Aug. 29, 1961 C. J. RUSSO ET AL 2,997,747

CRIMPING APPARATUS FOR TREATING FIBERS

Filed Dec. 21, 1959 4 Sheets-Sheet 1

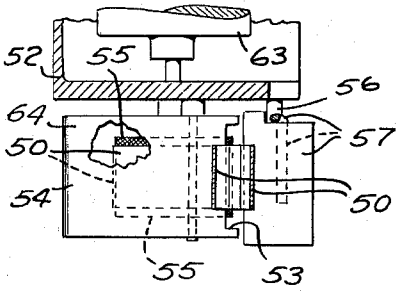


Fig. 2.

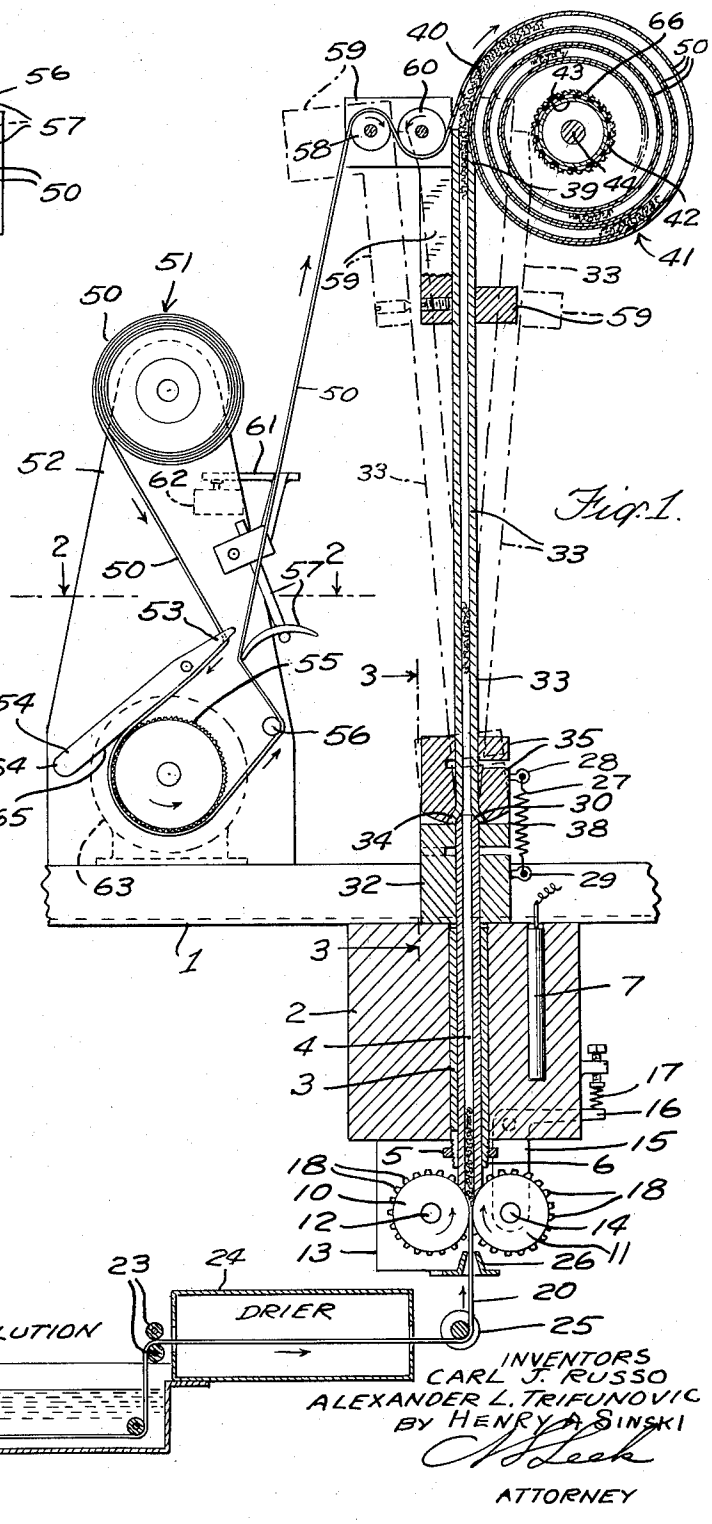


Fig. 1.

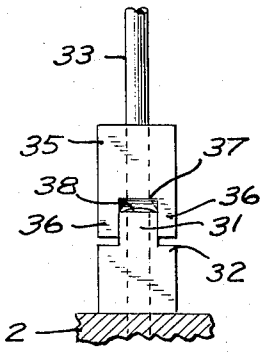


Fig. 3.

