Aug. 12, 1958 M. SONNINO 2,846,729

TOW CRIMPER

Filed Nov. 4, 1955 3 Sheets-Sheet 1

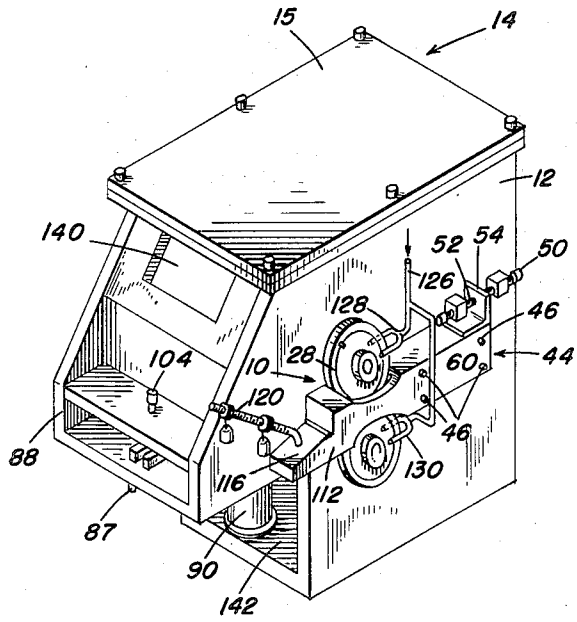

Fig. 1.

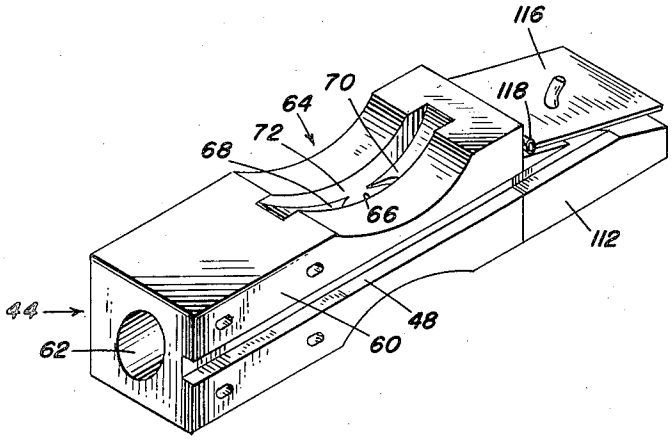

Fig. 5.

