



(12) **EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 158(3) EPC

(43) Date of publication:  
**31.10.2001 Bulletin 2001/44**

(51) Int Cl.7: **D02G 1/08**

(21) Application number: **99973312.4**

(86) International application number:  
**PCT/JP99/06614**

(22) Date of filing: **26.11.1999**

(87) International publication number:  
**WO 00/34558 (15.06.2000 Gazette 2000/24)**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

(72) Inventors:  
• **NAITO, Shunzo Teijin Seiki Co., Ltd.  
Matsuyama-shi Ehime-ken 791-8041 (JP)**  
• **SHIGEKAWA, Yasushi Teijin Seiki Co., Ltd.  
Matsuyama-shi Ehime-ken 791-8041 (JP)**  
• **KISHIDA, Shinichi  
Kawasaki-shi Kanagawa-ken 215-0013 (JP)**

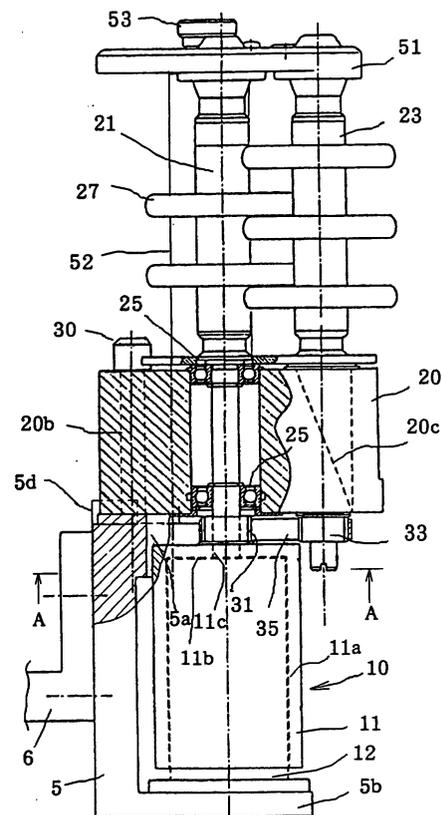
(30) Priority: **07.12.1998 JP 34631998**  
**16.02.1999 JP 3779599**

(74) Representative: **von Hellfeld, Axel, Dr. Dipl.-Phys.  
Wuesthoff & Wuesthoff  
Patent- und Rechtsanwälte  
Schweigerstrasse 2  
81541 München (DE)**

(54) **MOTOR-DRIVEN THREE-AXIS FRICTION FALSE TWISTING DEVICE**

(57) Three spindles 21, 22 and 23 have a plurality of friction discs 27, respectively, and are rotatably supported on a spindle mount 20, the spindle mount being detachably disposed on a bracket 5, one of the three spindles has a rotor of a drive motor mounted thereon and a stator of the drive motor being fixed to the bracket, wherein the drive motor is a radial gap type outer rotor brushless motor 10, the outer rotor 11 of the brushless motor is formed in a bell shape, and the outer rotor is fixed to an end of one 21 of the spindles so that it covers the peripheral outside and the spindle side end of the stator of the brushless motor forming a small clearance therebetween and that the peripheral portion of the outer rotor and the peripheral portion of the stator are magnetically connected with each other.

Fig.2



## Description

### Technical Field to which the Invention Relates

**[0001]** The present invention relates to a motor drive type friction false twisting device provided with three spindles. More specifically, the present invention relates to a motor drive type friction false twisting device provided with three spindles which device may be used in a false twist texturing machine or a draw texturing machine, by which device twists are imparted to a synthetic yarn such as polyester, polyamide and so on and which device is driven by an individual motor.

### Background Art

**[0002]** A motor drive type friction false twisting device provided with three spindles having a plurality of friction discs mounted thereon and being disposed at apexes of an imaginary triangle so as to locate the peripheries of the friction discs along a helix has been widely used in a draw texturing machine or a false twist texturing machine.

**[0003]** Conventionally, a tangential belt type device is known as such a friction false twisting device provided with three spindles. More specifically, a running belt is extended along a machine frame of a yarn processing machine such as a draw texturing machine or a false twist texturing machine wherein a plurality of such friction false twisting devices are disposed, and drive whorls of the friction false twisting devices provided with three spindles are pressed to and in contact with the belt so that drive force is transmitted to all the spindles from the whorls so as to rotate the three spindles in the same direction at the same rotational speed.

**[0004]** In a friction false twisting device, the spindles are disposed on a unit base as described above. Further, in such a tangential belt type device wherein a plurality of friction false twisting devices are driven by a single belt, pressing of the whorls of the false twisting devices and running of the drive belt for a long distance are noise generating source. Further, in the tangential belt type, since the drive whorl is driven by means of frictional engagement between the belt and the whorls, it is very difficult to individually control the false twisting devices so as to eliminate twisting unevenness in a plurality of false twisting devices.

**[0005]** In order to obviate such problems, proposed is an individual motor drive type wherein a drive motor is disposed in each false twisting device and the drive motor is functionally connected with the spindles. As a connecting method, connection between the drive motor and the spindles by means of a coupling or connection by means of a timing belt engaging with the timing pulleys, which are secured to an output shaft of the drive motor and one of the spindles. (See for example Japanese Patent Laid-open No. Hei 4-209837.)

**[0006]** In such an individual motor drive type, it is nec-

essary to maintain the distance between the pulleys at a predetermined range and set the tension in the belt at a predetermined amount so as to ensure transmission between the driving timing pulley at the motor side and the driven timing pulley at the spindle side without necessity of maintenance service.

**[0007]** In order to satisfy such requirements, in a friction false twisting device of an individual motor drive type, it is necessary that the false twisting device and the motor unit base as a whole can be detached from the spindle mount or a frame of a textile texturing machine upon every maintenance service or every replacement of friction discs. However, such detachment cannot be done easily with respect to the devices which have been proposed.

**[0008]** In the meantime, Japanese Patent Publication No. Hei 8-19585 proposes that a base of a false twisting device is detachably disposed on a support block movable toward or a support plate swingable toward a drive motor which is fixed to the spindle mount of a textile texturing machine, that they are moved toward the drive motor together with the base of the false twisting device upon detachment of spindles, whereby a belt wrapping about the drive motor and the spindle is brought into a slackened condition, and that under this condition, the toothed belt having been wrapped about the drive motor and the spindle is detached, and then, the false twisting device is taken out upwardly together with the base.

**[0009]** However, in such a device, since the belt wrapping about the drive motor and the spindle is slackened upon detachment of the spindle, shop adjustment of the frictional engagement between the spindle and the drive belt has to be taken place at every installation of the false twisting device, and it is a very troublesome work to adjust a plurality of friction false twisting devices mounted on a false twist texturing machine or a draw texturing machine.

**[0010]** As a countermeasure of the problems, Japanese Patent No. 2657539 proposes a false twist texturing device for producing a textured synthetic yarn comprising a texturing device head including a friction disc assembly and an electric motor block including an electric motor for driving the friction disc assembly, a spindle of the friction disc assembly being supported in a cantilever fashion by the texturing device head via a bearing so as to protrude from the texturing device head, the spindle has a rotor of the electric motor at the portion thereof protruding from the texturing device head, and a stator of the electric motor is fixed within the electric motor block.

**[0011]** According to this proposed device, the adjusting problem of frictional engagement between the drive motor and the spindle can be obviated since the spindle is directly driven from the electric motor.

**[0012]** However, in the false twisting device disclosed in the Japanese Patent No. 2657395, a cylindrical stator of the electric motor is fixed within the electric motor block and a column type rotor is inserted into a hollow

portion of the stator. Since the stator is disposed within the electric motor device and is not seen from the outside, accurate positioning of the rotor relative to the stator is difficult.

**[0013]** Further, the false twisting device disclosed in the Japanese Patent No. 2657395 has a construction wherein the rotor is rotated within the inside of the cylindrical stator, and the rotor has a small diameter and accordingly small moment of inertia. Since the moment of inertia is small as described above, there is a problem with respect to stability of the rotating speed and unevenness in twisting.

**[0014]** In addition, although the false twisting device disclosed in the Japanese Patent No. 2657395 can be realized when the number of spindles is one, it can not be carried out in a friction false twisting device provided with three spindles, each of which is provided with a plurality of friction discs. The technical reasons will now be described below.

**[0015]** Figs. 1 and 2 of the Japanese Patent No. 2657395 disclose an embodiment of a friction false twisting device provided with three spindles. Although lines 4 to 8, in Column 5 of the official gazette describes that "Reference numeral 7 denotes a toothed belt wheel, via a toothed belt wrapping about the toothed belt wheel, drive of the spindles 8 and 9 is performed.", no toothed belt is illustrated in the drawings. Contrary to this, in the device illustrated in Figs. 1 and 2, a member for supporting three spindles has a projection at the lower end thereof, and the projection is engaging with a shoulder of a recess formed in the block so as to position the stator 4 and the rotor 3 of the electric motor at a predetermined position.

**[0016]** As it has been well known, in a false twisting device provided with three spindles, three spindles are located at apexes of an imaginary triangle, the distance between the adjacent apexes being larger than a diameter of a friction disc. When it is seen in a plan view, the positions where the spindles 8 and 9 are disposed locate at outside of the periphery of the recess of the electric motor block. It is difficult for a person skilled in the art to engage with a toothed belt with ends of the spindles 8 and 9 which are constructed as described above even if he fully utilizes his technical common sense, and as an actual problem, it is difficult to drive the spindles 8 and 9 by a belt which is engaging with the belt wheel 7.

**[0017]** Referring to United States Patent No. 4,899,533 which is a United States counterpart of said Japanese Patent No. 2657539, it discloses an arc portion 20 projecting from the lower end of the motor guide in Fig. 2, and lines 45 to 50, in column 3 of its specification read "There is a toothed disc 7 on the shaft 1 above the rotor from which the shafts 8 and 9 are driven by the endless belt 20 that wraps around the disc 7 and around corresponding discs on the shafts 8 and 9. The belt 20 may be a gear belt or a toothed belt and a round or a flat belt."

**[0018]** However there is no such an endless belt as

disclosed in Fig. 2 of the United States Patent No. 4,899,533 as far as a person skilled in the art knows, and accordingly, it is difficult to wrap around and engage with such an endless belt around the pulleys mounted on the spindles 8 and 9 and the toothed wheel 7.

**[0019]** Therefore, there is no possibility for the device proposed in Japanese Patent No. 2657539 or United States Patent No. 4,899,533 to be actually carried out in a friction twisting device provided with three spindles, while it may be carried out in a false twisting device of a single spindle type.

**[0020]** It is an object of the present invention to provide a friction false twisting device provided with three spindles which can be actually carried out and which can overcome the above-described problems of lack of actual applicability inherent in the false twisting device provided with three spindles which is disclosed in the Japanese Patent No. 2657539.

