ballooning the yarn around a supply package and comprising a drive motor provided for each spindle shaft to drive it, or one in an individual-spindle-driven type ring spinning machine comprising a spinning machine for swiveling a guide ring around a winding bobbin and on its circumference to twist a yarn and comprising a drive motor provided for each spindle shaft to drive it.

[0017] The present invention enables the spindle shaft to be inserted into or removed from the drive motor separately of the rotor of the drive motor rather than integrally with the rotor, thereby enabling the drive motor to be configured without the need to install the spindle shaft.

[0018] The aspect of the present invention is characterized in that the unit comprises a holding means for holding the rotor opposed to a stator of the drive motor after the spindle has been removed from the drive motor. According to the present invention, the rotor is held in the drive motor even after the spindle motor has been removed from the drive motor, that is, the spindle motor can be removed while the rotor is held inside the drive motor (the motor housing) opposite to a stator.

[0019] The aspect of the present invention is characterized in that the unit comprises a sleeve configured separately from the spindle shaft and having the rotor secured to its outer circumferential surface, a motor housing having the stator secured to its inner circumferential surface, and a bearing for rotatably supporting the sleeve on the motor housing, and in that the unit is configured so that the spindle shaft can be inserted into or removed from the sleeve. By rotatably supporting the sleeve on the motor housing, the present invention enables the drive motor to be configured totally regardless of the spindle shaft. That is, if the rotor comprises a permanent magnet, the rotor (not magnetized) is secured by adhesion to the outer circumferential surface of the sleeve configured separately from the spindle shaft, magnetizing the rotor, and after magnetization, rotatably supporting the sleeve on the motor housing via the bearing.

[0020] The aspect of the invention is characterized in that the bearing is provided both above and below the rotor. The present invention supports the sleeve via the bearings both above and below the rotor to enable the length of the spindle shaft to be reduced compared to, for example, the spindle shaft supported at two positions in the upper part of the spindle shaft.

[0021] The aspect of the present invention is characterized in that the sleeve has a large-diameter section in its middle in the axial direction and has at both axial ends thereof, small-diameter sections having a smaller diameter than the large-diameter section, the sleeve having the rotor secured to the outer circumferential surface of the large-diameter section, the sleeve being rotatably supported at the small-diameter sections by the bearings. According to the present invention, the outer diameter of the rotor adhesion section is increased to increase the outer circumferential area of the rotor and thus the opposed area between the rotor and stator. The increased opposed area between the rotor and stator serves to provide a large rotation torque. In addition, by reducing the outer diameter of the bearing support section, the fast-rotation durability can be improved.

[0022] The aspect of the present invention is characterized in that the unit comprises a tapered hole formed in the inner circumferential surface of the sleeve and a tapered section formed on the outer circumferential surface of the spindle shaft so that the spindle shaft is inserted to taper-fit the tapered section in the tapered hole. The present invention guides the inserted spindle shaft through the tapered hole to enable the spindle shaft to be centered accurately.

[0023] The aspect of the present invention is characterized in that after the spindle shaft has been inserted into the sleeve, the weight of an inserted body including the spindle shaft provides such a predetermined frictional force as prevents the sleeve and the spindle shaft from being relatively rotated on the taper-fitting surface during twisting. According to the present invention, since the spindle shaft is inserted into the sleeve from above, a separate means for fixing the sleeve and the spindle shaft so as to prevent them from rotating need not particularly be provided and the sleeve and the spindle shaft can be rotated in synchronism during twisting. In addition, by tapping the lower end of the spindle shaft from below, the spindle shaft can be removed easily.

[0024] In order to achieve the second object as described above, the aspect of the present invention is a twisting unit comprising a motor that individually drives a spindle for twisting a yarn, characterized in that the unit comprises a removal member for removing the spindle shaft upward from a housing that rotatably supports the spindle shaft, and in that the removal member is attached to an lower end of the spindle shaft and comprises a screw hole coaxial with the spindle shaft.

[0025] By placing a lubricant supply port on a working passage side while placing a wiring port on the opposite side, the lubricant supply operation becomes easier to enable the working efficiency to be improved. In addition, the distance to a wiring duct provided on the side opposed to the working passage can be reduced to simplify wiring for a power line for supplying power to a stator coil of the motor and a signal line from a magnetic sensor for detecting a detection magnet used to detect the rotation speed of the motor.

[0026] Since the lubricant supply ports are formed at plurality of positions above and below the housing and the plurality of lubricant supply ports are placed on approximately the same vertical line, the lubricant supply operation becomes easier to enable the working efficiency to be further improved.

[0027] In order to achieve the third object as described above, the aspect of the present invention is a twisting unit comprising a motor that individually drives a spindle for twisting a yarn, characterized in that a lubricant supply port for supplying a lubricant to a bearing that rotatably supports the spindle shaft is formed at a particular position of a housing that rotatably supports the spindle shaft, and in that a wiring port through which a wiring passes to feed power to the motor driving the spindle shaft is formed at a position of the housing other than one approximately vertically under the lubricant supply port and its neighborhood.

Brief Description of the Drawings

[0028]

Figure 1 is a side sectional view showing a twisting unit according to the first embodiment.

Figure 2 is a side sectional view showing an integral part of the twisting unit in Figure 1 wherein a spindle shaft has been installed.

Figure 3 is a side sectional view showing an integral part of the twisting unit in Figure 1 wherein the spindle shaft is being inserted.

Figure 4 is a side sectional view showing an integral part of a twisting unit according to the second embodiment wherein a spindle shaft has been installed.

Figure 5 is an overall view showing an individual-spindle-driven type multiple twister with a large number of twisting unit installed therein in a line according to the third embodiment.

Figure 6 is a perspective view showing an individual-spindle-driven type multiple twister for spun yarns.

Figure 7 is a side sectional view showing a twisting unit of an individual-spindle-driven type multiple twister.

Figure 8 is a side sectional view showing a drive motor section of the twisting unit.

Figure 9 is a side sectional view showing the case where a bolt has been inserted and screwed in a cap for a lower support member of a motor housing.

Figure 10 is a side sectional view showing a section for supplying a lubricant to a bearing of an upper support member.

Figure 11 is a side sectional view showing a section for supplying a lubricant to a bearing of the lower support member.

Figure 12 is a top view showing the position relationship between a lubricant supply port and a wiring port.

Figure 13 is a side sectional view showing a twisting unit of an individual-spindle-driven type multiple twister for filament yarns.

Figure 14 is a side sectional view showing a drive motor section of the twisting unit in Figure 13.

Figure 15 is a side sectional view of Figure 13 showing the case where a bolt has been inserted and screwed in a cap for a lower support member of a motor housing.

Figure 16 is a side sectional view of Figure 13 showing a section for supplying a lubricant to a bearing of an upper support member.

Figure 17 is a side sectional view of Figure 13 showing a section for supplying a lubricant to a bearing of the lower support member.

Figure 18 is a top view of Figure 13 showing the position relationship between a lubricant supply port and a wiring port.

Detailed Description of the Preferred Embodiments

[0029] The first embodiment of the present invention is described below with reference to Figures 1 to 3. In the first embodiment, a twisting unit in a double twister is described as an example of a twisting unit comprising a drive motor provided coaxially with a spindle shaft to drive this shaft, the spindle shaft being rotated to twist a yarn. Of course, however, this embodiment is applicable to other types of twisters and spinning machines. The double twister is composed a plurality of spindles installed in parallel and in particular, is of an individual-spindle-driven type comprising a drive motor individually provided for a spindle shaft in a twisting unit for each spindle.

[0030] Figure 1 is a side sectional view of a twisting unit (a supply section) for a single spindle in a double twister according to the present invention. Although not shown in the drawings, each spindle has arranged between the twisting unit and a winding device located at the most downstream position, a feed roller for feeding a twisted yarn in a yarn running direction, a traverse device for traversing a yarn in the axial direction of a winding package, and a yarn guide change guide located at an appropriate position.

[0031] First, the structure of a twisting unit composed of a peripheral section of a supply package P including a drive motor M is described with reference to Figure 1.

[0032] Each twisting unit has a single spindle shaft 1 the axial direction of which corresponds to the vertical direction, and a package loading table (a stationary board) 2 on which a supply package P is loaded is relatively rotatably provided at an upper end of the spindle shaft 1 via bearings 3, 4. A stationary attraction member 5 for holding the supply package P stationary during twisting (during the rotation of the spindle shaft 1) is provided in an outer circumferential section of the package loading table 2. For example, the attraction member 5 is a magnet so that the supply package P is held stationary by a magnetic attraction effected between this magnet and a magnet (not shown in the drawings) provided on a fixed side opposite to the suction member 5.

[0033] A rotating disc 6 is secured to the upper end of the spindle shaft 1 so as to be located immediately below the package loading table 2 and so as not to rotate. The rotating disc 6 is composed of a circular bowl section 7 having a diameter larger than a supply diameter and a cylindrical winding section (a yarn storage section) 8 secured under the bowl section 7. A yarn passage 9 is formed in the winding section 8 in a radial direction. The variation in releasing tension is absorbed by automatically varying the amount of yarn wound around the winding section 8 (a delay angle).

[0034] The spindle shaft 1 extends downward from the rotating disc 6, and the drive motor M for rotationally driving the spindle shaft 1 is coaxially provided on the extension of the shaft. That is, while the spindle shaft 1 is installed, the drive motor M is directly provided on part of the spindle shaft 1, and no couplings for transmitting a rotation torque are used between the two coaxial shafts arranged in the axial direction.

[0035] The drive motor M is provided so as to be loaded on a fixed support (spindle rails) 10 extending in a longitudinal (lateral) direction of the body. The drive motor M has a cylindrical sleeve 11 provided around the spindle shaft 1 so as to have a predetermined length in the axial direction, a rotor (a permanent magnet) secured to part of the outer circumferential surface of the sleeve 11, a motor support section 13 provided externally of the rotor 12, a stator 14 provided on the inner circumferential surface of the motor support section 13 opposite to the outside of the rotor 12, a lower bearing support member 15 fitted in the bottom of the motor support section 13, an upper bearing support member 16 fitted in the top of the motor support section 13, a lower bearing (ball bearing) 17 provided between the sleeve 11 and the lower bearing support member 15 to rotatably support the sleeve 11 below the rotor 12, a lower cap 19 penetrating the support 10 in the vertical direction and having a bottom surface engagingly-locking section for the lower bearing 17, an upper cap 20 fitted on the upper bearing support member 16 and having a top surface engagingly-locking section for the upper bearing 18, and a detection piece (a permanent magnet) 21 secured to the outer circumferential surface of the sleeve between the rotor 12 and the lower bearing 17.

[0036] In this manner, the drive motor M is loaded on the support 10 to enable the delay angle to be visually checked easily without interference from the support 10. A motor housing is composed of the upper cap 20, the upper bearing support member 16, the motor support section 13, the lower bearing support member 15, and the lower cap arranged in this order from the top. The motor housing, the sleeve 11, and the upper and lower bearings 18, 17 constitute a holding means for holding the rotor 12 opposed to the stator 14 regardless of the insertion or removal of the spindle shaft 1, that is, after the spindle shaft 1 has been removed from the sleeve 11 of the drive motor M.

[0037] The sleeve 11 has a large diameter section 11a provided in the middle thereof in the axial direction and small-diameter sections 11b, 11b provided at the respective axial ends thereof (both upper and lower ends) and having a smaller outer diameter than the large diameter section 11a. The rotor 12 is secured to the outer circumferential surface 11a of the sleeve 11, and the upper and lower bearings 18, 17 are provided between the outer circumferential surface of the small diameter sections 11b, 11b and the motor housing (the upper and lower bearing members 16, 15). The large diameter section 11a of the sleeve 11 has an engagingly locking section with which the upper end of the rotor 12 is engaged when the rotor 12 is installed.

[0038] In addition, an engagingly locking section that engages with the lower end of the upper bearing 18 is formed at the upper end of the sleeve 11, and an engagingly locking section that engages with the upper end of the lower bearing 17 is formed at the lower end of the sleeve 11. Both engagingly locking sections define the distance between the upper and lower bearing sections 18, 17 to be larger than the axial length of the rotor 12.

[0039] Furthermore, a tapered hole 11c the diameter of which gradually decreases toward one axial side (from top to bottom) is formed at a required position of the sleeve 11. A tapered section 1a having an inclination as large as that of the tapered hole 11c of the sleeve is formed at a required portion of the spindle shaft 1 in such a way that its diameter gradually decreases toward one axial side. When the spindle 1 is installed, the tapered hole 11c and the tapered section 1a are taper-fitted together so as to transmit a rotation torque. The inclination of the tapered surface between the tapered hole 11c and the tapered section 1a is designed so that a rotation torque can be reliably transmitted and so that the spindle shaft 1 can be inserted and removed easily.

[0040] The axial length of the tapered hole 11c is larger than that of the rotor 12, so that the upper end of the tapered hole 11c is located above the secured section of the rotor 12, while the lower end of the tapered hole 11c is located below the secured section of the rotor 12. The rotor 12 is directly subjected to a drive torque caused by the magnetic effect of the stator 14, but an axial through-hole is formed inside the sleeve 11 in this manner and includes at least the tapered hole 11c leading from above the rotor 12 to below the rotor 12. This configuration enables a drive torque generated in the rotor 12 to be reliably transmitted to the spindle shaft 1 via the taper-fitting surface.

