Feb. 6, 1968 M. H. COMER ETAL 3,367,096

APPARATUS FOR FALSE-TWISTING AND PLYING YARNS

Filed June 7, 1965 2 Sheets-Sheet 1

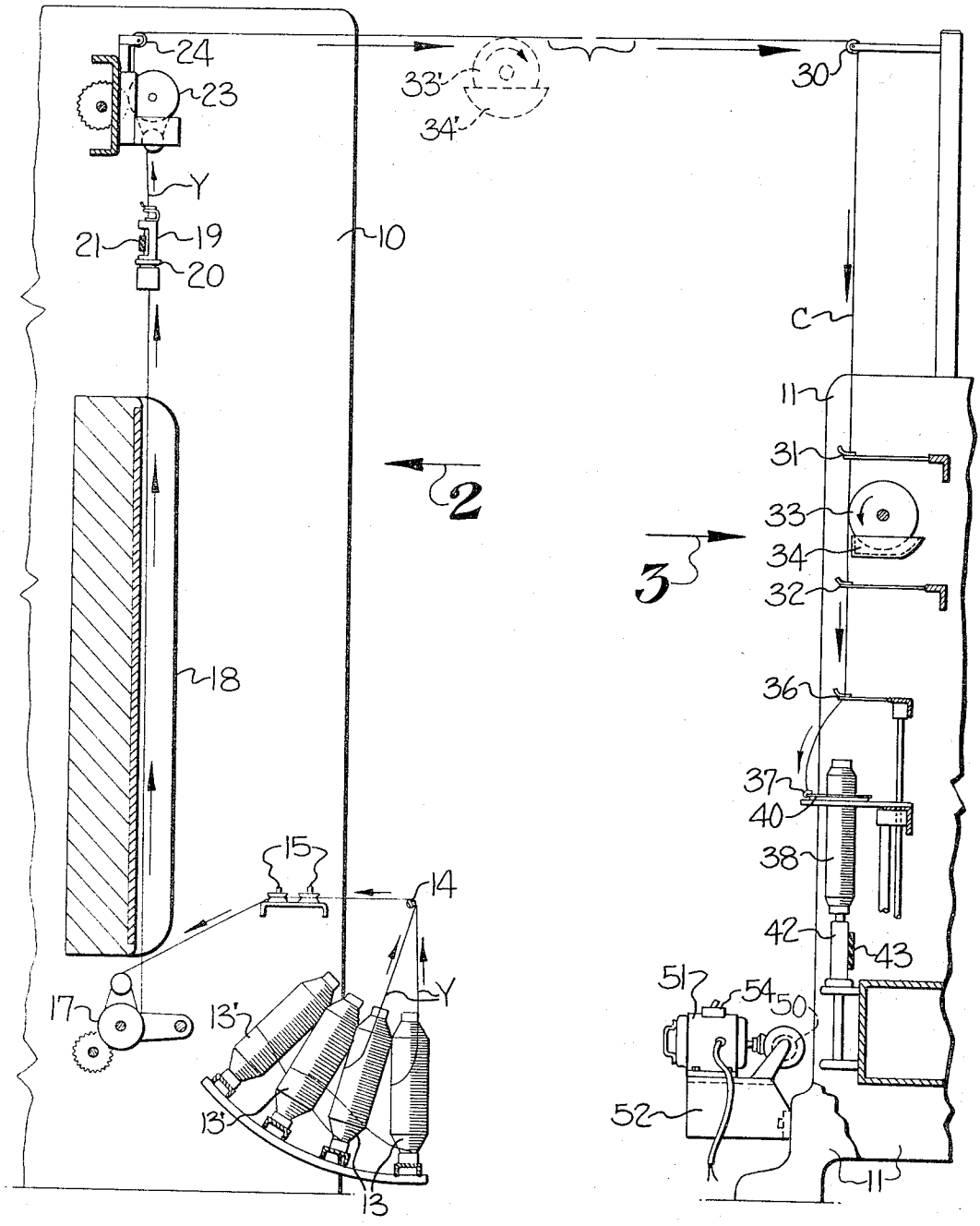


Fig-1

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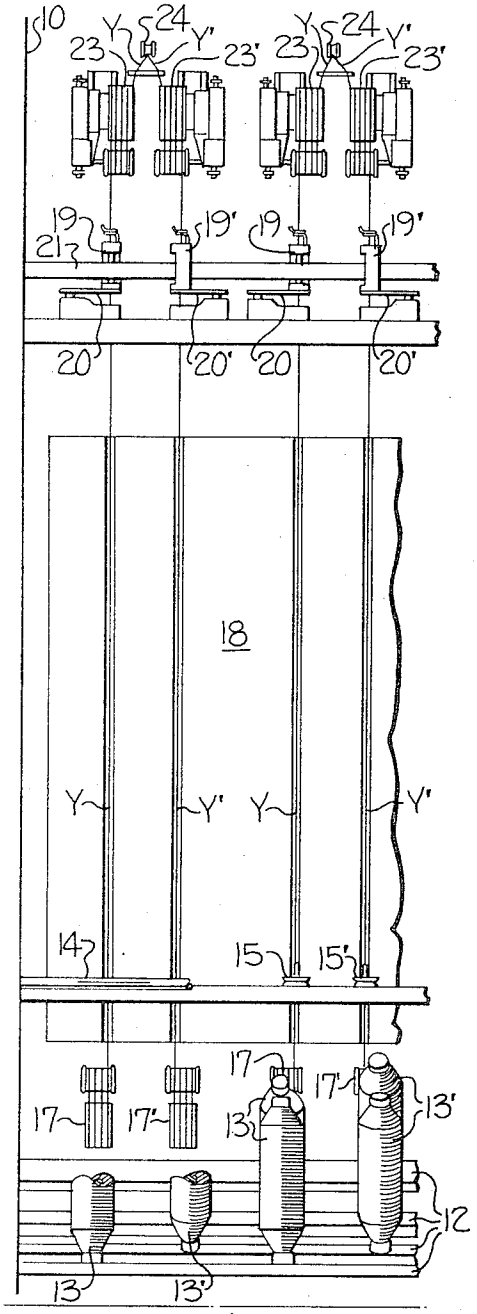


