June 28, 1966 F. CATALLO 3,257,735

DRYING OF FABRICS

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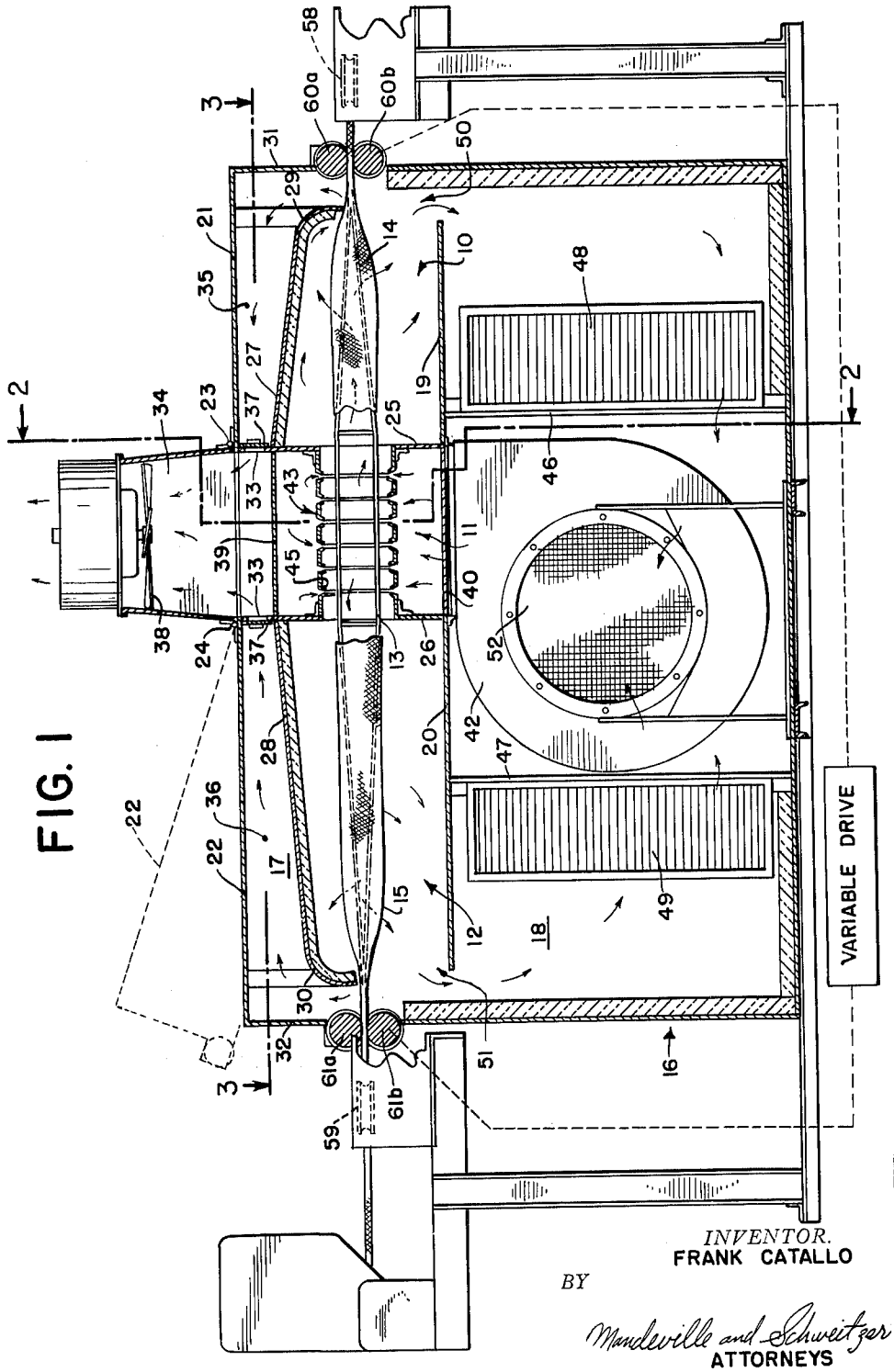


