Oct. 25, 1966 R. K. STANLEY 3,280,444

STRAND WINDUP TREATMENT

Filed Oct. 22, 1965 2 Sheets-Sheet 1

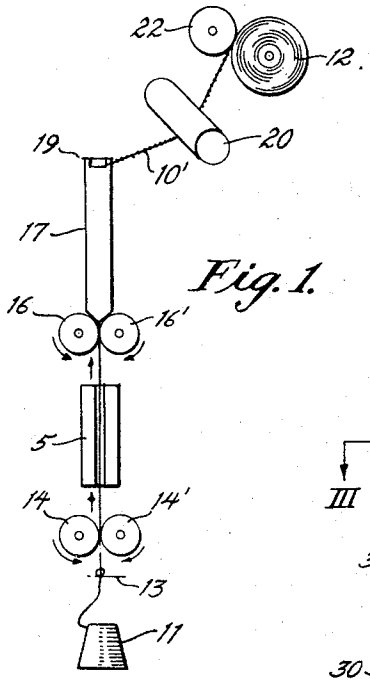

Fig. 1.

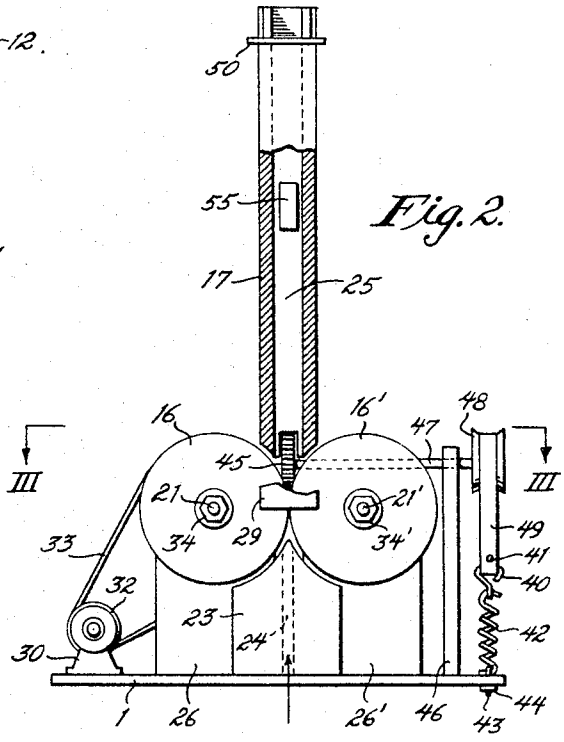

Fig. 2.

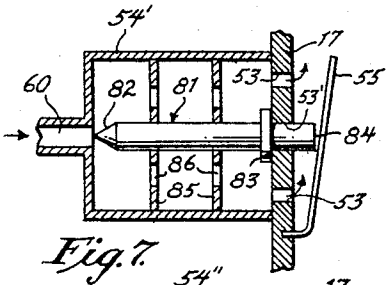

Fig. 7.

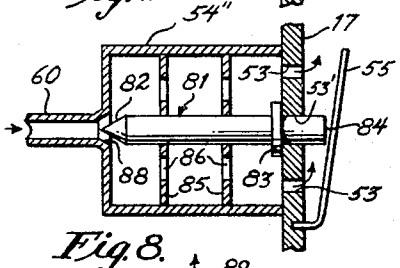

Fig. 8.

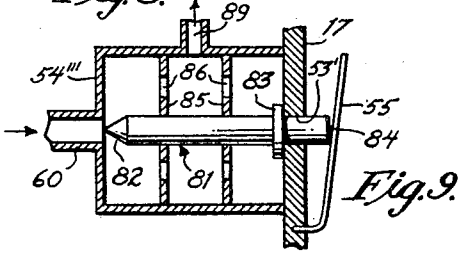

Fig. 9.

