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YARN SPINDLE

Original Filed Jan. 4, 1954

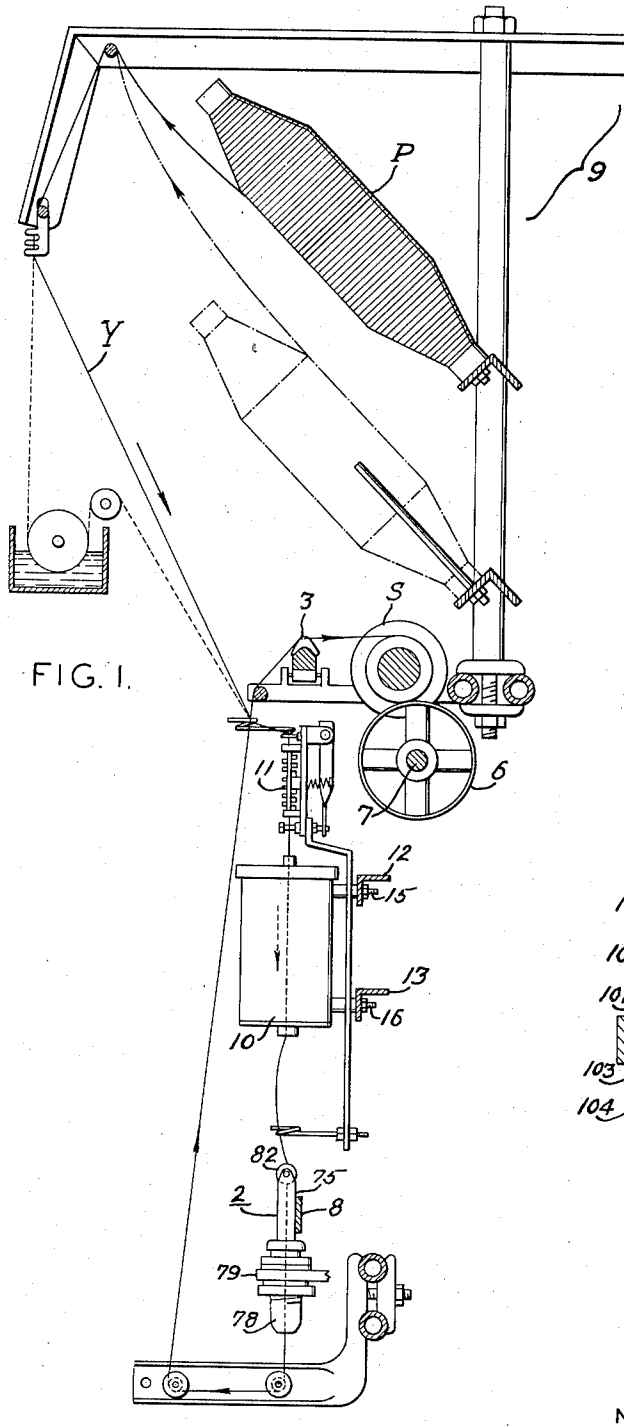

FIG. 1.

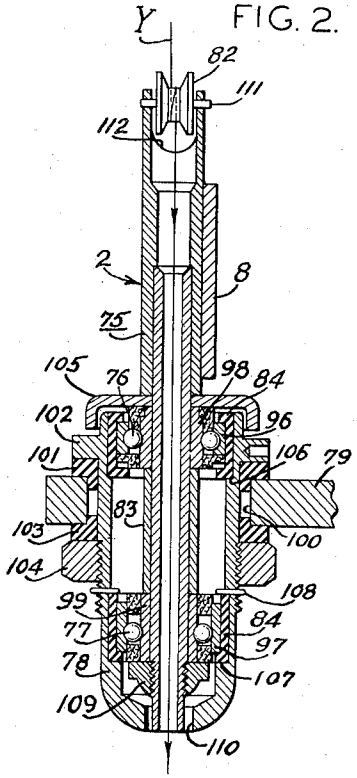

FIG. 2.