FIG. 1

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FIG. 2

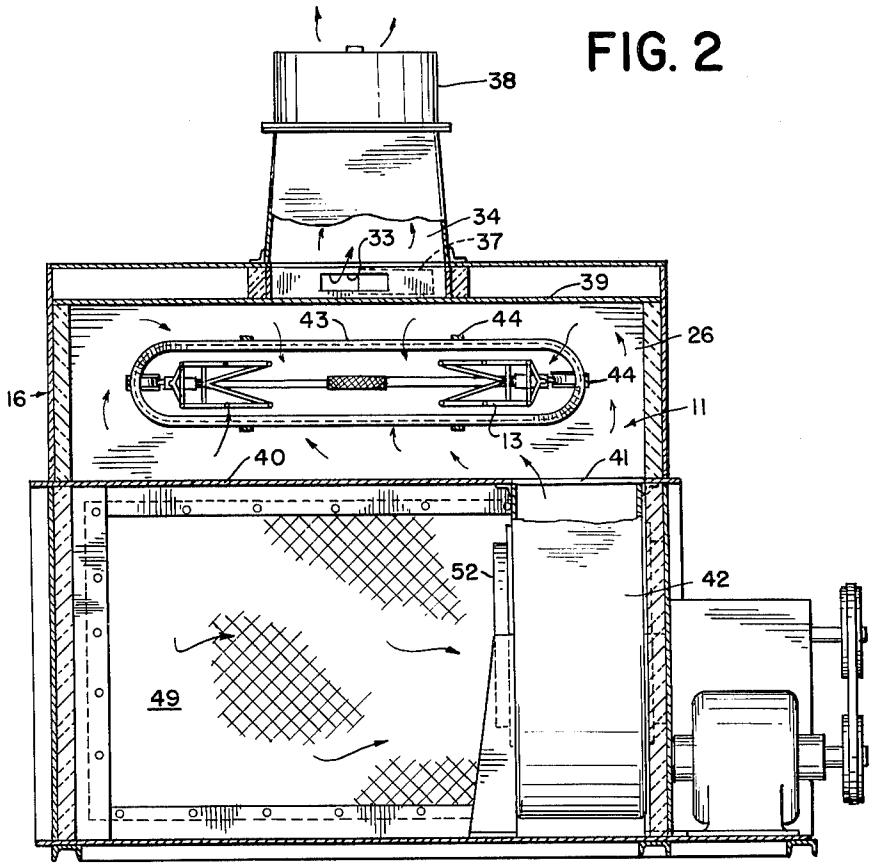
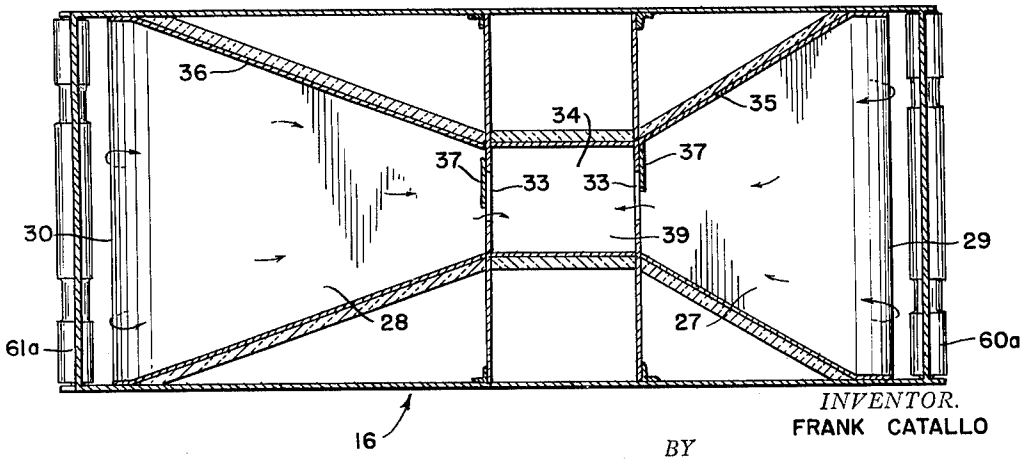


