July 16, 1963 B. H. FOSTER 3,097,471

METHOD AND APPARATUS FOR COVERING THREAD

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FIG. 1.

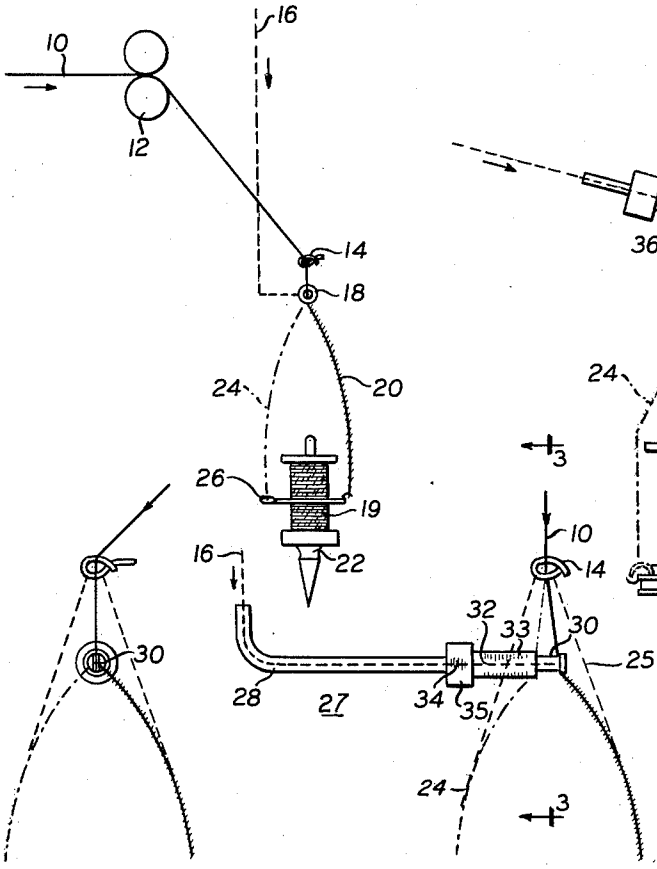
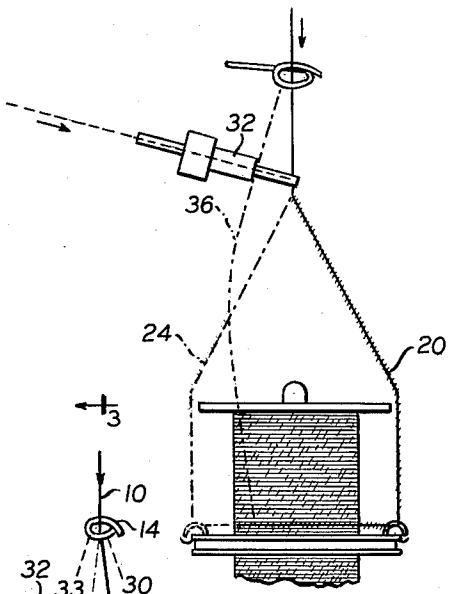


FIG. 4.



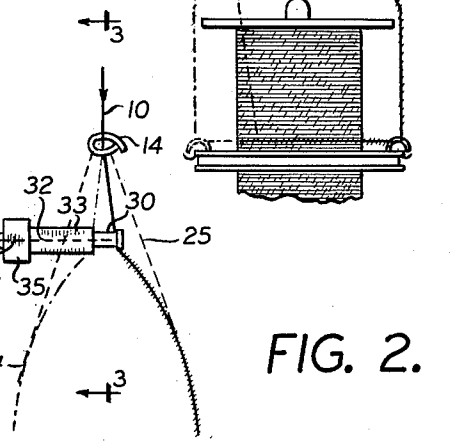


FIG. 2.

FIG. 3.

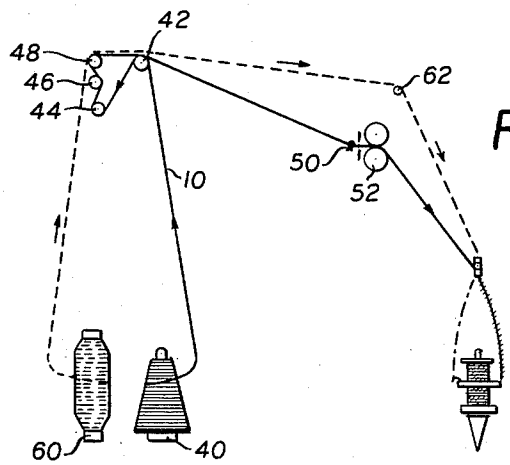


FIG. 5.

