

Jan. 11, 1955

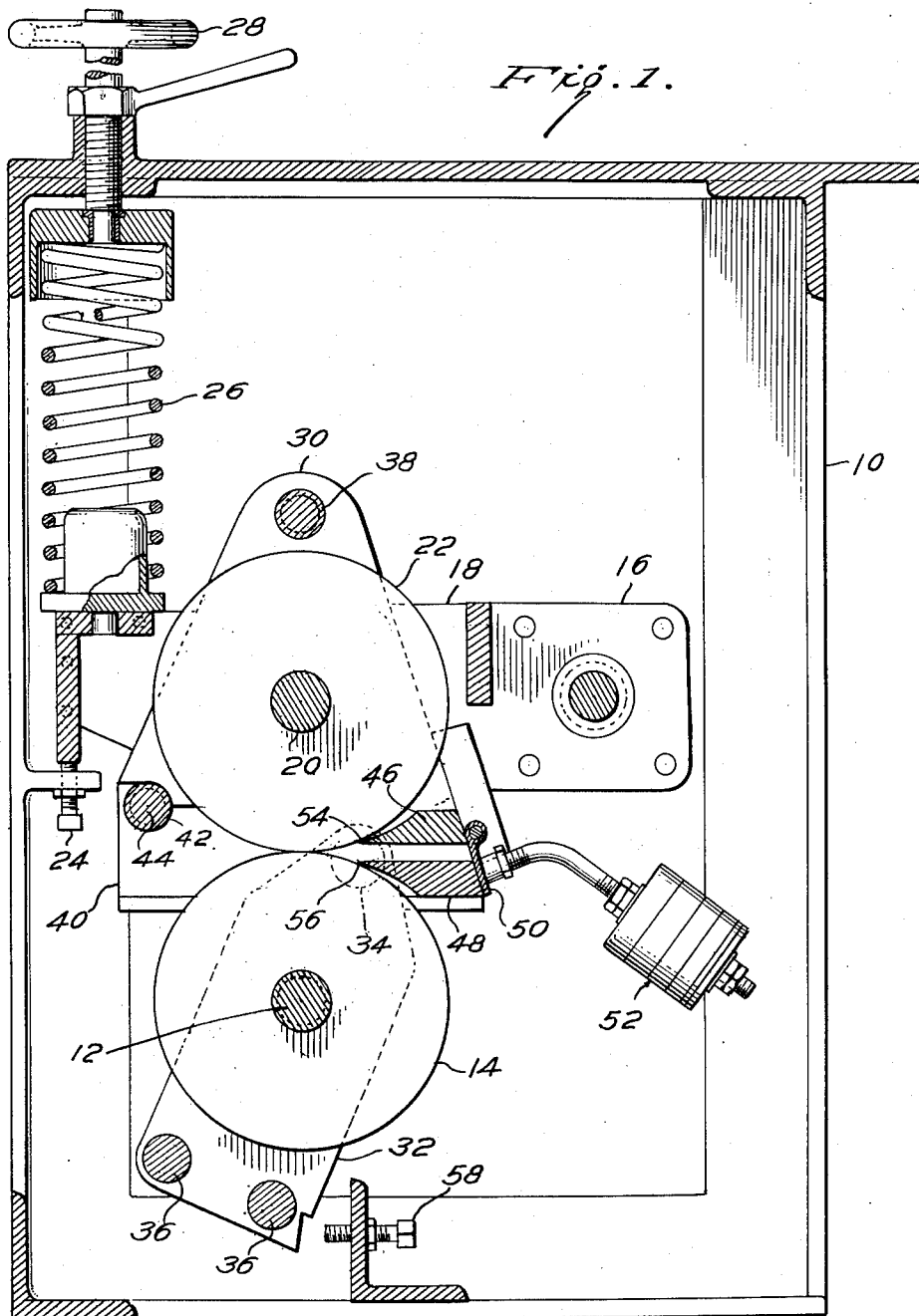
D. B. WICKER

2,698,970

TOW CRIMPER

Filed Nov. 24, 1951

3 Sheets-Sheet 1



