June 11, 1968 A. L. TRIFUNOVIC ET AL 3,387,349

DIFFERENTIAL FEED ROLL CRIMPER AND METHOD

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Fig. 1.

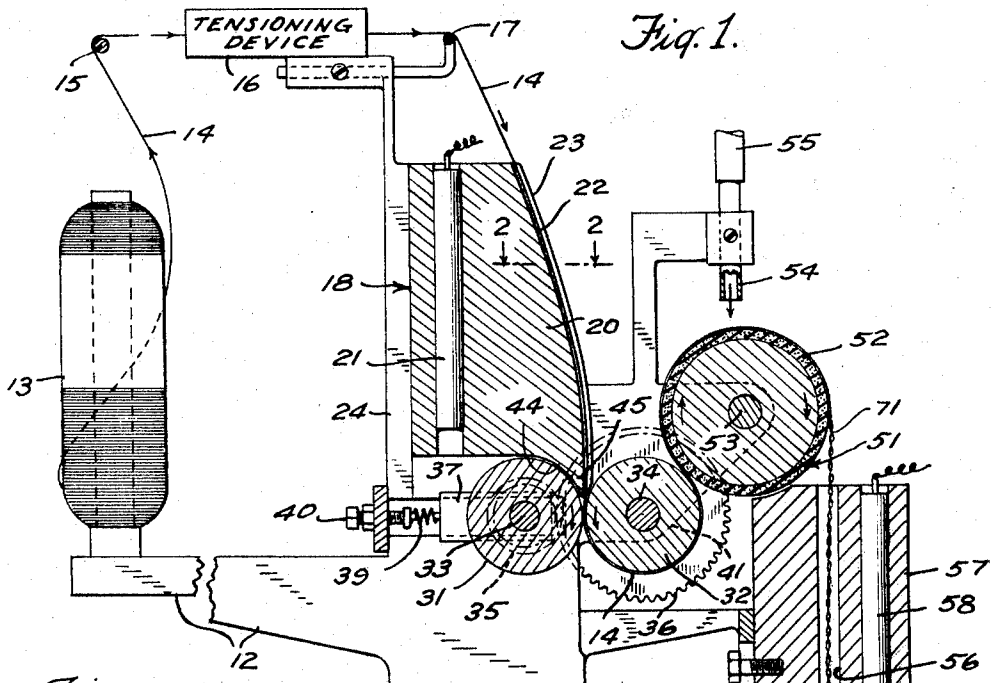


Fig. 2.

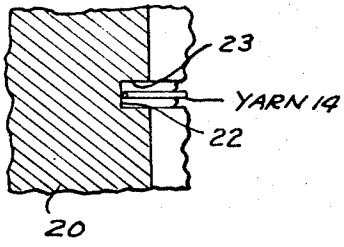
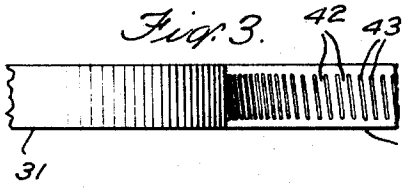
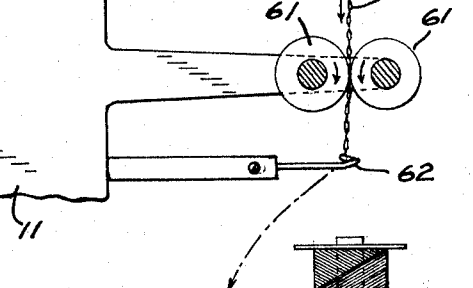


Fig. 3.





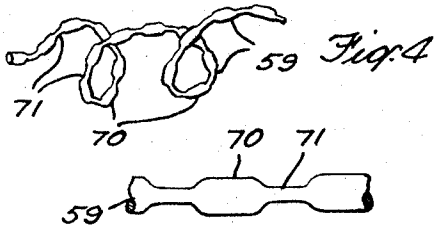


Fig. 4

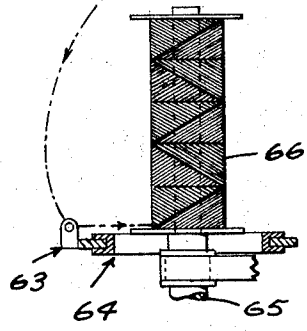


Fig. 5.