Fig-2

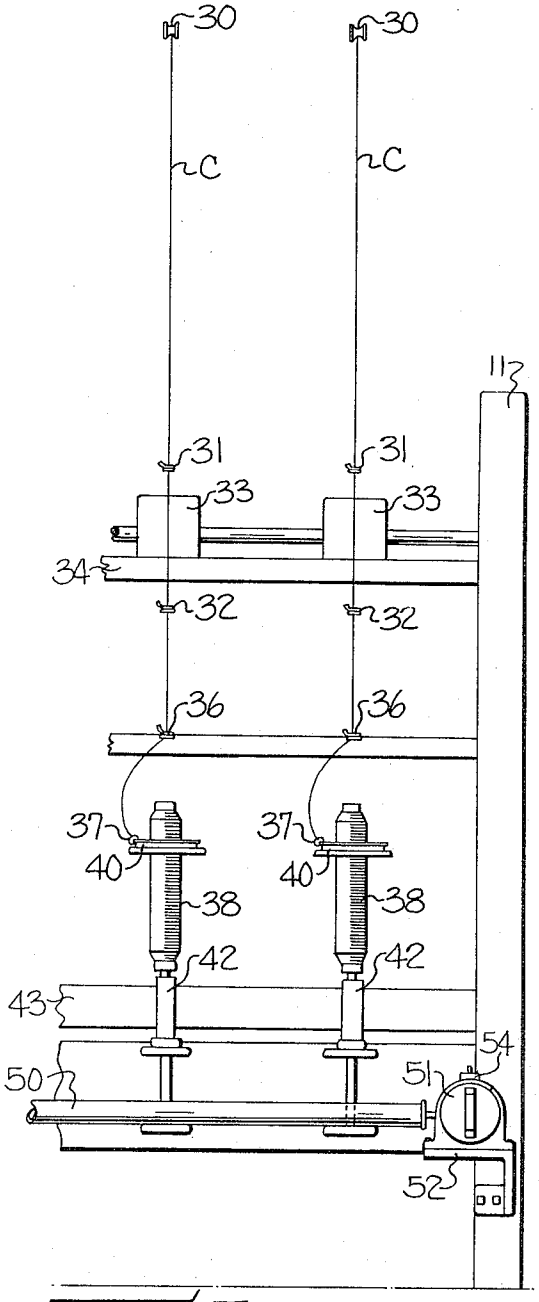


Fig-3

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APPARATUS FOR FALSE-TWISTING AND PLYING YARNS

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ABSTRACT OF THE DISCLOSURE

A false-twisting frame is spaced from a yarn plying frame to provide an access aisle therebetween so that a false-twisted torque-free yarn is produced in a single continuous operation. The yarn supply packages are positioned on the false-twisting frame and in a convenient location along one side of the access aisle while the yarn take-up packages are positioned on the plying frame and in a convenient location along the opposite side of the access aisle. This arrangement provides ready accessibility to the complete path of travel of the yarn during both the false-twisting and plying operations.

This invention relates to an improved apparatus for false-twisting a plurality of separate ends of continuous filament thermoplastic yarn and then plying the separately false-twisted ends together in a continuous operation.

As is well known, a false-twisted thermoplastic yarn is heat-set while it is twisted in one direction and it is then untwisted. This false-twist process forms crimps or curls in the yarn and also imparts torque to the yarn so that it has a tendency to twist in one direction, depending upon the direction in which the false-twist spindle is rotated. It is the normal practice to ply together two ends of false-twisted yarns which have torque in opposite directions to provide a yarn in which the overall torque is balanced and to thereby provide a "torque-free" yarn which may be knitted or woven into a fabric. Heretofore, the formation of this type of false-twisted torque-free yarn has required at least three separate operations, as for example, separately false-twisting two single yarn ends in opposite directions, plying the two ends together, and then coning the plied yarn while applying a suitable lubricating oil so that the yarn may be properly fed to the knitting machine or loom.

With the foregoing in mind, it is a main object of the present invention to provide an apparatus for economically producing a false-twisted single end or plied yarn that has balanced torque in a single continuous operation and wherein the yarn is withdrawn directly from the producer's supply package and then wound to form a delivery package that may be used directly in a knitting or weaving operation.

The main object of this invention is accomplished by providing a single machine that is adapted to produce a false-twisted and plied yarn having balanced torque in a single continuous operation. This machine includes a plurality of side-by-side false-twisting stations with means for rotating adjacent pairs of false-twist devices in opposite directions whereby adjacent yarns have torque in opposite directions, means for guiding adjacent pairs of oppositely false-twisted yarns together, means for applying a suitable lubricant to the joined together yarns, and means for plying the oppositely false-twisted yarns together with a predetermined number of turns per inch while winding the plied together yarns to form a delivery package that may be used directly in a weaving or knitting operation.

It is another object of the present invention to provide a single machine of the type described which includes an elongate false-twisting frame and an elongate plying or winding frame that is spaced from the false-twisting frame to provide an access aisle therebetween. Thus, the false-twisting, plying and coning operations can be carried out in one continuous operation and the operator can reach the parts of the machine as he walks along the access aisle.

It is a further object of the present invention to provide means for continuous operation of the false-twist spindles while doffing a filled delivery package of the plied yarn. To this end, a yarn take-up machanism is provided adjacent the twisting and plying positions. The take-up mechanism includes a rotatable shaft or drum on which the yarn is adapted to be taken up while the delivery package is doffed to permit continuous operation of the corresponding false-twist spindles during the doffing operation so that the machine may be continuously operated.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds, when taken in connection with the accompanying drawings, in which:

FIGURE 1 is a somewhat schematic vertical sectional view through one side of the present false-twisting and plying machine and illustrating the manner in which the yarn is continuously removed from the supply bobbins, false-twisted, plied, lubricated and then wound onto a package suitable for knitting;

FIGURE 2 is a fragmentary front elevation of the false-twisting portion of the machine, looking in the direction of the arrow **2** in FIGURE 1; and

FIGURE 3 is a fragmentary front elevation of the corresponding oiling and plying portion of the machine, looking inwardly in the direction of the arrow **3** in FIGURE 1.

