Feb. 11, 1969 E. ERB 3,426,553

APPARATUS FOR CONTINUOUSLY TREATING A YARN

Filed July 27, 1966 Sheet 1 of 3

FIG. 1

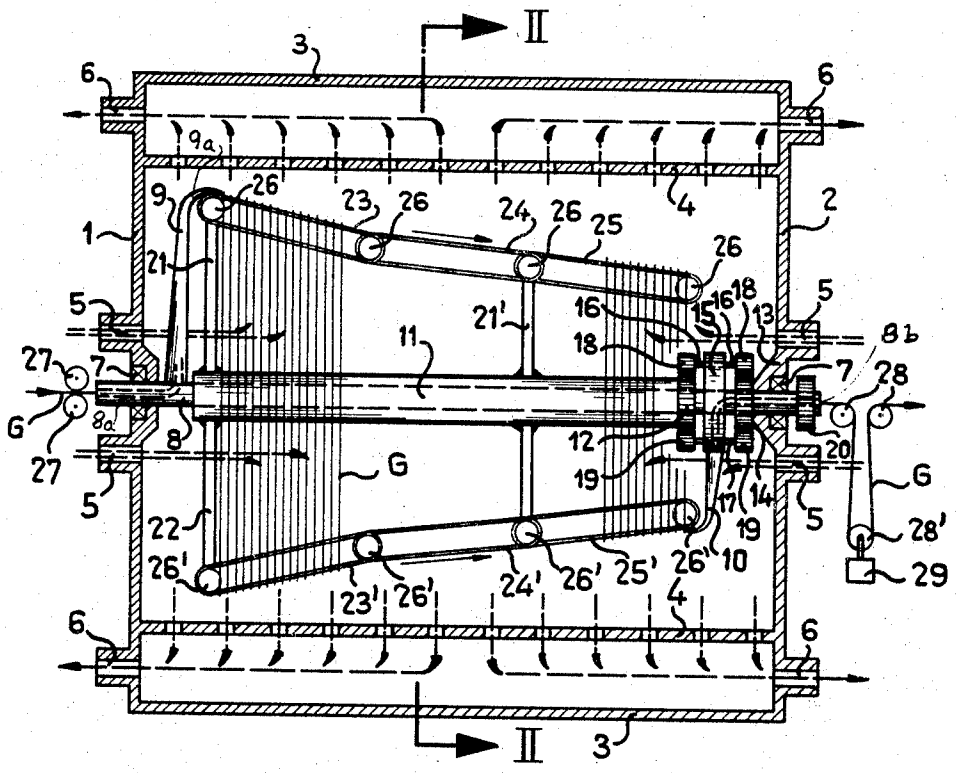
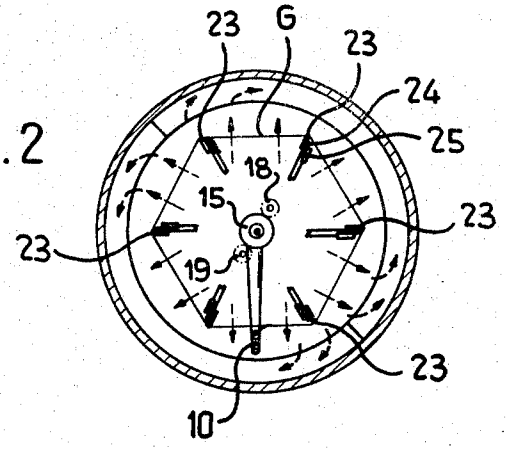