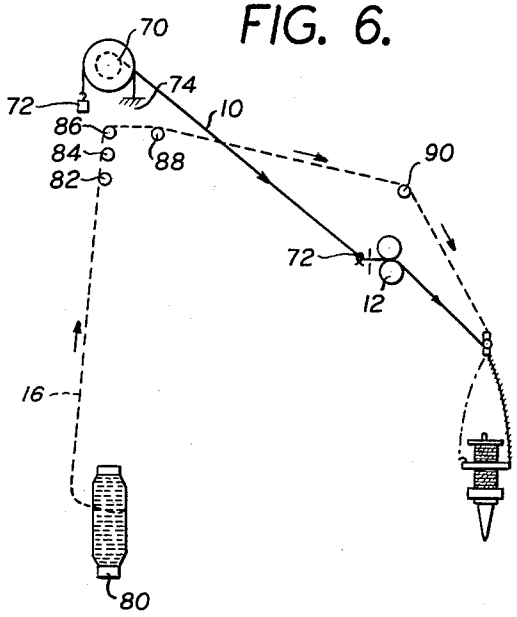
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METHOD AND APPARATUS FOR COVERING THREAD

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FIG. 6.



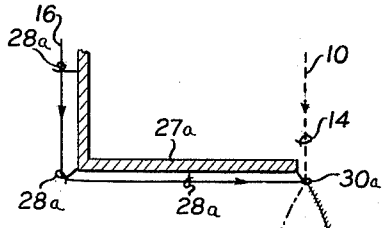


FIG. 2A.

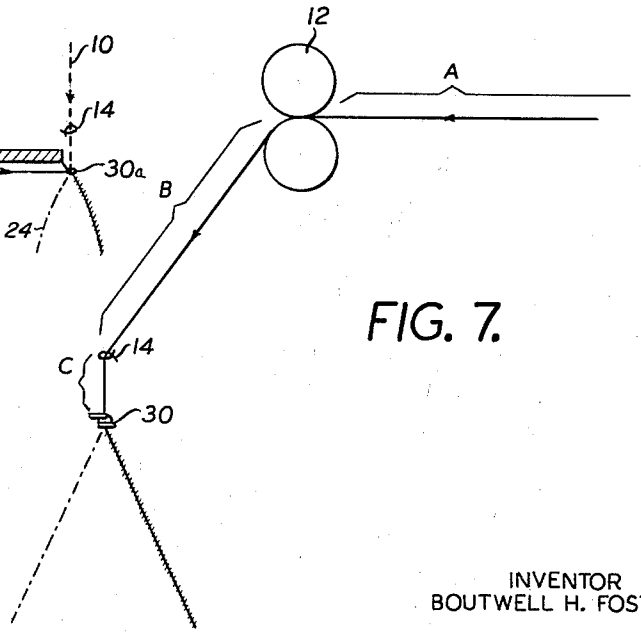


FIG. 7.

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FIG. 8.