INVENTORS:
NICHOLAS J. STODDARD
WARREN A. SEEM
BY Howson & Howson
ATTYS.

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YARN SPINDLE

Nicholas J. Stoddard, Philadelphia, and Warren A. Seem, Gwynedd, Pa., assignors to Universal Winding Company, Cranston, R. I., a corporation of Massachusetts

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2 Claims. (Cl. 57—77.45)

This invention relates to apparatus for processing thermoplastic textile yarns and is a division of our copending application Serial No. 401,952, filed January 4, 1954.

More particularly, the invention is concerned with the provision of a novel spindle for use in processing polyamide and other thermoplastic yarns such as nylon, Vinyon, Orlon, Velon, Dacron, Saran, and the like, by thermal treatment according to the improved continuous methods disclosed in our copending application Serial No. 401,951, filed January 4, 1954.

The present invention is directed primarily to a novel yarn spindle by means of which the aforesaid continuous methods can be expeditiously carried out at high speeds.

Other objects and the attendant advantages will appear from the following description wherein the present invention is set forth and described with reference to the accompanying drawings, in which:

Fig. 1 is a fragmentary sectional view vertically through a thermoplastic yarn processing apparatus embodying the novel high speed spindle of the present invention; and

Fig. 2 is an enlarged vertical sectional view of the high speed spindle which is the subject of the present invention.

Referring now more particularly to the drawings, the apparatus shown in Fig. 1 is basically what is known in the textile art as an "up-twister." In the present instance the apparatus has been provided with a special overhead creel **9** for the yarn package P which is to be processed. The novel spindle of the present invention is indicated at **2** and has a diametrically enlarged portion arranged for tangential contact by the customary spindle drive belt **8**. As shown in Fig. 1, the yarn Y from the package P passes through a specially constructed tensioning device **11** and thence through a specially designed heating device **10** before it reaches the novel high speed spindle **2** of the present invention. From the package P to the spindle **2** the yarn Y travels in a generally downward direction and after passing through the spindle **2** the direction of travel of the yarn Y is substantially reversed so that the yarn travels upwardly and ultimately passes over a traverse guide **3** and is wound upon the take-up spool which is indicated at S. The take-up spool S is driven by a roll **6** fixed on a shaft **7** which is driven from one end of the apparatus.

The device **10** is heated electrically by current conducted to it through two fixed horizontal bus bars **12** and **13** to which the heating device is secured by means of screws **15** and **16**. The required degree of heat is uniformly maintained by current at a constant voltage through an induction regulator which is governed automatically by a thermally responsive sensing means in the heating device which operates to control or modulate the temperature therein compensatively with changes in the ambient or room temperature and the rate of transfer of heat to the yarn travelling therethrough, for example, as more particularly described in the aforesaid copending applications.

Our improved twisting and untwisting spindle illustrated in detail in Fig. 2 is an improvement over the types of spindles disclosed in U. S. Patents Nos. 2,089,198 and 2,089,199.

As shown, the spindle **75** is relatively short in length and formed by two sections of light weight tubing preferably of steel, the lower section being telescopically force-fitted partway into the upper section and having a small bore of a diameter to freely pass the travelling yarn. In actual practice, the upper section of the spindle **75** may be 2 in. long and have a diameter of ½ in., and the lower section may be 3⅝ in. long with an outside diameter of 5/16 in. and a bore of 3/16 in., the whole spindle weighing approximately 2 3/10 ounces and the total length of the tube being approximately 4⅝ inches. The periphery of the upper section serves as a driving surface in contact with the belt 8*x* of the otherwise conventional spinning machine. The spindle **75** is journalled in a pair of high speed anti-friction bearings **76**, **77** which are vertically spaced by a sleeve **83** approximately 1 in. long surrounding the lower section of the spindle. The bearings **76**, **77** are lodged, with interposition of rubber cushioning annuli **84**, **84** embracing outer races **96**, **97**, within a compact cylindric housing **78** which extends downward, with circumferential clearance, through an opening **100** in the swing arm **79**, and which itself is cushioned by a rubber washer **101** interposed between a flange **102** adjacent the top thereof and the top surface of said arm, and a similar washer **103** interposed between the bottom surface of said arm and a clamp nut **104** threadedly engaged on the lower protruding portion of said casing.

