

[54] **PROCESS FOR WINDING SYNTHETIC YARN**

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[51] Int. Cl. **D01h 9/02, B65h 54/86**

[58] Field of Search **57/34 TT, 34 PW, 36, 156; 242/18 EW, 18 PW**

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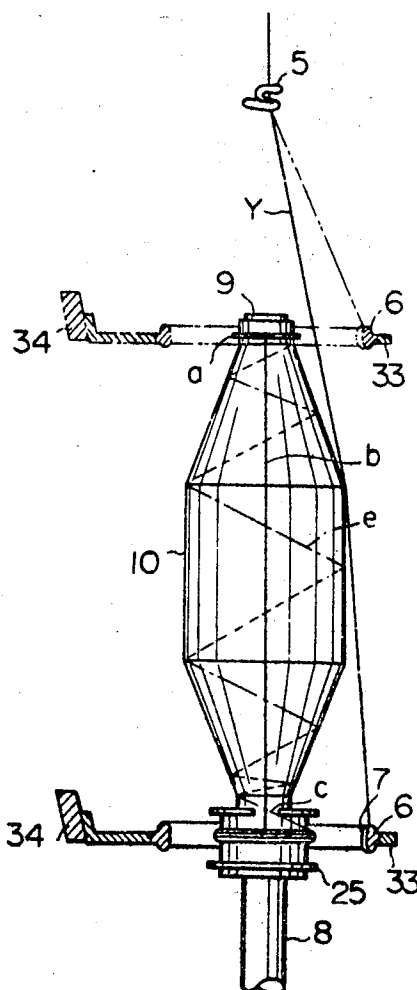
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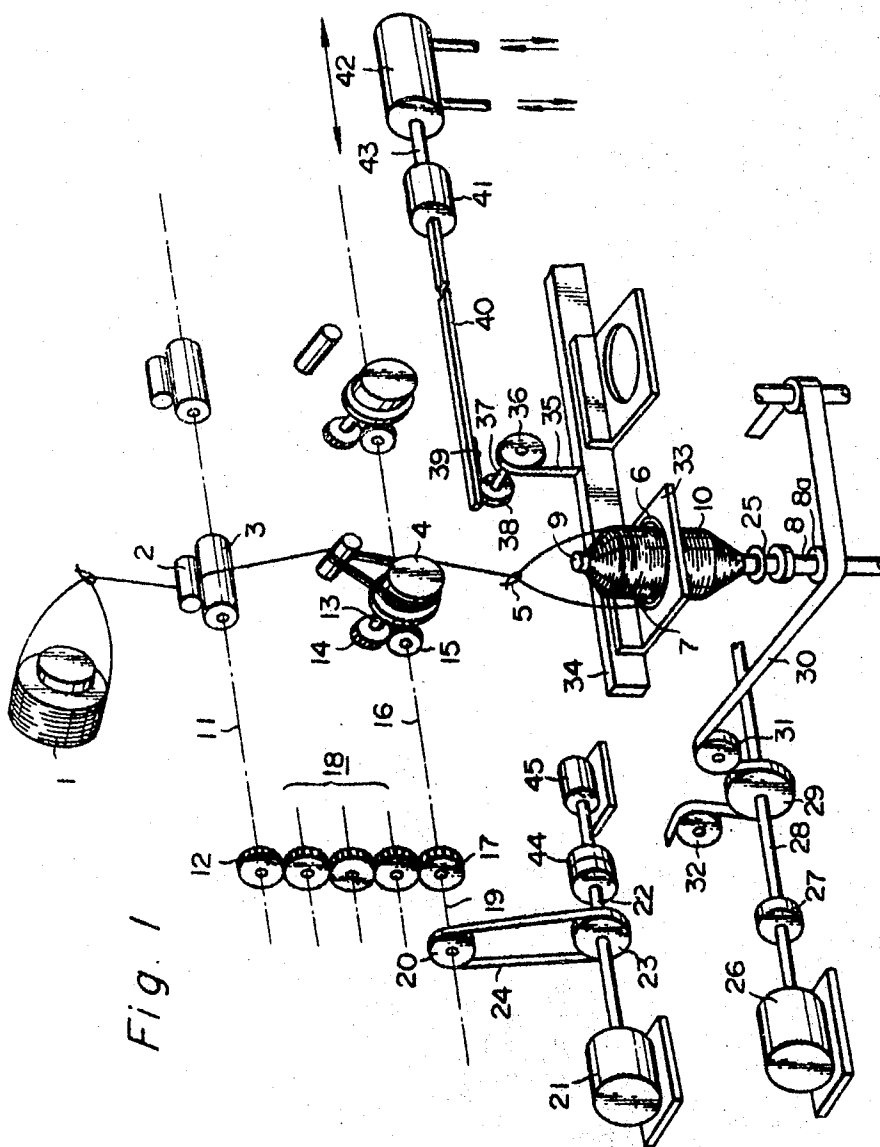
[57] **ABSTRACT**

The present invention is to provide an improved yarn winding process in a drawtwister for drawing, twisting and packaging synthetic yarn, particularly a yarn winding process when the drawtwister is brought to a standstill.

When a package is completed and the drawtwister is to be stopped, a ring is moved to the uppermost end of a bobbin with a full package to wind irregular yarn occurring while the machine is being stopped. In this state the machine is temporarily stopped and thereafter rerun for a short time to lower the ring to a waste spool at the base of the spindle to wind the irregular yarn on the waste spool and the machine is completely stopped.

