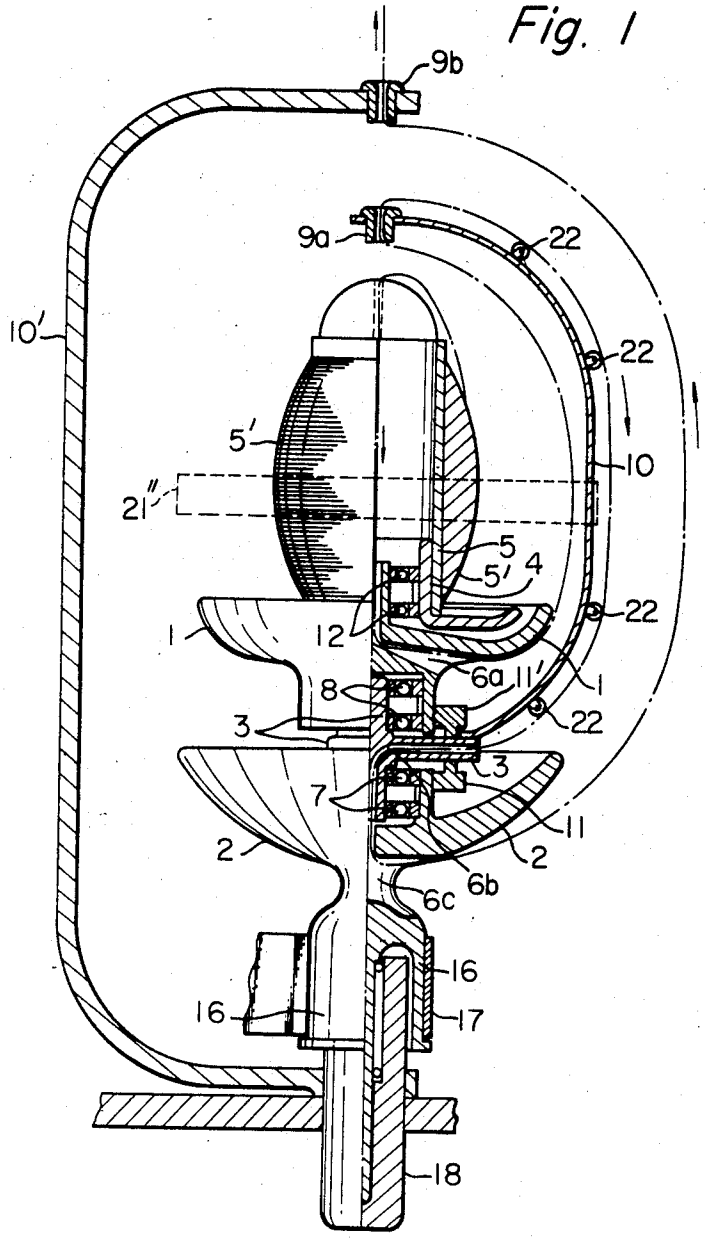
Nov. 4, 1969 KEON TAIRA ET AL 3,475,892

MULTIPLE-TWIST SPINDLE

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Fig. 1



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MULTIPLE-TWIST SPINDLE

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Fig. 2