**[0021]** Further, it is another object of the present invention to provide a friction false twisting device provided with three spindles wherein the rotor and the stator of the false twisting device can be readily positioned whereby the false twisting device can be installed easily upon assembling and installing again after detaching for cleaning or maintenance service.

**[0022]** In addition, it is a still other object of the present invention to provide a friction false twisting device provided with three spindles which does not cause unevenness in rotation at a high speed rotation, and which can generate sufficiently large driving torque, whereby even a tick yarn with a large denier can be twisted thereby.

#### Disclosure of the Invention

**[0023]** According to the present invention, the objects are achieved by a motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being detachably disposed on a bracket, one of the three spindles having a rotor of a drive motor mounted thereon and a stator of the drive motor being fixed to the bracket, characterized in that the drive motor is a radial gap type outer rotor brushless motor.

**[0024]** According to the false twisting device provided with three spindles having a plurality of discs, each false twisting device is driven by an individual motor, and no tangential belt is used, generation of noise can be highly decreased. Further, when the operating conditions of the individual motors for respective work stations are changed, adjustment of the false twisting conditions for respective work stations can be achieved easily.

**[0025]** According to the device of the present invention, a radial gap type outer rotor brushless motor is used as a drive motor. In a brushless motor, a rotor can be constructed with permanent magnets, and accordingly, wound wire can be omitted from the outer rotor and such a disposition as wound wire can be gathered

at the stator side. Therefore, the present invention is appropriate for a device wherein the outer rotor can be detachably installed.

**[0026]** Further, since the present invention uses a radial gap type outer rotor brushless motor, the rotor is located at the outside and has a large diameter, and accordingly, a large moment of inertia. Therefore, it is beneficial for rotation at a constant speed. Further, since magnets, i.e., permanent magnets, are disposed in the rotor having a large diameter, the size of the magnets can be relatively large. Accordingly, the present invention can exert high efficiency and high torque, and it is effective as a device for false twisting a thick yarn. In addition, since the stator is located at the inner position, the resistance of its wire can be small, and the copper loss of the drive motor can be reduced. Therefore, the drive motor and accordingly, the false twisting device, can easily become of high efficiency.

**[0027]** Further, the present invention achieves the above-described objects by a motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being detachably disposed on a bracket, one of the three spindles having a rotor of a drive motor mounted thereon and a stator of the drive motor being fixed to the bracket, characterized in that the drive motor is a radial gap type outer rotor brushless motor, and the outer rotor of the brushless motor is formed in a bell shape, and the outer rotor is fixed to an end of one of the spindles so that it covers the peripheral outside and the spindle side end of the stator of the brushless motor forming a small clearance therebetween and that the peripheral portion of the outer rotor and the peripheral portion of the stator are magnetically connected with each other.

**[0028]** Since the brushless motor used in the invention is a radial gap type outer rotor brushless motor, it is not provided with any shaft within the outer rotor not like a conventionally known outer rotor brushless motor. More specifically, the outer rotor of the brushless motor according to the present invention is formed in a so-called bell shape and has cavity inside thereof, and the cavity portion is covered over the stator forming a small clearance therebetween.

**[0029]** Since it has such a construction as described above, the outer rotor of the present invention does not require any bearings between it and the stator, and accordingly, it achieves a further advantage that the outer rotor can be secured easily in addition to those described above.

**[0030]** Further, according to the present invention, the above-described objects are achieved by a motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being detachably disposed on a bracket, one of the three spindles having a rotor of a drive motor mounted thereon and a stator of the drive motor being fixed to

the bracket,

characterized in that the spindle mount and the bracket have engaging portions mounted thereon, respectively, at positions away from positions where the rotor and the stator of the drive motor are disposed, and the drive motor is a radial gap type outer rotor brushless motor.

**[0031]** In the invention disclosed in the above-described Japanese Patent No. 2657539, the rotor guide member supporting the spindles and the electric motor block are engaged with each other by means of convex portion and concave portion formed around the stator and the rotor. Accordingly, when it is tried to be carried out in the false twisting device provided with three spindles, their driving connection cannot be realized. Contrary to this, according to the present invention, taking into consideration the problems inherent in the Japanese Patent No. 2657539 and easiness in assembling operations, the engaging portions are formed in the spindle mount and the bracket, respectively, independently and separately from the rotor and the stator of the drive motor at positions away from positions where the rotor and the stator of the drive motor are disposed.

**[0032]** When the spindle mount is secured to the bracket using the engaging portions, the rotor, i.e., the outer rotor, of the motor disposed on the spindle mount is positioned at a predetermined position relative to the stator of the motor mounted on the bracket, and their positioning can readily be performed. Further, under the condition thus positioned, the clearance between the outer rotor and the stator of the brushless motor of an outer rotor type can be a predetermined amount, and accordingly, a desired magnetic connection can be formed between them.

**[0033]** Further, according to the present invention, the three spindles may have pulleys at ends thereof, respectively, and the three spindles are rotated in the same direction at the same speed by means of a drive belt wrapping about the three pulleys. Since the present invention is constructed as described above, even when the three spindles have pulleys at ends thereof, the device according to the present invention can be realized without any difficulty. In short, since the present invention does not use the lower portion of the spindle mount as a portion for engaging with the bracket, this area is open sufficiently, and accordingly, driving pulley can be disposed at this area.

**[0034]** Furthermore, as illustrated in the embodiments of the present invention, it is preferred that the three spindles are supported at ends thereof opposite to the pulleys by a top plate, whereby the three spindles are supported by the top plate and the spindle mount at both the ends thereof. According to this construction, since the spindles are supported at both the ends thereof, the operating speed of the device can be further enhanced.

**[0035]** In addition, according to the present invention, the above-described objects are achieved by a motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respec-

tively, and rotatably supported on a spindle mount, the spindle mount being disposed on a bracket detachably in a lateral direction,

characterized in that the spindle mount has a stator of a radial gap type outer rotor brushless motor mounted at the lower surface thereof, an outer rotor is supported rotatable about the stator, the stator and one of the three spindles are operably connected, the three spindles have pulleys at the lower ends thereof, respectively, and the pulleys are connected by a drive belt.

**[0036]** According to the present invention, the three spindles having a plurality of friction discs are rotatably supported on a spindle mount, and the spindle mount is disposed on a bracket detachably in a lateral direction. Accordingly, upon its dismounting, it does not abut with nor damage other parts which are mounted on a false twist texturing machine or draw texturing machine, and the dismounting operation can be done easily. Thus, there does not occur any trouble which has been caused by upward lifting of the main portion of a false twisting device.

**[0037]** Further, according to the present invention, a radial gap type outer rotor brushless motor is used as an individual drive motor. Therefore, the reliability of the drive motor is high, and it is unnecessary for the drive motors to be subjected to maintenance or repair service while they are being mounted on a false twist texturing machine or a draw texturing machine. Thus, the construction wherein the spindle mount is dismount laterally relative to the bracket while it has the drive motor mounted thereon can be applied. When the drive motor requires maintenance or adjustment service, it is first dismount from a false twist texturing machine or a draw texturing machine and then is subjected to the maintenance or repair service. Thereafter, it is mounted in a lateral direction while it has a drive motor mounted thereon.

**[0038]** In addition, according to the present invention, the spindle mount has a stator of a radial gap type outer rotor brushless motor mounted thereon, while an outer rotor is supported rotatable about the stator, the stator and one of the three spindles are operably connected, the three spindles have pulleys at the lower ends thereof, respectively, and the pulleys are connected by a drive belt. Therefore, the construction becomes compact, and the spindle mount can be dismounted or attached in a lateral direction relative to the bracket while it has the drive motor mounted thereon.

**[0039]** According to the present invention, a radial gap type outer rotor brushless motor is used as a drive motor. In a brushless motor, a rotor can be constructed by permanent magnets, and accordingly, wound wire can be omitted from the outer rotor and such a disposition as wound wire can be gathered at the stator side.

**[0040]** Further, since the present invention uses a radial gap type outer rotor brushless motor, the rotor is located at the outside and has a large diameter, and accordingly, a large moment of inertia. Therefore, it is ben-

eficial for rotation at a constant speed. Further, since magnets, i.e., permanent magnets, are disposed in the rotor having a large diameter, the size of the magnets can be relatively large. Accordingly, the present invention can exert high efficiency and high torque, and it is effective as a device for false twisting a thick yarn. In addition, mean value of wound wire per a coil of the stator becomes short, and the copper loss can be reduced, and therefore, the drive motor and accordingly, the false twisting device, can easily become of high efficiency.

**[0041]** Further, in a more concrete shape, the present invention provides a motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively,

characterized in that the spindle mount has a stator of a radial gap type outer rotor brushless motor at the lower surface thereof, the stator having a hollow hole extending in an axial direction, one of the three spindles passing through the hollow hole has an outer rotor of the outer rotor brushless motor and a pulley at a lower end thereof, the other two of the three spindles have pulleys correspondingly to the pulley, and a drive belt is engaged around the pulleys.

**[0042]** According to the present invention, the lower end of one spindle having a plurality of discs passes through the stator, the entire construction of the false twisting device can be compact while the diameter of the outer rotor can be enlarged. Further, the driving construction from the drive motor to the spindles can be simple.

**[0043]** In these cases, bearings may be disposed at the inside of the radial gap type outer rotor brushless motor and the spindle mount, respectively, and one of the three spindles may be rotatably supported by a pair of bearings. When this construction is adopted, since the spindle is supported by a pair of bearings, its rotation becomes stable, and its high speed rotation becomes possible.

**[0044]** Further, in a more concrete shapes, the present invention provides a motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively,

characterized in that the spindle mount has a stator of a radial gap type outer rotor brushless motor at a position which correspond to none of the three spindles on the lower surface thereof, an outer rotor is supported rotatable about the stator, the three spindles pass through the bracket of the spindle mount and have pulleys at lower ends thereof, and a drive belt is engaged around the pulleys secured to the three spindles and the pulley secured to the outer rotor.

**[0045]** In the invention, the three spindles may be driven as follows. More specifically, the three spindles may have pulleys at the lower ends thereof, respectively, and a drive belt may be engaged with the three spindles. Alternatively, one of the three spindles may have pulleys vertically overlaid at a lower end thereof, and the other spindles may have pulleys corresponding to the verti-

cally overlaid pulleys, respectively, and drive belts may be engaged with the vertically overlaid pulleys and the other pulleys, respectively.

#### Brief Description of the Drawings

**[0046]** The present invention will now be explained in detail with reference to drawings illustrating some embodiments of the present invention, wherein:

Fig. 1 is an elevation of an embodiment of a motor driven type friction false twisting device provided with three spindles according to the present invention;

Fig. 2 is a side view of Fig. 1, wherein a part is sectioned;

Fig. 3(a) is a plan view of the device illustrated in Figs. 1 and 2, and Fig. 3(b) is a view seen in a direction A-A;

Fig. 4 is an elevation of another embodiment of the present invention;

Fig. 5(a) is a bottom view of Fig. 4, and Fig. 5(b) is a bottom view of another embodiment;

Fig. 6(a) and (b) are bottom views of still other embodiments of the present invention;

Fig. 7 is an elevation of a still other embodiment of the present invention; and

Fig. 8 is a bottom view of Fig. 7.