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DIFFERENTIAL FEED ROLL CRIMPER AND METHOD

Filed April 8, 1965 2 Sheets-Sheet 2

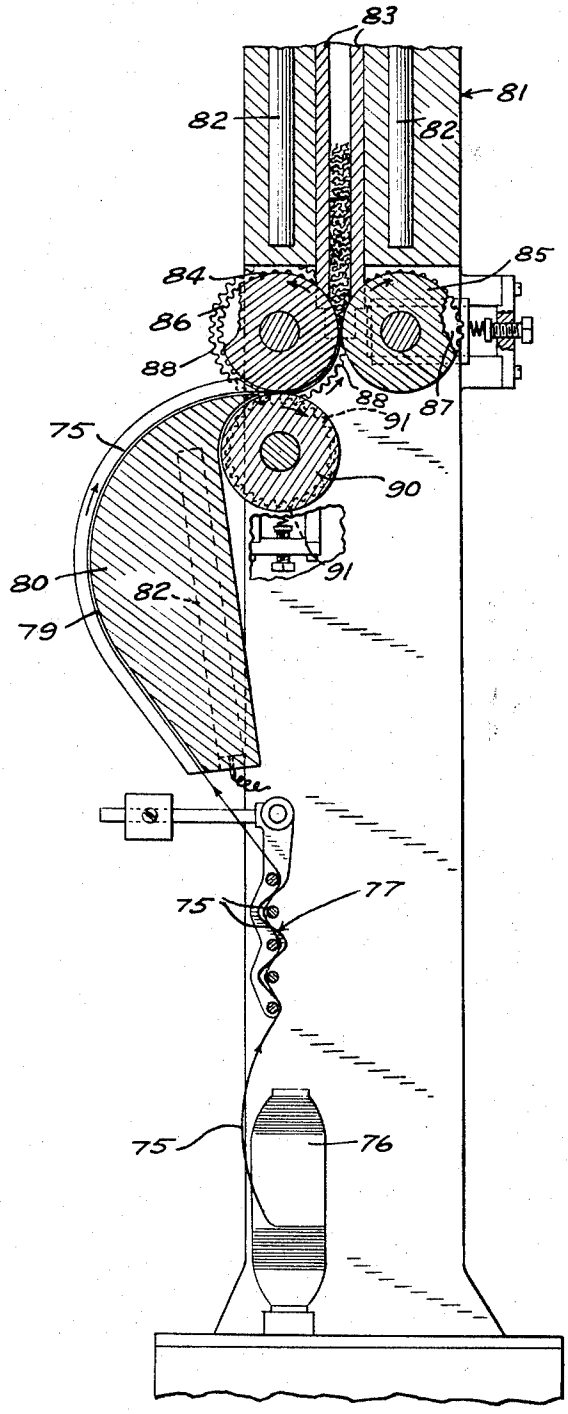


Fig. 6.

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United States Patent Office 3,387,349
Patented June 11, 1968

3,387,349

DIFFERENTIAL FEED ROLL CRIMPER AND METHOD

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Filed Apr. 8, 1965, Ser. No. 446,555
17 Claims. (Cl. 28—1)

ABSTRACT OF THE DISCLOSURE

Yarn crimping apparatus having a pair of feed rolls driven at different peripheral speeds, one of which is provided with grooves and ridges for forming a coil crimp in the yarn fed therebetween. In one embodiment, the feed rolls are disposed to feed yarn into the stuffer crimper having a crimping chamber in which the yarn is folded over and crimped so as to superimpose a stuffer crimper on the coil crimp.

This invention relates to yarn crimping apparatus and methods and more particularly to a method and apparatus for imparting a helical crimp to yarns composed of synthetic, thermoplastic material.

An object of the invention is to provide a method and apparatus of the above type having novel and improved characteristics.

Another object is to provide a synthetic, thermoplastic yarn having novel and improved crimp characteristics.