FIG. 3



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FIG. 4

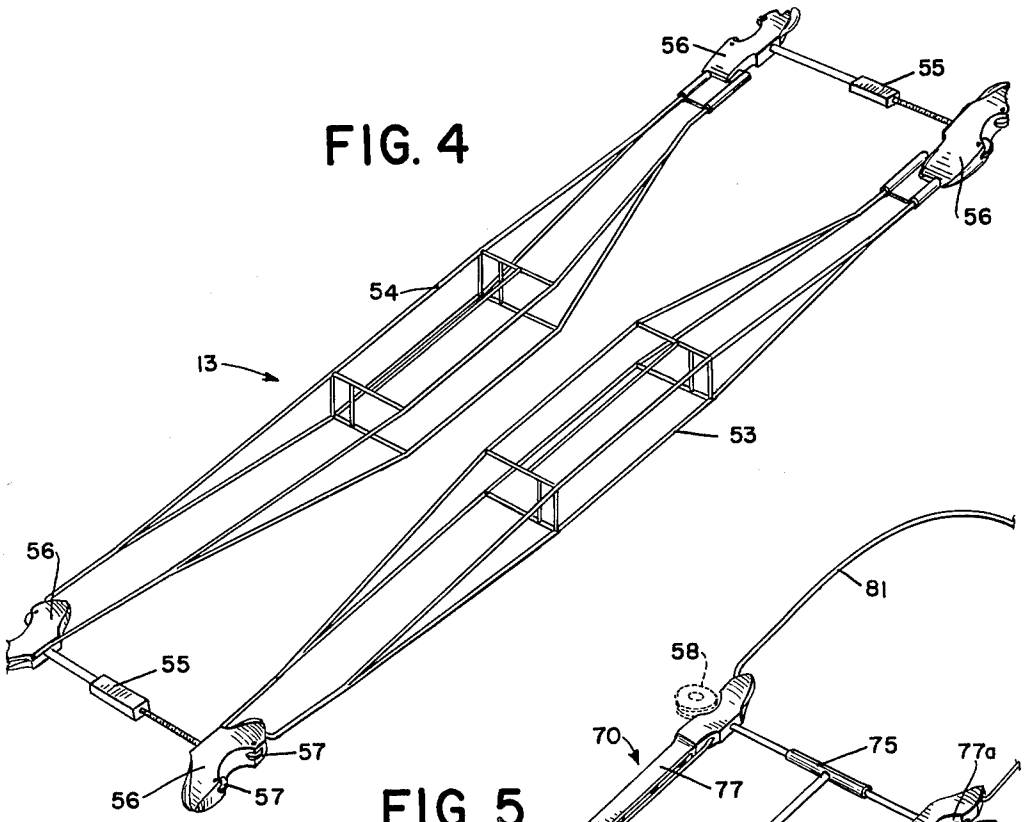
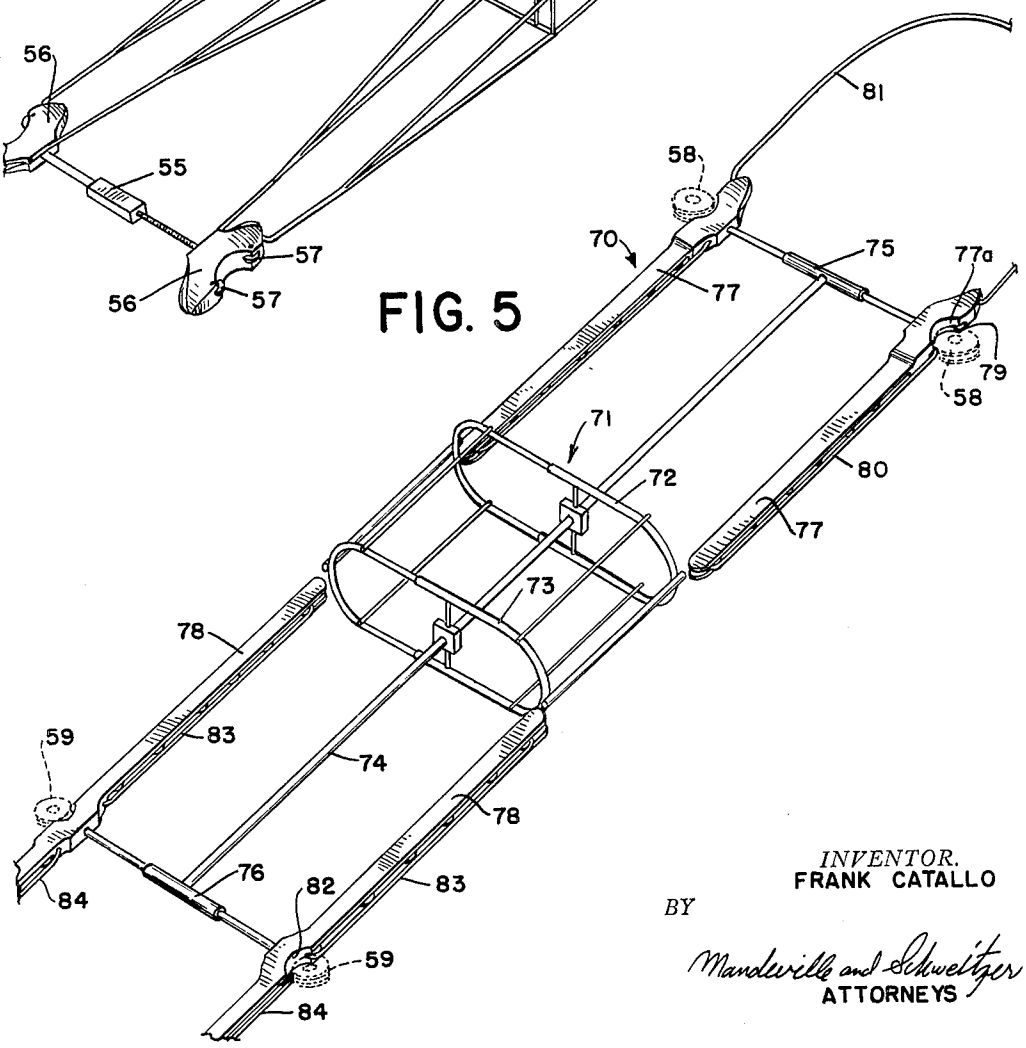


