United States Patent [19]

Carruthers

[11] **3,916,651**

[45] **Nov. 4, 1975**

[54] **CONTINUOUS BULKING AND HEAT SETTING OF YARN**

[75] Inventor: **George Alan Carruthers,** Caton, England

[73] Assignee: **Turbo Machine Company,** Lansdale, Pa.

[22] Filed: **Nov. 28, 1973**

[21] Appl. No.: **419,536**

[52] **U.S. Cl.** ..... **68/5 E;** 68/DIG. 1; 68/22 R; 68/27; 68/175; 68/177; 68/181 R; 68/207

[51] **Int. Cl.²..D06B 3/04;** D06B 21/00; D06B 23/18

[58] **Field of Search** ..... 68/5 E, 22 R, 27, 175, 68/177, 178, 179, 181 R, 184, 207, DIG. 1, DIG. 9, 5 D, 6, 20

[56] **References Cited**

UNITED STATES PATENTS

1,399,230	12/1921	Touchstone et al.	68/27 X
2,529,991	11/1950	Belcher	68/178 X
2,712,977	7/1955	Keggin	68/181 R X
2,753,706	7/1956	Franklin	68/177 X
3,058,327	10/1962	Hablutzel et al.	68/5 E
3,230,745	1/1966	Bittle et al.	68/5 E
3,330,134	7/1967	Carpenter	68/178 X
3,364,705	1/1968	Thornber	68/184 X
3,546,902	12/1970	Sando et al.	68/5 E

Primary Examiner—Harvey C. Hornsby
Assistant Examiner—Philip R. Coe

[57] **ABSTRACT**

Yarn is continuously bulked and heat set by conveying it into a pressurized zone containing hot liquid, continuously relaxing the yarn under substantially zero tension and continuously conveying the relaxed yarn out of the hot pressurized liquid zone.

Air pressure zones are provided, before and after the liquid zone, and air locks are provided through which the yarn can be continuously introduced into and withdrawn from the treating apparatus without significant loss of pressure.

19 Claims, 10 Drawing Figures

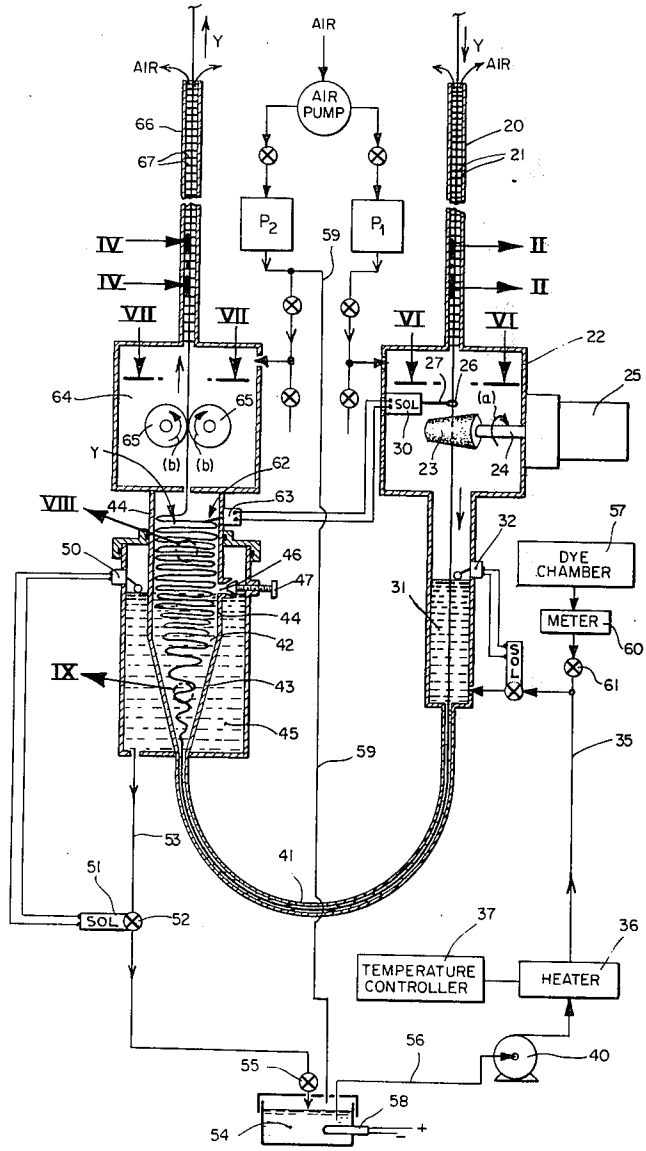
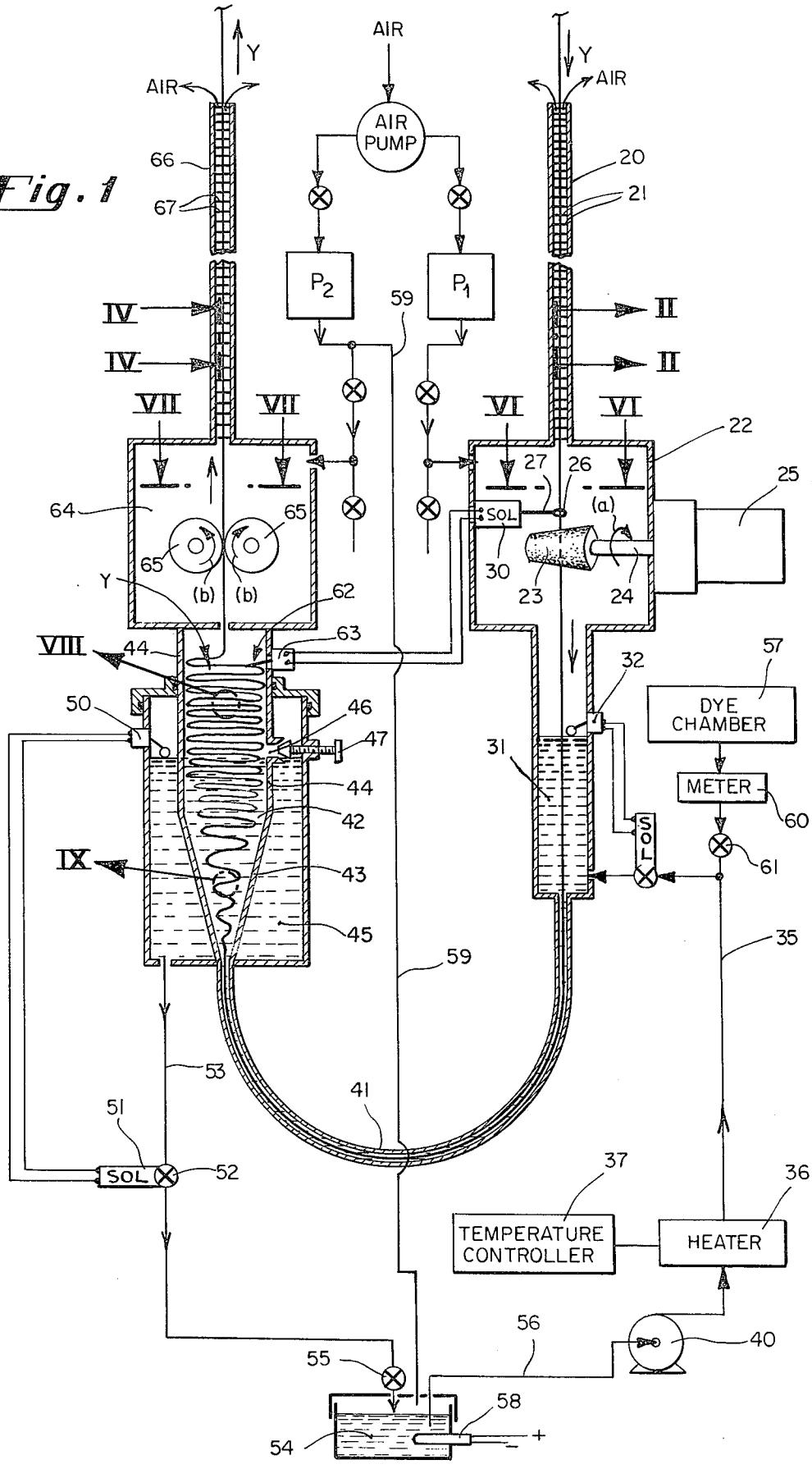