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TOW CRIMPER

Filed Nov. 4, 1955 3 Sheets-Sheet 2

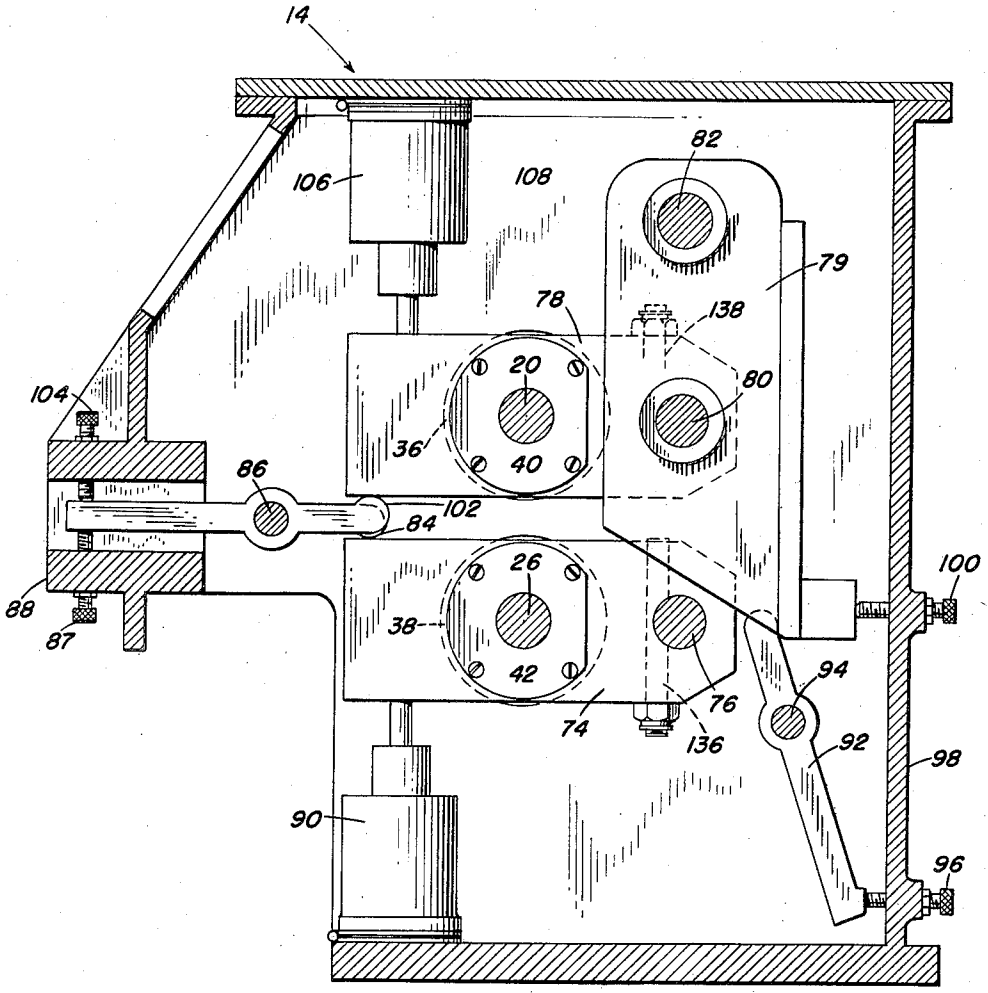

Fig. 2.

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TOW CRIMPER

Filed Nov. 4, 1955 3 Sheets-Sheet 3

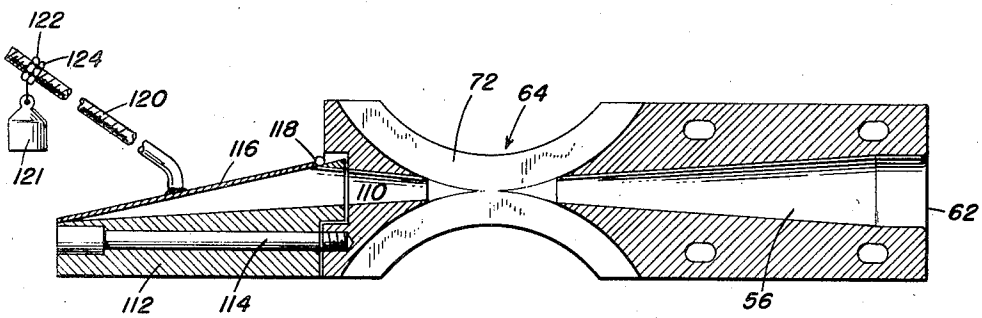

Fig. 4.

