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PATENT SPECIFICATION
DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Method and Apparatus for Crimping Yarn.

We, JOSEPH BANCROFT & SONS Co., a Corporation organised and existing under the Laws of the State of Delaware, United States of America, of Rockford, Wilmington, County of New Castle, Delaware, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method and apparatus for crimping yarn.

According to one aspect of this invention, there is provided apparatus for crimping yarn comprising a crimping chamber having inlet and discharge ends, feed means for feeding said yarn into the inlet end of said chamber to be folded over and crimped against a core of previously crimped yarn held compacted in said chamber, a series of peripherally spaced members registering with the discharge end of said chamber and forming a continuation thereof and along which said core is in use of the apparatus, advanced for cooling, and confining means comprising sets of fingers extending between said spaced members and engaging said core on opposite sides to exert a compacting pressure thereon, and means withdrawing said yarn from said core at a point beyond said compacting fingers.

According to yet another aspect of the invention there is provided a method of imparting an artificial crimp to filaments which comprises feeding said filaments into a confined crimping zone to be folded over and crimped against a mass of previously crimped filaments held compacted in said zone, and advancing the crimped filaments as a core from said crimping zone to a cooling zone wherein the core of filaments is confined in spaced areas only, a retarding pressure being applied to said core by re-

tarding means located at points between said spaced areas.

In order that this invention, may more readily be understood, reference will now be made by way of example to the accompanying drawings, in which:—

Figures 1 and 1A, when joined along the line a—a, show a side elevation of a stuffer crimper embodying the invention;

Figures 2 and 2A, when joined along the line b—b, show a front elevation of the stuffer crimper;

Figures 3, 4, 5 and 6 are horizontal sections taken along the lines 3—3, 4—4, 5—5, and 6—6, respectively, of Figure 1 showing the construction of the parts embodied in the crimping and cooling zones;

Figure 7 is a sectional detail showing the construction of the dye applicators of the stuffer crimper;

Figure 8 is a section on the line 8—8 of Figure 7; and,

Figure 9 is a detail illustrating a further embodiment of the feed roll drive mechanism of the stuffer crimper.

Referring to the drawings more in detail the invention is shown as embodied in a stuffer crimper comprising a housing 11 having an elongated, vertical bore 12 therein forming a crimping chamber. The chamber, as shown in Figure 6, is of elongate form in horizontal cross-section with straight front and back walls 13 and end walls 14 which are rounded so as to avoid sharp corners which might damage the crimped yarn therein. The housing 11 is enclosed within a block 15 having heating rods 16 disposed therein for maintaining a desired degree of heat in the crimping chamber and extends above the block 15. At its upper end the housing 11 carries a collar 17 in which a series of spaced vertical rods 19 are supported. The rods 19 extend around the periphery of the crimping chamber 12 with their

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inner surfaces tangential thereto so that the rods form an extension of the chamber. The upper ends of the rods 19 are held in a horizontal wall 20 so as to form a cooling cage for the crimped filaments as the core 21 of crimped filaments advances upwardly along the rods.

A pair of choke members in the form of opposed rakes are disposed to maintain a predetermined back pressure on the core 21 of crimped filaments in the cooling zone. These members each comprise a set of curved fingers 23 carried on a pivotal shaft 25 which is journaled in a frame 26. The frame 26 includes end members having bosses 27 depending from the frame which are adjustably supported on rods 31 secured in the collar 17. Each shaft 25 carries a rod 32 having a weight 33 thereon which is adjustable along the rod 32 for controlling the pressure exerted by the fingers 23 against the core of crimped filaments in the cooling cage. The fingers extend between the rods 19 into contact with the opposite sides of the core 21. The point of contact of the fingers 23 with the core 21 and the consequent length of core held compacted in the cooling zone is controlled by adjusting the bosses 27 along their supporting rods 31. In the embodiment shown the fingers 23 are provided with internal passages 35 communicating with an axial passage 36 in the shaft 25 and having discharge openings 37 at or about the point of contact with the sides of the core. A dye or other treating liquid may be supplied to the axial passage 36 by a flexible tube 38.

The dye or other treating liquid is caused to impregnate the filaments in the cooling zone to a degree which is determined by the rates of feed of the core 21 and of the liquid and the density of the core. Additional treating liquid may be applied to the core above the compacting fingers 23 where the core is less highly compacted and the liquid can penetrate more freely by a series of nozzles 41 held in a bracket 42 and terminating in felt pads 43 in contact with the sides of the core 21. The nozzles 41 may be supplied with treating liquid by supply ducts 44.