Fig. 1


AIR
Y
AIR
AIR PUMP
66
67
20
21
P2
P1
59
IV
IV
II
II
VII
VII
VI
VI
22
27
26
25
64
65
65
SOL
(a)
30
23
24
(b)
(b)
Y
62
63
VIII
44
32
57
50
46
47
DYE CHAMBER
31
44
42
METER
60
IX
43
61
SOL
45
59
35
53
41
51
37
36
SOL
52
TEMPERATURE CONTROLLER
HEATER
56
40
55
58
54
+
−

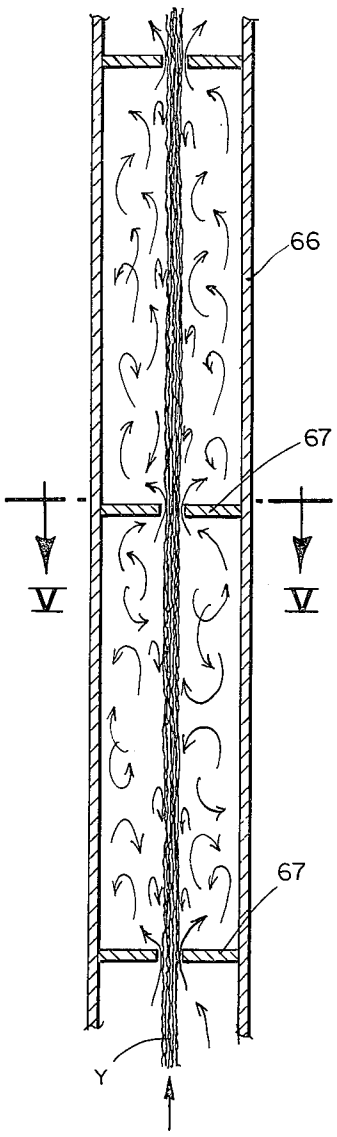


Fig. 4

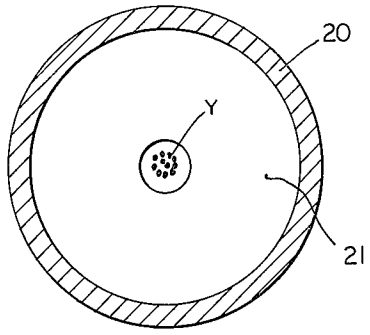


Fig. 3

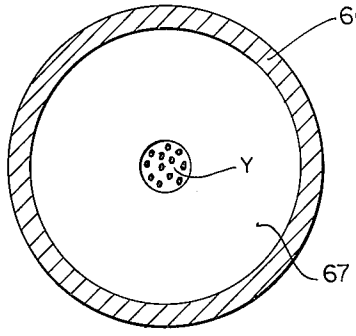


Fig. 5

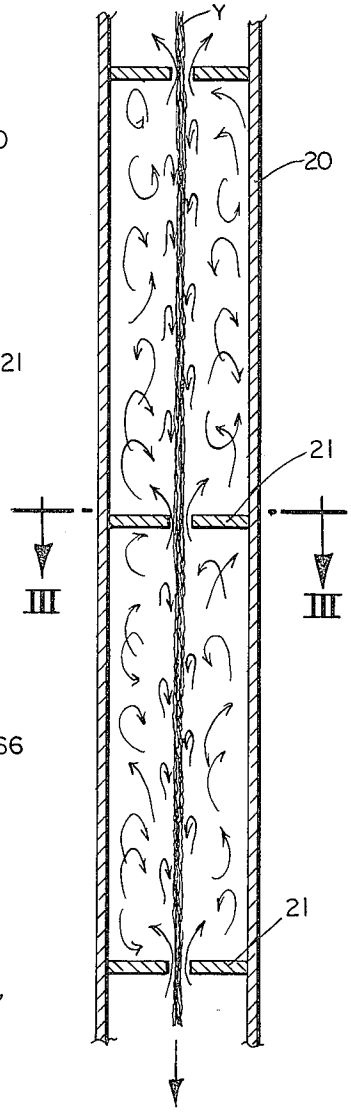


Fig. 2

Fig. 9

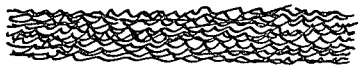


Fig. 8

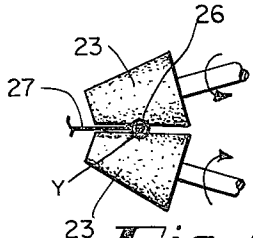


Fig. 6

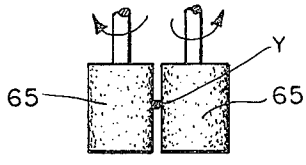


Fig. 7

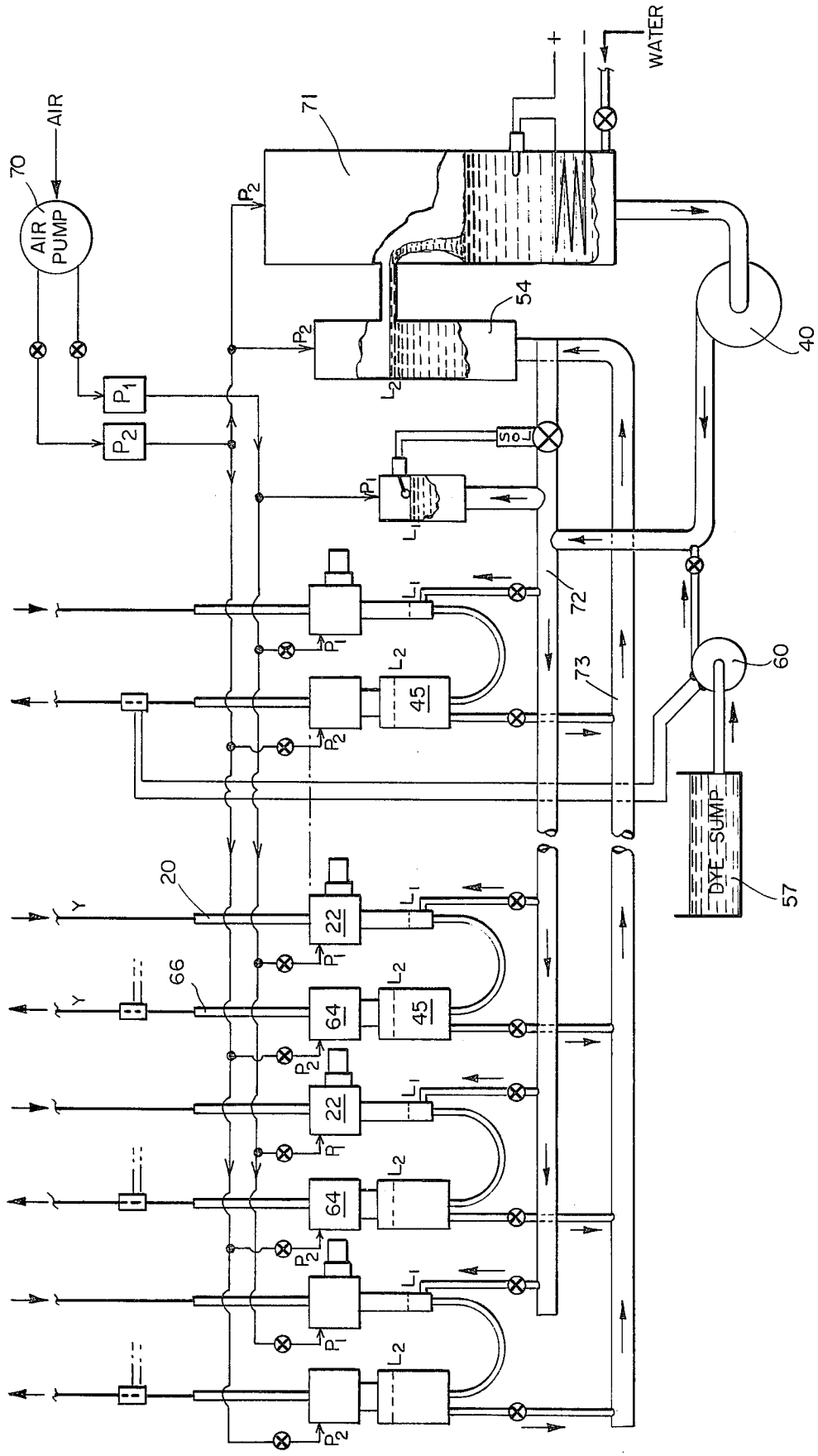

WATER
AIR
70
AIR PUMP
71
P2
54
40
P1
Sol
L1
L2
72
73
60
45
20
22
64
66
Y
DYE SUMP
57

Fig. 10

CONTINUOUS BULKING AND HEAT SETTING OF YARN

BRIEF DESCRIPTION OF THE INVENTION

This invention relates to the treatment of continuously running elongated material such as yarn, and particularly concerns an apparatus and method for continuously heat relaxing yarns and the like.

Although this invention relates to the treatment of wide varieties of yarn, it is particularly applicable to the bulking and setting of relatively large denier yarn such as that intended for use in carpets and the like.

The feed yarn that is used in this invention may be a continuous filament yarn in which case the yarn is melt-spun, drawn and texturized either by crimping, false twisting or the like, and the resulting yarns are usually plied together and used as the infeed yarns for processing according to this invention. Alternatively, the yarn may be a spun yarn in which case the yarn is spun from short length fibres such as silver or the like, and the spun yarns are preferably plied in order to prepare a plied feed yarn for processing according to this invention.

BRIEF DESCRIPTION OF THE PRIOR ART

Heretofore, yarns which have already been subjected to a texturizing operation of one kind or another have been heat relaxed or bulked by forming sections of the yarns into hanks and by hanging these hanks in an autoclave or steam chamber under conditions of substantially zero tension. The heat treatment under the conditions of temperature and pressure that exist within the autoclave have been found to relax the yarn, causing the crimpiness or texturized characteristics to develop, producing a substantial increase in bulk. This increase in bulk is highly desirable for many uses, particularly including the use of the yarn as piles or tufts in carpet manufacture. This autoclaving process also "sets" the yarn, i.e. stabilizes it so that it remains in the bulked form with little tendency, in use in a carpet, to untwist or to lose its crimp.