[0041] By using the above configuration to rotationally drive the drive motor M, the spindle shaft 1 installed in the sleeve 11 can be rotated in synchronism with the rotor 12. Rotating magnetic fields from the detection piece 21 is obtained by an external control device (not shown in the drawings) via a magnetic sensor (not shown in the drawings), and the detected rotation speed is used to maintain the drive motor M at a desired rotation speed during twisting.

[0042] Next, for the twisting unit in Figure 1, a yarn guide and threading for the twisted yarn Y are described.

[0043] A yarn passage hole 22 is formed above the spindle shaft 1 so as to lead to the upper end of the shaft 1. The yarn passage hole 22 is in communication with the yarn passage 9 formed in the rotating disc 6. In addition, a tenser 23 for applying a predetermined tension to the yarn Y is provided inside a center shaft of the supply package P in such a way as to be located above the spindle shaft 1. The yarn Y released from the supply package P advances into the center shaft of the supply package P from above, where the tenser 23 applies the predetermined tension to the yarn Y. Subsequently, the yarn Y passes through the yarn passage hole 22 and the yarn passage 9 and then jumps outward (in the radial direction of the rotating disc 6) to reach a balloon guide (not shown in the drawings) located above the supply package P on an extension of the center shaft. The yarn Y leaving the yarn passage 9 swivels around the supply package P due to the rotation of the rotating disc 6 while forming a balloon guide between the spindle and the balloon guide. With a yarn guide, while the yarn is moving from the supply package P to the balloon guide, the spindle shaft 1 rotates once to twist the yarn twice. The package loading table 2 has a package cover 24 provided so as to cover part or all of the outside of the supply package P to prevent the ballooned yarn T from coming in contact with the outer circumferential surface of the supply package P.

[0044] A portion of the spindle shaft 1 other than that in which the yarn passage hole 22 is formed has an air supply hole 25 formed there through in such a way as to lead to the lower end thereof. In this manner, the spindle shaft 1 is hollow, and like the yarn passage hole 22, the air supply hole 25 is in communication with the yarn passage 9. A joint member 26 is provided below the spindle shaft 1. An air supply pipe (not shown in the drawings) is connected to the joint member 26 so as to supply injected air to the air supply hole 25 from below. By supplying the inside of the air supply hole 25 with air moving upward from the lower end of the spindle shaft 1, an air flow can be generated in the yarn passage hole 22 and the yarn passage 9 in the yarn feeding direction. Such an air flow can be used to thread the yarn so as to form the above yarn guide.

[0045] Next, referencing Figures 2 and 3, description is made of the assembly structure of the drive motor M and of the installation of a rotating body including the spindle shaft 1, both of which are the integral parts of this embodiment. First, the assembly structure of the drive motor M will be explained. Using an adhesive, the rotor 12 of a predetermined size is secured to the large diameter section 11a of the sleeve 11 so as to rotate integrally with the sleeve. The rotor 12 secured to the sleeve 11 is then magnetized to constitute a rotating section of the drive motor M, and the rotating section is subjected to a predetermined balancing operation.

[0046] The rotating section of the drive motor M is installed so that the lower bearing 17 is located between the lower bearing support member 15 and the small diameter section 11b of the sleeve 11 at its lower end, while the upper bearing 18 is located between the upper bearing support member 16 and the small diameter section 11b of the sleeve 11 at its upper end. After the rotating section has been installed in this manner, the upper and lower caps 19, 20 are installed to constitute the drive motor M in which the stator 14 is located outside the rotor 12 opposite thereto to provide a predetermined rotation torque to the rotor 12.

[0047] In this condition, the drive motor M is actually rotationally driven to carry out predetermined quality inspections.

[0048] Since the rotation torque of the drive motor M relates to the opposed are a between the rotor 12 and the stator 14, the rotor 12 is secured to the large diameter section 11a to enable the reduction of the axial length of the rotor 12 required to obtain a required rotation torque. Accordingly, it enables the reduction of the axial length of the spindle shaft. In addition, the outer diameters of the portions of the spindle shaft supported by the upper and lower bearings 18, 17 are reduced despite the increased outer diameter of the portion to which the rotor 12 is secured. Consequently, the fast-rotation durability of the bearings 18, 17 is improved.

[0049] By securing the rotating disc 6 to the spindle shaft 1 separately from assembly of the drive motor M, an inserted body is configured that is inserted into the drive motor M (the sleeve 11). This inserted body is also subjected to a predetermined balancing operation. After this balancing operation has been completed, the inserted body including the spindle shaft 1 is inserted from above into the drive motor M with the sleeve 11 rotatably installed therein as described above (see Figure 3), thereby enabling the spindle shaft 1 to be installed so as to rotate integrally with the sleeve 11. During the insertion, the spindle shaft 1 is inserted in such a way that its lower end passes beyond the lower end of the sleeve 11. The inserted spindle shaft 1 is guided through the tapered hole 11c so as to be accurately positioned on a predetermined center axis (the rotating axis of the drive motor M) and at a predetermined height. This enables the spindle shaft 1 to be rotated stably at a high speed. Once the spindle shaft 1 has been inserted, such a friction as integrally rotating the sleeve 11 and the spindle shaft 1 during twisting acts on the taper-fitting surface due to the weight of the inserted body including the spindle shaft 1.

[0050] Next, a second embodiment with a different method for installing the spindle shaft 1 in the sleeve 11 is described with reference to Figure 4.

[0051] The second embodiment shows an example of a means for fixing the spindle shaft 1 to the sleeve 11, comprising an engagingly locking section 1b for abutting and locking the sleeve 11 on the spindle shaft 1 in the axial direction, a thread groove section 1c formed in the outer circumferential surface of the spindle shaft 1, and a nut 27 that is screwed in the thread groove section 1c of the spindle shaft 1, wherein the nut 27 is used to press the sleeve 11 against the engagingly locking section 1b of the spindle shaft 1 in the axial direction to fix them together so that they cannot be rotated.

[0052] Specifically, the engagingly locking section 1b with which the lower end of the sleeve 11 is engaged from below is formed in a required portion of the spindle shaft 1. In addition, the thread groove 1c in which the nut 27 is screwed is formed on the outer circumferential surface of the lower end of the spindle shaft 1. The spindle shaft 1 is long enough for its lower end 11 to protrude from the lower end of the sleeve 11 when the sleeve 11 is inserted. In this configuration, when the spindle shaft 1 is inserted into the sleeve 11 from above after the construction of the drive motor M, the engagingly locking section 1b engages with the upper end of the sleeve 11 to restrain the spindle shaft 1 from further falling. The spindle shaft 1 is inserted with an open space provided below the shaft 1, and after the insertion, the nut 27 is tightened into the thread groove 1c from below to press the upper end of the sleeve 11 against the engagingly locking section 1b of the spindle shaft 1 so that the sleeve and the spindle shaft cannot be rotated.

[0053] According to the second embodiment, the external shape of the spindle shaft 1 and the inner diameter of the sleeve 11 can have a margin to the extent that the spindle shaft 1 does not rotate unstably during twisting. Tightening the nut 27 ensures that the spindle shaft and the sleeve can be rotated integrally, whereas releasing the tightened nut 27 allows the spindle shaft 1 to be removed easily.

[0054] The two embodiments have been described in conjunction with the use of the taper fitting and the tightening of the nut 27 for the integral rotation of the spindle shaft 1 and the sleeve 11. For example, however, a plurality of recess and projecting sections may be formed on the outer circumferential surface of the spindle shaft 1 and the inner circumferential surface of the sleeve 11 and may be gear-coupled together so as to transmit a rotation torque. These methods may be combined together, for example, the taper fitting may be employed to reliably center the spindle shaft 1 and the tightening with the nut or the gear coupling may further be added to reliably transmit a rotation torque.

[0055] As described above, according to the second embodiment, the stator 14 of the drive motor M is provided on the fixed side, and with the rotor 12 rotatably held opposite to the stator 14, the spindle shaft 1 can be installed in the rotor 12 (sleeve 11) so that they cannot be rotated, while it can be detached from the rotor 12 so as to achieve the same condition. That is, by holding the rotor 12 opposite to the stator 14 irrespective of insertion or removal of the spindle shaft 1 into or from the drive motor M (the sleeve 11), the spindle shaft 1 can be inserted into or removed from the drive motor M separately from the stator 14 and rotor 12 of the drive motor M. Consequently, the drive motor M can be inspected for quality separately from the rotation balancing operation for the spindle shaft 1. This configuration also precludes the rotor 12 from coming in contact with the periphery to damage it when the spindle shaft 1 is attached or detached.

[0056] In addition, when a condition such as the supply diameter is to be changed, this can be achieved by inserting the spindle shaft 1 on which the rotating disc 6 or package loading table 2 having a different diameter is installed, without the need to change the set of the rotor 12 and stator 14 for which quality inspections have been completed. Furthermore, this configuration eliminates the need to limit the bearing diameter to the diameter of the rotor secured to spindle shaft, that is, enables the bearing to be replaced without the need to increase the inner diameter of the bearing beyond the outer diameter of the rotor secured to the spindle shaft. As a result, the bearing diameter can be reduced and this is advantageous for fast rotations.

[0057] An individual-spindle-driven type textile machine according to a third embodiment of the present invention will be described with reference to Figures 1 to 18. In Figure 5, a large number of twisting units 101 are installed in a line that correspond to spindles of an individual-spindle-driven type multiple twister as an individual-spindle-driven type textile machine. In Figure 5, on a side of the individual-spindle-driven type multiple twister closer to the reader relative to the sheet of the drawing, a working passage is provided in a longitudinal direction of the individual-spindle-driven type multiple twister. In Figure 5, a duct for various wires is provided on the side of the individual-spindle-driven type multiple twister opposed to the working passage.

[0058] An individual spindle shaft 104 provided for each twisting unit 101 and a rotating disc 115 located at the upper end of the spindle shaft 104 are configured to rotate integrally, and the spindle shaft 104 is rotationally driven by a drive motor 110 provided for each twisting unit 101. Accordingly, a rotating disc 115 is integrally rotated. The rotating disc 115 is placed above the drive motor 110, and the twisting unit 101 is supported on a frame 109 below the drive motor 110.

[0059] The twister is further configured so that the rotating disc 115 is rotationally driven via the spindle shaft 104 to twist a raw yarn 112a released from a supply package 111 disposed stationarily above the rotating disc 115. The drive condition of each individual-spindle-driven type multiple twister is controlled by a control section 114.

[0060] The twisting unit 101 according to this embodiment is configured as one for spun yarns that twists a spun yarn formed by spinning short fibers into one long yarn.

[0061] In Figures 6 and 7, the supply package 111 of the twisting unit 101 is loaded on a stationary board 121 placed over the rotating disc 115, and the stationary board 121 is fitted on the top of the spindle shaft 104 and supported. A stationary magnet 121a is fixedly installed in the stationary board 121 so that the stationary board 121 is held stationary by an attractive force effected between this stationary magnet 121a and an attractive magnet 122 placed in an outer circumferential section of the stationary board 121 so as not to be in contact with it. In addition, the outer circumference of the supply package 111 is covered with a cheese cover 103 that is formed integrally with the stationary board 121.

[0062] The raw yarn 112a drawn out from the supply package 111 enters a tension device 147 from above, where a predetermined tension is applied to the yarn 112a. Subsequently, the yarn 112a is guided from the center of the rotating disc 115 through a guide section 115a in the outer circumferential direction and is then extended from the outer circumferential section of the rotating disc 115 to the exterior until it reaches a balloon guide 148 located above the twisting unit 101.

[0063] The raw yarn extended from the outer circumferential section of the rotating disc 115 is ballooned as the rotating disc 115 is driven by the drive motor 110 to rotate at a high speed. During a single rotation of the rotating disc 115, the yarn is twisted twice: once between the tension device 147 and the rotating disc 115 and once between the rotating disc 115 and the balloon guide 148.

[0064] In this manner, this individual-spindle-driven type multiple twister is configured as, for example, a double twister that twists the raw yarn twice during a single rotation of the rotating disc 115.

[0065] A winding device 102 is disposed above the twisting unit 101 so as to wind up a twisted yarn 112b that has been twisted by the twisting unit 101.

[0066] The twisted yarn 112b extended upward from the balloon guide 148 passes through guide rollers 149, 150 and a feed roller 108 to a traverse guide 107. After reaching the traverse guide 107, the twisted yarn 112b is wound around the supply package 105 in rolling contact with a drum 106 while being traversed by the traverse guide 107.

[0067] Next, the twisting unit 101 is explained with reference to Figures 7 and 8. As shown in Figure 7, the raw yarn 112a drawn out frown the supply package 111 enters a tension hole 147a in the tension device 147 from its upper end and then advances into a guide hole 104a in the spindle shaft 104 located below in the tension device 147 from its upper end. The lower end of the guide hole 104a is in communication with the guide section 115a of the rotating disc 115 so that the raw yarn 112a that has entered the guide hole 104a is extended to the exterior through the guide section 115a.