FIG. 2



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APPARATUS FOR CONTINUOUSLY TREATING A YARN

Filed July 27, 1966 Sheet 2 of 3

FIG. 3

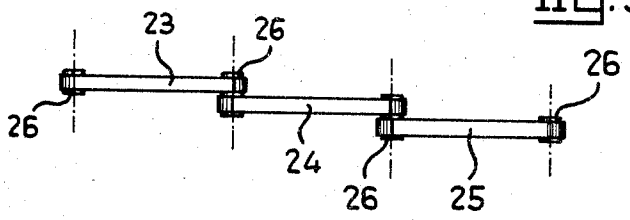


FIG. 4

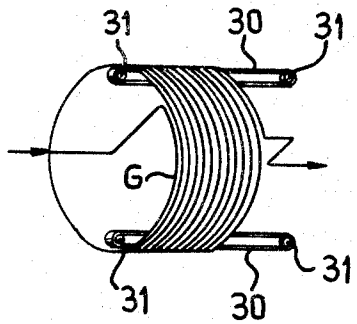
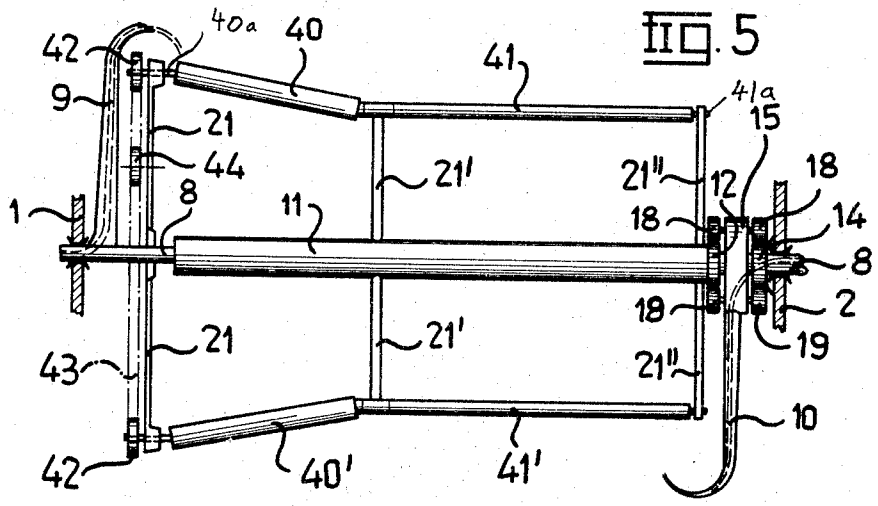


FIG. 5



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APPARATUS FOR CONTINUOUSLY TREATING A YARN

Filed July 27, 1966 Sheet 3 of 3

FIG. 6

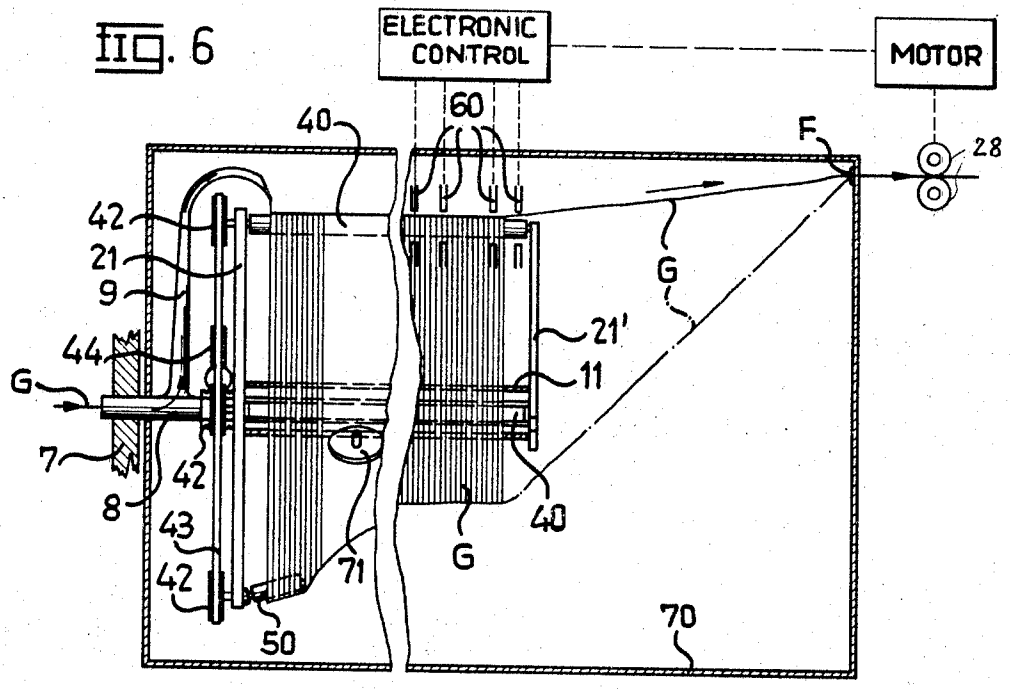
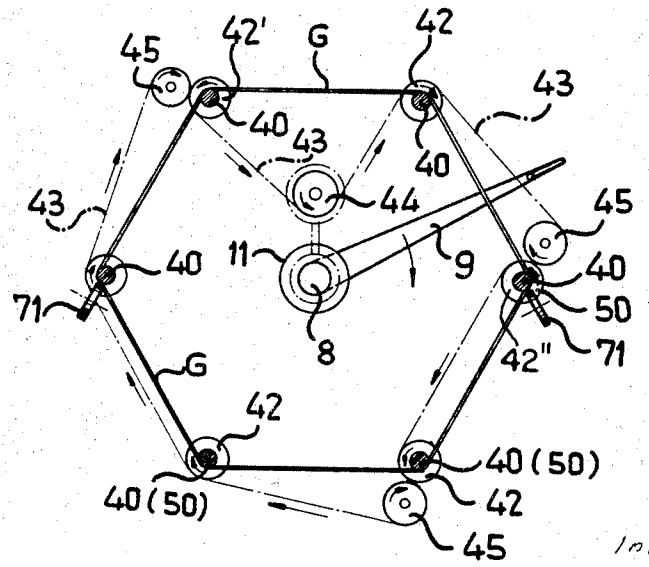


