

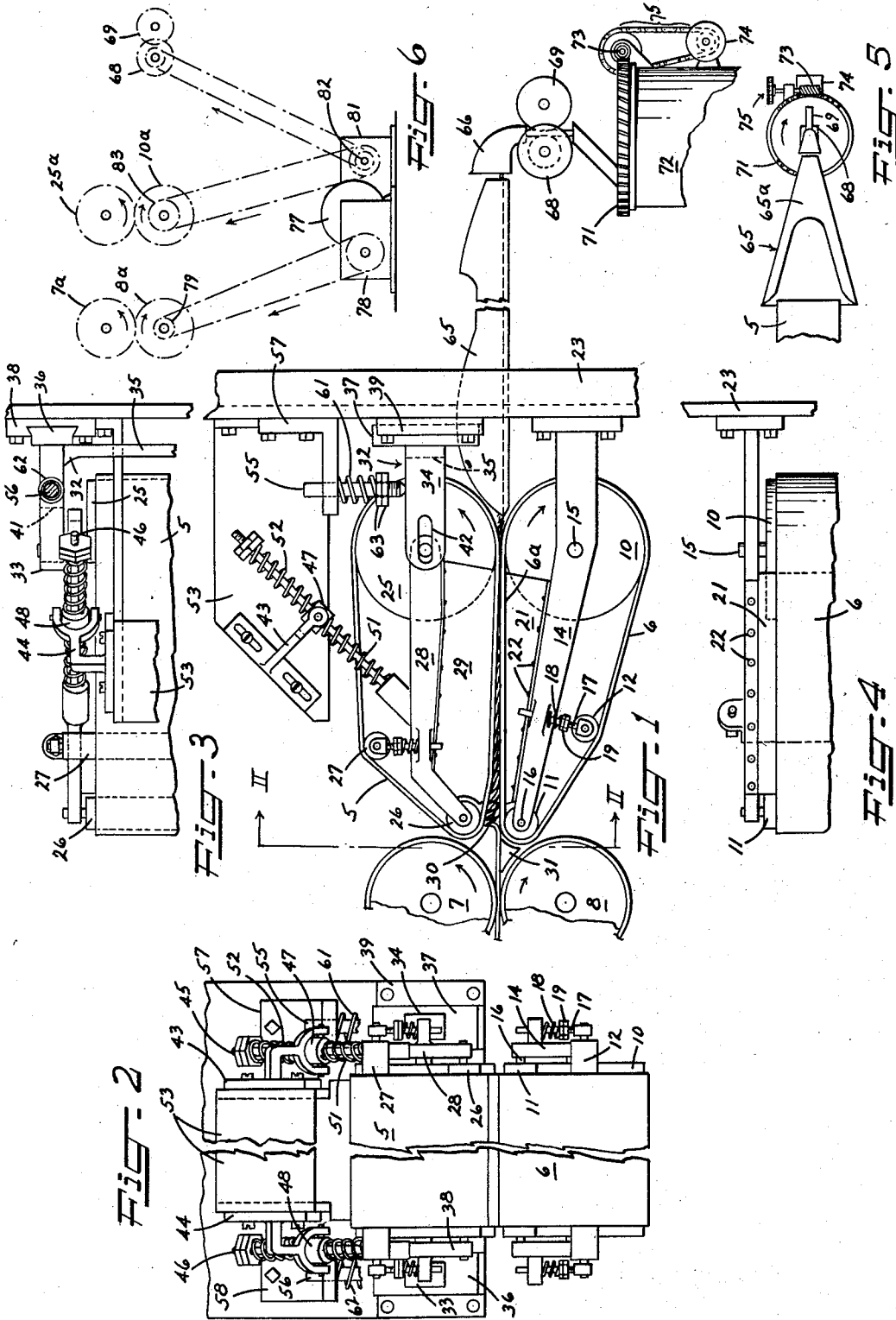
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STAPLE FIBER CRIMPING APPARATUS

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STAPLE FIBER CRIMPING APPARATUS

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The present invention relates to apparatus for crimping fibers such as continuous filaments or staple fibers of regenerated cellulose, cellulose derivatives or polymer type resins such as the polyamides, the polyesters, and the polyacrylics. In particular, the invention concerns the mechanical crimping of fibers disposed in the form of a continuous sheet.