[0068] In addition, an air hole 104b in communication with the guide section 115a is formed at the lower end of the spindle shaft 104, and air can be supplied from the lower end of the air hole 104b. The air flows from the center of the guide section 115a toward its outer circumference, so the raw yarn 112a entering the tension hole 147a in the tension device 147 is automatically guided to the outer circumferential end of the guide section 115a of the rotating disc 115.

[0069] As shown in Figure 8, the drive motor 110 for rotationally driving the spindle shaft 104 is disposed below the rotating disc 115. The drive motor 110 is composed of a rotor magnet 132 fixedly installed in the outer circumference of the spindle shaft 104, a stator coil 131 placed in an outer circumferential section of the rotor magnet 132 opposite to the magnet 132, and a motor housing 134 for the drive motor 110.

[0070] The motor housing 134 is composed of a motor support section 126 having the stator coil 131 secured to its inner circumferential surface, an upper support member 127 that is a bearing support section mounted at the upper end of the motor support section 126 to rotatably support the spindle shaft104 via a bearing 127a, and a lower support member 128 that is a bearing support section mounted at the lower end of the motor support section 128 to rotatably support the spindle shaft104 via a bearing 128a. The spindle shaft 104 is pressed in the bearings 127a, 128a.

[0071] In addition, the lower support member 128 of the motor housing 134 located at its lower end is secured to the frame 109 in order to support the twisting unit 1 on the frame 9.

[0072] A cap 129 composed of an approximately cylindrical member is attached to the lower end of the lower support member 128, and a screw hole 129a penetrating the cap 129 in the vertical direction is formed approximately at its center in a top view. The screw hole 129a is placed coaxially with the spindle shaft 104, and an air joint 130 is screwed and fitted in the screw hole 129a from below. The air joint 130 is in communication with the guide hole 104a in the spindle shaft 104 to guide air from the exterior of the motor housing 134 to the guide hole 104a.

[0073] The rotor magnet 132 of the drive motor 110 is composed of a rare earth magnet such as a neodium magnet that is a permanent magnet having a very high magnetic force, thereby enabling the drive motor 110 to be compactified and to have a high drive capability.

[0074] In addition, the stator coil 131 is configured as a cored coil having an iron core 131a.

[0075] Furthermore, a detection magnet 133 is secured to the spindle shaft 104 under the rotor magnet 132 in order to detect the rotation speed of the spindle shaft 104, and is composed of a plastic magnet that is a permanent magnet having a low magnetic force (weaker than that of the rotor magnet 132). A magnetic sensor 133a is mounted on the motor support section 126 opposite to the detection magnet 133 to detect magnetic fields from the magnet sensor 133 in order to detect the rotation speed of the spindle shaft 104.

[0076] In addition, a plurality of fins 126a protruding outward are formed on the outer circumferential surface of the motor support section 126 constituting the motor housing 134. The fins 126a are formed to extend in the vertical direction so as to efficiently cool hot air resulting from driving effected by the drive motor 110 when an air flow (shown by the arrow in Figure 7) generated due to the rotation of the rotating disc 115 passes through the motor housing 134 of the drive motor 110.

[0077] A fitting section 127b in which the motor support section 126 is fitted is formed on the inner circumferential surface of the lower end of the upper support member 127, and the motor support section 126 has formed at its upper end a fitting section 126b configured to have a smaller diameter than the remaining portion. Thus, the upper support member 127 and the motor support section 126 are connected together by fitting the fitting section 126b in the fitting section 127b so that they are in contact with each other.

[0078] In addition, the fitting sections of the motor support section 126 and the lower support member 128 are fitted together in such a way that the inner circumferential surface of the motor support section 126 is in contact with the outer circumferential surface of the lower support member 128.

[0079] As described above, the drive motor 110 is configured as a DC brushless motor comprising the rotor magnet 132 secured to the spindle shaft 104 and comprising a permanent magnet having a high magnetic force, the stator coil 131 placed in the outer circumferential section of the rotor magnet 132 and including the iron core 131a, and the motor housing 134 covering the stator coil 131 and the rotor magnet 132. The drive motor 110 is capable of fast rotational driving.

[0080] In addition, a lubricant such as grease is supplied through lubricant supply ports in the motor housing 134 to the bearing 127a of the upper support member 127 rotatably supporting the spindle shaft 104 driven by the drive motor 110 and to the bearing 128a of the lower support member 128.

[0081] That is, as shown in Figure 10, a lubricant passage 127d is formed in such a way as to penetrate the upper support member 127 of the motor housing 134 so that a lubricant is supplied to the bearing 127a through the lubricant passage 127d from an upper lubricant supply port 127c formed by opening the lubricant passage 127d in the outer circumferential surface of the upper support member 127.

[0082] The upper lubricant supply port 127c is located outer-circumferentially laterally of the bearing 127a, that is, radially outward of the bearing 127a. The lubricant passage 127d is disposed to extend inward from the upper lubricant supply port 127c and approximately horizontally up to the middle thereof and then to incline diagonally upward toward the inside from the middle to a passage outlet 127e at the terminal of the lubricant passage 127d.

[0083] The passage outlet 127e is open in the inner circumferential surface of the upper support member 127 and is located above the bearing 127a, and over the passage outlet 127e, the inner circumferential surface of the upper support member 127 protrudes inward of the passage outlet 127e to form a protruding section 127f. The upper lubricant supply port 127c may be located slightly below the outer circumferential section of the bearing 127a.

[0084] A lubricant is supplied from the upper lubricant supply port 127c through the lubricant passage 127d to the bearing 127a. In this case, since the passage outlet 127e is located above the bearing 127a, a lubricant filled in a space 136 inside the upper support member 127 through the passage outlet 127e is reliably supplied to the lower bearing 127a.

[0085] In addition, the protruding section 127f protruding inward is formed above the passage outlet 127e of the lubricant passage 127d, so a lubricant filled in the space 136 through the passage outlet 127e is pushed downward while being inhibited from being pushed upward and is further reliably supplied to the baring 127a.

[0086] By fitting a nipple 135 in the lubricant passage 127d from the upper lubricant supply port 127c, the upper lubricant supply port 127c is blocked except during a lubricant supply to prevent the lubricant from leaking to the exterior from the upper lubricant supply port 127c.

[0087] In addition, as shown in Figure 11, in order to supply a lubricant to the bearing 128a of the lower support member 128, a lubricant passage 126d penetrating the side wall of the motor support section 126 and a lubricant passage 128b penetrating the side wall of the lower support member 128 are formed in the fitting section between the motor support section 126 and the lower support member 128. The lubricant passage 126d is in communication with the lubricant passage 128d, and is open in the outer circumferential surface of the motor support section 126 as the lower lubricant supply port 126c. The lower lubricant supply port 126c is located outer-circumferentially laterally of the bearing 128a, that is, radially outward of the bearing 128a. A lubricant is supplied from the lower lubricant supply port 126c through the lubricant passages 126d, 128b to the bearing 128a.

[0088] A passage outlet 128c formed by opening the lubricant passage 128b in the inner circumferential surface of the lower support member 128 is located above the bearing 128a, and a seal member 137 protruding inward to occlude the gap between the inner side of the lower support member 128 and the spindle shaft 104 is disposed above the passage outlet 128c. The seal member 137 prevents a lubricant filled in a space 138 inside the lower support member 128 through the passage outlet 128c from being pushed up above the seal member 137, while allowing the lubricant to be reliably supplied to the baring 128a placed under the space 138. By fitting the nipple 135 in the lubricant passage 126d from the lower lubricant supply port 126c, the lower lubricant supply port 126c is blocked except during a lubricant supply to prevent the lubricant from leaking to the exterior from the lower lubricant supply port 126c.

[0089] The upper lubricant supply port 127c is formed above the lower lubricant supply port 126c, and the upper lubricant supply port 127c and the lower lubricant supply port 126c are arranged on approximately the same vertical line. The upper lubricant supply port 127c and the lower lubricant supply port 126c are formed on the working passage side of the individual-spindle-driven type multiple twister (the side closer to the reader relative to the sheet of Figure 5).

[0090] In addition, as shown in Figure 12, a wiring port 126e allowing the inside of the motor support section 126 to communicate with the exterior is formed approximately opposite to the lower lubricant supply port 126c and upper lubricant supply port 127c of the motor support section 126 in a top view. In the wiring port 126e, a power line for supplying power to the stator coil 131 of the drive motor 110 and a signal line from the magnetic sensor 133a for detecting the magnetic force of the detection magnet 133 are wired in a wiring duct so as to pass from the interior of the motor support section 126 toward the exterior.

[0091] When the wiring port 126e is formed approximately vertically under the lubricant supply port 126c or 127c and if a lubricant spills while being supplied to the lubricant supply port 126c, 127c, the spilled lubricant will inconveniently adhere to the wiring. Thus, the wiring port 126e must be at least formed at a position other than one approximately vertically under the lubricant supply port and its neighborhood.

[0092] According to this embodiment, the wiring port 126e is not only formed off set from a position approximately under the lubricant supply port and its neighborhood but in order to facilitate the lubricant supply operation and simplify the wiring between the wiring port 126e and the wiring duct, the lower lubricant supply port 126c and the upper lubricant supply port 127c are also formed on the individual-spindle-driven type multiple twister working passage side of the motor support section 126, whereas the wiring port 126e is formed opposite to the working passage side.

[0093] In this case, the working passage side of the motor support section 126 refers to a range of 180 degrees on the working passage side relative to a line 141 parallel with a longitudinal direction of the individual-spindle-driven type multiple twister. The opposite side refers to a range of 180 ° on the side opposed to the working passage relative to the line 141 parallel with the longitudinal direction of the individual-spindle-driven type multiple twister.

[0094] As described above, the upper and lower lubricant supply ports 127c, 128c are formed in one side of the motor support section 126 of the motor housing

134, so before or after a lubricant supply, the spindle shaft 104 need not be removed from or inserted into the motor housing 134 supporting the spindle shaft 104. This configuration can prevent the axis of the spindle shaft 104 from being shifted due to an excessive force, prevent the drive motor 110 for driving the spindle shaft 104 from being damaged, and simplify the lubricant supply operation.

[0095] Furthermore, the wiring port 126e is formed at a position other than one approximately vertically under the lubricant supply port and its neighborhood, for example, in the side of the motor support section 126 opposed to the upper or lower lubricant supply port 127c, 126c. Thus, if a lubricant such as grease that is supplied from the upper or lower lubricant supply port 127c, 126c spills inside or outside the motor housing 134, because the wiring port 126e is located at a position other than the one under the upper or lower lubricant supply port 127c, 126c, the spilled lubricant is unlikely to adhere to the wiring passing through the wiring port 126e, thereby preventing the wiring from being adversely affected by the lubricant.

[0096] In addition, since the upper and lower lubricant supply ports 127c, 126c are located on the working passage side of the individual-spindle-driven type multiple twister, the lubricant supply operation becomes easier to enable the working efficiency to be improved.

[0097] Furthermore, since the wiring port 126e is located on the side of the individual-spindle-driven type multiple twister opposed to the working passage, it is closer to the wiring duct provided on the side opposed to the working passage and having a drive substrate for the drive motor 110 housed therein, thereby enabling simplification of the wiring including the power line for supplying power to the stator coil 131 of the drive motor 110 and the signal line from the magnetic sensor 133a for detecting the magnetic force of the detection magnet 133.

[0098] In addition, a plurality of upper and lower lubricant supply ports 127c, 126c are formed in the vertical direction as lubricant supply ports and arranged on approximately the same vertical line, so the lubricant supply operation becomes easier to enable the working efficiency to be further improved.

[0099] Next, in the twisting unit 101 of the individual-spindle-driven type multiple twister configured as described above, a removal member for removing the spindle shaft 104 from the motor housing 134 is described. The cap 129 shown in Figure 8 is attached via a bolt to the lower end of the lower support member 128 of the motor housing 134 supporting the spindle shaft 104, and the air joint 130 is normally fitted in the screw hole 129a in the cap 129 from below.

[0100] To remove the spindle shaft 104 from the motor housing 134 during maintenance of the twisting unit 101, the air joint 130 is removed from the cap 129 and a bolt 143 is inserted and screwed in the screw hole 129a in the cap 129 from below. The bolt 143 inserted and screwed in the screw hole 129a abuts on the lower end of the spindle shaft 104. The bolt 143 is further screwed to push the spindle shaft 104 upward, thereby enabling the shaft 104 to be simply removed. That is, the cap 129 is used as a removal member for removing the spindle shaft 104.

[0101] In this manner, the cap 129 acting as the removable member for removing the spindle shaft 104 is attached to the periphery of the spindle shaft, thereby eliminating the needs for special jigs to simplify the removal operation.

[0102] In addition, the cap 129 is placed at the lower end of the spindle shaft 104, so by simply allowing the cap 129 to push the bottom surface of the spindle shaft 104 upward, the spindle shaft 104 that has been pressed in the bearings 127a, 128a can be removed. Accordingly, the structure of the cap 129 and the relevant operation can be simplified.

