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Frezza

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[54] **APPARATUS FOR DISTENDING AND HEAT-TREATING TUBULAR KNITTED FABRIC**

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[52] **U.S. Cl.** ..... **26/56,** 26/55 WC

[51] **Int. Cl.** **D06c 5/00**

[58] **Field of Search** ..... 26/55 R, 55 WC, 56

[56] **References Cited**

UNITED STATES PATENTS

3,257,735 6/1966 Catallo ..... 26/56 X

Primary Examiner—Robert R. Mackey

Attorney—Hubert T. Mandeville et al.

[57] **ABSTRACT**

Apparatus is provided for heat treating knitted fabric in tubular form, particularly synthetics in a manner whereby contact marks or lines on the internal surfaces of such fabric are substantially avoided by the utilization of a frame configuration for the spreader therefor which eliminates continuous horizontal contact with the internal surface of the fabric during treatment with a spreader; the spreader comprised of a series of criss-cross connected frames which present only a series of sequential contact areas against the internal surface of the fabric. In addition, cooling means are provided in combination with the heat treating apparatus for defining the end of the heat treating zone. Also included herewith is an arrangement for selectively delivering the heat treated fabric in a tubular form or an open width form, and for accommodating either a pre-dyeing step or a post-dyeing step in tubular form.

7 Claims, 4 Drawing Figures

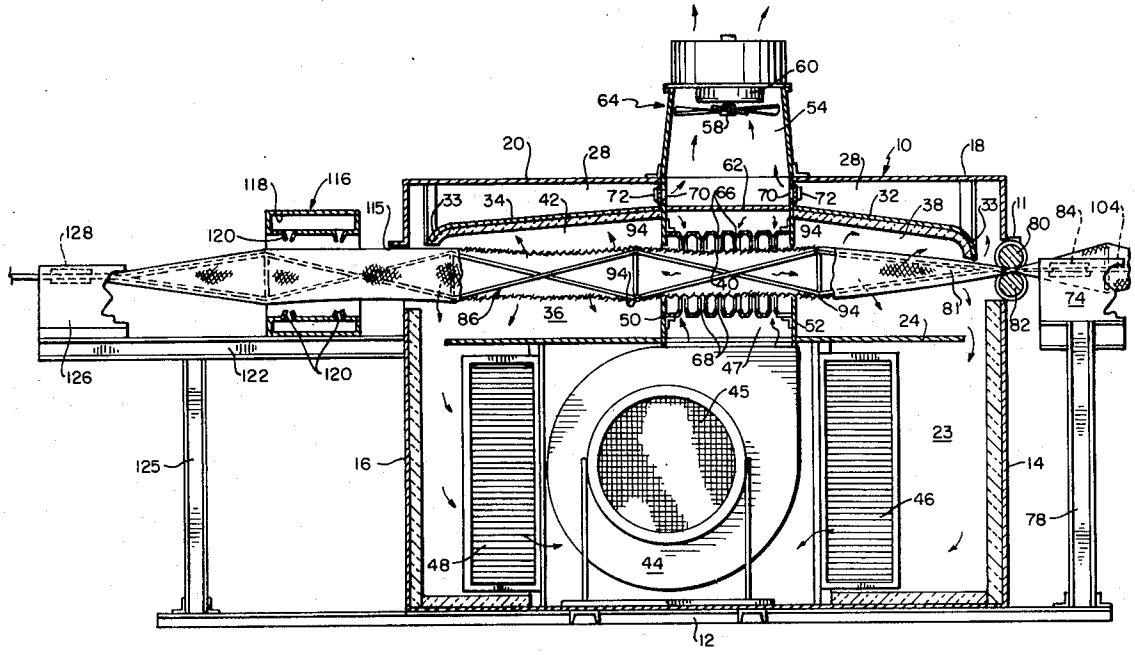
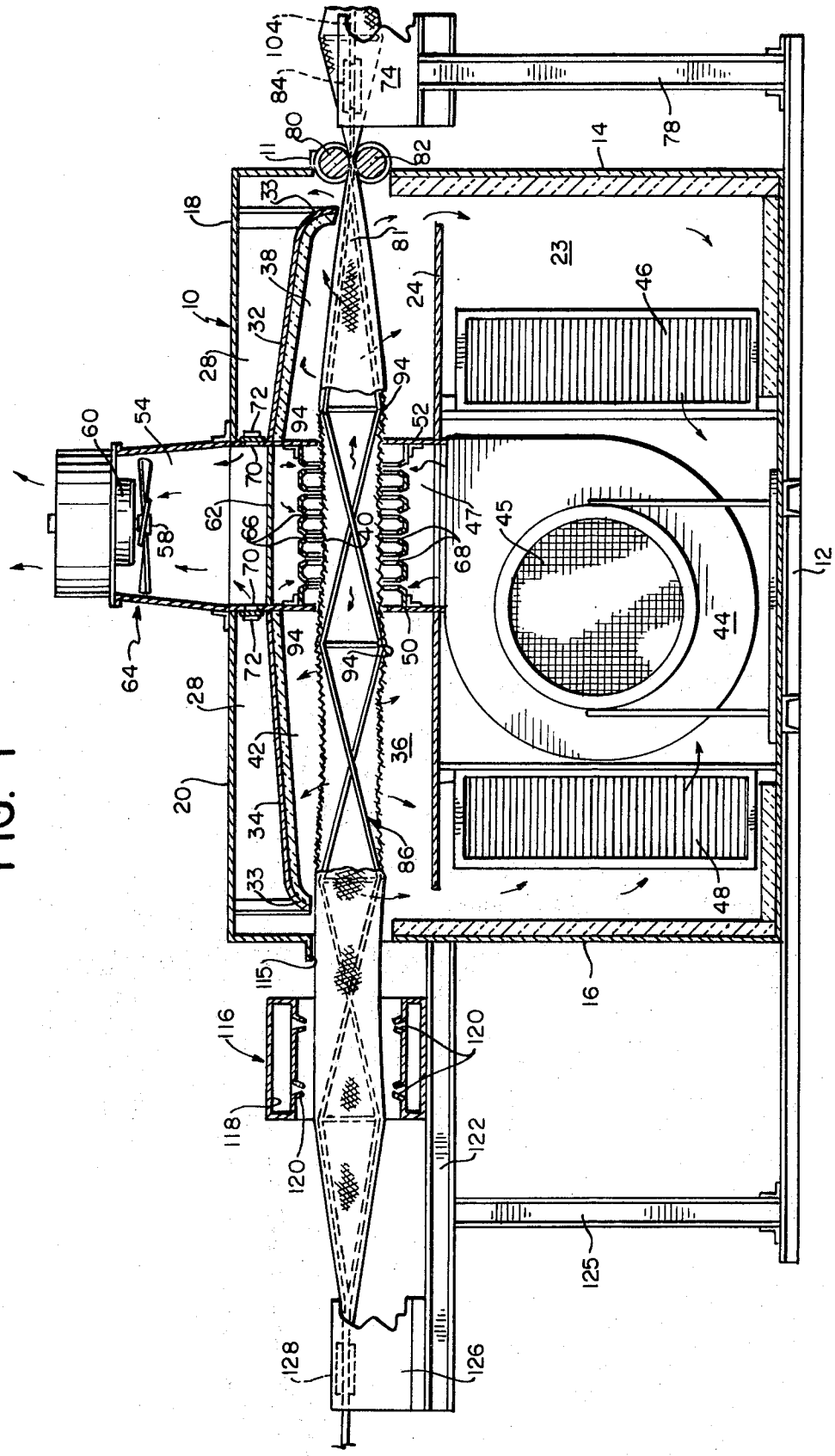