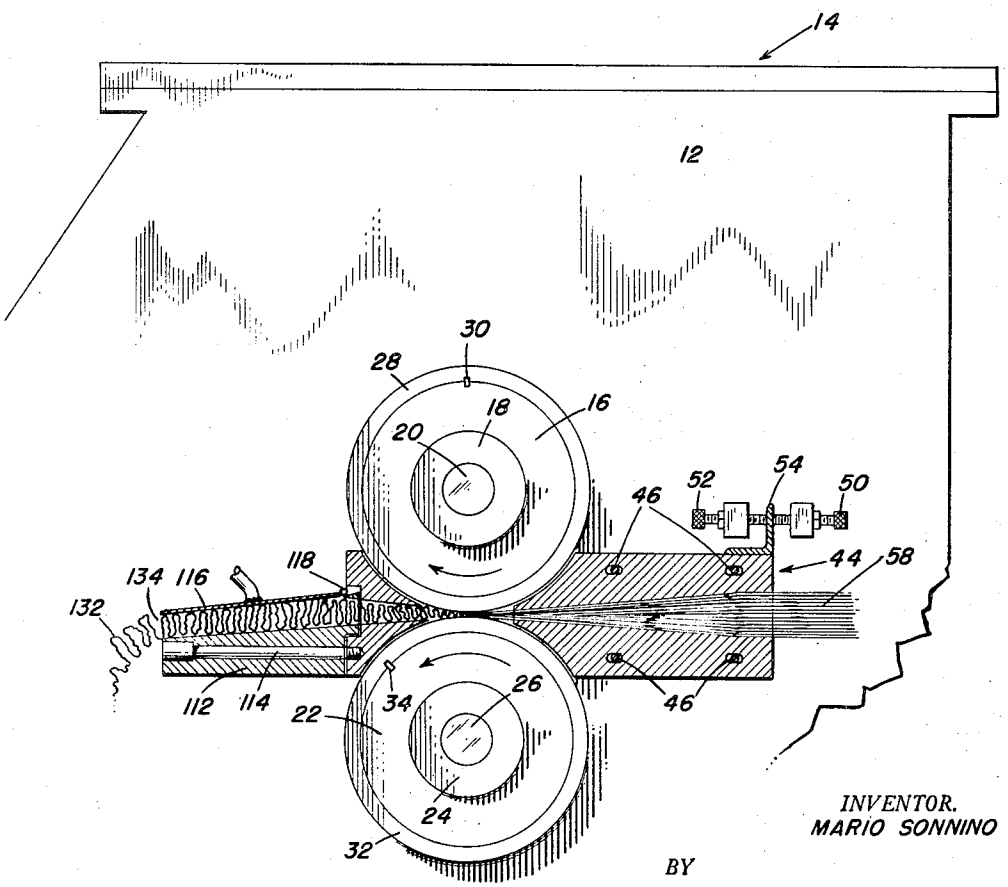

Fig. 3.

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2,846,729

TOW CRIMPER

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Application November 4, 1955, Serial No. 545,023

11 Claims. (Cl. 19—66)

This invention relates to apparatus for crimping or crinkling a tow or bundle of textile filaments, especially parallel, continuous, synthetic filaments. Such a device is commonly called a "tow crimper."

In the processes employed for producing spun yarn from staple fibers it is desirable to use crimped fibers, that is, fibers which have been crinkled or curled, in order to obtain superior yarns. In general, extruded fibers do not have this curl or crimp as initially produced; and, therefore, it is necessary that they 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 filaments to staple lengths. With a crimper of the "nip-rolls and stuffing-box type," careful control of the crimping operation is necessary to obviate or minimize damage to the filaments from abrasion and/or excessive pressure during crimping.

It is a primary object of the present invention to provide an improved device or apparatus for crimping a tow or strand of continuous filaments.

Another object of the invention is to provide an improved tow crimper wherein the sides of the tow are prevented from being differently crimped than that of the middle of the tow.

Another object of the invention is to provide an improved tow crimper which will impart maximum uniformity of crimp to the tow.

Still another object of the invention is to provide a tow crimper which is adapted to be used in conjunction with other apparatus employed for continuously producing a crimped tow of filamentary material, and specifically a polyacrylonitrile filamentary material, that is, one which is comprised of a polymer (fiber-forming polymer) of acrylonitrile.

Other objects of the invention will be apparent to those skilled in the art from the following more detailed description and the accompanying drawing.

The present invention is concerned with certain improvements in a tow crimper of the nip-rolls and stuffing-box type, which type of crimper, for brevity, is sometimes designated merely as "stuffing-box" type. In the tow crimper of this invention, the stuffing-box includes a feed trumpet that tapers inwardly and extends to the nip of the crimping rolls. The tow is confined at the nip, thereby preventing the sides of the tow from being differently crimped than that of the middle of the tow. The feed trumpet may be included in an extension of the stuffiing box on the feed side of the crimper, in which case the extension further serves to provide rigid support for the stuffing box proper, the length of which is kept to a minimum in order to obtain maximum uniformity of crimp. The crimped tow is discharged continuously through an upwardly movable discharge gate, to which is attached a loading rod that can be suitably weighted in order to provide the proper load for crimping the particular tow to the desired degree.

The tow crimper of the present invention is especially adapted for use as a unit of the apparatus disclosed and claimed in my copending application Serial No. 545,043, filed concurrently herewith, and in connection with practicing the method of producing a crimped tow of filamentary material that also is disclosed and claimed in said copending application. However, it can be used in other relationships in crimping a tow or strand of artificial filaments, especially polyacrylonitrile filamentary material, as well as various natural fibers or filaments. Thus, it can be employed in crimping a tow or bundle of many of the various vegetable fibers (especially cotton, hemp, jute, ramie and flax), animal fibers, e. g., wool, and various uncrosslinked synthetic filaments, e. g., viscose and acetate rayons, nylon, filaments made from condensation products of terephthalic acid and glycol, filaments made from polyvinylidene chloride, vinyl chloride-vinyl acetate copolymers, etc. It is especially useful in crimping a tow of polyacrylonitrile filamentary material, numerous examples of which are given in, for example, Cresswell U. S. Patent No. 2,558,730, dated July 3, 1951, and in my aforementioned copending application; and especially polyacrylonitrile filamentary material that is produced by the process described in the aforementioned Cresswell patent.