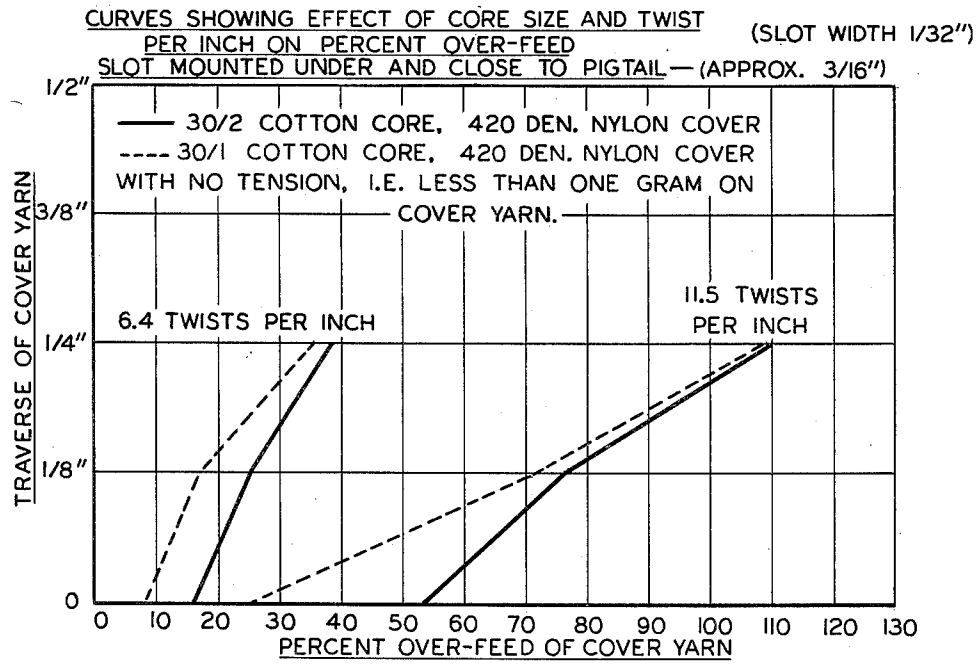
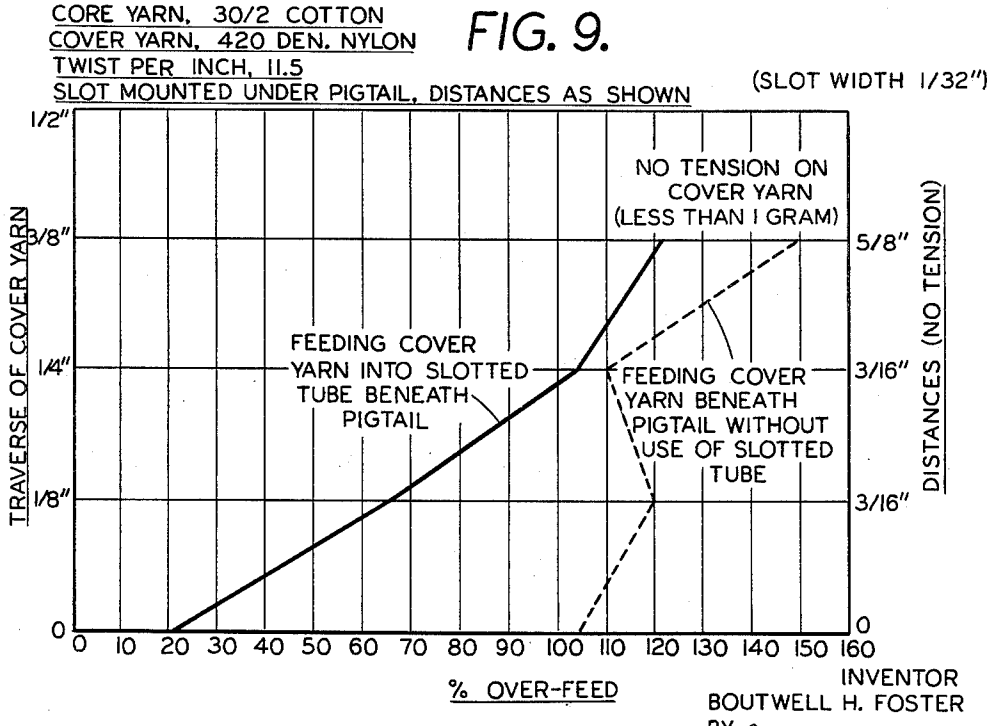


FIG. 9.



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FIG. 10.