FIG. 1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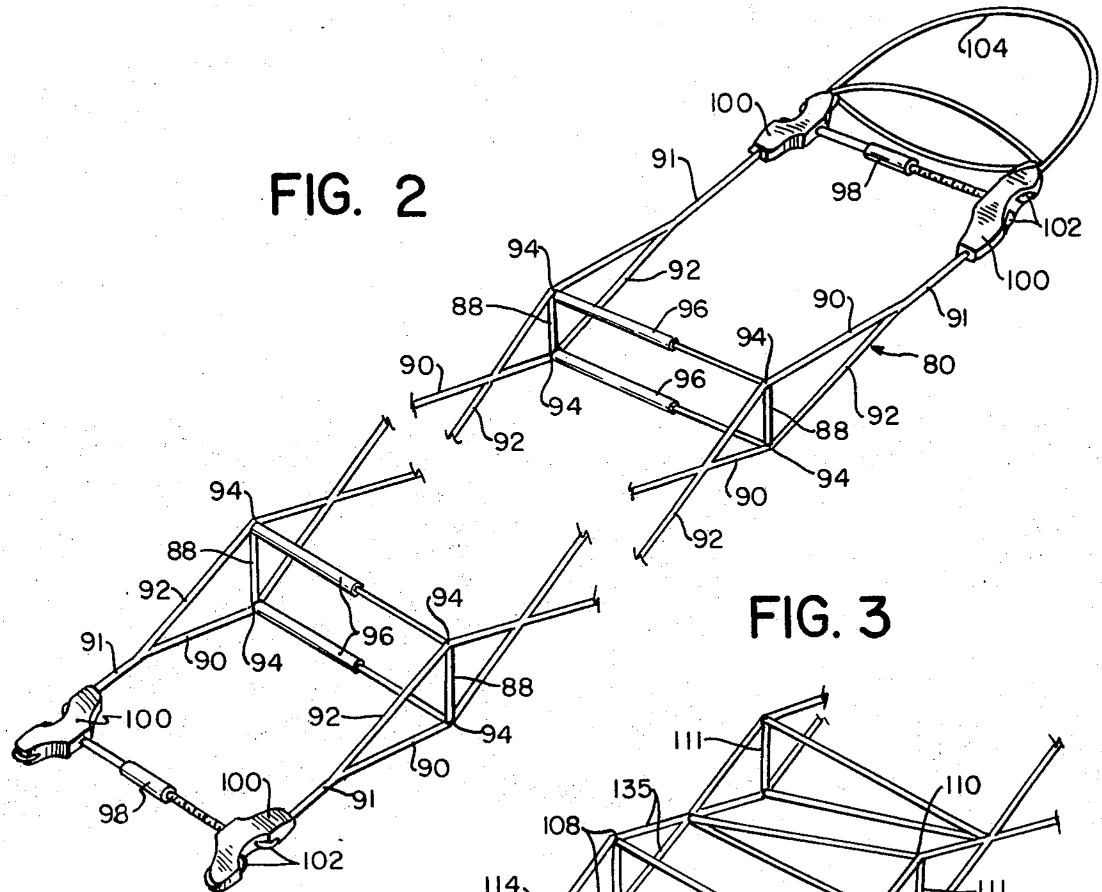
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FIG. 2