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CRIMPING APPARATUS FOR TREATING FIBERS

Filed Dec. 21, 1959 4 Sheets-Sheet 2

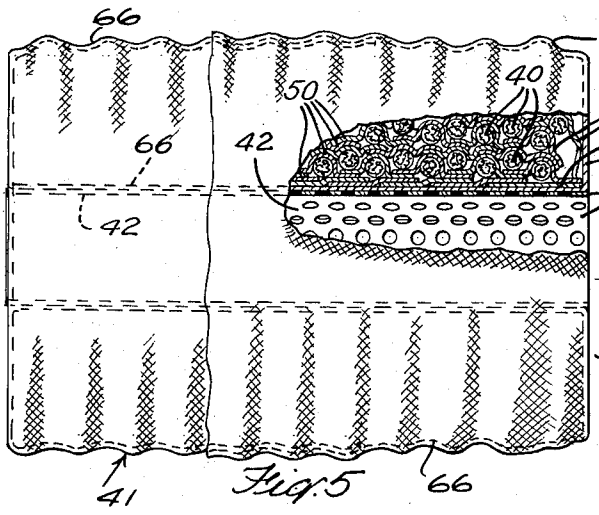


Fig. 5

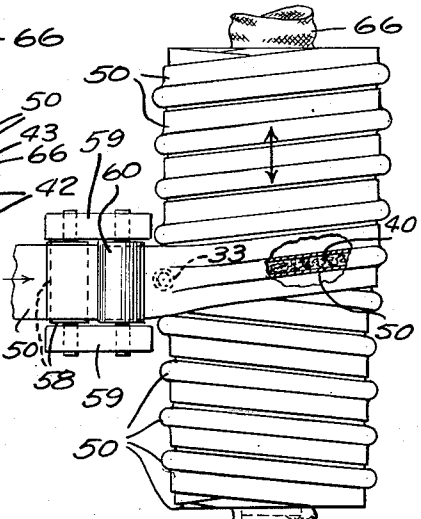


Fig. 4

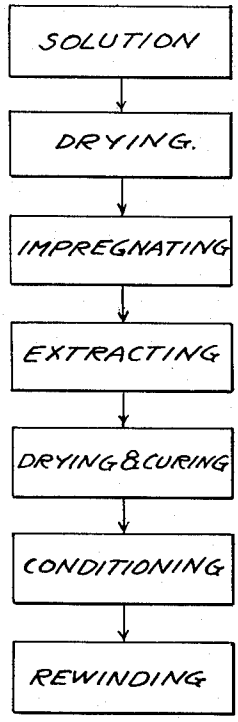
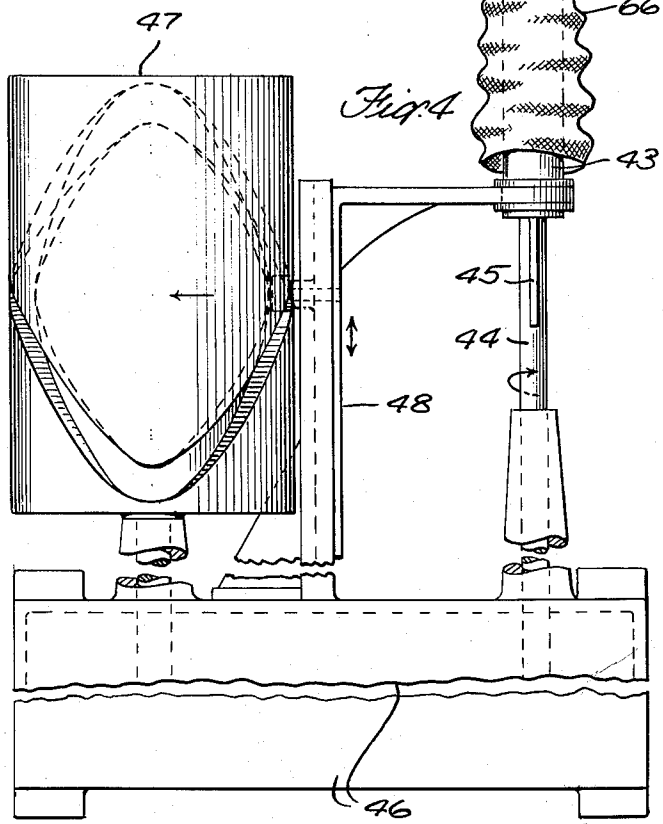


Fig. 6.



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Aug. 29, 1961 C. J. RUSSO ET AL 2,997,747