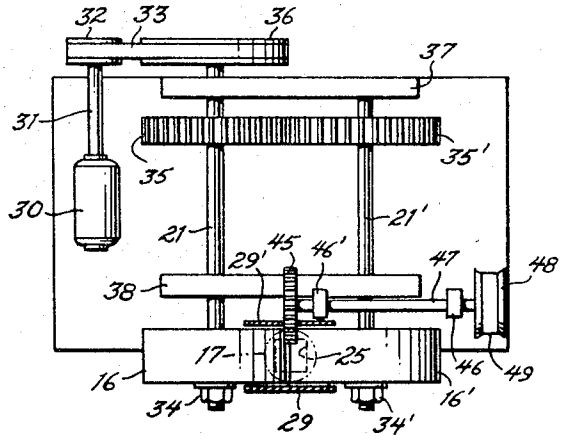

Fig. 3.

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Oct. 25, 1966 R. K. STANLEY 3,280,444

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Filed Oct. 22, 1965 2 Sheets-Sheet 2

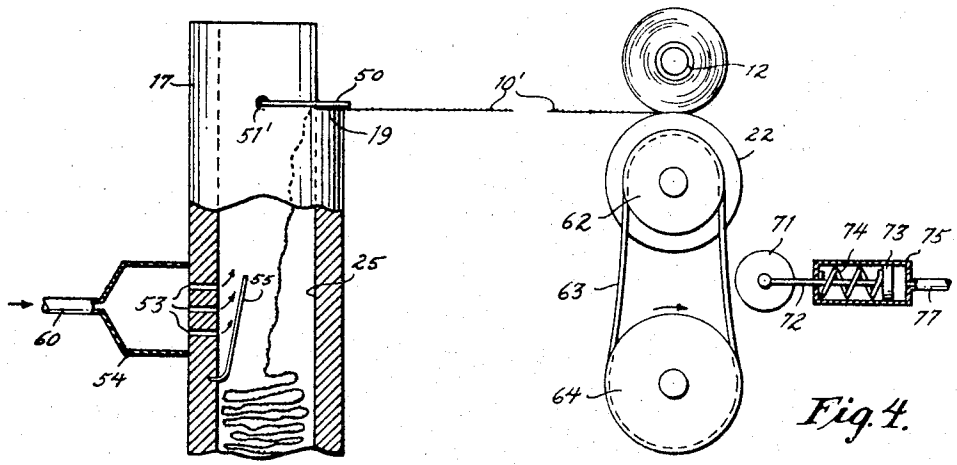

Fig. 4.