FIG. 7



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3,426,553

APPARATUS FOR CONTINUOUSLY TREATING A YARN

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U.S. Cl. 68—5 17 Claims
Int. Cl. D06f *35/00;* B65h *49/04*

ABSTRACT OF THE DISCLOSURE

A non-rotatable structure including a plurality of conveyors disposed about an axis, receives yarn loops at the receiving ends of the conveyors which transport the loop in the form of a coil to the delivery ends of the conveyors where the leading loop is taken off. The conveyors are designed to cause no rotation of the coil. The apparatus is located in a closed chamber where the yarn is treated.

The present invention relates to an apparatus for continuously treating a yarn, or like flexible element, and more particularly to an apparatus permitting the continuous treating of a coil of the yarn in a treating chamber filled with a treating medium.

It is well known that yarns have to be treated at different stages of the manufacturing process. The treatings may include washing, cleaning, dyeing, finishing, soaking, shrinking, conditioning, drying, and other treatments. For example, a dyed and twisted yarn must be washed, dried, and steamed. If the yarn contains synthetic fibers, a shrinking treatment must also be carried out. If the yarn is a wool yarn, oily deposits have to be removed, and the usual refining treatment has to be carried out.

In accordance with the prior art, the yarn is treated in the form of strands, hanks, coils or packages, resulting in a discontinuous process since the yarns have first to be wound into hanks or coils suitable for the treatment. Operations of this type require a great deal of handling of the yarn, since the washed yarn has to be centrifuged to remove the water, whereupon it is manually taken out of the centrifuge and placed in a drier. The drying requires a great deal of energy, since the many superimposed layers of yarns forming the strands, hanks, or coils very slowly dry throughout requiring not only a great amount of heat, but also a great deal of time causing high labor costs.

It is one object of the invention to overcome the disadvantages of discontinuous yarn treatments, and to provide apparatus for continuously treating the yarn, subjecting the same to one or several different treatments without requiring any manual operation.

Another object of the invention is to provide apparatus for continuously treating a great length of yarn in a comparatively small treating chamber in a continuous process.

Another object of the invention is to treat a yarn in the form of a single layer coil in a continuous automatic process.

The term "yarn" is used in the present application to include any kind of flexible elongated materials, which may be made of endless fibers, of short fibers, of mixtures of endless and short fibers, a monofilament, multifilament, yarns consisting of natural or synthetic fibers, and of any mixtures of natural and synthetic fibers. The thickness or titre of the yarn is irrelevant and the term is meant to include a thin filament and a thick cable.

In accordance with the invention, it is possible to form a bundle, strand, or hank of several yarns, treat the yarn bundle as a whole, and to then separate the yarns again. Such a bundle of yarn must also be considered as a "yarn" as the term is used in the present application.

The treatment of such a yarn bundle according to the present invention is possible because the yarns are not stretched in any way by the treatment so that the length of the separated yarns is not changed after the treatment.

