Aug. 13, 1968 R. K. STANLEY 3,396,443

STRAND TREATMENT PROCESS AND APPARATUS

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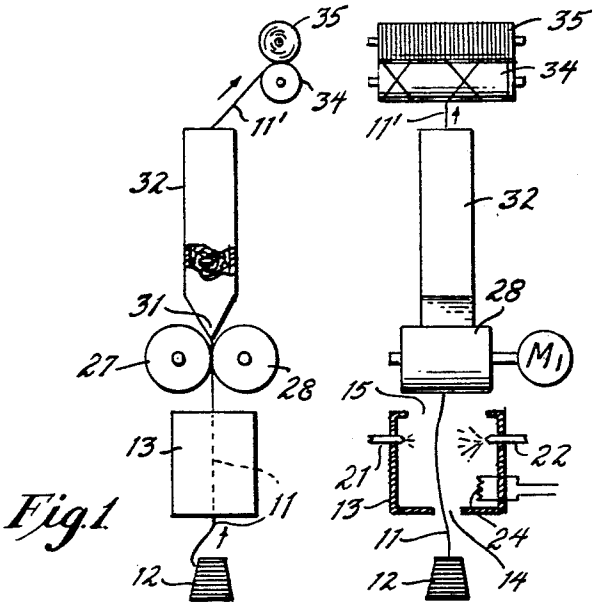


Fig. 1

Fig. 2

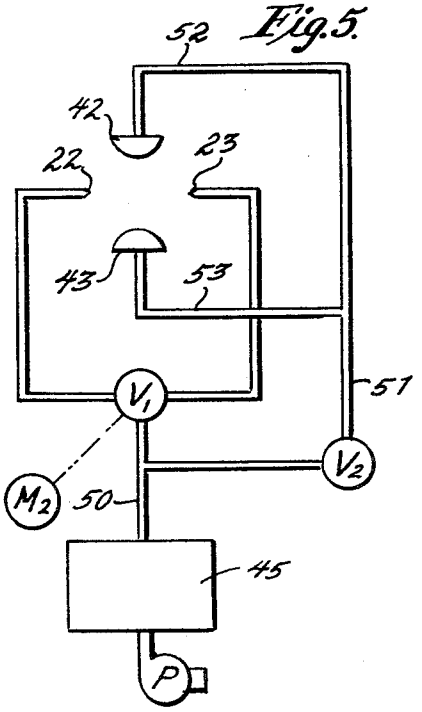


Fig. 5

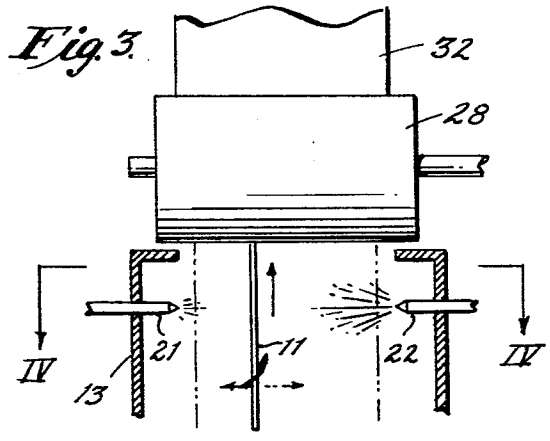


Fig. 3

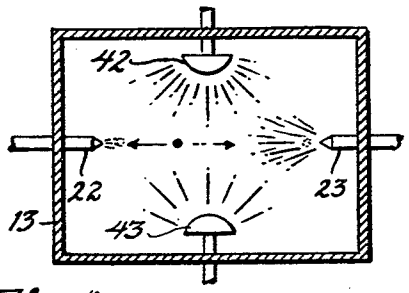


Fig. 4

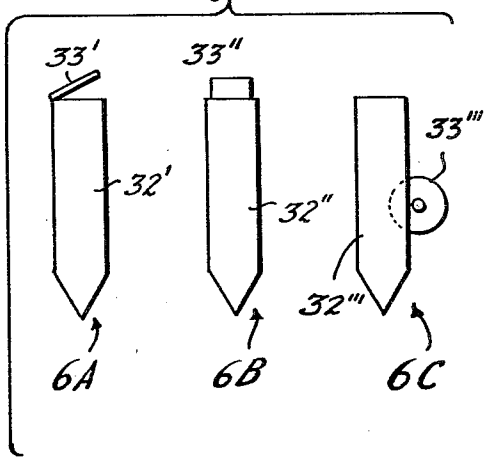


Fig. 6

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STRAND TREATMENT PROCESS AND APPARATUS

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14 Claims. (Cl. 28—1)

ABSTRACT OF THE DISCLOSURE

This invention relates to treatment of textile strands, concerning especially pretreatment thereof for crimping, particularly compressive or "stuffer" crimping, or as an initial step therein. Steam or other suitable vapor is applied to the strand from opposite sides, and the strand is conveniently traversed to and fro just ahead of a crimper entrance by increasing and decreasing the force of application thereof alternately from the respective sides.