The present textile machine includes false-twisting means in the form of an elongate false-twisting frame **10**, only one-half of which is shown in the vertical sectional view of FIGURE 1, and yarn plying means in the form of a pair of elongate twisting or yarn plying frames **11**, only one of which is shown in FIGURE 1. The yarn plying frames **11** are spaced from opposite sides of the false-twisting frame **10** to provide an access aisle along which the operator may walk on each side of the false-twisting frame **10**. In the continuous production of a balanced torque plied yarn in accordance with the preferred form of the present invention, adjacent pairs of yarns are false-twisted in opposite directions on the frame **10**, then guided across and above the access aisle to the plying frame **11** where they are ply-twisted together and wound onto a take-up tube to form a package that is suitable for directly knitting therefrom.

The false-twisting frame **10** includes a plurality of closely spaced false-twisting stations along opposite sides, only one side of which is shown in FIGURE 2. Each of the false-twisting stations includes means for separately false-twisting a pair of continuous filament thermoplastic yarns in closely spaced, side-by-side relationship (FIGURE 2). Yarn feed means is provided for passing the pair of yarns through corresponding heated zones and false-twist spindles at predetermined speeds.

A yarn support rack or creel **12** supports at least a pair of yarn supply packages **13** at each false-twisting station with the trailing end of the yarn from one package being connected to the leading end of the yarn from an adjacent package so that a continuous supply of yarn Y may be withdrawn from the yarn supply packages **13**. As one supply package is exhausted, it is replaced by another supply package and the leading end is tied to the trailing end of a remaining supply package so that when the yarn is exhausted from one supply package, it will be continuously withdrawn from the next succeeding supply package. The supply packages are preferably pirns on which the yarn is wound by the yarn manufacturer.

As shown in FIGURE 1, the yarn Y is withdrawn from the yarn supply package **13** and passes over a guide rod **14** in its path of travel to a yarn tension device **15**, in the form of tension disks. The yarn Y is then wound around a lower feed roll mechanism **17** that is suitably driven at the desired speed. The yarn then passes upwardly through a suitable groove in the face of an elongated heater plate **18**.

The yarn then passes through a hollow false-twist spindle **19** that is supported on a swing bracket **20** for movement into and out of driving engagement with a drive belt **21**. The hollow false-twist spindle **19** may be of any conventional type that is adapted to operate at high speeds, such as the type disclosed in the Dudzik et al. U.S. Patent No. 3,152,436.

After the yarn Y leaves the false-twist spindle **19**, it is wound about an upper feed roll mechanism **23** which is driven at selected speed that is coordinated with the speed of the lower feed roll mechanism **17** to provide a preselected degree of tension in the yarn as it passes over the heater plate **18** and through the false-twist spindle **19**. From the upper feed roll mechanism **23**, the yarn is passed over a guide roller **24** that is suitably supported above the upper feed roll mechanism **23**.

At the guide roller **24** the false-twisted yarn Y is joined with another false-twisted yarn, indicated at Y′ in FIGURE 2, which has been false-twisted through a false-twist spindle **19′** that is positioned adjacent the first false-twist spindle **19**. The parts associated with the false-twist spindle **19′** are identical to the parts described in connection with the false-twist spindle **19** and corresponding parts bear like reference characters, with the prime notation added.

The false-twist spindles **19**, **19′** are preferably positioned for movement into and out of engagement with opposite sides of the drive belt **21** so as to provide rotation thereto in opposite directions. Thus, the adjacent false-twist spindles **19**, **19′** apply opposite directions of false-twist and torque to the corresponding side-by-side yarns Y and Y′. The oppositely false-twisted yarns Y and Y′ are joined together in side-by-side relationship as they pass over the guide roller **24** to form a composite yarn, incidated at C (FIGURE 1). The composite yarn C thus includes a false-twisted yarn end having torque in one direction and another similarly false-twisted yarn having torque in the opposite direction.

The composite yarn C is then guided across and above the access aisle between the false-twist frame **10** and the plying frame **11** and passes over a guide pulley **30** that is suitably supported on the upper portion of the twisting and plying frame **11** (FIGURES 1 and 3). The yarn C then passes downwardly and through pigtail yarn guides **31**, **32** that maintain it in engagement with a rotating lubricant applying roller **33**. The roller **33** is preferably rotated in a suitable lubricant supply trough **34**. The yarn C then passes through a yarn pigtail guide **36**, a ring traveler **37** and is wound onto the take-up package **38**.