CRIMPING APPARATUS FOR TREATING FIBERS

Filed Dec. 21, 1959 4 Sheets-Sheet 3

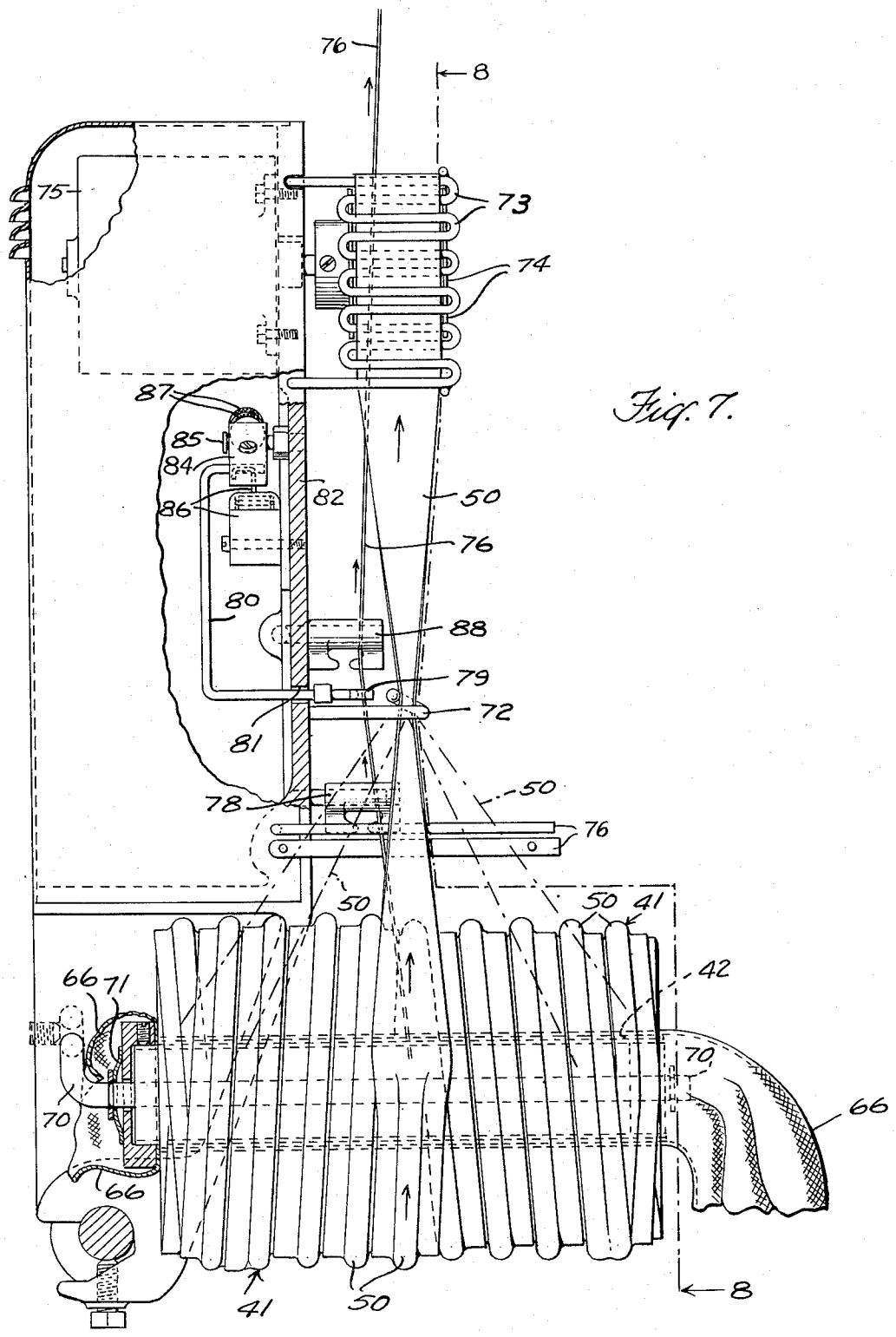


Fig. 7.