FIG. 5



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DRYING OF FABRICS

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10 Claims. (Cl. 34—21)

The present invention relates to the treatment of fabrics, and more particularly to improved method and means for drying and treating tubular knitted fabrics. Although the invention is not thus limited, it is particularly advantageous in connection with the drying and treating of tubular knit wool fabrics, where it is advantageous to maintain the fabric under tension during the treatment.

In connection with the drying of fabrics, such as tubular knit goods, it has been proposed heretofore to convey tubular material through a treatment zone, in which the material is expanded to form a tube and air is directed into the interior of the tube at one area and caused to flow out of the tube at another area, the air thus flowing picking up moisture from the fabric and carrying the moisture away to be exhausted, precipitated, etc. The present invention involves the treatment of tubular fabric in this known, general way, but in a manner which is novel and substantially improved in several more specific respects, all to the end that the drying and treating of tubular knitted fabric may be carried out more expeditiously and with substantially greater efficiency.

In accordance with one aspect of the invention, tubular knit fabric is conveyed through a treating zone, in which the material is expanded to form a hollow tube, the treating zone being divided into smaller zones which, for ease of reference, may be referred to herein as pre-heating, drying, and post-heating zones. The drying zone is located between the pre-heating and post-heating zones and contains air under pressure which is caused to flow "radially" into the tube of material as it is conveyed through the treating zone. The air thus entering the tube of fabric is caused to flow axially in both directions, and is caused to flow out of the fabric in the pre-heating and post-heating zones. The improved arrangement results in a superior and more efficient drying of the material and also provides for an advantageous "ballooning" of the fabric tube on both sides of the drying zone.

In accordance with one of the more specific aspects of the invention, the material being conveyed through the drying zone is subjected to the action of discrete, relatively high velocity streams of air directed generally normal to the surface of the material so as to pass readily through the walls of the tube. In the pre-heating and post-heating zones, however, the air is allowed to flow generally uniformly out through the walls of the fabric, over the entire surface thereof exposed in the zones. Advantageously, the fabric tube is substantially closed at the outer ends of the pre-heating and post-heating zones, so that these zones have rather finite limits.

The method and apparatus of the invention are particularly useful in connection with the drying and treating of tubular knit woolen fabrics, where it is desired to maintain the woolen fabric under longitudinal tension during the treating procedure. To this end, the apparatus of the invention incorporates controllably driven means, in front of and behind the drying zone, for advancing the fabric on opposite sides of the drying zone at independently controllable speeds. Most advantageously, the advancing means comprises pairs of sealing rollers serving to close off the outer ends of the pre-heating and post-heating zones and also having driving engagement with the fabric tube substantially across its

width. The pairs of sealing rollers are connected for variable speed operation, relative to each other, so that the exit side rollers may be driven at a slightly higher speed than the entry side rollers, for example, to place the fabric tube under desired longitudinal tension.