5 Claims, 11 Drawing Figures





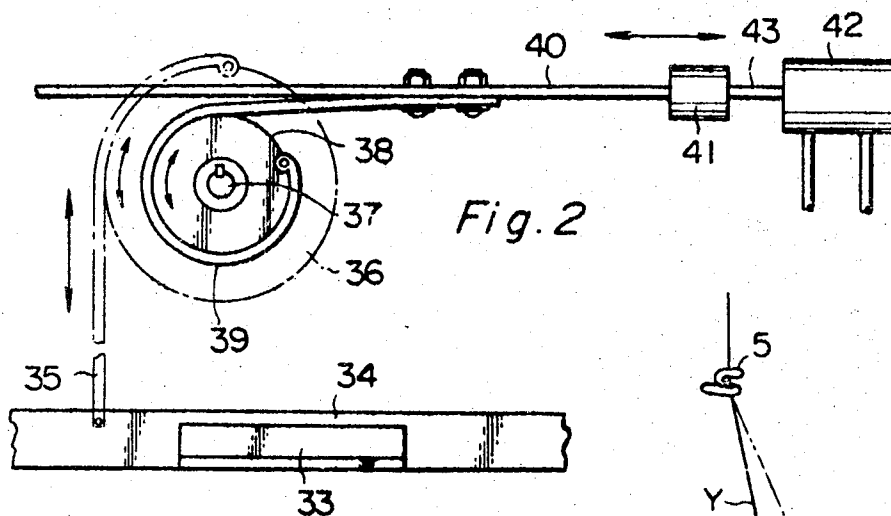


Fig. 4

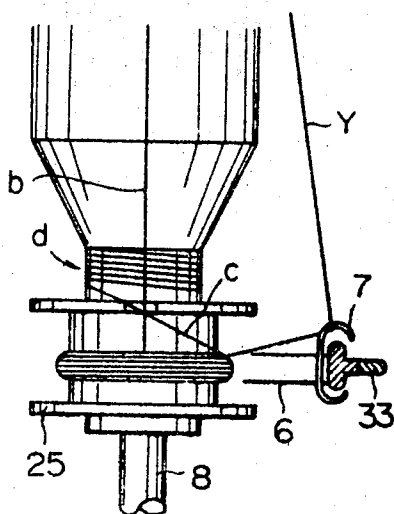


Fig. 3

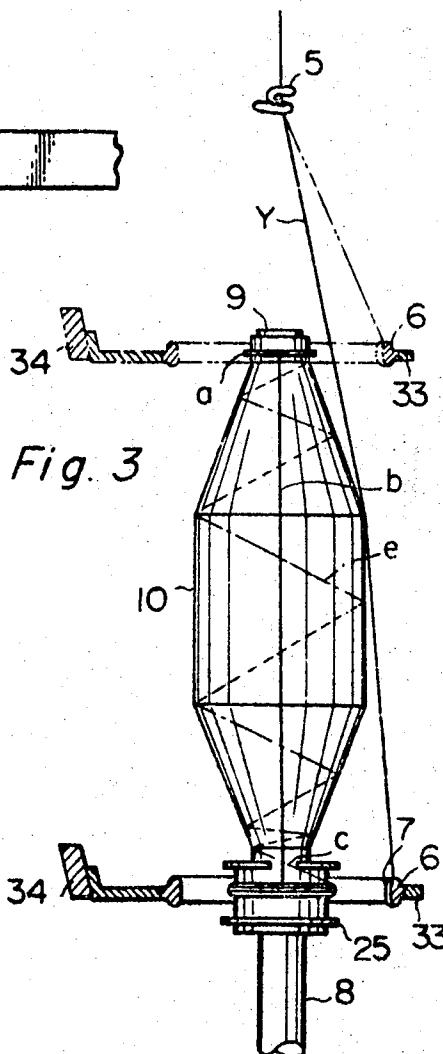
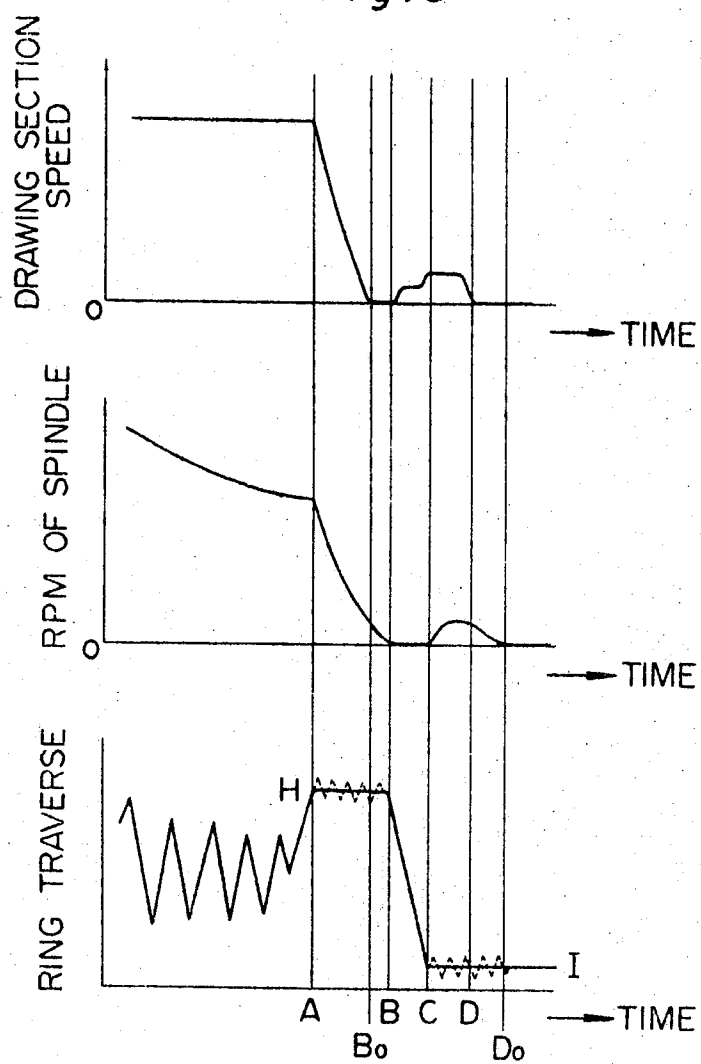