#### Best Mode for Carrying out the Invention

**[0047]** According to the first embodiment of the present invention as illustrated in Fig. 2, a bracket formed in a substantially U-shape is secured to a friction beam 6 of a false twist texturing machine or a draw texturing machine by means of bolts (not shown).

**[0048]** The bracket 5 is formed in a substantially U-shape as illustrated in Fig. 2, and its upper side 5a is shorter than its lower side 5b. The upper side 5a is formed in a semi-circular shape 5c as illustrated in Fig. 2 so that an outer rotor 11 of a radial gap type outer rotor type brushless motor is not prevented from its installing and detaching operations. In other words, vertical movement of the outer rotor 11 can be done readily. The lower side 5b of the bracket 5 is formed in an adequate shape such as a rectangular shape.

**[0049]** The bracket 5 has a stator 12 of the outer rotor type brushless motor 10 mounted on and secured to the lower side 5b thereof. The stator 12 is formed by laminated iron cores having a wire wound thereon and has a substantially circular cylinder shape. The wound wire of the stator 12 is supplied with drive electric current by means of a wire extending from a power source (not shown) for brushless motors 10 of the false twist texturing machine or draw texturing machine through the friction beam 6 to the stator 12 in a known method.

**[0050]** According to the present invention, since the stator 12 is mounted on and secured to the lower side

5b of the bracket 5, the outer profile of the stator 12 can be observed from the outside unless the outer rotor 11 which will be described later has not been covered thereon, and accordingly, the disposing position of the stator 12 on the lower side 5b of the bracket 5 and its positional relationship relative to the outer rotor 11 can be accurately positioned by visually checking them. Consequently, compared to the false twisting device disclosed in the above-described Japanese Patent No. 2657539 wherein the stator is accommodated within the electric motor block, their positioning can be done more accurately.

**[0051]** As illustrated in Fig. 3(a), the bracket 5 has engaging projection 5d which serves to position the spindle mount 20 projecting from the upper side 5a thereof at the center thereof seen in the lateral direction of and adjacent to the friction beam 6. In the illustrated embodiment, the engaging portion 5d is formed in a projection of trapezoid. Contrary to this, the spindle mount 20 has a recess 20a formed in a trapezoid as another engaging portion which engages with the projecting portion 5d formed on the upper side 5a of the bracket 5 formed therein. When both the engaging portions 5d and 20a are engaged with each other, positioning of the spindle mount 20 and the bracket 5 in a horizontal plane can be done.

**[0052]** The vertical positioning of the spindle mount 20 and the bracket 5 can be achieved by the upper surface of the upper side 5b of the bracket 5 and the lower surface of the spindle mount 20.

**[0053]** Screw holes 5e with each of which a clamping bolt 30 such as a hexagon socket set screw is engaged is formed in the bracket 5, and holes 20b for inserting the clamping bolts 30 are formed in the spindle mount 20. After the spindle mount 20 and the bracket 5 are positioned to each other as described above, the clamping bolts 30 are inserted through the holes 20b formed in the spindle mount 20, and the ends of the clamping bolts 30 are screwed with the tapped holes 5e formed in the bracket 5, and thus, the spindle mount 20 is secured to the bracket 5 at a predetermined position.

**[0054]** In place of the above-described projection of trapezoid, while one engaging portion may be formed as locating pins (not shown) projecting upwardly from the upper surface of the bracket 5, the other engaging portion may be formed as pin holes with which the locating pins engage and which are formed in the spindle mount 20. In this occasion, when the numbers of the locating pins and the pin holes are set two, respectively, the positioning of the spindle mount 20 and the bracket 5 is assured. Further, when the spindle mount 20 is suitably secured to the bracket 5 by means of the engagement between the locating pins and pin holes, the clamping bolts which has been described above may be omitted.

**[0055]** The spindle mount 20 has a certain thickness in the vertical direction as illustrated in Figs. 1 and 2, and in this embodiment, as illustrated in Figs. 3(a) and

3(b), it is shaped in a substantially pentagon. As illustrated in Fig. 3(a), the spindle mount 20 has three spindles 21, 22 and 23 accurately disposed thereon at positions corresponding to the apexes of an equilateral triangle. As illustrated in Fig. 2 with respect to the spindle 21, the three spindles 21, 22 and 23 are rotatably supported by bearings 25 located at upper and lower portions, respectively.

**[0056]** The spindles 21-23 have a plurality of friction discs 27 mounted thereon, respectively. The friction disc 27 is made of a material such as ceramic or polyurethane which has resistance to wear and which can hold yarn to be twisted well as it is common in a known friction false twisting device. As illustrated in Figs. 1 to 3, the spindle 21 has a toothed pulley 31 mounted at the portion thereof projecting from the bearing 25, and the spindles 22 and 23 have toothed pulleys 32, 33 mounted thereon, respectively. As illustrated in Fig. 3(b), a toothed belt 35 is wrapped around the toothed pulleys 31, 32 and 33 in such a manner that it surrounds their outer peripheries in a triangular shape.

**[0057]** Further, the spindle 21 has an outer rotor 11 formed in a bell shape mounted at a position thereof below the toothed pulley 31. More specifically, the outer rotor 11 comprises a circular cylindrical portion 11a and an end plate 11b covering the upper end of the circular cylindrical portion 11a to form a bell shape and does not have any shaft within the inside thereof. The outer rotor 11 has permanent magnets (not shown) equidistantly disposed in a peripheral direction within the inside of the circular cylindrical portion 11a.

**[0058]** A hole 11c for inserting and securing the lower end of the spindle 21 is formed at the center of the end plate 11b with positioning accuracy and precise size. When the lower end of the spindle 21 is inserted into the hole 11c formed in the end plate 11b of the outer rotor 11 and is secured by an appropriate means such as glue, the outer rotor 11 is precisely secured to the spindle 21.

**[0059]** As described above, while the stator 12 is mounted on and secured to the lower side 5b of the bracket 5, the outer rotor 11 is accurately secured to the spindle 21 which is supported on the spindle mount 20, and thus, the positioning accuracy between the spindle mount 20 and the bracket 5 can be achieved by engaging the engaging portions 5d and 20a of the spindle mount 20 and bracket 5. Accordingly, positioning accuracy between the outer rotor 11 and the stator 12 is also achieved. As a result, the inner surface of the circular cylindrical portion 11a of the outer rotor 11 and the inner surface of the upper end plate 11b form small clearances relative to the outer surface and the upper surface of the stator 12 secured to the bracket 5, and rigid magnetic connection is formed between the rotor and the stator of the radial gap type outer rotor brushless motor.

**[0060]** The spindle mount 20 has two locating pins 20b (see Fig. 3(b)) projecting therefrom at a side of the spindles 21-23. A column 52 formed in a regular prism

has holes 52a at the bottom thereof. The holes 52a are inserted onto the locating pins 20b, and thus, as illustrated in Figs. 1 and 2, the column 52 is standing on the spindle mount 20 at the side of the spindles 21-23. As illustrated in Fig. 3(a), a top plate 51 formed in a substantially triangular shape is screwed at the top of the column 52 by means of a bolt 53. The top plate 51 has three bearings 54 (see Fig. 3(a)) at the apexes of an imaginary equilateral triangle corresponding to the spindles 21-23 and supports the upper ends of the spindles 21-23 via the bearings 54. As a result, the spindles 21-23 are supported by the bearings 25 mounted on the spindle mount 20 and the bearings 54 mounted on the top plate 51 at both the ends, respectively.

**[0061]** As illustrated in Fig. 3(a), the top plate 51 formed in a substantially triangular shape has a threading slit 51b formed at one end thereof, and a yarn guide bracket provided with a yarn guide 61 is disposed swingable about a pin 63 above the threading slit 51b of the top plate 51. The yarn guide 61 is made of a material having resistance to wear, such as ceramic, and is formed in a C-shape.

**[0062]** As illustrated in Fig. 1, the spindle mount 20 has recess 20c with a narrow width formed therein at the same side as the above-described threading slit 51b formed in the top plate 51 so that the yarn passing by the friction discs 27 mounted on the three spindles 21-23 is withdrawn to the outside while it avoids the brushless motor 10 of the radial gap type outer rotor. The recess 20c is located at the central position of the three spindles 21-23 at the top of the spindle mount 20 as illustrated in Fig. 2, and then, it inclines outwardly. Further, the spindle mount 20 has a detecting device (not shown) for detecting the rotating speed of the outer rotor 11 mounted therein.

**[0063]** The spindle mount 20 having three spindles 21, 22 and 23 with a plurality of friction discs 27 rotatably mounted thereon at the apexes of an imaginary equilateral triangle is put on the upper side 5a of the bracket 5 in such a manner that it covers the bracket 5 from the above, and while the recess 20a of the spindle mount 20 and the engaging portion 5d formed at the upper surface of the bracket 5 are engaged with each other, the locating bolts 30 are inserted into the holes 20b formed in the spindle mount 20, and the ends of the locating bolts 30 are screwed to the tapped holes 5e formed in the bracket 5. Thus, the spindle mount 20 can be readily secured to the bracket 5 at a predetermined position.

**[0064]** According to this construction, the inner surface of the circular cylindrical portion 11a and the upper inside surface of the end plate 11b of the outer rotor 11 attached to the end of the spindle 21 which is supported on the spindle mount 20 form small clearances between them and the outer surface and the upper end surface of the stator which is attached to the bracket, and a rigid magnetic connection between the rotor and the stator in a radial type outer rotor brushless motor is formed between the outer rotor 11 and the stator 12. Under this

condition, when the drive electric current is supplied with the coil winding of the stator 12, the outer rotor 11 is rotated in a manner similar to an ordinary brushless motor, and the rotation of the outer rotor 11 is transmitted to the spindles 21-23.

**[0065]** Since the present invention uses a radial gap type outer rotor brushless motor 10, the rotor 11 is located at the outside, has a large diameter and accordingly, a large moment of inertia. Therefore, it is beneficial for rotation at a constant speed. Further, since magnets, i.e., permanent magnets, are disposed in the rotor 11 having a large diameter, the size of the magnets can be relatively large. Accordingly, the present invention can exert high efficiency and high torque, and it is effective as a device for false twisting a thick yarn. In addition, since the stator is disposed at the inner side, its wire has low resistance, and the copper loss can be reduced. Therefore, the drive motor and accordingly, the false twisting device, can easily become of high efficiency.