In any event, in order to develop the crimp or texturized characteristics of the yarn, it is necessary to heat relax the yarn and this is the step with which this invention is concerned.

Heretofore, heat relaxation of the yarn has also been obtained on a batch basis by utilizing hot water or saturated steam. Hot air has also been used, even in a continuous manner, but it has produced a product of doubtful quality.

The U.S. Pat. No. 3,408,716 to Tradewell discloses the idea of heat relaxing a yarn in a moving fluid (hot air), and overfeeding at the feed end in a manner to correlate the feed rate with the wind-up rate so that the yarn will be substantially tensionless while it passes through the heat relaxing treatment area.

The U.S. Pat. No. 2,634,596 to Pendleton et al. shows the idea of sensing the degree of yarn build-up, and automatically connecting such a sensing device to a device for controlling the speed of the yarn input.

One of the problems with which the prior art is confronted is the problem of treating the yarn continuously in a hot pressurized liquid, without losing pressure or temperature as a result of the step of continuously conducting the yarn from ordinary atmospheric conditions into and from the pressurized treatment area. Another problem has been the tendency of the yarn to tangle and snarl when it is completely relaxed while moving at a high rate of speed; this problem is particularly in evidence when attempts are made to relax the yarn in hot air.

Another problem facing the art has been the rough treatment with which it has heretofore been considered necessary to treat a running end of yarn, when the yarn is moving at the high rate of speed that is necessary for the economic justification of the heat relaxing aspects of the treatment process.

OBJECTS OF THE INVENTION

It is accordingly an object of this invention to provide for the heat relaxation and setting of yarn in a continuous manner by exposing the yarn to an environment characterized by pressures and temperatures which are considerably above normal ambient conditions.

Another object of the invention is to provide for the continuous heat relaxing and setting of yarn which is running at a very high speed without wrapping, snarling or tangling the yarn.

Still another object is to provide for setting yarn with the development of substantial amounts of bulkiness in the yarn, coupled with continuous operation at high rates of yarn speed.

Still another object is to provide for high speed continuous relaxation of yarn in a manner to produce yarn having a high degree of bulkiness and having excellent uniformity and quality.