Fig. 5



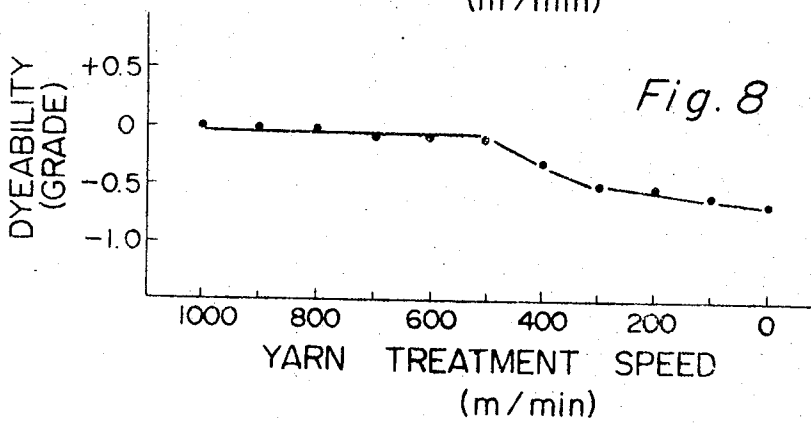
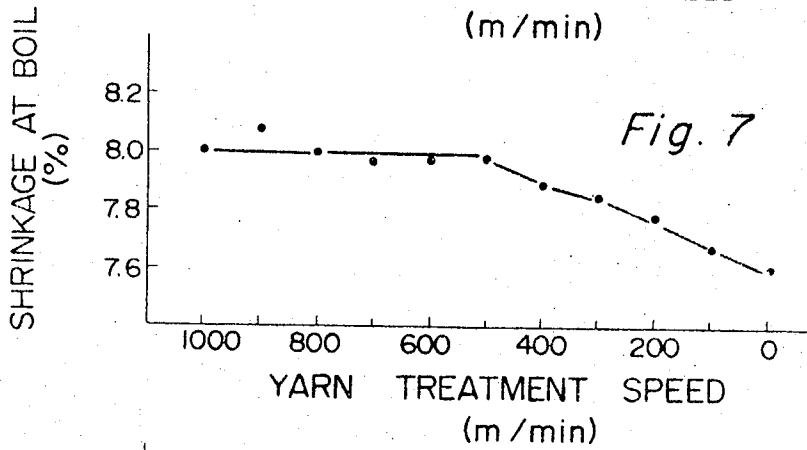
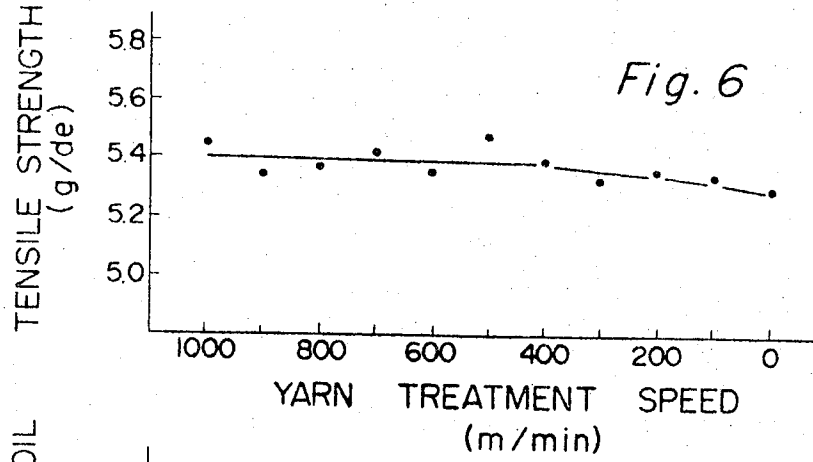


Fig. 9

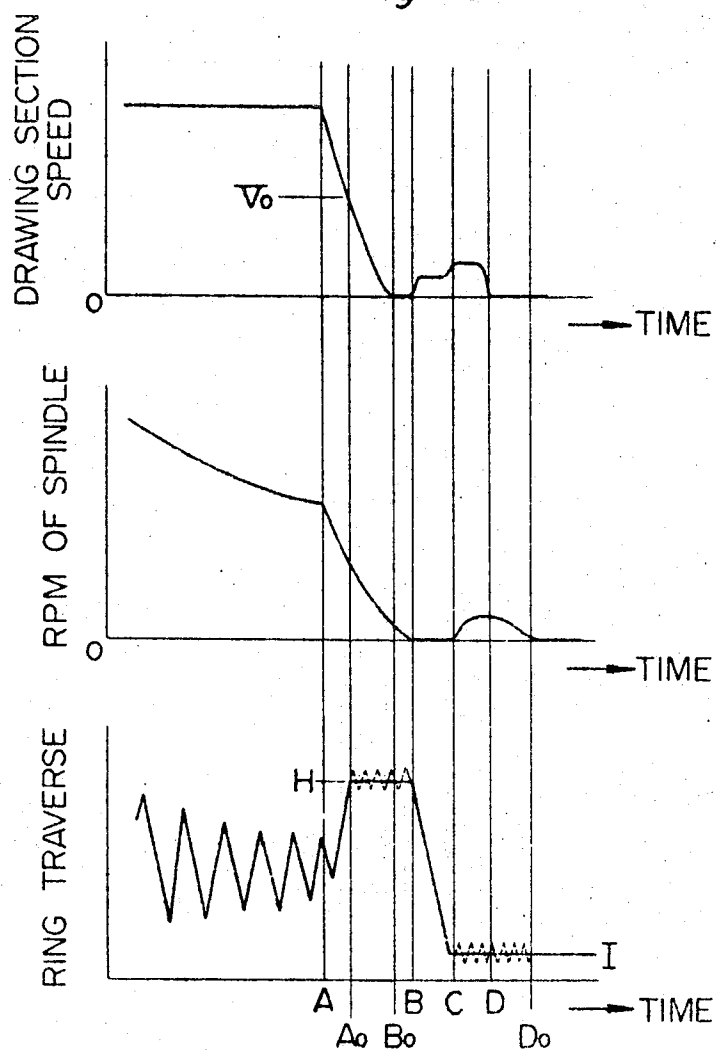


Fig. 10

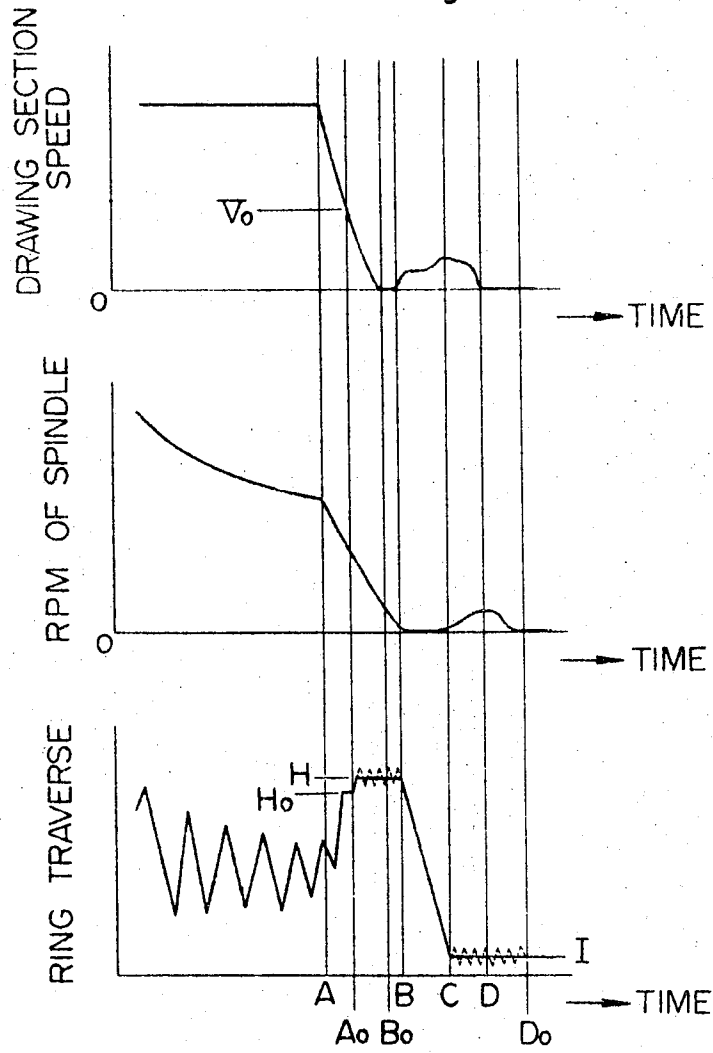
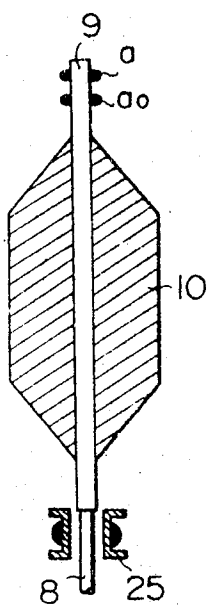