**[0066]** When the spindle mount 20 of the present invention is required to be detached from the bracket 5, the locating bolt 20 is taken out, and the spindle mount 20 is upwardly withdrawn in a vertical direction. Thus, the spindle mount 20 having three spindles 21, 22 and 23 provided with a plurality of friction discs 27, respectively, rotatably mounted thereon at apexes of an imaginary equilateral triangle can be easily taken out from the bracket 5. Under this condition, another spindle mount 20 which has been prepared separately and which has three spindles 21, 22 and 23 provided with a plurality of friction discs 27, respectively, rotatably mounted thereon at the apexes of the imaginary equilateral triangle may be installed in a manner described above, alternatively, the taken out spindle mount may be installed in a manner described above after it is cleaned up or after it is disassembled and is subjected to a maintenance service.

**[0067]** Other embodiments of the present invention will now be explained with reference to Figs. 4-6. In the embodiment which has been explained with reference to Figs. 1-3, the spindle mount is dismantled from the bracket 5 by withdrawing it upwardly in a vertical direction. Contrary to this, in the embodiments which will be described below, the spindle mount is dismantled from the bracket by withdrawing it laterally, i.e., in a horizontal direction.

**[0068]** Referring to Figs. 4 and 5(a), a stationary bracket 106 is fixedly disposed on a machine frame of a false twist texturing machine or a draw texturing machine. The stationary bracket 106 has a pair of rods 117a and 117b (Fig. 4 and Fig. 5(a) designate them only by their central lines) projecting in parallel in a horizontal direction from a side thereof. The rod 117a has a groove which serves as an engaging portion (not shown) formed at the front end thereof.

**[0069]** Contrary to this, a spindle mount 120 has a pair of through holes (not shown) formed corresponding to the rods 117a and 117b in a horizontal direction at a side

thereof, into which holes the rods 117a and 117b projecting from the stationary bracket 106 can be inserted. Further, the spindle mount 120 has a lock member(not shown) which is manually operable about an axis disposed near one of the holes.

**[0070]** When the through holes formed in the spindle mount 120 are inserted onto the rods 117a and 117b, the engaging portion formed at the front end of the rod 117a protrudes outward from the spindle mount 120. By manually turning the lock member, the lock member engages with the engaging portion formed at the protruding portion of the rod member 117a, and thus, the spindle mount 120 can be integrally secured to the stationary bracket 106. Further, when the lock member is manually turned in a direction opposite to that described above, the engagement between the lock member and the engaging portion of the rod member 117a can be disengaged, and thus, the spindle mount 120 can be laterally withdrawn in a horizontal direction, i.e., to the right in Fig. 4, from the stationary bracket 106.

**[0071]** The spindle mount 120 has vertical spindles 132a, 132b and 132c rotatably mounted thereon. Each spindle 132a, 132b or 132c has a plurality of (three in the illustrated embodiment) friction discs 131 mounted thereon, and the three spindles 132a, 132b and 132c are located at apexes of an imaginary equilateral triangle seen in a plan view or a bottom view. Like a known friction false twisting device, the friction disc 131 is made of a material such as ceramic, polyurethane which has resistance to wear and which can hold well a yarn to be twisted.

**[0072]** The spindle mount 120 has a reverse L-shape when it is seen in a front view as illustrated in Fig. 4. The spindle mount 120 has a circular hole 120a formed at a thin portion thereof, and a bearing 125 is disposed within the hole 120a. One spindle 132a of the above-described three spindles which is adjacent to the stationary bracket 106 is rotatably supported by the bearing 125. The spindle mount 120 has the other spindle 132b and 132c rotatably mounted at the thick portion thereof via bearings (not shown).

**[0073]** In this embodiment, the spindle mount 120 has a column 152 (Fig. 5) projecting upwardly from the surface thereof, which has a top plate 151 attached thereto by a set screw 153 so that the top portions of the spindles 132a, 132b and 132c are supported thereby.

**[0074]** The spindle mount 120 has a stator 112 of a radial gap type outer rotor brushless motor 110 mounted coaxially with the spindle 132a at the thin portion thereof. The stator 112 of this embodiment is formed in a hollow circular cylinder shape, the body comprises laminated iron cores having coils wound thereon. The wound coils are supplied with power drive source in accordance with a known method from the power source (not shown) for the brushless motor 110 of the false twist texturing machine or draw texturing machine through the stationary bracket 106 and an electric wire connected to the stator 112.

**[0075]** The hollow circular cylindrical shaped stator 112 has a top portion 112a and a flange portion 112b, the outer diameter of which is larger than the top portion 112a, and a shoulder portion is formed between the top portion 112a and the flange portion 112b. The top portion 112a has such a size that it engages with a circular hole 120a formed in the spindle mount 120. The flange portion 112b of the stator 112 is formed below the top portion 112a.

**[0076]** The top portion 112a of the stator 112 is inserted into the circular hole 120a from the side opposite to the spindle 132a, i.e., from the below, so that the shoulder of the flange portion 112b formed below the top portion 112a of the stator 112 is engaged with the thin portion of the spindle mount 120. Under this condition, the flange portion 112b is secured to the spindle mount 120 by bolts 113. Thus, the hollow circular shaped stator 112 is secured to the lower surface of the thin portion of the spindle mount 120 coaxially with the circular hole 120a.

**[0077]** The lower end of the spindle 132a passes through the hollow portion of the stator 112 from the circular hole 120a of the spindle mount 120, while the lower ends of the spindles 132b and 132c pass through the spindle mount 120.

**[0078]** The spindle 132 has an outer rotor 111 of the radial gap type outer rotor brushless motor at a lower end thereof which passes through the hollow portion of the stator 112. The outer rotor 111 is formed in a reverse bell shape. More specifically, the outer rotor 111 comprises a circular cylindrical portion 111a and an end plate 111b covering the lower end of the circular cylindrical portion, and thus, it is formed in a reversely positioned bell shape. The outer rotor 111 has permanent magnets (not shown) equidistantly disposed at the inner side of the circular cylindrical portion 111a.

**[0079]** A hole 111c into which the lower end of the spindle 132 is inserted and secured to is formed at the center of the end plate 111b at the accurate position with a precise dimension. The lower end of the spindle 121 is inserted into the hole 111c formed at the center of the end plate 111b and is secured by means of an appropriate means such as adhesive, welding ¥, pressure welding or screw cramping, and thus the outer rotor 111 can be accurately positioned to the spindle 121.

**[0080]** The spindles 132a, 132b and 132c have pulleys 140, respectively, at the lower ends thereof. As illustrated in Fig. 5(a), a spindle drive belt 141 which is constructed by an endless belt wraps around the pulleys 140. In this embodiment, the pulley 140 is a toothed pulley, and the spindle drive belt 141 is a toothed belt.

**[0081]** Because of the construction described above, when the outer rotor 111 of the radial gap type outer rotor brushless motor 110 is rotated, the rotation of the outer rotor 111 is transmitted to the spindle 132a, and the spindle 132a is rotated. Then, since the spindles 132a, 132b and 132c are connected to each other by means of the pulleys 140 and the spindle drive belt 141, the rotation of the outer rotor 111 is transmitted to the friction discs

131 mounted on the respective spindles 132a, 132b and 132c, and thus the friction discs 131 are rotated in the same direction.

**[0082]** Further, the spindle mount 120 has a narrow cavity 120c formed at a side thereof same as that of the threading slit (not shown) formed in the top plate 151 for withdrawing a yarn, which has passed through the friction discs 131 mounted on the three spindles 132a, 132b and 132c, to the outside avoiding the radial gap type outer rotor brushless motor 110. As illustrated in Fig. 5, the cavity 120c reaches at the center of the three spindles 132a, 132b and 132c at the top of the spindle mount 120, and from there it is inclined downwardly and outwardly. Further, the spindle mount 120 has a detecting means (not shown) for detecting the rotation of the outer rotor 111.

**[0083]** In the above-described embodiment, the spindle 132a having the outer rotor 111 of the radial gap type outer rotor brushless motor 110 mounted thereon and the other spindles 132b and 132c have pulleys 140 at the same level at the lower ends thereof, respectively, and one single drive belt 141 is wrapped around the three pulleys. As illustrated in Fig. 5(b), one 132a of the three spindles may have vertically overlaid pulleys 140' at the lower end thereof, while the remaining two spindles may have pulleys 140 corresponding to one of the vertically overlaid pulleys, respectively, and drive belts 141 and 141' may be wrapped between one of the overlaid pulleys and the pulley 140, respectively.

**[0084]** As described above, the three spindles 132a, 132b and 132c having a plurality of friction discs 131 mounted thereon are rotatably supported on the spindle mount 120, and the spindle mount 120 is laterally mounted and dismounted relative to the stationary bracket 106. Thus, upon withdrawal of the spindle mount, its collision with or damage to other parts mounted on the false twist texturing machine or the draw texturing machine does not occur, and the operation can be done easily, and therefore, the problems which may cause by upward withdrawal of the main parts of a false twisting device do not occur.

**[0085]** Further, a radial gap type outer rotor brushless motor 110 is used as an individual drive motor of a false twisting device. Accordingly, the reliability of the drive motor is high, and it is unnecessary for the drive motors to be subjected to maintenance or repair service while they are being mounted on a false twist texturing machine or a draw texturing machine. Thus, the construction wherein the spindle mount 120 is dismount laterally relative to the stationary bracket 106 while it has the drive motor mounted thereon can be applied. When the drive motor requires maintenance or adjustment service, it is first dismount from a false twist texturing machine or a draw texturing machine and then is subjected to the maintenance or repair service. Thereafter, it is mounted in a lateral direction while it has a drive motor mounted thereon.

**[0086]** Other embodiments will now be explained with

reference to Figs. 6 (a) and (b). Fig. 6(a) is a bottom view of another embodiment of the present invention, and Fig. 6(b) is a bottom view of a still other embodiment of the present invention.

**[0087]** In the above-described embodiment, the spindle mount 120 has the stator 112 of the radial gap type outer rotor brushless motor 110 mounted at the lower surface thereof, and the stator 112 has the hollow through hole axially extending. One 132a of the three spindles is passed through the hollow through hole of the stator 112 and has the outer rotor 111 of the outer rotor brushless motor 110 and the pulley 140 or 140' mounted at the lower end thereof, while the remaining two 132b and 132c of the three spindles have pulleys 140 corresponding to the pulley 140 or 140' mounted thereon, respectively, and the pulleys 140 and 140' are wrapped by the drive belt or belts.

**[0088]** Contrary to this, in the embodiments which will be described below, the spindle mount 120 has a stator 112 of a radial gap type outer rotor brushless motor 110 mounted at the lower surface thereof at a position which does not correspond to any of three spindles 132a, 132b and 132c (in Figs. 6(a) and (b), at the center of the three spindles), while an outer rotor 111 is supported rotatably around the stator 12, and the three spindles 132a, 132b and 132c penetrate through the spindle mount 120.