Another object is to provide a yarn or filament having successive thick and thin portions disposed to minimize the slippage of the yarn or filament along adjacent yarns or filaments when woven into a fabric.

Another object is to provide a yarn or filament having a contoured surface.

Various other objects and advantages will be apparent from the following description, taken in connection with the accompanying drawings in which a specific embodiment has been set forth for purposes of illustration.

In one embodiment of the invention the yarn to be processed is passed over a preheater into the bite of a pair of feed rolls which are operated at different speeds. The slower roll may be formed with transverse ridges and grooves on its peripheral surface. These grooves are formed by a milling tool or a grinder which is moved transversely of the peripheral surface, preferably in a direction parallel to the axis of the roll or at a slight angle thereto while the roll is indexed between successive passes of the tool. The faster roll is formed with a smooth surface or with a surface which is sandblasted for increasing the friction on the yarn.

The preheater preferably heats the yarn to a temperature slightly below the softening temperature without rendering the yarn tacky so that crimping is facilitated. The differential effect of the feed rolls introduces stresses in the yarn which cause the yarn to assume a helical form when relaxed. The helix, however, is somewhat irregular and reverses in direction at irregular intervals along the length of the yarn.

During the crimping operation the transverse ridges on the slow roll serve to form indentations along the surface of the yarn so that the yarn has alternate thick and thin areas which impart a novelty effect to the yarn.

In order to prevent the yarn from wrapping around the grooved feed roll a rubber surfaced take-off roll is provided. The yarn may be slightly cooled to eliminate tackiness while on the take-off roll and is then passed through a heating zone in tensionless state to relax the yarn and allow the crimp to form after which it is cooled and wound as on a ring twister.

In the drawings:

FIG. 1 is a side elevation of an apparatus according to the invention, with parts in section for clarity;

FIG. 2 is a partial transverse section taken on the line 2—2 of FIG. 1 showing the construction of the preheater;

FIG. 3 is a broken detail view of the feed rolls;

FIG. 4 is a greatly magnified elevation of a yarn produced by the present invention;

FIG. 5 is a further detail of the yarn on a still larger scale; and

FIG. 6 is a side elevation partly in section showing a stuffer crimper embodying the present invention.

Referring to FIGS. 1–3 more in detail, the invention is shown as embodied in an apparatus comprising a frame 11 having an arm 12 on which a cop 13 is mounted. Yarn 14 from the cop 13 is fed over a guide rod 15 through a tension device 16 and over a guide rod 17 to a preheater 18. The preheater comprises a block 20 having a heater element 21 therein and having an arcuate surface 22 formed with an open longitudinal groove 23 in which the yarn 14 lies as it is fed along and in contact with the heated surface. The heater block 20 is carried on a support 24 attached to the base 11.

From the heater block 20 the yarn passes to the bite of the pair of feed rolls 31 and 32 which are mounted on shafts 33 and 34 respectively and driven at different speeds by meshing gears 35 and 36. In the form shown the feed roll 31 is mounted in bearing blocks 37 only one of which is shown and are slidable in frame 11 and are spring-pressed into feeding engagement with the yarn by springs 39. The spring pressure is adjustable by adjusting screws 40. The roll 32 is mounted in fixed bearings 41.

The surface of the roll 31 which is the faster roll may be smooth or may be finely sandblasted to improve its grip on the yarn. The peripheral surface of the roll 32 is formed with transverse ridges 42 and grooves 43 which extend in a direction parallel to the axis of the roll or at a slight angle thereto. These grooves 43 are closely spaced and are of the order of .0007 inch. The grooves may be formed by milling or grinding or by being impressed from a master roll.

The curved surface 22 of the heater block 20 is extended to form a tip 45, the end of which is disposed within and closely adjacent the bite of the feed rolls 31 and 32 so that the yarn is discharged directly from the heated surface into the bite of the feed rolls without appreciable cooling. After emerging from the bite of the feed rolls the yarn 14 passes around a take-off roll 51 which may have a soft surface 52 such as natural or synthetic rubber. This roll 51 is mounted on a shaft 53 and is held in pressure contact with and driven by the grooved roll 32.