Fig. 11



PROCESS FOR WINDING SYNTHETIC YARN

The present invention relates to improvements in a winding process in which yarn is wound with a draw-
wister, and particularly to improvements in a winding
process when the drawtwister is being stopped.

In drawing synthetic yarn such as polyamides and
polyesters, the undrawn yarn unwound from an un-
drawn yarn package is drawn, twisted and wound in a
package on a bobbin inserted into a wind-up spindle in
a drawtwister. This drawing and packaging operation is
simultaneously carried out on all the spindles of the
drawtwister and when desired packages on each bobbin
are completed, the machine is stopped to remove all
the full packages from the machine and insert new
empty bobbins for a second drawing and packaging op-
eration.

Since the amount of yarn on one undrawn yarn pack-
age corresponds to that of four to five drawn yarn pack-
ages, drawing and packaging operations are continu-
ously carried out with four to five consecutive opera-
tions if one undrawn yarn package is threaded on the
drawtwister, and consequently, the drawtwister is
started up and stopped four to five times.

An undrawn yarn on an old package and an undrawn
yarn on a new package are tied with each other before
the undrawn yarn on the old package becomes empty,
and the undrawn yarn is provided to enable continuous
drawn yarn packaging.

However, as described above, when one drawn yarn
package becomes full, the drawtwister should be
stopped to replace an empty bobbin for the full bobbin
and restarted.

The synthetic yarn drawn at the start-up of the draw-
wister before the machine reaches normal speed is dif-
ferent from the yarn drawn at normal speed in yarn
qualities and should be prevented from being included
in the regular yarn package. For this reason, a traverse
ring is maintained in the position of a waste spool se-
cured at the base of the spindle at the start-up of the
machine to wind up initial irregular yarn thereon. After
the machine has reached normal speed, the ring is tra-
versed along a bobbin situated above the waste spool
to form a regular yarn package on the bobbin.

On the other hand, when the package is completed
on the bobbin and the drawtwister is to be stopped, the
machine runs by inertia for some time after the turning
off of its drive motor to stop, during which the machine
runs at speed lower than normal speed and the resulting
drawn yarn should be prevented from being included in
a regular yarn package at the start-up of the machine.
Hence, at the stoppage of the machine, the ring is low-
ered in a waste spool position, and irregular yarn during
the rotation by momentum is wound on the waste spool
after motors for driving the machine are switched off.

In such a way, irregular yarn is prevented from being
included into a regular yarn package by holding the
ring in waste spool position at the start up and stoppage
of the machine. At the same time, a simultaneous bob-
bin change operation becomes possible throughout the
machine. It is called simultaneous doffing. At the ma-
chine downtime, yarn is in the state of being threaded
on the drawing section and wound on the waste spool
below the bobbin through a traveler running on the
ring.

Since the ring is situated in the waste spool position
at the beginning of a winding operation and returns to
the position at the end of the operation, two yarns
bridge the waste spool and the bobbin. In replacement
of bobbins, a full bobbin can be removed from the spin-
dle without interfering with the yarn threaded on the
machine when the two yarns are severed. Accordingly
after the removal of a full bobbin, a subsequent winding
operation can be started only with the insertion of the
empty bobbin into a spindle.

When in such a way one winding operation is com-
pleted, the machine is stopped without severing the
yarn threaded on the machine and thereafter a full bob-
bin is replaced by an empty bobbin. Without rethread-
ing the machine with yarn, the machine can immedi-
ately be started for a subsequent winding operation.
This is called continuous simultaneous doffing.

Recently drawing and packaging speed in a draw-
wister has become exceedingly high to increase pro-
duction and at the time of start up of the machine, the
time required for reaching normal speed takes longer.
In like manner, after the switching-off of the machine,
the time of rotation by inertia up to a complete stop-
page takes longer; in other words, the time required for
deceleration has become longer. When the amount of
windings on a package becomes greater and the weight
of package is heavier, momentum of the spindle assem-
bly holding a package becomes greater, and conse-
quently, inertial rotating time is further lengthened.
Accordingly, the amount of irregular yarn to be wound
on the waste spool at the times of starting and stopping
of the machine becomes exceedingly great.

However, if the amount of irregular yarn to be wound
on a waste spool increases, the above-described "con-
tinuous simultaneous doffing" becomes actually impos-
sible. When each waste spool becomes full, it may be
replaced by an empty spool or the waste on the spool
may be severed. In this case, since the yarn wound on
the waste spool is severed, continuous simultaneous
doffing is inevitably suspended. Threading each spindle
of the machine with yarn is newly carried out and irreg-
ular yarn during the threading is wound on the waste
spool. When the threading is completed throughout the
machine, the ring is lifted to a bobbin position. There-
fore, if the amount of irregular yarn at the start and
stoppage of the machine becomes greater as described
above, this is an extreme case but the waste spool hap-
pens to be full with only one winding operation and
continuous winding operations become impossible.

On the other hand, a wound-up package is unwound
and undergoes various treatments in subsequent treat-
ment processes. In this case, yarn is drawn off over the
end of the package. Thus a terminal winding of the
wound yarn, that is, a leading thread end of yarn is pref-
erably located at the top of the package. In order to at-
tain the two objects of minimizing the amount of waste
yarn to be wound on the waste spool during one wind-
ing operation and positioning the initial thread end of
the yarn at the upper end of the package, it has been
proposed that the ring is lifted to the upper end of a
bobbin where the bulk of a package is not held at the
mechanical stoppage of the drawtwister to lead and
wind an initial thread end of the package there and spin
the most part of irregular yarn caused during the iner-
tial rotation of the machine on the uppermost end of
the bobbin, and then the ring is lowered to a waste
spool position below the bobbin.