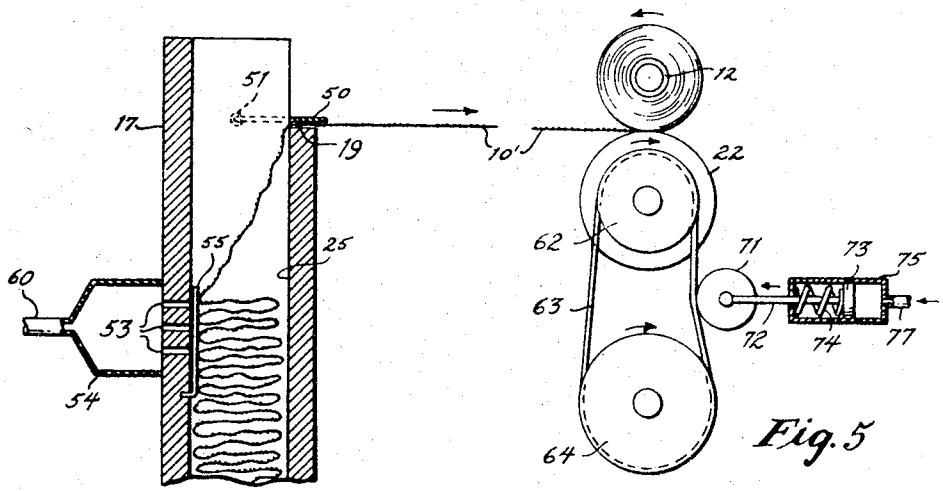

Fig. 5

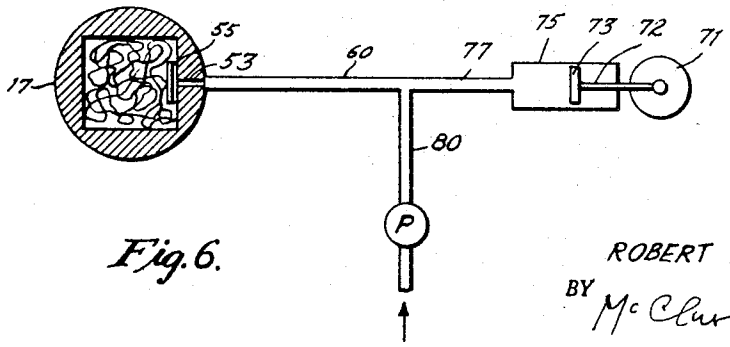

Fig. 6.

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STRAND WINDUP TREATMENT

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8 Claims. (Cl. 28—72)

This application is a continuation-in-part of my co-pending application Serial No. 294,035, filed July 10, 1963, which was a continuation-in-part of my prior application 790,658, filed Feb. 2, 1959 (now Pat. No. 3,111,740).

This invention relates to stuffer-crimping of textile strands, concerning particularly improved windup of the strands after being stuffer-crimped.

Well known methods, primarily mechanical, of modifying the regularity of surface or rectilinearity of configuration of textile strands include gear-crimping, jet-crimping, twist-crimping, and stuffer-crimping. Synchronization of the windup of the crimped strand with the infeed of the strand to be crimped is an accepted procedure in stuffer-crimping, as well as in the other mentioned crimping methods. In stuffer-crimping the strand to be crimped is fed by and between a pair of counter-rotating nip rolls into a confined region or passage from which its escape is impeded by a suitable back-pressure means sufficiently to cause the strand entering the region to assume a crimped configuration upon coming into forcible contact with the accumulation of strand already present therein. Stuffer-crimping is dependent upon accumulation and temporary confinement of the strand under crimping pressure. It will be apparent that while the crimped strand preferably is wound up preparatory to further use, rather than being collected in the form of an accumulated mass, an excessive windup rate might impair the crimping process or tend to uncrimp or even break the strand.

A primary object of the present invention is improved crimping of textile strands.

Another object is fluid treatment of stuffer-crimped strands at or after emergence from compact accumulation thereof.

A further object is provision of fluid-actuated windup synchronizing means for stuffer-crimpers.

Other objects of the present invention, together with means and methods for attaining the various objects, will be apparent from the following description and the accompanying diagrams.

FIG. 1 is a schematic representation of a stuffer-crimper and related apparatus suited to practice of the present invention;

FIG. 2 is a front elevation, partly broken away, of the stuffer-crimper of FIG. 1; and

FIG. 3 is a plan of the same apparatus taken at III—III of FIG. 2.

FIG. 4 is a side sectional elevation of a portion of the apparatus previously shown, with yarn in place and including winding apparatus;

FIG. 5 is a view corresponding to that of FIG. 4 but with the winding apparatus activated; and

FIG. 6 is a schematic representation of interconnections for the apparatus shown in FIGS. 4 and 5;

FIG. 7 is a sectional elevation of a modified form of a portion of the apparatus of the preceding views;

FIG. 8 is a sectional elevation of another modified form of such portion of the previous apparatus; and

FIG. 9 is a sectional elevation of yet another modified form thereof.

In general, the objects of the present invention are accomplished, in strand-crimping apparatus including a stuffer-crimper having a strand passage therethrough and

including windup means for removing the crimped strand from the exit of the passage, by fluid-supply means located adjacent the passage intermediate the entrance and the exit, the pressure or throughput of fluid being dependent upon the presence of crimped strand accumulated in the passage, and fluid-actuated means adapted to control the action of the windup means so as to regulate the rate of removal of crimped strand from the passage, preferably through a cocurrent flow of the fluid injected into the passage.

