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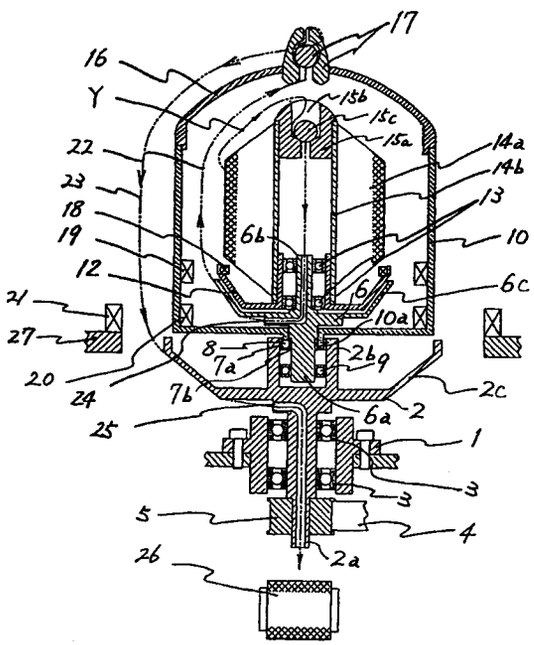
(54) Yarn twisting spindle device.

(57) A yarn twisting spindle device comprising two spindles (2,6), having yarn introducing holes (24, 25) formed therein, respectively, and coaxially disposed in an axial line rotatably in opposite directions, for twisting a yarn passed through the introducing holes. An end (2b) of one (2) of the two spindles is formed in a cylindrical portion and has outer annular members (7a) fitted inside thereof. An end (6a) of the other spindle (6) is formed in a shaft portion (6) and has inner annular members (7b) fitted outside thereof. Balls (8) are disposed between both the annular members (7a, 7b) so as to rotatably support the two spindles, and a prohibiting member is disposed for prohibiting revolution of the balls.

FIG. 1



EP 0 611 841 A1

The present invention relates to a yarn twisting spindle device for continuously imparting real twists to a continuously fed yarn. More specifically, the present invention relates to a so called yarn twisting spindle device comprising two spindles, having yarn introducing holes formed therein, respectively, and coaxially disposed in an axial line rotatably in opposite directions, for twisting a yarn passed through the yarn introducing holes.

In an example of a conventional yarn twisting spindle device disclosed in Japanese Patent Publication No. Sho 47-40100, rollers are sandwiched between a pair of upper and lower flat plates, and the rotation of one of the flat plates is transmitted to the other flat plate the flat plate in an opposite direction via the rollers, and the loads applied in an axial direction and in a direction perpendicular to the axial direction are supported, respectively, by bearings disposed separate from the flat plates.

In yarn twisting spindle devices disclosed in Japanese Patent Application Laid-open No. Sho 50-135347 and No. Sho 47-33246, two spindles are supported by bearings, respectively, and a toothed gear or belt is disposed between the two spindles so that the spindles are rotated in opposite directions.

The prior art disclosed in the above-described Japanese Patent Publication No. Sho 47-40100 has the following problems because the rollers are sandwiched between a pair of flat plates.

(1) As the rotational speed of the yarn twisting spindle device increases, an excessive force is exerted, due to centrifugal force of the rollers, to the rollers and a regulating plate for supporting the rollers, and seizure of the device may occur.

(2) Lubricating oil applied to the rollers may be scattered due to the centrifugal force, and accordingly, seizure of the device may occur due to decrease of the lubricating oil.

(3) Because both a power transmitting mechanism and bearings for supporting spindles are necessary, the size of the yarn twisting device becomes large, and ballooning of yarn formed during yarn twisting operation also becomes large in such a large sized yarn twisting spindle device, and operating speed of such a yarn twisting spindle device cannot be enhanced.

(4) The upper rotatable flat plate is supported only via rollers, its center of rotation may be shifted or it may displace vertically. Accordingly, the yarn twisting spindle device may be easily vibrated at high speed, and therefore, the yarn twisting spindle device is dangerous during high speed operating range.

Contrary to this, according to the yarn twisting spindle device disclosed in the above-described Japanese Patent Application Laid-open No. Sho 50-135347 or No. Sho 47-33246, the toothed gear or belt is used to change the rotational directions between the two spindles. Accordingly, such a yarn twisting device has the following problems.

(1) Large noise is generated when the yarn twisting spindle device is operated at a high speed, and the life of the device is short.

(2) Because both a power transmitting mechanism and bearings for supporting spindles are necessary, the size of the yarn twisting device becomes large, and ballooning of yarn formed during yarn twisting operation also becomes large in such a large sized yarn twisting spindle device, and an operating speed of such a yarn twisting spindle device cannot be enhanced.

It is an object of the present invention to provide a yarn twisting spindle device which can obviate the problems inherent to the above-described conventional yarn twisting spindle devices.

It is another object of the present invention to provide a yarn twisting spindle device which is substantially free from generation of large noise during a high speed operation, which has a large durability, and the size of which can be small.

It is still another object of the present invention to provide a yarn twisting spindle device by which the ballooning of the yarn can be minimized, and accordingly, the tension in the yarn caused by the centrifugal force of the ballooning is prevented from being increased excessively. Thus, according to the present invention, a yarn twisting spindle device is provided by which a yarn twisting speed can be increased.