Preparation of textile strands for crimping by wet or dry heating is known. For uniformity of crimping and of subsequent dyeing the strands should be treated uniformly, but this is difficult to do satisfactorily for a number of interrelated reasons, some of which are only imperfectly understood.

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

Another object is improved distribution of textile strands in the stuffing chamber of a compressive strand crimper.

A further object is provision of crimped textile strands characterized by uniform dyeability and which when dyed are characterized by uniform and long-lasting color retention even under adverse conditions of fumes, sunlight, and traffic.

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 front elevation, partly cut away and partly schematic, of apparatus of the present invention including or in conjunction with a stuffer crimper;

FIG. 2 is a side elevation, also partly schematic, of the apparatus of FIG. 1;

FIG. 3 is a fragmentary side elevation, considerably enlarged and partly in section, of the apparatus of the preceding views:

FIG. 4 is a plan taken at IV—IV on FIG. 3 and showing additional elements omitted from that preceding view;

FIG. 5 is a schematic diagram of jet elements shown in certain of the preceding views, together with interconnecting piping and related elements; and

FIG. 6 is a schematic view of several kinds of stuffer crimpers useful as disclosed herein.

In general, the objects of the present invention are accomplished, in compressive crimping of a textile strand wherein it is forced on the run into the entrance of a temporarily confining region from which its exit is impeded, by applying hot vapor to the strand adjacent and in advance of the entrance. In particular, the strand is traversed thereby from side to side along the entrance.

FIGS. 1 and 2 show, largely in elevation from the front and side, respectively, apparatus according to this invention, reduced to its essentials by schematization of the showing. Uncrimped strand **11** is withdrawn from conical package **12** and is forwarded on the run through enclosure **13**, which has small opening **14** and large opening **15** at the bottom and top, respectively, to accommodate it. Located on opposite sides of the strand therein

are jets **21** and **22** directed toward one another. Auxiliary heater **24** is also located in enclosure **13** is position to heat the strand as or before it passes between the jets. The strand may be preheated ahead of the enclosure where desirable in addition to, or instead of in the enclosure. Immediately above the enclosure the strand passes through the nip of pair of rolls **27** and **28** to which is juxtaposed entrance end **31** of stuffing chamber **32**, which has a longitudinal bore therethrough to provide a temporarily confining region for the strand. The rolls are driven in opposite directions of rotation by mechanical interconnection (indicated by broken line) to motor M_1.

After buckling into crimped configuration at the entrance as it comes into contact with an overlying mass of strand previously accumulated therein, the entering strand accumulates and is forced upward in the chamber bore. The wall of the stuffing chamber is partly cut away in FIG. 1 to reveal the strand accumulation in the bore thereof. At the same time crimped strand (now denoted as **11'**) is being withdrawn from the top of the chamber and is forwarded onto surface-driven windup package **35** after passing through the helical traversing groove of drive roll **34** on which the windup package rests.

FIGS. 3 and 4 show on an enlarged scale in side sectional elevation and sectional plan, respectively, the upper portion of enclosure **13**, together with adjacent elements. An instantaneous position of strand **11** is shown in solid lines, while extreme side-to-side traverse positions of the strand are indicated in flanking phantom lines. Vapor is indicated (in broken lines) as issuing strongly from jet **22** and less strongly from jet **21** onto the strand, which is indicated by transverse solid arrow as moving to the left, at the same time as it is running forward as indicated by longitudinal arrow. An oppositely directed transverse broken-line arrow indicates the counter movement of the strand when the force of vapor from jet **21** is stronger than that from jet **22**. As elsewhere described herein, the force of the vapor from the respective jets is alternately increased and decreased to traverse the strand back and forth along the concealed (behind roll **28** in FIG. 3) nip of the rolls and the juxtaposed entrance to stuffing chamber **32**.

FIG. 4 also shows an additional pair of auxiliary wide-angle jets **42** and **43** located at opposite sides of the strand and perpendicular to and in the same plane as jets **22** and **23**, which direct the vapor onto the strand through a relatively narrow angle in the horizontal plane. Jets **42** and **43** are operated, if at all, at relatively fixed intensity and are useful in ensuring that the strand receives a sufficient application of vapor wherever that is a problem, which it may not be with certain strand compositions.