In the improved apparatus, the treating zone is formed by a housing, which is divided by walls or baffles to form the pre-heating, drying, and post-heating zones, as described. A spreader extends throughout the treating zone and, advantageously, projects outwardly of each end thereof. The tubular fabric conveyed toward the treating zone may be in rope or flat form and is opened out to form an expanded tube as the fabric enters the pre-heating zone. The tube is maintained in an open condition substantially throughout the entire treating zone but advantageously is closed at the entry and exit sides of the zone.

The above and other advantageous features of the invention may be better understood upon reference to the following detailed specification and to the accompanying drawing, in which:

FIG. 1 is a longitudinal, cross-sectional view of a treating apparatus incorporating features of the invention and adapted especially for carrying out the new method;

FIGS. 2 and 3 are cross-sectional views taken generally along lines 2—2, 3—3 of FIG. 1;

FIG. 4 is a perspective view of a fabric spreading device incorporated in the apparatus of FIG. 1; and

FIG. 5 is a perspective view of an alternative form of spreading device which may be incorporated in the new apparatus.

In accordance with the invention, tubular fabric, such as tubular knitted wool fabric, which is usually though not necessarily in rope form, is conveyed successively through a pre-heating zone **10**, a drying zone **11**, and a post-heating zone **12**, the zones **10–12** collectively forming a treating zone. Within the zone, the fabric is passed over a spreader **13** which opens up the fabric tube, forming an enlarged internal passage therein. The fabric tube passing through the drying zone **11** is subjected to the action of air under pressure, which causes streams of air to flow into the interior of the fabric, through the walls of the opened tube. The air thus directed into the interior of the tube flows generally axially, in both directions, into the portions of the tube lying within the pre-heating and post-heating zones **10**, **12**. In the zones **10**, **12** the air pressure within the fabric tube is greater than that surrounding the tube, so that air flows outwardly through the walls of the tube and into the surrounding areas of the chamber.

As illustrated in FIG. 1, the fabric tube lying within the pre-heating and post-heating zones **10**, **12** is unconfined, externally, and therefore tends to balloon out, as indicated at **14**, **15**, under the influence of the higher pressure air within the tube.

Advantageously, the fabric tube is substantially closed off at each end of the treating zone, so that substantially the entire volume of air entering the fabric tube within the drying zone **11** must pass out through the walls of the tube in the pre-heating and post-heating zones **10**, **12**. In addition, the zones **10**, **12** are provided with outlet openings only at the ends so that air flowing into these zones, through the walls of the fabric tube, must flow in a generally axial direction, about the fabric tube, to reach the ends of the zone.

At least part of the air flowing out of the pre-heating and post-heating zones **10**, **12** may be heated and recirculated through the fabric. The remaining portion of the air may be dispelled to the atmosphere through suitable exhaust duct means. Advantageously, the respective portions of the air which are recirculated and exhausted

may be varied to provide for maximum operating efficiency under a variety of circumstances.

The apparatus of the invention advantageously comprises a housing generally designated by the numeral **16**, which is divided into upper and lower portions **17**, **18** by horizontal baffle plates **19**, **20**. The housing **16** may be of generally rectangular form, and the upper portion thereof is closed by cover members **21**, **22** hinged at **23**, **24** to vertical walls **25**, **26** of the housing structure. The upper portion **17** of the housing, in general, constitutes a treating zone and is divided by the vertical walls **25**, **26** to form the pre-heating zone **10**, drying zone **11** and post-heating zone **12**.

Advantageously, the upper walls of the pre-heating and post-heating zones **10**, **12** are formed by baffle plates **27**, **28** which extend generally horizontal and slightly downward from the vertical walls **25**, **26** and which have downwardly curved outer end portions **29**, **30** forming, in effect the ends of the respective chambers. The end portions **29**, **30** of the baffles are spaced inwardly from the end walls **31**, **32** of the covers **21**, **22** to provide passages into the spaces above the baffles. These spaces communicate with openings **33** in the vertical walls **25**, **26** leading into an exhaust duct **34**. As shown in FIG. 3, the exhaust passages formed by the baffles **27**, **28** are defined in part by internal vertical walls **35**, **36**, which converge toward the outlet openings **33** to provide for more efficient air flow. The outlet openings **33** may be adjustably restricted by means of sliding plates **37**, and a fan **38** may also be provided in the exhaust duct **34** to provide further control over the quantities of air flowing through the exhaust system.