A blast of cooling air is applied to the yarn on the take-off roll 51 from an air jet 54 which is mounted above the rolls and is connected to a source of cooling air by a hose 55. This cooling air is only used if the yarn is in tacky state when discharged from the bite of the rolls 31 and 32 and is intended to prevent the yarn from sticking to the surface of the take-off roll 51. Obviously the cooling air may be omitted if not required in any particular instance.

From the take-off roll the yarn passes into the bore 56 of a heating block 57 carrying a heating element 58. The bore 56 is of a diameter such that the yarn hangs freely therein, out of contact with the surfaces of the block and is free to coil in tensionless state into a succession of helical loops 59.

From the heater block 57 the yarn passes along an air path of sufficient length to allow the yarn to cool to set the crimp, thence between a pair of delivery rolls 61 and through a pigtail 62 to the traveller 63 of a ring twister 64 having a spindle 65 carrying a winding 66. The delivery

rolls are driven at a speed such that the yarn is held is tensionless state in the heating and cooling zones but is fed to the twister under a controlled tension for twisting and winding.

Obviously, if the nature of the yarn is such that it does not tend to wrap around the feed roll the take-off roll may be omitted and the yarn fed directly from the feed rolls to the post heater. Also the post heater can be omitted if the yarn as discharged from the feed rolls is in a relaxed state such that the crimp becomes set in its path to the winder.

The coil type crimp can be varied as to coil dimension and frequency by varying the speed ratios of the feed rolls and by varying the surface characteristics. A speed ratio of the order of 2:1 to 3:1 has been found satisfactory for small denier monofilament nylon yarn of the size used for ladies sheer hosiery. The grooved surface of the roll 32 improves the crimp characteristics and provides a yarn having successive thick portions 70 and intervening thin or grooved portions 71. Smooth surfaced rolls may, however, be used if other yarn characteristics are desired.

In some instances the rolls 31 and 32 may be used for forming a patterned or embossed effect upon the yarn without introducing the crimping effect. For this purpose the rolls may be operated at the same peripheral speed so that the pattern on the surface of the feed roll 32 is impressed into the filament while the filament is somewhat flattened due to the pressure of the roll 31. This operation may be facilitated by passing the filament first over the preheater for heating the filament to a softening temperature. The imprint of the roll 32 is set into the flattened yarn as the yarn cools after leaving the bite of the rolls.

In the embodiment of FIG. 6 the yarn 75 is withdrawn from a cop 76 through an adjustable tension gate 77 and passes in an arcuate path along a slot 79 in a heated block 80.

A stuffer crimper composed of a block 81 heated by suitable means such as Calrods 82 is formed with a vertical bore carrying a crimping tube 83 which forms an elongated crimping chamber. A pair of feed rolls 84 and 85, driven at the same peripheral speed by gears 86 and 87 are disposed at the lower end of the tube 83 and are adapted to feed the yarn into the tube to be folded over and crimped against the mass of crimped yarn held confined in the tube and to be advanced along the tube by the pressure exerted by the feed rolls.

A third roll 90 is disposed below and in peripheral contact with the feed roll 84 and is driven at a higher periperal speed by gears 88 and 91. The feed roll 84 is formed with a fluted or grooved surface similar to roll 32 of FIG. 1.

The yarn 75 is discharged directly from the heated surface of the block 80 directly into the bite between the feed roll 84 and the third roll 90 where the yarn is distorted and crimped as in the embodiment of FIGS. 1 to 5. From the bite of the feed roll 84 and the third roll 90 the yarn passes around a portion of the periphery of the roll 84 to the bite between the feed rolls 84 and 85 where it is fed into the stuffer crimper and a second crimp is superimposed on the first crimp to form a randomly crimped and bulked yarn.

In this embodiment the third roll 90 is driven at a speed slightly in excess of the speed of the feed roll 84. For example, the speed of the feed roll 90 may be of the order of 5% above that of the feed roll 84. The amount of overfeed is restricted to a value such that the yarn is picked up by the feed rolls 84 and 85 without forming an excessive amount of slack between the bites of the third roll 90 and of the feed roll 85 with the feed roll 84.