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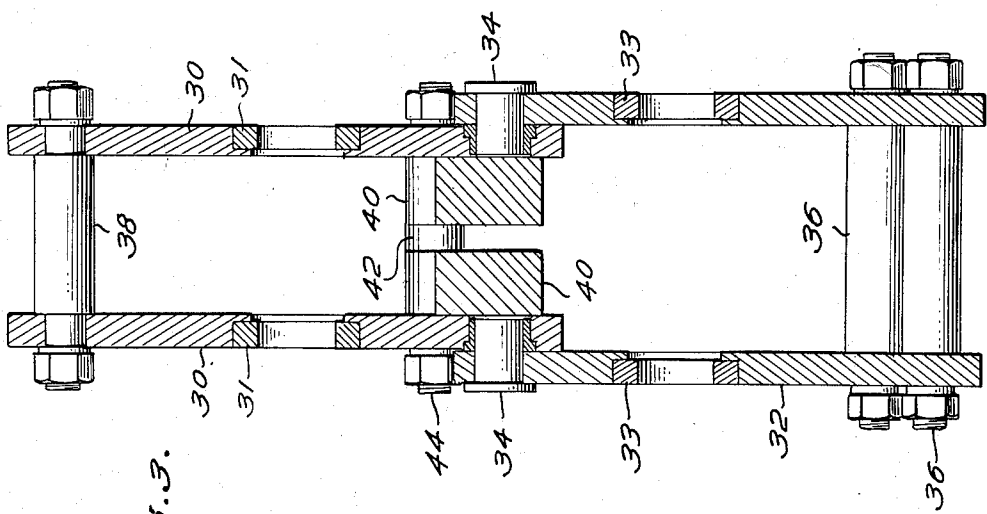


Fig. 3.

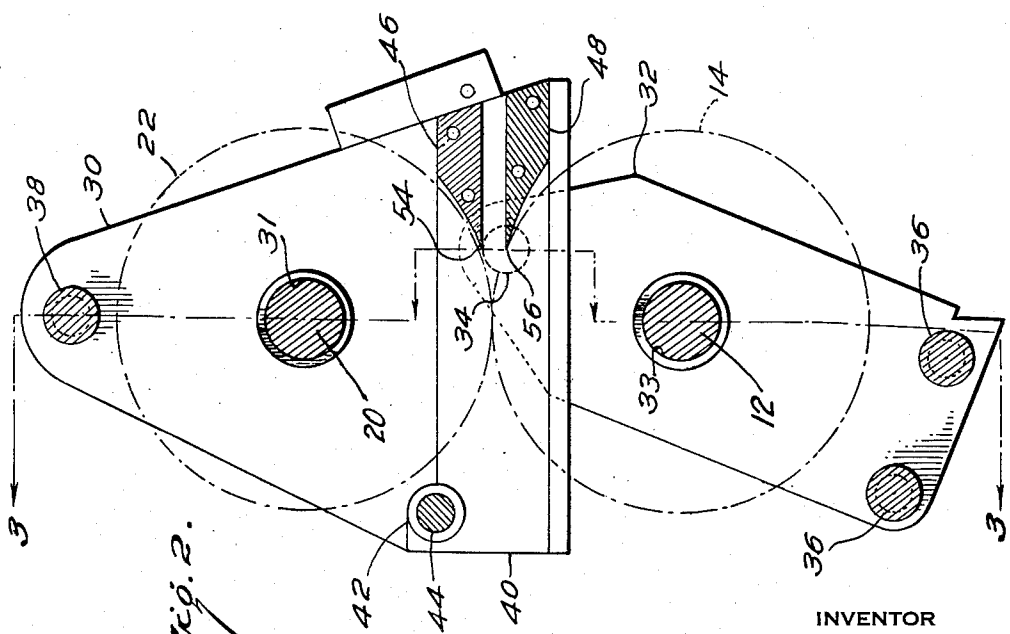


Fig. 2.