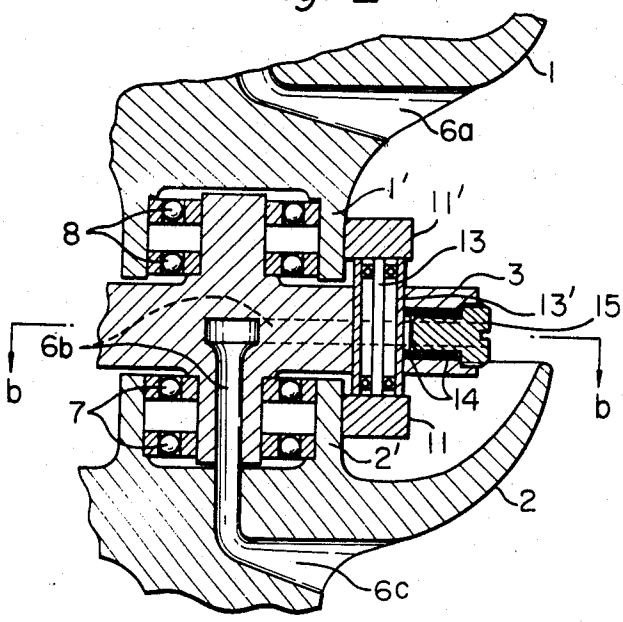
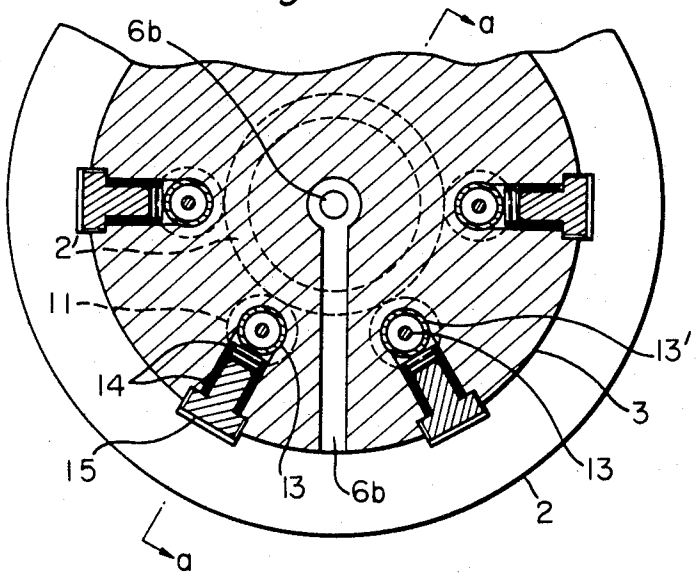


Fig. 3



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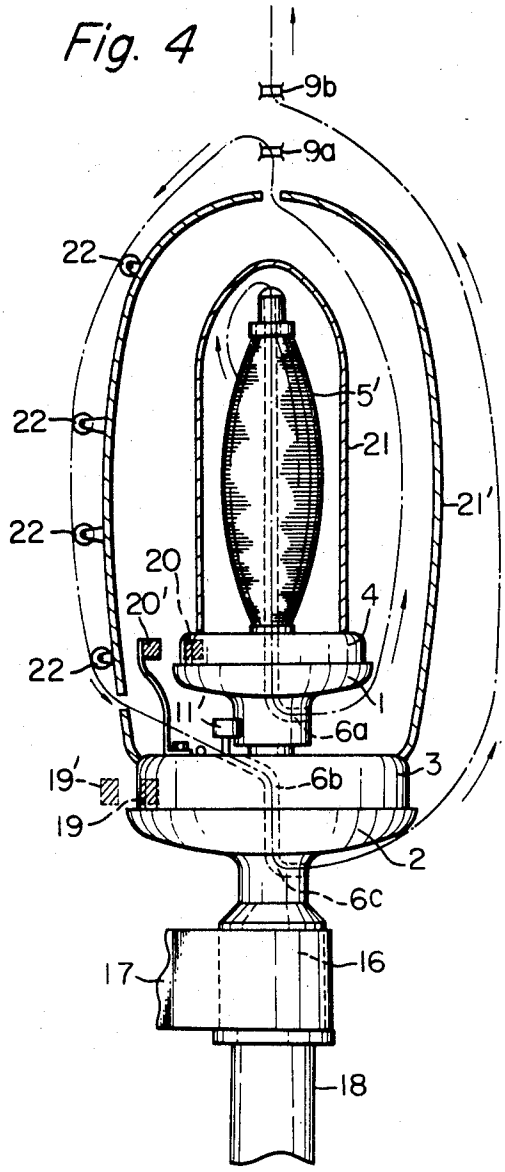
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MULTIPLE-TWIST SPINDLE