The crimped yarn 50 is withdrawn from the top of the core 21 through a weighted bar tension gate 51, over a guide bar 49 to a roll 52, thence to a roll 58 mounted on a bracket 57 and to a winder, not shown, which may be of the constant speed type.

For controlling the feed of the core a feeler 60 is positioned to rest lightly on the top of the core 21 and is carried by an arm 61 which forms the control arm of a micro-switch 62 mounted on the bracket 42.

A pair of feed rolls 70 and 71 is disposed at the lower end of the crimping chamber 12 in a position to feed the yarn thereto for

crimping. The feed roll 70 is mounted on a shaft 72 which is journaled in a bracket 73 and carries a stepped pulley 74 driven by a belt 75 from the shaft 76 of a motor 77. Two bifurcated arms 80 actuated by a solenoid 81 are adapted to shift the belt 75 between the larger and smaller diameter steps of the pulley 74 for varying the speed of the feed rolls 70 and 71. The feed roll 71 is mounted on a bracket 82 which is pivoted at 83 and is spring pressed into pressure engagement with the yarn at the bite of the rolls. A set screw 85 which may have a micrometer setting is held in the bracket 82 to form an adjustable stop to limit the minimum clearance between the feed rolls 71. This prevents damaging the filaments by the application of excessive pressure and also prevents the feed rolls from coming into contact with consequent danger of injury to the surfaces of the feed rolls on the absence of the filament in the bite. This is particularly important where one of the feed rolls has a roughened surface.

The feed roll 71 may be driven with the roll 70 by gears, not shown. At least one of the feed rolls, for example roll 70, may have a transversely ground peripheral edge. That is, the grinding wheel is reciprocated axially of the peripheral surface of the roll as the roll is slowly rotated. This forms broken microscopic grooves (i.e. grooves having a depth of the order of 45 to 80 micro inches) with intervening ridges extending across the peripheral surface of the roll as indicated by lines 86 (Figure 2A). The grooves are so microscopic in size that they are barely visible except by reflected light and the surface feels slightly rough to the touch. However, the frictional grip of the rolls on the yarn is increased to an extent such that a lower pressure may be maintained on the filaments as they are fed through the bite of the rolls 70 and 71. Hence the filaments are not distorted or deformed by the feed rolls. This is of particular importance in the case of soft filaments such as preheated acrylics. It has been found that a roll having peripheral ridges and grooves of a depth of the order of 45 to 80 micro-inches is suitable for the above purposes.

The feed rolls 70 and 71 are mounted with their axes parallel to the long sides 13 of the crimping chamber 12. A traversing guide 90 is disposed to feed the yarn 50 to the bite of the rolls. This guide 90 is carried by a forked arm 91 supported to slide on bars 92 having a cam follower 93 reciprocated by a helical groove 94 of a cam roll 95 which is driven by a train of gears 96 from the feed roll 125 shaft 72. The reciprocation of the guide 90 is designed to effect a uniform packing of the yarn across the entire cross-sectional area of the crimping chamber. In certain instances, however, where a non-uniform

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or, if a desired effect is desired, the yarn guide 90 may remain stationary in a position to feed the yarn into the centre of the crimping chamber. In this case the yarn may become more highly crimped and compacted at the centre of the chamber and less highly crimped and compacted at the edges of the chamber so that different crimp effects are randomly distributed along the yarn.

The yarn 50 is fed around a stretch roll 97 and a guide roll 98 in a succession of loops 99, thence over the arcuate surface 100 of a preheater 101 and through the traversing guide 90 to the bite of the feed rolls 70 and 71. The stretch roll 97 is driven by a belt 102 from the driven shaft 72 and the guide roll 98 is driven with the stretch roll 97 by a train of gears 103. The rate of rotation of the stretch roll 97 is so related to the rate of rotation of the feed rolls 70 and 71 that the yarn is stretched in the preheating zone. The amount of stretch is such that the molecules of the filament are oriented longitudinally for increasing the tensile strength of the filaments. Although this would tend to impart a harsher feel to the filaments this effect is compensated for by the softening in the preheating stage and the crimping and bulk- ing to which the filaments are later sub- jected. The microswitch 62 is connected to control the solenoid 81 in a sense to increase or decrease the rate of feed of the filaments in accordance with the position of the top surface of the core with respect to the feeler member 60.