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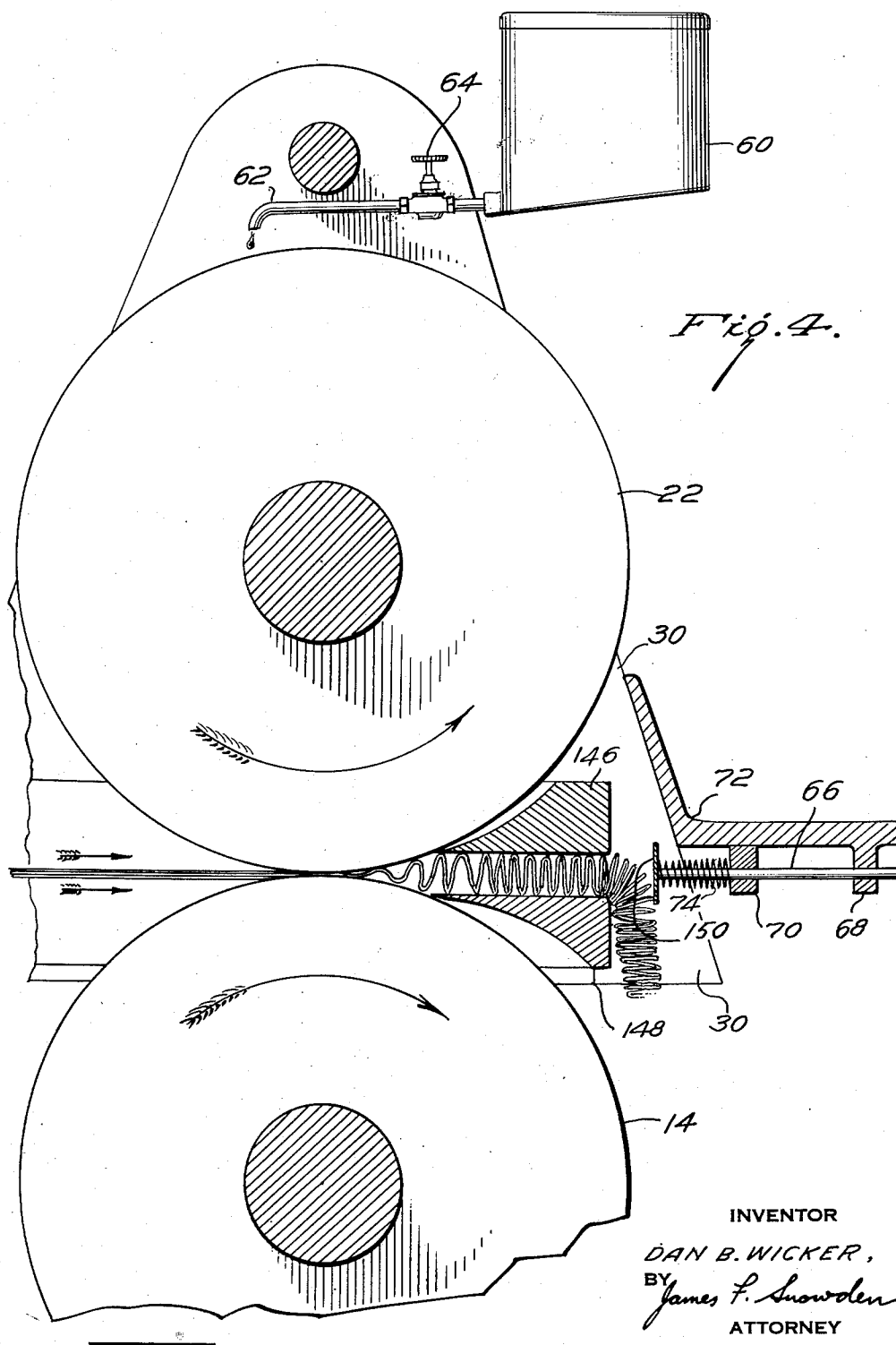
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TOW CRIMPER

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7 Claims. (Cl. 19—66)

This invention relates to apparatus for crimping or crinkling tow or bundles of textile fibers, especially parallel continuous artificial fibers.

In the processes for producing spun yarn from staple fibers, it is desirable to use crimped fibers, that is fibers which are crinkled or curled, in order to obtain superior yarns. Extruded fibers in general do not have this curl and therefore should be crimped or crinkled by artificial means as a prerequisite to spinning the best yarn therefrom. The crimping step is preferably carried out prior to cutting continuous extruded fibers to staple lengths. With a crimper of the "nip roll and stuffing box" type, careful control of the crimping operation is necessary to minimize or prevent damage to the fibers from abrasion and excessive pressures.

An object of the invention is to provide an improved device for crimping tow or bundles of fibers.

Another object of the invention is to provide improved guide means for handling tow in a crimping machine.

A further object of the invention is to provide an improved crimping device in which the edges of certain crimping chamber walls are automatically maintained at a fixed distance from the axis of the nearer feed roll irrespective of the distance between feed rolls.