Aug. 29, 1961 C. J. RUSSO ET AL 2,997,747

CRIMPING APPARATUS FOR TREATING FIBERS

Filed Dec. 21, 1959 4 Sheets-Sheet 4

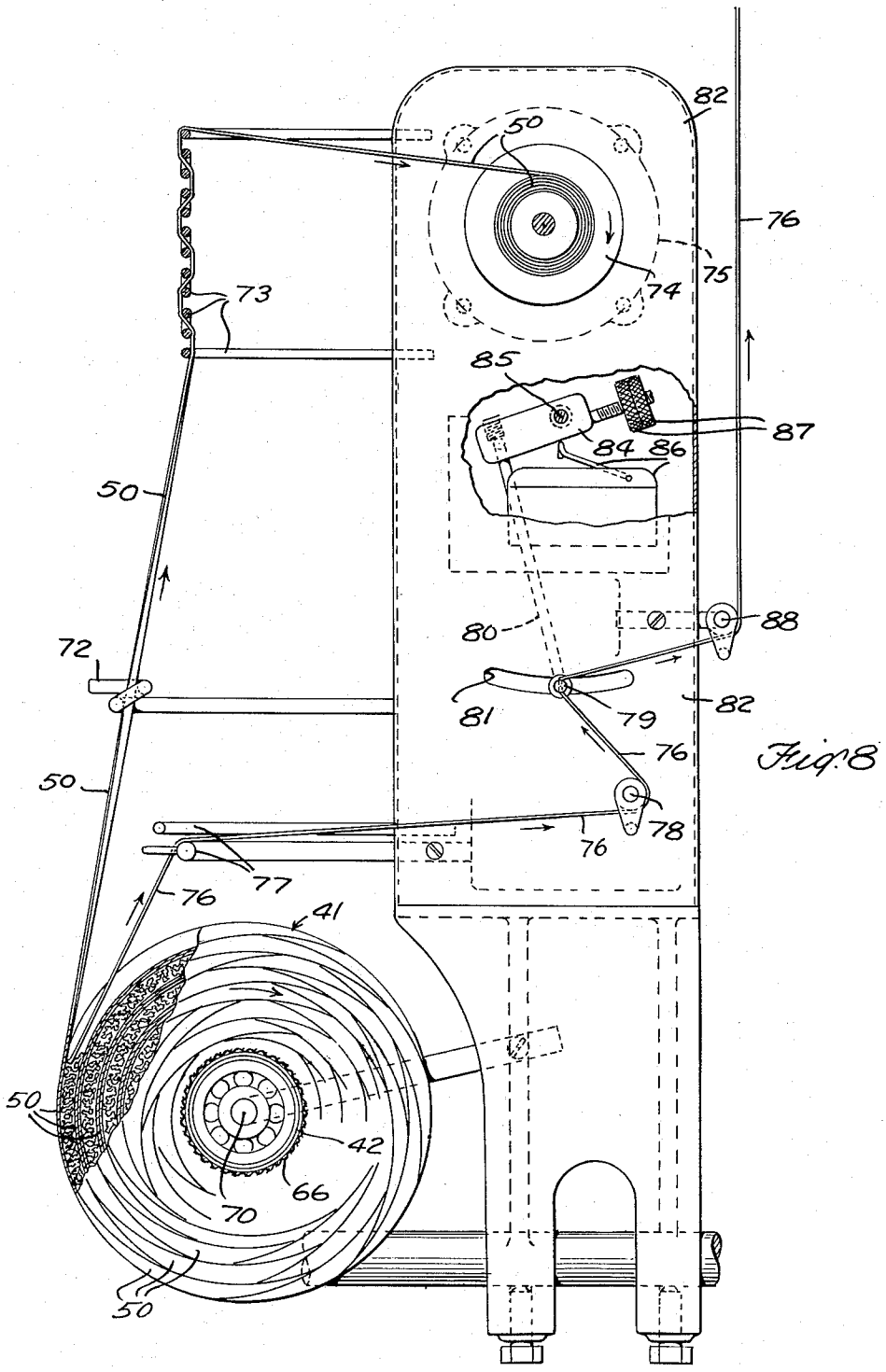


Fig. 8

United States Patent Office 2,997,747 Patented Aug. 29, 1961

2,997,747

CRIMPING APPARATUS FOR TREATING FIBERS

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Filed Dec. 21, 1959, Ser. No. 861,001
11 Claims. (Cl. 19—66)

This invention relates to a method and apparatus for crimping, packaging and treating textile fibers and has for an object to provide a method and apparatus of the above type having novel and improved characteristics.

Another object is to provide an apparatus of the above type which packages the crimped fibers in the form of a core which is wound in a plurality of layers on a pervious support of the type used for package dyeing and is held in compacted form by a tape to prevent the core from opening during the treating steps.

Another object is to provide such an apparatus wherein the core is laid directly onto the package as it is gripped by the tape and is held without loss of compacting pressure.

Another object is to provide novel and improved apparatus for removing the treated yarn from the package.

Another object is to provide a novel and improved method and means for crimping and processing yarns of various types.

Another object is to provide a yarn package wherein the crimped yarn is adapted to be processed in standard processing equipment.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

The nature of the invention will be better understood from the following description, taken in connection with the accompanying drawings in which a specific embodiment has been shown for purposes of illustration.

In the drawings:

FIG. 1 is a vertical section illustrating an apparatus according to the invention;

FIG. 2 is a partial horizontal section taken on the line 2—2 of FIG. 1;

FIG. 3 is a partial vertical section taken on the line 3—3 of FIG. 1;

FIG. 4 is a top plan view of the apparatus of FIG. 1;

FIG. 5 is an elevation of a completed package with parts broken away to show the interior;

FIG. 6 is a block diagram illustrating representative steps in the treating process;

FIG. 7 is a side elevation of an apparatus for unwinding the package with parts broken away to show the structure; and

FIG. 8 is a section taken on the line 8—8 of FIG. 7.

Referring to the drawings more in detail, the invention is shown as embodied in a stuffer crimper comprising a base plate 1 carrying a heating and crimping block 2 having a bore in which a sleeve 3 is fixed as by a press fit. A crimping tube 4 is held in the sleeve 3 by a clamping nut 5 on the lower tapered, split end 6 of the sleeve 3. A source of heat, such as a resistance rod 7 is held in a bore in the block 2 parallel to the tube 4. A pair of feed rolls 10 and 11 are positioned to feed the fibers into the lower end of the tube 4 to be folded over and crimped against the pressure of a mass of previously crimped fibers held compacted in the tube 4. The feed roll 10 is mounted on a shaft 12 which is journalled to rotate in a bearing 13 supported by the block 2. The feed roll 11 is mounted on a shaft 14 carried in a pivoted bracket 15 carried by the block 2 and having an arm 16 pressed by a spring 17 to hold the roll 11 in feeding engagement with the roll 10. The rolls 10 and 11 are driven by gears 18 to operate in unison. The shaft 12 is driven by a drive motor not shown, preferably through a constant torque clutch so that a constant pressure is maintained on the fibers as they are fed into and crimped in the crimping chamber in the tube 4.