The ring traveler **37** is supported in the usual manner on a ring that is supported on a vertically movable ring support rail **40**. The take-up package **38** is preferably formed on a pirn and is wound thereon in a suitable manner for forming a delivery package from which the yarn may be directly fed on a knitting machine. The package **38** is supported on a rotating spindle **42** which is preferably driven by engagement with a drive belt **43**. The speed of the drive belt **43** is correlated with the speed of the upper feed roll **23** of the false-twist frame **10** to impart the desired number of turns of ply twist per inch to the composite yarn C as it is wound onto the take-up package **38**.

It is preferred that the composite yarn C be formed of a pair of oppositely false-twisted yarn ends. However, it is to be understood that the composite yarn C could be formed of more than two ends of the false-twisted yarn, if desired. Also, a single yarn can be false-twisted and wound onto the take-up package **38**.

As has been explained heretofore, the trailing and leading ends of successive supply packages **13**, **13′** are connected so that the yarns Y, Y′ are continuously fed through the corresponding false-twisting spindles **19**, **19′**. In order that the twisting and playing frame **11** may also be continuously operated, means is provided for temporarily taking up the composite yarn C while a filled take-up package **38** is being doffed. This temporary take-up means includes a rotatable yarn take-up shaft or drum **50** (FIGURE 3) which is suitably connected to and rotated by an electric motor **51**. The electric motor **51** is suitably supported on a bracket **52**, at one end of the plying frame **11**. The take-up drum **50** extends adjacent each of the plying spindles **42** and is suitably supported at spaced points therealong. A switch **54** is provided to start and stop the motor **51** and the take-up drum **50**.

As the take-up packages **38** reach the desired size, the operator may start at one end of the twisting and plying frame **11** and successively doff the filled take-up packages **38** and replace them with empty pirns. In the doffing operation, the composite yarn C is led down to and wrapped around the take-up drum or roll **50**, which is rotated at the required speed to take up the yarn C at the same rate that it is being produced by the false-twisting frame **10**. The filled take-up package **38** is removed from the spindle **42** and an empty pirn replaced thereon while the yarn is being taken up on the roll **50**. The yarn C is then guided through the traveler **37** and started on the empty pirn to begin the formation of another take-up package. It is preferred that a transfer tail be formed as the package begins its wind so that during the knitting operation, the yarn may be continuously fed from one delivery package to the next.

In recent years the speed of operation of false-twisting machines has steadily increased in an attempt to more economically process false-twisted, crimped or curled type "torque stretch" yarns and the false-twist spindles have been improved to the point that they are capable of operating at speeds in excess of 350,000 revolutions per minute. However, in the conventional false-twisting machine there are several factors that limit the maximum operational speed of the machine. One of the mimiting factors has been the length of the yarn heater plate **18**. This plate has remained relatively short, on the order of about 27 inches, and if the yarn speed is substantially increased, it passes over the heater at such a fast rate that it is not heated sufficiently to set the false-twist in the thermoplastic yarn. Also, the false-twisted yarn is wound onto take-up bobbins that are usually supported in upper and lower decks on the machine. A traverse mechanism is provided for each deck to properly wind the yarns onto the take-up bobbins, which are usually rotated by means of surface contact with a cork roll. Even though the false-twist spindles of conventional machines are capable of increased speeds, the speed of operation of the machine is otherwise limited by the speed at which the traverse mechanism and the take-up bobbins can be operated.

By eliminating the need for a traverse mechanism and the driven take-up bobbins the production speed can be greatly increased. Also, since the false-twisted yarn is guided directly to a ply twisting frame and continuously formed into a package that is suitable for direct knitting therefrom, the conventional rewinding, plying and coning steps are eliminated to further reduce the cost of production of a balanced torque yarn.