FIG. 3

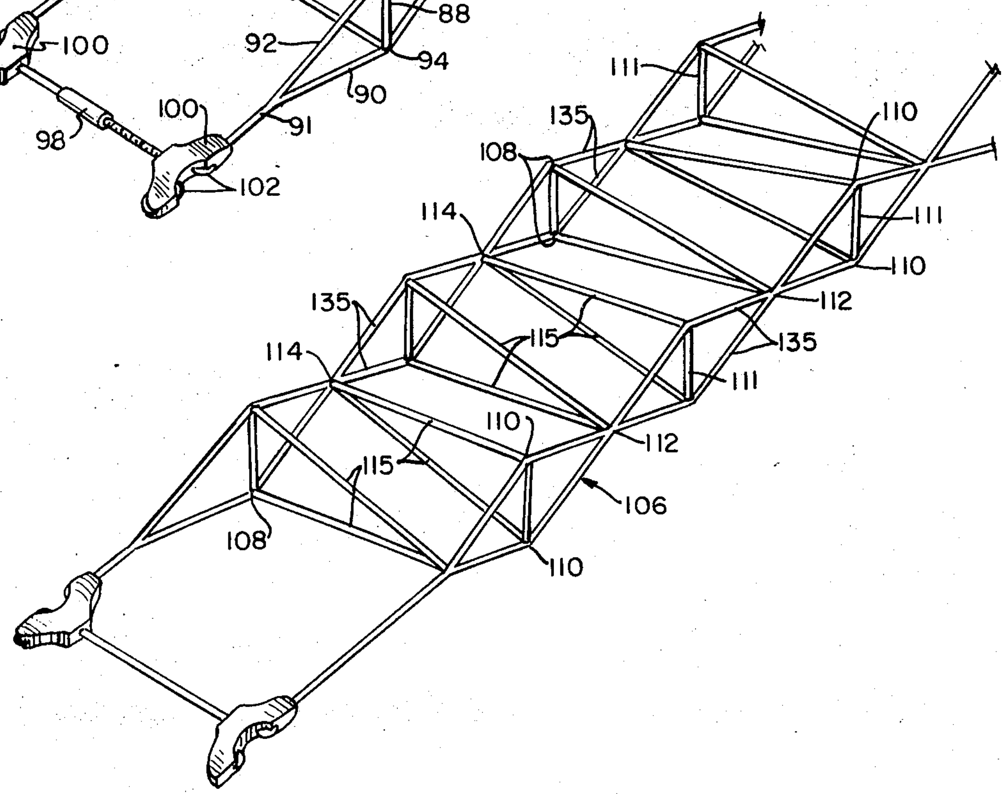
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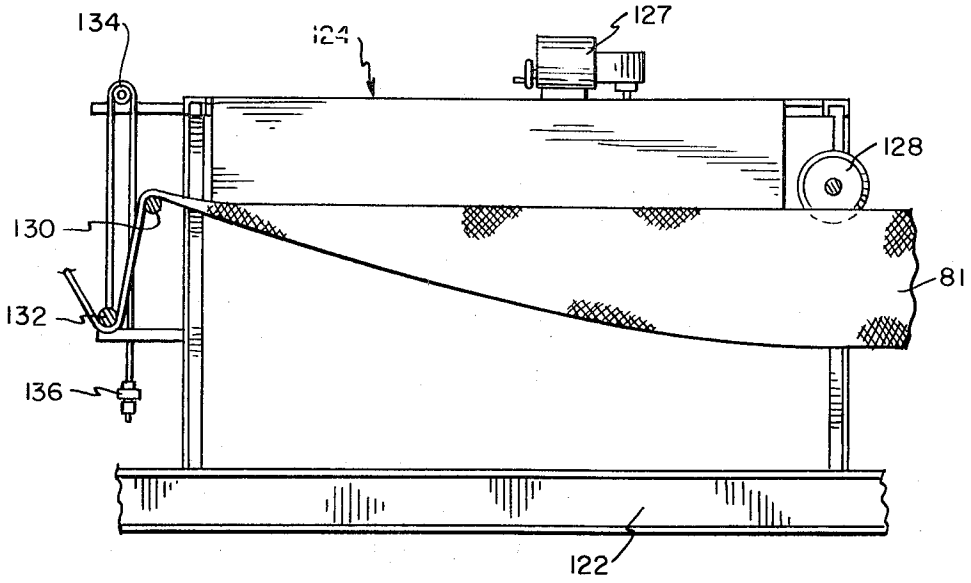
FIG. 4