In general, the conventional practice in the art of mechanical crimping of fibers comprises processes in which the crimping is performed upon continuous strands or bundles and rarely upon thin sheets thereof. This is particularly true in the operation of machines for converting filament to staple fiber wherein the continuous staple product thereof may be condensed into a bundle or sliver and then subjected to mechanical crimping. As one consideration underlying the emergence of the present invention is the belief that the thinness of the body in which the fibers are disposed is a primary factor for facilitating the mechanical development of crimp in the fibers, and rather than following the conventional practice of first condensing and then crimping, it is better to first crimp the fibers in the form of a thin sheet and then condense them into a sliver or other desired bundle form. Such machines as are known to exist for the purpose of crimping thin sheets of fibers include the type known as the "tongue and groove" crimper in which the fibers are subjected to deformation between opposing crimping members. The hard metallic surfaces tend to injure the fibers folded therebetween.

It is a primary object of the present invention to provide a new improved and more satisfactory apparatus adapted for crimping a sheet or blanket of fibers. Another object is to provide apparatus which is readily adjustable for obtaining different degrees of crimp and for handling sheets of different thickness. It is also an object to provide apparatus for first crimping a sheet of fibers and then condensing the crimped fibers into a bundle of rotund cross-section such as a sliver. A further object is to provide crimping apparatus which may be adjusted to control the fineness and the intensity or set of the crimp.

Other objects, features, and advantages will become apparent from the following description of the invention and the drawing relating thereto in which:

Fig. 1 is a side elevation of crimping apparatus in accordance with the invention;

Fig. 2 is an end view of a portion of the apparatus of Fig. 1 as viewed from line II—II;

Fig. 3 is a fragmentary plan view of a side portion of the upper crimping apron and supporting assembly therefor;

Fig. 4 is a fragmentary plan view of a side portion of the lower crimping apron and supporting assembly therefor;

Fig. 5 is a fragmentary plan view of the fiber-condensing section of the apparatus shown in Fig. 1; and

Fig. 6 is a diagrammatic view of the drive system for the apparatus shown in Fig. 1.

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In brief, the invention consists of apparatus comprising a pair of opposed crimping belts or aprons which are relatively adjustable to change the contour of the fiber-storage region, defined by mutually-facing sections of the belts, and a feeding device for positively advancing a sheet of fibers into the fiber-storage region. In a preferred embodiment wherein the crimped sheet-like product of the crimping belts is transformed into a bundle of rotund cross-section, the apparatus additionally includes a condensing section for applying lateral forces to the crimped product so as to bunch the fibers into a continuous rotund fiber body, and also a drive system for varying the speed of the crimping belts relative to the speed of the feeding device. The belts are preferably formed of a resilient material, such as an elastic vulcanizate or an elastic vulcanizate reinforced with one or more plies of fabric.

Proceeding now to a description of the invention in greater detail, Figs. 1 and 2 show two belts or aprons 5 and 6, positioned one above the other to receive a sheet of fibers discharged from the nip of a pair of rolls 7 and 8. The apron 6 is supported by a driven roll 10 and idler rolls 11 and 12. As shown in Fig. 1, shafts 15 and 16 of rolls 10 and 11, respectively, are journaled in portions of a frame 14. The roll 12 is resiliently supported with respect to the frame 14 by two assemblies, each of which comprises a guide-bearing element 17 and a spring 18 in bearing relation with a trunnion or shaft portion of the roll 12 extending beyond each of its end surfaces. A nut 19 is threaded onto a shank portion of the element 17 whereby the compression of the spring 18 may be changed to alter the pressure of the roll 12 against the interior surface of the belt 6. The upwardly-facing section or reach 6a of the belt 6 passes over the top surface of a supporting panel 21 which is secured by a flange portion thereof and screws 22 to the upper surface of the frame 14. The panel 21 supports the belt along a desired path as it passes from the roll 11 to the roll 10. The frame 14 is secured in fixed position to a stanchion 23.

The upper belt 5 is supported by a driven roll 25 and idler rolls 26 and 27, of which the roll 26 has an axis fixed with respect to a frame 28, while the roll 27 is supported in the same manner as roll 12 to resiliently engage with the inner surface of the belt 5 and thus tension the belt. Cooperating with the rolls supporting the belt 5 is a panel or housing 29 which has a downwardly-facing belt-supporting surface contoured convexly or extending along an angular path, as shown in Figure 1, to provide an enlarged fiber-receiving portion in the region 30, defined by the mutually-facing surfaces or opposing reaches of the belts. Preferably, the fiber engaging surfaces of the belts 5 and 6 each comprise a soft resilient layer, similar in hardness to that of a pneumatic tire tread, whereby the belts may be urged toward each other under any desired pressure without crushing or otherwise injuring the structure of individual fibers. A stationary guide 31 is fixedly supported between the roll 8 and the fiber-receiving end of the belt 6. The upper flat surface of the guide 31 underlies the entire width of the fibrous blanket discharged by the rolls 7 and 8 whereby it channels the blanket into the region 30.