However, though in this process, the amount of irregular yarn to be wound on the waste spool becomes less, a great amount of irregular yarn is wound on the surface of the package during this lowering movement of the ring to a waste spool position, and after the removal of the package from the machine, it should be stripped off from the package. This stripping off operation which is much complicated and requires a lot of hand labor leaves much room for improvement. Further in this process, the proper timing of the ring lowering movement from the top of a bobbin to the position of the waste spool is very difficult. If the commencement of descent of the ring is too early, the machine is still rotating at considerably high speed when the ring has reached the waste spool position, resulting in that the waste yarn wound on the waste spool becomes more. In contrast, if the commencement of descent of the ring is too late, troubles will arise that the machine stops before the ring reaches the waste spool; that is, during this lowering movement, the machine stops to cause yarn breakage. Further even if the machine does not stop before the ring reaches the waste spool position, another trouble occurs that yarn is broken to prevent a normal winding operation when the machine has been started unless it is fully wound on the waste spool.

In packaging, a transfer tail is, in general, formed at the base of a bobbin. The transfer tail is formed on the lower end of the bobbin where package of yarn is not formed by the yarn layer initially wound on the innermost layer of package, that is, on the surface of the bobbin. When at the completion of a wind operation, the ring descends to the waste spool position and irregular yarn is laid on the transfer tail at the base of the bobbin. This transfer tail becomes frayed or sloughed off when the irregular yarn thereon is stripped off from the bobbin, and becomes impossible to use as a transfer tail.

In a conventional drawtwister, the drawing section where yarn is drawn, and a spindle of the ring twisting and packaging section where the drawing yarn is twisted and packaged have so far been driven by a common drive source. The drawing, and the twisting and packaging sections have been started and stopped at the same time. However, drawing speed has recently become higher and the weight of a yarn package has been increased. This renders difficult the driving of the drawing section and the twisting and packaging section with one and the same motor. Further, it is arranged that revolutions per minute of a spindle holding a yarn package is gradually decreased as the package is near full to lessen the load on the motor at the time of completion of packaging and prevent the increase of packaging tension of the yarn. For this reason, a modern drawtwister is provided with individual motors for use in driving the drawing section, and the twisting and packaging section or the spindle section independently of each other. The present invention provides an improved yarn winding process in such a drawtwister having individual drive means.

SUMMARY OF INVENTION

In the present invention, when a drawtwister having individual drive sources for the drawing and packaging sections is set in stoppage, a ring is raised to the uppermost end of a bobbin for winding irregular yarn thereon to be generated a time when the machine is being stopped. The machine is temporarily stopped as it is.

Afterwards only the drawing section of the machine is rerun at low speed and the ring is lowered to a waste spool position below a bobbin. When the ring has descended to that position, the spindle as well is rerun at low speed and the irregular yarn is wound on the waste spool. Then, the drawing section and the spindle are completely stopped. Thus a terminal end of yarn of a package is led to the uppermost end of the bobbin and the amount of irregular yarn to be wound on the waste spool is minimized to cause as many continuous simultaneous doffings as possible. At the same time, irregular yarn is prevented from wrapping itself around the surface of the full package of regular yarn during the lowering movement of the ring to facilitate the stripping-off of irregular yarn, and a transfer tail is prevented from the entanglement.

According to the present invention, the drawing section is rerun, with an auxiliary, low speed drive source instead of the normal drive source for the drawing section and the timing of ring descending speed in reference to a drawing speed is easily adjusted to prevent yarn breakage.

Further objects and advantages of the present invention will become readily apparent as the following detailed description of the invention unfolds when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a perspective view of outlined mechanism of one embodiment of a drawtwister of the present invention.

FIG. 2 is a fragmental side elevation of traversing mechanism of a ring rail of the drawtwister in FIG. 1.

FIG. 3 is a detail side elevation of a twisting and packaging section of the drawtwister.

FIG. 4 is a detail view of the waste spool of FIG. 3.

FIG. 5 is speed diagrams of each section of the drawtwister at the stoppage thereof for describing the process of the present invention in the drawtwister of FIG. 1.

FIGS. 6, 7 and 8 are graphs showing the relation of lowering of treatment speed with qualities of treated yarn: Tensile strength of yarn in FIG. 6, shrinkage of yarn in boiling water in FIG. 7, and dyeability of yarn in FIG. 8.

FIG. 9 is speed diagrams of each section of a drawtwister when the machine is set in stoppage for explaining another embodiment of the present invention.

FIG. 10 like FIG. 9 is a speed diagram in still another embodiment of the present invention.

FIG. 11 is a sectional view of a package wound by the process as shown in FIG. 10.

For the drawing and packaging sections, only one drawing and packaging unit is shown for simplicity in a driving system. Ordinarily one drawtwister is provided with about 140 to 150 drawing and twisting units and these are simultaneously driven by driving source.

In FIG. 1, undrawn yarn unwound from an undrawn yarn package 1 is received with a feed roller 3 bearing on a nip roller 2 and drawn to several times the original length between the feed roller 3 and a draw roller 4 having a peripheral speed higher than that of the feed roller 3. In drawing, heat treatment may be carried out whenever necessary with appropriate heating means

(not shown). Besides one-step drawing as shown in the FIG. 1, multi-step drawing is carried out with a plurality of draw rollers in some cases. The yarn thus drawn passes through a lappet guide 5 and a traveler 7 mounted on a ring 6 and sliding thereon. Then the yarn is wound on a bobbin 9 mounted on a revolving spindle 8 to form package 10.

Driving mechanism of the drawing section comprising the feed roller 3 and the draw roller 4 will be described below.

The feed roller 3 is directly arranged on a rotary shaft 11 longitudinally extending along a drawtwister and at one end of the rotary shaft 11 is provided a gear 12. On the other hand, to the rotary shaft 13 of the draw roller 4 is attached a helical gear 14, which meshes with a helical gear 15 intersecting it at right angles. The helical gear 15 is secured to a driving shaft 16 longitudinally extending along the drawtwister. A gear 17 is connected to one end of the driving shaft 16 and to the gear 17 is connected a gear 12 through a gear train 18. The feed roller 3 and the draw roller 4 rotate in interlocking arrangement and the speed ratio, that is draw ratio, is determined by the size of each gear and the diameter of each roller. A pulley 20 is mounted on a shaft 19 of the gear 17 and is connected to a pulley 23 secured to an output shaft 22 of a motor 21 through a belt 24. The rotation of the driving motor 21 for driving the drawing section is transmitted by the aid of such transmission gears to the feed and draw rollers constituting the drawing section.