[0103] In addition, the cap 129 forms the screw hole 129a coaxial with the spindle shaft 104, so in removing the spindle shaft 104, the spindle shaft 104 can be pushed upward by simply inserting and screwing the bolt in the screw hole 129a. Consequently, the removal operation and the cap structure can be further simplified.

[0104] In this example, the cap 129 is not only the removal member for removing the spindle shaft 104 but is also annexed to the twisting unit beforehand as amounting member for the air joint 130. Thus, the cap 129 does not increase the number of parts of the twisting unit 101.

[0105] Next, a twisting unit used for filament yarns to twist a filament yarn formed by aligning long fibers such as silk or chemical fibers is explained as another embodiment of the twisting unit 101.

[0106] As in the above twisting unit 101, a supply package 161 in a twisting unit 151, which is shown in Figure 13, is loaded on a stationary board 171 placed stationarily over a rotating disc 165. The stationary board 171 is rotatably fitted and supported on the top of a spindle shaft 154. A raw yarn 162a drawn out from the supply package 161 of the twisting unit 151 enters a tension hole 197a in a tension device 197 from its upper end and then advances into a guide hole 154a in the spindle shaft 154 located below the tension device 197, from the upper end of the spindle shaft. The lower end of the guide hole 154a is in communication with a guide section 165a of the rotating disc 165 so that the raw yarn 162a that has entered the guide hole 154a is extended to the exterior through the guide section 165a.

[0107] As shown in Figure 14, a drive motor 160 for rotationally driving the spindle shaft 154 is disposed below the rotating disc 165. The drive motor 160 is composed of a rotor magnet 182 fixedly installed in the outer circumference of the spindle shaft 154, a stator coil 181 placed in an outer circumferential section of the rotor magnet 182 opposite to the magnet 182, and a motor housing 184 for the drive motor 160. The motor housing

184 is composed of a motor support section 176 having the stator coil 181 secured to its inner circumferential surface, an upper support member 177 mounted at the upper end of the motor support section 176 to rotatably support the spindle shaft154 via a bearing 177a, and a lower support member 178 mounted at the lower end of the motor support section 176 to rotatably support the spindle shaft154 via a bearing 178a. The spindle shaft 154 is pressed in the bearings 177a, 178a.

[0108] In addition, the lower support member 178 of the motor housing 184 located at its lower end is secured to the frame 159 in order to support the twisting unit 151 on a frame 159. A cap 179 composed of an approximately cylindrical member is attached to the lower end of the lower support member 178, and a screw hole 179a penetrating the cap 179 in the vertical direction is formed approximately at its center in a top view. The screw hole 179a is placed coaxially with the spindle shaft 154.

[0109] The rotor magnet 182 of the drive motor 160 is composed of a rare earth magnet such as a neodium magnet that is a permanent magnet having a very high magnetic force, thereby enabling the drive motor 160 to be compactified and to have a high drive capability. In addition, a detection magnet 183 is secured to the spindle shaft 154 under the rotor magnet 182 in order to detect the rotation speed of the spindle shaft 154, and is composed of a plastic magnet that is a permanent magnet having a low magnetic force (weaker than that of the rotor magnet 182). A magnetic sensor 183a is mounted on the motor support section 176 opposite to the detection magnet 183 to detect magnetic fields from the detection magnet 183 in order to detect the rotation speed of the spindle shaft 154.

[0110] In addition, a plurality of fins 176a protruding outward are formed on the outer circumferential surface of the motor support section 176 constituting the motor housing 184. The fins 176a are formed to extend in the vertical direction so as to efficiently cool hot air resulting from driving effected by the drive motor 160 when an air flow (shown by the arrow in Figure 13) generated due to the rotation of the rotating disc 165 passes through the motor housing 184 of the drive motor 160.

[0111] A fitting section 177a in which the motor support section 176 is fitted is formed on the inner circumferential surface of the lower end of the upper support member 177, and the motor support section 176 has formed at its upper end a fitting section 176b configured to have a smaller diameter than the remaining portion. Thus, the upper support member 177 and the motor support section 176 are connected together by fitting the fitting section 176b in the fitting section 177b so that they are in contact with each other.

[0112] In addition, the fitting sections of the motor support section 176 and the lower support member 178 are fitted together in such a way that the inner circumferential surface of the motor support section 176 is in contact with the outer circumferential surface of the lower support member 178.

[0113] As described above, the drive motor 160 is configured as a DC brushless motor comprising the rotor magnet 182 secured to the spindle shaft 154 and comprising a permanent magnet having a high magnetic force, the stator coil 181 placed in the outer circumferential section of the rotor magnet 182 and including the iron core 181a, and the motor housing 184 covering the stator coil 181 and the rotor magnet 182. The drive motor 160 is capable of fast rotational driving.

[0114] In addition, a lubricant such as grease is supplied through lubricant supply ports in the motor housing 184 to a bearing 177a of the upper support member 177 rotatably supporting the spindle shaft 154 driven by the drive motor 160 and to a bearing 128a of the lower support member 178.

[0115] That is, as shown in Figure 16, a lubricant passage 177d is formed in such a way as to penetrate the upper support member 177 of the motor housing 184 so that a lubricant is supplied to the bearing 177a through the lubricant passage 177d from an upper lubricant supply port 177c formed by opening the lubricant passage 177d in the outer circumferential surface of the upper support member 177.

[0116] The upper lubricant supply port 177c is located outer-circumferentially laterally of the bearing 177a, that is, radially outward of the bearing 177a. The lubricant passage 177d is disposed to extend inward from the upper lubricant supply port 177c and approximately horizontally up to the middle thereof and then to incline diagonally upward toward the inside from the middle to a passage outlet 177e at the terminal of the lubricant passage 177d. The passage outlet 177e is open in the inner circumferential surface of the upper support member 177 and is located above the bearing 177a, and over the passage outlet 177e, the inner circumferential surface of the upper support member 177 protrudes inward of the passage outlet 177e to form a protruding section 177f. The upper lubricant supply port 177c may be located slightly below the outer circumferential section of the bearing 177a.

[0117] A lubricant is supplied from the upper lubricant supply port 177c through the lubricant passage 177d to the bearing 177a from above.

[0118] In this case, since the passage outlet 177e is located above the bearing 177a, a lubricant filled in a space 186 inside the upper support member 177 through the passage outlet 177e is reliably supplied to the lower bearing 177a.

[0119] In addition, the protruding section 177f protruding inward is formed above the passage outlet 177e of the lubricant passage 177d, so a lubricant filled in the space 186 through the passage outlet 177e is pushed downward while being inhibited from being pushed upward and is further reliably supplied to the baring 177a.

[0120] By fitting a nipple 135 in the lubricant passage 177d from the upper lubricant supply port 177c, the upper lubricant supply port 177c is blocked except during a lubricant supply to prevent the lubricant from leaking to the exterior front the upper lubricant supply port 177c.

[0121] In addition, as shown in Figure 17, in order to supply a lubricant to the bearing 178a of the lower support member 178, a lubricant passage 176d penetrating the side wall of the motor support section 176 and a lubricant passage 178b penetrating the side wall of the lower support member 178 are formed in the fitting section between the motor support section 176 and the lower support member 178. The lubricant passage 176d is in communication with the lubricant passage 178b, and is open in the outer circumferential surface of the motor support section 176 as the lower lubricant supply port 176c. The lower lubricantsupply port 176c is located outer-circumferentially laterally of the bearing 178a, that is, radially outward of the bearing 178a. A lubricant is supplied from the lower lubricant supply port 176c through the lubricant passages 176d, 178b to the bearing 178a.

[0122] A passage outlet 178c formed by opening the lubricant passage 178b in the inner circumferential surface of the lower support member 178 is located above the bearing 178a, and a seal member 187 protruding inward to occlude the gap between the inner side of the lower support member 178 and the spindle shaft 154 is disposed above the passage outlet 178c. The seal member 187 prevents a lubricant filled in a space 188 inside the lower support member 178 through the passage outlet 178c from being pushed up above the seal member 187, while allowing the lubricant to be reliably supplied to the baring 178a placed under the space 188.

[0123] In addition, by fitting the nipple 135 in the lubricant passage 176d from the lower lubricant supply port 176c, the lower lubricant supply port 176c is blocked except during a lubricant supply to prevent the lubricant from leaking to the exterior from the lower lubricant supply port 176c.

[0124] The upper lubricant supply port 177c is formed above the lower lubricant supply port 176c, and the upper lubricant supply port 177c and the lower lubricant supply port 176c are arranged on approximately the same vertical line. The upper lubricant supply port 177c and the lower lubricant supply port 176c are formed on the working passage side of the individual-spindle-driven type member twister (the side closer to the reader relative to the sheet of Figure 5).

[0125] In addition, as shown in Figure 18, a wiring port 176e allowing the inside of the motor support section 176 to communicate with the exterior is formed in a side of the motor support section 176 located approximately opposite to the lower lubricant supply port 176c and upper lubricant supply port 177c of the motor support section 176. In the wiring port 176e, a power line for supplying power to the stator coil 181 of the drive motor 160 and a signal line from the magnetic sensor 183a for detecting the magnetic force of the detection magnet 183 passes from the interior of the motor support section 176 toward the exterior and enters a wiring duct.

[0126] That is, the lower lubricant supply port 176c and the upper lubricant supply port 177c are also formed on the individual-spindle-driven type multiple twister working passage side of the motor support section 176, whereas the wiring port 176e is formed opposite to the working passage side.

[0127] In this case, the working passage side of the motor support section 176 refers to a range 202 of 180 degrees on the working passage side relative to a line 201 parallel with a longitudinal direction of the individual-spindle-driven type multiple twister. The opposite side refers to a range 203 of 180 degrees on the side opposed to the working passage relative to the line 201 parallel with the longitudinal direction of the individual-spindle-driven type multiple twister.

[0043]

[0128] As described above, the upper and lower lubricant supply ports 177c, 176c are formed in one side of the motor support section 176 of the motor housing 184, so before or after a lubricant supply, the spindle shaft 154 need not be removed from or inserted into the motor housing 184 supporting the spindle shaft 154. This configuration can prevent the axis of the spindle shaft 154 from being shifted due to an excessive force, prevent the drive motor 160 for driving the spindle shaft 154 from being damaged, and simplify the lubricant supply operation.

[0129] Furthermore, the wiring port 176e is formed on the side of the motor support section 176 opposed to the upper or lower lubricant supply port 177c, 176c in a top view. Thus, since the wiring port 176e is located at a position other than one approximately under the upper or lower lubricant supply port 177c, 176c and its neighborhood, if a lubricant such as grease that is supplied from the upper or lower lubricant supply port 177c, 176c spills inside or outside the motor housing 184, the spilled lubricant is unlikely to adhere to the wiring passing through the wiring port 176e, thereby preventing the wiring from being adversely affected by the lubricant.

[0130] In addition, since the upper and lower lubricant supply ports 177c, 176c are located on the working passage side of the individual-spindle-driven type multiple twister, the lubricant supply operation becomes easier to enable the working efficiency to be improved.

[0131] Furthermore, since the wiring port 176e is located on the side of the individual-spindle-driven type multiple twister opposed to the working passage, it is closer to the wiring duct provided on the side opposed to the working passage and having a drive substrate for the drive motor 160 housed therein, thereby enabling simplification of the wiring including the power line for supplying power to the stator coil 181 of the drive motor 160 and the signal line from the magnetic sensor 183a for detecting the magnetic force of the detection magnet 183.

[0132] In addition, a plurality of upper and lower lubricant supply ports 177c, 176c are formed in the vertical direction as lubricant supply ports and arranged on approximately the same vertical line, so the lubricant supply operation becomes easier to enable the working efficiency to be further improved.

[0133] Next, in the twisting unit 151 of the individual-spindle-driven type multiple twister configured as described above, a cap 179 attached to the lower end of the motor housing 184 is described as a removal member for removing the spindle shaft 154 from the motor housing 184. The cap 179 shown in Figure 14 is attached via a bolt to the lower end of the lower support member 178 of the motor housing 184 supporting the spindle shaft 154.

[0134] To remove the spindle shaft 154 from the motor housing 184 during maintenance of the twisting unit 151, a bolt 143 is inserted and screwed in the screw hole 179a in the cap 179 from below. The bolt 143 inserted and screwed in the screw hole 179a abuts on the lower end of the spindle shaft 154. The bolt 143 is further screwed to push the spindle shaft 154 upward, thereby enabling the shaft 154 to be simply removed.

[0135] In this manner, the cap 179 acting as the removable member for removing the spindle shaft 154 is attached to the periphery of the spindle shaft, thereby eliminating the needs for special jigs for removing the spindle shaft 154 to simplify the removal operation.

[0136] In addition, since the cap 179 is placed at the lower end of the spindle shaft 154, it has only to be adapted to push the bottom surface of the spindle shaft 104 upward. Accordingly, the structure of the cap 179 can be simplified.