**[0089]** A spindle 114 is rotatably supported in the hollow portion of the stator 112. The spindle 114 has an outer rotor 111 of the radial gap type outer rotor brushless motor 110 at a lower end thereof which passes through the hollow portion of the stator 112. Similar to the above-described embodiment, the outer rotor 111 is formed in a reverse bell shape. More specifically, the outer rotor 111 comprises a circular cylindrical portion 111a and an end plate 111b covering the lower end of the circular cylindrical portion, and thus, it is formed in a reversely positioned bell shape. The outer rotor 111 has permanent magnets (not shown) equidistantly disposed at the inner side of the circular cylindrical portion 111a.

**[0090]** A hole 111c into which the lower end of the spindle 114 is inserted and secured to is formed at the center of the end plate 111b at the accurate position with a precise dimension. The lower end of the spindle is inserted into the hole 111c formed at the center of the end plate 111b and is secured by means of an appropriate means such as adhesive, welding, pressure welding or screw cramping, and thus the outer rotor 111 can be accurately positioned to the spindle 114.

**[0091]** The spindle 114 has a pulley 140" mounted at the lower end thereof, one of the spindles 132a, 132b and 132c has vertically overlaid pulleys 140' mounted at the lower end thereof, while the remaining two spindles 132b and 132c have pulleys 140 at the lower ends thereof, respectively. The pulley 140" mounted on the spindle 114 and one of the vertically overlaid pulleys 140' are connected to each other by means of a drive belt 141'. As illustrated in Fig. 6(a), a spindle drive belt

141 which is constructed by an endless belt is wrapped around the other one of the pulleys 140' mounted on the spindle 132a and the pulleys 140 mounted on the spindles 132b and 132c. In this embodiment, the pulley 140 is a toothed pulley, and the spindle drive belt 141 is a toothed belt.

**[0092]** Because of the construction described above, when the outer rotor 111 of the radial gap type outer rotor brushless motor 110 is rotated, the rotation of the outer rotor 111 is transmitted to the spindle 132a, and the spindle 132a is rotated. Then, since the spindles 132a, 132b and 132c are connected to each other by means of the pulleys 140 and the spindle drive belt 141, the rotation of the outer rotor 111 is transmitted to the friction discs 131 mounted on the respective spindles 132a, 132b and 132c, and thus the friction discs 131 are rotated in the same direction. The other construction of this embodiment is similar to those which were explained with reference to the abovedescribed embodiment, their detailed explanation is omitted here.

**[0093]** In the above-described embodiment, the spindle 132a, 132b and 132c have pulleys 140 and 140' at the same level at the lower ends thereof, respectively, and one single drive belt 141 is wrapped around the three pulleys. As illustrated in Fig. 6(b), one of the three spindles, for example 132a, may have pulleys 143, which are vertically overlaid in three stages, at the lower end thereof, while the remaining two spindles may have pulleys 140 corresponding to either one of the vertically overlaid pulleys 143, respectively, and drive belts 141 and 141" may be wrapped between one of the overlaid pulleys 143 and the pulley 140, respectively.

**[0094]** A still other embodiment of the present invention will now be explained with reference to Figs. 7 and 8. In the embodiment which has been explained with reference to Figs. 4-6, the support of the spindle which is connected to the outer rotor on the spindle mount is done by means of one single bearing. Contrary to this, in the embodiment which will now be explained, the support of a spindle which is connected to an outer rotor on a spindle mount is done by means of two bearings, i.e., a bearing mounted on the spindle mount and a bearing mounted within the outer rotor motor, so as to assure the stability of the rotation of the spindle and to enable its higher rotation.

**[0095]** Referring to Figs. 7 and 8, a stationary bracket 106 is fixedly disposed on a machine frame of a false twist texturing machine or a draw texturing machine. The stationary bracket 106 has a pair of rods 117a and 117b (Figs. 7 and 8 designate them only by their central lines) projecting in parallel in a horizontal direction from a side thereof. The rod 117a has a groove which serves as an engaging portion (not shown) formed at the front end thereof.

**[0096]** Contrary to this, a spindle mount 120 has a pair of through holes (not shown) formed corresponding to the rods 117a and 117b in a horizontal direction at a side thereof, into which holes the rods 117a and 117b pro-

jecting from the stationary bracket 106 can be inserted. Further, the spindle mount 120 has a lock member(not shown) which is manually operable about an axis disposed near one of the holes.

**[0097]** When the through holes formed in the spindle mount 120 are inserted onto the rods 117a and 117b, the engaging portion formed at the front end of the rod 117a protrudes outward from the spindle mount 120. By manually turning the lock member, the lock member engages with the engaging portion formed at the protruding portion of the rod member 117a, and thus, the spindle mount 120 can be integrally secured to the stationary bracket 106. Further, when the lock member is manually turned in a direction opposite to that described above, the engagement between the lock member and the engaging portion of the rod member 117a can be disengaged, and thus, the spindle mount 120 can be laterally withdrawn in a horizontal direction, i.e., to the right in Fig. 4, from the stationary bracket 106.

**[0098]** The spindle mount 120 has vertical spindles 132a, 132b and 132c rotatably mounted thereon. Each spindle 132a, 132b or 132c has a plurality of (three in the illustrated embodiment) friction discs 131 mounted thereon, and the three spindles 132a, 132b and 132c are located at apexes of an imaginary equilateral triangle seen in a plan view or a bottom view. Like a known friction false twisting device, the friction disc 131 is made of a material such as ceramic, polyurethane which has resistance to wear and which can hold well a yarn to be twisted.

**[0099]** The construction of the spindle mount 120 will now be explained with reference to Fig. 7. The spindle mount 120 has a hole 120C for disposing an upper bearing mount and a hole 120B for disposing an outer rotor formed from the upper surface thereof. The hole 120B for disposing the outer rotor 111 has a circular cross section, the inner diameter of which is larger than that of the outer rotor 111 of the outer rotor brushless motor 110. The lower end of the hole 120B for disposing the outer rotor is connected to a hole with a small diameter for disposing a stator, and a shoulder is formed between the hole 120B for disposing the outer rotor and the hole for disposing a stator. A stator 112 formed in a hollow circular cylinder of a radial gap type outer rotor brushless motor 110 is attached to the shoulder.

**[0100]** The stator 112 of this embodiment is formed in a hollow circular cylinder shape, the body comprises laminated iron cores having coils wound thereon. The wound coils are supplied with power drive source in accordance with a known method from the power source (not shown) for the brushless motor 110 of the false twist texturing machine or draw texturing machine through the stationary bracket 106 and an electric wire connected to the stator 112.

**[0101]** The hollow circular cylindrical shaped stator 112 has a top portion 112a and a flange portion 112b, the outer diameter of which is larger than that of the top portion 112a, and a shoulder portion, the diameter of

which is so selected that it engages with the hole 120A for disposing the stator, at the bottom surface of the flange portion 112b. The shoulder formed between the hole 120B for disposing the outer rotor motor and the hole 120A for disposing the stator is put on the flange portion 112b of the stator 112, and then, the stator 112 is screwed to the spindle mount 120 by means of clamp screws 151 which are inserted from the blow.

**[0102]** A hole for disposing a bearing is so formed at the lower end of the stator 112 that it is connected to the central hole formed at the center, and the lower bearing 125A is disposed in the bearing disposing hole. The lower end of the spindle 132a adjacent to the stationary bracket 106 among the three spindles is rotatably supported by means of the bearing 125A.

**[0103]** An outer rotor 111 of a radial gap type outer rotor brushless motor 110 formed in a bell shape is disposed over the stator 112 of the spindle 132a. In short, the outer rotor 111 comprises a circular cylindrical portion 111a and an end plate 111b covering the top of the circular cylindrical portion, and the circular cylindrical portion has permanent magnets (not shown) equidistantly disposed at the inside thereof.

**[0104]** A hole 111c into which the spindle 132 is secured to is formed at the center of the end plate 111b at the accurate position with a precise dimension. The lower end of the spindle 132a is inserted into the hole 111c formed at the center of the end plate 111b of the outer rotor 111 and is secured to by means of an appropriate means such as adhesive, welding, pressure welding or screw cramping, and thus the outer rotor 111 can be accurately positioned to the spindle 121.

**[0105]** The upper portion of the outer rotor disposing hole 120B is connected to a circular cross sectioned hole 120C for disposing upper bearing mount, the outer diameter of which is smaller than that of the outer rotor disposing hole 120B and which is slightly larger than that of the outer rotor 111, and the upper bearing mount disposing hole 120C is open at the upper surface of the spindle mount 120.

**[0106]** The upper bearing mount 150 is disposed within the the upper bearing mount disposing hole 120C. The upper bearing mount 150 comprises a body which engages with the upper bearing mount disposing hole 120C and a flange portion 150b formed at and projecting from the top of the body. Thus, the upper bearing mount 150 is secured to the top surface of the spindle mount 120 by screwing the flange portion 150b by means of set screws 153.

**[0107]** The upper bearing mount 150 has a circular cross sectioned upper bearing disposing hole 150a formed at the axis thereof, and it supports the upper bearing 125. The upper bearing 125 rotatably supports the spindle 132a at the upper portion of the bearing 130A.

**[0108]** The procedure for assembling this embodiment will now be explained. The upper bearing 125 is inserted into the upper bearing disposing hole 150a of

the upper bearing mount 150, and the spindle 132a is inserted into the upper bearing 125. Then, the rotor 111 is attached to the spindle 132a at the front end relative to the upper bearing 125. Further, the stator 112 is supported at the end of the spindle 132a and at the inside of the outer rotor 111 via the lower bearing 125A.

**[0109]** Under the condition wherein the rotor 111 is attached to the spindle 132a while the spindle 132a supports the stator 112 via the lower bearing 125A, and wherein further it supports the upper bearing mount 150 via the upper bearing 125, the stator 112 is disposed into the outer rotor disposing hole 120B from the above of the spindle mount 120 so that the shoulder formed at the bottom of the flange portion 112b of the stator 112 is engaged with the stator disposing hole 120A. In addition, the upper bearing mount 150 is engaged with the upper bearing mount disposing hole 120C.

**[0110]** Then, the flange 112b is screwed to the spindle mount 120 by means of set screws 151 which are inserted from the below of the spindle mount 120 so that the stator 112 is secured to the spindle mount 120. Further, the flange portion 150b of the upper bearing mount 150 is screwed to the spindle mount 120 by set screws 153 so that the upper bearing mount 150 is secured to the upper surface of the spindle mount 120 together with the spindle 132a. As a result, the spindle 132a penetrates through the spindle mount 120 while it is rotatably supported by the upper bearing 125 and the lower bearing 125A.

**[0111]** In addition, the spindle mount 120 has spindles 132b and 132c rotatably supported by bearings (not shown) at positions different from the spindle 132a, and the lower ends of the spindles 132b and 132c penetrate through the spindle mount 120.