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Fig. 4



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MULTIPLE-TWIST SPINDLE

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Fig. 5

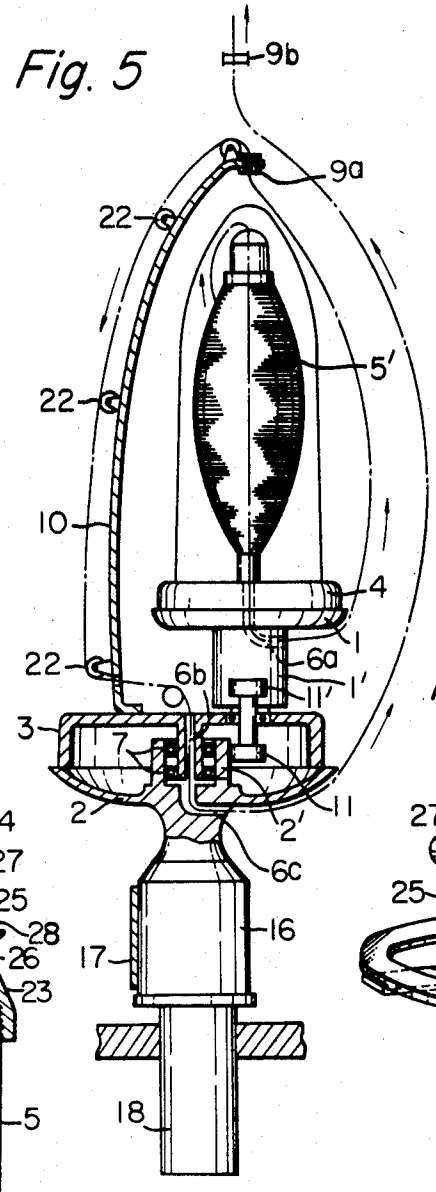


Fig. 6A

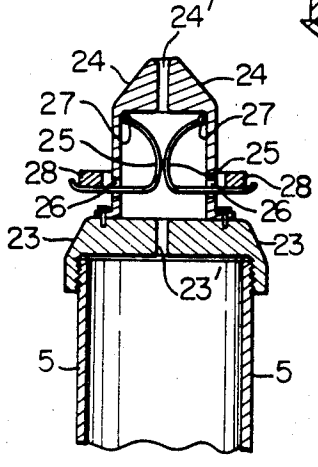
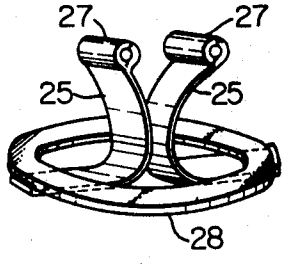


Fig. 6B



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3,475,892

MULTIPLE-TWIST SPINDLE

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Int. Cl. D01h 1/10, 7/86
U.S. Cl. 57—58.61 9 Claims

ABSTRACT OF THE DISCLOSURE

Multiple-twist spindle of a simple structure which can impart to an untwisted yarn a multiple twist of an arithmetical progression beginning with 4 and having a common difference of 2 such as fourth-twist, sixth-twist, eighth-twist . . . , per one rotation of the twist spindle shaft and which can make a high-speed twisting possible.

This invention relates to a multiple-twist spindle of a simple structure which can impart to an untwisted yarn a multiple twist of an arithmetical progression beginning with 4 and having a common difference of 2 such as fourth-twist, sixth-twist, eighth-twist . . . per one rotation of the twist spindle shaft and which can make a high-speed twisting possible.