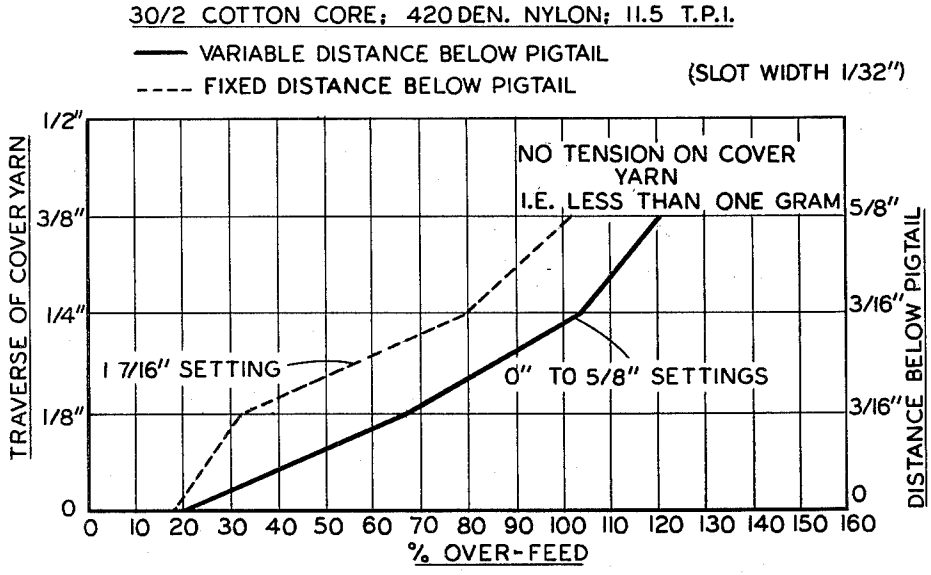
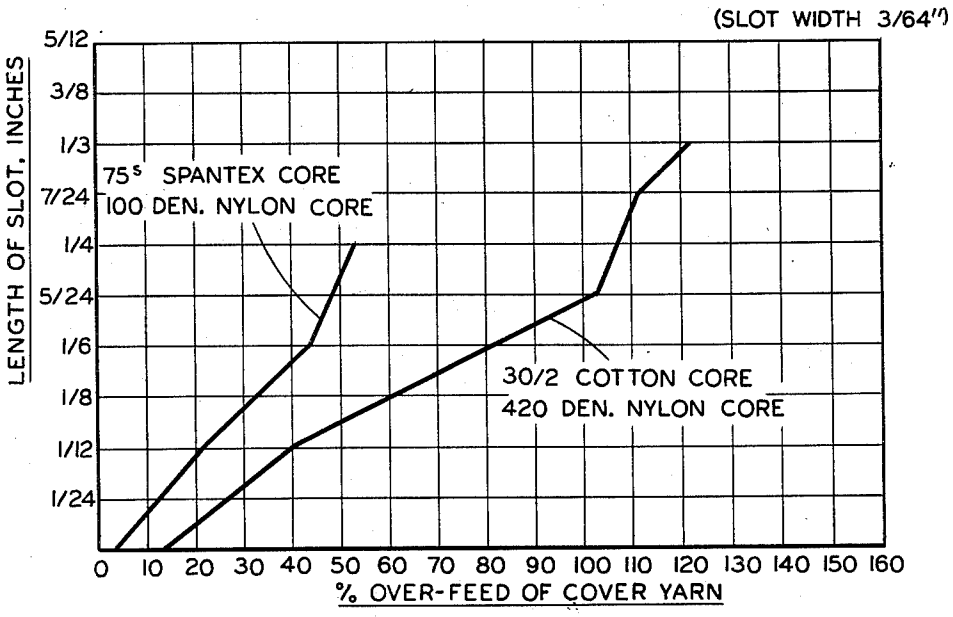


FIG. 11.



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METHOD AND APPARATUS FOR COVERING THREAD

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12 Claims. (Cl. 57—12)

This invention relates to a novel method and apparatus for covering threads. More particularly, this invention relates to a method and apparatus for covering threads, the apparatus comprising feed means for said thread, a spool for storing yarn-covered thread, means for disposing the covered thread on the spool, means for guiding the thread from the feed means to the disposing means, means for delivering the cover yarn to the thread in a lateral zone between the thread guiding means and the disposing means, whereby the yarn balloon is caused to conform to a predetermined pattern so that the length of the cover can be regulated at the point of wrapping.

At the present time there are three well known methods for the covering of threads with a suitable cover yarn. One of these utilizes a hollow spindle for the passage of the core thread and a ring-traveler to wrap the covering yarn about the core. A second method utilizes a cotton spinning frame wherein drafted fibers are wrapped about a rubber thread (during the twisting operation). The rubber thread either by-passes the set of drafting rolls or else is fed through the front delivery rolls along with the drafted fibers. The third method utilizes a twister frame. This twister frame is generally equipped with an extra set of feed rolls in order to feed the cover yarns faster than the core thread.

In all cover yarn constructions the cover yarn is always longer than the core thread for any given length of covered yarn. That is, the cover yarn must be fed faster than the core thread for twisting. This difference in length is frequently referred to as "over-feed." The over-feed has an important bearing on such properties as softness, bulk, the degree to which the core thread is covered, balance, hand, appearance of the end product, and the like.

Whenever the over-feed is less than about 12%, the length of the cover yarn is governed primarily by the number of turns of twist and the diameter of the core thread. With over-feeds of greater than about 12%, however, a genuine problem is encountered, for heretofore there has been no reliable or accurate way of controlling the length of the cover yarn.

Accordingly, it is an object of this invention to provide a novel apparatus for controlling the length of cover yarn at ranges beyond the length of that obtained from the usual twisting operation, that is, by the number of twists and the diameter of the core thread.

Another object is to provide an apparatus whereby a greater degree of precision and control of feeding cover yarn to core thread is afforded than was heretofore possible.

Yet another object is to provide an apparatus for covering core threads whereby a greater variety of end characteristics of the covered thread are obtainable.