[0137] In addition, the cap 179 forms the screw hole 179 coaxial with the spindle shaft 154, so in removing the spindle shaft 154, the spindle shaft 154 can be pushed upward by simply inserting and screwing the bolt in the screw hole 179a. Consequently, the removal operation and the structure of the cap 179 can be further simplified.

[0138] In this case, the individual-spindle-driven type multiple twister has the large number of twisting units 151 installed in parallel and each twisting unit 151 has the cap 179 attached beforehand. The individual-spindle-driven type multiple twister may be configured so that an inexpensive resin cap is normally attached to the lower end of the lower support member 178 of the motor housing 184 to occlude this lower end and so that only when the spindle shaft 154 is to be removed from the motor housing 184, the cap 179 with the screw hole 179a formed therein is attached to the lower end of the lower support member 178 prior to the removal operation.

[0139] With this configuration, only several caps 179 need to be prepared so that in removing the spindle shaft 154, the removal operation can be performed by sequentially attaching the cap to the twisting 151 from which the spindle shaft 154 is to be removed, thereby reducing the number of parts of the individual-spindle-driven type multiple twister to reduce costs.

[0140] Due to the above configuration, the present invention has the following effects.

[0141] According to the aspects of the present invention, the drive motor can be constructed without inserting or installing the spindle shaft, so the drive motor M can be inspected for quality in parallel with a rotation balancing operation for the spindle shaft.

[0142] In addition, this configuration eliminates the needs for simultaneous attachment or detachment of the spindle shaft and the rotor to prevent the rotor from being damaged upon attachment or detachment of the spindle shaft.

[0143] Furthermore, in changing a condition, for example, replacing the feed yarn, the spindle shaft can be replaced with the rotor or the stator untouched.

[0144] Furthermore, if the drive motor and the spindle shaft are separated from each other and the motor shaft of the drive motor and the spindle shaft are connected together via a coupling, then it is very difficult to accurately center both shafts together and the run-out during rotations may increase to reduce the efficiency. The present invention, however, inserts the spindle shaft into the drive motor, that is, integrates the spindle shaft and the motor shaft together to eliminate the need to center both axes in order to enable efficient and stable rotations. In addition, although the separate spindle shaft and motor shaft require bearings for supporting the respective shafts, the integrated shafts can minimize the number of bearings required.

[0145] According to the aspect of the present invention, even after the spindle shaft has been removed, the holding means can reliably hold the rotor opposed to the stator.

[0146] According to the aspect of the present invention, the simple structure can be used to hold the rotor opposed to the stator after the spindle shaft has been removed, thereby enabling the spindle to be inserted or removed separately from the rotor.

[0147] According to the aspect of the present invention, the sleeve is supported via the bearings both above and below the rotor and the spindle shaft is inserted into the sleeve, thereby enabling the length of the spindle shaft to be reduced and the rotation of the spindle shaft to be stabilized.

[0148] According to the aspect of the present invention, the simple structure can be used to rotate the rotating body with a large inertia at a high speed.

[0149] According to the aspect of the present invention, by accurately centering the inserted spindle shaft, the spindle shaft can be rotated stably during twisting.

[0150] According to the aspect of the present invention, the simple structure can be used to insert or remove the spindle shaft easily.

[0151] The aspect of the present invention eliminates the need to specially prepare a jig for removing the spindle shaft upward to simplify the removal operation. In addition, by simply screwing the bolt in the screw hole in the removal member, the interference between the rotor and the stator can be reliably prevented during removal of the spindle shaft.

[0152] According to the aspect of the present invention, the lubricant supply port is formed in the housing of the motor for driving the spindle shaft, so a lubricant can be supplied to the bearing without the need to remove the spindle shaft, thereby simplifying the lubricant supply operation and preventing the motor from being damaged during removal of the spindle shaft. In addition, even if a lubricant supplied from the lubricant supply port spills inside or outside the housing, the lubricant spilling on the wiring passing through the wiring port is unlikely to adhere to the wiring, thereby preventing the wiring from being adversely affected by the lubricant.

Claims

1. A twisting unit comprising a drive motor provided coaxially with a spindle shaft to drive this shaft, the spindle shaft being rotated to twist a yarn, characterized in that the unit is configured so that the spindle shaft can be inserted into or removed from the drive motor separately from a rotor of the drive motor.

2. A twisting unit as in Claim 1, characterized in that the unit comprises a holding means for holding said rotor opposed to a stator of the drive motor after said spindle has been removed from the drive motor.

3. A twisting unit as in Claim 2, characterized in that the unit comprises a sleeve configured separately from said spindle shaft and having said rotor secured to its outer circumferential surface, a motor housing having said stator secured to its inner circumferential surface, and a bearing for rotatably supporting said sleeve on the motor housing, and in that the unit is configured so that said spindle shaft can be inserted into or removed from said sleeve.

4. A twisting unit as in Claim 3 characterized in that said bearing is provided both above and below said rotor.

5. A twisting unit as in Claim 4, characterized in that said sleeve has a large-diameter section in its middle in the axial direction and has at both axial ends thereof, small-diameter sections having a smaller diameter than said large-diameter section, the sleeve having said rotor secured to the outer circumferential surface of said large-diameter section, the sleeve being rotatably supported at said small-diameter sections by said bearings.

6. A twisting unit as in any one of Claims 3 to 5, characterized in that the unit comprises a tapered hole formed in the inner circumferential surface of said sleeve and a tapered section formed on the outer circumferential surface of said spindle shaft so that said spindle shaft is inserted to taper-fit said tapered section in said tapered hole.

7. A twisting unit as in Claim 6, characterized in that after the spindle shaft has been inserted into said sleeve, the weight of an inserted body including the spindle shaft provides such a predetermined frictional force as prevents the sleeve and the spindle shaft from being relatively rotated on said taper-fitting surface during twisting.

8. A twisting unit comprising a motor that individually drives a spindle for twisting a yarn, characterized in that the unit comprises a removal member for removing the spindle shaft upward from a housing that rotatably supports the spindle shaft, and in that the removal member is attached to an lower end of the spindle shaft and comprises a screw hole coaxial with the spindle shaft.

9. A twisting unit comprising a motor that individually drives a spindle for twisting a yarn, characterized in that a lubricant supply port for supplying a lubricant to a bearing that rotatably supports the spindle shaft is formed at a particular position of a housing that rotatably supports the spindle shaft, and in that a wiring port through which a wiring passes to feed power to the motor driving the spindle shaft is formed at a position of the housing other than one approximately vertically under the lubricant supply port and its neighborhood.