More specifically, this invention relates to a multiple-twist spindle which comprises a plurality of rotary discs each having a yarn-passage for passing a yarn along the longitudinal axis of the disc and forwarding the yarn outwardly in the edge direction of the disc, a stationary member mounted between two adjacent discs and so adapted as to be stationary regardless of the rotation of said adjacent discs, said stationary member having a yarn passage for receiving the yarn drawn out of the disc mounted above said stationary member and passing through a yarn guide positioned above a yarn package on the bobbin, and forwarding the yarn to the disc positioned below said stationary member, a rotation-transferring device mounted on said stationary member to transfer the rotation movement of the rotating disc driven by drive means, a final yarn guide positioned above said yarn guide and adapted to pass the yarn drawn from the yarn passage of said lowest rotating disc, and a top-end stationary member stationarily mounted on the uppermost rotating disc and adapted to mount thereon a bobbin having a penetrating hollow along the axis of said top-end stationary member.

Conventionally, in the art of yarn-twisting there has been a problem of performing the twisting operation at high speed without giving any bad influence to qualities of twisted yarns, and many proposals have been made as solutions of said problems. Thus, double-twist spindles (two-for-one twisting spindles) have been developed to impart a double-twist to untwisted yarns per one rotation of the twist spindle shaft. But, there has not been developed any twist spindle which can give an untwisted yarn a multiple twist greater than the double twist.

With a view to providing a twist spindle which has a simple structure and hence can be constructed easily, and by which a twisting operation can be performed with ease and at a higher twisting speed, we have succeeded in developing a multiple-twist spindle such as fourth-twist spindle, sixth-twist spindle and eighth-twist spindle, which has never been proposed and whose possibility has never been suggested.

Accordingly, the primary object of this invention is to provide a multiple-twist spindle which can impart to untwisted yarns a multiple twist of at least a fourth-twist per one rotation of the twist spindle shaft and which has such advantages as follows; the structure thereof is very simple, it can be easily constructed, it can be smoothly operated, it can produce twisted yarns of high qualities and by employing the multiple-twist spindle of this invention it is possible to practice the twisting operation at a rate at least twice as high as in the conventional double-twist spindles.

Other objects and advantages of this invention will be illustrated hereinbelow.

In principle the conventional known double-twist spindle (two-for-one twisting spindles) commonly comprise a yarn package on a bobbin which is held fast in any suitable way on a hollow spindle shaft which is driven at high speed, the spindle shaft carrying disc. The yarn passes through the spindle shaft and outwardly at the edge of the disc and then through a thread guide lying on the axis of rotation of the spindle shaft. As the yarn is drawn from the bobbin into the shaft it forms a first balloon and is twisted within the shaft. The yarn between the disc and the thread guide forms a second balloon and is then again twisted. Several means have been proposed to hold the package fast against rotation—mechanical, electrical and electro-magnetic.

We have found that the above mentioned object can be attained by utilizing ingeniously the above principle and providing a stationary member between each two adjacent rotating discs of a plurality of rotating disc to receive a yarn drawn out of the disc mounted above said stationary member and passing through a yarn guide positioned above the yarn package on the bobbin said to introduce the yarn to the yarn passage of the disc mounted below the stationary member, and a rotation-transferring device mounted on said stationary member between discs to tranfer the rotation of the lowest rotating disc to upper rotating discs.

By referring to the appended drawings, the structure of the multiple-twist spindle of this invention and several embodiments thereof will be illustrated hereinbelow.

FIGURE 1 is a partially cut-out side view illustrating one embodiment of a fourth-twist spindle as the typical instance of this invention.

FIGURE 2 is a partially enlarged view illustrating an arrangement of a first rotating disc, a second rotating disc and a stationary member disposed between both discs,

FIGURE 2 is a partially enlarged view illustrating an line *a*—*a* of FIGURE 3.

FIGURE 3 shows a section taken along the line *b*—*b* of FIGURE 2.

FIGURE 4 is a side view illustrating another embodiment where magnetic means are utilized for holding fast the stationary arrangement of a stationary member between the discs, and a top-end stationary member.

FIGURE 5 shows a section of still another embodiment where rotating discs are not positioned on the same axis.