According to the present invention, the above-described objects are achieved by a yarn twisting spindle device comprising two spindles, having yarn introducing holes formed therein, respectively, and coaxially disposed in an axial line rotatably in opposite directions, for twisting a yarn passed through the introducing holes, characterized in an end of one of the two spindles is formed in a cylindrical portion and an end of the other spindle is formed in a shaft portion, a rolling member is disposed between the cylindrical portion and the shaft portion so as to rotatably support the two spindles, and a prohibiting member is disposed for prohibiting revolution of the rolling member.

According to the present invention, both the power transmitting mechanism for transmitting the rotations, which are opposite to each other, and the functions of bearings for supporting loads are born by the cylindrical portion, the shaft portion, the rolling member, which is disposed between the cylindrical portion and the shaft portion and which may comprise balls or rollers, and the prohibiting member, which prohibits revolution of the rolling member, such as balls or rollers. Thus, the size of the yarn twisting spindle device of the present invention may be small, and increase of the tension

due to the ballooning can be prevented.

Further, since the relative rotational speeds of the cylindrical portion and the shaft portion are different from each other, the spindle which may be subjected to a small ballooning may be operated at a higher speed while the other spindle which may be subjected to a large ballooning may be operated at a lower speed, if necessary. Thus, the difference of the tensions in the yarn due to the ballooning behavior can be compensated.

Further, according to the present invention, since the rolling member, such as balls or rollers, and the prohibiting member are disposed inside the cylindrical portion, the lubricating oil can be prevented from scattering due to the centrifugal force.

In addition, according to the present invention, the two spindles are completely regulated, the yarn twisting spindle device of the present invention has a high rigidity and safety against vibration, and accordingly, it can be operated at a high speed. For example, the yarn twisting spindle device of the present invention can be operated at a high speed which is substantially double the speed of a conventional yarn twisting spindle device. In other word, if the yarn twisting spindle device of the present invention is operated at a speed which is substantially the same as that for a conventional yarn twisting spindle device, size of a supply yarn package can be increased to about fourth times of that for a conventional yarn twisting spindle device. Thus, operational efficiency for supplying yarn package is highly improved according to the present invention.

Some embodiments of the present invention will now be explained in detail with reference to the attached drawings, wherein:

Fig. 1 is a cross sectional side view of an embodiment of a yarn twisting spindle device according to the present invention;

Fig. 2 is an enlarged cross sectional view illustrating annular members, a prohibiting member and balls which are illustrated in Fig. 1;

Fig. 3 is a cross sectional view taken along line 3-3 in Fig. 2;

Fig. 4 is an enlarged cross sectional view of another embodiment similar to Fig. 2;

Fig. 5 is an enlarged cross sectional view of still another embodiment similar to Fig. 2;

Fig. 6 is an enlarged cross sectional view of a further embodiment similar to Fig. 2;

Fig. 7 is a cross sectional side view, similar to Fig. 1, of another embodiment of a yarn twisting spindle device according to the present invention;

Fig. 8 is a perspective view of the lower spindle illustrated in Fig. 7;

Fig. 9 is a perspective view of a lower spindle of another embodiment of the present invention;

Fig. 10 is a side view of another lower spindle; and

Fig. 11 is a plan view of Fig. 10.

Referring to Fig. 1, reference numeral 1 denotes a stationary bracket fixedly disposed on a frame. Reference numeral 2 denotes a lower spindle, which is formed in a substantially T-shaped cross section which comprises a horizontal flange portion and a vertical shaft 2a perpendicular to the flange portion.

The T-shaped lower spindle 2 has a tapered portion 2c extending outwardly from the horizontal flange portion. The vertical shaft 2a is located at the center of the horizontal flange portion and is formed in a cylindrical form. The shaft 2a is rotatably supported on the stationary bracket 1 via bearings 3 and has a pulley 5 secured to the lower end thereof for transmitting the rotational force from a belt 4.

The shaft 2a of the lower spindle 2 has a yarn introducing hole 25 extending along an axial direction at the center of the shaft 2a and cranked at the upper portion thereof to the periphery of the shaft 2a.

The lower spindle 2 further has a bearing portion 2b integrally formed at the center of and above the horizontal flange portion thereof. The bearing portion 2b is an example of the cylindrical portion of the present invention. The bearing portion 2b has outer annular members 7a and outer laces of of bearings 9 fitted within the inner surface thereof.

Reference numeral 6 denotes a upper spindle, which is also formed in a substantially T-shaped cross section which comprises a vertical shaft 6a and a horizontal flange portion perpendicular to the shaft portion 6a.

The T-shaped upper spindle 6 also has a tapered portion 6c connected to the horizontal flange portion. The vertical shaft 6a is located at the center of the horizontal flange portion and serves as a shaft portion of the present invention.

Inner laces of the bearings 9 are fitted to the shaft portion 6a of an upper spindle 6. Further, the shaft portion 6a has inner annular members 7b fitted thereto. A plurality of balls 8 are disposed between the inner and outer annular members 7a and 7b. Thus, the upper spindle 6 is disposed coaxially and vertically superimposed with the lower spindle 2. The hollow shaft 6b of the upper spindle 6 has a yarn introducing hole 24 extending along an axial direction at the center of the shaft 6b and cranked outwardly at the lower portion thereof.

Reference numeral 10 denotes a prohibiting member for prohibiting revolutions of a plurality of balls 8, which member is formed in a pot shape with bottom. The center portion 10a of the pot

shaped prohibiting member 10 is formed in annular shape and extends downwardly to the cylindrical space formed between the bearing portion 2b of the lower spindle 2 and the shaft 6b of the upper spindle 6. As illustrated in Figs. 2 and 3, a plurality of apertures 11 are equidistantly formed around the annular shaped center portion 10a, and the above-described balls 8 are rotatably engaged within the apertures 11, respectively.