The driving of a spindle at the twisting and packaging section will be described below. A tin pulley 29 is mounted on a tin pulley shaft 28 longitudinally arranged along the drawtwister. A spindle belt 30 is extended between the pulley 8a of the spindle 8 and the tin pulley 29 through idle pulleys 31, 32, and the spindle 8 is driven by friction in contact with the spindle belt 30 through the pulley 8a. A motor 26 for driving the spindle is direct-coupled with an end of the tin-pulley shaft 28 through a coupling 27, and is generally variable in speed.

The traversing motions of the ring 6 reciprocating up and down along the bobbin 9 will be described below.

A ring holder 33 holding in place the ring 6 is secured to a ring rail 34 extending along the length of the draw twister and makes up-and-down motions with those of the ring rail 34. One end of a suspension belt 35 is attached to the ring rail 34 and the other end thereof to a pulley 36. Another pulley 38 is secured to a rotary shaft 37 of the pulley 36 and to the pulley 38 is attached one end of a belt 39. The other end of the belt 39 is attached to a traverse bar 40 reciprocating left and right (see FIG. 2). The end of the traverse bar 40 is connected to a piston rod 43 of a cylinder 42 through a coupling 41. Pressure oil is alternately fed to both sides of the piston rod 43 of the cylinder 42 to permit the piston rod 43 to make a reciprocating motion and the pulley 38 to make a reciprocal turn by the aid of the traverse bar 40. The pulley 36 arranged coaxially with the pulley 38 is also caused to make a reciprocal turn to reciprocate ring rail 34 through the suspension belt 35. The stroke of the piston rod 43 is amplified according to the ratio of diameter of the pulley 38 to that of the pulley 36 and transmitted to the ring rail 34. The

ring traversing mechanism is driven and controlled independently of the drawing section and the spindle.

A lower-speed auxiliary driving source at the drawing section will be described below. A lower-speed auxiliary drive motor 45 is connected to the end of an output shaft 22 of a motor 21 by the aid of an electromagnetic clutch 44. The motor 45 is variable in speed, for instance, with the use of a pole change type. In normal driving, the electromagnetic clutch 44 is off and the drawing section is driven with the motor 21. However, after the temporary stoppage of the drawtwister and at its restart, the electromagnetic clutch 44 is actuated during the ring lowering movement to connect the output shaft 22 with the motor 45 such that the motor 45 restarts the drawing section at lower speed.

The winding process in such a drawtwister in the present invention is described below.

At the start of drawtwisting, the ring rail 34 is positioned in the lowest position to hold the ring 6 to the position of a waste spool 46 mounted on the spindle 8 at the base of the bobbin 9. The state of the packaging section is shown in FIG. 3. In this case one drawtwisting operation has already been carried out and yarn Y is threaded on the drawing section and kept wound on a waste spool 25 via a traveler 7 (At the initial start of drawtwisting, a threading-up operation is required, but in this instance the threading-up operation can be omitted because of the continuous simultaneous doffing operation described before). After the full package is replaced by an empty bobbin, the motors 21 and 26 are turned on at this state to start the drawtwister and the ring 6 is held in the position of the waste spool 25 until the feed roller, the draw roller and the spindle resume normal speed. Afterwards the ring 6 is traversed along the bobbin 9 to form a package 10. During the ascending movement of the ring 6 from the position of the waste spool 25 to the position of the bobbin 9, a transfer tail *d* is formed at the base of the bobbin as shown in FIG. 4. In FIG. 4, the traversing motions form package of yarn by what is called a parallel winding process in which traverse length gradually lessens. To decrease gradually traverse length, the stroke of the hydraulic cylinder 42 reciprocating up and down the ring rail 34 is shortened by controlling the change-over timing of pressure oil fed to the hydraulic cylinder.

In this way, the desired package 10 is completed on the bobbin 9, and thereafter the ring 6 is lifted to the upper end of the bobbin 9 immediately before or simultaneously with the turning-off of the motors 21 and 26 of the drawtwister. This state is shown by the two-dot chain line in FIG. 3. The drawtwister is temporarily stopped in that state and irregular yarn generated during the inertial rotation of the machine is wound on the uppermost end of the bobbin as a bunch of yarn *a*. The irregular yarn produced after the mechanical stop of the machine has been reached and before the spindle is brought to a complete standstill is all wound on the uppermost end of the bobbin. Then the ring 6 is lowered to the waste spool position for the start of a subsequent winding operation. The electromagnetic clutch 44 is actuated to start only the drawing section (feed and draw rollers) and drive it at an exceedingly low speed with the lower speed auxiliary drive motor 45 while the primary motor 21 is kept suspended and the ring 6 is lowered to the position of the waste spool 25 with preventing yarn *b* from wrapping itself around the package. In order that the ring 6 may be lowered, the

rate of flow of pressure oil to be fed to the hydraulic cylinder 42 is increased by the control of a flow control valve (not shown). Generally, this ring lowering speed becomes about several times as high as an ordinary ring traversing speed. When the ring 6 has lowered, the pole number of the motor 45 is reduced to increased speed in the drawing section and the motor 26 for driving the spindle is also started at low speed and 5 to 20 windings are laid on the waste spool 25. Thereafter the motors 45 and 26 are turned off to bring the machine to a complete standstill.

FIG. 5 shows speed diagrams at the stoppage of members of a draw twister in conducting such a winding process. In the diagrams, drawing section speed (draw roller speed), rpm of the spindle and ring traverse (ring position) are plotted as ordinate and periods of time as abscissa. The diagrams just illustrate the time relations of start and stoppage of the drawing section, the spindle and the ring traverse. The ordinate does not show the accurate size of the actual speed nor does the abscissa show actual time intervals.

Referring to FIG. 5, the winding process as embodied will be described. When the package 10 is completed on the bobbin 9 (a time A), the ring 6 is lifted to the upper end of the bobbin (point H) and the motors 21 and 26 are turned off. Since the drawing section and the spindle are separately driven with individual motors, it is difficult to synchronize the stoppage of the spindle and that of the drawing section. After the switch off, the drawing section and the spindle rotate by inertia, gradually decelerate and come to a complete standstill (from the time A to a time B₀ or a time B). However, the drawing section is widely distinguished from the spindle in inertia. Ordinarily, the inertia of the spindle holding a considerably heavier package becomes greater. Hence, when both motors 21 and 26 are simultaneously turned off, the spindle continues to rotate for a long period of time after the stoppage of the drawing section.