FIG. 1 represents in rather schematic form apparatus useful in practicing the present invention. Strand **10** is withdrawn from bobbin or similar package **11** through pigtail or similar guide **13** by forwarding rolls **14**, **14'** between which it passes. After the forwarding rolls, which themselves may be heated, the strand passes over heating block **5** to stuffer rolls **16**, **16'** at hidden entrance to stuffing-chamber **17**. Passage of the strand through the chamber is impeded by a suitable back-pressure element **45** (concealed in this view but shown in subsequent views). It is to be understood that the stuffing-chamber extends in close-fitting manner well over the ends of the adjacent rolls and to their nip so as to receive the strand therefrom. From the open top of the chamber the crimped strand (denoted as **10'** to distinguish it from uncrimped portion **10**) passes over recessed front edge **19** and then about idler roll **20** and is wound onto bobbin or cone **12** by contacting winding roll **22**.

FIG. 2 shows in front elevation (partly cut away), and FIG. 3 in sectional plan (taken at III—III of FIG. 2), a stuffer-crimper useful according to the present invention. Besides rolls **16**, **16'** and chamber **17**, already shown schematically in FIG. 1, additional elements are shown in some detail in this view. Base **1** carries upstanding supports **26**, **26'** for the rolls and infeed guide **23**, which conforms closely to the bight of those rolls, immediately underneath them. Bore **24** (shown in broken lines) of the guide is aligned with the nip of the rolls, and an arrow indicates the direction of passage of the strand to be crimped. Aligned with the nip and extending into the bight of the rolls from the rear is back-pressure gear **45**, which intercepts bore **25** of the chamber from the rear. Depending front flange **29** of chamber **17** is largely cut away in this view, along with part of the chamber itself, to reveal various interior elements of the apparatus. A corresponding flange **29'** at the rear is slotted, as is the rear wall of chamber **17**, to receive the back-pressure gear.

The base also supports motor **30**, which has drive pulley **32** affixed to motor shaft **31**. Belt **33** passes about the drive pulley and about a driven pulley **36** mounted on shaft **21'** of roll **16'**. Drive gear **35** and driven gear **35'** are keyed onto the respective shafts between rear and front walls **37** and **38**, in which the shafts are journaled. Rolls **16**, **16'** are retained on their respective shafts **21**, **21'** by hex nuts **34**, **34'** visible at the front.

The back-pressure gear is carried on shaft **47** mounted in upstanding supports **46**, **46'** carried on the base. The other end of the gear shaft carries pulley **48**, about which passes belt **49**. This belt loops over coupling **40**, which attaches to one end of extension spring **42** and is secured non-rotatively by means of rivet **41**. The other end of the expansion spring is retained against the base by eye-bolt **43** secured by nut **44**.

Somewhat more than halfway up bore **25** of chamber **17**, leaf **55** is visible against the inside wall. Near the top of the chamber bail **50** is pivoted at the sides and extends to the front and rests on the top of recessed front edge **19**. These portions of the apparatus appear in further detail in subsequent views.

Operation of the strand-crimping portion of this apparatus is conventional and readily understandable. The

illustrated motor drives the belt affixed to the pulley on the left-hand roll axle. Rotation of that axle ensues, as does counter-rotation of the axle of the right-hand roll, inasmuch as the two axles are geared directly to one another. The relative sizes of the gears and of the rolls themselves (all shown equal here) are selected so that the peripheral surfaces of the respective rolls turn at identical linear speeds. Uncrimped strand **10**, which may have been preheated, is fed through the bore of the infeed guide and injected into the nip of the counter-rotating rolls, which stuff the strand into the confined region provided at the entrance of the stuffing chamber, thereby compressing the strand longitudinally, buckling it into a crimped configuration, and normally heating it. Upon sufficient accumulation of the strand to rotate the back-pressure gear against the frictional retardation imparted to it by slippage of the attached pulley against the belt on contact with it, the strand accumulation proceeds upward into the chamber proper, where it cools either immediately or subsequent to any further heating therein. The operation of the novel windup features of this invention will be as readily understood by reference to the subsequent views and the accompanying description.