Reference numeral 12 denotes upper stationary disk which is coaxially supported on the hollow shaft 6b formed at the upper portion of the upper spindle 6 by means of bearings 13 and onto which a supply package 14a is inserted.

The stationary disk 12 is tapered so as to correspond to the tapered portion 6c of the upper spindle 6 and to form a small clearance therebetween.

Reference numerals 15a to 15c denote tenser which has a capability for regulating tension in the yarn Y and which is disposed above a bobbin 14b of the supply package 14a. The tenser comprises a holder 15a and a ball 15c disposed in a cavity 15b formed in the holder 15a. Reference numeral 16 is a ballooning cover which is detachably connected to the upper end of the prohibiting member 10 and which has an upper tenser 17 attached thereto.

Reference numeral 21 denotes a magnet which is secured to the frame 27. The prohibiting member 10 has a magnet 20 secured thereto at a position corresponding to the magnet 21. The magnetic force acting between the magnets 20 and 21 serves to prevent the rotation of the prohibiting member 10. The prohibiting member further has magnet 19 secured thereto in addition to the magnet 20. The upper stationary disk 12 has magnet 18 secured thereto at a position corresponding to the magnet 19. The magnetic force acting between the magnets 18 and 19 serves to prevent the rotation of the upper stationary disk 12.

The driving force from the belt 4 is transmitted to the pulley 5 secured to the lower portion of the lower spindle 2 so as to rotate the lower spindle 2. When the lower spindle 2 is rotated, the rotational force of the annular members 7a is transmitted to the balls 8. However, since the revolution of the balls 8 is prohibited by the prohibiting member 10, the rotational force opposite to that of the lower spindle 2 is transmitted to the annular members 7b. Thus, the upper spindle 6 and the lower spindle 2 rotate in opposite directions.

In order to exert sufficient contacting pressure between the annular members 7a and the balls 8 and between the balls 8 and the annular members 7b, axial load, i.e., the weight applied to the upper spindle 6, has been previously applied to the upper spindle 6 in the present embodiment. Further, the annular members 7b and the upper spindle 6, or the annular member 7a and the lower spindle 2 are engaged with each other with some interference therebetween so that there occurs no slip therebetween during power transmission. Alternatively, the annular members 7b and the upper spindle 6, or the annular member 7a and the lower spindle 2 may be engaged with each other via O-rings or may be adhered to each other.

The operation of the yarn twisting spindle device of the present embodiment will now be explained. In the present embodiment, the lower spindle 2 is rotated by means of the driving power from a power source (not shown) transmitted through the belt 4 and pulley 5. The rotational force is transmitted to the balls 8, and since the balls 8 are prohibited their revolution by means of the prohibiting member 10, the upper spindle 6 rotates in a direction opposite to that of the lower spindle 2.

In Fig. 1, a yarn Y withdrawn from the outer periphery of the supply package 14a passes through the tenser 15a to 15c, the inside of the bobbin 14b and the yarn introducing hole 24 formed in the upper spindle 6 to the outside of the supply package 14a. Then the yarn Y slide contacts the tapered portion 6c of the upper spindle 6 and then forms a balloon 22 at the outside of the supply package 14a. Thereafter, the yarn Y is guided to the tenser 17 disposed at the upper portion of the prohibiting member 10, and then it is guided from the tenser 17 to the outside of the prohibiting member 10. The yarn Y is subjected to a predetermined tension during the above-described operation and forms a balloon 23 at the outside of the prohibiting member 10. Then, the yarn Y slide contacts the surface of the tapered portion 2c of the lower spindle 2, and then it is guided to the yarn introducing hole 25 formed in the lower spindle 2. The yarn Y which has passed through the yarn introducing hole 25 is wound in a package 26 by means of a take-up device (not shown).

The regulation of the tension in yarn at the balloons 22 and 23, which are generated by the rotations of the upper spindle 6 and the lower spindle 2, is performed by the tenser 17 disposed at the upper portion of the ballooning cover 16 and contacting friction between the yarn Y and the tapered portions 2c and 6c of the lower and upper spindles 2 and 6.

Assuming that the number of rotation of the lower spindle 2 is N_1 while the diameters of the trajectory of the contacting points between the annular members 7a and 7b and the balls 8 are designated by D_1 and D_2, respectively, the number of rotation of the upper spindle 6 becomes

$$N_1 \times D_1/D_2$$

under the further assumption that there is no slip between the annular members 7a and 7b and the balls 8.

Thus, the yarn Y withdrawn from the supply package 14 is imparted with real twists of

$N_1 \times D_1/D_2$ (turns)

between the tenser 15 and the yarn introducing hole 24.

Then, after the yarn Y wraps appropriately around the outer surface of the tapered portion 6c of the upper spindle 6, it forms balloon 22 and is imparted with real twists of

$N_1 \times D_1/D_2$ (turns)

in the same direction as that of the previously imparted twists between the yarn introducing hole 24 and the tenser 17. Accordingly, real twists of $2 \times N_1 \times D_1/D_2$ (turns) are imparted to the yarn Y.

When the yarn Y with twists thus imparted is introduced to the yarn introducing hole 25 of the lower spindle 2 through the tenser 17, the yarn Y forms a balloon 23. Since the lower spindle 2 rotates in a direction opposite to that of the upper spindle 6, the yarn Y is imparted with real twists of N_1 (turns) in a direction the same as that of the twists imparted by the upper spindle 6 between the tenser 17 and the yarn introducing hole 25. Further, while the yarn Y passes through the yarn introducing hole 25, the yarn Y is imparted with twists, the direction of which is the same as that of the previously imparted real twists and the number of which is N_1 (turns).