A further object is to provide a novel method for covering a core thread with cover yarn, which method affords a greater degree of precision and control and hence a greater variety of end characteristics of covered thread than was heretofore obtainable.

Additional objects and characteristics of the invention will become apparent hereinafter.

My invention will be more fully understood by reference to the accompanying drawings, wherein:

FIG. 1 is a schematic representation showing one embodiment of my apparatus for feeding the thread and cover yarn;

FIG. 2 is an enlarged section of that area of FIG. 1 around the pigtail guide and shows an adjustable slotted tube for the introduction of the cover yarn to the core thread beneath the thread guide means;

FIG. 2A shows an alternative embodiment of my invention and is an enlarged section of that area around the pigtail guide and shows a member to which is attached a series of guides for the introduction of the cover yarn to the core thread beneath the thread guide means;

FIG. 3 is a side view taken along the line 3—3 of FIG. 2;

FIG. 4 is a schematic illustration showing the two images that are seen by the naked eye when my apparatus is in operation;

FIG. 5 is a schematic representation showing the apparatus arranged for use in the production of covered thread wherein the core thread is non-stretchable;

FIG. 6 is a schematic representation showing the apparatus arranged for use in the production of a covered thread wherein the core thread is elastic or stretchable;

FIG. 7 schematically illustrates certain desirable operating conditions of my apparatus when used to produce such covered stretchable thread;

FIG. 8 is a graph showing the over-feed obtainable as a function of the length of traverse of the cover yarn and core thread in the slotted tube shown in FIG. 2;

FIG. 9 is a graph showing the degree of control in over-feed obtainable with and without the use of my slotted tube construction;

FIG. 10 is a graph showing the effect of distance of the slotted tube from the core thread guide means upon the degree of control obtainable and upon end yarn characteristics; and

FIG. 11 is a graph showing the wide range of control in over-feed characteristics obtainable through the use of my apparatus.

My invention will be better understood by reference to the accompanying drawings, and particularly to FIGS. 1 and 2. Core thread **10** is fed into a pair of rollers **12** and then through a pigtail guide **14**. Cover yarn **16** is introduced at a zone generally designated by the reference numeral **18**, this zone being beneath the pigtail guide **14**, that is, between the pigtail guide **14** and spool **19**. Spool **19** serves to store the covered thread **20**. The spool is mounted on rotatable twister spindle **22**. The rotating twister spindle **22** causes the cover yarn to be twisted around the core thread. The centrifugal force from the rotation causes the covered thread **20** to conform to the shape of a yarn balloon **24**. Ring-traveler **26** traverses up and down the length of spool **19** and accordingly distributes the covered thread **20** evenly over the spool. Referring to FIG. 2, cover yarn **16** passes into a guide device, generally designated by the numeral **27**. This guide device comprises a tube **28**, one end of which contains a slot **30**. A sleeve **32** has internal threads **33** which match external threads **34** on tube **28**. Accordingly, the sleeve can be adjusted by rotating the head **35** thereof to thereby cause the sleeve **32** to either decrease or increase the length of the slot **30**. The slot **30** is desirably disposed directly beneath pigtail guide **14**. Both the core thread **10** and the cover yarn **16** are caused to traverse through this slot. Since the cover yarn **16** is introduced to the core thread **10** at a point beneath the pigtail **14**, the periphery of the yarn balloon **24** is restricted and caused to conform to a desired predetermined pattern. (The periphery of the yarn balloon as it would have appeared without restriction is shown by dotted line **25**.) Further, slot **30** provides a zone wherein both cover yarn **16** and core thread **10** traverse laterally back and forth a predetermined distance as they join for twisting. This

slot compels the cover yarn to remain in close proximity with the core thread while the twisting occurs so as to promote uniform coverage of the core thread.

The over-feed is readily controlled and adjusted by merely controlling the length of the lateral traverse of the core thread and cover yarn in the slot **30**, and this control is effected by simply adjusting the position of the sleeve **32** with respect to the slot **30**.

In accordance with another embodiment of my invention shown in FIG. 2A, instead of a guide device comprising a slotted tube and rotatable sleeve (FIG. 2), a solid member **27***a*, to which a plurality of pigtail guides **28***a* are attached, can be used to deliver the cover yarn **16** to the core thread **10** at a point below pigtail guide **14**. A pigtail guide **30***a* having a small cross-sectional area is secured at one end of member **27***a*. As the cover yarn **16** and core thread **10** are brought together through pigtail guide **30***a*, the small cross-sectional area of the guide **30***a* keeps the cover yarn in close proximity with the core thread while the twisting occurs and this results in uniform coverage of the core thread.