As shown, the casing **78** is open at the top but protected against ingress of dirt or lint by a disk **105**, with a pendant circumferential overhang flange, rotative with the spindle and secured between the lower end of the upper section of said spindle and the top of the inner race **98** of the upper ball bearing. It is to be noted that the rubber cushioning annuli **84** for the ball bearings **76**, **77** respectively are seated upon circumferential shoulders **106**, **107** circumferentially of the casing **78**, and that the lower bearing **77** is held against upward displacement by inward radial projections of a semi-circular spring keeper **108** element, and that a clamp nut **109** threadedly engaged upon the lower section of the spindle and contacting the bottom of the inner race **99** of the lower ball bearing **77** serves to hold the spindle in the assembly, the lower end of the latter being somewhat reduced in diameter and extending through an axial clearance aperture **110** in the bottom of the casing. In addition to preventing dirt and lint from entering the housing **78**, the disk **105** operates to draw air inwardly of the aperture **110**, through ball bearing assembly **77**, through the housing **78**, through ball bearing assembly **76** to the center of the circumscribing flange of disk **105** and then outwardly through the space between disk **105** and housing **102** to thereby cool the bearings and prolong their life and permit operation at higher speeds. The high speed rotation of disk **105** with its pendant circumscribing flanged portion may be compared in action to a centrifugal impeller on an air blower. The air confined under the disk is caused to move outwardly because of the pressure differential between its axis and periphery at high speeds with the only source of air influx to this impeller being at its center.

A small flanged roll **82** within the top end of the upper section of the spindle is freely revolvable about a crosswise axis pin **111**. It is also to be particularly observed that the opposing side portions of the top end of the upper section of the spindle **75** are cut away concavely as at **112** on a radius greater than that of the flanges of the roll **82**.

Of importance in carrying out the objects of this invention are the improvements in and the advantages of our twisting-untwisting spindle assembly over previously disclosed twisting-untwisting spindles, these advantages being: the interchangeability of the spindle with conventional spindles on conventional twisters; the one-half inch outside diameter of the driving surface of the spindle **75** results, without changing the belt speed, in about double the spindle speed of conventional spindles which usually have approximately one inch outside diameter of their driving surface; the thin wall, short 2 inch length and small one-half inch outside diameter result in a spindle with a substantially irreducible minimum of weight and inertia; the small one-half inch outside diameter and the short 2 inch length of the exposed upper section of the revolving spindle result in a substantially irreducible minimum of windage; the wall thickness of the hollow spindle and the 2 inch length of the exposed section of the revolving spindle are substantially irreducible minima for such type of spindle to be driven in excess of 20,000 R. P. M. by a conventional flat belt; the joining of two metal tube sections provides the most economical means of producing the most durable thin walled and light weight hollow spindle with a driving surface outside diameter of approximately one-half inch and smaller outside diameter bearing surface to accommodate sealed ball bearings of the most suitable presently known size and type to reduce friction losses to substantially an irreducible minimum when operating in excess of 20,000 R. P. M. under the known inertia, friction, windage, vibratory and work loads, and requiring no added lubrication for years; the 1 inch spacing between the ball bearings **76**, **77** is substantially the optimum for operation in excess of 20,000 R. P. M. under the known operating loads; the rubber housing annuli **84** and rubber washers **101** and **103** absorb vibratory shocks and reduce vibratory loads, friction losses, windage and wear; the concaved roundings **112** at the upper end of the hollow spindle permit easy threading of the reverse twist roll **82**; the cover disk **105** protects the ball bearings from dust, lint and yarn waste; the retaining spring **108** serves as a most economical yet reliable means of holding the hollow spindle and bearings in position in the bearing housing **78** as well as an easy means to release the same when required; and the reverse twist roll has many advantages herein more fully set forth.