The heating chamber **11**, which is located between the vertical walls **25**, **26**, is separated from the exhaust duct **34** by a horizontal plate **39**, which extends substantially from one side to the other of the housing **16**. The bottom of the chamber is substantially closed off by a plate **40**, as shown in FIG. 2, an opening **41** being provided at one side, however, through which the chamber **11** is connected to the outlet of an air blower **42**.

In accordance with one of the specific aspects of the invention, the chamber **11** is provided with a series of ring-like or tubular sections **43**, which are of oval outline, as shown in FIG. 2, and which are of generally channel-shaped cross-section, as shown in FIG. 1. The tubular members **43** are arranged in a series, in axial alignment, and extend, as a series, from one end to the other of the drying chamber. The individual tubular members **43** are spaced from each other, and the series thereof is supported by means of axially disposed structural elements **44**. The arrangement is such that narrow spaces are defined between the flange portions **45** of the adjacent pairs of tubular members. These spaces form, in effect, nozzles through which air under pressure in the area surrounding the tubular members is discharged at relatively high velocity into the generally tubular open space formed by the series of members. Thus, when the outer portion of the chamber **11** is supplied with air under pressure by the blower **42**, relatively high velocity streams of air of a more or less discrete nature are issued between pairs of tubular members.

As shown in FIG. 1, the lower portion **18** of the housing is divided by vertical walls **46**, **47** and heater assemblies **48**, **49** into three chambers. The end chambers are in communication with the pre-heating and post-heating chambers **10**, **12**, through openings **50**, **51**, while the central chamber is in communication with the inlet **52** of the air blower. The end chambers are also in communication with the center chamber through the heater assemblies **48**, **49**. Accordingly, when the blower **42** is in operation, air is drawn from the pre-heating and post-heating zones **10**, **12** into the end chambers, through the heaters **48**, **49** and into the blower **42**. In this manner, air drawn from the zones **10**, **12** is reheated and discharged into the drying zone **11**.

The spreader **13** advantageously is of such length as to extend throughout the entire housing **16** and to project a short distance from each end of the housing. The spreader shown to be incorporated in the apparatus of FIG. 1 is illustrated in greater detail in FIG. 4 and is comprised of a pair of beamlike sections **53**, **54** connected at their ends by adjustable spacers **55**. The beam sections **53**, **54** are of open construction and are relatively flat at the ends while having center portions of substantially increased thickness. The beam sections may also be shaped to diverge progressively toward the outer ends thereof, whereby the assembled spreader structure has a substantially uniform girth throughout its length. At the opposite ends of each of the beam structures **53**, **54** is a recessed journal block **56**, in which are mounted rollers **57**. Each journal block has a pair of the rollers **57**, which are freely rotatable, and these rollers are adapted to be engaged by pairs of driven edge rolls **58**, **59** located outside of the housing **16**. The edge rolls **58**, **59** are grooved to receive the rollers **57**, so that the spreader structure may be supported and locked in position by the driven rollers.

As shown best in FIG. 1, the flat end portions of the spreader **13** extend inward from the driven edge rolls **58**, **59**, substantially to the ends of the pre-heating and post-heating chambers **10**, **12**. Mounted above and below the flat portions of the spreader, at each end, are pairs of driven sealing rollers **60***a*, **60***b* and **61***a*, **61***b*. The rollers **60***b*, **61***b* may be journaled in fixed positions on the housing structure, while the upper rollers **60***a*, **61***a* may be carried by the hinged covers **21**, **22**. Normally, when the covers **21**, **22** are in the positions illustrated in full lines in FIG. 1 the sealing rollers **60**, **61** are spaced apart a distance not substantially greater than the thickness of the spreader **13**.

Advantageously, the driven sealing rollers are provided with spaced grooves or recesses for receiving the extending end portions of the spreader frame. Thus, the spreader frame is accommodated by the rollers, which are at the same time able to be brought substantially into contacting relation, in order to have gripping engagement with the fabric passing over the spreader frame. In accordance with one aspect of the invention, the rollers **60**, **61** (as well as the driven edge rolls **58**, **59**) are arranged to be driven at controlled, related speeds, by a suitable variable drive mechanism indicated schematically in FIG. 1. The arrangement is such that the edge rolls **58** and sealing rolls **60** may be set to operate at a first predetermined speed, while the sealing rolls **61** and the edge rolls **59** may be set to operate at a slightly faster speed, for example, in order to maintain the fabric tube under a predetermined degree of longitudinal tension, where desired. This is particularly advantageous in connection with the processing of knitted woolen fabrics, for example.

