Dec. 1, 1959 A. ROBINSON ET AL 2,914,810

CRIMPING OF TEXTILE FIBRES

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FIG. 1

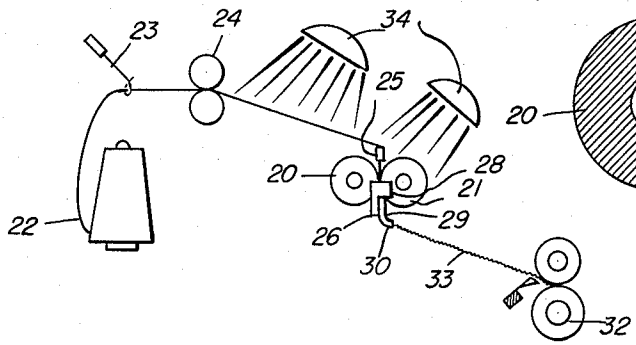


FIG. 2

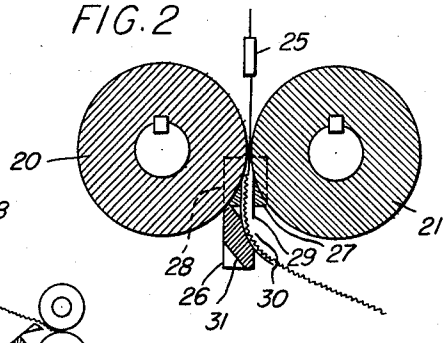


FIG. 3

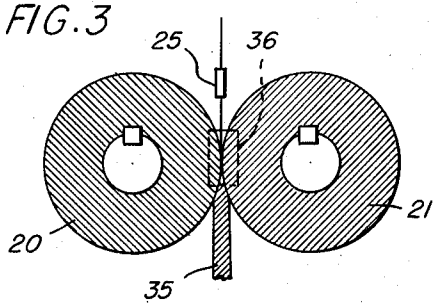


FIG. 4

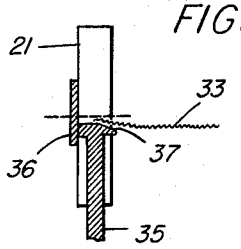


FIG. 5

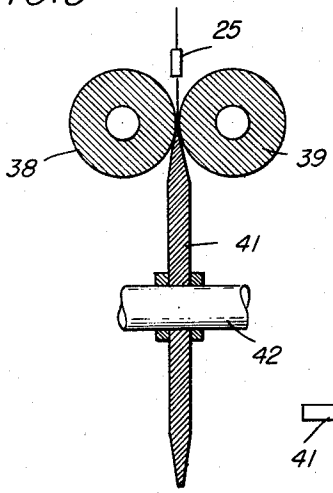


FIG. 6

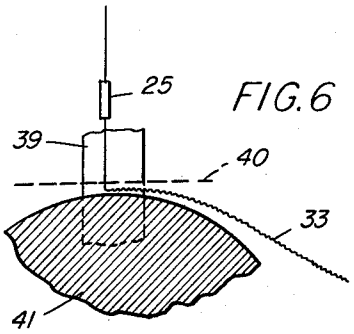
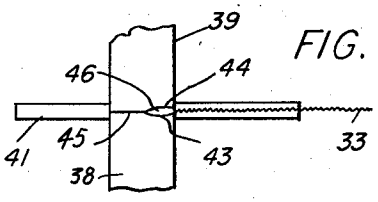


FIG. 7



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CRIMPING OF TEXTILE FIBRES

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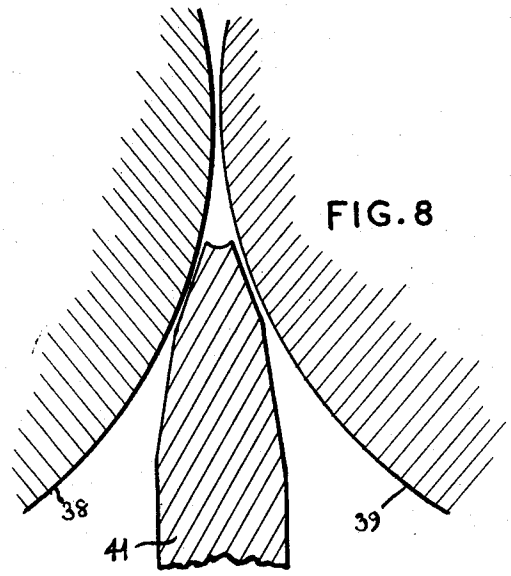