FIG. 1

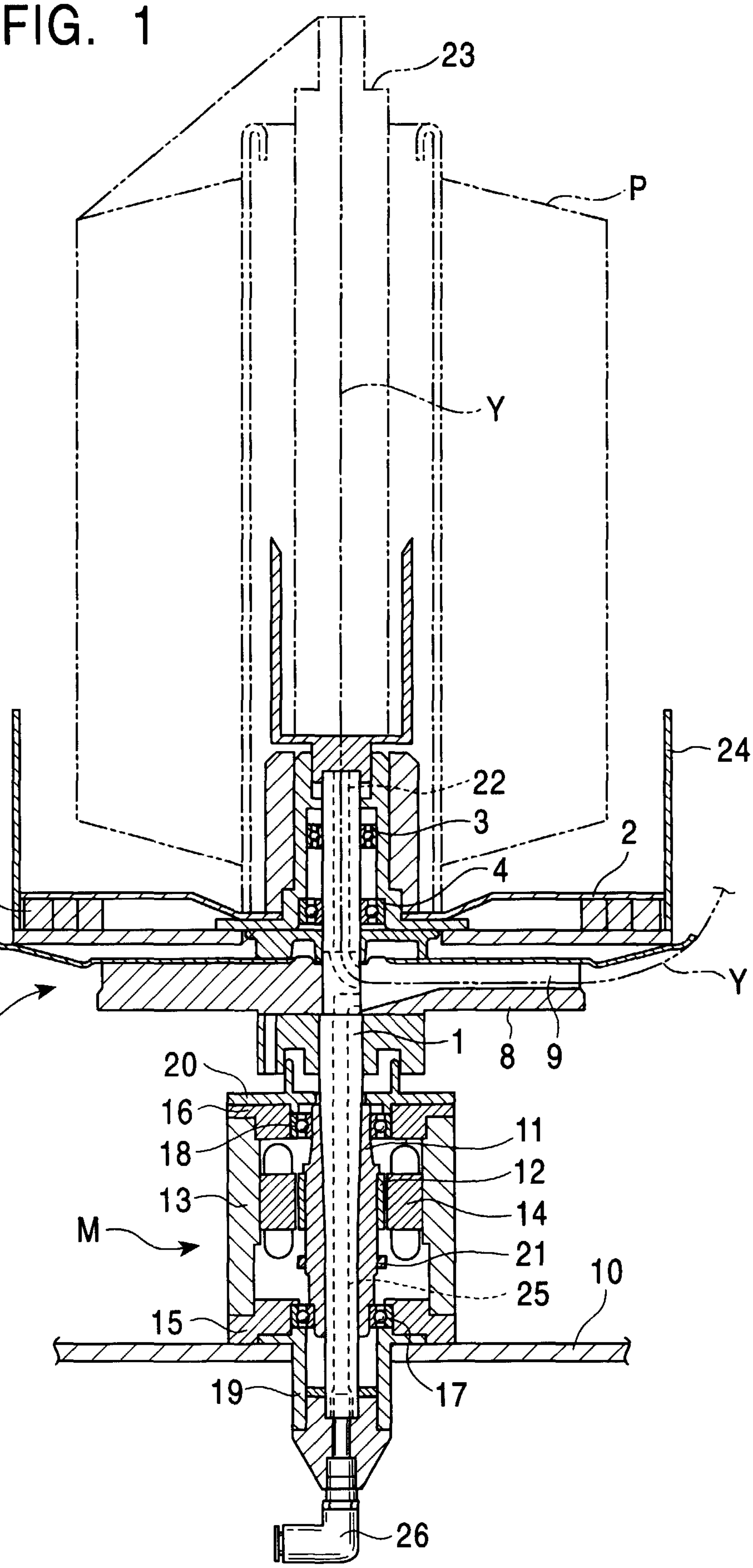


FIG. 2

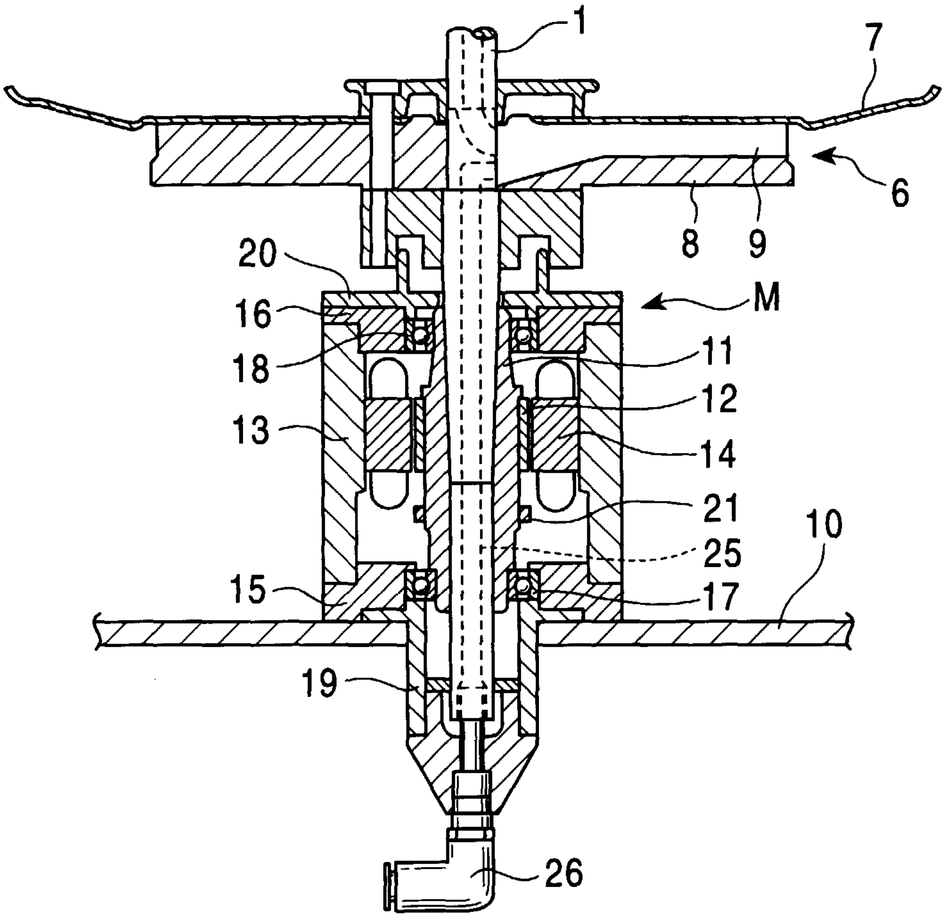


FIG. 3

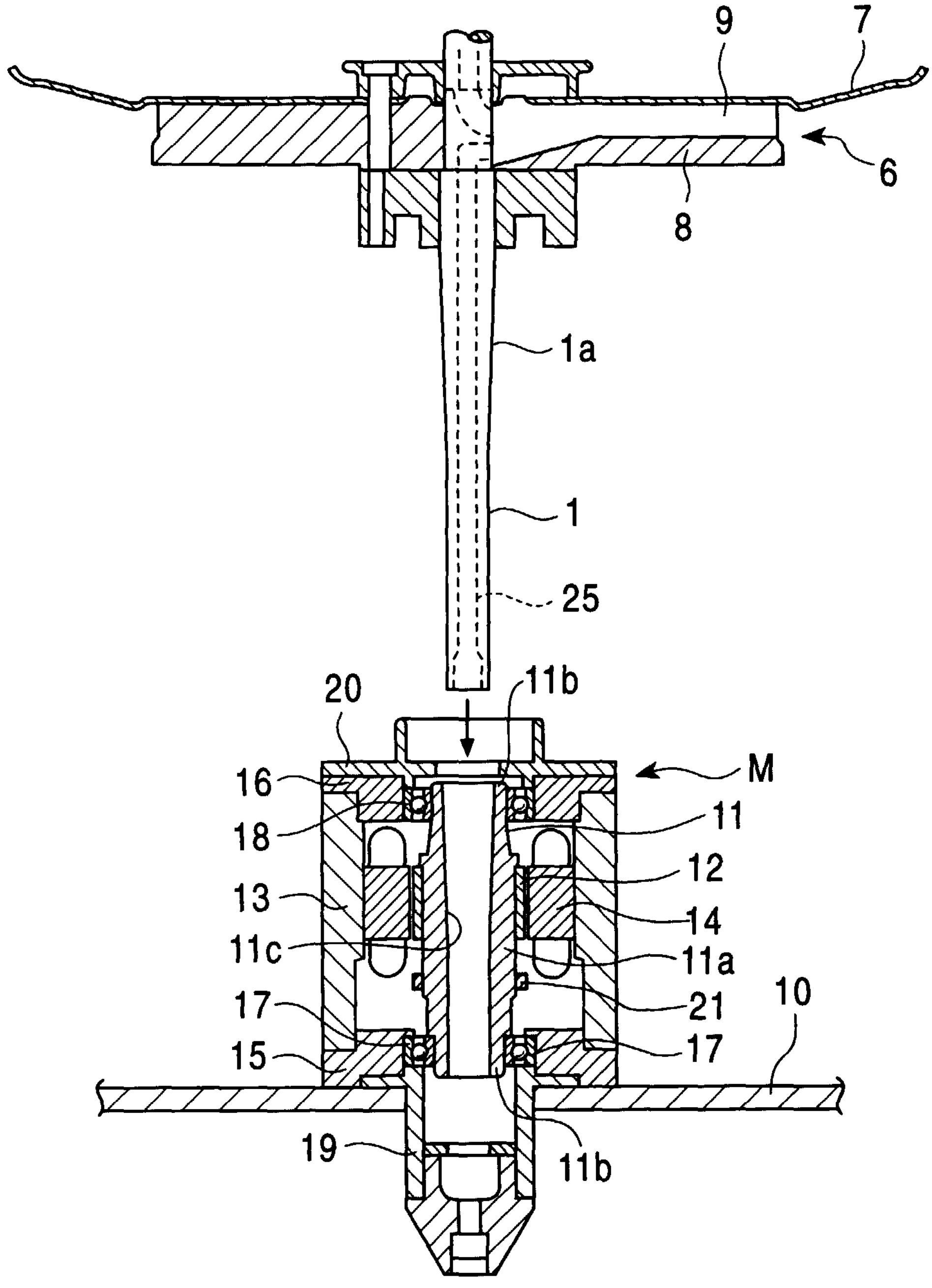
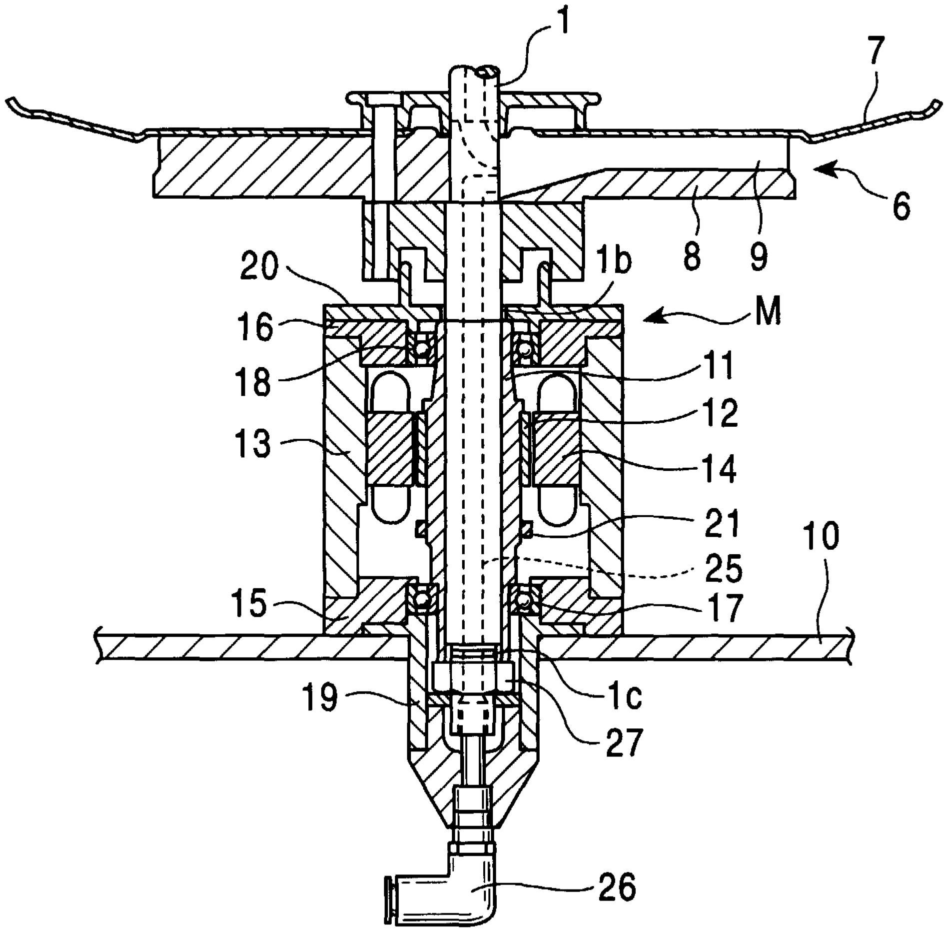


FIG. 4



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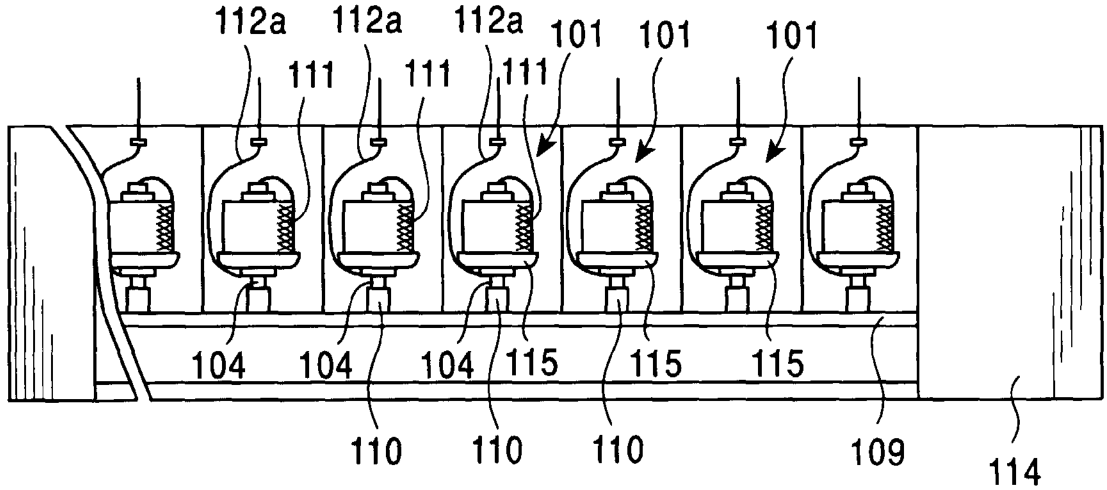
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FIG. 6

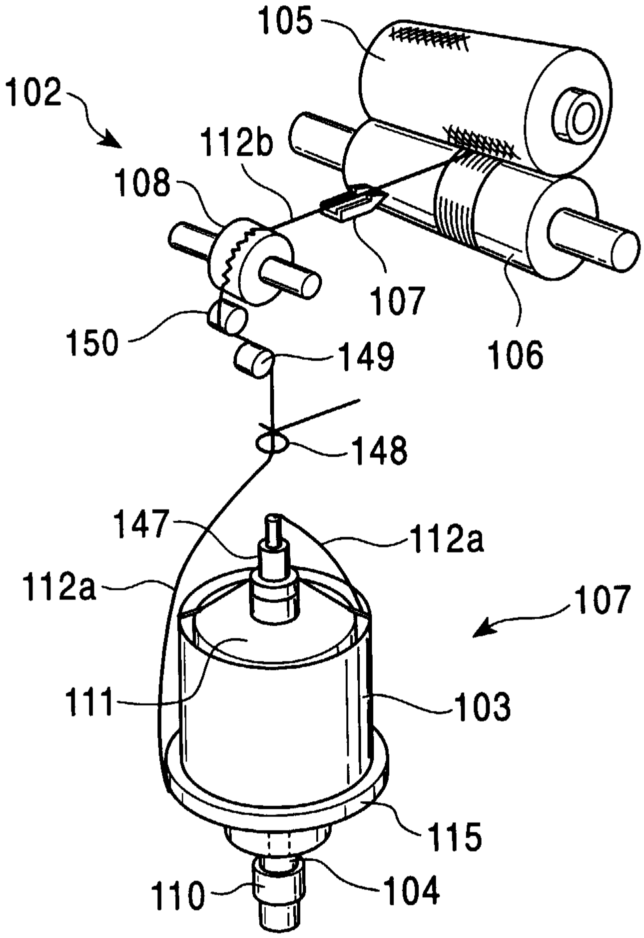
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FIG. 7

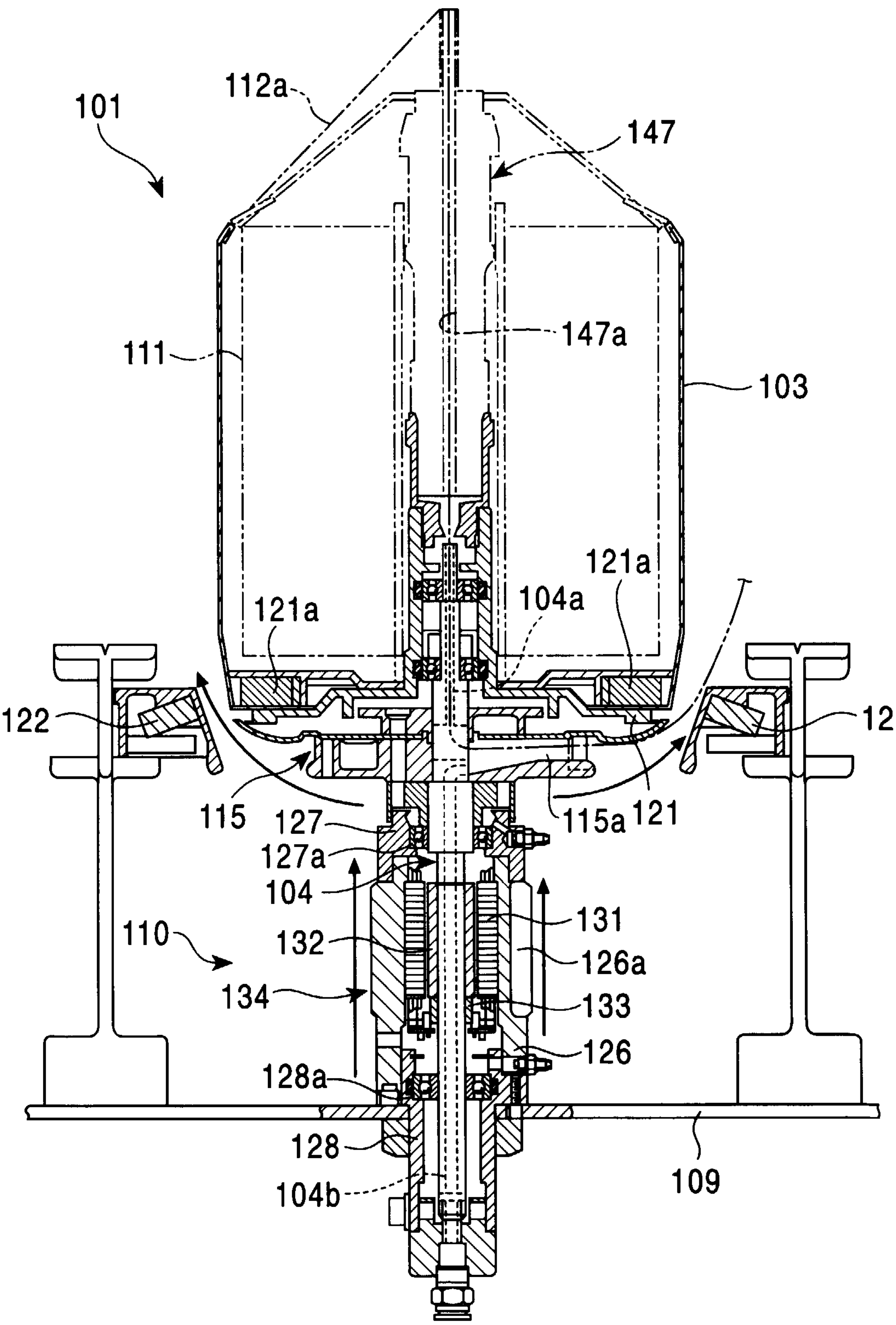
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FIG. 8