As a whole, the yarn Y is imparted with real twists of

$N_1 + N_1 + 2 \times N_1 \times D_1/D_2$ (turns)

$= 2 \times (N_1 + N_1 \times D_1/D_2)$ (turns).

In short, the yarn is subjected to real twists, the number of which is double of the sum of the rotational numbers of the upper spindle 6 and that of the lower spindle 2. The yarn Y passed through the yarn introducing hole 25 is wound in a package 26 by means of the take-up device (not shown).

Although a plurality of balls 8 are used between the pairs of annular members 7a and 7b in the above-explained embodiments, rollers 8' or 8'' formed in a cylinder (see Fig. 6) or in a frusto-conical shape (see Fig. 4) may be used in place of the balls 8.

In the above-described embodiment, the material of the prohibiting member 10 is selected to be a resin having a self lubricating capability, because the prohibiting member 10 has to be in sliding contact with a plurality of balls 8. However, the material may be carbon or ceramic having high durability.

The prohibiting member may prohibit a plurality sets of balls or rollers, which sets are aligned in axial direction of the annular members as illustrated in Fig. 5. Rollers and balls may be used simultaneously between the annular members 7a and 7b. Further, according to the present embodiment, the contacting pressure between the upper spindle 6 and the lower spindle 6 for transmitting the opposite rotational forces is applied by previously applied pressure or by the weight applied to the upper spindle 6. However, an elastic member, such as springs 28 as illustrated in Fig. 5, may be disposed between a plurality of annular members.

Further, especially when cylindrical rollers 8' are used (see Fig. 6), it is preferred that the annular members 7a and 7b and the rollers 8' are engaged with each other with some interference therebetween so as to ensure power transmission to the cylindrical roller 8'. The cylindrical roller 8' may be of a hollow type or of a solid type.

Although the cylindrical portion, i.e., the bearing portion formed in cylindrical shape, is formed in the lower spindle while the shaft portion is formed in the upper spindle, the formation of the cylindrical portion and the shaft portion may be reversed.

In a yarn twisting spindle device, when the yarn Y moves towards the center of rotating axis and forms so called reverse balloon 23, the yarn tends to wraps around the tapered portion 2c of the lower spindle 2 as the twisting spindle rotates. The tension in yarn at the balloon is regulated by adjusting the wrapping angle θ (see Fig. 8) so as to adjust friction between the yarn Y and the tapered portion 2c of the lower spindle 2. However, if the wrapping angle θ is excessively large, the tension adjusting function of the lower spindle 2 may be lost. As a result, breakage of filaments constituting the yarn Y of yarn breakage may occur.

In an embodiment of yarn twisting spindle device illustrated in Figs. 7 and 8, a specifically designed means for regulating the wrapping angle θ of the yarn Y is disposed so as to always maintain the tension adjusting function at an adequate level.

In Figs. 7 and 8, parts the same as or similar to those illustrated in Fig. 1 are designated by the same reference numerals as those used in Fig. 1 and their description is omitted here. Further, the embodiment illustrated in Figs. 7 and 8 may be altered along the lines indicated in the embodiments illustrated in Figs. 4 to 6.

Referring to Figs. 7 and 8, an annular horizontal flange 2d is formed at the outer periphery of the tapered portion 2c, and a slit 2f in an arc is formed in the annular horizontal flange 2d. The length of the arced slit 2f is set at a predetermined amount.

The yarn left the tenser 17 enters into the slit 2f after it forms a balloon 23 and then it contacts the surface of the tapered portion 2c of the lower spindle 2.

When the yarn Y locates at a position between the ends of the slit 2f, the wrapping angle θ of the yarn Y is within an allowable range, and accordingly, the tension in yarn at the balloon 23 is regulated by the friction contact between the yarn Y and the tapered portion 2c. Contrary to this, if the yarn wraps around the tapered portion 2c beyond the allowable wrapping angle, the tension in yarn may become excessively large. However, according to this embodiment, the wrapping angle θ of the yarn Y is limited by the slit 2f, and the tension adjusting function can be always maintained within an adequate level. The slit 2f is means for maintaining the tension within a predetermined level.

In an embodiment illustrated in Fig. 9, in place of the elongated slit 2f in the embodiment illustrated in Figs. 7 and 8, small circular aperture 2h is formed on the annular horizontal flange 2d. The yarn entering into the yarn introducing hole 25 is guided through the aperture 2h. Accordingly, the tension in yarn at balloon 23 is determined and regulated by the locational relationship between the aperture 2h, through which the yarn passes, and the yarn introducing hole 25. In addition to the aperture 2h, three apertures 2h' are formed on the annular horizontal flange 2d so that the apertures 2h and 2h' are equidistant and balanced about the central axis of the rotation.

Figs. 10 and 11 show an modification of the embodiment illustrated in Figs. 7 and 8 or in Fig. 9. In Figs. 10 and 11, hooks 2j are disposed at the upper portion of the tapered portion 2c as means for maintaining the tension within a predetermined level.

According to the present invention, since the rolling member, for example, a plurality of balls or rollers, disposed within the cylindrical portion has both the power transmitting function and the bearing function, the yarn twisting spindle device of the present invention obviate a problem that it requires an extra bearing member, which is essential for a conventional yarn twisting spindle device, for power transmitting member. As a result, the size of the yarn twisting spindle device can be easily reduced, and the tension in the outer balloon becomes excessively small compared with that for a conventional yarn twisting spindle device. Consequently, the operating speed of the yarn twisting spindle device according to the present invention can be enhanced, and the twisting speed also can be enhanced while the size of the supply package can be enlarged.