The stoppage of both motors is preferably simultaneous. If the spindle continues to rotate for a long period of time after the stoppage of the drawing section yarn is twisted off. For this reason, a brake is actuated on the spindle motor to stop the spindle in as short a time as possible. In FIG. 5, the motors 21 and 26 are supposed to be turned off simultaneously at the time A for convenience sake, but the motor 26 is turned off a little earlier than the motor 21 to have their time of stoppage agree with each other. In stopping the drawtwister, the drawing section is stopped at the time B₀ and the spindle a little later at the time B by applying a brake or staggering a time for turning off each motor to adjust their stoppage timing and prevent yarn from being twisted off.

The ring is held in a position H until the spindle is brought into a complete stoppage at the time B to wind the irregular yarn at the uppermost end of the bobbin.

Afterwards, only the drawing section is driven at lower speed for a short time with the auxiliary motor 45 and the ring is lowered from the upper end (the position H) of the bobbin to the waste spool (position I). When the ring has completed its descent to the waste spool position (position I) (a time C), the pole number of the motor 45 is reduced to increase speed in the drawing section and the spindle motor 26 is started at low speed while the ring is being held in the position.

The spindle motor 26, which is variable in speed, is capable of being started at low speed and there is no need to use an auxiliary motor for low-speed driving. Even if the rpm of the spindle at the time of restart at a lower speed is somewhat greater, it does not interfere with packaging through the rpm of a traveler becomes greater.

The drawing section stops when a time D comes and the spindle stops a little later at a time D₀ to stop the drawtwister completely. Since it is still difficult to stop the drawing section and the spindle at the same time, the driving periods of time and speed of the motors 45 and 26 are controlled such that the spindle stops a little later than the drawing section.

The irregular yarn produced during the internal rotation of the machine from A to the time B₀ is wound on the uppermost end of the bobbin as the bunch of yarn *a* in FIG. 4, but since as described above during the ring lowering movement (from B to the time C), the spindle is not in rotation, the irregular yarn will not wrap itself around the package. In the prior art, the spindle has so far been rotated during the ring lowering movement and the irregular yarn has been allowed to wrap itself on the surface of a package as shown by the one-dot chain line *e* in FIG. 3.

After the time C when the descent of the ring to the position of the waste spool is completed, the spindle is driven at low speed, and consequently the desired amount of yarn (5 to 20 windings of yarn) is wound on the waste spool so as to give a satisfactory start-up for a subsequent winding operation without any yarn breakage.

At the machine downtime, doffing and donning are carried out by severing the portion of yarn *c* extending from the waste spool 25 to the transfer tail section (FIG. 4), removing the package 10, and mounting an empty bobbin on the spindle 8 to complete one winding operation.

As irregular yarn does not wrap itself around the surface of the package wound by the process of the present invention, the removal of the irregular yarn from the surface of the package becomes unnecessary and only the bunch *a* of irregular yarn at the uppermost end of the bobbin has only to be stripped. Thus the stripping operation becomes very simple.

Further, because yarn is not laid on the transfer tail *d* formed at the base of a bobbin (FIG. 4) at the completion of a winding operation the entanglement and the being frayed of the transfer tail can be eliminated.

The leading thread end of a package is led to the upper end of the bobbin after the completion of the package by the shifting of a ring to the upper end of a bobbin, and thereby the handling of the package in a subsequent process becomes convenient.

During the ring lowering movement, the drawing section is driven at a lower speed and yarn is fed with ring lowering speed, resulting in no yarn breakage at the time. Further, at the beginning of a subsequent drawtwisting, yarn wound accurately on a waste spool will not cause yarn breakage at the start of the machine.

Further the amount of irregular yarn to be wound on the uppermost end of a bobbin depends on the length of time from A to the time B; that is, the longer the time of inertial rotation at the drawing section, the more is the amount of irregular yarn (waste yarn). It is preferable that the time is as short as possible. After turning

off the motor 21, it is desirable to apply the brake to the motor 21 or the driving system of the drawing section and minimize the period of time of the inertial rotation.

As described above, in the present invention no irregular yarn is wound on the surface of package and only the stripping off the bunch *a* (FIG. 3) of irregular yarn at the uppermost end of the bobbin is required.

In the conventional methods, about 170 to 200 meters of irregular yarn has so far been wound on one bobbin, but in the present invention it has widely been decreased to 10 meters. As a result, about only 1 minute is now required to strip off 80 packages compared with 7 minutes in the conventional methods. The number of operators required for treating 10,000 packages/day have been reduced. That is, the reduction of six operators has become possible.

As described above, yarn to be discarded as irregular yarn has been reduced and it contributes much to cost reduction.

As described before, the time as abscissa in FIG. 5 does not denote an actual time. The actual time at the stoppage of the drawing section and the spindle in the process of FIG. 5 will be described below.

In a drawtwister having 140 to 150 units, drawing is conducted at a speed of 1,000 to 1,300 m/min and a package weighing 2.5 to 3.0 kg is completed by a spindle varying from 15,000 to 7,000 rpm.

First, after the turning off of the motor, the drawing section stops in 15 to 25 sec (A to the time B) and the spindle stops 10 to 15 sec behind the stoppage of the drawing section. In the spindle section, inertia is great and the brake is usually applied to the motor to adjust the time required for complete stoppage. Accordingly, between A and the time B is 25 to 40 sec in FIG. 5. The time required for the ring lowering movement between B and the time C is 3 to 5 sec, during which time the drawing section is driven at low speed at a peripheral speed of the draw roller of about 2 to about 7.5 m/min. When the ring reaches the position of the waste spool, the peripheral speed of the draw roller is raised to 8 to 24 m/min, preferably about 15 m/min as shown in FIG. 5 C - D in winding yarn on the waste spool. A time C - D requires about 20 sec. In this way, low driving speed is changed over in two steps to eliminate yarn breakage during the ring lowering movement and wind yarn accurately on the waste spool after the completion of ring descent. As a result, a time B - D for low speed driving in the drawing section is about 25 sec. Five to 10 seconds after the stoppage of the drawing section, the spindle is adapted to stop and a time C - D for low speed driving in the spindle section becomes 25 to 30 sec.