Other objects and advantages of this invention, including the ease with which multiple units may be adapted to a mass production operation, and the simplicity and economy of operation of the process, and its ready adaptability to the use of additional procedures such as dyeing or applying lubricants or spin finish to the yarn, will further become apparent hereinafter and in the drawings.

Drawings

FIG. **1** represents a view in side elevation of one form of apparatus for carrying out the process according to this invention, with certain of the parts being shown schematically for the purpose of clarity of illustration;

FIG. **2** represents a center sectional view of a portion of the infeed apparatus appearing in FIG. **1**, taken as indicated by the lines and arrows II—II which appear in FIG. **1**;

FIG. **3** is a sectional view taken as indicated by the lines and arrows III—III which appear in FIG. **2**;

FIG. **4** is a sectional view taken centrally through an exit portion of the apparatus appearing in FIG. **1**, taken as indicated by the lines and arrows IV—IV which appear in FIG. **1**;

FIG. **5** is a sectional view taken as indicated by the lines and arrows V—V which appear in FIG. **4**;

FIG. **6** is a fragmentary view in plan, looking down upon a pair of infeed rollers comprising a part of the apparatus illustrated in FIG. **1**, taken as indicated by the lines and arrows VI—VI which appear in FIG. **1**;

FIG. **7** is a plan view similar to FIG. **6**, showing a pair of delivery rollers looking as indicated by the lines and arrows VII—VII which appear in the left central portion of FIG. **1**;

FIG. **8** is an enlarged fragmentary view of a length of yarn which has been subjected to heat relaxation and which indicates a typical crimp development configuration that can be achieved in a stuffer crimped carpet

yarn at a location such as that indicated by the arrow VIII appearing in FIG. 1;

FIG. 9 represents a view similar to FIG. 8 but showing the same yarn prior to heat relaxation, such for example as illustrated at the inlet to the heat relaxing portion of the apparatus as indicated by the arrows IX'IX, appearing in FIG. 1; and

FIG. 10 is a schematic view in side elevation of a machine for processing a plurality of separate ends of yarn using a plurality of individual yarn-relaxing units according to this invention in a common machine, and wherein all of the units are connected to a common source of heat relaxing medium.

DETAILED DESCRIPTION OF THE INVENTION

Although specific terms have been used in the abstract of the disclosure and will be used for the purpose of clarity in the specific description which follows, it will be appreciated that this description is intended to relate to the particular forms of the invention illustrated in the drawings, and is not intended to limit the scope of the invention which is defined in the appended claims.

In accordance with this invention a continuously running yarn is conducted into a chamber containing a hot pressurized liquid such as pressurized hot water, for example, and is conducted through this liquid at a high rate of speed. It then moves into a reservoir containing a substantial quantity of this hot pressurized liquid, and is fed into the reservoir in such a way that the yarn within the reservoir is subjected to substantially zero tension and is acted upon by the heat and pressure of the hot pressurized liquid in a manner to heat relax and to bulk the yarn while the yarn in maintained at substantially zero tension. After the yarn is permitted to dwell or remain in the hot pressurized liquid for a predetermined period of time, it is withdrawn under a minimum of tension, preferably as close to zero as possible, and is continuously conveyed from the reservoir and delivered for collection under natural ambient conditions. If the yarn, as delivered, still contains some of the hot pressurized liquid, it is conducted through a dryer or the like and the dried yarn is wound onto packages and otherwise prepared for collection, storage or delivery.

Referring particularly to FIG. 1, the number **20** designates a tube having a diameter considerably larger than the diameter of the incoming yarn Y, which tube contains a multiplicity of spaced apart orifice plates **21**, each having a central orifice of a diameter which is slightly larger than the diameter of the yarn Y. The tube **20** leads to a pressurized air chamber **22** comprising a pressurized inlet for the yarn Y. A pair of conical feed rolls **23** are provided in the chamber **22**, each mounted upon a shaft **24** and driven in rotation by a motor **25** in the direction indicated by the arrow *a* appearing at the right center of FIG. **1**. Also mounted within the chamber **22** is a guide eye **26** carried on a rod **27** and actuated back and forth along the axis of the rod **27** by a solenoid **30**. As will be apparent, the shifting of the yarn Y under the influence of the guide eye **26**, axially with respect to the conical rolls **23**, changes the effective circumference of the conical rolls that are nipping the yarn Y, and thereby varies the speed with which the yarn is fed into the apparatus by the conical feed rolls **23**. The pressurized air chamber **22** is connected to and is in pressure communication with a pressurized fluid inlet chamber **31** which contains a liquid such as hot water at a level which is maintained by a float valve **32** actuated by a solenoid to control a valve, as illustrated in FIG. **1** to the right of chamber **31**, to selectively admit the hot liquid from a pipe **35** which is connected to a heater **36** having a temperature controller **37**, the flow of the liquid being actuated by a pump **40**.

At the exit end of the chamber **31** is a long tube **41** of small diameter which has a generally U-shaped configuration and curves upwardly into the bottom of a pressurized heat relaxing chamber **42**. As shown, the chamber **42** has an upwardly diverging substantially conical shape, and above it has an upper generally cylindrical portion **44**. The chamber **42** is surrounded by and enclosed within a pressure chamber **45**. The cylindrical portion **44** of heat relaxing chamber **42** is provided with an opening **46** controlled by an adjustable valve **47** for controlling the rate of flow of fluid from the chamber **42** outwardly into the collecting chamber **45**.

