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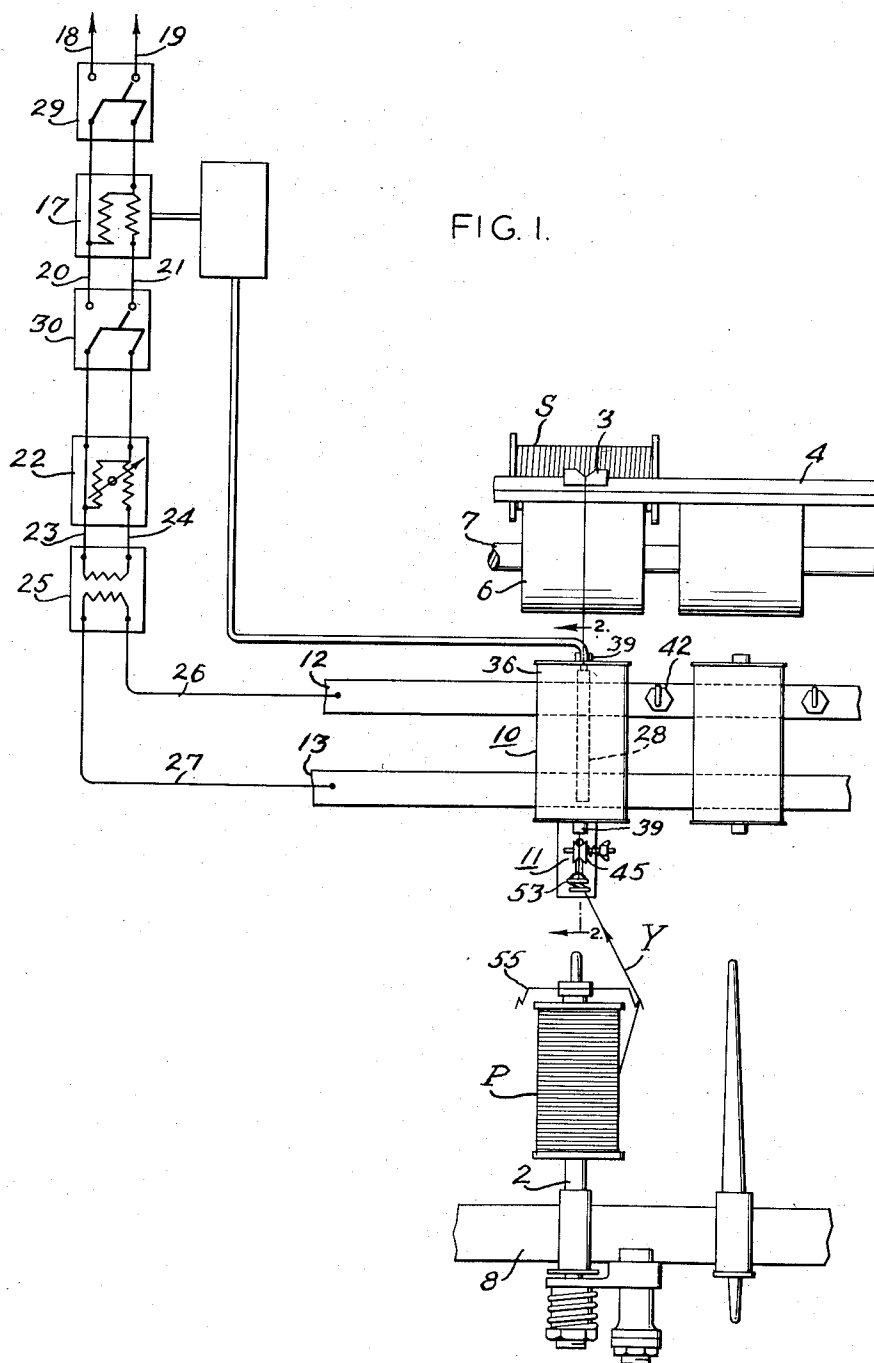
N. J. STODDARD ET AL

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HEATING DEVICE FOR USE IN PROCESSING TEXTILE YARNS

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INVENTORS:

NICHOLAS J. STODDARD

WARREN A. SEEM

BY *Houson & Houson*
ATTYS.