Of course, devices other than slot **30** or pigtail guide **30***a* can be used to provide the requisite small cross-sectional area zone for the juncture of cover yarn and core thread. I have found that the maximum cross-sectional area at this juncture point should not exceed about 0.20 square inch when making non-stretchable covered threads, and should not exceed about 0.02 square inch when making stretchable covered threads. The minimum cross-sectional area at this juncture point is limited only by the cross sectional areas of the core thread and cover yarn. That is, the cross-sectional area at the juncture point must exceed the cross-sectional area of cover yarn and core thread by a margin sufficient to permit the covered thread to pass through such cross-sectional area without appreciable frictional drag.

The lateral traverse of the thread and cover yarn in the slot while being twisted together is clearly seen when my machine is in operation. This is schematically shown in FIG. 4. The position of core thread and cover yarn at the end of the slot remote from the sleeve **32** is shown by the solid line whereas when the position of core thread and cover yarn at the opposite end of the slot (wherein the core thread and cover yarn virtually abut the end of sleeve **32**) is shown by the dot-dash line **36**. Both images are visible to the naked eye when my apparatus is in operation.

A schematic representation of my apparatus arranged for use in the production of covered threads wherein the core thread is of a non-stretchable material is shown in FIG. 5. The non-stretchable core thread **10** is led off from cone **40**, travels across lease rods **42**, **44**, **46** and **48**, through pigtail **50**, past a pair of positively driven feed rolls **52**, and then into pigtail **14** and slot **30** as previously described and shown in FIG. 2. Cover yarn **16** is led off pirn **60** and travels past guide rod **62** and into tube **28** and slot **30** (FIG. 2).

A schematic representation of my apparatus arranged for use in the production of covered threads wherein the core thread is of a stretchable or elastic material is shown in FIG. 6. The core yarn **10** is led off a tensioned flange spool **70**. A tensioned weight **72** is attached to the flange spool **70** against a fixed point **74**. The cover yarn is thus stretched as it is led off the roll **70**, through pigtail guide **72**, and through the pair of positively driven feed rollers **12**. From feed rollers **12** the thread **10** is led through the pigtail guide **14** and into slot **30** as previously described (FIGS. 1 and 2). The cover yarn **16** is led off pirn **80** and passes lease rods **82**, **84**, **86** and **88**, then passes guide rod **90**, and from there enters into the slotted tube **28** and passes through slot **30**.

I have found that the operating conditions for covering a stretchable core thread are rather exacting. FIG. 7 shows three zones, A, B and C, wherein certain specified conditions should prevail in order to obtain optimum results. Specifically, it is advisable that the elastic core thread **10** be stretched from 350 to 450 percent prior to reaching feed rolls **12**, that is, in the zone designated A. In the zone between feed rolls **12** and pigtail guide **14**, zone B, the core thread should be stretched less than that imparted to it in zone A, say from 200 to 250 percent. The weight of the traveler **26** selected for controlling the size of the yarn balloon **24** and the tension of the core thread as it leaves rolls **12** should be such as to permit an accumulation of twist spirals in the zone between pigtail guide **14** and slot **30** (zone C), and to permit some of the twist spirals formed in zone C to pass through the pigtail guide and into zone B. Desirably the twist spirals in zone B should be approximately half in number of the spirals in zone C and should approximate the number of turns of twist obtained in the relaxed end product. For example, for a covered yarn having 16 t.p.i., the number of twist spirals that are visually observed under operating conditions should be about 16 to the inch in zone B. This is brought about by weight adjustment of the flange spool and by selection of the size or weight of the traveler.

The operating conditions for the obtaining of a covered non-stretchable core thread are not so exacting. However, essentially the same mechanism does occur with the exception that the core thread is not appreciably elongated. With a non-stretchable core thread it is much more difficult to observe accumulation of twist in zones B and C, however a similar accumulation probably does take place, although in lesser magnitude than that occurring when covering a stretchable core thread.

It is desirable that the tension in the cover yarn at the point of twisting with the core thread be kept to a minimum i.e. the weight on the cover yarn at the point of twisting should not exceed about three grams.

Referring to FIG. 8, there is shown a plot of over-feed as a function of the length of lateral traverse of the cover yarn, that is, the length of the slot **30** through which the cover yarn traverses. Curves are shown for twists per inch of 6.4 and 11.5 respectively. It will be noted that whereas yarn diameter does not appreciably effect the over-feed control, the number of twists per inch is an important factor. Thus, the higher the twists per inch, the greater the range of over-feed obtainable.