In the form shown, the fibers 20 are fed between rolls 21 into a pretreating tank 22, thence through the tank 22 and between rolls 23 into a heater or dryer 24. Thence through a tension device 25 and a guide 26 to the bite of the feed rolls 10 and 11.

The upper end of the tube 4 is formed with a rounded top surface 30 and extends through a central flange 31 in a block 32 carried by the block 2. A feed tube 33 forming an extension of the tube 4, is formed with a curved bottom wall 34 seating on the top wall 30 of the tube 4 and carries at its lower end a block 35 having side flanges 36 spanning the central flange 31 of the block 32 and having a curved lower sufrace 37 seating on the top surface 38 of the flange 31 so as to allow the tube 33 to pivot about the upper end of the tube 4 for the purpose to be described.

The upper end of the tube 33 is formed with an arcuate surface 39 to lay the core of crimped fibers 40 which is discharged therefrom in successive convolutions on a package 41. The discharge end of the tube 33 is held against the package 41 by a spring 27 connected by eyes 28 and 29 to blocks 35 and 32, respectively.

The package 41 is shown as wound on a perforated tube 42 of the type used for package dyeing. The tube 42 is mounted on a sleeve 43 which is slidably mounted on a shaft 44 and is keyed thereto by a key 45. The shaft 44 is driven from a gear box 46 through a constant torque clutch of any standard type. A cam 47 driven by the gear box 46 actuates a traversing slide 48 having at its end a yoke riding in a groove formed in the sleeve 43 to reciprocate the sleeve 43 for laying the core 40 in successive convolutions and in successive layers on the tube 42. The gear box may be driven by a suitable motor.

A tape 50 is held on a reel 51 mounted on a bracket 52 attached to the base plate 1. The tape 50 is fed through the forked end 53 of a pivoted arm 54 to a feed roll 55 having a roughened surface, thence around a pin 56 and over a lever 57 pivoted to the bracket 52 and over a guide roll 58 mounted on a bracket 59 carried by the feed tube 33 under a guide roll 60 mounted on the bracket 59 adjacent the discharge end of the tube 33 to lay the tape 50 over the core 40 of crimped fibers as they are fed from the end of the tube 33 onto the package 41. The lever 57 carries an arm 61 which is positioned to actuate a microswitch 62, which is connected to control the operation of the entire machine. A constant speed motor 63 drives the roll 55. The end 64 of the arm 54 is provided with a surface 65 which is adapted to hold the tape 50 in gripping engagement with the feed roll 55.

In winding the package 41 a sock 66 is placed over the tube 42 and a layer of the tape 50 is wrapped thereabout. As the core 40 is discharged from the end of the tube 33 beneath the tape 50 it is held compacted in its original cross section by the pressure of the tape as it is wound in successive convolutions and successive layers on the perforated tube 42 until a package of the desired size has been built up. The feed of the tape is controlled by the feed roll 55 which is actuated by the drive motor 63.

In operation the mass of crimped fibers is discharged from the end of the feed tube 33 in the form of a core having the same cross section as the tubes 4 and 33 and is in effect stuffed into the space between the tape 50 and the previous layer of winding where it is held in compacted form without any chance to open up or relax its crimped form. It is confined on the package 41 between tapes 50 in the form of a plurality of convolutions in several layers with the core of crimped fibers in adjacent

convolutions bound and separated by the intervening convolutions of tape.

After the package has been wound to the desired size the winding is stopped, the package removed from the sleeve **43** while still on the tube **42** and the sock **66** is turned over the package from both ends to form a confining cover as shown in FIG. 5. This package is then of the size and form adapted for treatment in the usual package dyeing apparatus.

The microswitch **62** is adapted to stop the machine including the various drive motors and heating elements in response to a breakage or running out of tape **50**. When the end of the tape passes the lever **57** the lever is released to release the microswitch **62** and thereby stop the machine.

In order to permit the machine to be started up, for example, for warming the crimping chamber prior to the actual beginning of the crimping operations, the arm **54** is raised from the feed roll **55** thereby permitting the feed roll to turn without feeding the tape. The arm **54** is held in this position by engagement with the lever **57** and thus causes the lever **57** to maintain the switch **62** closed during this warm up period. The lever **57** is moved counterclockwise to close the switch **62** and is held in this position by the arm **54**.