2,864,931

2 Sheets-Sheet 2

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

1
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HEATING DEVICE FOR USE IN PROCESSING TEXTILE YARNS

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

Original application January 4, 1954, Serial No. 401,952, now Patent No. 2,803,105, dated August 20, 1957. Divided and this application April 25, 1955, Serial No. 503,672

5 Claims. (Cl. 219—19)

This invention relates to apparatus for processing thermoplastic textile yarns, and is a division of our application Serial No. 401,952, filed January 4, 1954, now Patent No. 2,803,105. More particularly it is concerned with heating devices on apparatus useful in processing polyamide and other thermoplastic yarns such as nylon, Vinyon, Orlon, Velon, Dacron, saran and the like by thermal treatment with incidental winding, twisting, twisting-untwisting, plying, coning, copping, nubbing, drying, dyeing, coating, singeing, sizing and the like, according to the improved continuous methods disclosed in our co-pending applications, Serial Nos. 401,803 and 401,951, filed January 4, 1954, now Patents Nos. 2,803,108 and 2,803,109, respectively.

Our present invention is directed toward the provision of simple reliable heating device or apparatus with the aid of which the aforesaid methods can be expeditiously carried out at high speeds and at much less cost than possible with the stepwise methods which had to be resorted to heretofore, for the production of improved monofilament, multi-filament, or spun thermoplastic yarns which are of improved uniformity throughout as regards their physical characteristics, i. e., denier size, elongation, elasticity, strength, yield value, contractural force, shrinkage, residual shrinkage, torsion and the like; permanently stabilized uniformly crimped, wavy or fluffed thermoplastic yarns; straight thermoplastic yarns of the kinds disclosed in U. S. Patents Nos. 2,353,666 and 2,411,132; as well as improved uniformly stabilized ply yarns whereof the components may all be thermoplastic, or some of them may be of rayon or the like, or of silk, cotton, linen, or other non-thermoplastic materials.

Other objects and attendant advantages will appear from the following description of the attached drawings, wherein:

Fig. 1 is a fragmentary view, in front elevation, of a thermoplastic yarn processing apparatus conveniently embodying our invention in one form.

Fig. 2 is a fragmentary detail section on a larger scale taken on line 2—2, Fig. 1 showing in detail a specially constructed heating device.

Fig. 3 shows the heating device in top plan, and

Figs. 4 and 5 are views corresponding respectively to Figs. 2 and 3 of a modified form of heating device.

With more specific reference first to Fig. 1 of the drawings, the apparatus there illustrated is basically what is known in the textile art as an "up-twister." One of the usual spindles for a package P of yarn Y to be processed is indicated at 2, one of the traverse guides at 3, the traverse rail at 4, the take-up spool for the processed yarn at S, the drive roll for the spool at 6, and the shaft for the drive roll at 7, said spindle 2 having a diametrically enlarged portion at the bottom tangentially contacted by the belt 8.

In adapting such an up-twister to the purposes of our invention, we arrange in the interval between the spindle 2 and the traverse guide 3, a specially designed heating device 10 and immediately below said device, a specially

2

constructed tensioning means 11 along the line of upward travel of the yarn Y from the supply package P to the take-up spool S.