In the variation of Figure 9 a pulley 107 having a hub 108 is pinned to the shaft 72 and is driven by the belt 75. The hub 108 carries the inner race of a ball bearing 109 on which a flywheel 110 is mounted. The ball bearing 109 is packed with a material such as heavy grease which is adapted to provide a friction drag between the shaft 72 and the flywheel 110. The flywheel 110 thus rotates with the shaft 72 and, by its inertia, retards the deceleration of the shaft 72 when the driving motor is deenergized. The friction drag of the bearing 109 reduces the shock on the shaft 72 when the drive is again energized, thereby smoothing out the cycles of operation of the shaft and of the feed rolls as the drive motor 77 is alternately energized and deenergized by the micro- switch 62 as the feeler 60 rises and falls. The action is timed so that the feed rolls do not come to rest during the off portions of the cycle. Either the stepped pulley 74 or the inertia drive prevents the filaments from becoming stationary and overheating on the preheater.

While the choke rakes 23 maintain the core 21 under the predetermined back pres- sure in the crimping and cooling zones, the portion of the core above the points of contact of the fingers 23 is free of back

pressure except for the pressure exerted by the light feeler member 60. Hence the cool- ing air can permeate more readily the less highly compacted core in this portion of the cooling zone prior to the yarn being with- drawn under tension.

The stepped drive pulley for the feed rolls shown in the accompanying drawings is the subject of our co-pending Application No. 27512/67 (Serial No. 1,116,236), while the flywheel arranged for the feed roll shaft as shown in the accompanying drawings is the subject of our co-pending Application No. 27513/67 (Serial No. 1,116,237).

Certain features of the crimping chamber and associated parts of the apparatus shown in the accompanying drawings are the sub- ject matter of our co-pending Application No. 52940/67 (Serial No. 1,116,238). More specifically our co-pending Application No. 52940/67 (Serial No. 1,116,238) describes and claims apparatus for crimping yarn com- prising an elongated crimping chamber hav- ing a heated crimping and setting zone there- in, feed rolls disposed to feed a yarn for crimping into one end of said chamber to be folded over and crimped against a core of previously crimped yarn in said chamber and exert pressure to advance the core of crimped yarn along said chamber to a dis- charge point, means extracting the crimped yarn from said core at said discharge point, a pressure member disposed to press against the side of said core at a point in said chamber in advance of said discharge point, yieldable means connected to cause said pressure member to exert a continuous con- trolled pressure on said core for retarding the advance thereof and controlling the back pressure on said core in advance of said member, and a sensing means disposed to sense the position of the discharge end of said core without the introduction of appre- ciable additional back pressure in the por- tion of said core between said presser means and said discharge point, and means respon- sive to said sensing means to vary the rela- tive rates of feed and withdrawal in a sense to maintain said discharge point at a sub- stantially constant level.

WHAT WE CLAIM IS:—

1. Apparatus for crimping yarn compris- ing a crimping chamber having inlet and dis- charge ends, feed means for feeding said yarn into the inlet end of said chamber to be folded over and crimped against a core of previously crimped yarn held compacted in said chamber, a series of peripherally spaced members registering with the dis- charge end of said chamber and forming a continuation thereof and along which said core is, in use of the apparatus, advanced for cooling, and confining means comprising sets of fingers extending between said spaced

or spaced effect is desired, the yarn guide 90 may remain stationary in a position to feed the yarn into the centre of the crimping chamber. In this case the yarn may become more highly crimped and compacted at the centre of the chamber and less highly crimped and compacted at the edges of the chamber so that different crimp effects are randomly distributed along the yarn.

The yarn 50 is fed around a stretch roll 97 and a guide roll 98 in a succession of loops 99, thence over the arcuate surface 100 of a preheater 101 and through the traversing guide 90 to the bite of the feed rolls 70 and 71. The stretch roll 97 is driven by a belt 102 from the driven shaft 72 and the guide roll 98 is driven with the stretch roll 97 by a train of gears 103. The rate of rotation of the stretch roll 97 is so related to the rate of rotation of the feed rolls 70 and 71 that the yarn is stretched in the preheating zone. The amount of stretch is such that the molecules of the filament are oriented longitudinally for increasing the tensile strength of the filaments. Although this would tend to impart a harsher feel to the filaments this effect is compensated for by the softening in the preheating stage and the crimping and bulk-ing to which the filaments are later subjected. The microswitch 62 is connected to control the solenoid 81 in a sense to increase or decrease the rate of feed of the filaments in accordance with the position of the top surface of the core with respect to the feeler member 60.