Still another object of the invention is to provide an improved crimping device in which the edges of certain crimping chamber walls are automatically maintained at a constant clearance from the surface of the nearer feed roll regardless of the spacing between the feed rolls.

Other objects and advantages of the invention will be apparent to those skilled in the art from the detailed description hereinafter.

The present invention is concerned with a tow crimping device and especially with the structural relation between the feed rolls and the associated crimping chamber. In particular it relates to a structural arrangement for maintaining each of the leading edges of the crimping chamber in fixed relation to one of the feed rolls even when the rolls move toward or away from one another.

The greatest utility of the apparatus appears to lie in crimping artificial continuous filament fibers; however, it can also crinkle natural fibers and discontinuous filament fibers. Hence, even though the device disclosed herein is particularly adapted for the crimping of polyacrylonitrile fibers of the types disclosed in Patent No. 2,558,730 to Cresswell, it may be employed with any textile fibers such as viscose and cuprammonium rayon, cellulose acetate and other cellulose derivatives, nylon, wool, cotton, silk, etc.

The present invention is best understood by reference to the accompanying drawings illustrating the invention in which:

Fig. 1 is a sectional elevation of the tow crimper;

Fig. 2 is a fragmentary sectional view of Fig. 1 with certain elements removed;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 2, and

Fig. 4 is a fragmentary sectional elevation taken on the center line of a modified form of the invention.

Referring now to Fig. 1, frame 10 carries fixed bearings (not shown) for the shaft 12 to which is keyed feed roll 14. Another set of fixed bearings (not shown) mounted on frame 10 rotatably supports the shaft 16 on which is pivotally mounted a bracket 18 equipped with a pair of bearings (not shown) supporting the rotating shaft 20 on which is keyed the feed roll 22 of similar construction to roll 14. Both rolls are positively driven

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in synchronization. The width of the peripheral surfaces of these rolls is usually quite narrow in comparison with their diameters, and a milled or fluted surface is recommended to insure a positive feed through the rolls, especially if damp fibers are being crimped. Such indentations desirably have rounded edges to avoid any possibility of injury to the fibers. The minimum clearance between the coacting rolls may be regulated by means of the adjusting screw 24, and the compression spring 26 is provided to exert pressure on the bracket 18 and thus on the tow in the nip of the rolls. This spring permits movement of roll 22 up or down in response to the thickness of the fiber bundle passing between the rolls. The pressure exerted by spring 26 may be varied as desired by means of the adjusting screw 28 provided with conventional locking means. At each end of roll 22 a support member 30 is pivotally mounted on shaft 20 in bearings 31 (see Fig. 3) so that it may be turned clockwise or counterclockwise independently of the rotation of shaft 20. On the lower shaft 12 the link members 32 are mounted in the same manner, that is they are provided with bearings 33 (Fig. 3) which permit them to pivot freely on shaft 12.

Turning now to Figs. 2 and 3, it will be seen that the link plates 32 are pivotally joined to the supports 30 by means of the pins 34. The dowels or spacer bolts 36 are provided to insure the correct spacing of the plates 32 and a similar bolt 38 is used for the same purpose in respect to the support members 30.

As is readily apparent in Figs. 2 and 3 the plates or walls 40 are rigidly attached to the supports 30 and are spaced at the correct distance by means of the spacer 42 through which passes bolt 44. Spacer 42 should be of a size sufficient to provide a running fit, say about 0.001 inch clearance, between the side wall members 40 and the ends of rolls 14 and 22. In order to prevent the galling or scoring of the wall plates 40 and the disc-like rolls, it has been found desirable to construct the wall members entirely of solid nylon or with liners of nylon. Micarta and other materials of suitable bearing properties and relatively good dimensional stability may be used in place of the nylon.