**[0112]** The spindles 132a, 132b and 132c have pulleys 140, respectively, at the lower ends thereof. As illustrated in Fig. 5(b), a spindle drive belt 141 which is constructed by an endless belt wraps around the pulleys 140. In this embodiment, the pulley 140 is a toothed pulley, and the spindle drive belt 141 is a toothed belt.

**[0113]** In this embodiment, a top plate 151 is secured to by a set screw 153 at a upper end of a column 152 (Fig. 5) standing upward from the upper surface of the spindle mount 120, and it supports the top portions of the spindles 132a, 132b and 132c. Thus, the spindles 132a, 132b and 132c are supported at both the ends.

**[0114]** Because of the construction described above, when the outer rotor 111 of the radial gap type outer rotor brushless motor 110 is rotated, the rotation of the outer rotor 111 is transmitted to the spindle 132a, and the spindle 132a is rotated. Then, since the spindles 132a, 132b and 132c are connected to each other by means of the pulleys 140 and the spindle drive belt 141, the rotation of the outer rotor 111 is transmitted to the friction discs 131 mounted on the respective spindles 132a, 132b and 132c, and thus the friction discs 131 are rotated in the same direction.

**[0115]** Further, the spindle mount 120 has a narrow

cavity 120c formed at a side thereof same as that of the threading slit (not shown) formed in the top plate 151 for withdrawing a yarn, which has passed through the friction discs 131 mounted on the three spindles 132a, 132b and 132c, to the outside avoiding the radial gap type outer rotor brushless motor 110. As illustrated in Fig. 7, the cavity 120c reaches at the center of the three spindles 132a, 132b and 132c at the top of the spindle mount 120, and from there it is inclined downwardly and outwardly. Further, the spindle mount 120 has a detecting means (not shown) for detecting the rotation of the outer rotor 111.

**[0116]** In the embodiment which has been explained with reference to Fig. 4, a bearing may be disposed at the inside of the stator so that bearings are disposed within the brushless motor of a radial gap type outer rotor and the spindle mount like the present embodiment.

**[0117]** In the above-described embodiment, the spindle 132a having the outer rotor 111 of the radial gap type outer rotor brushless motor 110 mounted thereon and the other spindles 132b and 132c have pulleys 140 at the same level at the lower ends thereof, respectively, and one single drive belt 141 is wrapped around the three pulleys. As illustrated in Fig. 5(b), one 132a of the three spindles may have vertically overlaid pulleys 140' at the lower end thereof, while the remaining two spindles may have pulleys 140 corresponding to one of the vertically overlaid pulleys, respectively, and drive belts 141 and 141' may be wrapped between one of the overlaid pulleys and the pulley 140, respectively.

**[0118]** As described above, the three spindles 132a, 132b and 132c having a plurality of friction discs 131 mounted thereon are rotatably supported on the spindle mount 120, and the spindle mount 120 is laterally mounted and dismantled relative to the stationary bracket 106. Thus, upon withdrawal of the spindle mount, its collision with or damage to other parts mounted on the false twist texturing machine or the draw texturing machine does not occur, and the operation can be done easily, and therefore, the problems which may cause by upward withdrawal of the main parts of a false twisting device do not occur.

**[0119]** Further, a radial gap type outer rotor brushless motor 110 is used as an individual drive motor of a false twisting device. Accordingly, the reliability of the drive motor is high, and it is unnecessary for the drive motors to be subjected to maintenance or repair service while they are being mounted on a false twist texturing machine or a draw texturing machine. Thus, the construction wherein the spindle mount 120 is dismantled laterally relative to the stationary bracket 106 while it has the drive motor mounted thereon can be applied. When the drive motor requires maintenance or adjustment service, it is first dismantled from a false twist texturing machine or a draw texturing machine and then is subjected to the maintenance or repair service. Thereafter, it is mounted in a lateral direction while it has a drive motor mounted thereon.

[0120] In this embodiment, the spindle 132a connected to the radial gap type outer rotor brushless motor 110 is supported by the bearing 125 disposed on the spindle mount 120 and the bearing 125A disposed within the outer rotor motor 110, and thus, the rotation of the spindle 132a becomes stable, and its higher rotation is possible. Further, the top portions of the spindles 132a, 132b and 132c are supported by the top plate 151, and the advantages are further achieved since the spindles 132a, 132b and 132c are supported at both the ends.

#### Industrial Applicability

[0121] According to the false twisting device provided with three spindles having a plurality of friction discs according to the present invention, each false twisting device is driven by an individual motor, and no tangential belt is used, therefore, generation of noise can be highly decreased. Further, when the operating conditions of the individual motors for respective work stations are changed, adjustment of the false twisting conditions for respective work stations can be achieved easily.

[0122] According to the present invention, a motor drive type friction false twisting device provided with three spindles which can be actually used is provided. Further, the present invention provides a friction false twisting device provided with three spindles wherein the rotor and the stator 112 of the false twisting device can be readily positioned whereby the false twisting device can be installed easily upon assembling and installing again after detaching for cleaning or maintenance service. In addition, the present invention provides a friction false twisting device provided with three spindles which does not cause unevenness in rotation at a high speed rotation, and which can generate sufficiently large driving torque, whereby even a tick yarn with a large denier can be twisted thereby.

#### Claims

1. Motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being detachably disposed on a bracket, one of the three spindles having a rotor of a drive motor mounted thereon and a stator of the drive motor being fixed to the bracket, **characterized in that** the drive motor is a radial gap type outer rotor brushless motor.
2. Motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being detachably disposed on a bracket, one of the three spindles having a rotor of a drive motor mounted thereon and

a stator of the drive motor being fixed to the bracket, **characterized in that** the drive motor is a radial gap type outer rotor brushless motor, and the outer rotor of the brushless motor is formed in a bell shape, and the outer rotor is fixed to an end of one of the spindles so that it covers the peripheral outside and the spindle side end of the stator of the brushless motor forming a small clearance therebetween and that the peripheral portion of the outer rotor and the peripheral portion of the stator are magnetically connected with each other.

3. Motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being detachably disposed on a bracket, one of the three spindles having a rotor of a drive motor mounted thereon and a stator of the drive motor being fixed to the bracket, **characterized in that** the spindle mount and the bracket have engaging portions mounted thereon, respectively, at positions away from positions where the rotor and the stator of the drive motor are disposed, and the drive motor is a radial gap type outer rotor brushless motor.
4. Motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being detachably disposed on a bracket, one of the three spindles having a rotor of a drive motor mounted thereon and a stator of the drive motor being fixed to the bracket, **characterized in that** the spindle mount and the bracket have engaging portions mounted thereon, respectively, at positions away from positions where the rotor and the stator of the drive motor are disposed, the drive motor is a radial gap type outer rotor brushless motor, and the outer rotor of the brushless motor is formed in a bell shape and is fixed to an end of one of the spindles so that it covers the peripheral outside and the spindle side end of the stator of the brushless motor forming a small clearance therebetween and that the peripheral portion of the outer rotor and the peripheral portion of the stator are magnetically connected with each other.
5. Motor drive type friction false twisting device provided with three spindles according to any one of claims 1 to 4, **characterized in that** the three spindles have pulleys at ends thereof, respectively, and the three spindles are rotated in the same direction at the same speed by means of a drive belt wrapping about the three pulleys.
6. Motor drive type friction false twisting device provided with three spindles according to claim 5, **characterized in that** the three spindles are sup-

ported at ends thereof opposite to the pulleys by a top plate, whereby the three spindles are supported by the top plate and the spindle mount at both the ends thereof.

- 7. Motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being disposed on a bracket detachably in a lateral direction, **characterized in that** the spindle mount has a stator of a radial gap type outer rotor brushless motor mounted thereon at the lower surface thereof, an outer rotor is supported rotatable about the stator, the stator and one of the three spindles are operably connected, the three spindles have pulleys at the lower ends thereof, respectively, and the pulleys are connected by a drive belt. 5
  
- 8. Motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being disposed on a bracket detachably in a lateral direction, **characterized in that** the spindle mount has a stator of a radial gap type outer rotor brushless motor at the lower surface thereof, the stator having a hollow hole extending in an axial direction, one of the three spindles passing through the hollow hole has an outer rotor of the outer rotor brushless motor and a pulley at a lower end thereof, the other two of the three spindles have pulleys correspondingly to the pulley, and a drive belt is engaged around the pulleys. 10 15 20 25 30 35
  
- 9. Motor drive type friction false twisting device provided with three spindles having a plurality of friction discs, respectively, and rotatably supported on a spindle mount, the spindle mount being disposed on a bracket detachably in a lateral direction, **characterized in that** the spindle mount has a stator of a radial gap type outer rotor brushless motor at a position which correspond to none of the three spindles on the lower surface thereof, an outer rotor is supported rotatable about the stator, the three spindles pass through the bracket of the spindle mount and have pulleys at lower ends thereof, and a drive belt is engaged around the pulleys secured to the three spindles and the pulley secured to the outer rotor. 40 45 50
  
- 10. Motor drive type friction false twisting device provided with three spindles according to claim 7, 8 or 9, wherein the three spindles have pulleys at the lower ends thereof, respectively, and a drive belt is engaged with the three spindles. 55
  
- 11. Motor drive type friction false twisting device pro-

vided with three spindles according to claim 7, 8 or 9, wherein one of the three spindles has pulleys vertically overlaid at a lower end thereof, and the other spindles have pulleys corresponding to the vertically overlaid pulleys, respectively, and drive belts are engaged with the vertically overlaid pulleys and the other pulleys, respectively.

- 12. Motor drive type friction false twisting device provided with three spindles according to claim 7, 8, wherein bearings are disposed at the inside of the radial gap type outer rotor brushless motor and the spindle mount, respectively, and one of the three spindles is rotatably supported by a pair of bearings.