The novel features of the invention are set forth in the appended claims. The invention itself, however, will be understood most readily from the following detailed description thereof when considered in connection with the accompanying drawing, and in which:

Fig. 1 is a perspective view of an apparatus embodying the invention;

Fig. 2 is a front sectional elevation of that part of the apparatus shown in Fig. 1 that is housed back of the crimping unit proper, and with the front of the housing removed;

Fig. 3 is a front elevation, partly in section, of part of the crimping unit proper that is illustrated in Fig. 1; and showing the passage of the uncrimped tow through the inlet or feed-in end of the stuffing-box assembly or unit, thence between the nip of the rolls, where the tow of filaments begins to bunch-up (folding back and forth upon itself) and becomes crimped by reason of the compression that builds up until the loading on the discharge gate is overcome by the internal pressure and the crimped tow is discharged from the exit end;

Fig. 4 is a longitudinal sectional view of part of the stuffing-box unit or assembly illustrated in Figs. 1–3, and showing the discharge gate in a closed position; and

Fig. 5 is a perspective view of part of the stuffing-box unit shown in the other figures.

Referring to the drawing, the tow crimper shown by way of illustration in Fig. 1 comprises a crimping unit **10** which is exterior of, and adjacent to, a front wall **12** of a housing **14** having a removable top cover **15**, which housing encloses other parts of the tow crimper. The crimping unit **10** includes parallel coacting, first and second feed rolls; and a stuffing-box unit or assembly **44** adapted to receive the aforesaid rolls in a middle part of said unit. These rolls are adjustably movable so that their peripheries can be brought close to each other thereby to nip the tow that is passed therebetween and also are adjustably movable so that they can be positioned in a plane perpendicular to the axis of said stuffing-box unit.

In a preferred embodiment of the invention and as shown in Figs. 1 and 3, the parallel coacting first and second feed rolls comprise an upper roll or wheel **16** having a hub **18** keyed on rotatable upper shaft **20**; and a lower roll or wheel **22** having a hub **24** keyed on rotatable lower shaft **26**. The upper roll **16** is provided with a rim **28** which is keyed in position by means of the key **30**, while the lower roll **22** is provided with a rim **32** which is keyed in position by means of the key **34**. The rims **28** and **32** advantageously are made of a material that will obviate or minimize the possibility of damage to the stuffing-box, e. g., a non-metallic substance such, for instance, as nylon, a laminate of cloth or other fabric material bonded together with a phenolic or other water-resistance thermosetting resin, etc. The main body portion of each of the rolls **16** and **22** is advantageously made from a suitable metal or alloy, e. g., stainless steel, chromium-plated brass, etc.

The rotatable shafts **20** and **26** are suitably mounted in front and rear bearing assemblies (not shown) and wherein they are supported upon bearings that constitute an essential part of each of said assemblies. Both of these shafts, and the rolls **16** and **22** mounted thereon, are positively driven in synchronization by gear or other means (not shown) receiving power from a suitable power source (not shown).

Suitable openings are provided in the front wall **12** of the housing **14** for the passage therethrough of the front ends of the shafts **20** and **26**, while the rear ends of said shafts pass through corresponding openings **36** and **38**, respectively, in rear wall **108**.

As shown in Figs. 1, 3, 4 and 5 the crimping unit **10** (Fig. 1) includes a stuffing-box unit or assembly **44**. This unit is held to the front wall **12** by means of screws **46** (Fig. 1), and is located by a keyway **48** (Fig. 5) on a machined key (not shown) fastened to wall **12**. The unit **44** can be adjusted forward and backward, as may be required, by means of the screws **50** and **52** that contact the angle **54** which is welded, screwed or otherwise suitably attached to the end of the stuffing-box unit as shown in Figs. 1 and 3.