The top and bottom of the crimping chamber are bounded by the upper and lower walls or guide shoes 46 and 48 respectively and the rear of the crimping chamber is yieldably closed by the pivoted gate 50 which is loaded as desired with the weights 52. The shoes 46 and 48 are provided with the edges 54 and 56 respectively which are closely adjacent to the surfaces of the rolls. The purpose of the close fit between the crimping box and the roll peripheries is to assure that all fibers enter this box without fouling the machine as they are pushed forward by the rolls. Although a knife edge may be employed for the purpose, a sharpened or honed edge is not necessary as no cutting is required. The location of these edges with respect to the peripheries of the rolls is important and the best results have been obtained by maintaining a clearance between the edges and the associated rolls substantially less than the average diameter of the fibers being processed: for instance 0.001" clearance for filaments of about 0.002" average diameter. Larger clearances running up to about 5 to 10 times the average diameter of the filaments have been fairly satisfactory, but this required closer attention by the machine operators in removing stray and abraded fibers which followed the rolls instead of entering the crimping chamber. However, operations with a still larger clearance amounting to about 15 diameters were unsuccessful as the tow either jammed against the edges 54 and 56 or escaped outside one of the edges and followed the roll. Contact between the edge of the shoe and with the roll is usually unnecessary and undesirable as it introduces complications in connection with wear, adjustment of the members and the dissipation of heat generated by friction; moreover, it is probably not even practicable where the roll has a surface with milled or grooved indentations parallel to the shaft. The shoes 46 and 48 are fastened to the plates 40 and supports 30 by bolts, rivets or the like with edge 54 separated from the center of shaft 20 by a distance very slightly greater than the radius of roll 22. As the upper roll 22 moves toward and away from roll 14 in response

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to variations in the thickness of the tow, shoes 46 and 48 move away from or toward the nip of the rolls; but the edge 54 is always maintained at a constant clearance from the roll 22, since the support members 30 swing on the shaft carrying roll 22. A similar clearance is maintained between roll 14 and edge 56 by locating the edge 56 on the center line of the pivots 34. This, of course, fixes the distance between the edge 56 and the center of shaft 12, and therefore, it fixes the clearance or distance between the edge and the surface of roll 14. Thus edge 56 is maintained at a fixed distance from roll 14 regardless of the angular positions of the supports 30 and links 32 even though the edge is fixedly mounted on supports 30 which are pivoted on shaft 20 rather than on the shaft supporting roll 14. In order to restrict the movement of edges 54 and 56 into the nip of the rolls and consequently to similarly limit the maximum separation of the rolls, an adjustable stop screw 58 equipped with a lock nut is provided (see Fig. 1). This screw restricts the swing of the link plates 32. It will also be noted that the wall members 46 and 48 are arcuately shaped on the side facing the roll associated therewith in order to maintain sufficient clearance at all points.

Fig. 4 illustrates a modified form of the invention as well as its operation. A textile lubricant, such as triethylene glycol or emulsifiable petroleum oil, is allowed to flow from a reservoir 60 through line 62 controlled by stop cock 64 and to drip onto roll 22. Other feed means such as metering pumps may be used if desired. It appears that less physical damage to the fibers from abrasion during the crimping operation occurs when such an agent is used. In processing polyacrylonitrile fibers in the wet stretched (oriented) gel state, triethylene glycol and glycerine are preferred over conventional textile lubricants since they also act as humectants or humidifying agents which aid subsequent processing of the crimped fiber. In the modification shown in Fig. 4, the shoes 146 and 148 are of a slightly different form and the spring-loaded gate 150 is mounted for movement in a straight line instead of swinging on a hinge. This reciprocating outlet gate is attached to a shaft 66 mounted to slide freely in the guides 68 and 70 which are fastened to bracket 72 mounted on supports 30. If desired suitable guide means may be provided for preventing rotation of the gate, as for instance, by employing a shaft 66 of square cross-section sliding in square holes in guide members 68 and 70. The pressure exerted by the gate is determined by the strength of spring 74 and by the degree to which it is compressed. The spring compression may be easily adjusted by shifting guide 70, which is adjustably mounted (not shown) in conventional manner on bracket 72, either nearer to or farther from the discharge end of the crimping chamber. Where only a small back pressure is desired as in the case of fibers in the wet gel state, a reciprocating gate actuated by a small force, e. g. 5 ounces, is preferred. With dry, firm, unyielding fibers the pivotal gate of Fig. 1 and heavier loading produce excellent results.

In operating the tow crimper described herein, one or more bundles or ropes of parallel continuous fibers are fed into the nip of the feed rolls 14 and 22 which compress the material into a ribbon and drive it into the crimping chamber. The movement of this ribbon into the chamber is resisted by the gate 50 or 150 pressing against the material already in the chamber and the pressure crimps the ribbon into fine crinkles or curls and also wads it into folds of a length corresponding to the height of the chamber. The force exerted by the rolls is, of course, greater than the back pressure of the gate; so the gate is pushed open and the folded, crimped ribbon is discharged downward. During operation of the machine, gate 50 or 150 usually moves back and forth somewhat but not into the fully closed position. From this it should not be thought that the gate is unnecessary, for in its absence the rolls simply feed the tow through the crimping chamber as a flat uncrimped ribbon; therefore, even the rather slight pressures exerted by the gate are essential to the crinkling or crimping of the fibers.