I have found that the use of my apparatus results in greatly improved uniformity of coverage of the core thread as compared to prior-art methods. I have compared the use of my apparatus for controlling the lateral traverse of core thread and cover yarn with the use of an unmodified twister wherein the cover yarn was fed in to the periphery of the yarn balloon below the pigtail guide, but without the use of such a slotted traverse. Whereas excellent coverage and excellent control of over-feed from 20% to in excess of 100% could be obtained by the use of my apparatus, without such apparatus, when the cover yarn was fed to the core thread at a point beneath the pigtail guide so as to restrict the periphery of the yarn balloon, no genuinely satisfactory covering of the core thread was obtained. Further, over-feed was erratic and not readily controllable. FIG. 9 shows the difference in control of overfeed obtainable when (1) using my apparatus including the slotted tube beneath the pigtail **14** and introducing the cover yarn therethrough to control the cover thread at the slot for twisting, and (2) introducing the cover yarn beneath the pigtail but not using my slotted tube construction, so that the periphery of the core yarn balloon is not restricted. When the tension in the cover yarn is less than 1 gram the control of over-feed, using my invention, is excellent over a wide range, i.e., for about 20 to 120% over-feed. In striking contrast, the degree of control obtainable without the use of the slotted tube **26** is erratic.

FIG. 10 is of interest in showing that the distance of the slot **30** from the pigtail guide **14** has no particular

effect upon the degree of control of overfeed. Thus, even at a distance of 1 7/16 inches, uniform and consistent control of over-feed is obtained.

FIG. 11 shows the very considerable range of control in over-feed available whether the core thread is elastic or non-stretchable. For the elastic core thread it will be noted that the range of over-feed varies from approximately 4 up to in excess of 50%. For a non-stretchable core thread the range varies from about 12 to excess of 120%.

As will be seen from a consideration of FIGS. 8–11, the degree of control of over-feed is largely a function of the length of slot **30** for this controls the extent of lateral traverse of the cover yarn and core thread. I have found that good results are obtained when the length of the slot is from approximately 1/64 to 1/8 of an inch. More preferably, I prefer a range from about 1/32 to 5/64 of an inch.

I have also found that the relative angle between the axis of the slotted tube **26** and the horizontal has an effect upon the overall operation of my apparatus. Thus, the tube may be slightly inclined from the horizontal so that the slotted end **30** is inclined downwardly such that the angle between the axis of the tube and the horizontal is from about zero to 20 degrees. A more preferred range is from about 5 to 15 degrees, with an angle of about 10 degrees conferring optimum results.

The following two examples, presented in table form, show specific yarns used both for core and cover, show the machine settings utilized (size of slot opening, etc.), and indicate the type of superior coverage obtainable.

EXAMPLE 1

Stretchable Covered Yarns

	Latex rubber core	Polyurethane core	Polyurethane core
Yarns:			
Core	50's Lactron	135's Spandex	110's Spandex.
Cover	24's cotton	70 den. nylon	70 den. nylon.
Machine settings:			
Twist per inch	5.7	2.5	5.7.
Tension weight ozs	2.6	0.9	1.2.
Traveler size	#17	#6	#11.
Dimensions of slot opening (length x width)	1/32" x 3/64"	1/32" x 3/64"	1/32" x 1/32".
Tests on covered yarn (reloped):			
Twist per inch	13.3	16.8	16.0.
Length of core in 36" of yarn	7.7"	6.3"	8.1".
Length of cover in 36" of yarn	39"	37.2"	36.5".
Description of cover on core	Loosely wrapped	Loosely wrapped	Loosely wrapped.

EXAMPLE 2

Non-Stretchable Covered Yarns

Yarns:			
Core	30/2 cotton	30/2 cotton	185 den. polypropylene.
Cover	420 den. nylon	420 den. nylon	2-ends of 40 den. nylon.
Machine settings:			
Twist per inch	11.5	11.5	24.0.
Tension on core	Lease rods	Lease rods	Lease rods.
Traveler size	#12	#12	#6.
Dimension of slot opening (length x width)	1/32" x 3/64"	3/6" x 3/64"	1/32" x 1/32".
Tests on covered yarn:			
Twist per inch	11.8	12.0	26.0.
Length of core in 36" of yarn	36"	36"	36.4".
Length of cover in 36" of yarn	40"	79"	52".
Description of cover on core	Tightly wrapped	Loop yarn formations	Tightly wrapped.

Throughout this application I have used the word "thread" with the intention that it cover a single monofilament as well as a plurality of filaments or staple fibers twisted together to form a yarn.