The packing of the core in the winding is determined by the rate of feed of the tape **50** with respect to the feed of the feed rolls **10, 11**. These elements may be driven at a constant but adjustable ratio or the feed rolls **10** and **11** may be driven through a constant torque clutch in which event the rate of feed is controlled by the back pressure on the fibers due to the tension of the tape **50** as it is wound on the package **41**. The tape **50** envelops the end of the tube **33** in a sufficiently close manner to control the back pressure exerted on the mass of crimped fibers within the tubes **4** and **33**. The pressure exerted on the fibers may thus be controlled by varying the rate of feed of the tape **50** or the relative speed of the tape feed with relation to the feed rolls **10, 11**.

For processing, a plurality of packages **41** of crimped fibers are stacked on perforated tubes in a dye vat which may be closed to permit a treating liquid or vapor such as steam or wash water or hot air as the case may be to be forced through the package from the inside to the outside or vice versa depending upon the particular treatment step involved. The packages may then be dried or excess treating liquid removed in a centrifuge or the packages may be placed in an oven for the final drying or curing step. If the package is to be treated under pressure as by steam or by heated air for drying, the packages may be placed in an autoclave. In any event the fibers on the perforated tube **42** are pervious and readily treated by known techniques.

The process may be applied to natural fibers such as wool or cotton in the form of a roving, or to silk in twisted or untwisted form, or to continuous filament synthetic fibers in the form of a tow or in the form of a yarn. In the case of wool the roving may be presoftened by hot water or steam in the tank **22** and dried to a predetermined moisture content in the dryer **24**, then crimped in the stuffer crimper and the package subjected to steam treatment or to hot water and dried in an oven or autoclave to set the crimp while the fibers are held compacted in the package. In the case of cotton or synthetic cellulosic fibers such as rayon or acetate the fibers may be pretreated by heat and moisture as above, crimped and packaged, then subjected to heat and moisture under pressure and dried to set the crimp. Alternatively, the cellulosic fibers may be impregnated with a thermosetting resin in the tank **22**, partially dried in the dryer **24**, crimped and packaged as above, and the package dried to resin curing temperature in an oven. As a further example the cellulosic fibers may be crimped and packaged, the package impregnated by a resin and catalyst, then centrifuged to remove excess impregnant, cured in an oven, washed and dried.

Other synthetic fibers may be preheated for softening, crimped, packaged, subjected to heat and moisture in a closed vessel, and dried in an oven. In all of these cases it is possible to utilize a treating cycle of several minutes or even hours regardless of the speed of operation of the crimping apparatus.

After treatment the fibers may be removed from the package and processed into yarn in the usual manner. In the case of staple fibers such as wool or cotton the package is unwound, the core removed and the fibers opened up for spinning. In the case of continuous filaments the tape may be unwound to expose the core and the tow or yarn pulled from the core as it is exposed and wound onto a cone or otherwise packaged for further use. This may be effected by hand or by the unwinding and packaging apparatus shown in FIGS. 7 and 8, to be described.

FIG. 6, for example, illustrates a process which involves first passing a treating solution through the package, then drying, then applying an impregnating agent, extracting the excess impregnating agent as by centrifuging, then drying and curing as in a heating oven for setting the impregnant, followed by conditioning the yarn as by the application of sizing and then rewinding.

Cellulosic yarns whether spun or filament should have a moisture content approximating their natural moisture content at 65% relative humidity and 70° F. before entering the crimper. If the moisture is appreciably below the natural moisture content the fibers are too brittle. If the moisture is more than about 2½ times the natural moisture, the fibers tend to stick to the walls of the crimper.

All fibers except those that melt below about 212° F. may be used in the process. This would include most of the thermoplastic fibers and all of the cellulosics such as cotton, regenerated cellulose rayon, linen, ramie, jute, etc.

In the case of cellulosics it is necessary to treat the fibers so as to make the artificial crimp durable to washing and/or dry cleaning.

Following are various examples of the sequence of steps which may be used in carrying out the invention for cellulosic fibers.

(1) The yarns may be treated with a crimp fixative and partially dried before entering the crimping chamber, then crimped, packaged, cured in the package, and finally unwound.

(2) The yarns may be crimped, packaged, treated with the crimp fixative in the package, cured in the package and finally unwound.

As the crimp fixative a few of the many materials that can be used are dimethylol ureas, di or tri-methylol melamines, methylated methylol ureas, methylated methylol melamines, dimethylol ethylene ureas, dimethylol propylene ureas, dimethylol triazones, formaldehyde, etc.

The following examples are illustrative (parts are by weight unless otherwise indicated):

Example I

980 parts methylated methylol melamine (80% solids)
210 parts $MgCl_2 \cdot 6H_2O$
12 parts wetting agent
Water to 10,000 parts

200 denier 21½ S twist 44 fiament viscose rayon is wound on a Franklin type dye spring. Several such packages are placed in a dye package machine and impregnated with the above solution by pumping the solution from the inside to the outside for 15 miutes, follower by pumping the solution from the outside to the inside for 15 minutes.