It will be noted that the stuffing-box unit **44** has a member comprising a feed trumpet **56** (Fig. 4) that tapers inwardly and through which the uncrimped tow **58** (Fig. 3) is fed to the nip of the feed rolls **16** and **22**. The member or part comprising the feed trumpet **56** may be integral with the stuffing box proper and constitute an extension thereof so that it is a unitary structure as shown in Figs. 1 and 5. Although this type of construction has certain manufacturing and operating advantages, it is not essential that this be done since the member comprising the feed trumpet **56** could be separately built and then bolted or clamped to the other part of the unit **44**; or it might merely be fastened to the front wall **12** so that it fitted closely to the stuffing box proper (that is, to a point near the nip of the rolls) without being bolted, clamped or otherwise fastened to the said stuffing box. However, in the preferred embodiment of the invention the unit **44** is provided with a feed-in extension **60** (Figs. 1 and 5) having a centrally disposed, longitudinal extending tow-inlet port or opening **62** (Figs. 4 and 5) that tapers (for example, after entering the port a short distance as shown in Fig. 4) toward the nip of the rolls. The taper of feed trumpet **56** may be varied depending, for example, upon the particular tow being crimped, the conditions of crimping, the degree of crimp wanted, the rate of travel of the tow through the crimper and other influencing factors. For instance, the taper may be varied between about 4° and about 15°; however, in crimping a tow of polyacrylonitrile filaments as briefly described hereinafter and more fully in my copending application Serial No. 545,043, filed concurrently herewith, the taper of the tow-inlet port toward the nip of the rolls preferably is about 8°.

The middle part of section **64** of the stuffing-box unit **44** is constructed as shown in Figs. 3, 4 and 5. It has a slot **66** adapted to receive the periphery and part of the outer edge of the upper roll **16**. A similar slot is provided for lower roll **22**. The upper walls **68** and **70** of this slot conform to the perimeter of the upper roll **16** while corresponding walls (not shown) of the lower slot conform to the perimeter of the lower roll **22**. Minimum clearance between the sides of the feed rolls **16** and **22** and the sides of the slot (side **72** being shown in Figs. 4 and 5) are essential for optimum performance. This construction provides positive assurance that the tow will be confined at the nip of the rolls and that the sides of the tow will not be crimped differently from that of the middle of the tow, which has been an outstanding fault of most of the prior art tow crimpers.

The stuffing-box unit **44** also includes a stuffing box or crimping chamber comprising a discharge trumpet **110** that tapers toward the nip of the rolls (or outwardly from the nip as the tow is being crimped and discharged). This taper may vary, for instance, as described hereinbefore with reference to feed trumpet **56**; that is, for example, between about 4° and about 15°, and preferably about 8° when crimping a tow of polyacrylonitrile filaments. The stuffing box or chamber should be suitably surfaced to minimize friction, e. g., by being chrome-plated and well-polished.

Extension **112** may be integral with the middle section **64** of the unit **44**; or, as shown in Figs. 3 and 4, it may be rigidly but removably attached to section **64** by suitable means, e. g., by a plurality of screws, one of which is identified as **114** in Figs. 3 and 4. A gate **116** is pivotally mounted on the hinge **118** and is adapted to close the outlet of the discharge trumpet **110**. The gate **116** is yieldably raisable, during operation of the tow crimper, under the pressure of the crimped tow to be discharged from the discharge trumpet **110**. This gate is relatively light in weight (being made, for instance, of lightweight stainless steel), and is well-polished on its underside to minimize friction during operation. Suitable means are provided at the gate **116** for regulating the pressure in the discharge trumpet or chamber **110**, which pressure causes the tow to fold over and become crimped. Such means may take the form of, for instance, a loading rod **120** which may be threaded as indicated in Fig. 4 and suitably weighted by weight **121** (or a plurality of such weights), which is held in position by means of nuts **122** and **124** on the threaded portion of the said loading rod.

The angle formed by the gate **116** and the longitudinal axis of the discharge trumpet **110** is important from the standpoint of optimum, uniform performance. This angle may range, for instance, from about 8° to about 20° depending upon such influencing factors as mentioned hereinbefore with respect to the taper of the feed trumpet **56**. In the crimping of a tow of polyacrylonitrile filaments as briefly described hereinafter and more fully in my aforementioned copending application Serial No. 545,043, optimum results from the standpoint of uniformity of performance are obtained when this angle is about 12°.

It is not essential that the extension **112** and associated parts such as the gate **116** be positioned as shown in Figs. 1, 3, 4 and 5, although optimum results are obtained when the extension is positioned as shown with respect to the discharge trumpet **110**. The extension **112** and associated parts may be rotated about the axis of the discharge trumpet **110**, for instance, at angles varying between about 0° and 180°. Air- or spring-actuated means can be employed to regulate the opening of the gate **116** when its angle of mounting with respect to the discharge trumpet is such that a loading rod would be unsatisfactory or inoperative.