FIGURE 6–A shows a lateral section of a tensioner (tensioning device) mounted on a bobbin, a lower part of which is cut out.

FIGURE 6–B is a perspective view, partially seen through, of the tensioner.

In FIGURE 1, when a wharve **16** rotatably mounted on an insert **18** is allowed to rotate by a suitable means such as a belt **17**, the lowest rotating disc (a second rotating disc **2** in this embodiment) is likewise allowed to rotate. A yarn passage **6***c* is provided piercing through said rotating disc **2** to pass the yarn along the longitudinal axis of the disc and to forward outwardly the yarn in the direction of the edge of said disc. A stationary member **3** is mounted via a bearing **7** above said disc **2**.

The provision of said stationary member **3** between rotating discs is one of the prominent features of the multiple-twist spindle of this invention. A yarn passage

6*b* is provided piercing through said stationary member 3 to receive the yarn drawn out of a first rotating disc 1 (an uppermost rotating disc in this embodiment) mounted via a bearing 8 above said stationary member 3 and to forward the yarn to said yarn passage 6*c* of said second rotating disc 2 positioned below said stationary member. The yarn coming out of the first rotating disc 1 passes through a yarn guide 9*a* disposed above the yarn package on the bobbin and is then introduced to the passage 6*b* of said stationary member.

Said yarn guide 9*a* is secured to said stationary member 3 by a suitable means, for instance, an arm 10 such as shown in the drawings. Guide rollers 22 are rotatably fitted on said arm 10. There is further provided a yarn guide 9*b* (a final yarn guide in this embodiment) above said yarn guide 9*a* to introduce the yarn drawn from the lowest rotating disc, and said guide 9*b* is supported by a suitable means. For instance, as is shown in the drawings, the yarn guide 9*b* may be supported on a support of the insert 18 by means of an arm 10'.

Further, a top-end stationary member 4 is stationarily mounted via a bearing 12 on said rotating disc 1 coaxially with said disc. A yarn package 5' on a bobbin 5 may be mounted on the upper portion of said top-end stationary member.

Although in the above described embodiment shown there are provided only two rotating discs, it would be apparent that third, fourth and more rotating discs may be provided together with posing stationary members interposing between each two adjacent discs. Thus, a fourth-twist spindle may be provided by a combination of two rotating discs, one stationary member between discs, and two yarn guides. Likewise, a sixth-twist spindle may be provided by a combination of three rotating discs, two stationary members between discs, and three yarn guides, and an eighth-twist spindle by a combination of fourth rotating discs, three stationary members betwen discs, and four yarn guides.

The rotating discs which are rotatably mounted and each two adjacent discs of which are interposed with a stationary member 3, are so arranged that the rotating movement of the lowest rotating disc driven by a drive means is gradually transferred to rotating discs at the upper positions by means of a rotation-transferring device. This mechanism is clearly illustrated in FIGURES 2 and 3.

In FIGURES 2 and 3 the rotation movement of the second rotating disc 2 is transferred to the first rotating disc 1 by means of a rotation-transferring device which comprises a transfer roll 11 pressingly contacting the outer side surface of a circular sleeve 2' provided on the upper surface of said disc 2 and a pressing transfer roll 11' to transfer the rotation of said roll 11 via a shaft 13 to a circular sleeve 1' provided on the bottom surface of the first rotating disc 1. In this embodiment, in order to ensure the rotation of either the roll 11 or 11', a bearing 13' piercing through the stationary member between discs is pressed by a nut 15 via a spring 14. It is preferred to provide a plurality of such rotation-transferring devices. It may be possible to use gear rolls instead of pressing transfer rolls 11, 11' while providing engaging zones on the confronting peripheries of the sleeves 2', 1'.