Fig. 1

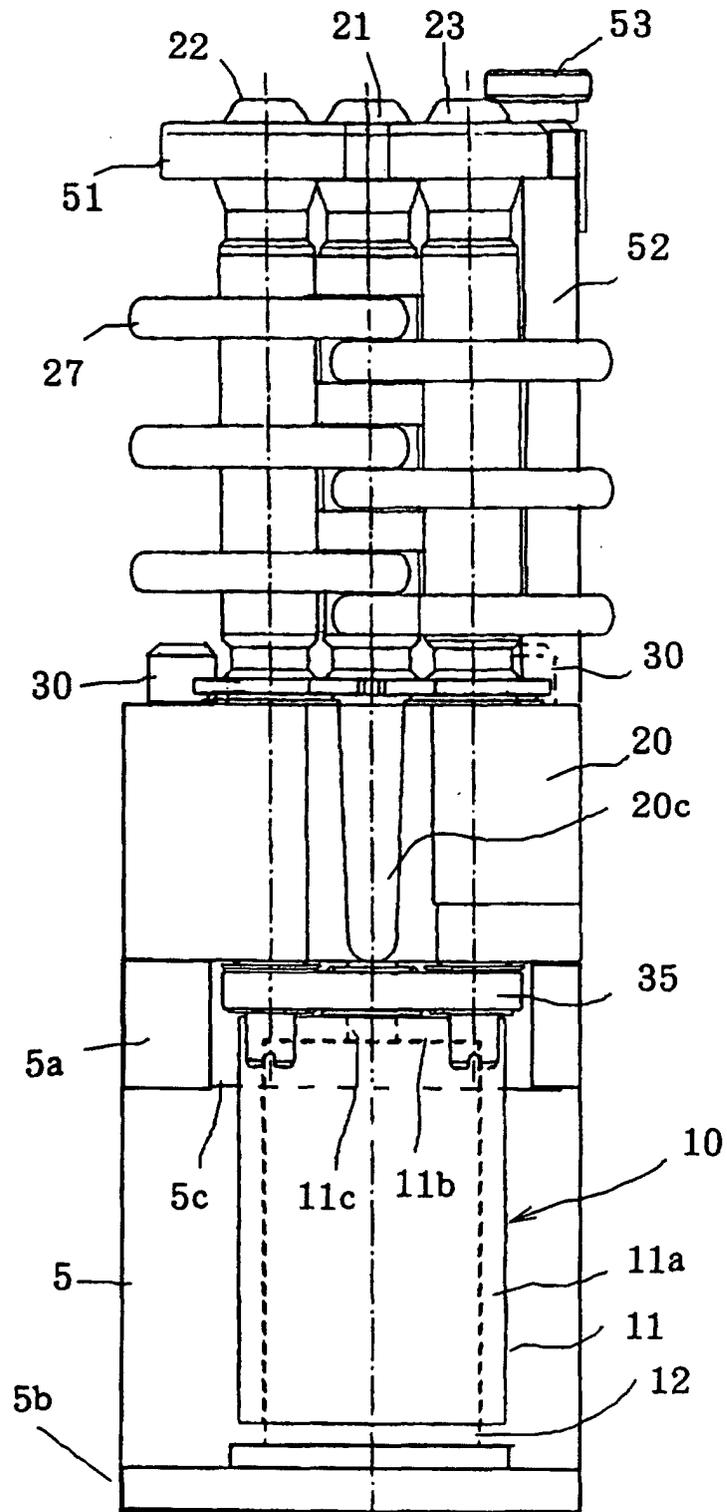


Fig.2

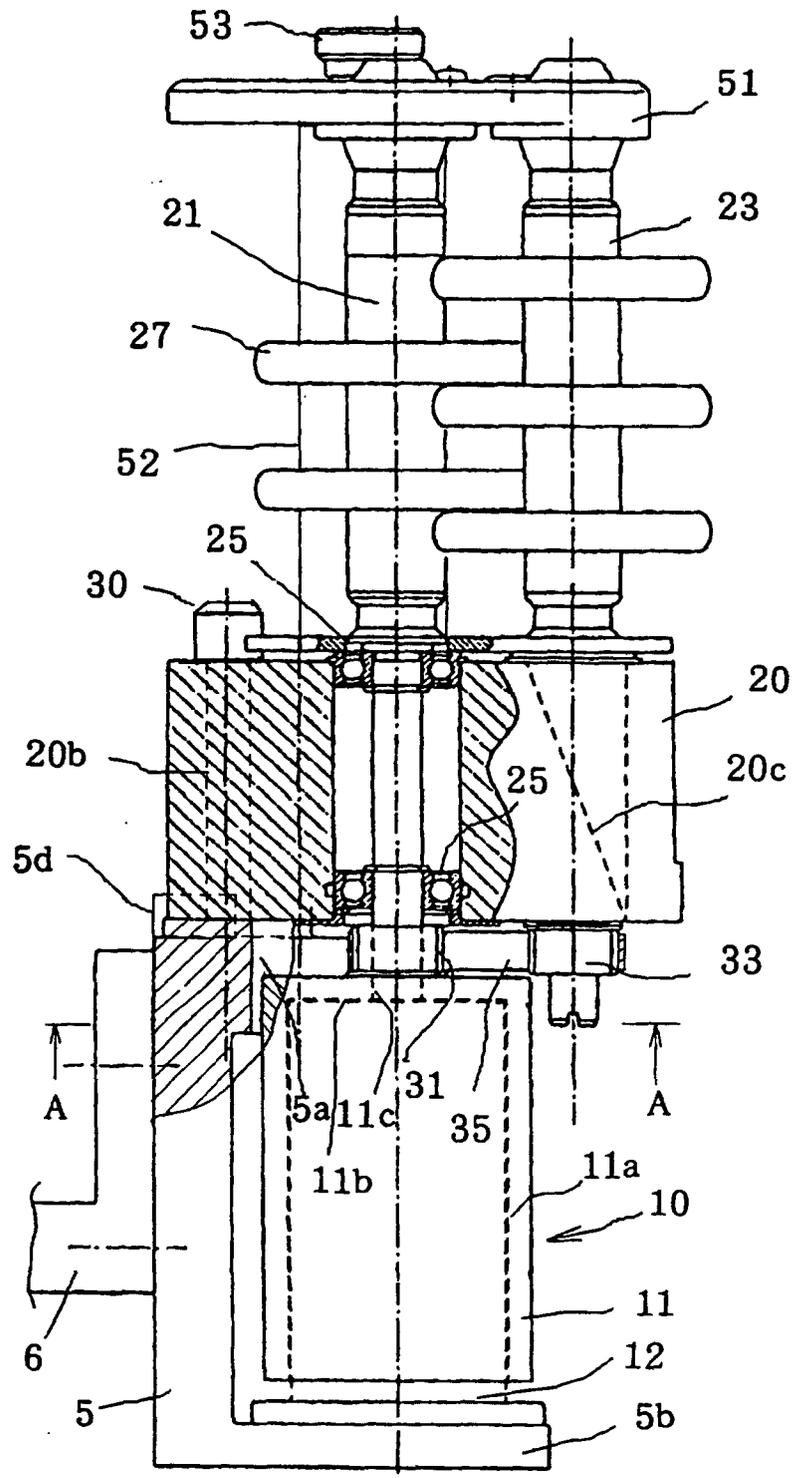


Fig.3(a)

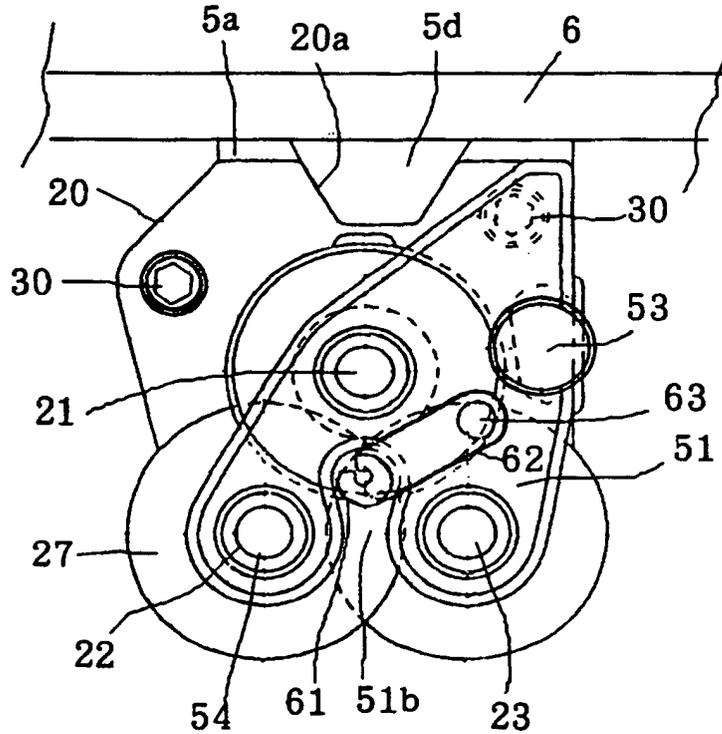


Fig.3(b)