It is generally desirable that the feed rolls **16** and **22** be cooled by suitable means during operation of the tow crimper in order to prevent expansion due to heat. This

may be done, for example, as shown in Fig. 1, by permitting water to drip upon the sides of the wheels **16** and **22**. As shown in this figure, water from a suitable supply source (not shown) is introduced through the inlet conduit **126**, part of which is applied to the upper wheel **16** through the upper fork **128**, while another portion is applied to the lower wheel **22** through the fork **130**.

Referring now more particularly to Fig. 2, lower roll **22** (Figs. 1 and 3) mounted on rotatable lower shaft **26** is supported by means of lower linkage **74** to the housing **14** by means of lower pivot shaft **76**. This arrangement allows the lower roll to be adjustable as to its vertical position but it remains fixed with respect to its horizontal position. The upper roll **16** (Figs. 1 and 3) mounted on rotatable upper shaft **20** is connected to the housing **14** by means of two linkages, upper linkage **78** and pivot arm **79**. Upper linkage **78** is connected to the pivot arm **79** by means of upper pivot shaft **80**, while pivot arm **79** is connected to the housing **14** by means of pivot arm shaft **82**. By means of these linkages upper roll **16** can be adjusted with respect to both its horizontal and its vertical positions. Shafts **20** and **26** are provided with bearing caps **40** and **42**, respectively.

In a preferred embodiment of the invention, pivot arm shaft **82** is mounted on housing **14** by means of thrust bearings and it extends through an opening in, and slightly beyond, the front wall **12** of the housing **14**. Upper pivot shaft **80** and lower pivot shaft **76** are also provided with thrust bearings and, in the preferred embodiment of the invention, they also extend through corresponding openings in, and slightly beyond, the front wall **12** of housing **14**. Lower pivot shaft **76** is fixedly mounted on front wall **12**, while upper pivot shaft **80** is free to move in a circular path about the axis of the pivot arm shaft **82**. It is not essential that shafts **76**, **80** and **82** extend slightly beyond the front wall **12**, which fact has been indicated in Fig. 1 by not showing the ends of said shafts extending beyond said wall.

Lower roll **22** is adjusted in its vertical position by means of lower roll vertical adjustment lever **84** pivoted about vertical adjustment levers pivot shaft **86** and lower roll vertical adjustment screw **87** mounted on side **88** of housing **14**. Adjustment screw **87** and adjustment lever **84** will act upon lower linkage **74** against the pressure applied by air piston **90**.

The horizontal position of upper roll **16** is adjusted by means of horizontal adjustment lever **92** mounted on horizontal adjustment lever pivot shaft **94** and acted upon by horizontal adjustment screw **96** mounted on side **98** of housing **14**. Adjustment screw **96** and adjustment lever **92** act upon pivot arm **79** against the action of stop screw **100** also mounted on side **98** of housing **14**.

The adjustment of upper roll **16** on a vertical plane is accomplished by means of upper roll vertical adjustment lever **102** pivoted on vertical adjustment pivot shaft **86** and acted upon by upper roll vertical adjustment screw **104**. Screw **104** and adjustment lever **102** will act upon upper linkage **78** against the pressure applied by air piston **106**. Front and back adjustment of rolls **16** and **22** is made so that they will be properly positioned in slot **66**. This is accomplished by positioning of linkages **74** and **78** on pivot shafts **76** and **80**, respectively, their position being retained by locking pins **136** and **138**.

The openings **140** and **142** in the side wall **88** and front wall **12**, respectively, of the housing **14** provide convenient means for inspection of, and limited access to, the working parts within the housing **14** without removal of the top cover **15**.

In adjusting the machine for operation, the lower roll **22** is first adjusted as to its vertical position by means of lever **84** and screw **87** acting against the pressure supplied by air piston **90**. The stuffing box unit **44** is then adjusted to conform with lower roll **22** by means of screws **52** and **50**. Upper roll **16** is then adjusted to conform with stuffing box unit **44** first by horizontal adjustment lever **92** and screws **96** and **100**. Then the vertical position of upper roll **16** is adjusted by means of lever **102** and screw **104** acting against the pressure supplied by air piston **106**.

During operation of the crimper, air pistons **90** and **106** allow the wheels **16** and **22** to provide the necessary traction for the tow and are yieldable so that, in case of a knot or tangle in the tow, the wheels will automatically spread and permit the knot or tangle to pass through the crimping zone without damage to the machine.