If desired, it may be also possible to vary the rotation ratio of the rolls 11, 11' by changing the diameters thereof. For instance, in the case the rolls 11, 11' are so arranged that the first rotating disc 1 may be allowed to rotate more than once per one rotation of the second rotating member 2 by making the diameter of the roll 11' larger than the diameter of the roll 11, it is possible to impart a multiple-twist more than the fourth twist to untwisted yarns per one rotation of the spindle. Of course, it is usual to arrange the rolls 11, 11' so that the rotation ratio thereof is 1. In this case, the fourth-twist is imparted to untwisted yarn per one rotation of the first spindle shaft. However, it should be understood that this

invention includes an embodiment where a multiple-twist more than the fourth-twist can be imparted to untwisted yarns by modifying the transfer rolls 11, 11' as described above, even with the use of two rotating discs, besides an embodiment of using more than two rotating discs and imparting a multiple-twist more than the fourth twist to untwisting yarns, the principle of which has been described hereinabove.

Further, in the multiple-twist spindle of this invention, in order to ensure the stationary mounting of the top-end stationary member 4 and/or the stationary member 3 between discs by bearings, it is possible to adopt in combination conventional known means such as means using magnets or weights.

An instance of such modification is illustrated in FIGURE 4, where like in FIGURE 1 there is shown a fourth-twist spindle comprising two rotating discs 1, 2, a top-end stationary member 4 and a stationary member 3 mounted between the discs 1 and 2. Permanent magnets 19, 20 are provided on the periphery portions of the stationary members 3, 4. In FIGURE 4 one magnet is buried in each of stationary at one end of the periphery portion thereof. However, they may be provided on the surfaces of the stationary members. Generally, it is preferred to provided a plurality of magnets along the periphery of each stationary member at suitable intervals. Magnets 19', 20' are provided at the adjacent positions confronting to the magnets 19, 20, respectively. The magnet 20' is supported by an arm disposed at a suitable portion of the stationary member 3, and the magnet 19' may be secured to a suitable stationary member, for instance the arm 10' shown in FIGURE 1.

In FIGURE 4, a cover 21 surrounding a yarn package on the bobbin is provided on the stationary member 4 and a cover 21' surrounding said cover 21 with a balloon-forming space interposing therebetween is provided on the stationary member 3. These covers exhibit an action of preventing occurrence of yarn breakage or yarn napping due to the contact or entanglement of yarn. Particularly, these covers are useful for preventing such contact or entanglement of balloons which is apt to occur at the initial stage of the operation. For this purpose it is also possible to use a ring 21'' surrounding the yarn package on the bobbin and secured to the arm 10 (as is shown by the dotted line in FIGURE 1).

It is preferred to provide, as shown in FIGURES 1 and 4, a suitable number of guide rollers on the arm 10 and the cover 21' as auxiliary means for passing the yarn stably.

In FIGURES 1 and 4, the yarn drawn from the yarn package 5' on the bobbin 5 mounted on the top-end stationary member 4 passes through a hollow passage in the bobbin and then through the yarn passage 6*a* in the first rotating disc and is forwarded outwardly in the edge direction of said disc. Thus, the yarn is subjected to a first twisting action. Next, the yarn forms a balloon, passes through the first yarn guide 9*a* and is subjected to a second twisting action during its travel from said disc 1 to said guide 9*a*. In the embodiment of FIGURE 4 it is a matter of course that an opening for passing the yarn is provided on the top of the cover 21'. Instead of providing separately the yarn guide 9*a* above said opening, it is possible to make said opening integrated with said yarn guide 9*a*.

Thereafter, the yarn is introduced, while contacting guide rollers 22, into the yarn passage 6*b* provided in the stationary member 3 between discs. Thus, the yarn is subjected to a third twisting action during its travel from said guide 9*a* to the stationary member 6*c*. In the embodiment shown in FIGURE 4 an opening is naturally provided at a suitable position of the lower portion of the cover 21 to introduce the yarn into the yarn passage 6*b* in the stationary member 3. Then, the yarn passes through the yarn passage 6*b*, and is introduced to the yarn passage 6*c* in the second rotating disc 2, after which it passes through said passage 6*c* and is outwardly for-

warded in the edge direction of said disc **2**. Then, forming a fourth balloon, the yarn reaches the final yarn guide **9***b*. The yarn is thus subjected to a fourth twisting action during its travel from the disc **2** to the guide **9***b*.