In accordance with the invention, a yarn is continuously laid about the receiving ends of conveyor means so that layer consisting of a coil of loops is formed on the conveyor means and transported by the same without rotation toward the delivery end of the conveyor means where the yarn is taken up, or transported to take-up means. While the yarn is in the form of a coil on the conveyor means, it is treated, preferably in a treating chamber into which a treating medium, such as hot steam, is admitted. A yarn guide is rotated in the region of the receiving end of the conveyor means, which preferably include a plurality of conveyors arranged about an axis, and the yarn loops are continuously transported to the delivery ends of the conveyors from which the leading loops are successively removed either by transporting rollers, or by a second rotating yarn guide which moves about the delivery ends of the conveyors.

If it is desired to relieve the tension of the yarn forming the coil on the conveyors, the conveyors are inclined to the axis of the coil so that the receiving ends of the conveyors are spaced a greater distance from the axis than the delivery ends. The conveyors may form a frusto-conical basket-like structure, or may consist of several successive conveyors converging at different angles. It is also possible to have converging and non-converging sections of the conveyors.

In order to prevent that the yarn loops are always supported on the conveyors at the same points it is advantageous to make each conveyor of a plurality of conveyor sections which are circumferentially spaced from each other.

In order to maintain on the conveyors a yarn coil of constant length, while new loops are laid and the leading loops removed from the conveyors, the feeding speed must be the same as the take-up speed. This can be accomplished by rotating the feeding thread guide at the same speed as the thread guide which takes the leading loops off the conveyors. In accordance with a modified embodiment of the invention, photoelectric sensing means are provided which sense the position of the leading yarn loops at the delivery ends of the conveyors and control the take-up means to transport the yarn at a corresponding speed so that the right length of yarn is taken off the delivery ends of the conveyors. This is particularly advantageous if one treating apparatus is followed by another in which event the feeding of the yarn to the second apparatus can be automatically synchronized with the taking off of the yarn in the first apparatus.

A series of treating apparatus may follow each other directly or other treating devices may be provided between two treating apparatus of the invention.

For washing and following drying of a yarn it is advantageous to guide the yarn in the form of a helix over a drum with a correlated spacing roller, while the yarn is washed due to immersion of the drum and/or the distance roller into a washing liquid. After this continuous washing operation, the yarn is guided into the apparatus of the invention and dried in the same while transported as a coil by the conveyors.

The conveyors may be constructed as endless conveyor bands, as conveyor chains, as threaded spindles or any other suitable transporting conveyor.

In a preferred embodiment of an apparatus of the invention, the conveyors are circumferentially spaced about an axis, but are supported so as to not rotate about the axis. A drive shaft is located in the axis, and has a thread guiding arm which has a yarn outlet revolving about the

receiving ends of the conveyors to lay successive yarn loops about the same which are immediately transported by the conveyors toward the delivery ends of the same so that room for new yarn loops is available at the receiving ends. The leading loop at the delivery ends of the conveyors is either guided through a rotating second thread guide and then transported to a suitable take-up means, or transporting rollers draw off and transport the yarn in axial direction away from the delivery ends of the conveyors while taking off one leading loop after the other from the delivery ends.

The speed at which the yarn is taken off the conveyors and the speed at which it is laid in loops about the conveyors are synchronized with the speed of the conveyors.

The angle of the conveyors to the axis may be adjusted either for the entire length of the conveyors or for sections of the same. Some conveyors may be shorter than others so that the yarn coil is suspended from the remaining longer conveyors permitting untensionnig of the yarn.

The thickness of the yarn layer on the conveyors depends on the thickness of the yarn, assuming a certain speed of the apparatus. By changing the ratio between the angular speed of the thread guide, and the speed of the conveyors, the thickness of the layer can be varied for the same yarn. However, overlapping yarns are to be avoided since they render the taking off of the yarn from the conveyors very difficult.

When several yarns are successively treated on the same apparatus it is advantageous to connect the yarns by an intermediate yarn or cord which remains on the conveyors in the machine after the first yarn has been removed so that it is easy to wind the second yarn on the conveyor structure.