The degree of crimping is governed chiefly by the amount of back pressure imposed by the gate on the ribbon of tow in the crimping chamber. Increasing the pressure produces a finer crinkling of the fibers and a decrease in the force exerted by the gate results in a coarser crimp. Actual trial is necessary to determine the optimum pressure for each type of fiber, as the required force seems

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to vary with the kind, condition and probably size of the individual filaments.

While it is recommended that both rolls be positively driven at the same speed, this invention also contemplates operations in which only one roll is positively driven as well as those in which both rolls are driven at different speeds. The drive mechanism for separable rolls is well understood by those skilled in the art therefore is not described here. In general peripheral linear roll speeds of about 20 to about 110 yards per minute are contemplated and excellent results have been obtained with polyacrylonitrile tow at 65 yards per minute; however, the speed does not appear to be critical and may be higher or lower than the values indicated.

Although the invention has been described in connection with a lower roll 14 mounted in fixed bearings and a movable spring-loaded upper roll 22, the invention is not limited to this particular structure since the upper roll might be the fixed one and the lower one spring-loaded or both rolls may be mounted in movable or displaceable bearings. Thus support plates 30 may be swingably mounted on a shaft mounted in fixed bearings and link plates 32 similarly mounted on a shaft or axle mounted in movable bearings.

Some crimping devices in the prior art have been limited by reason of their structure to operating in only one position, for example, the downward feeding of tow between horizontally disposed rolls. This is not true of the device described herein as it may be operated in any position at any angle although slight and obvious modification of the crimping chamber outlet gate and its loading means may be necessary. The vertical alignment of the rolls as shown in the drawings is advantageous in that the nip of the rolls squeezes any excess lubricating or humidifying agent off of the tow instead of allowing it to drain into and over the crimping chamber to rewet the crimped product.

While there are disclosed above only a limited number of embodiments of the structure of the invention herein presented, it is possible to produce still other embodiments without departing from the inventive concept herein disclosed, and it is desired therefore that only such limitations be imposed on the appended claims as are stated therein, or required by the prior art.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A device which comprises parallel coating first and second feed rolls, a chamber having an open side facing the bite of the rolls, an outlet gate at another side of the chamber operable at a preselected pressure, a support pivotally mounted on the shaft of the first roll, a first wall of the chamber fastened to the support and provided with a first edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the first roll, a link pivotally attached to both the support and the shaft of the second roll, a second wall of the chamber opposite the first wall and provided with a second edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the second roll, the second wall being fastened to the support with the second edge substantially aligned with the center line of the pivot connecting the support and link, whereby said edges are maintained at a constant distance from the axes of the respective rolls regardless of the distance between the peripheral surfaces of the rolls.

2. A device for crimping a bundle of substantially parallel continuous fibers which comprises positively driven parallel coating first and second feed rolls for feeding the fiber bundle into a crimping chamber, the crimping chamber having an open side facing the bite of the rolls, an outlet gate at another side of the chamber operable at a preselected pressure to release the bundle of crimped fibers from the chamber, a support pivotally mounted on the shaft of the first roll, a first wall of the chamber fastened to the support and provided with a first edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the first roll, a link pivotally attached to both the support and the shaft of the second roll, a second wall of the chamber opposite the first wall and provided with a second edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the second roll, the second wall being fastened to the support with the second edge substantially aligned with the center line of the pivot connecting the support and link, whereby said edges are maintained

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at a constant distance from the peripheries of the respective rolls regardless of the distance between the peripheral surfaces of the rolls.