As shown by the dotted line in FIG. 5, when the ring is positioned on the uppermost end of the bobbin or the waste spool, it is preferable to traverse the ring in a small traverse length and wind yarn in good order.

In the above-described example, the lifting of the ring to the uppermost end of the bobbin was conducted just before or at the same as the turning off of the driving motor in the drawtwister. That is, in the process in FIG. 5, the ring was lifted at a time A.

However, it has been found that in drawing synthetic yarn, yarn drawn at a lower speed than usual is not substantially different from the yarn drawn at normal speed in yarn properties. Hence, the yarn drawn during the inertial rotation after the turning off of the motors

of the drawtwister has the same yarn properties as the drawn yarn produced under normal conditions until drawing speed lowers to a certain extent and that it can be used as regular yarn. This will be described in more detail below.

In general, it is said that in yarn treatment such as drawtwisting, etc., yarn properties change with decrease in treatment speed (drawing speed). However, changes in yarn properties do not appear a time when decrease in drawing speed has started, that is, a time when the driving motor has been turned off but often appear a time when the drawing speed has widely been decreased. Accordingly the yarn treated during the time from the turning off of each driving motor to the substantial appearance of changes in yarn properties can be inserted to a package without any trouble and wound as the package instead of being discarded as irregular yarn, waste. Substantial changes in yarn properties in reference to the decrease of treatment speed depend upon types of yarn and treatment process, and consequently they should be empirically determined from treatment process to treatment process.

According to experiments of the inventors, for instance, when undrawn polyethylene terephthalate yarn having an intrinsic viscosity of 0.65 was drawn at 85°C (drawing temperature), 150°C (heating temperature), 3.7 times (draw ratio) and 1,000 m/min (drawing speed) into 75-denier, 48-filament drawn yarn, tensile strength, shrinkage in boiling water and dyeability in reference to each yarn speed were measured after the turning off of driving motors for the machine. The results are shown in FIGS. 6, 7 and 8.

Dyeability here means a grade of a disperse dye affinity for yarn. Assuming that the dyeability of yarn drawn at a drawing speed of 1,000 m/min is zero whether the yarn dyes heavier or lighter is measured by a sensory test (+ stands for heavier dyeing and - stands for lighter dyeing).

Shrinkage in boiling water is a percentage of the contracted length of a yarn specimen having a given length to the original length after the yarn specimen has been dipped in boiling water a few minutes. FIG. 6 shows that the yarn has little or no different properties from regular yarn until the drawing speed declines to 500 m/min.

In view of this point, there is no need to lift a ring rapidly until the time A when each driving motor of the machine has been turned off as taught by the winding process in FIG. 5, but the ring may be lifted until a time A₀ when after the turning off of driving motors, the speed of the drawing section is on the verge of reaching the limit speed V₀ as in FIG. 9.

The winding process as in FIG. 9 is identical with that in FIG. 5 except the timing of ring lifting. In this way, the ring is lifted to the upper end of the bobbin until drawing speed has reached the limit speed V₀ after the turning off of the machine to make easy stripping operation of the irregular yarn and to save the amount of yarn to be discarded as waste which is economical.

When a package wound in a drawtwister is subsequently used, a leading end of the package is desired to be easily located and drawn. For this purpose, at the stoppage of the machine, the ring is led to the outer side (upper end) of a package and temporarily stopped there to wind a bunch of regular yarn. Thus the leading portion of yarn can be secured thereon.

Such a winding process will be described with reference to FIGS. 10 and 11. The winding process in FIG. 10 is almost the same as that of FIG. 9 except a slight difference in ring traversing. FIG. 11 is a cross sectional view of a package wound by the process of FIG. 10.

In FIG. 10, when a package becomes full, the motors for driving the drawing section and the spindle are first turned off at a time A. Just before the time A₀ when the speed of the drawing section has reached the limit speed V₀, the ring is lifted to position H₀ and temporarily stopped there. The position H₀ is located outside (upper end) the bulk of the package and below the position H where a bunch of irregular yarn is wound. Thus immediately after a bunch of regular yarn a₀ is formed in the position H₀ if the bobbin, the ring is lifted in the time A₀ to form a bunch of irregular yarn a in the position H. Then the ring is rapidly lowered to the waste spool position. The process after the formation of a bunch of irregular yarn in the position H is identical with that of FIG. 5.

The periods of time during which ring traversing is temporarily stopped in the position H₀ are sufficient enough to obtain the number of windings required for securing the end of yarn to the bobbin and ordinarily about 0.2 to 3 sec will be enough. The bunch of yarn a₀ should be formed outside the bulk of the package, that is, the upper end of the bobbin. The bunch can be formed on the belly of the package, but induces disadvantageously stains, fuzzing and sloughing off of the package. The bunch a₀ for securing a leading end of yarn should be always composed of standard yarn because the yarn of this bunch portion a₀ is subsequently processed as regular.

We claim:

1. A process for winding synthetic yarn in a drawtwister in which a drawing section and a twist spindle are driven individually with separate motors, a ring is reciprocated up and down along the twist spindle, an irregular yarn winding section is arranged below a bob-

bin mounted on the twist spindle, and irregular yarn occurring at the starting and stopping of the drawtwister is wound on the irregular yarn winding section, which comprises switching off each of said motors when winding of the yarn on the bobbin is completed, then moving the ring to the uppermost end of the bobbin to wind the bunch of irregular yarn, formed during the inertial rotation before the drawtwister is brought to a complete standstill, restarting only the drawing section at low speed after the completion of the standstill of the drawtwister, lowering the ring to the irregular yarn winding section, then restarting the spindle at low speed to wind the irregular yarn on the irregular yarn winding section, and thereafter stopping the drawing section and the spindle.

2. A process for winding synthetic yarn as set forth in claim 1 wherein the low speed restart of the drawing section is carried out with an auxiliary drive motor other than the primary driving motor.

3. A process for winding synthetic yarn as set forth in claim 1 wherein after the ring has been lowered to the irregular winding section position, speed in the drawing section is rendered higher than that at the time of the lowering movement of the ring and the spindle is restarted at low speed.

4. The process of claim 1 wherein after the driving motors of the drawtwister are turned off, the ring is regularly traversed to the uppermost end of the bobbin to wind the irregular yarn occurring upon the stopping of the drawtwister.

5. The process of claim 4 wherein after the driving motors of the drawtwister are turned off, the ring is temporarily stopped on the upper end of the bobbin before the formation of the irregular yarn bunch to wind regular yarn on the upper end of the bobbin, and the ring is then further moved upward to the uppermost portion of the bobbin to wind the irregular yarn.

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