If several yarns are to be treated simultaneously, the yarns are guided toward each other to form a bundle, and this bundle is treated as a yarn and laid in loops about the conveyor structure, as explained above. Since the yarn is wound up and taken off the conveyors at the same rotary speed, it is easy to separate the individual yarns of the bundle for winding the same on separate reels. To separate the yarns of a bundle, a perforated strip is used through which the individual yarns are guided.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a schematic longitudinal sectional view illustrating an embodiment of the invention, with some of the conveyors omitted for the sake of simplicity;

FIG. 2 is a fragmentary schematic cross section on a reduced scale taken on line II—II in FIG. 1, with some parts omitted for the sake of clarity;

FIG. 3 is a fragmentary, schematic plan view illustrating the uppermost conveyor means of the embodiment of FIG. 1;

FIG. 4 is a fragmentary schematic view illustrating the formation of a coil of the yarn on the conveyor means;

FIG. 5 is a fragmentary schematic elevation illustrating another embodiment of the invention, with certain parts illustrated in FIG. 1 omitted for the sake of simplicity;

FIG. 6 is a fragmentary schematic longitudinal section illustrating another embodiment of the invention; and

FIG. 7 is a fragmentary schematic end view, partially in section, illustrating the embodiment of FIG. 6.

Referring now to the drawings, and more particularly to FIGS. 1 and 2, a treating chamber has a front wall **1**, a rear wall **2**, and an inner cylindrical wall **4**. An outer cylindrical wall **3** forms an annular chamber with cylindrical wall **3** provided with outets **6**. Front wall **1** and rear wall **2** have inlet openings **5** for treating medium, for example steam, which fills the treating chamber and

then passes through openings in the inner cylindrical wall **4** into the outer annular chamber from where it is discharged through outlet openings **6** from which it may be recirculated into a treating chamber.

Walls **1** and **2** support bearings **7** for a drive shaft **8** which carries a feed arm **9** and a take-off arm **10**.

A pair of feeding rollers **27** feeds a yarn G into a guide channel **8***a* in the end portion of shaft **8** from where the yarn passes through a guide channel in the rotating arm **9** and out of the outlet portion **9***a* at the outer free end of the same. The arm **10** has an inner guide channel communicating with a guide channel **8***b* in the other end of shaft **8**. A yarn guided through arm **10** and guide channel **8***b* is transported by rollers **28** forming a compensating loop in which a roller **28'** supports a weight **29**.

A tubular support **11** envelops shafts **8** and carries a gear **12**. The inner portion of guide arm **10** is secured to a circular flange **15** of shaft **8**, in which a pair of shafts **16** and **17** is mounted. Pinions **18** and **19** are secured to shafts **16** and **17**, one pair of pinions **18**, **19** meshing with gear **12** on support **11**, and the other pair of pinions **18**, **19** meshing with a gear **14** secured to a stationary portion of wall **2**. During rotation of shaft **8** with flange **15** and shafts **16**, **17**, pinions **18** and **19** roll on gears **14** and **15** so that support **11** cannot turn on shaft **8**. In this manner support **11** is locked, although it is separated from the walls of the casing by the rotating arms **9** and **10**.

Radial arms **21**, **22**, **21'**, **22'** and other arms, not shown, respectively support rollers **26** about which conveyor bands **23**, **24**, **25** pass. In the illustrated embodiment six conveyor means **23**, **24**, **25**, are arranged equidistant from the axis of shaft **5** and tubular support **11** and angularly spaced the same distance from each other, as shown in FIG. 2. In FIG. 1 only two conveyor means are shown for the sake of simplicity. The conveyor bands **23**, **24**, **25** of the same conveyor means are circumferentially staggered, and the conveyor bands **23** converge toward the axis of shaft **8** at a steeper angle than conveyor bands **24** and **25**. The conveyor bands are driven so that the outer band portions move in the direction of the arrows from the receiving ends of the conveyor means located on the left of FIG. 1 to the delivery ends of the conveyor means located on the right of FIG. 1. The outlet portion **9***a* of yarn guide arm **9** moves along a circle about the receiving ends of the conveyor means, and overlaps the receiving ends of the conveyor means so that during rotation of shaft **8**, a loop of the yarn is laid about the receiving ends of the six conveyor means. Since the conveyor means transport the loop immediately toward the right as viewed in FIG. 1, room is made for the next following loop which is laid by the outlet portion **9***a* of the rotating yarn arm guide **9**. A coil is formed of the yarn loops and the leading thread loop in the region of the delivery end of the conveyor means is guided into the inlet portion of yarn guide arm **10** and out of the shaft portion **8***b* to the transporting take-up rollers **28** so that the yarn moves in the form of a coil continuously through the treating chamber. The progress of the yarn coil is schematically shown in FIG. 4 which shows, however, only two conveyors **30** running over roll **31** while actually more conveyors are provided to support the yarn loops in a substantially circular or polygonal shape.