FIG. 8

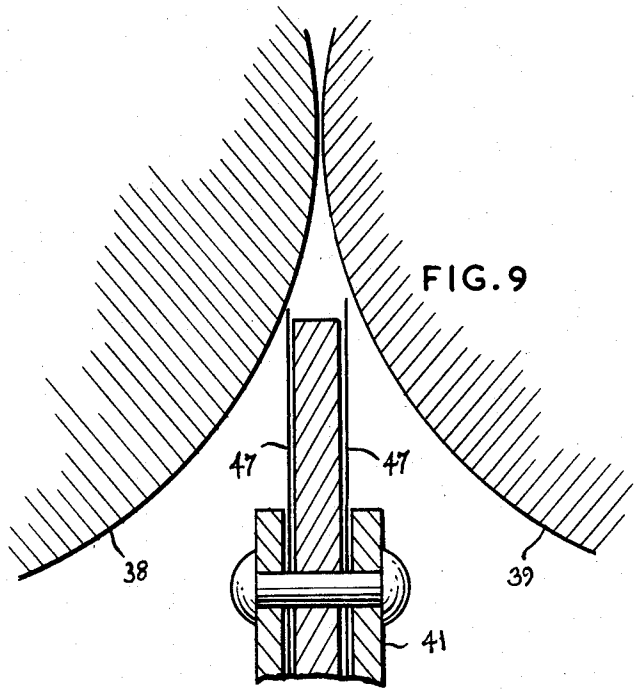


FIG. 9

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CRIMPING OF TEXTILE FIBRES

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Claims priority, application Great Britain July 16, 1957
9 Claims. (Cl. 19—66)

This invention relates to the crimping of textile fibres (whether continuous filaments or staple fibres) and is particularly concerned with the crimping of the fibres in the form of a yarn or like continuous product, e.g. tow or sliver, by the "stuffer box" method, in which the continuous product (hereinafter referred to as a "strand") is forcibly fed by nip rollers or the like into a confined space from which its emergence is resisted so that the filaments or fibres of the product are crimped under the pressure developed in the confined space.

According to the present invention a method of crimping by the stuffer box method comprises forcibly feeding a strand of textile fibres into a confined space of which the boundary opposite to and in the line of entry of the material constitutes an unyielding obstruction, and withdrawing the crimped product from the confined space laterally of said line of entry. In this way the pressure is built up in the material by forcing it against the unyielding opposite wall of the confined space and the crimped product can be withdrawn from the confined space laterally while still allowing the pressure to be built up and without the necessity of providing a yielding member having an intermittent and irregular motion to allow the escape of the crimped product. This results in greater uniformity in the pressure developed and in the degree of crimp, largely by the avoidance of irregularities in the manner of the emergence of the material from the confined space which are liable to occur if it emerges under its own pressure.

An apparatus according to the invention, suitable for carrying out the method described above, comprises a pair of nip rollers for feeding the strand forcibly into a confined space between the roller surfaces, means fitting closely to the nip rollers beyond the nip and constituting, in conjunction with said surfaces, a confined space and means for drawing away the crimped product from said confined space laterally of the line of entry of material into it. The member constituting the unyielding obstruction may also be adapted to provide lateral walls for the confined space, except on the lateral line of exit of the crimped product. Thus the member may be in the form of a curved tubular channel having one end shaped to fit the surfaces of the rollers beyond the nip thereof, the curve of the tubular channel bringing it across the line of entry of the material into and through the nip of the rollers. Once clear of the rollers the channel may be cut away so as to be open on the inner side of the curve, the outer side of the curve being the side which is operative to constitute the obstruction against which the pressure is built up. The curve of the channel may follow the curve of one of the nip rollers, so that the material is drawn away beneath that nip roller.