FIGS. 4 and 5 show in front and side elevation, respectively, partly in section, a portion of the apparatus previously shown, together with a more or less diagrammatic representation of associated variable-speed winding apparatus. Crimped strand **10'** (shown somewhat stylized) accumulates inside chamber **17**, rising therein as more uncrimped strand is fed into the chamber from below. At about the level of the strand accumulation in the chamber bore, flexible leaf **55** is fastened at its lower end in a slot provided in the back portion of the chamber wall. Immediately behind the leaf, the wall is pierced by apertures **53**, which communicate with housing **54** terminating supply pipe **60** for the actuating fluid (flow thereof being indicated by arrows). In the following description the fluid is referred to for convenience as air, although it will be understood that other gas or vapor (e.g., steam) may be employed, as may water or other liquid, or mixtures of fluids, such as sprays, for example.

A single strand rising from the strand accumulation exists over recessed edge **19** at the top, underneath bail **50**, which is pivoted at opposite ends in recesses **51**, **51'** in opposite sides of the outside wall of the chamber. The strand proceeds to cone or bobbin **12**, which is in contact with winding roll **22** and is rotated thereby. Attached to winding roll **22** is pulley **62**, which carries belt **63**; the belt also surrounds second pulley **64**, which may be mounted on shaft **31** of the drive motor or on other suitable driving means for this variable-speed winding means for withdrawing crimped strand from the chamber. The belt appears slack in FIG. 4, corresponding to relative inaction of the windup. Immediately to the right of the slack belt is roller **71** carried on shaft **72** of piston **73**. Located about the piston shaft is helical compression spring **74**, while the portion of surrounding cylinder **75** on the other side of the piston from the spring receives pipe **77** through which air can be forced. The mechanical linkage interconnecting the spring-biased piston with the winding means is shown, largely diagrammatically, in these views in only two extreme positions; it will be understood that a continuous range of intermediate positions occurs in practice.

It will be apparent that injection of air into the cylinder to the right of piston **73**, as occurs when flow into bore **25** of the chamber through apertures **53** is diminished or cut off entirely, will move it toward the left, thereby compressing the spring and forcing the roller against the belt between the pulleys. Ensuing tightening of the belt actuates the windup by transmitting the driving force from pulley **64** to pulley **62** and attached winding roll **22**. When the windup is actuated, crimped strand **10'** is withdrawn from the top of the chamber, out of the underlying strand accumulation in the lower portion of the chamber, and through the flow of air or other fluid, thereby cooling the strand and fixing or setting the crimp therein unless the fluid itself is hotter than the strand, in which event exposure thereto will heat-reflux the strand (preferably already cooled).

FIG. 5 shows the changed position of the various elements when the strand accumulation has become sufficient to actuate the windup fully. At the illustrated higher level of strand accumulation in the chamber, leaf **55** is forced against the chamber wall by compaction of the strand accumulation thereagainst, closing off the apertures that previously acted as air inlets. By suitable pipe connections (shown in the next view) the air is diverted into the cylinder carrying the piston and the belt-tightening idler roller, forcing the roller as shown against belt **63** to tauten it. Once this occurs, the strand will wind onto the package until the level in the chamber drops sufficiently to permit the air pressure to be dissipated past the leaf into the chamber instead of being forced into the pressure cylinder. When the pressure drops sufficiently the piston is forced back to the right by the helical spring, retracting the roller and allowing slippage of the belt interconnecting the pulleys. It can be seen that at intervening positions, when the flow is merely diminished, rather than entirely cut off, intermediate windup speeds are provided by partial slippage of the belt; also, inertia of winding roll **22** and pulley **62** ensures gradual variation in the windup speed, as will be apparent. The net effect will be to regulate or maintain essentially constant the quantity of crimped strand accumulated in the chamber, within the indicated extremes or limits.