The number **50** designates a float valve at a predetermined controllable level in the chamber **45**, connected electrically to a solenoid **51** which operates a valve **52** controlling the flow of fluid through line **53** to the feed end of the pump **40**, similar to the solenoid and control valve associated with the float valve **32** heretofore described, or selectively a collecting sump **54**. Sump **54** is pressure tight and is connected to the pressure source at P_2 by line **59**. The flow of fluid into the sump **54** is by gravity and regulated by a valve **55**, and the sump is connected by a line **56** to the feed end of the pump **40**. Sump **54** has a heater **58** to control the temperature of the liquid.

It will be appreciated, accordingly, that fluid is forced by the pump **40** through the heater **36** and the line **35** into the chamber **31**, and that this fluid flows under the influence of the air pressure in the chamber **22**, at a high rate of speed through the narrow elongated tube **41** and upwardly into the chamber **42**. This fluid then flows out through the opening **46** into the outer collecting chamber **45** and down through the line **53** to the sump **54**. The level of the fluid in the chamber **45** is, as heretofore mentioned, controlled by the float valve **50**. Dye may be metered into the fluid, if desired, from the dye chamber **57** through the meter **60** and valve **61**.

The number **62** designates a feeler which actuates an electric switch **63** which is connected electrically to operate the solenoid **30** heretofore mentioned, in a manner to change the speed of yarn infeed automatically in response to changes in the level of the yarn Y contained within the relaxing chamber **42**, particularly the height which the relaxed yarn has reached in the upper cylindrical portion **44** of the chamber **42**, as shown in FIG. **1**.

The number **64** designates a pressurized air chamber which is connected to the top of the cylindrical portion **44** and which is maintained under a pressure designated in the drawings as P_2 by the air pump, the lines and valves for accomplishing this being schematically illustrated at the upper central portion of FIG. **1**. As will be apparent, the valves are arranged to provide a controllable air pressure P_2 within the chamber **64** and sump **54**. Also in the chamber **64** is a pair of cylindrical nip rolls **65** which are driven by a motor (not shown) in the direction illustrated by the arrows (b) which appear in FIG. **1**. These nip rolls **65** are driven at a speed

which is carefully correlated with respect to the speed of the winder or other takeup and collecting means for the yarn product (not shown), in order to deliver the heat-relaxed yarn at the lowest feasible tension. The number **66** designates a tube which may be similar to the tube **20** having orifice plates **67** which may be similar to the orifice plates **21**, all forming an air lock for permitting the passage of yarn from the pressurized air chamber **64** to the ambient air, with a minimum of air loss from the chamber **64** and yet permitting the rapid and continuous exiting movement of the yarn Y.

In operation, the yarn Y is conducted from any convenient source which is located in the ambient air, through the air lock formed by the tube **20** and its multiple orifice plates **21** into the air pressure chamber **22** which is maintained at a pressure designated as P_1 in the upper central portion of FIG. **1.** Passing through the nip between the rolls **23**, along a path that is controlled by the guide eye **26**, the yarn moves at a carefully controlled high rate of speed through the tank **31** which contains hot pressurized liquid having a pressure approximately equal to the air pressure P_1. Since the pressure P_1 is controlled to assure that it must be greater than the pressure P_2, the resulting pressure differential forces fluid to flow downwardly from chamber **31** and rapidly through the small-diameter tube **41**, along with the yarn, into the chamber **42.** Because of the widening of the diameter in the conical portion **43**, the yarn is gradually relaxed in the turbulently flowing fluid, assuming the undulating configuration shown schematically in FIG. **1.** Drifting relatively slowly toward the top of the heat relaxing chamber **42**, the yarn is ultimately picked up by the rolls **65** in the pressurized air chamber **64**, passes continuously out through the air lock formed by tube **66** and orifice plates **67**, and is delivered to any convenient location in the ambient air for collection on a winder or other takeup device. The yarn is damp at this stage and may be collected in a can with a perforated bottom through which warm air can be passed for drying.

Where reference is made to an "air lock" herein it should be understood that it is not necessarily intended to lock out the flow of air completely in the apparatus according to this invention. Since the air starts off at a pressure P_2 p.s.i. above atmospheric pressure, and finally emerges from the air lock tube into the atmosphere, then the total pressure drop through all the orifices must equal P_2. It follows that as the number of orifices is increased the pressure drop through each is reduced. However, the amount of air passing through any orifice depends on the pressure drop through it. The lower the pressure drop the smaller the air rate. Thus, in theory, with an infinite number of orifices no air would be used, and with a larger number less air will be used than with a small number.

Referring to FIGS. **2** and **5** of the drawings, it will be observed that although there is some space between the yarn Y and the opening in orifice plate through which it passes, the limited area of this opening severely limits the rate of air flow that the opening permits, and the turbulence of the air in the tube sections between the orifice plates, creates a pressure drop and further limits the flow of the air. Since, in accordance with this invention, the tubes **20, 66** are each preferably provided with great numbers of orifice plates **21, 67**, preferably as many as **20** or more, the summation of the pressure drops through the orifices themselves, coupled with the friction drops due to the turbulent flow in the intervening spaces, greatly reduce the rate of flow of the air out through the air lock and make it entirely practicable to run the yarn at high rates of speed continuously into and out of the pressurized air chambers **22, 64** heretofore referred to, without excessively costly losses of pressurized air.