As presently explained, the device 10 is electrically heated, current being conducted to it through two fixed horizontal bus bars 12 and 13 whereeto said device is secured, with interposition of insulation bushings 14, by screws 15 and 16 as best shown in Fig. 2. The required degree of heat is uniformly maintained by current at a constant voltage (not exceeding twenty-four volts for personal safety) through an automatic induction voltage regulator 17 from a power line 18, 19, said regulator being connected by conductors 20, 21 to a manually adjustable induction voltage regulator 22 connected in turn by conductors 23, 24, to the primary of a step-down transformer 25 in circuit through conductors 26, 27 with the bus bars 12, 13. The output of the induction voltage regulator 17 is automatically governed by a thermally-responsive sensing means 28 incorporated in the heating device 10. The automatic and the manual induction voltage regulators 17 and 22 and the thermostatic sensing means 28 may all be of any approved standard and commercially available types by cooperation of which the temperature in the heating device is modulated compensatively with changes in ambient or room temperature and transfer of heat to a yarn travelling therethrough. Also included in the lines 18, 19 and 20, 21 respectively are suitable manually operable safety hand switches 29 and 30.

As best shown in Figs. 2 and 3, the heating device 10 comprises a tube 32 of non-ferrous material and of small diameter and bore, defining an elongated restricted passage or zone through which the yarn Y is passed, said tube being exteriorly insulated as at 33 with glass or other electrical insulation, and surrounded by a coil 34 of resistance wire. As further shown, the tube 32 is embedded in a thick walled jacket 35 of electric and thermal insulation which may be of fiber glass or of Sil-O-Cel granules encased in a thin cylindric metallic shell 36. At the top and at the bottom, the shell 36 is partly closed by covers 37, which also may be of sheet metal, with interposition between them and the jacket material of disks 38 of Transite or the like to minimize heat transfer from the hot tube 32 to said shell. Fitted over the opposite ends of the tube 32 and passing through the disks 38, are hard wear-resistant bushings 39 of porcelain or the like which prevent cutting of the tube by the yarn passing through it.

It is to be particularly noted that the winding pitch of the heating coil increases progressively from the bottom of the tube 32 at which the yarn enters to the mid height of the tube and progressively decreases at a similar rate toward the top or exit end of said tube. As a result, a greater amount of electrical energy is provided at the entrant and exit ends of the tube thereby making possible the maintenance of a desired uniform temperature throughout tube 32 and the use of a much shorter tube than otherwise would be required. The lead 40 from one end of coil 34 is extended to the exterior through the insulation jacket 35 to the screw 15, and the lead 41 from the other end of said coil to the screw 16, with interposition in the former lead of a hand switch which is diagrammatically indicated at 42 in Figs. 1 and 2 and shown as insulatedly mounted on bus bar 12.

In the modified heating device 10a of Figs. 4 and 5 which may be used in lieu of the one illustrated in Figs. 2 and 3, the yarn tube 32a is axially arranged in an evacuated round ended shell 36a of non-collapsible material, with its ends sealed in bushings 39a hermetically set into the ends of said shell. In this instance, the heating coil 34a is non-inductively wound about the tube 32a which has an exterior coating of insulation like that of the tube 32 of the first described heating unit. In all other respects, the modified heating device 10a may be

considered to be generally like the device 10 and to function in an analogous capacity.

Again referring to Fig. 1, the yarn from the supply package P is threaded upwardly through one eye of the flyer 55 associated with spindle 2, then through the guide 53, then wrapped about the small wheel 45 of the tensioning means 11 in the manner previously stated, then through the tube 32 of the heating device 10, and finally over the traverse guide 3 enroute to the take-up spools S. For the processing of twisted nylon yarn, for example, the induction voltage regulator is adjusted for maintenance of an effective temperature of 250° F. which is modulated with changes in ambient or room temperature by the thermostatic means 28 for maintenance of heat substantially constant in the device 10. In being unravelled from the supply package P in Fig. 1, the yarn is twisted by rotation of the package before it passes to the tensioning means 11 and enters the tube of the heating device 10 enroute to the take-up spool S.

Many of the irregularities in the physical characteristics of commercially delivered thermoplastic yarns are substantially corrected by our means of applying uniform heat to the yarn while under uniform tension as for example, sectional lengths of yarn, stretched less than other sections in the manufacturers producing thereof will stretch more under a given tension and temperature and uniform elevated temperatures while under various uniform tensions, will improve properties of the yarn such as dyeing, tensile strength modulus of elasticity and the like. Also our means of quickly heating and cooling the yarn prevents heat degradation normally resulting from prolonged heating of thermoplastic yarns.