Thus, in an extremely compactly designed zone the yarn is subjected to four twisting actions while passing through the passages provided in stationary members and rotating discs, and balloon-forming spaces successively via guides **9***a* and **9***b*. As described hereinabove, a multiple-twisting such as sixth-twisting and eighth-twisting can be performed by increasing the number of travel units.

As is shown in FIGURES 1 and 4, in order to prevent the contact among a plurality of balloons formed during the operation, it is possible, as described above, to use the ring **21''** or covers **21, 21'** in a suitable combination. Further, as is apparent from these figures, it is also possible to design the rotating discs such that the diameter of the disc at the upper position is smaller than that of the disc at the lower position, whereby the contact among the balloons can be also prevented.

In case covers **21, 21'** are used, it is preferred to make these covers of a tranparent synthetic resin in order that the state of the balloon formation may be observed from the outside. It is a matter of course that these auxiliary means are optionally selected and used in a suitable combination.

In the above mentioned embodiments plurality of the rotating discs are provided coaxially with one another. But, it is not essential that these rotating discs should be coaxial with one another. In the embodiment of FIGURE 5, the stationary member **3** is mounted above the second rotating disc **2** via a bearing **7** and the first rotating disc **1** is mounted above said stationary member **3** with the axis deviated from the axis of said rotating disc **2**. On said disc **2** there is provided an arm **10** in the position relative to stationary member **3**. Further, on the stationary member **3** there is provided the rotation-transferring device whose rolls **11** and **11'** pressingly contact the circular sleeves **2'** and **1'** of each rotating disc, whereby the rotation of the rotating disc **2** is transferred to the first rotating disc **1**. By providing the rotating discs in such non-coaxial state, it is made possible to reduce the bulk of the balloons, and hence the increase in either tension of yarn or power for driving the spindle can be avoided, thus resulting in the reduction of the space between each two spindles. There are advantages of the embodiment where the rotating discs are provided in the non-coaxial state.

Usually, the yarn drawn from the yarn package **5'** is allowed to pass through a tensioner (tensioning device) before it is introduced in a hollow passage of the bobbin. Though various conventional tensioners may be applied to this invention, it is recommendable to use an improved tensioner newly developed by us.

In the conventional tensioners, a tension plate is so arranged that it may be pushed by a spring which is tightened by means of a nut, etc. Thus, the releasing tension of the yarn drawn from the yarn package is adjusted by adjusting the tightening degree of the nut. Accordingly, in case the nut loosens, the tension on the yarn is naturally varied, and hence it becomes impossible to impart a constant tension to the yarn. The improved tensioner developed by us is to overcome the above mentioned shortcomings of the conventional tensioners, and is practically advantageously applied to the multiple-twist spindle of this invention.

As is shown in FIGURES 6–A and 6–B, the improved tensioner is provided dismountably on the upper end of the bobbin **5**. In the drawings, the tensioner is secured to the bobbin by means of screws. However, any change of design may be applied to the securing of the tensioner. For instance, it may be merely forced into the bobbin or inserted into grooves provided in the bobbin. In the drawings, a casing of the tensioner is composed of two members of a cap **23** and a cap **24** secured to the cap **23** by means of screws. But the casing may be integrally composed. Further, the legs of the cap **24** may be dismountably secured into the grooves provided on the cap **23** by an optional procedure such as screwing, insertion and forcible fitting. Along the axial direction there are perforated a yarn-introducing opening **24'** through the cap **24** and a yarn-passing opening **23'** through the cap **23**. In the space inside the cap **24** there are provided a pair of tension plates **25, 25**, whose crooked portions contact each other and whose extending portions project to the outside respectively through slit-like openings **26, 26** sectionally symmetrically provided on both side walls of the cap **24**. The other ends **27, 27** of each tension plate are fastened with pins at the upper portions of said space inside the cap **24**. The extending portions of said tension plates **25, 25** projecting to the outside through slit-like openings **26, 26** are so arranged that washer-type weights may be placed on said projecting portions from above the cap **24**.