The packages are then extracted for 6 minutes in a centrifugal extractor so that the yarn retains about 64% of the impregnating solution, that is, 1 lb. of the yarn contains about 0.64 lb. of the impregnating solution.

After extraction the yarn is dried to about 17% moisture in an oven with circulating air at about 210° F.

The impregnated yarns are then crimped using a heated core type crimper as described above to form a core which is wound onto a Davidson type spring using 1⅝ inch cotton tape. The cotton tape has a greige construction 56 x 44 176 yds./lb.

The packaged yarn is cured in a heated atmosphere at about 260° F. for about 30 minutes. After curing the crimped yarn is unwound and oiled if necessary. The yarn is then ready for knitting.

Example II

200 denier 3 S twist 40 filaments viscose rayon yarn is crimped in the heated crimping chamber as described above at 320 yds./min. entering speed and wound on Franklin type springs using 1⅝ inch cotton tape at 26 inch/min. Several packages of the crimped yarn on the Franklin type springs are placed in a package dye unit and treated with the following crimp fixative:

2496 parts methylated methylol melamine (80% solids)
780 parts magnesium chloride hexahydrate (70% solids)
32 parts wetting agent diluted to 26,000 parts with water

by pumping the solution through the packages from the inside-out for 15 minutes and then pumping from the outside in for 15 minutes. The packages are placed in a centrifugal extractor and extracted for about 6 minutes. The solution take-up was about 55%. The impregnated and extracted yarns are dried about 1 hour at 220–230° F. followed by curing 30 minutes at 250° F. The crimped yarn is conditioned and lubricants and/or softeners applied to the yarn while coning for knitting.

Example III

300 denier 3½ S twist 60 filaments blue viscose rayon is processed as in Example II to give a durable crimp that is fast to washing and dry cleaning.

Example IV

200 denier 2½ S twist 44 filaments bright filament viscose yarn is treated as in Example II except that the following mix is used to fix the crimp:

1875 parts dimethylol ethylene urea (50% solids)
240 parts zinc nitrate hexahydrate (70% solids)
24 parts acetic acid 75%
75 parts polyvinyl alcohol
420 parts glycerine
16 parts wetting agent diluted to 13,000 parts with water

The crimp is durable to washing and dry cleaning after being made into a knitted or woven fabric.

Example V

Size 30 bleached cotton yarn is handled as in Example I except that the following crimp fixative is used in place of the one in Example I:

800 parts dimethylol ethylene urea (50%)
20 parts 2 amino-2 methyl-1 propanol hydrochloride
10 parts wetting agent
Water to 10,000 parts

The crimp is durable to washing and dry cleaning.

Example VI

Size 26 bleached cotton yarn is impregnated with the following mixture:

200 parts formaldehyde
10 parts zinc nitrate hexahydrate (70%)
1 part wetting agent diluted to 1,000 parts with water

by running the yarn into a tank containing the mixture, the yarn then goes between squeeze rollers to remove the excess solution. The impregnated yarn is dried to about 10% moisture by passing it through a chamber heated to about 220° F. The partially dried yarn is then crimped as described above and wound onto the core packages. The core package is heated for about 40 minutes by passing air heated to 250° F. through the package from the outside in. The cured package is allowed to cool and condition before rewinding onto a cone. An oil is applied to the yarn during this rewinding to facilitate knitting.

A crimp durable to washing and dry cleaning is obtained.

Example VII

Example I is repeated except that the package of crimped yarn is cured for 25 minutes in an autoclave where the steam pressure inside the autoclave is 45–50 lbs. A durable crimp is obtained.

Example VIII

Example II is repeated except that the following mixture was used:

950 parts methylated methylol melamine (80% solids)
210 parts magnesium chloride hexahydrate
10 parts wetting agent
100 parts water

Isopropyl alcohol is added to make 10,000 parts. A durable crimp is obtained.

Example IX

Example II is repeated except that a linen yarn is used. A durable crimped linen yarn is obtained.

Example X

Silk yarn, either spun staple or continuous filament may be presoftened by a light treatment with steam or hot water, crimped in the stuffer crimper at a temperature not exceeding about 140° F., packaged and subjected to heat and moisture, for example, steam or hot water, or subjected to a heated dye liquid for dyeing after which the excess liquid may be extracted and the package dried for setting the crimp.

The pretreatment may be omitted in some instances and if desired the crimped silk core package may be impregnated with a thermosetting resin which may be dried and cured as in the previous examples.

Example XI

Nylon yarn in continuous filament form may be hot crimped in the stuffer crimper as above set forth, packaged and treated with a dye solution which may be passed through the package preferably while heated after which the excess liquid may be extracted and the package heated by the passage of hot air therethrough or by oven drying to dry the yarn and set the crimp therein.

Example XII

The above treatment with or without a resin setting according to the results desired may be repeated for wool fibers and for other synthetic fibers such as acrylic, modacrylic, polyesters, nitrilic, vinyl and olefinic fibers, and Vinyon, Orlon, Dacron and saran.