It will be noted particularly that the incoming yarn as represented in FIG. **2** is running countercurrent to the escape of air from its chamber, and this countercurrent motion further inhibits the escape of air. Although the yarn itself has not been relaxed at the time it reaches the tube **20**, and each yarn has a rather small diameter as appears in FIG. **3**, the yarn has indeed been relaxed and has a much greater bulk as it leaves the apparatus through the air lock shown in FIG. **4.** Thus, although the yarn as it moves in FIG. **4** has a direction that is cocurrent with the escape of air itself, its greater bulk further closes the orifices in the orifice plates **67** in FIG. **4** and thus impedes the escape of air. The larger effective diameter of the yarn is shown schematically in FIG. **5** of the drawings.

FIGS. **6** and **7** of the drawings are intended to show further details relating to the operation of the conical nip rolls **23** in FIG. **6**, and the manner in which they control the infeed rate of the yarn, while the rolls **65** of FIG. **7** may be cylindrical as shown.

FIG. **8** shows schematically a segment of yarn after it has been heat relaxed and its crimpiness has been developed. The yarn shown in FIG. **9** has not been so relaxed and is considerably more compact.

Turning now to FIG. **10** of the drawings, a multiplicity of units of the type shown in FIG. **1** are all connected into a common system. It will be apparent from FIG. **10** that, in each unit, the number **22** designates the pressurized air chamber for the incoming yarn Y, the letter L_1 designates the fluid level in the pressurized fluid chamber for the incoming yarn, which is connected by the small diameter connecting tube, to the pressure chamber of the heat relaxing chamber **45**, the number **64** designates the pressure air chamber for the outgoing yarn Y, and the numbers **20** and **66** designate the tubes for the respective air locks for the incoming and outgoing yarns.

In the apparatus according to FIG. **10**, a common air pump **70** is used, and is connected through pressure controls P_2 and P_1, respectively, into the chambers **64** and **22.** Similarly, a common reservoir **71** is connected to the pump suction of the pump **40.** The pump delivery is connected to header **72** which is connected to the pressurized fluid chambers below the level L_1. All of the pressure chambers **45**, which contain the hot fluid as it has come from the heat relaxing chamber, are connected into a common return header **73.** The same numbers are used in FIG. **10** as were used in FIG. **1** to designate the sump **54**, the dye chamber **57**, its meter **60**, the circulating pump **40**, and other associated equipment.

The apparatus appearing in FIG. **10** is particularly advantageous commercially because of the ease and uniformity of control of the pressures and temperatures and the dye levels, if applicable, of the fluid that is caused to flow continuously through each one of the yarn relaxing units. The apparatus according to FIG. **10** has the advantage of certainty that two similar yarns, fed into two units of a set, will result in the production of substantially identical products having the same de-

gree of heat relaxation and bulkiness and having the same depth and penetration of dye or color. This is a significant advantage, particularly when the yarns are intended to be tufted or woven into carpets, because even slight variations of degree of relaxation or of dye shade or penetration, tend to cause streakiness in the carpets, rendering them defective.

Where reference has been made in the foregoing description to the presence of air in the chambers **22, 64,** it should be appreciated that any other compatable fluid may be substituted provided it is not miscible with the liquid contained in the chambers **31, 42** and provided, of course, that it does not damage the yarn or any associated parts of the apparatus. However, air is preferred because it is plentiful and inexpensive.

The liquid that is used in the chambers **31** and **42** is preferably hot water, because it has no adverse affect upon the yarn and assists greatly in the heat relaxing and bulking operation. Indeed, it is surprising that a very significant increase of bulkiness is achieved according to this invention when the yarn emerges at a high rate of speed from the narrow tube **41** and expands upwardly through the conical portion **43** and relaxes under substantially zero tension in the turbulent liquid which carries the relaxed yarn along in the heat relaxing chamber **44.**

Although reference has been made with respect to one specific means for controlling the infeed speed of the yarn, it will be appreciated that various other ways may be provided for feeding the yarn. For example, parallel cylindrical rolls may be used instead of the conical rolls **23,** but with provision for varying the speed relative to the output rollers for control purposes.

Although the use of a dye chamber and a meter have been disclosed in the description of this invention, it will be appreciated that the use of a dye is optional and in many cases plain hot water is the preferred yarn relaxing medium. However, the apparatus and process of this invention lend themselves admirably to the incorporation of dye, if desired.

It will be appreciated that the relative pressures P_1 and P_2 may readily be controlled by simply adjusting the associated valves, and that an increase of pressure differential causes a more rapid flow of fluid from the chamber **31** to the chamber **42.** Further, it will be appreciated that the retention time of the relaxed yarn within the chamber **44** may readily be controlled by simply varying the level of fluid in the chamber **44** itself. Within certain limits, greater degrees of heat relaxation and bulkiness are obtained with longer periods of exposure of the relaxed yarn to the hot treating liquid. In FIG. **10** this is done by varying the height of the pipe which connects tank **54** to tank **71** or, for example, using a variable height weir between tanks **54** and **71.**

Although a specific form of air lock has been described and shown in the drawings, other forms of air locks or even no air lock at all may be utilized if the conservation of air or other gaseous medium should be relatively unimportant or of no importance in connection with a particular installation. However, it is believed that the novel air lock described and claimed herein possesses the special advantages of ease of use and efficiency in conservation of pressurized air.