The yarn passes through the opening **24'** and then runs through between the contacting crooked portions of each tension plate where a constant stress is maintained. Then, the yarn is introduced into a hollow passage of the bobbin. Depending on the kind of the yarn to be twisted, it is possible to vary washer-type weights **28** and select ones of a suitable load. Accordingly, it is possible to draw continuously the yarn from the yarn package on the bobbin at a constant and suitable releasing tension.

Twisted yarns of a twist number of 300 T/M

(T=twist; M=meter)

were prepared at a spindle rotation rate of 10,000 r.p.m. from untwisted nylon yarns of 70 deniers and 24 filaments by employing the fourth-twist spindle of this invention shown in FIGURE 1 and a double-twist spindle which is similar to the above fourth-twist spindle of this invention except that it has not any stationary member between discs nor any rotation-transferring device but only one rotating disc. The twisted yarn prepared by employing the fourth-twist spindle of this invention was not so different in respect of the qualities from the yarn prepared by the above mentioned double-twist spindle. But, in the case of the fourth-twist spindle of this invention the twisting can be performed at such a high yarn speed at 133.3 m./min. while the yarn speed is only 66.6 m./min. in the case of the double-twist spindle.

What we claim is:

1. A multiple-twist spindle which comprises a plurality of rotating discs each having a yarn passage for passing a yarn along the longitudinal axis of the disc and forwarding the yarn outwardly in the edge direction of the disc, a stationary member mounted between two adjacent discs and so adapted as to be stationary regardless of the rotation of said two adjacent discs, said stationary member having a yarn passage for receiving the yarn drawn from the disc mounted above said stationary member and passing through a yarn guide positioned above a yarn package on the bobbin, and forwarding the yarn to the disc positioned below said stationary member, a rotation-transferring device mounted on said stationary member to transfer the rotation movement of the lowest rotating disc driven by drive means, a final yarn guide positioned above said yarn guide and adapted to pass the yarn drawn from the yarn passage of said lowest rotating disc, and a top-end stationary member stationary mounted on the uppermost rotating disc and adapted to mount thereon a bobbin having a penetrating hollow along the axis of said top-end staionary member.

2. The multiple-twist spindle described in claim **1**, wherein the stationary member is provided between two adjacent rotating discs via bearings, and the top end stationary member is stationary mounted on the uppermost rotating disc via a bearing and adapted to mount there-

on a bobbin having a penetrating hollow along the axis of said top-end stationary member.

3. The multiple-twist spindle described in claim 1, wherein the yarn guide is supported on a support secured to the stationary member mounted between the discs.

4. The multiple-twist spindle described in claim 3, wherein guide rollers are provided on the arm or cover supported by the stationary member between discs.

5. The multiple-twist spindle described in claim 1, wherein the stationary member between discs comprises at least one rotation-transferring device.

6. The multiple-twist spindle described in claim 1, wherein magnets are provided on the periphery portions of the stationary members at suitable intervals and other magnets are provided at the positions confronting and adjacent to each of said magnets provided on the stationary members.

7. The multiple-twist spindle described in claim 1,

wherein covers are fitted on the stationary members to prevent the contact of balloons with one another.

8. The multiple-twist spindle described in claim 7, wherein the covers fitted on the stationary members are transparent.

9. The multiple-twist spindle described in claim 1, wherein the stationary member between discs is so mounted between two adjacent rotating discs that said two discs are not coaxial with each other.

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