It will be noted that my invention comprehends an apparatus with means for delivering a cover yarn to a core thread in a lateral zone, i.e. the slot **30** (FIG. 2) or the opening defined by the pigtail guide **30***a* (FIG. 2A), between the ring traveler **26** and the guide means, e.g. pigtail guide **14**. Of course, additional guide means can be employed in the apparatus besides pigtail guide **14**, so long as the means for delivering the cover yarn to the core thread are disposed between the last of such guide means and the ring traveler.

Variations can, of course, be made without departing from the spirit of my invention.

Having thus described my invention, what I desire to secure and hereby claim by Letters Patent is:

1. An apparatus for covering a core thread with a cover yarn, said apparatus comprising feed means for core thread, a spool for storing yarn-covered thread, said spool being mounted on a rotatable spindle, said rotatable spindle being adapted to impart twist to core thread and cover yarn, means for disposing covered thread on said spool, means for guiding core thread from said feed means to said means for disposing covered thread on said spool, and means for delivering cover yarn to core thread in a delivery zone between said thread guiding means and said means for disposing covered thread on said spool, said delivering means comprising a slotted tube for cover yarn to pass through, said slot being disposed beneath said thread-guiding means so that core thread will pass therethrough, whereby cover yarn will be delivered to core thread in the zone defined by said slot, said apparatus having space between said delivering means and said means for disposing covered thread on said spool whereby no restriction is imposed upon core thread and cover yarn.

2. An apparatus for covering a core thread with a cover yarn, said apparatus comprising feed means for core thread, a spool for storing yarn covered thread, said spool being mounted on a rotatable spindle, said rotatable spindle being adapted to impart twist to core thread and cover yarn, means for disposing covered thread on said spool, core thread guide means between said feed means and said means for disposing covered thread on said spool, means for delivering cover yarn to core thread at a delivery zone between said core thread guiding means and said means for disposing covered thread on said spool, means for limiting the movement at said delivery zone of cover yarn and core thread in a direction substantially perpendicular to the longitudinal axis of the core thread to maintain cover yarn in close proximity with core thread

at said delivery zone and to permit core thread to generate a balloon between said guide means and said delivery zone and covered thread to generate a balloon between said delivery zone and said means for disposing covered thread on said spool, said apparatus having space between said delivering means and said means for disposing covered thread on said spool whereby no restriction is imposed upon core thread and cover yarn.

3. A method for covering a core thread with a cover yarn in apparatus having means for guiding the core thread from a core thread supply to means for disposing covered thread on a rotatable spool adapted to impart twist to core thread and cover yarn, this method comprising passing core thread from said supply means to said disposing means, delivering cover yarn to said core thread in a delivery zone between said core thread guiding means and said means for disposing covered thread on said spool, limiting the movement at said delivery zone of said cover yarn and said core thread in a direction perpendicular to the longitudinal axis of said core thread to maintain said cover yarn in close proximity with said core thread at said delivery zone and to permit said core thread to generate a balloon between said guide means and said delivery zone and said covered thread to generate a balloon between said delivery zone and said means for disposing covered thread on said spool.

4. The apparatus of claim 2 wherein said means for delivering said cover yarn to said thread are disposed beneath said thread-guiding means.

5. The apparatus of claim 1 wherein said slotted tube is axially disposed substantially perpendicular to the longitudinal axis of said thread.

6. The apparatus of claim 1 wherein the slotted tube

is provided with means for adjusting the length thereof.

7. The apparatus of claim 6 wherein said adjusting means comprises a sleeve disposed around said tube.

8. The apparatus of claim 1 wherein said slotted tube is disposed so that the slotted end thereof is tilted downwardly with respect to the opposite end thereof, the angle of said tilt being from about 5 to 15 degrees.

9. The apparatus of claim 2 wherein said delivery means for said covering yarn comprises a plurality of pigtail guides, the last of said pigtail guides disposed beneath said thread-guiding means so that said thread will pass therethrough, whereby said covering yarn will be delivered to said thread in the zone defined by said last pigtail guide.

10. The apparatus of claim 2 wherein the cross-sectional area of said lateral zone does not exceed about 0.2 square inch.

11. The method of claim 3 wherein said cover yarn is delivered to said core thread in a delivery zone beneath said thread-guiding means, the cross-sectional area of said zone not exceeding about 0.2 square inch.

12. The method of claim 3 wherein the traverse of said cover yarn just prior to delivery thereof to said core thread is substantially perpendicular to the traverse of said core thread.

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