In order that fibers discharged by the rolls 7 and 8 may be crimped in accordance with varying conditions of operation and the requirements of the trade, the belts 5 and 6, and the respective supporting assemblies therefor are preferably movable relative to each other to permit adjustment of the inclination of one fiber-engaging section or reach of one belt with respect to the mutually-facing section or opposing reach of the other belt. Adjustability of one belt assembly with respect to the other is required also for changing the spacing between or the pressure with which the opposing belt reaches are urged

toward each other so as to facilitate control over the degree of crimp imparted to the fibers. To achieve this adjustability in the crimping system, the apron 6, and supporting apparatus therefor, is mounted in fixed position relative to the path of the fibrous material through the system, while the upper belt assembly is movably mounted by a frame 23 which is pivotable with respect to a vertically reciprocable carriage 32. The carriage 32 is slotted longitudinally within each of its bearing sections 33 and 34 and comprises a tie plate 35, extending between the bearing sections, and slide portions 36 and 37 which are dovetailed to guide plates 38 and 39. The slots 41 and 42 in the sections 33 and 34 permit the entire assembly comprising the belt 5, the frame 23, and the rolls 25, 26, and 27 to move in a direction toward and away from the stanchion 23.

When the periphery of the fiber-feeding roll 7 overhangs the fiber-receiving end of the belt 5 as it does in Fig. 1, it is necessary for the upper belt, and a supporting assembly therefor, to move in a horizontal direction in order that the portion of the belt passing around the roll 26 may clear the overhanging portion of the periphery of the roll 7. If for any reason it is necessary for the subjacent portion of the belt assembly to swing upwardly about the axis of the roll 25 as a fulcrum, the assembly as a whole must move horizontally in a direction away from the roll 7. For this reason, the frame 28 is resiliently attached to a pair of stationary brackets 43 and 44 by extension of rods 45 and 46 which pass through pivotable elements 47 and 48 of the brackets 43 and 44 respectively. Resilient support of the frame 28 with respect to the brackets is provided by springs 51 and 52 disposed on opposite sides of each of the elements 47 and 48 and surrounding the rods 45 and 46. Both brackets 43 and 44 are rigidly connected to the stanchion 23 by a support 53.

To maintain constant pressure on the fiber being discharged by the crimping belts, irrespective of the mass or the bulk of the fiber passing through the nip of the rolls 10 and 25, the reciprocable carriage 32 is urged downwardly by push rods 55 and 56 which extend through guides 57 and 58. Springs 61 and 62 urge the push rods against the carriage 34 by being compressably supported between respective guides and lock nuts 63 threaded onto the push rods.

The crimping belts discharge a sheet of fibers in crimped condition into a flume 65, the sides of which are curved upwardly and converge lengthwise toward a curvate condenser 66 to facilitate condensing of the fibers within the flume 65 itself. The forward section 65a of the flume is entirely continuous across its top, or closed over. The condenser 66 has a nozzle portion adapted to feed the condensed fibers between condenser rolls 68 and 69. The condensing roll 68 has a middle section of a diameter smaller than its side sections but of approximately the same axial length as the roll 69, whereby the latter roll may radially overlap and rotate between the side sections of the roll 68 to provide a condensing passageway between the two rolls. In addition to further condensing the fibers, the rolls 68 and 69 also advance the continuous condensed product through the flume 65 and the condenser 66. The condensing rolls discharge a sliver-like product in the rotary top 71 of a coiler 72. The top 71 is rotated by means, such as that shown, comprising a bevel gear 73, a motor 74, and a sprocket drive 75 interconnecting the bevel gear and motor.

The various driven components of the apparatus herein described may be driven in the manner as illustrated in Fig. 6 wherein a motor 77 drives the feed rolls 7 and 8 through a gear reduction unit 78, with a sprocket drive connecting the unit with the shaft 79 of the roll 8 and a pair of gears 7a and 8a interconnecting rolls 7 and 8 for simultaneous movement. Since it is desired that the fiber-advancing rate of the crimping system be adjustable with respect to that of the rolls 7 and 8, the motor 77 drives a variable speed unit 81, the output shaft 82 of

which is connected with the shaft 83 of the roll 10. The rolls 10 and 25 are driveably connected by gears 10a and 25a respectively. The condensing rolls 68 and 69 may be driven in an unvarying ratio with the crimping aprons by connecting the output shaft of the unit 81, as by a sprocket drive, with one of the condensing rolls 68 or 69 in the manner shown. The driving system described is merely illustrative of one of the many ways in which the various driven components of the crimping apparatus may be driveably connected. Although the position of the axis of the roll 25 is not positively fixed with respect to the axis of the roll 10, the length of the teeth of the meshing gears 10a and 25a is sufficient to maintain driving relation between the rolls, even though the roll 25 may undergo shifts in position.