Preferably, however, the member constituting the unyielding obstruction is arranged not to obstruct the lateral drawing-away of the product along a passage bounded by the surfaces of the rollers and the said member. Thus the triangular space between the roller surfaces beyond the nip of the rollers can be closed on its third side by a simple transversely extending member in contact with the roller surfaces. A plain circular rod urged against the surfaces of the rollers and parallel to the axes thereof

can serve this purpose, though it is preferable to employ a member shaped to make contact over an appreciable area with the roller surfaces. The face of the shaped member opposite to the entry of the material may be slightly relieved to encourage the draw-off of the material in a direction generally parallel to the axes of the rollers and through a lateral opening bounded by the roller surfaces and by the obstructing member. The lateral opening on the opposite side may be closed by a suitable flat plate fitting against the end surfaces of the roller. If desired the member may be hollowed (shaped) so that the edges of the surface thereof bounding the confined space meet the surfaces of the rollers at an angle (measured within the space) of at least 90°. Yet again, a moving member may be employed, to encourage the drawing-away of the material, the member moving in the direction of lateral withdrawal of the filaments but being unyielding in the direction along the line of entry of the filaments. Thus wheel of a diameter which is large compared with that of the nip rollers for example by at least four times, may be arranged with its axis beneath and at right angles to those of the nip rollers and with its edge entering into the space between the nip rollers beyond the nip thereof and fitting against the surface of the rollers. To give a close and consistent fit along the whole axial length of the nip rollers, the rollers may be ground slightly hollow. The two faces of the wheel may be provided with projecting discs of springy material which maintain contact with the rollers by being sprung inwards at the point of deepest engagement of the wheel in the far nip of the rollers; by employing this device the precision with which the wheel and/or the rollers are shaped may be reduced.

The crimped product is drawn away laterally from the confined space at linear speed which is constant, in relation to the rate of feeding the yarn into the confined space, and is less than that rate to allow for the substantial shortening of the material as a result of crimping. The drawing away can be effected by collecting the crimped material by means of a constant-speed winder, or by means of a set of draw-off rollers supplying the product to a constant-speed winder or other collecting means such as a coiler can or centrifugal winding or other twisting-and-winding apparatus. It is found that by initially adjusting the draw-off speed in relation to the nip roller speed, it is possible to run indefinitely without further adjustment. However, if desired means may be provided for automatically adjusting the draw-off speed or the nip roller speed under the control of the tension in the product issuing from the confined space or of the quantity of material within the confined space. Where a constant-speed winding device is employed in association with a set of draw-off rollers it may be found desirable to run the winding device at a slightly lower speed than the draw-off rollers to allow the product to recover from any straightening of the crimp that may have been effected by the tension under which the product is drawn away from the confined space.

According to the nature of the substance of the filaments or fibres in the material being treated, and the readiness with which they assume and retain a crimped condition, the materials may be crimped without further assistance or they may be subjected to the action of liquid or gaseous softening media or of heat, preferably before they are fed into the confined space. Thus, the materials themselves, and also the nip rollers and other elements of the apparatus may be heated by means of infrared lamps suitably disposed; or the materials may be drawn through a bath of liquid softening medium; or a liquid or gaseous softening medium, e.g. steam, may be supplied within the confined space itself. Thus, where a rotating wheel is employed as the obstructing

boundary of the confined space, the wheel may be formed with radial passages opening on its periphery through which gaseous softening media may be fed from the centre of the wheel, the passages other than those communicating with the confined space being masked off so that fluid is supplied only to the confined space itself. Again, where a rotating wheel is employed as the obstructing boundary of the confined space, provision may be made for heating the wheel. Thus radiant heaters may be provided to radiate heat on to the wheel.