Further, since the upper spindle 6 and the lower spindle 2 of the present invention are completely controlled by the annular members and the balls 8 or rollers, their centers of rotation will not be shifted from each other or they will not displace vertically. Accordingly, the yarn twisting spindle device of the present invention has sufficient resistance to vibration and is high safety in a high speed range operation.

Claims

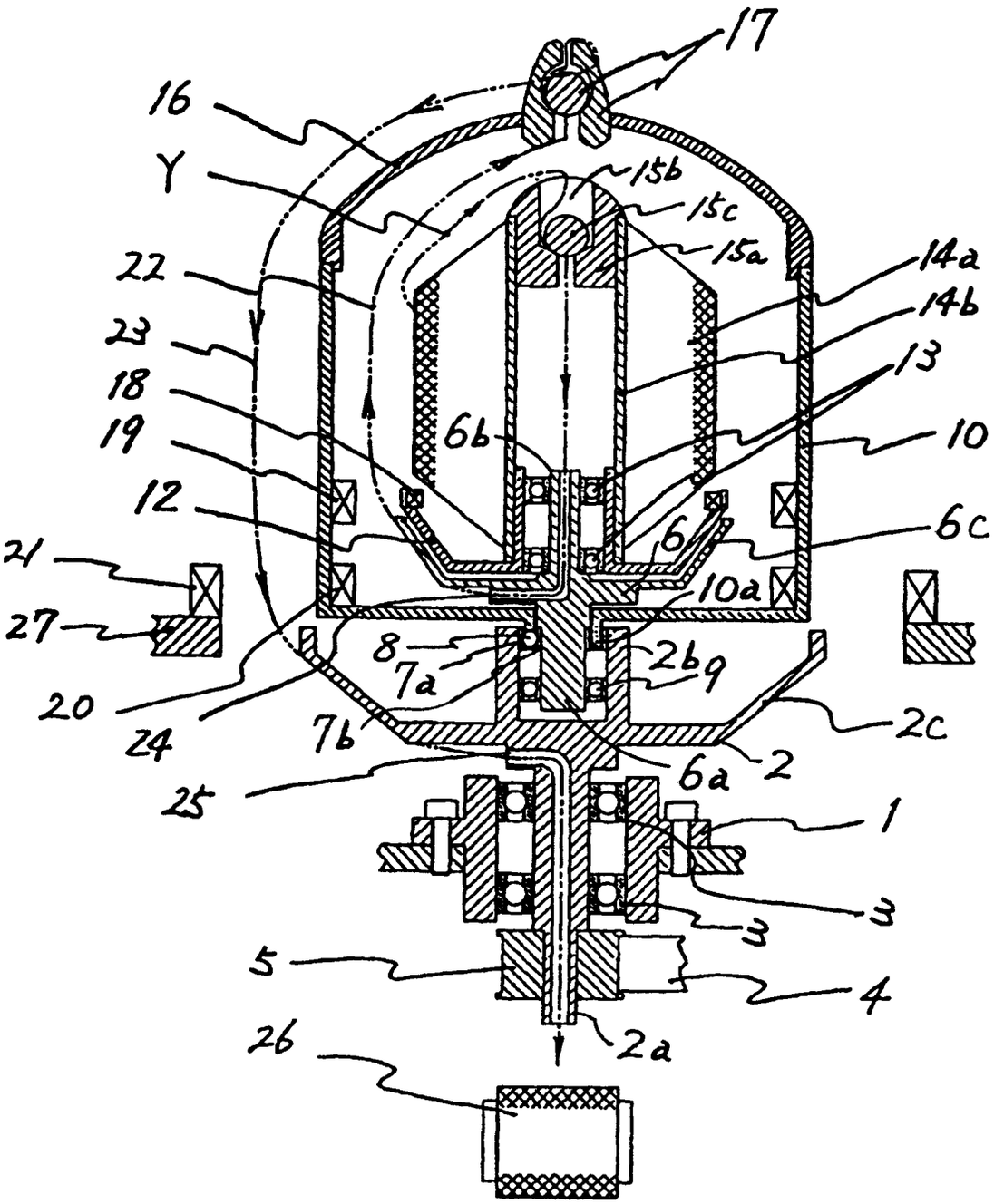
1. A yarn twisting spindle device comprising two spindles (2, 6), having yarn introducing holes (24, 25) formed therein, respectively, and coaxially disposed in an axial line rotatably in opposite directions, for twisting a yarn (Y) passed through said introducing holes (24, 25), characterized in that an end (2b) of one (2) of said two spindles (2, 6) is formed in a cylindrical portion and an end (6a) of the other spindle (6) is formed in a shaft portion, a rolling member (8, 8') is disposed between said cylindrical portion (2b) and said shaft portion (6a) so as to rotatably support said two spindles (2, 6), and a prohibiting member (10) is disposed for prohibiting revolution of said rolling member (8).

2. A yarn twisting spindle device according to claim 1, characterized in that said rolling member comprises balls (8).

3. A yarn twisting spindle device according to claim 1, characterized in that said rolling member comprises rollers (8').

4. A yarn twisting spindle device according to claim 1, 2, or 3, wherein said lower spindle (2) has a portion (2c) with which the yarn (Y) contacts so as to regulate tension in yarn at balloon characterized in that it further comprises means (2f, 2h, 2j) for maintaining the tension within a predetermined level.