As also shown in FIG. 3, the conveyor belts **23**, **24**, **25** pass over common rollers **26** so that the delivery end of each conveyor overlaps with the receiving end of the next following conveyor. Since adjacent receiving and delivery ends are circumferentially spaced, they support different portions of the loops travelling with the conveyors in axial direction which has the advantage that no pressure marks are formed on the inside of the yarn loops. Due to the inward slant of the conveyor bands, the loops are less tensioned as they are transported toward the delivery end of the conveyor structure. The conveyor bands are driven from drive shaft **8** over transmission means, not shown in FIG. 1, corresponding to

the chain drive which will be explained with reference to FIG. 6 hereinafter. The transporting speed of the conveyors is regulated depending on the rotary speed of yarn guide arm **9** so that the coil formed on the conveyor structure by yarn G is a helix having a substantially uniform pitch. The coil travels in substantially axial direction along conveyors **23**, **24**, **25** while the loop leading at any time is removed through guide arm **10** by the action of transporting take-up rollers **28**. The roller **28'** and the weight **29** assure a uniform tension of the transported yarn. The yarn may be wound on a take-up reel, or transported to another treating apparatus.

The embodiment illustrated in FIG. 5 corresponds to the embodiment of FIG. 1 and corresponding parts are illustrated by like reference numerals. Only portions of front wall **1** and rear wall **2** are shown, and it will be understood that a casing with a treating chamber as shown in FIG. 1 surrounds the structure illustrated in FIG. 5. Drive shaft **8**, yarn guide arms **9** and **10**, tubular support **11**, gear means **12**, **14**, **18** and **19** and supporting arms **21'**, **21''** are provided as in the embodiment of FIG. 1. Instead of conveyor bands, threaded spindles **40**, **41** and **40'** and **41'** are mounted for rotation on arms **21**, **21'** and **21''**. Spindles **40** and **41** are connected for relative angular movement by universal joints schematically shown in FIG. 5, which are supported by support support arms **21'**. Shaft portions **40***a* and **41***a* are respectively supported for rotation in support arms **21** and **21''**. Shaft portions **40***a* carry chain wheels **42**, see also FIG. 7, about which a chain **43** passes which is driven by a chain roller **44** connected by adjustable transmission means to shaft **8**.

As described with reference to FIG. 1, the yarn guide arm **9** rotating with shaft **8** lays loops about the receiving ends of threaded spindles **40** which are rotated in such a direction that the newly laid yarn loops travel to the right as viewed in FIG. 5, providing room for the next following laid yarn loop. The leading yarn loop at the delivery ends of threaded spindles **41** is taken off by the rotating yarn guide arm **10**, and the corresponding length of yarn is transported by transporting rollers, not shown in FIG. 5, out of the guide channel in shaft **8**.

As shown in FIG. 7, it is possible to guide the chain **43** about chain wheels secured to auxiliary rollers **45** which drive rollers **42'** on some of the threaded spindles **40** in a direction of rotation opposite to the direction of rotation of the other rollers and spindles. Oppositely rotating spindles have opposite threads, for example the spindles rotating in one direction have right hand thread and the spindles rotating in the opposite direction have left hand thread. Consequently, all spindles transport the yarn loops thereon in the same direction as explained above, but since opposing forces are exerted by the oppositely rotating threaded spindles in circumferential direction on the yarn, the yarn loops and the coil formed of the same is not rotated as a whole in one direction, which is possible if all conveyor spindles rotate in the same direction. Consequently, the yarn does not move in circumferential direction lengthwise, but the loops formed of the yarn are transported in parallel positions in the longitudinal direction of the conveyor spindles **40**, **41**. The newly laid loops pass to the delivery ends of the threaded spindles **40**, **40'**, which are spaced a lesser distance from each other than the receiving ends of threaded spindles **40**, **40'** so that the loops are loosely supported on the delivery ends of threaded spindles **40**, **40'** and are not tensioned when they are transported by the transporting spindles **41**, **41'**.