While certain embodiments of the present invention have been illustrated and described herein, it is not intended that the invention be precisely limited to this disclosure and it is contemplated that changes and modifications may be made and incorporated therein and thereto within the scope of the following claims.

We claim:

1. An electric heating device, for use in processing thermoplastic yarn comprising a thin-walled tube of small bore defining an elongated restricted heating zone through which the yarn is continually passed, a coil of resistance wire surrounding the tube substantially throughout the length thereof, the pitch of the coil turns increasing progressively from one end of the tube to the midpoint of the tube and thereafter decreasing progressively toward the other end of the tube, a jacket of thermal insulating material enclosing said tube, a protective shell surrounding said jacket, cover members closing the ends of said protective shell, disks of thermal insulation disposed interiorly adjacent said cover members, and bushings of wear resisting material mounted in said disks of thermal insulation and fitting over the ends of the tube, said bushings having stop flanges in engagement with the inner faces of said disks.

2. An electric heating device, for use in processing thermoplastic yarn comprising a thin-walled tube of small bore defining an elongated restricted heating zone through which the yarn is continually passed, a coil of resistance wire surrounding the tube substantially throughout the length thereof, the pitch of the coil turns increasing progressively from one end of the tube to the midpoint of the tube and thereafter decreasing progressively toward the other end of the tube, a jacket of thermal insulating material enclosing said tube, a protective shell surrounding said jacket, a conductor, the wire of the coil having leads for supplying electric current thereto, one lead of the coil being imbedded in the insulating jacket and connected to a terminal extending exteriorly of the heating

device through the protective shell and the other lead of the heating coil extending through the insulating jacket and shell to the exterior of the heating device and connected to a second terminal mounted in said shell, and a cutout switch connected in the exterior portion of said other lead of the heating coil.

3. An electric heating device, for use in processing thermoplastic yarn comprising a thin-walled tube of small bore defining an elongated restricted heating zone through which the yarn is continually passed, a coil of resistance wire surrounding the tube substantially throughout the length thereof, the pitch of the coil turns increasing progressively from one end of the tube to the midpoint of the tube and thereafter decreasing progressively toward the other end of the tube, and thermal insulating means surrounding said tube comprising an evacuated envelope having seal bushings in its opposite ends through which the corresponding opposite ends of the tube project.

4. An electric heating device, for use in processing thermoplastic yarn comprising a thin-walled tube of non-ferrous material having a small bore and defining an elongated restricted heating zone through which the yarn is continually passed, an exterior coating of insulation on said tube, a coil of resistance wire surrounding the tube substantially throughout the length thereof, the pitch of the coil turns increasing progressively from one end of the tube to the midpoint of the tube and thereafter decreasing progressively from the midpoint toward the other end of the tube, an electric current supply circuit for said coil of wire, an adjustable means in said circuit for determining the voltage of current conducted to said wire, and thermostatic means operable to modulate the voltage of the current compensatably with changes in ambient temperature and rate of transfer of heat to yarn passing through the bore of the tube to thereby automatically regulate the temperature within the tube for uniform processing of the yarn.

5. An electric heating device, for use in processing thermoplastic yarn comprising a thin-walled tube of small bore defining an elongated restricted heating zone through which the yarn is continually passed, a coil of resistance wire surrounding the tube substantially throughout the length thereof, the pitch of the coil turns increasing progressively from one end of the tube to the midpoint of the tube and thereafter decreasing progressively toward the other end of the tube, an alternating electric supply current for the coil of wire, an automatic induction voltage regulator in said circuit, an adjustable induction voltage regulator interposed in the primary circuit of a transformer with said wire coil in the secondary circuit of said transformer, and a thermostatic means operable to govern the automatic induction voltage regulator to modulate the voltage of the current supplied to the wire coil compensatably with changes in ambient temperature and rate of transfer of heat to yarn passing through the bore of the tube.

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