FIG. 1


17
16
Y
15b
15c
15a
14a
14b
13
22
23
18
19
12
6b
10
6
6c
10a
21
27
8
7a
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7b
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6a
2
25
1
3
3
5
4
2a
26

FIG. 2

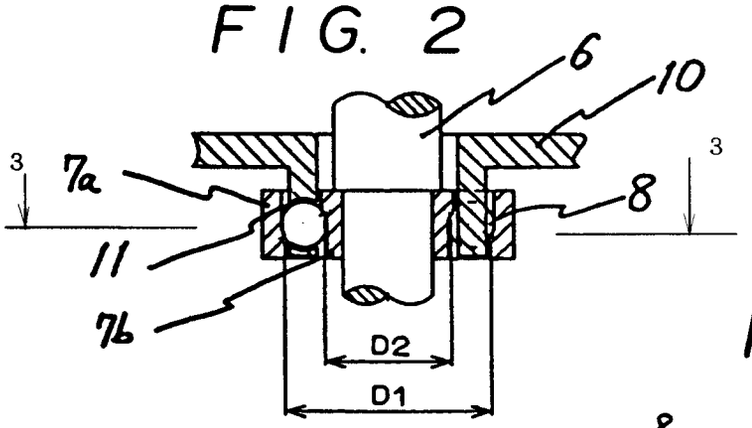


FIG. 3