Another embodiment of the invention is illustrated in FIG. 6. The treating chamber **70** is only schematically indicated, and may be constructed as described with reference to FIG. 1. Shaft **8** carries a yarn guide arm **9** by which loops are laid about the receiving ends of a plurality of threaded spindles **40**, as described with reference to FIG. 5. In the lower portion of the conveyor structure, the two lowermost threaded spindles **50** are made very short so that only the first laid loops are supported on the upper four threaded conveyor spindles and on the short threaded conveyor spindles **50**, see also FIG. 7. The loops transported by the upper conveyor spindles beyond the ends of the lower conveyor spindles **50** are no longer tensioned and are loosely suspended from the upper threaded conveyor spindles **40** while travelling toward the delivery ends of the threaded spindles **40**. Casing **70** has an outlet opening F for the end of the yarn and transporting rollers **28** pull the yarn G off the delivery ends of the threaded spindles **40**. Photoelectric sensing means **60** including sources of light and photocells respond successively when covered by loops of the yarn, or when uncovered by the same, and control the drive means of transporting rollers **28**, so that the speed of the transporting rollers is adjusted in such a manner that neither too much yarn or too little yarn is taken off the delivery ends of the threaded conveyor spindles **40**.

The leading loops on the delivery ends of the threaded conveyor spindles **40** are successively pulled off the conveyor spindles. Since no rotating yarn guide arm is provided in the embodiment of FIG. 6, the gear arrangement for locking tubular support **11** against rotation can be omitted. A wheel **71** is supported on the casing **70** and rolls on a cylindrical member **40** to prevent rotation of the conveyor structure.

The arrangement of the invention has the advantage that the yarn passes into and out of the treating chamber through very small inlet and outlet openings, so that the inlet and outlet openings can be sealed about the yarn without difficulties. For example, a suitably dimensioned tube consisting of polytetrafluoroethylene can be inserted through the guide channel in shaft **8** into the guide channel in guide arm **9** up to the outlet portion **9***a* so that a sealing which is pressure tight is obtained. If the curvatures of the sealing tube and of the yarn guide arm are merged into each other, the yarn passes to the same with very little friction.

In the embodiments of the invention in which the take-up yarn guide **10** is provided, it is not absolutely necessary to rotate guide arm **10**. When the yarn is pulled out by transporting rollers **28**, it is capable of rotating a yarn guide arm which is mounted for free rotation on shaft **8**. Yarn guide arm **10** only serves the purpose of preventing the pulling off of several loops from the conveyor structure and even if the take-off yarn guide **10** is provided take-up transporting means, as shown at **28**, are required.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of yarn treating apparatus differing from the types described above.

While the invention has been illustrated and described as embodied in a yarn treating apparatus for transporting a yarn coil through a treatment station in a continuous operation, it is not intended to be limited to the details shown since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

What is claimed as new and desired to be secured by Letters Patent is:

1. An apparatus for continuously treating a yarn or like elongated flexible element, comprising, in combination, a conveyor structure including a plurality of conveyor means disposed about an axis and having receiving ends and delivery ends spaced along said axis; support means for non-rotatably supporting said conveyor structure; drive means; yarn guide means located in the region of said receiving ends and rotated by said drive means about said axis for laying a yarn in successive loops about said receiving ends so that a coil of yarn loops is formed on said plurality of conveyor means, said plurality of conveyor means including displacing means for moving said yarn loops only in axial direction between said receiving and delivery ends of said conveyor

means without rotation of said coil about said axis; transporting means for taking the end of the yarn off said delivery ends of said conveyor means; and treating means for treating said coil of yarn loops on said conveyor means.

2. An apparatus as claimed in claim 1 comprising other yarn guide means mounted for rotation about said axis in the region of said delivery ends for guiding the yarn from said delivery ends to said transporting means.

3. An apparatus as claimed in claim 2 wherein said drive means include a drive shaft having said axis and supporting and rotating both said yarn guide means.

4. An apparatus as claimed in claim 1 wherein said axis is horizontal; and wherein said transporting means include driven take-off roller means located at said delivery ends and transporting the yarn in axial direction so that the leading loop of the yarn is taken off said delivery ends.