The elimination of the traverse mechanism and the upper and lower decks of take-up bobbins provides sufficient room on the present machine to increase the length of the heater plate **18** to about four feet. Thus, the yarn is in contact with the heater plate **18** over a length about twice the length of contact in the conventional machine so that the yarn can be run much faster on the present machine and still be heated to a sufficient degree to set the false-twist therein. While the length of the heater plate could be increased in the conventional false-twist machine, this would raise the level of the false-twist

spindles and the take-up bobbins to such an extent that the operator would have to use a ladder to reach them.

In the present textile machine, the linear speed and tension of the yarn is under continuous control so that the yarn is of uniform character throughout. Also, the speeds of the feed rolls **17**, **23** and the take-up spindle **42** may be correlated to impart the desired number of turns of false-twist per inch in the separately false-twisted yarn ends and to then ply the yarns together with a preselected number of turns of ply twist per inch. For example, with the false-twist spindles **19**, **19'** rotating at 255,000 r.p.m. and the linear speed adjusted to impart **85** turns per inch of false-twist to each yarn, the spindle **42** is rotated at 4,000 r.p.m. to provide a ply twist of 1.2 turns per inch in the composite yarn. The false-twist spindle speed may be increased to 700,000 or more r.p.m.'s per minute with a corresponding increase in linear speed of the yarn by the feed roll mechanisms **17**, **23** and a proportional increase in rotational speed of the spindle **42** to maintain the same number of turns of false-twist in the individual yarn ends and the same number of turns of ply twist in the composite yarn. Of course, the speeds of the feed rolls, the false-twist spindle, and/or the rotational speed of the take-up spindle may be varied relative to each other to provide other yarn constructions, and to increase or decrease the tension in the yarn as it is being processed.

If desired, the lubricant applying roller **33** (FIGURES 1 and 3) and the supply trough **34** may be eliminated and a lubricant applying roller **33'** and supply trough **34'** (shown in dotted lines in FIGURE 1) may be added. The roller **33'** is positioned above the access aisle to engage the yarns as they pass from the false-twisting frame **10** to the plying frame **11**. When the roller **33'** is utilized, the lubricant will be applied to the yarns well in advance of the plying step so that the lubricant will have time to penetrate the yarn before it is plied and wound onto the take-up package **38**. Since the lubricant will have penetrated into the yarn, it is not as apt to be thrown off as it is drawn around the take-up package **38** by the ring traveler **37**.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. A textile machine for separately false-twisting a plurality of thermoplastic yarns and then plying at least adjacent pairs of the separately false-twisted yarns together in a continuous operation, said machine comprising:

(a) an elongate false-twisting frame having a plurality of false-twisting stations spaced therealong for separately false-twisting adjacent pairs of thermoplastic yarns in opposite directions, each false-twisting station comprising at least two yarn supply packages, a false-twist spindle spaced above said supply packages, and an elongated heater plate positioned between said supply packages and said false-twist spindle,

(b) an elongate plying frame spaced from said false-twisting frame and defining an access aisle therebetween, said plying frame having twist plying stations spaced therealong and corresponding in number to the false-twisting stations of said false-twisting frame, each twist plying station including a take-up package,

(c) said supply packages being supported on the lower portion of said false-twisting frame, said take-up packages being supported on the lower portion of said plying frame, and said supply packages and said take-up packages being conveniently located on opposite sides of the access aisle whereby the supply packages and take-up packages are readily accessible from the aisle, and

(d) guide means associated with said false-twisting frame and said plying frame for continuously advancing the separately false-twisted yarns from said false-twisting frame across and above the access aisle and to said plying frame.

2. A textile machine according to claim **1**, including lubricant applying means positioned above the access aisle and supported for engagement with the false-twisted yarns as they pass above the access aisle and from said false-twisting frame to said plying frame.

3. A textile machine according to claim **1**, including temporary take-up means supported on the lower portion of said plying frame and being operable to collect the adjacent pairs of false-twisted yarn to permit the continued operation of said false-twisted frame while doffing a filled take-up package at one of said twist plying stations, said temporary take-up means comprising take-up roller means supported for rotation on said plying frame, said take-up roller means extending throughout the length thereof and adjacent said twist plying stations, and drive means connected to said take-up roller means for rotating the same at the proper speed that the adjacent pairs of false-twisted yarn may be wound and collected thereon while the filled take-up packages at said twist plying stations are being doffed.

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