The invention is applicable to the crimping of textile fibres generally, whether in the form of continuous filaments or of staple fibres and whether the continuous product incorporating the fibres is of a weight suitable for use directly as a yarn or is of substantially greater weight, e.g. of a total denier of 10,000 to 100,000 or more so as to be suitable for drafting (in the case of a staple fibre product) or cutting into staple fibres (in the case of a continuous filament tow) for subsequent conversion into a yarn. The invention may also be applied to a bundle or collection of continuous filament yarns which, after crimping, may be separated from one another and used as yarns. While the invention is applicable, under suitable conditions and with suitable softening or other assisting agents, to crimp or increase the crimp of natural textile fibres, it is particularly applicable to the crimping of artificial continuous filaments and straight staple fibres made therefrom. It is of particular importance in relation to thermoplastic fibres, e.g. fibres of cellulose acetate (whether partly or substantially fully acetylated) or other organic derivatives of cellulose, and wholly synthetic fibres, for example, polyhexamethylene adipamide, polyaminocaproic acid and polyethylene terephthalate. The yarns crimped in accordance with the present invention, and yarns made from fibres so crimped, may be woven into fabrics alone or in combination with other types of yarn, being used as the warp or weft or both, or the yarns may be formed alone or with other yarns into knitted fabrics (warp knitted or otherwise) or into fabric articles, or may be employed in any other way appropriate to textile yarns.

By way of example several forms of apparatus in accordance with the present invention and the different methods of employing them will now be described in greater detail with reference to the accompanying drawings in which

Figure 1 shows an apparatus in which a short tubular member having a curved and cut away portion fits into the nip of a pair of rollers.

Figure 2 is a section of part of Figure 1 showing the rollers and tubular member in greater detail.

Figure 3 shows in end view a second form of apparatus in which the tubular member of Figure 1 is replaced by a T-shaped key, the arms of which fit closely into the nip of the rollers.

Figure 4 is a side view in section of the apparatus shown in Figure 3.

Figure 5 shows an end view of a third form of apparatus in which the unyielding obstruction is in the form of a wheel entering the nip of the nip rollers.

Figure 6 is a side view in section of the apparatus of Figure 5.

Figure 7 is a plan view of the apparatus shown in Figure 5.

Figures 8 and 9 show on an enlarged scale a detail of Figures 5, 6 and 7.

Referring to Figures 1 and 2, one form of apparatus comprises a pair of driven nip rollers or wheels **20, 21** of a diameter of 4" and of a width or axial length of ½" and mounted so as to be pressed together to form a nip by means (not shown) of springs under the control of adjusting screws whereby the pressure can be varied. Yarn is fed to the nip rollers **20, 21** from a package **22** via a pigtail guide **23**, draw rolls **24** and a slotted tubular guide **25**. Beyond the nip of the rollers **20, 21** is a member, generally indicated at **26**, comprising a substantial block **27** shaped so as to fit against the surfaces of the rollers on the far side of the nip and also presenting cheeks **28** extending beyond the shaped portion, which engage the end faces of the rollers. The block **27** is bored to receive a tube **29** having an internal diameter of the order of ¼". After extending straight for a distance of about 1" from the nip, the tube curves away beneath one of the rollers at a radius of about 1" and is cut away on the inner side of the curve so as to constitute an open channel **30**. The cheeks **28** are also united by a bar **31** through which the assembly constituting the member **26** may be mounted. In a direction tangential to the end of the channel lies a constant-speed take-up device generally indicated at **32**, by means of which the product **33** is drawn away and is wound up on a cheese or like cylindrical package driven by surface contact with a driving roller rotated at constant speed. A pair of infra-red lamps **34** are disposed above the apparatus, one directed against the upper surfaces of the nip rollers and the other against the yarn proceeding to the guide **25** leading to the nip rollers. By these means the nip rollers are heated to a temperature of 70–90° C.