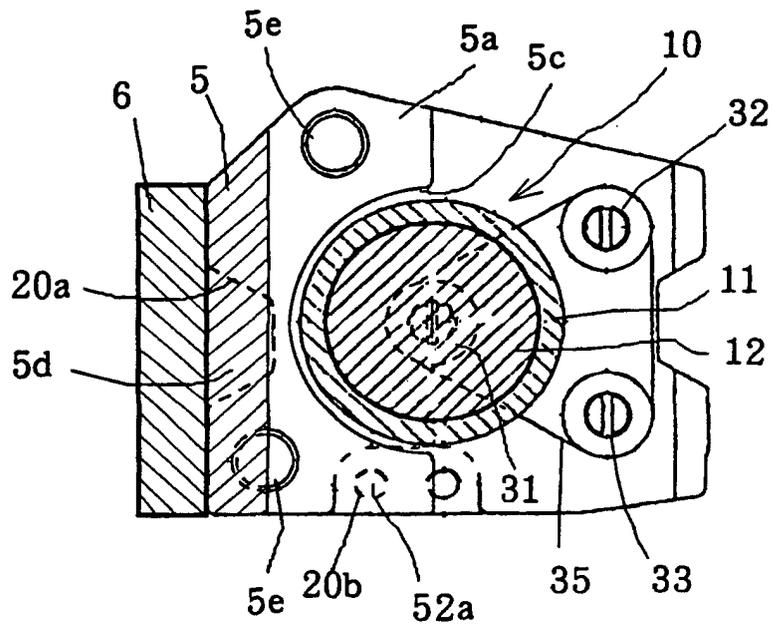


Fig.4

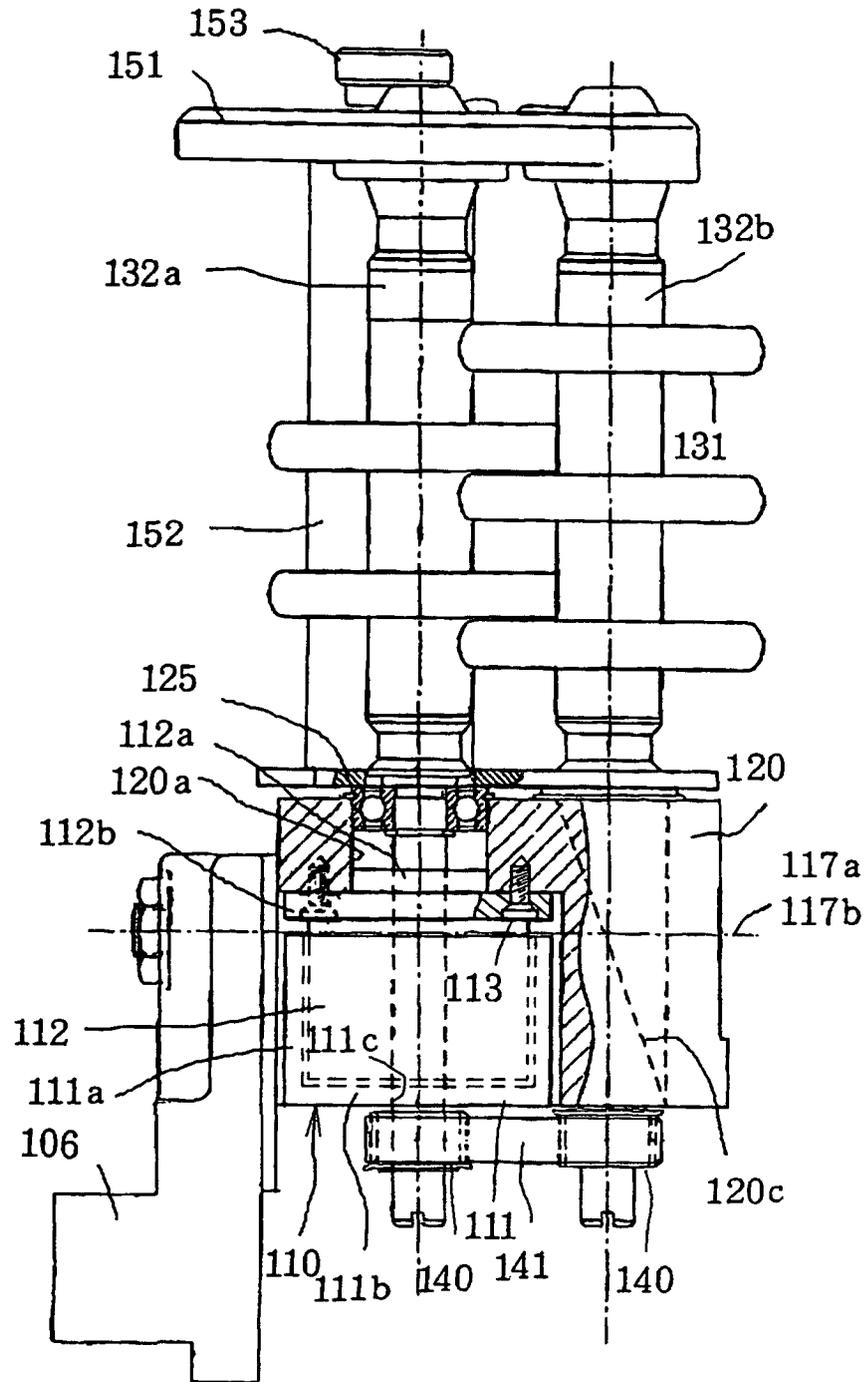


Fig. 5(a)

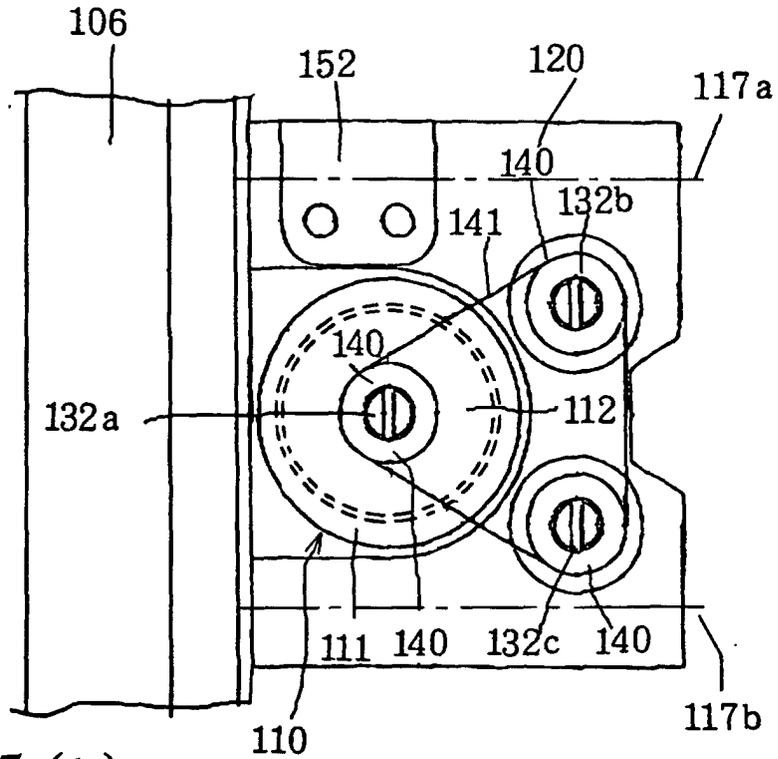


Fig. 5(b)

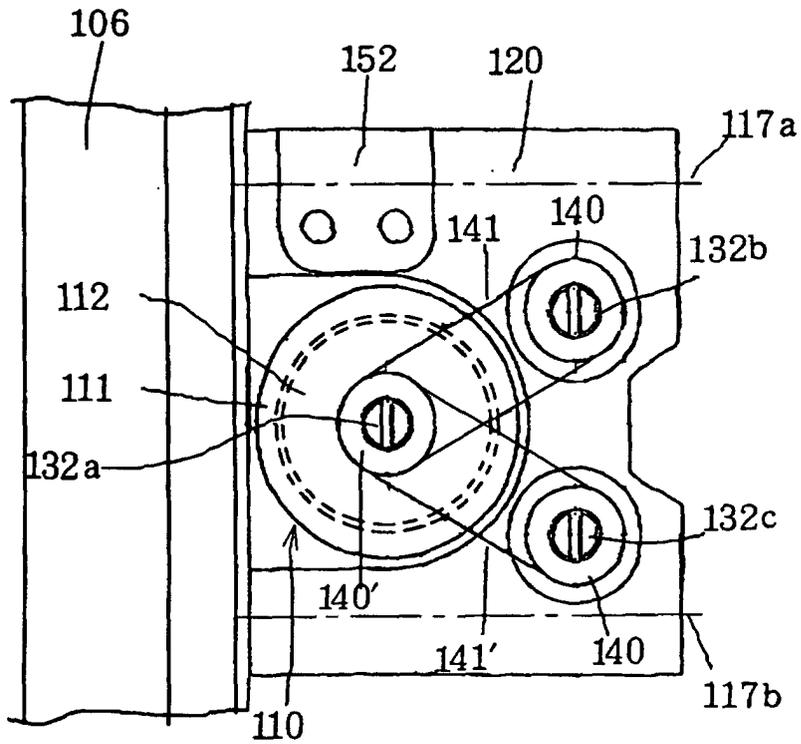


Fig. 6 (a)

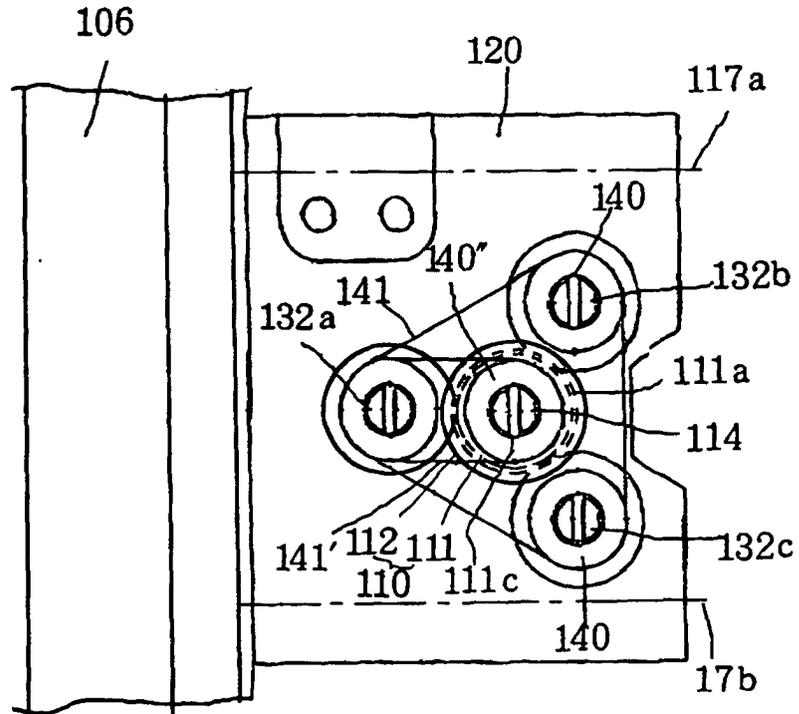
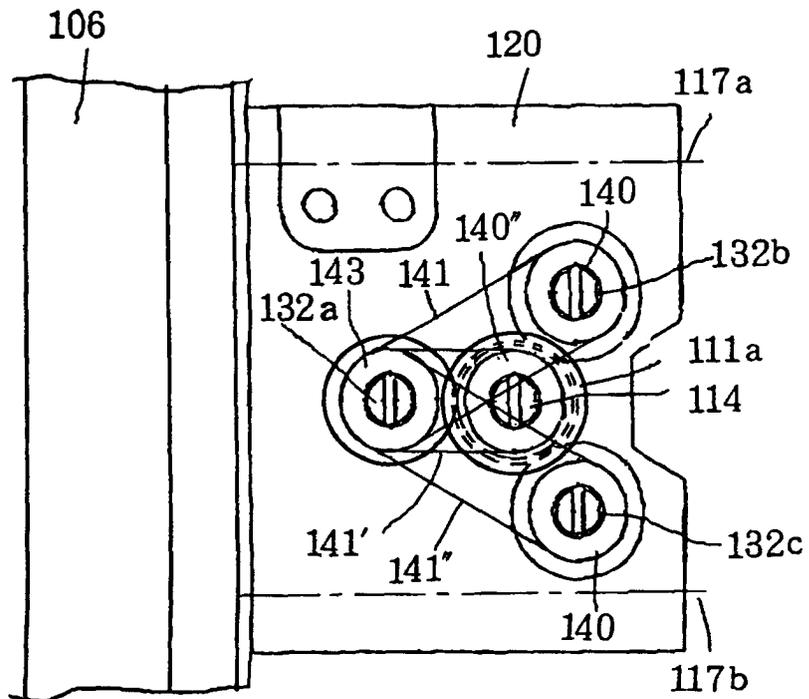


Fig. 6 (b)





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP99/06614

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. <sup>7</sup> D02G1/08		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) Int.Cl. <sup>7</sup> D02G1/08		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Jitsuyo Shinan Toroku Koho 1996-1999 Kokai Jitsuyo Shinan Koho 1971-1999 Toroku Jitsuyo Shinan Koho 1994-1999		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) F Team Theme Code 4L036 ECLA DB:D02G1/08B		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, 4899533, A (FAG Kugelfischer Georg Schafer), 13 February, 1990, Full text & JP, 1-201539, A	1-10, 12
A		11
Y	JP, 4-295242, A (Tokyo Electric Co., Ltd.), 20 October, 1992, Full text (Family: none)	1-10, 12
A		11
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 23 February, 2000 (23.02.00)		Date of mailing of the international search report 07 march, 2000 (07.03.00)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)