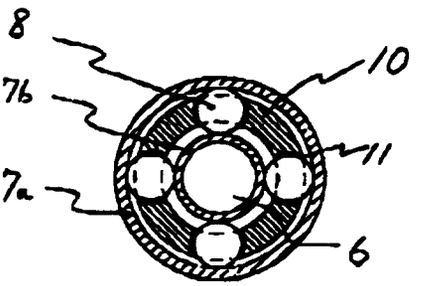


FIG. 4

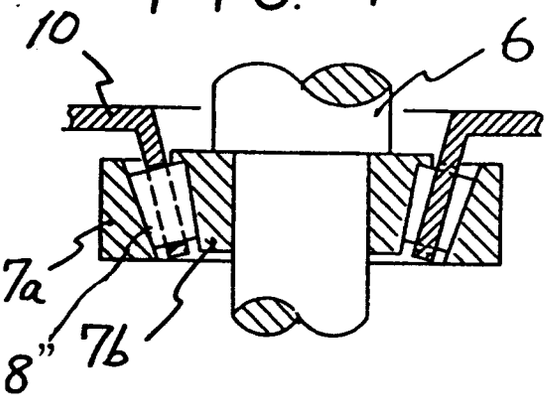


FIG. 5

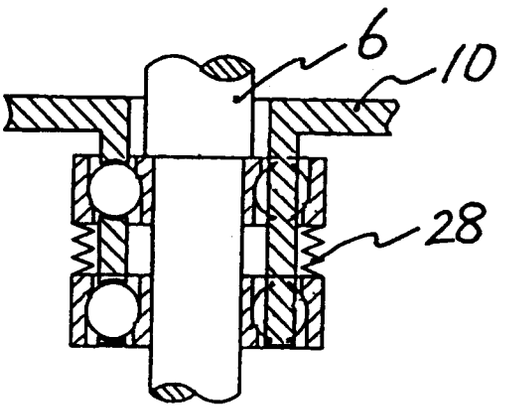


FIG. 6

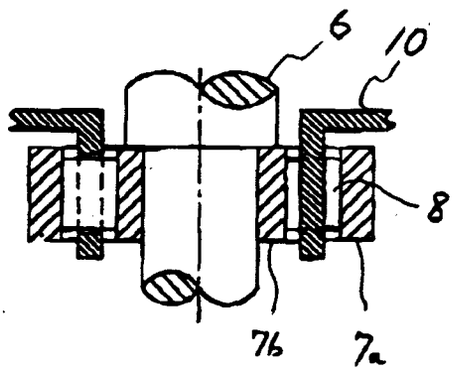


FIG. 8

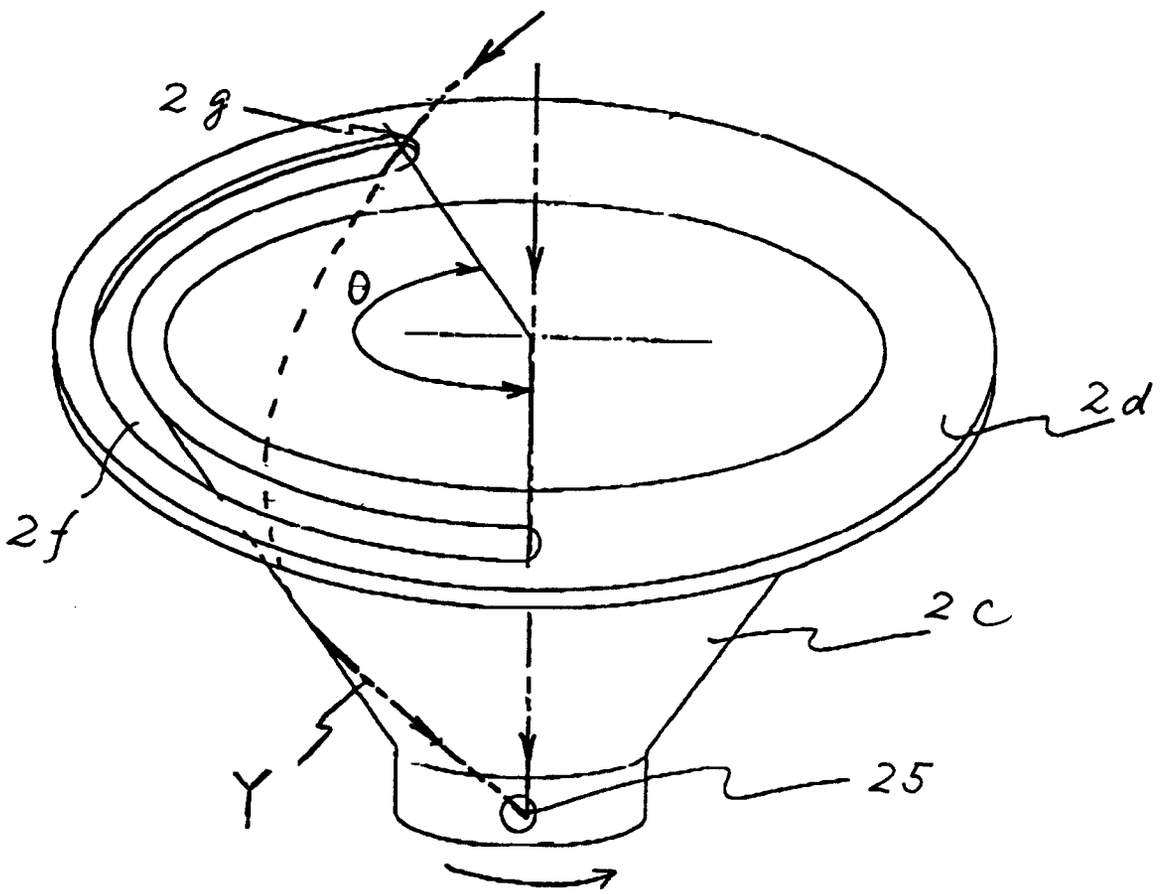
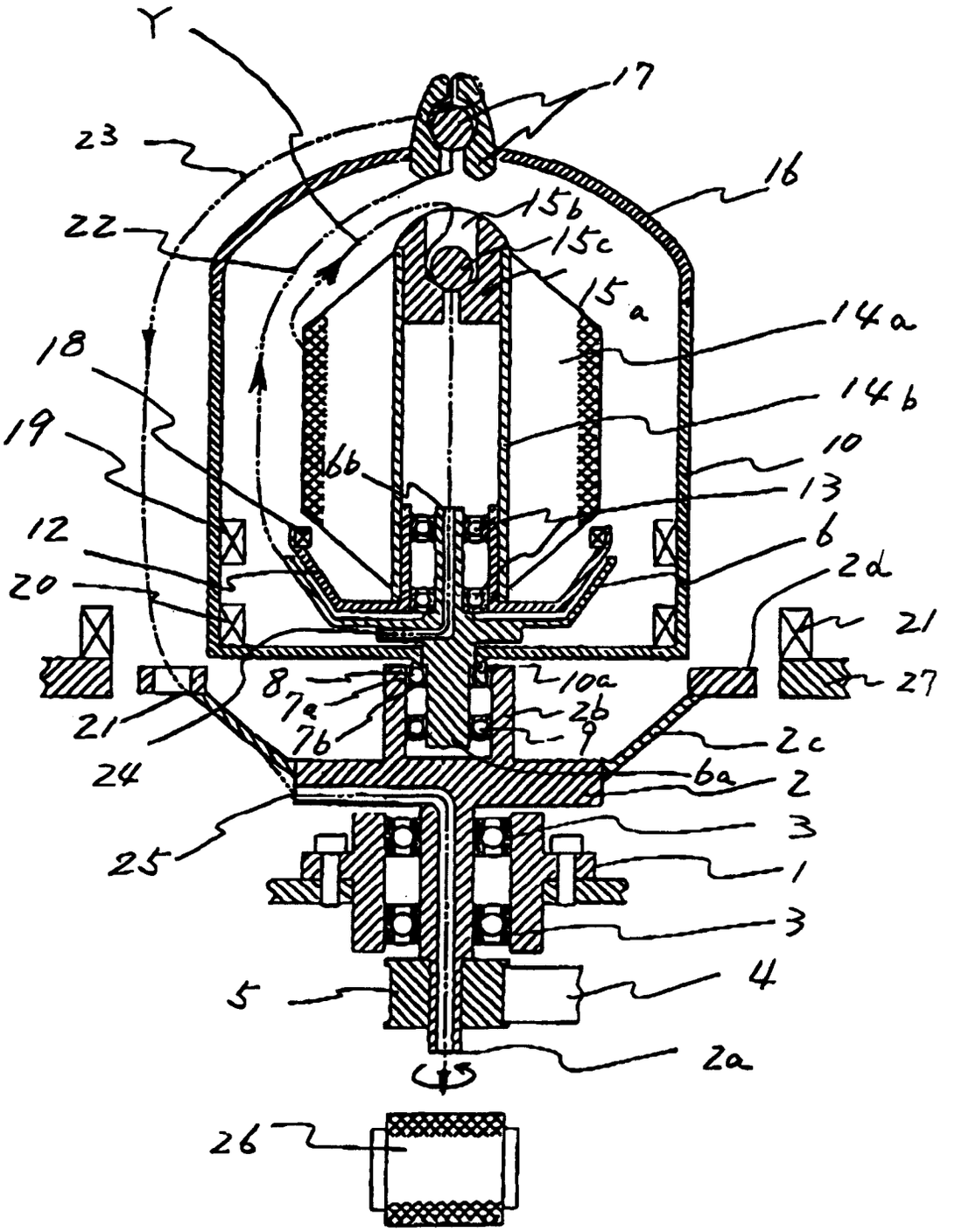