In the operation of the apparatus, moist tubular fabric, which may be in rope form, is applied over the spreader **13**, being engaged at its edges by the edge rolls **58**, **59** and being passed between the pairs of driven sealing rollers **60**, **61**. Fabric is drawn through the apparatus by the rolls **58**, **59**, while air under pressure is supplied to the drying zone **11** by operation of the blower **42**.

As the fabric is conveyed through the housing **16**, the tube is opened by the spreader **13**, at least during its passage through the drying zone **11**. Heated air under pressure is discharged in discrete, relatively high velocity streams, through the nozzles formed by the tubular sections **43**, and passes through the walls of the fabric tube, into the interior of the tube. Some of the moisture of the fabric is picked up by the air as it passes into the tube, as will be understood.

Air flowing into the fabric tube, in the drying zone **11**, tends to flow axially in both directions, into the pre-heating and post-heating zones **10**, **12**. If desired, suitable adjustable baffle means may be carried by the spreader frame, at spaced positions corresponding generally to the

ends of the drying zone, to permit desired variation in the relative proportions of air flow into the pre-heating and post-heating zones.

Air flowing into the pre-heating zone **10** balloons the fabric in the manner shown in FIG. 1 and passes outwardly through the walls of the tube, as illustrated. This serves to pre-heat the fabric approaching the drying zone **11**, as well as to remove some of the moisture therefrom. The air thus entering the preheating zone **10** flows axially, about the fabric tube, to the end of the pre-heating zone, where the air flow is divided, part of the air being exhausted through the outlet **33** and duct **34** and part of the air being recirculated through the heater **48** and blower **42** to the drying zone **11**. As will be understood, the driven sealing rollers **60***a*, **60***b* at the entry side of the apparatus effectively close the fabric tube and thereby substantially prevent the axial flow of air through the tube beyond the confines of the housing **16**.

Air flowing axially within the tube toward the post-heating chamber **12** causes ballooning of the fabric being conveyed through that chamber and passes through the walls of the fabric tube into the chamber area surrounding the fabric. The air then flows axially toward the end of the post-heating chamber and is divided for exhaust flow and recirculation flow in the manner before described. The air flowing forward in the post-heating chamber, through and about the tube of fabric, removes further moisture therefrom. The moisture-laden air is substantially prevented from escaping through the exit opening in the housing by the sealing rollers **61***a*, **61***b*.

In some cases it may be advantageous to use an alternative form of spreading device, as shown in FIG. 5. The alternative spreading device, generally designated by the reference numeral **70**, is provided with means extending into the treating zone for propelling the fabric tube by its edges. The spreader **70** comprises a central body section **71**, which includes axially spaced, adjustable tubular forms **72**, **73** of oval outline. The forms **72**, **73** are mounted on a longitudinal frame member **74**, which is of sufficient length to extend out of the housing **16** at both ends.

Mounted at the ends of the member **74** are cross braces **75**, **76** which adjustably support pairs of longitudinally disposed arms **77**, **78**. The arms **77** at the entry end of the spreader are recessed at **77***a* to receive the grooved, driven edge rolls **58**, idling roller **79** being provided to engage the driven rollers. The arms **77** are also provided with belts **80** which engage the edge rolls **58** and extend along the arms into the housing. A U-shaped opener **81** extends longitudinally from the arms **77** for initially opening incoming material.

The arms **78** at the exit side of the frame are provided with recesses **82** for receiving the edge rolls **59**, and belts **83**, **84** extending in both longitudinal directions from the rolls are driven thereby.

Tubular fabric travelling over the spreader **70** is engaged at its edges by the belts **77**, **83**, **84**, so that propelling force is applied to the fabric substantially throughout the length of the treating zone. The center portion **72** of the frame is positioned within the drying zone **11** of the housing and supports the material as it passes through that zone. The pairs of arms **77**, **78** lie within the pre-heating and post-heating zones **10**, **12**, where the tube of material is ballooned by the out-flowing air.

The specific forms of spreaders shown in FIGS. 4 and 5 have been found to have specific advantages for certain frequently encountered operating conditions. However, it should be apparent that the new method may be carried out successfully with spreaders of other design.