FIG. 5 shows schematically suitable means for supplying hot vapor to the various jets. Pump P compresses vapor from any suitable source (not shown) into tank **45** in which it may be heated as desired. Main supply line **50** from the tank branches into auxiliary line **51**, which contains valve V_2 and feeds branch lines **52** and **53** for respective auxiliary wide-angle jets **42** and **43**. Valve V_1 is located at the junction of main supply line **50** and branch lines **56** and **57** for jets **42** and **43**, respectively. Valve V_1 is of rotary type adapted to vary the feed to the respective branch lines in alternately increasing and decreasing manner, the total feed remaining essentially constant, and is driven conveniently by motor M_2. If desired, this rotary valve-motor combination may be replaced by a bistable fluid amplifier, thereby eliminating moving parts in the hot vapor main line and providing a desirable dwell at each end of the traverse.

FIG. 6 illustrates schematically at 6A, 6B, and 6C, respectively, three conventional types of stuffing chamber, each with associated means for applying back-pressure to

the strand accumulation therein. Chamber 32' of the first type has weighted or spring-loaded flap at the top or exit end thereof; chamber 32'' has plunger 33'' resting on the strand accumulation in the chamber bore; and chamber 32''' has rotary element 33''' partially inset through the wall thereof to intercept the strand accumulation partially. The last arrangement is preferable to the other two because the strand is withdrawn freely from the chamber for windup without rubbing lengthwise over a solid element as is conducive to loss of crimp. A further embodiment of stuffer crimper, which like those above, is also suited to the practice of the present invention though lacking their back-pressure elements is disclosed in my copending application, Ser. No. 401,160, filed Oct. 2, 1964, now U.S. Patent 3,279,025, granted Oct. 18, 1966.

Regardless of the type of stuffer crimper employed, the entrance to the stuffing chamber thereof will be elongated lengthwise of the nip of the rolls to which it is juxtaposed, and the present invention ensures that the strand passing into the chamber will be more evenly distributed than if it were merely fed in along the center of the nip. No mechanical guide means is used, and the strand is traversed solely by the alteration in force of vapor impinging thereon from opposite sides parallel to the nip. Simultaneous plasticization of the strand by the vapor aids in the operation.

The present invention is operable upon strands having a wide, almost limitless, variety of chemical compositions and physical characteristics so that any recital thereof would be superfluous, although synthetic linear organic polymeric compositions having thermoplastic characteristics are perhaps most suitable. A strand to be subjected to this invention normally may be expected to comprise one or more long strand lengths or continuous filaments as compared with strands made solely of staple fibers although it is useful with the latter, as well and, of course, with combinations of continuous filaments and staple fibers.

The above description and related illustration are intended to provide a teaching sufficient for persons having ordinary skill in the art to practice the invention, rather than to indicate all the variations that may be made while retaining all or some of its benefits and advantages. Modifications may be made, as by adding, combining, or subdividing parts or steps, or by substituting equivalent parts or steps, without departing from the invention, which is defined in the following claims.

The claimed invention:

1. In compressive crimping of a textile strand by forcing it on the run into the entrance of a temporarily confining region from which its exit is impeded sufficiently to impart a crimped configuration thereto, the improvement comprising the step of treating the strand by applying hot vapor to it from opposite sides adjacent and in advance of the entrance.

2. The process of claim **1** wherein the strand is traversed from side to side along the entrance by increasing and decreasing the force of application of the vapor to the strand alternately from the respective sides.

3. The process of claim **2** wherein the vapor is applied also to the strand essentially uniformly in a direction transversely of the application thereof from said opposite sides.

4. The process of claim **3** wherein the vapor is applied also to the strand transversely from opposite sides substantially perpendicular to said previously mentioned opposite sides.

5. The process of claim **1** wherein the hot vapor applied to the strand is at plasticization temperature for the strand composition.

6. The process of claim **1** wherein the hot vapor is applied to the strand within an enclosure through which the strand passes on the run.

7. The process of claim **1** wherein the hot vapor is steam.

8. Process of improving dye characteristics of textile strands, comprising applying steam to opposite sides of such a strand immediately before feeding the strand into a temporarily confining region to be compressively crimped therein, varying the force of application thereof on the respective sides while maintaining application thereof from both sides, and thereby traversing the strand to and fro along and just ahead of the entrance to the confining region.

9. In strand-treating apparatus having a stuffing chamber with an entrance and an exit and having means for feeding a textile strand into the entrance of the chamber to be compressively crimped therein and thereafter to exit therefrom, the improvement comprising means adjacent the entrance but outside the chamber for applying hot vapor to the strand from opposite sides.

10. The apparatus of claim **9** including means for increasing and decreasing the force of application of the hot vapor alternately from the respective sides.

11. The apparatus of claim **9** including a pair of nip rolls juxtaposed to the chamber entrance to feed the strand thereinto, the nip of the rolls parallelling the directions of application of the hot vapor to the strand.

12. The apparatus of claim **9** including an enclosure about the means for applying the hot vapor and having openings therein to receive the strand therethrough.

13. The apparatus of claim **9** including radiant heating means adjacent the means for applying the hot vapor.

14. The apparatus of claim **9** wherein the means for applying the hot vapor comprises a pair of steam jets.

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