Referring to Figures 3 and 4, in a second form of crimping apparatus the member **26** of Figure 1 is replaced by a generally T-shaped closing key **35**, the vertical leg of which extends upwards to the far nip of the rollers **20, 21** so that the horizontal arm extends along the nip, generally parallel to the axes of the rollers. One end of the horizontal arm of the T is furnished with a flat plate **36**, adapted to engage one end surface of each of the nip rollers so as to close at one end of the triangular space bounded above by the surfaces of the nip rollers **20, 21** and below by the upper surface of the key **35**. The flanks of the horizontal member of the T are ground to fit against the curved surfaces of the nip rollers. The upper surface of the key is not wholly flat but is slightly relieved towards the end **37** remote from the flat plate **36**, so that material forced into the triangular space by the nip rollers is encouraged to emerge from the space by the end thereof which is not closed by the flat plate. In this case, the direction of draw-off of the crimped product **33** is generally parallel to the axes of the nip rollers, instead of being at right-angles thereto as in the case previously described with reference to Figures 1 and 2. The constant speed take-up device is suitably placed to draw off the product in this direction.

Referring to Figures 5, 6 and 7, in a third form of apparatus, similar nip rollers **38, 39**, of about 1" diameter, are employed and the far side of the nip is obstructed by a wheel **41** having a diameter of about 6" and bevelled on both faces to leave an edge of about 0.07" wide. The wheel is mounted on a slowly driven spindle **42** beneath and at right-angles to the axes of the nip rollers **38, 39** and at such a height that the edge of the wheel is about ⅛" below the nip line **40** of the rollers, i.e. the plane of their axes. The wheel axis is not directly beneath the mid-point of the nip but is displaced about ¼" in the direction in which the fibres will emerge from the confined space between the far nip of the rollers **38, 39** and the edge of the wheel **41**. The rollers **38, 39** are ground slightly concave to form waists **43, 44** centred directly above the axis of the wheel **41**, the maximum depth of material removed at the waist being of the order of 0.009". The grinding is effected by means of a hardened wheel of the same dimensions as the wheel **41** to be employed and disposed (relatively to the nip rollers being ground) in the intended position of the wheel. In this way a concavity is generated which fits the edge of the wheel along a substantial length of its periphery. Over about one-half the length of the nip, the rollers **38, 39** remain cylindrical as at **45** and engage closely while the remaining length of the nip includes a gap **46** due to the concavities **43, 44**.

The edge of the wheel **41** may be shaped and provided with a hollow edge as shown in Figure 8. Again, as shown in Figure 9, the wheel **41** may be provided on either side with a disc or annulus of thin springy material **47** extending radially slightly beyond the periphery of the main part of the wheel.

The wheel **41** is driven in such a sense that its upper edge moves away from the unground, cylindrical portion of the nip rollers and with a peripheral speed substantially less that that of the nip rollers. The degree of crimping can be adjusted by adjusting the speed of the wheel in relation to that of the rollers, the rotation of the wheel ejecting the crimped product at a constant speed. In this case the speed of the take-up device or of the draw rollers, if such are employed, may be slightly higher than the peripheral speed of the wheel though still substantially lower than the speed of the nip rollers.

In the operation of the device the pressure between the nip rollers is adjusted so as to be only just sufficient to feed the yarn into the confined space in the far nip. The material is fed into the nip, under the control of the input guide, in the neighborhood of the point where the nip rollers change from cylindrical to hollow-ground form.

Due to the rotation of the rollers **38**, **39** there is little or no tendency for the material undergoing crimping to escape through the gap **46** formed by the concavities in the rollers. This gap **46** may be used to feed liquid softening agents to the material undergoing crimping in the space between the rollers **38**, **39** and the wheel **41**.

The following are given as examples of the use of the above forms of apparatus in the production of crimped yarns.

Example I

A yarn of 52 continuous filaments of secondary cellulose acetate, having an acetyl value of about 53.5 (calculated as acetic acid) and having a total denier of 300, is fed to the apparatus of the type described above with reference to Figures 1 and 2 at a speed of 19 yards per minute, the nip rollers being heated to a temperature of 80° C., and is withdrawn as a crimped yarn and wound up at a speed of 15 yards per minute.