The apparatus herein described is especially adapted for operation in conjunction with machines such as filament-to-staple fiber converting machines which discharge fibers in the form of a flat continuous blanket. This apparatus effectively utilizes the principle of disposing a large body of fibers in a flat thin blanket whereby the fibers may be sharply and advantageously folded in a direction transversely to the general plane of the blanket. Furthermore, the present invention does not depend on metallic or other hard surfaces to impress crimp in the fibers but instead, crimping is accomplished between the resilient surfaces of cooperating belts which minimize crushing or other injury of the fibers. If desired, the crimping apparatus herein described may be readily adapted to other treatments such as liquid treatments or heat setting of the fibers. To implement such treatments the belts 5 and 6 and the belt-supporting panels may be made permeable to permit the passage of gas or liquid.

While a preferred embodiment of the invention has been shown and described, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. Apparatus for producing a continuous body of crimped fibers of rotund cross-section comprising a pair of endless crimping belts and means for supporting the belts with sections thereof in opposed mutually-facing relationship, means for driving the belts at the same speed with said sections moving concurrently, said sections being spaced to define a fiber-storage region larger at its fiber-receiving end than at its fiber-discharging end, a sheet-condensing means, means for advancing the fibers through the condensing means operating at substantially the same rate of fiber-advancement as the endless crimping belts, said belts being disposed for advancing the fiber directly to the condensing means, and means for advancing said body of relatively uncrimped fibers into the fiber-receiving end of said region at a rate greater than the rate of advancement of said belts.

2. Apparatus as described in claim 1 wherein the condensing means comprises a flume having upcurving side portions which converge in the direction of fiber-advancement.

3. Apparatus as defined in claim 1 wherein said means for advancing the fiber through said condensing means comprises a pair of condensing rolls in peripheral re-entrant relationship.

4. Apparatus for crimping a continuous sheet of fibers comprising means for positively advancing said fibers as a sheet, a pair of endless crimping belts and means for supporting the belts with sections thereof in opposed mutually-facing relationship, means for driving the belts with said sections moving concurrently at the same speed, said sections being spaced to define a fiber-storage region between the belts larger at its fiber-receiving end than at its fiber-discharging end, means for condensing the sheet of crimped fibers discharged by the belts into a continuous product of rotund cross-section, means for drawing the fibers through the condensing means, said belts being dis-

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posed between the first advancing means and the condensing means to advance fibers directly away from said first advancing means to the condensing means, means for driving the first advancing means at a rate in predetermined ratio and in excess of that of the belts, and means for driving the second advancing means at a rate in a predetermined ratio not exceeding the speed of said belts.

5. Apparatus for crimping a continuous body of fibers comprising means for positively advancing said body, a pair of endless belts and means for supporting the belts with sections thereof in opposed mutually-facing relationship, one of said belts being disposed above the other, said sections being spaced in gradually converging relationship to define a fiber-storage region larger at its fiber-receiving end than at its fiber-discharging end, means for driving the advancing means at a speed in excess of that of the belts at a predetermined ratio, the supporting means for the lower belt being mounted for maintaining the belt along a substantially horizontal fixed path, and the supporting means for the upper belt being resiliently mounted for movement in a direction away from the lower belt with respect to a normal position of equilibrium.

6. Apparatus for crimping a continuous body of fibers comprising means for positively advancing said body, a pair of endless belts and means for supporting the belts with sections thereof in opposed mutually-facing relationship, one of said belts being disposed above the other,

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said sections being spaced to define a storage region larger at its fiber-receiving end than at its fiber-discharging end, said means for supporting the belts having a backing surface for one of said sections which is arched toward said section of the opposing belt, and means for driving the advancing means at a speed in excess of that of the belts at a predetermined ratio.

7. Apparatus as defined in claim 6 wherein the supporting means for the lower belt is mounted for supporting the belt along a substantially horizontal fixed path, and the supporting means for the upper belt is resiliently mounted for movement in a direction away from the other belt with respect to a normal position of equilibrium.

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