It has also been found that roll 90 can be eliminated in some cases and feed rolls 84 and 85 driven at different peripheral speeds to produce the crimped effect.

The crimped yarn is removed from the upper end of the crimping tube by any suitable means not shown or may be discharged in the form of a packed core as shown in U.S. Patent No. 2,997,747.

In this embodiment the yarn has thick and thin portions and is coiled as in FIGS. 4 and 5 and in addition has sawtooth crimps characteristic of the crimps produced in a stuffer crimper.

What is claimed is:

1. Apparatus for crimping yarn comprising a pair of feed rolls between which said yarn is fed, one of said feed rolls having a peripheral surface formed by successive grooves and ridges, means driving said feed rolls at different peripheral speeds for thereby forming coil crimp in said yarn and means for taking up said yarn after passage between said feed rolls.

2. Apparatus as set forth in claim 1 in which preheating means is provided to preheat the yarn as it is fed to the bite of said feed rolls.

3. Apparatus as set forth in claim 1 in which a take-off roll is disposed in contact with the surface of one of said feed rolls for stripping the crimped yarn from said feed rolls.

4. Apparatus as set forth in claim 3 in which said take-off roll is formed with a soft surface.

5. Apparatus as set forth in claim 4 in which said take-off roll is driven by surface contact with said feed roll.

6. Apparatus as set forth in claim 3 in which means is provided to supply cooling air to the yarn on said take-off roll for cooling the same to a non-tacky state thereon.

7. Apparatus as set forth in claim 1 in which a pair of delivery rolls is disposed to maintain the yarn in tensionless state for crimping, said delivery rolls being spaced from said feed rolls to provide a heating zone and a cooling zone therebetween whereby the yarn is crimped and crimp set prior to winding.

8. Apparatus as set forth in claim 1 in which said grooves and ridges extend at a slight angle to the axis of said feed roll.

9. The method of crimping yarn which comprises feeding said yarn between a pair of feed rolls having different peripheral speeds, one of which is provided with a transversely grooved surface, and withdrawing the yarn from the bite of said rolls.

10. The method set forth in claim 9 in which said yarn is preheated in advance of said rolls.

11. A method set forth in claim 9 in which the yarn is passed in tensionless state through a relaxing zone after passing between said rolls.

12. Crimping apparatus comprising an elongated crimping chamber, a pair of feed rolls having a bite disposed to feed yarn for crimping into one end of said chamber, to be folded over and crimped against a mass of previously crimped yarn held compacted in said chamber, and a third roll positioned to engage and grip the yarn on one of said feed rolls in advance of the bite of said feed rolls, means driving said feed rolls at the same peripheral speed, means driving said third roll at a higher peripheral speed for thereby forming a coil crimp in the yarn in advance of said bite.

13. Crimping apparatus as set forth in claim 12 in which said one of said feed rolls is formed with a grooved surface adapted to form thick and thin portions in the yarn.

14. Crimping apparatus as set forth in claim 12 in which preheating means is provided for heating the yarn in advance of said rolls.

15. Apparatus as set forth in claim 12 in which heating means is provided for heating the crimped yarn in said crimping chamber for heat-setting the crimp therein.

16. Crimping apparatus comprising an elongated crimping chamber, a pair of feed rolls having a bite disposed to feed yarn for crimping into one end of said chamber, to be folded over and crimped against a mass of previously crimped yarn held compacted in said chamber, and means driving said feed rolls at different periph-

eral speeds for thereby introducing a coil crimp into the yarn which is fed into said crimping chamber.

17. Apparatus as set forth in claim **16** in which one of said feed rolls is formed with a peripheral surface having successive grooves and ridges.

References Cited

UNITED STATES PATENTS

2,669,001	2/1954	Kien	28—1
2,917,779	12/1959	Kurzke et al.	28—72
2,975,474	3/1961	Smith	264—282
3,217,376	11/1965	Irwin et al.	28—1
3,253,314	5/1966	Shattuck	28—72
3,271,836	9/1966	Rosenstein	28—72

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