The tow crimper of this invention is particularly suitable for use in the crimping of a tow of polyacrylonitrile filaments. Such a tow is more fully described in my aforementioned copending application Serial No. 545,043, together with a brief description of the operation of the crimper. As therein described, the tow of polyacrylonitrile filaments is preferably conditioned prior to entering the tow crimper by being contacted with a hot, aqueous fluid comprised mainly or composed solely of water. This aqueous fluid is at a temperature of from about 155° F. to about 205 F. It may be hot water alone or it may be an aqueous fluid comprising mainly water and a lesser amount of an effect agent, e. g., an antistatic material containing a low-viscosity mineral or other suitable oil; a lubricant; or any other additive that will alter the properties of the tow or improve its processability either during manufacture or in subsequent textile operations.

The wetted tow, when it enters the tow-inlet port **62**, contains water in an amount corresponding to from about 100% to about 700%, by weight, based on the weight of the bone-dry tow. The wetted and heated polyacrylonitrile tow is continuously crimped at a temperature of from about 155° F. to about 205° F., and preferably at a temperature of from about 160° F. to about 195° F. Most of the water with which the tow is saturated is pressed out of the tow during crimping and flows through port **62**.

The crimped, hot tow **132** is discharged continuously from the discharge end **134** of the tow crimper. The temperature of the tow at this point ranges from about 150° F. to about 200° F. and, more particularly, from about 165° F. to about 195° F. It contains, for example, from about 50% to about 150% or 200% by weight of water, based on the weight of the bone-dry tow. The crimp in the tow is set by continuously passing the hot tow, while in a relaxed state (preferably while in a supported, relaxed state), to a cooling zone wherein the temperature of the tow is reduced to below 120° F., and preferably to a temperature not higher than about 100° F., e. g., 80°–90° F.

The tow crimper of the present invention provides substantial uniformity of crimp in the tow being processed and uniform performance. It is easy to adjust, operate and maintain. It can be operated for prolonged periods without maintenance. These and other practical advantages will be apparent to those skilled in the art from the foregoing description and the accompanying drawing.

I claim:

1. A tow crimper of the nip-rolls and stuffing-box type having a feed trumpet that tapers inwardly and through which the tow is fed to the nip of the rolls, thereby confining the tow at said nip, the taper of the said feed trumpet being between about 4° and about 15°, and the member comprising the said feed trumpet being integral with the stuffing box proper and constituting an extension thereof so that it is a unitary structure; a discharge trumpet that tapers toward the nip of the rolls, the taper of the said discharge trumpet being between about 4° and about 15°; a pivotally mounted gate adapted to close the outlet end of said discharge trumpet and which is yieldably raisable, during operation of the tow crimper, under the pressure of the crimped tow to be discharged from said discharge trumpet, the angle formed by the said yieldably raisable gate, when closed, with the horizontal

axis of the said discharge trumpet being between about 8° and about 20°; and means for regulating the pressure in the aforesaid discharge trumpet.

2. A tow crimper as in claim 1 wherein the means for regulating the pressure in the aforesaid discharge trumpet includes a loading rod mounted on the outside of the gate.

3. A tow crimper as in claim 1 wherein the taper of the feed trumpet is about 8°.

4. A tow crimper as in claim 1 wherein the taper of the discharge trumpet is about 8°.

5. A tow crimper as in claim 1 wherein the angle formed by the yieldably raisable gate, when closed, with the horizontal axis of the discharge trumpet is about 12°.

6. A tow crimper as in claim 1 wherein the taper of the feed trumpet and of the discharge trumpet each is about 8°, and the angle formed by the yieldably raisable gate, when closed, with the horizontal axis of said discharge trumpet is about 12°.

7. A tow crimper comprising parallel coacting, first and second feed rolls; a stuffing-box unit adapted to receive said rolls in a middle portion of said unit, said rolls being adjustably movable so that their peripheries can be brought close to each other thereby to nip tow that is passed therebetween and also being adjustably movable so that they can be positioned in a plane perpendicular to the axis of said stuffing-box unit, the latter being provided with a feed-in extension having a centrally disposed, longitudinally extending, tow-inlet port that tapers toward the nip of the aforesaid rolls, said feed-in extension being integral with said stuffing-box unit, and said stuffing-box unit being further provided with a stuffing box comprising a discharge trumpet that tapers toward the nip of the rolls, a pivotally mounted gate adapted to close the outlet end of said discharge trumpet and which is yieldably raisable, during operation of the tow crimper, under the pressure of the crimped tow to be discharged from said discharge trumpet, and means for regulating the pressure in the aforesaid discharge trumpet, the taper of the said tow-inlet port and of the said discharge trumpet each being between about 4° and about 15°, and the angle formed by the said yieldably raisable gate, when closed, with the horizontal axis of the said discharge trumpet being between about 8° and about 20°; and said tow crimper also including means for adjusting said feed rolls and for maintaining them in operative relationship with each other and with said stuffing-box unit.