If desired, the air within the chamber **64** may be heated, so that the wet relaxed yarn is partially or even completely dried as it passes through the chamber **64.** Similarly, the air in chamber **22** may be heated, if yarn preheating is desired.

The following examples illustrate the rather small amounts of air loss that result from operation of the air locks according to the invention:

EXAMPLES 1–4

1. Using **56** orifice plates, with a total pressure difference between air chamber and the atmosphere of 21 p.s.i., the loss of air from the chamber was 2.23 cu. ft. of air per minute.

2. With 3/32inch diameter holes, using 30 orifice plates, with a total pressure differential of 21 p.s.i., the loss of air was 1.83 cu. ft. per minute.

3. With 100 orifice plates and conditions above, the loss of air was 1 cu. ft. per minute.

4. With yarn present, and ⅛ holes, 56 orifice plates, 26 p.s.i. differential, the air loss was 2.53 cu. ft. per minute. Without yarn, 3.36 cu. ft. per minute.

Although this invention has been described with reference to specific embodiments thereof, it will be appreciated that various modifications may be made including the substitution of equivalents, reversal of parts and sequence of steps of the methods, and the use of certain features independently of the use of others, all without departing from the spirit and scope of this invention as defined in the appended claims.

The following is claimed:

1. In an apparatus for continuously bulking a texturized multifilament yarn, the combination which comprises: means providing a gaseous pressurized inlet zone into which said yarn is conducted, said gaseous inlet zone having a gas outlet, for escape of gas from said gaseous inlet zone, said gas outlet defining an inlet for said yarn into said inlet zone such that said yarn enters said inlet zone countercurrently with respect to the escaping gas, means providing a pressurized hot liquid zone in contact with said inlet zone and into which the yarn is conducted from said inlet zone, the pressure in said pressurized liquid zone being approximately equal to that in said gaseous inlet zone, said pressurized liquid zone including a yarn-relaxing chamber wherein the yarn tension is relaxed, means for introducing the liquid into said relaxing chamber concurrently with the yarn whereby said yarn travels in a relaxed condition concurrently with said pressurized hot liquid through said relaxing chamber, and means for continuously withdrawing said yarn from said liquid zone after said relaxation.

2. Apparatus according to claim **1,** wherein said liquid zone further includes an inlet chamber and a conduit extending from said inlet chamber to said relaxing chamber.

3. Apparatus according to claim **2,** wherein said conduit is substantially smaller in cross section area than said inlet chamber or said relaxing chamber, and wherein means are provided for causing said liquid to flow turbulently in said conduit from said inlet chamber toward said relaxing chamber.

4. Apparatus according to claim **2,** wherein said inlet chamber is substantially smaller in cross section than said relaxing chamber.

5. Apparatus according to claim **2,** wherein means are provided for causing hot pressurized liquid to flow continuously through said conduit in contact with said yarn, in a manner to influence said yarn for movement along with said liquid.

6. Apparatus according to claim 2, wherein means are provided for regulating the pressure in said inlet chamber and in said relaxing chamber.

7. Apparatus according to claim 1, wherein said means for continuously withdrawing said yarn includes a gaseous pressurized outlet zone in pressure contact with said pressurized liquid zone, through which the heat relaxed yarn is conducted for collection.

8. Apparatus according to claim 7 wherein means are provided for regulating the gas pressure in said outlet zone.

9. Apparatus according to claim 7 wherein means are provided for regulating the difference of pressure between said gaseous inlet zone and said gaseous outlet zone.

10. Apparatus according to claim 1 wherein means are provided for regulating the gas pressure in said inlet zone.

11. Apparatus according to claim 1 wherein automatic means are provided for regulating the flow of said yarn into said pressurized liquid zone in response to the quantity of relaxed yarn accumulated in said yarn relaxing chamber.

12. Apparatus according to claim 11 wherein said means includes a pair of conically shaped feed rolls, combined with yarn guide means responsive to said quantity of accumulated yarn arranged to shift said yarn in the direction of the axes of said conically shaped feed rolls in a manner to vary the yarn infeed speed.

13. Apparatus according to claim 1 wherein means are provided for continuously supplying fresh quantities of said liquid to said pressurized liquid zone, and for releasing excess quantities of said liquid from said relaxing chamber.

14. Apparatus according to claim 13 wherein means are provided for introducing a dye into said liquid.

15. Apparatus according to claim 14 wherein said providing means includes a metering means.

16. Apparatus according to claim 1 wherein means are provided for controlling the temperature of said liquid.

17. Apparatus according to claim 1 wherein said liquid is water.

18. Apparatus according to claim 1 wherein a plurality of continuous bulking apparatuses for separately treating a plurality of separate yarns are arranged in parallel and adjacent to one another, and are connected to a common source of said liquid.

19. Apparatus according to claim 18 wherein said common connection includes pressure headers extending from a liquid source to all of said pressurized liquid zones.

* * * * *