Referring to FIGS. 7 and 8 the package **41** is shown as placed on a spindle **70** for unwinding.

A friction washer **71** puts the necessary drag on the package during the unwinding operation. The tape **50** passes from the package **41** through a pigtail guide **72** thence over a tension control device **73** which smoothes out the tape for reeling, thence onto a reel **74** driven by a motor **75**.

The yarn **76** from the package **41** is fed through guides **77** and **78** thence through an eye **79**, carried by an arm **80** projecting through a slot **81** in a housing **82** and connected to actuate an arm **84** pivoted at **85** and adapted to actuate a micro-switch **86**. The arm **84** carries at its end weights **87** which are adjustable for controlling the tension of the yarn **76**. The yarn **76** passes from the eye **79** to a fixed guide **88**, and to a take-up device such as a constant speed winder (not shown) where it is wound onto a cone or spool to form a yarn package of the usual type.

The micro-switch **86** is connected to control the opera-

tion of the motor **75** so as to exert a pull on the tape when the tension on the yarn increases and to stop the motor **75** when the tension on the yarn decreases. In this way a substantially constant quantity of yarn is maintained at the discharge point at the bite of the tape **50** on the package **41**. As more yarn is pulled from the package the discharge point recedes into the area held compacted by the tape **50** which increases the drag on the yarn **76**. This increased tension closes the micro-switch momentarily and causes the motor **75** to pull the tape and thus turn the package to advance a further quantity of the core to the discharge point. This operation continues until the entire quantity of yarn has been withdrawn from the package and wound onto a cone or other form of package.

The above described method and apparatus is particularly suitable for imparting a permanent crimp to silk fibers and to acrylic, modacrylic, nitrilic, vinyl and olefinic fibers to produce therefrom a continuous filament yarn having saw tooth type crimps which are permanently set therein since these fibers require a more extended treatment for the setting of the crimp than can be obtained in the usual stuffer crimper. The core package of the present application permits these fibers to be subjected to a setting treatment for the period of time required for imparting a permanent set to the crimp so that the bulk effect produced in the yarn remains throughout the useful life of the yarn and is resistant to the usual cleaning and pressing steps to which the yarn or the fabric or garments fabricated therefrom may be subjected.

What is claimed is:

1. Apparatus for crimping and packaging textile fibers comprising a bored tube forming a crimping chamber having inlet and discharge ends, a pair of feed rolls positioned to feed said fibers into the inlet end of said tube against a mass of previously crimped fibers held compacted therein and to exert pressure for advancing said mass of fibers along said tube to the discharge end thereof, said discharge end having a cross section substantially coextensive with the bore of said tube for discharging the mass of crimped fibers as a continuous core corresponding in section to the bore of said tube, a package winder comprising a rotatable spindle, carrying a package support, a tape supply, means feeding said tape from said supply to said support for winding thereon in successive convolutions in superimposed layers, the discharge end of said tube being disposed substantially within the bite of said tape with said package at the point of winding whereby the core is wound with said tape in successive convolutions and is held confined and compacted by said tape with successive convolutions of said core separated by said tape.

2. Apparatus according to claim 1 having take-up means driving said spindle and positive feed means feeding said tape for winding thereon.

3. Apparatus as set forth in claim 2 in which said positive feed means includes a constant speed drive connected to feed said tape at a predetermined ratio to the speed of said rolls.

4. Apparatus as set forth in claim 2 having switch means for controlling the operation of said apparatus and means responsive to failure of said tape feed to release said switch for stopping said apparatus.

5. Apparatus as set forth in claim 1 having a driven feed roll for said tape, a pivoted member connected to hold said tape in driving engagement with said last mentioned roll, a master switch for controlling the operation of said apparatus, a tape controlled member adapted to maintain said switch closed when tape is being properly fed, and to release said switch in response to tape failure, said last means being also adapted to be manually positioned to hold said pivoted member out of contact with said tape to allow the apparatus to be operated without feeding said tape.

6. Apparatus as set forth in claim 1 having traversing means connected to cause said package support to traverse with respect to said tube for laying the core and tape in successive convolutions in a helical layer.

7. Apparatus as set forth in claim 6 in which said traversing means is reciprocated for winding said core and tape in successive layers.

8. Apparatus as set forth in claim 1 in which said tube is mounted for movement to conform to the diameter of said package as successive layers are wound thereon, and said package is traversed with respect to said tube for laying the convolutions in layers.

9. Apparatus as set forth in claim 1 in which said tube is articulated to provide a movable discharge end, said last end being movable to conform to changes in diameter of said package as the winding progresses.

10. Apparatus as set forth in claim 9 in which the discharge end of said tube is pivoted with respect to the remainder of said tube and is spring-pressed toward said package.

11. Apparatus as set forth in claim 1 in which the discharge end of said tube is formed with a curved surface conforming generally to the contour of said package.

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