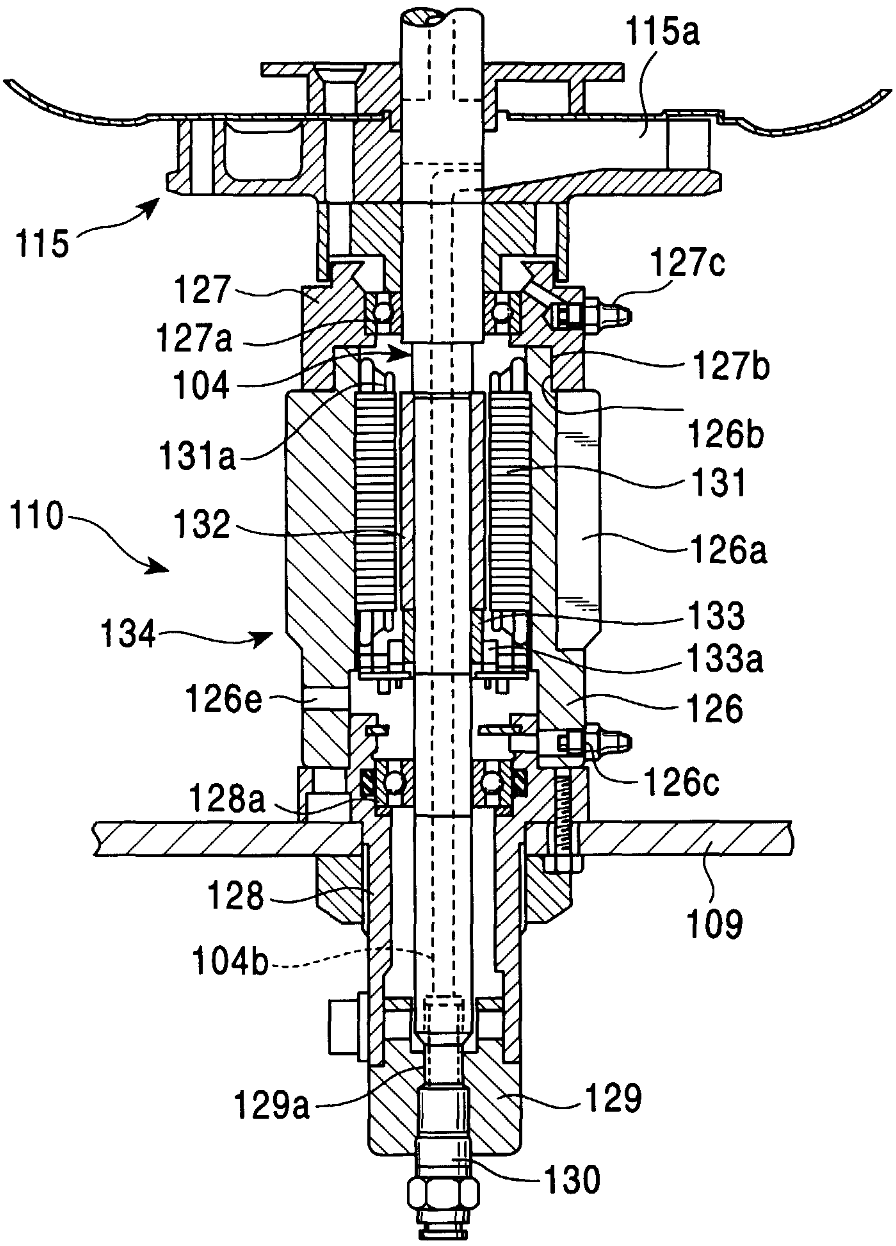
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FIG. 9

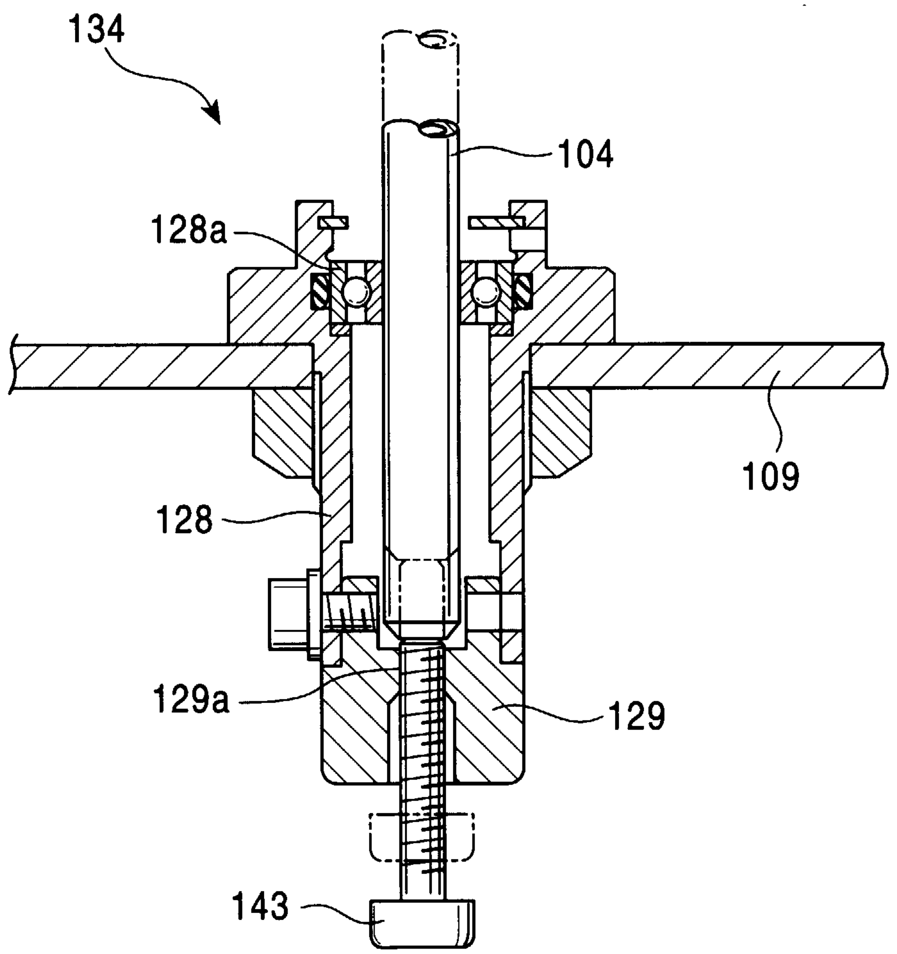

FIG. 10

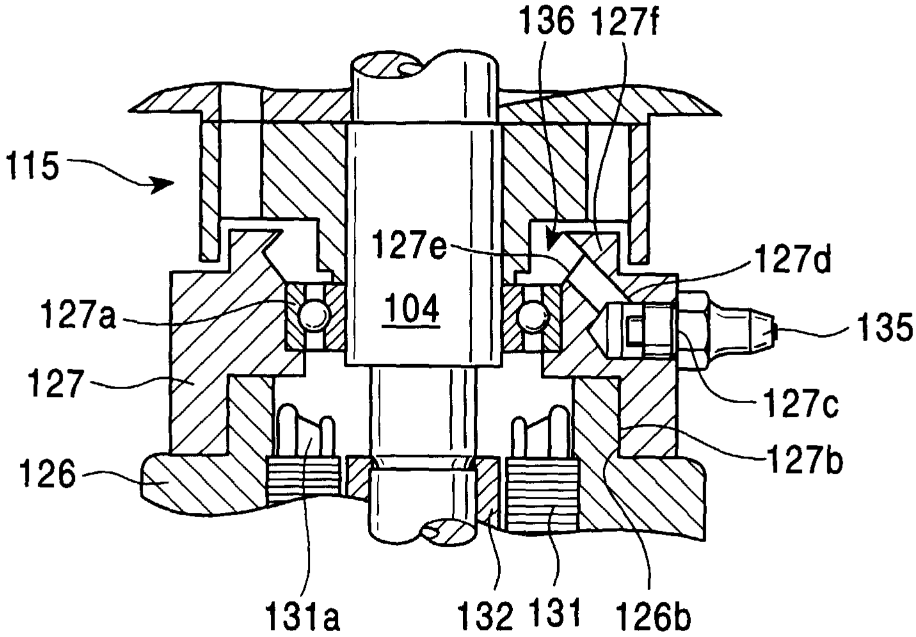
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FIG. 11

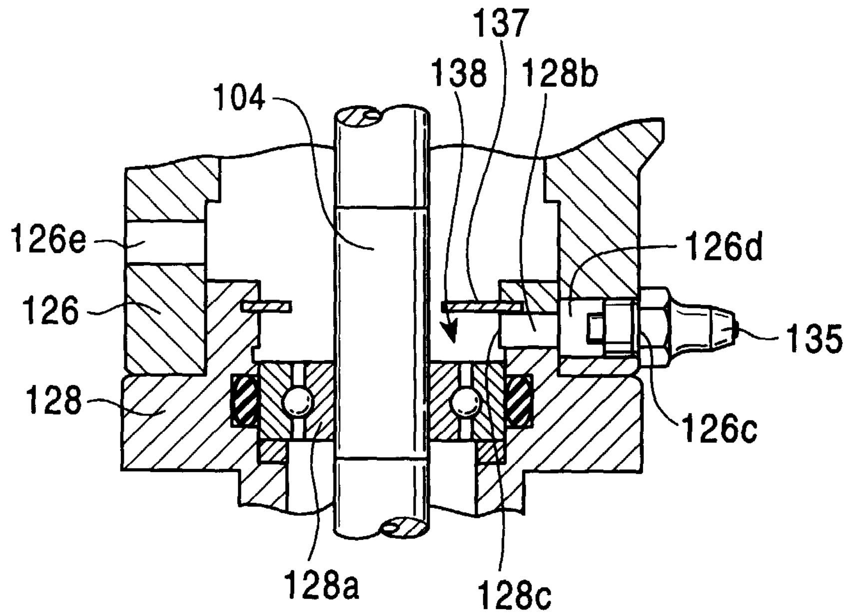
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FIG. 12