8. A tow crimper comprising parallel coacting, upper and lower feed rolls; and a stuffing-box unit adapted to receive said rolls in a middle portion of said unit, said middle portion being provided with upper and lower slots adapted to receive, respectively, the periphery and part of the outer edge of the said upper roll and of the said lower roll, the upper walls of the said upper slot conforming to the perimeter of the said upper roll and the corresponding walls of the said lower slot conforming to the perimeter of the said lower roll, said stuffing-box unit being provided with a feed-in extension having a centrally disposed, longitudinally extending, tow-inlet port which extends to the feed-in ends of the said slots and tapers toward the nip of the rolls.

9. A tow crimper comprising parallel coacting, upper and lower feed rolls each mounted, respectively, on rotatable upper and lower shafts; a stuffing-box unit adapted to receive said rolls in a middle portion of said unit, said rolls being adjustably movable so that their peripheries can be brought close to each other thereby to nip tow that is passed therebetween and also being adjustably movable so that they can be positioned in a plane perpendicular to the axis of said stuffing-box unit; and means for adjusting said feed rolls and for maintaining them in operative relationship with each other and with said stuffing-box unit, said means including (a) an upper linkage and a pivot arm which connect the said upper roll mounted on the said rotatable upper shaft to a housing that includes a front wall, the said upper linkage being connected to the said pivot arm by means of an upper pivot shaft and the said pivot arm being connected to the said housing by means of a pivot arm shaft, whereby the said upper roll can be adjusted with respect to both its horizontal and vertical positions, and (b) a lower linkage and a lower pivot shaft which connect the said lower roll mounted on the said rotatable lower shaft to the said housing, whereby the said lower roll can be adjusted with respect to its vertical position but remains fixed with respect to its horizontal position.

10. A tow crimper as in claim 9 wherein the pivot arm shaft is mounted on the housing by means of thrust bearings and extends through an opening in the front wall of the said housing; and the upper and lower pivot shafts are each also provided with thrust bearings and each extends through corresponding openings in the said front wall of the said housing, the said lower pivot shaft being fixedly mounted on the said front wall, while the said upper pivot shaft is free to move in a circular path about the axis of the said pivot arm shaft.

11. A tow crimper comprising parallel coacting, upper and lower feed rolls each mounted, respectively, on rotatable upper and lower shafts; a stuffing-box unit adapted to receive said rolls in a middle portion of said unit, said rolls being adjustably movable so that their peripheries can be brought close to each other thereby to nip tow that is passed therebetween and also being adjustably movable so that they can be positioned in a plane perpendicular to the axis of said stuffing-box unit, the latter being provided with a feed-in extension having a centrally disposed, longitudinally extending, tow-inlet port that tapers toward the nip of the aforesaid rolls, said feed-in extension being integral with said stuffing-box unit, and said stuffing-box unit being further provided with a stuffing box comprising a discharge trumpet that tapers toward the nip of the rolls, a pivotally mounted gate adapted to close the outlet end of said discharge trumpet and which is yieldably raisable, during operation of the tow crimper, under the pressure of the crimped tow to be discharged from said discharge trumpet, and means for regulating the pressure in the aforesaid discharge trumpet, the taper of the said tow-inlet port and of the said discharge trumpet each being between about 4° and about 15°, and the angle formed by the said yieldably raisable gate, when closed, with the horizontal axis of the said discharge trumpet being between about 8° and about 20°; and means for adjusting said feed rolls and for maintaining them in operative relationship with each other and with said stuffing-box, said means including (*a*) an upper linkage and a pivot arm which connect the said upper roll mounted on the said rotatable upper shaft to a housing that includes a front wall, the said upper linkage being connected to the said pivot arm by means of an upper pivot shaft and the said pivot arm being connected to the said housing by means of a pivot arm shaft, whereby the said upper roll can be adjusted with respect to both its horizontal and vertical positions, and (*b*) a lower linkage and a lower pivot shaft which connect the said lower roll mounted on the said rotatable lower shaft to the said housing, whereby the said lower roll can be adjusted with respect to its vertical position but remains fixed with respect to its horizontal position.

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