We have found that, due to the low inertia, friction, windage, vibratory and work loads of our improved spindle, it is possible to operate the spindle at more than twice the speed of conventional spindles, twisting a like yarn the same degree, without any increase in energy consumption; and we have also found that this saving in energy is adequate to operate our heating devices according to the teachings of this invention. Moreover, the design of our improved machine is such as to permit the use of large delivery packages, the absence of any revolving yarn packages makes for less yarn breakage, the twisting and untwisting at one time and at high speeds and the doubling prior to and/or after twisting and untwisting reduces the machine operator's work load, all of which results in substantial labor saving.

Reverse twist roll **82** of Fig. 2 is of particular importance in carrying out the objects of this invention; and it is of importance that anti-friction oilless bearings are utilized, that the approximate dimensions of the roll are 5/16" width, 1/2" diameter 30 tapered flanges, 3/16" diameter roll face 1/8" in width, and that the face tapered flanges of the roll are smooth and polished. With further reference to our reverse twist roll **82**, the oilless bearing is essential to insure free turning so that substantially no added tension is applied to the yarn at this critical point of its travel; the outside dimensions are important to create adequate windage to cool the yarn with a minimum of power consumption; the taper and depth

of the flanges are essential to control the shape of yarn balloon and flow of air to cool the previously heated travelling yarn; the diameter of the roll face is of importance to provide adequate traction to minimize the number of wraps of the yarn about the roll necessary to insure the insertion of one full turn of twist for each revolution of the spindle and to create an adequate balloon to insure adequate cooling of the yarn before the untwisting; the width of the face of the roll is of importance to insure no overlapping of the wraps of yarn about the roll but added traction as a result of the centrifugally induced abutting relation of one wrap of travelling yarn against the next; the smooth polished surfaces of the roll face and tapered flanges are important to prevent catching or chaffing of the yarn; and the size and shape of the tapered flanges in relation to the face of the roll are of importance for ease of removal of yarn waste.

While a particular embodiment of the present invention has been illustrated and described herein, it is not intended to limit the invention precisely to the disclosure and changes and modifications may be made and incorporated therein and thereto within the scope of the following claims.

We claim:

1. A device for twisting-untwisting yarns comprising an elongated tubular spindle having a continuous bore axially therethrough for the passage of yarn, a housing open at its inner end enclosing one end portion of the spindle, said housing having an opening therein at a point removed from the inner open end of the housing, means rotatably mounting the spindle coaxially in said housing comprising bearings fixedly secured in axially spaced relation on said end portion of the spindle, resilient members interposed between the bearings and the interior wall of the housing, and a disk fixed to the spindle intermediate its ends and extending transversely thereof adjacent the open inner end of the housing, said disk being of greater diameter than the housing with a continuous circumferential flange circumscribing the inner end of the housing and operating to cause air to flow inwardly of said opening in the housing and through the latter thereby cooling the spindle.

2. A device for twisting-untwisting yarns comprising an elongated tubular spindle having a continuous bore axially therethrough for the passage of yarn, a housing open at its inner end enclosing one end portion of the spindle, said housing having an opening therein at its outer end of greater diameter than the spindle and coaxially thereof, means rotatably mounting the spindle coaxially in said housing comprising bearings fixedly secured in axially spaced relation on said end portion of the spindle, resilient members interposed between the bearings and the interior wall of the housing, and a disk fixed to the spindle intermediate its ends and extending transversely thereof adjacent the open inner end of the housing, said disk being of greater diameter than the housing with a continuous circumferential flange circumscribing the inner end of the housing and operating to cause air to flow inwardly of said opening in the housing and through the latter thereby cooling the spindle.

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