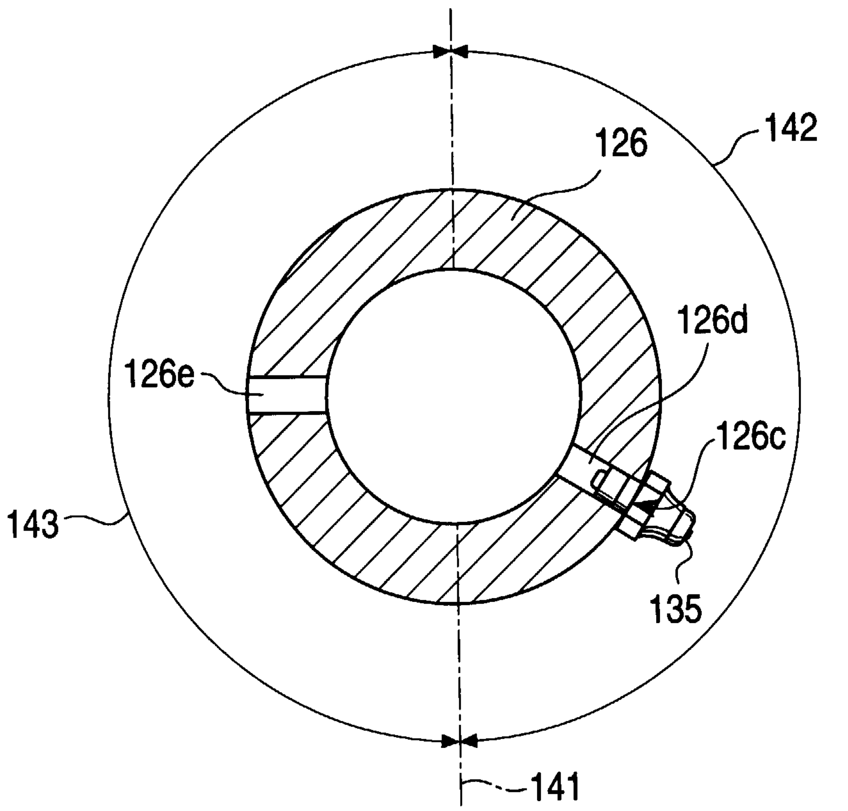

FIG. 13

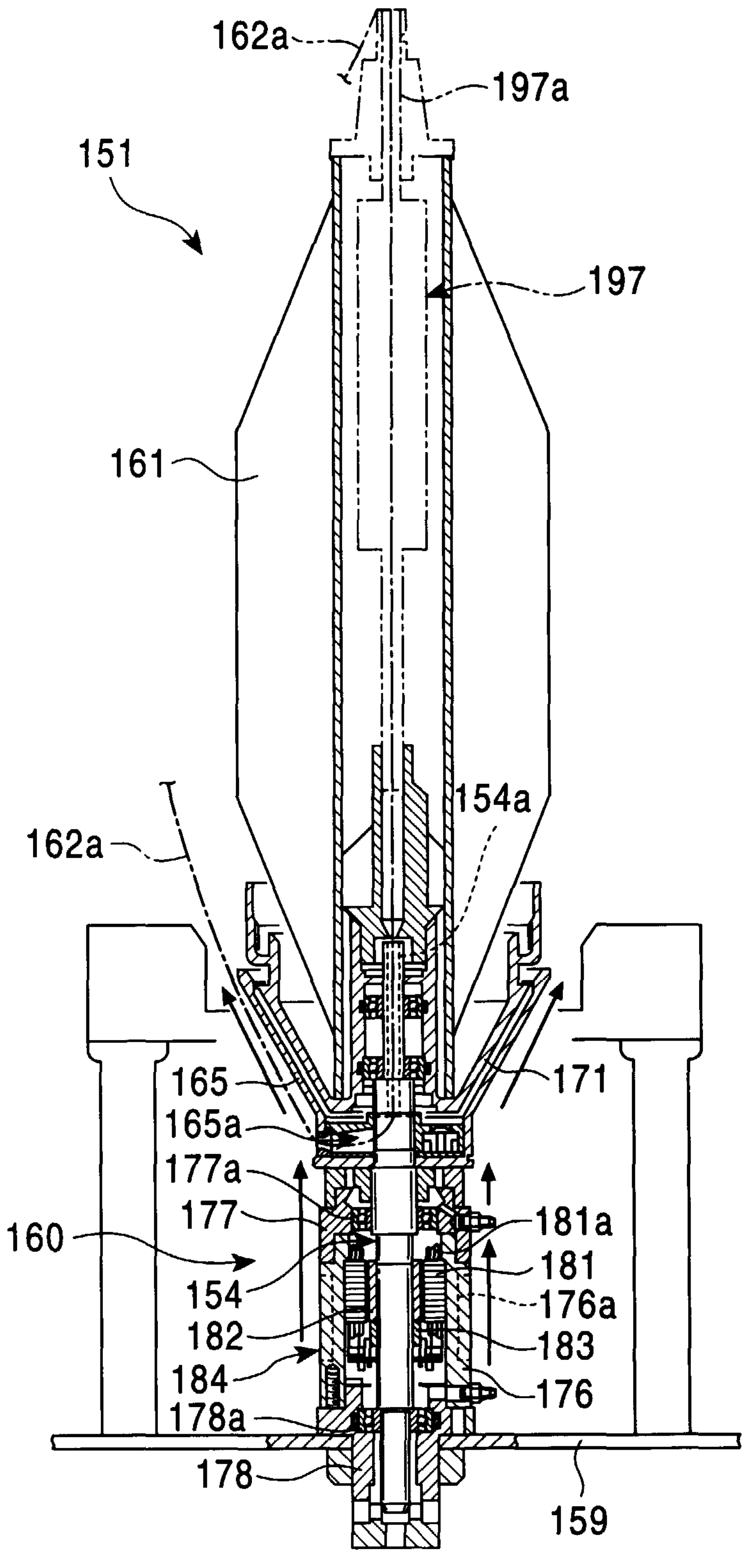
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FIG. 14

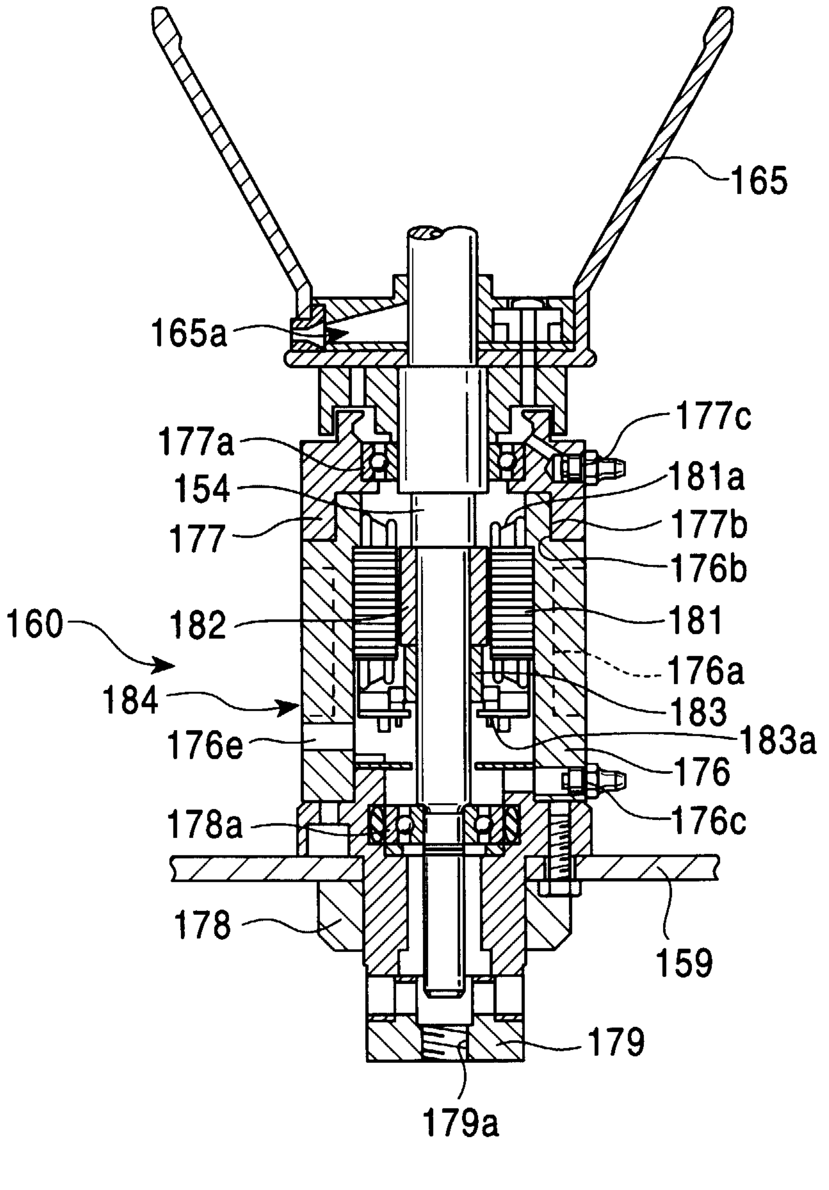
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FIG. 15

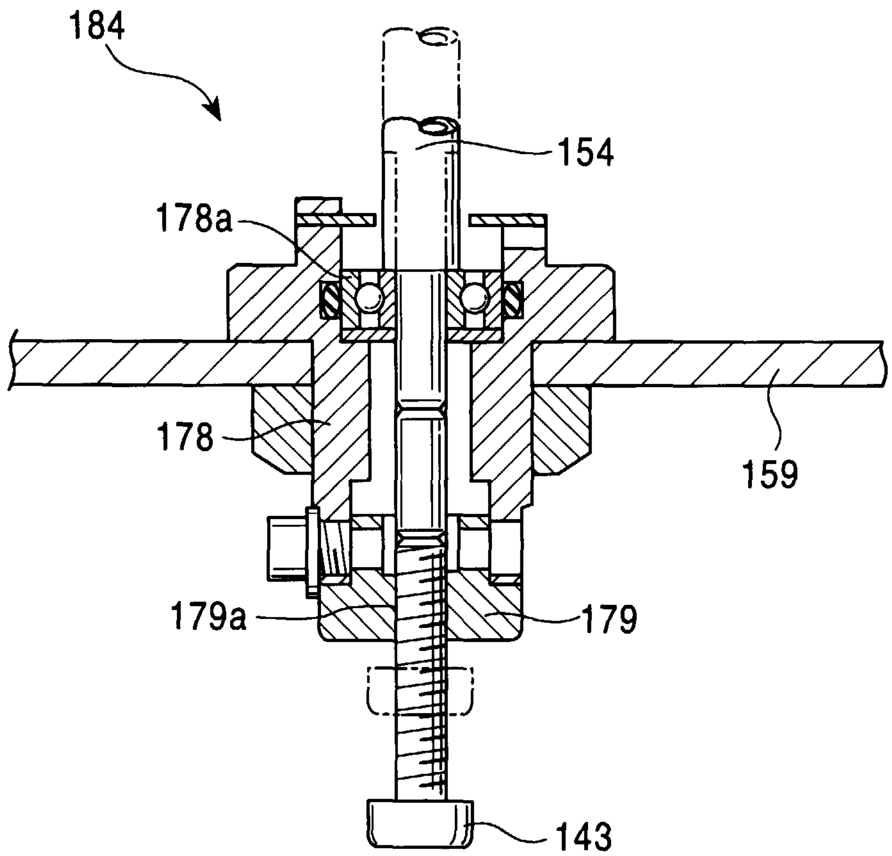

FIG. 16

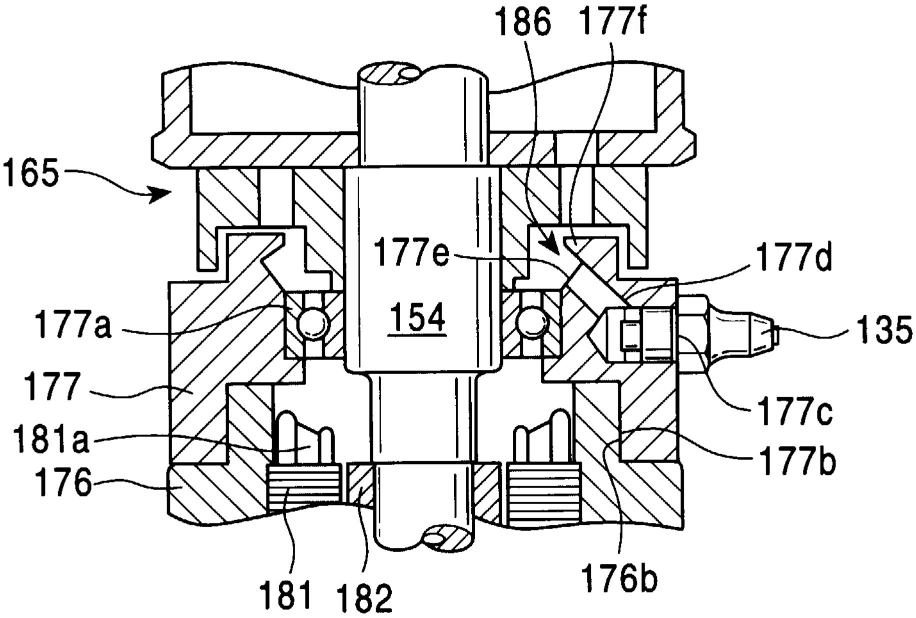
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FIG. 17

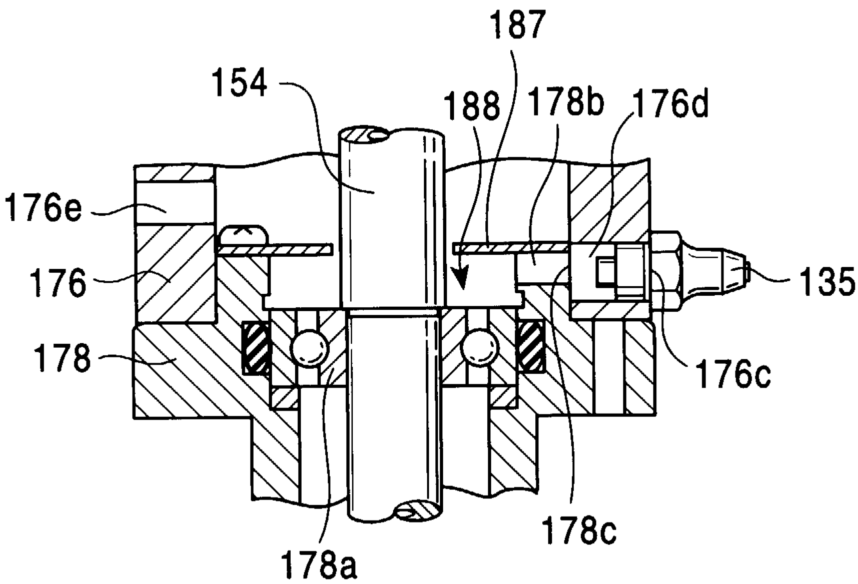
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FIG. 18