FIG. 7


Y
17
23
16
15b
22
15c
15a
14a
18
14b
19
10
13
6b
12
6
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20
21
27
8
10a
7a
2b
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7b
9
2c
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6a
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3
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2a
26

FIG. 9

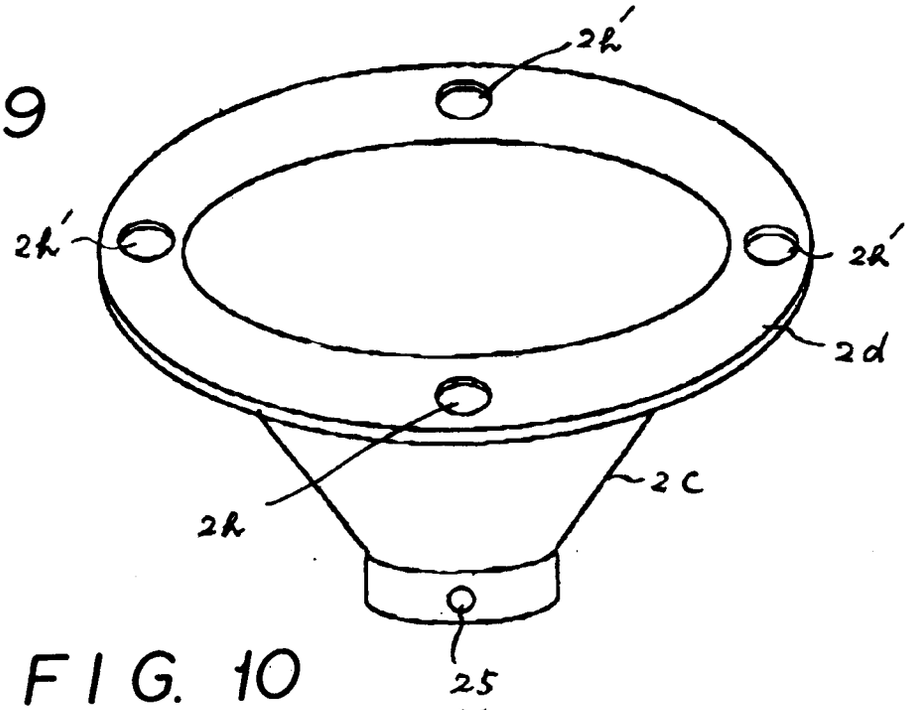


FIG. 10

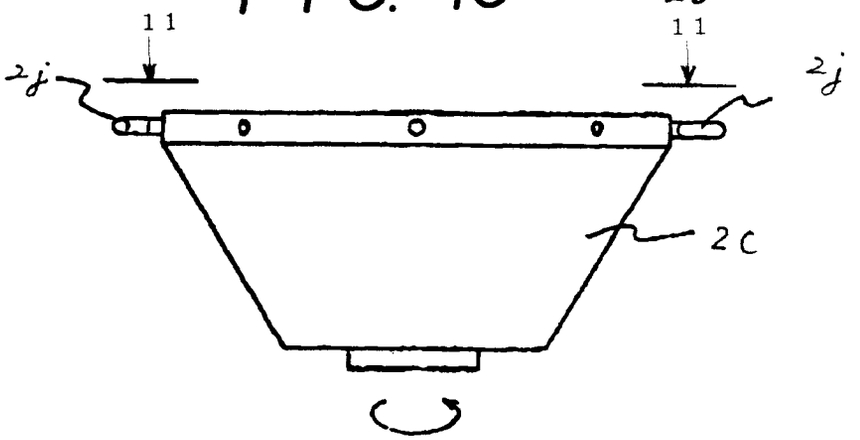
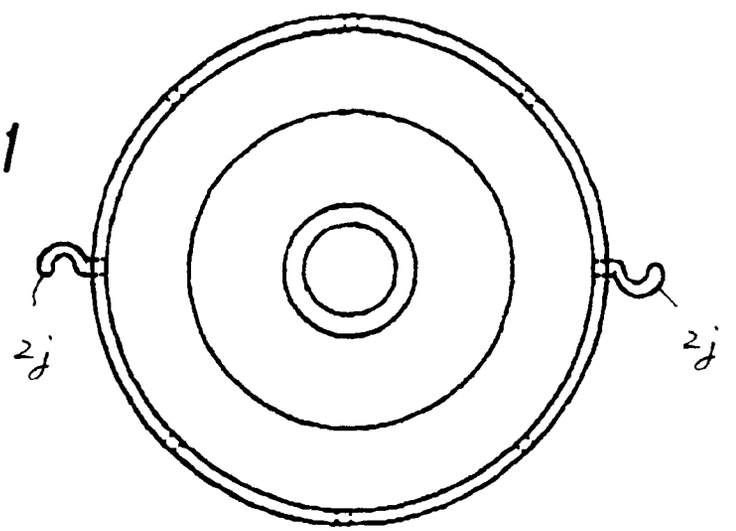


FIG. 11



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 10 2409

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X,D	DATABASE WPI Section Ch, Week 7241, Derwent Publications Ltd., London, GB; Class F01, AN 72-66337T & JP-B-47 040 100 (MURATA KIKAI CO LTD) * abstract *	1	D01H7/04 D01H7/88
A,D	JP-A-50 135 347 (UNKNOWN)		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

D01H
D07B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 June 1994	Tamme, H-M

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