FIG. 6 shows a suitable T-connection for the air lines or pipes of the previous views. Pump **P** in base **80** of the T supplies air or other suitable fluid at essentially constant pressure and forces it therethrough and into branches **60** and **77**, the former terminating at the stuffing chamber and the latter at the pressure cylinder. The respective areas of the inlet apertures in the chamber wall and the piston in the cylinder will be selected so that the force that must be applied to the leaf in order to actuate the piston is very much lower than the force applied by the piston to the idler roller. Rather than relying upon covering of apertures **53** by the leaf itself to impede or cut off the escape of air and thereby actuate the piston, the practitioner of this invention may interpose valve means to accomplish this, shown in FIGS. 7, 8 and 9, in which air flow is indicated similarly.

Thus, FIG. 7 shows, in side sectional elevation, modified housing **54'** terminating pipe **60** and having a pair of spiders **85** with openings **86** therein supporting valve member **81** slidably therein. Tapered end **82** of the valve member is shown spaced from the pipe terminus against which it is adapted to seat. Opposite end **84** of the valve member extends snugly through aperture **53'**; which is somewhat larger in diameter than remaining pair of apertures **53** in the wall of chamber **17** adjacent flexible leaf **55**. Collar **83** about the valve member nearer the latter end abuts the surface of the chamber wall inside the housing in the indicated open position of the valve member. It will be apparent that as the strand accumulation presses leaf **55** against the adjacent end of the valve member the opposite tapered end will seat as mentioned, thereby cutting off the indicated air flow and actuating the windup.

FIG. 8 shows a modification of the apparatus much as in FIG. 7 but with further modified housing **54''** having a tapered seat portion **88** to receive the tapered end of valve member **81**, which provides a more graduated control of the windup action. Fig. 9 is also similar but shows housing **54'''**, which is further modified from that of FIG. 7 by addition of outlet pipe **89** in the housing sidewall; former pair of apertures **53** in the chamber wall behind leaf **55** are omitted in this modification, in which no air from the windup control system enters the chamber, although the leaf continues to act as the control element by moving valve member **81** from the open to the closed position against the biasing effect of the air pressure.

If the benefits and advantages of using leaf **55** are not desired it may be omitted, of course, to permit the actuating fluid to impinge directly upon the strand accumulation itself rather than being directed in a cocurrent flow along the strand being wound up therefrom. Other modification in the number, shape, or size of parts or other structural changes may be made without departing from the invention as claimed.

I claim:

1. In stuffer-crimping of a textile strand, wherein the strand is fed into a temporarily confining region and is accumulated in compact crimped form therein and subsequently wound up from such accumulation, the steps of sensing by fluid flow theretoward the location of a boundary of the compact crimped strand accumulation dependent upon the relative infeed and winding rates and controlling the windup rate to counteract any change in location of that boundary.

2. The process of claim **1** wherein the windup is performed at minimal strand tension to preclude removal of the crimp.

3. In stuffer-crimping of a textile strand, wherein the strand is fed into a temporarily confining region and is accumulated in compact crimped form therein and subsequently wound up from such accumulation, the step of cocurrent application of fluid to the strand as it is wound up out of the compact accumulation of crimped strand.

4. The process of claim **3** wherein the fluid comprises air.

5. The process of claim **3** wherein the fluid comprises steam.

6. The process of claim **3** wherein the fluid comprises a spray of liquid droplets.

7. In stuffer-crimping of a textile strand, wherein the strand is fed into a temporarily confining region and is accumulated in compact crimped form therein and subsequently wound up from such accumulation, the steps of directing fluid toward a boundary of the compact crimped strand accumulation, the location of which is dependent upon the relative infeed and windup rates, sensing the impedance provided by the strand accumulation to the fluid flow, controlling the windup rate to counteract any change in location of that boundary, and further directing the fluid onto the strand as it is wound up out of the compact accumulation of crimped strand and thereby setting the crimp.

8. The process of claim **7** wherein the fluid flow is deflected to preclude contact with the campact strand accumulation and is redirected onto the strand as it is wound up out of the compact accumulation of crimped strand.

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