The new method and apparatus are advantageous in that highly efficient drying of tubular material may be carried out in a practical minimum of space. High efficiency in the drying of the material is realized by directing air into an opened tube of fabric intermediate the ends of a treating zone and causing the air to flow axially of the fabric, within the tube, and out through the walls of the tube in pre-heating and post-heating zones. The outflow of air through the fabric, in the pre-heating and post-heating zones, is particularly advantageous in that it results in a ballooning of the material, which imparts thereto desirable characteristics.

It should be understood that the method and apparatus herein specifically illustrated and described are intended to be representative only, as certain changes may be made therein without departing from the clear teachings of the disclosure. Accordingly, reference should be made to the following appended claims in determining the full scope of the invention.

What is claimed is:

1. The method of drying and treating tubular knitted fabric, which comprises

(a) conveying the fabric through a treating zone,

(b) opening the fabric tube within the treating zone by spreading the fabric internally over a substantial length,

(c) directing air in discrete relatively high velocity streams radially into the interior of the opened tube as the tube passes through a drying zone of limited length intermediate the ends of the treating zone,

(d) directing a first portion of the flow of air internally of the fabric tube from the drying zone toward the fabric entrance end of the treating zone and withdrawing the air generally and in a distributed manner through the walls of the tube to effect pre-heating of the fabric travelling toward the drying zone,

(e) directing a second portion of the flow of air internally of the fabric tube from the drying zone toward the fabric exit end of the treating zone and withdrawing the air generally and in a distributed manner through the walls of the tube to effect post-heating of the fabric, and

(f) maintaining the fabric tube substantially flat and closed adjacent the ends of the treating chamber and causing it to balloon within the pre-heating and post-heating zones.

2. The method of claim **1**, in which

(a) air flowing out of the fabric tube in the pre-heating and post-heating zones is caused to flow about the fabric and axially toward the ends of the treating zone.

3. The method of claim **1**, in which

(a) the fabric tube is flattened and substantially closed adjacent the ends of the treating chamber by being caused to pass between sets of rollers.

4. Apparatus for drying tubular knitted fabric, comprising

(a) means forming an enclosed treating zone,

(b) means intermediate the ends of the treating zone forming a drying zone of limited length and dividing the treating zone to form pre-heating and post-heating zones on opposite sides of the drying zone,

(c) means for spreading open the fabric tube within the drying zone,

(d) means for directing air in discrete relatively high velocity streams into the fabric tube within the drying zone,

(e) means for withdrawing air generally and in a distributed manner from the tube in the pre-heating and post-heating zones, and

(f) means at each end of the treating zone defining entrance and exit openings of limited size for the fabric.

5. The apparatus of claim **4**, in which

(a) the means for spreading extends throughout the treating zone, and

(b) portions of the spreading means project outward from the ends of the zone.

6. The apparatus of claim **4**, in which

(a) the drying zone comprises spaced entry-side and exit-side end walls and a tubular structure extend-

ing axially between the end walls and forming a tubular passage,

(b) the tubular structure being of a size to accommodate the axial passage therethrough of the fabric tube.

7. The apparatus of claim 6, in which

(a) the tubular structure is comprised of a plurality of axially disposed tubular sections of short axial length,

(b) the sections being substantially imperforate and being positioned axially end to end with predetermined axial spaces therebetween forming slots for the discharge of air radially inward in discrete, relatively high velocity streams.

8. The apparatus of claim 6, in which

(a) the treating zone comprises a substantially enclosed chamber having air outlet openings adjacent each end, and

(b) a blower is arranged with its outlet in communication with the drying chamber and with its inlet in communciation with the chamber outlet openings,

(c) said outlet openings being small in relation to the length of said pre-heating and post-heating zones, whereby air is caused to flow longitudinally over the exterior of the fabric tube in said zones.

9. The apparatus of claim 4, in which

(a) the spreading means includes means on opposite sides of said drying zone for engaging the fabric tube, and

(b) variable drive means are provided for the fabric engaging means,

(c) whereby the fabric tube may be maintained under predetermined longitudinal tension during drying.

10. The apparatus of claim 9, in which

(a) the fabric engaging means comprise pairs of driven rollers,

(b) said rollers engaging the fabric tube at the ends of the treating zone and serving additionally to close the tube.

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