In the variation of Figure 9 a pulley 107 having a hub 108 is pinned to the shaft 72 and is driven by the belt 75. The hub 108 carries the inner race of a ball bearing 109 on which a flywheel 110 is mounted. The ball bearing 109 is packed with a material such as heavy grease which is adapted to provide a friction drag between the shaft 72 and the flywheel 110. The flywheel 110 thus rotates with the shaft 72 and, by its inertia, retards the deceleration of the shaft 72 when the driving motor is deenergized. The friction drag of the bearing 109 reduces the shock on the shaft 72 when the drive is again energized, thereby smoothing out the cycles of operation of the shaft and of the feed rolls as the drive motor 77 is alternately energized and deenergized by the micro-switch 62 as the feeler 60 rises and falls. The action is timed so that the feed rolls do not come to rest during the off portions of the cycle. Either the stepped pulley 74 or the inertia drive prevents the filaments from becoming stationary and overheating on the preheater.

While the choke rakes 23 maintain the core 21 under the predetermined back pressure in the crimping and cooling zones, the portion of the core above the points of contact of the fingers 23 is free of back

pressure except for the pressure exerted by the light feeler member 60. Hence the cooling air can permeate more readily the less highly compacted core in this portion of the cooling zone prior to the yarn being withdrawn under tension.

The stepped drive pulley for the feed rolls shown in the accompanying drawings is the subject of our co-pending Application No. 27512/67 (Serial No. 1,116,236), while the flywheel arranged for the feed roll shaft as shown in the accompanying drawings is the subject of our co-pending Application No. 27513/67 (Serial No. 1,116,237).

Certain features of the crimping chamber and associated parts of the apparatus shown in the accompanying drawings are the subject matter of our co-pending Application No. 52940/67 (Serial No. 1,116,238). More specifically our co-pending Application No. 52940/67 (Serial No. 1,116,238) describes and claims apparatus for crimping yarn comprising an elongated crimping chamber having a heated crimping and setting zone therein, feed rolls disposed to feed a yarn for crimping into one end of said chamber to be folded over and crimped against a core of previously crimped yarn in said chamber and exert pressure to advance the core of crimped yarn along said chamber to a discharge point, means extracting the crimped yarn from said core at said discharge point, a pressure member disposed to press against the side of said core at a point in said chamber in advance of said discharge point, yieldable means connected to cause said pressure member to exert a continuous controlled pressure on said core for retarding the advance thereof and controlling the back pressure on said core in advance of said member, and a sensing means disposed to sense the position of the discharge end of said core without the introduction of appreciable additional back pressure in the portion of said core between said presser means and said discharge point, and means responsive to said sensing means to vary the relative rates of feed and withdrawal in a sense to maintain said discharge point at a substantially constant level.

WHAT WE CLAIM IS:—

1. Apparatus for crimping yarn comprising a crimping chamber having inlet and discharge ends, feed means for feeding said yarn into the inlet end of said chamber to be folded over and crimped against a core of previously crimped yarn held compacted in said chamber, a series of peripherally spaced members registering with the discharge end of said chamber and forming a continuation thereof and along which said core is, in use of the apparatus, advanced for cooling, and confining means comprising sets of fingers extending between said spaced



members and engaging said core on opposite sides to exert a compacting pressure thereon, and means withdrawing said yarn from said core at a point beyond said compacting fingers.

2. Apparatus according to claim 1 wherein a feeler member is disposed to engage the core at said withdrawal point beyond said compacting fingers and is connected to control the feed of yarn into the chamber in a sense to maintain said withdrawal point at a predetermined level.

3. Apparatus according to claim 1 or claim 2 wherein said fingers are provided with fluid passages having discharge openings positioned to apply a treating liquid to the contacting surface of said core.

4. Apparatus according to any one of claims 1 to 3 wherein a series of nozzles is positioned above said fingers in the direction of advance of said core and is adapted to apply a treating liquid to the sides of said core in the zone between said fingers and said withdrawal point.

5. Apparatus according to any one of the preceding claims, wherein the crimping chamber is of elongate cross-section and a traversing guide is provided to traverse the yarn axially as the yarn is fed to the chamber so as to cause the yarn to pack the latter uniformly throughout its whole cross-section.

6. Apparatus for crimping yarn substan-

tially as hereinbefore described with reference to and as shown by Figures 1 to 8 of the accompanying drawings.

7. Apparatus according to claim 6, modified substantially as hereinbefore described with reference to and as shown by Figure 9 of the accompanying drawings.

8. A method of imparting an artificial crimp to filaments which comprises feeding said filaments into a confined crimping zone to be folded over and crimped against a mass of previously crimped filaments held compacted in said zone, and advancing the crimped filaments as a core from said crimping zone to a cooling zone wherein the core of filaments is confined in spaced areas only, a retarding pressure being applied to said core by retarding means located at points between said spaced areas.

9. A method according to claim 8 wherein a treating liquid is applied to said core in said cooling zone at points between said spaced areas.

10. A method of imparting an artificial crimp to filaments substantially as hereinbefore described with reference to the accompanying drawings.

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