Example II

A yarn of 25 filaments of substantially fully acetylated cellulose acetate (acetyl content 61 percent) and of a total denier of 100, is supplied to the form of apparatus described above with reference to Figures 3 and 4, the nip rollers being rotated at a peripheral speed of 19 yards per minute, and withdrawn at 15 yards per minute to be wound up as a crimped yarn.

Example III

Two yarns of the kind described in Example II are doubled together with five turns per inch and fed to the third form of apparatus, the nip rollers having a peripheral speed of 60 yards per minute and the wheel a peripheral speed of 40 yards per minute. The resulting crimped yarn is wound up at 45 yards per minute.

Example IV

Two yarns of the kind used in Example II are doubled together with five turns per inch and fed into the third form of apparatus described above with reference to Figures 5 to 9 in which the nip rollers are driven with a peripheral speed of 34 yards per minute. The wheel is driven at 20 yards per minute and the yarn is wound up at 22 yards per minute.

What we claim is:

1. A method of crimping textile fibres in the form of a strand, which comprises forcibly feeding the strand into a confined space of which the boundary opposite to and in the line of entry of the strand is constituted by an unyielding obstruction, and withdrawing the crimped product from the confined space laterally of said line of entry.

2. A method according to claim 1 wherein the surface of the unyielding obstruction constituting the boundary opposite to the line of entry of the strand is a moving surface, the movement being in the direction of lateral withdrawal of the filaments.

3. Apparatus for crimping textile fibres in the form of a strand, said apparatus comprising a pair of nip rollers, means for feeding the strand into the nip of said rollers, a member fitting closely into the nip of said nip rollers on the exit side of the nip said member presenting a surface unyielding in the line of travel of said strand through the nip and constituting a confined space in conjunction with said roller surfaces, and means for drawing the strand out of said confined space laterally of said line of travel.

4. Apparatus for crimping textile fibres in the form of a strand, said apparatus comprising a pair of nip rollers, means for feeding the strand into the nip of said rollers, a member fitting closely into the nip of said nip rollers on the exit side of the nip said member presenting a stationary surface unyielding in the line of travel of said strand through the nip and constituting a confined space in conjunction with said roller surfaces, and means for drawing the strand out of said confined space laterally of said line of travel.

5. Apparatus according to claim 4, wherein the stationary unyielding surface of the member fitting into the nip extends substantially across the width of the nip rollers, the confined space is closed at one end by a closure plate abutting the rollers, and means are provided for drawing the strand from the other end of the confined space.

6. Apparatus according to claim 5, wherein the distance between the stationary unyielding surface and the line of the nip increases towards the end of said surface remote from the closure plate.

7. Apparatus for crimping textile fibres in the form of a strand, said apparatus comprising a pair of nip rollers, means for feeding the strand into the nip of said rollers, a member fitting closely into the nip of said nip rollers on the exit side of the nip, said member presenting a movable surface unyielding in the line of travel of the strand through the nip and constituting a confined space in conjunction with said roller surfaces, means for moving said surface relative to the nip rollers in a direction generally at right angles to the line of travel of the strand through the nip and generally parallel to the axes of the nip rollers, and means for drawing the strand out of said confined space in the direction of movement of the movable surface.

8. Apparatus for crimping textile fibres in the form of a strand, said apparatus comprising a pair of nip rollers, means for feeding the strand into the nip of said rollers, a rotatable wheel of large diameter relative to the nip roll diameter and having its axis substantially at right angles to the axes of the nip rollers, the edge of said wheel entering the space between the nip rollers on the exit side of the latter and forming a confined space in conjunction with said roller surfaces, and means for drawing the strand out of said confined space in the direction of movement of the edge of the wheel.

9. Apparatus according to claim 8, wherein the nip rollers are waisted over a part of their length to accommodate the edge of the wheel and the strand feeding means is adapted to feed the strand to the non-waisted section of the nip rolls.

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