5. An apparatus according to claim 1 wherein said treating means include a treating chamber enveloping said conveyor means and having inlet means and outlet means for steam.

6. An apparatus according to claim 1 wherein said drive means include a drive shaft having a guide channel for the yarn in a shaft end portion located in the region of said receiving ends; and wherein said yarn guide means includes an arm on said drive shaft having an inner guide channel communicating with said first mentioned guide channel and an outlet portion axially overlapping and located outwardly of said receiving ends and moving along a circular path about the same for laying a yarn supplied through said guide channel about said receiving ends.

7. An apparatus according to claim 6 wherein said drive shaft has a second guide channel in its other end portion in the region of said delivery ends; and including a second arm on said drive shaft having a guide channel communicating with said second guide channel and an inlet portion moving about a circular path in the proximity of said delivery ends; and wherein said transporting means transport the yarn from said delivery ends through said guide channel in said second arm and said second guide channel so that the leading loop is taken off said delivery ends.

8. An apparatus according to claim 6 and including a sealing tube consisting of polyfluorethylene polymer and located in said guide channels.

9. An apparatus according to claim 1 wherein each of said conveyor means includes at least one endless conveyor band.

10. An apparatus as claimed in claim 1 wherein each conveyor means includes a spindle; wherein said displacing means include right hand thread on some of said spindles and left hand thread on at least one other spindle; and wherein said drive means include transmission means for driving the right hand thread and left hand thread spindles in opposite directions for transporting the yarn loops from said receiving ends to said delivery ends without rotating said coil.

11. An apparatus according to claim 1 wherein each of said conveyor means includes a plurality of successive conveyors, said conveyors having delivery ends located in the region of the receiving ends of the next following conveyor; and including universal joint means connecting successive conveyors for angular relative movement.

12. An apparatus according to claim 1 wherein said receiving ends of said conveyor means are spaced a greater distance from said axis than said delivery ends so that said yarn loops are less tensioned in the region of said delivery ends than in the region of said receiving ends.

13. An apparatus according to claim 1 wherein each of said conveyor means includes a plurality of successive endless band conveyors inclined at different angles to said axis, and wherein the delivery end of at least one of said conveyors is spaced a lesser distance from said axis than said receiving ends.

14. An apparatus according to claim 1 wherein each conveyor means includes a plurality of successive conveyors, the delivery end of each conveyor being located adjacent the receiving end of the next following conveyor staggered in circumferential directions so that said conveyors support different portions of said yarn loops.

15. An apparatus according to claim 1 wherein said drive means include a drive shaft; wherein said support means include a tubular support member surrounding said drive shaft, and supporting arms for supporting said conveyor structure; and including a fixed sun gear, a sun gear secured to said tubular support, a planetary carrier secured to said drive shaft intermediate said sun gears, and planetary pinions supported on said carrier for rotation and meshing with said sun gears so that rotation of said tubular support by said drive shaft is prevented.

16. An apparatus according to claim 15 and including a yarn guide arm supported on said carrier and rotating with said drive shaft for guiding the yarn from said delivery ends of said conveyor means, said guide arm, carrier, and drive shaft being formed with a guide channel for the yarn opening in an end face of said drive shaft; and wherein said transporting means pull the yarn out of said guide channel.

17. An apparatus for continuously treating a yarn or like elongated flexible element, comprising, in combination, a plurality of conveyor means disposed about a horizontal axis and having receiving ends and delivery ends spaced along said axis; support means for supporting said conveyor means; drive means; yarn guide means located in the region of said receiving ends and rotated by said drive means about said axis for laying a yarn in successive loops about said receiving ends so that a coil of yarn loops is formed and transported between said receiving and delivery ends of said conveyor means, said conveyor means including upper conveyor means and lower conveyor means, said upper conveyor means being longer than said lower conveyor means, said lower conveyor means being located in the region of said receiving ends of said upper conveyor means and terminating in axial direction before the delivery ends of said upper conveyor means so that only the first loops are laid about said upper and lower conveyor means while the loops on said delivery ends of said upper conveyor means are suspended from the same and untensioned; transporting means for taking the end of the last yarn loop off said delivery ends of said conveyor means; and treating means for treating said coil of yarn loops on said conveyor means.

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WILLIAM I. PRINCE, *Primary Examiner.*

U.S. Cl. X.R.

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