3. A device for crimping a bundle of substantially parallel continuous fibers which comprises parallel coating first and second feed rolls, a crimping chamber having an open side facing the bite of the rolls, an outlet gate at another side of the chamber operable at a preselected pressure to release the bundle of crimped fibers from the chamber, a movable mounting for one of the rolls for varying the distance between the rolls in response to the thickness of the fiber bundle, means for regulating the pressure of the rolls on the fiber bundle, a support pivotally mounted on the shaft of the first roll, a first wall of the chamber fastened to the support and provided with a first edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the first roll, a link pivotally attached to both the support and the shaft of the second roll, a second wall of the chamber opposite the first wall and provided with a second edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the second roll, the second wall being fastened to the support with the second edge substantially aligned with the center line of the pivot connecting the support and link, whereby said edges are maintained at a constant distance from the axes of the respective rolls regardless of the distance between the peripheral surfaces of the rolls.

4. A device for crimping a bundle of substantially parallel continuous fibers which comprises parallel coating first and second feed rolls, means for applying a fiber lubricant to the fiber bundle on the rolls, a crimping chamber having an open side facing the bite of the rolls, an outlet gate at another side of the chamber operable at a preselected pressure to release the bundle of fibers from the chamber, a support pivotally mounted on the shaft of the first roll, a first wall of the chamber fastened to the support and provided with a first edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the first roll, a link pivotally attached to both the support and the shaft of the second roll, a second wall of the chamber opposite the first wall and provided with a second edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the second roll, the second wall being fastened to the support with the second edge substantially aligned with the center line of the pivot connecting the support and link, whereby said edges are maintained at a constant distance from the axes of the respective rolls regardless of the distance between the peripheral surfaces of the rolls.

5. A device for crimping a bundle of substantially parallel continuous fibers which comprises parallel coating first and second feed rolls, a crimping chamber having an open side facing the bite of the rolls, a reciprocable outlet gate at another side of the chamber for releasing the bundle of crimped fibers from the chamber, means for applying a preselected pressure against the opening of the gate, a support pivotally mounted on the shaft of the first roll, a first wall of the chamber fastened to the support and provided with a first edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the first roll, a link pivotally attached to both the support and the shaft of the second roll, a second wall of the chamber opposite the first wall and provided with a second edge substantially parallel to the bite of the rolls and closely adjacent to the periphery of the second roll, the second wall being fastened to the support with the second edge substantially aligned with the center line

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of the pivot connecting the support and link, whereby said edges are maintained at a constant distance from the peripheries of the respective rolls regardless of the distance between the peripheral surfaces of the rolls.

6. A device for crimping a bundle of substantially parallel artificial continuous fibers which comprises positively driven parallel coating first and second feed rolls for feeding the fiber bundle into a crimping chamber having an open side facing the bite of the rolls and an outlet gate at another side of the chamber operable at a preselected pressure to release the bundle of crimped fibers from the chamber, a movable mounting for one of the rolls for varying the distance between the rolls in response to the thickness of the fiber bundle, means for regulating the pressure of the rolls on the fiber bundle, means for applying a fiber lubricant to the fiber bundle on the rolls, a support at each end of the first roll pivoted on the shaft thereof, a link at each end of the second roll attached pivotally both to the shaft thereof and to the corresponding support, a first wall of the chamber fixed to both supports and provided with a first edge adjacent and parallel to the bite of the rolls and closely adjacent to the peripheral surface of the first roll, a second wall of the chamber fixed to both supports and provided with a second edge substantially aligned with the center line of the pivots connecting the supports to the links, the second edge being adjacent and substantially parallel to the bite of the rolls and closely adjacent to the peripheral surface of the second roll, and additional walls of the chamber on to the supports adjoining the first and second walls and further enclosing the bite of the rolls, the width of the first and second walls being very slightly greater than the width of the peripheral surfaces of the rolls to space the additional wall members sufficiently to provide a running fit between the additional wall members and the ends of the rolls, whereby the clearances between each edge and the peripheral surface of the associated roll remain constant and independent of the distance between the peripheries of the rolls.

7. A device which comprises parallel coating first and second feed rolls, a chamber having an open side facing the bite of the rolls, an outlet gate at another side of the chamber operable at a preselected pressure, a support pivotally mounted on the shaft of the first roll, a first wall of the chamber fastened to the support and provided with a first edge closely adjacent to the periphery of the first roll, a link pivotally attached to both the support and the shaft of the second roll, a second wall of the chamber opposite the first wall and provided with a second edge closely adjacent to the periphery of the second roll, the second wall being fastened to the support with the second edge substantially aligned with the center line of the pivot connecting the support and link, whereby said edges are maintained at a constant distance from the axes of the respective rolls regardless of the distance between the peripheral surfaces of the rolls.

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