APPARATUS FOR DISTENDING AND HEAT-TREATING TUBULAR KNITTED FABRIC

Generally speaking, this invention relates to methods and apparatus for the heat treatment of fabrics. More particularly, this invention relates to methods and apparatus for heat treating tubular knitted fabrics, including those comprised of synthetic fibers in which the tubular knitted fabric is heat treated in a form appropriate for subsequent use, and with the methods and apparatus herein eliminating substantially the contact lines usually associated with the heat treatment of such fabrics by the utilization of an arrangement of spreader in the treating zone of such apparatus which presents only sequential intermittent contact against the internal surface of the tubular knitted fabric as it proceeds through the apparatus.

As will be understood, the utilization of heat treatment for tubular knitted fabrics has been carried out for some time, especially for providing drying of such fabrics subsequent to previous moisture impregnating steps such as the application of steam, dye or "no press" resins with the heat treating usually being utilized for removing such moisture while the tubular knitted fabric is held in its tubular distended form as desired so as to provide a final product either in tubular form or open width form which retains its desired distended characteristics. As will be understood, further, in commercial operations, many yards of such tubular fabric may be processed in a single production run, and, as is obvious if contact marks have been imparted to the fabric edges, then the commercial value of the fabric is reduced because that portion of the fabric with marks must be either cut off or not used in garment manufacture.

Further, with the advent of synthetic fibers, such problems as the avoidance of marks during processing of tubular knitted fabric comprised of such synthetic fibers became even more difficult because the heat treating operations serve to actually set permanently the marks into the synthetic tubular knitted fabric. Because of the nature of synthetics, such as polyesters or nylon, for example, the application of heat in many instances affects to differing degrees the molecular structure of the fibers of such fabrics thus causing a much more severe problem when the tubular knitted fabric in synthetic form is processed through machinery and comes into contact with the various parts of that machinery. Thus, as will be understood, the cost factors in processing synthetic fibers, in particular, can be seriously affected by the manner in which such fabrics comprised of such fibers are handled, particularly in those instances where an entire production run may be carried out entirely automatically, and defects of this nature are not discovered until a substantial portion of the run is completed.

Certain other problems may arise in the heat treating of fabrics as discussed herein particularly with respect to heat treatment in conjunction with dyeing of the fabric. As will be understood, it may be appropriate to dye the fabric after heat treatment because such sequence of operations minimizes cracking of the dyed surface which takes place if heat is applied after the dyeing procedure. However, in the past, heat setting in tubular form applied undesirable contact marks to the internal surfaces of the tubular fabric to a degree making it undesirable to subsequently dye the fabric. Thus, it is

common practice to heat set the fabric in open width form and thereafter dye the fabric. Dyeing the fabric in open width form, however, presents certain problems in handling and it is much more effective and easier to be able to dye the fabric in tubular form.

In certain other instances, it may be appropriate to heat treat the fabric after it has been dyed, such as in those cases where the fabric is yarn dyed prior to knitting or in those instances where the fabric is piece-dyed for delivery to customers who desire a sequence of lengths of the same fabric of different colors delivered in tubular form. Also, it may be appropriate in certain instances to deliver the tubular knitted fabric to a customer in open width form.

In those instances where it is appropriate and desirable to deliver the fabric in open width form to a customer, in the past, such fabrics were set in open width form and such procedures may cause certain difficulties in that the fabric is not appropriately spread in all directions thus causing the application of set edges along the fabric extent, thus seriously affecting the use of the fabric for later application. On the other hand, in those instances where it was desired to obtain the fabric delivered in tubular form, certain problems arose in the past in that the heat treating procedures, because of the contact with the internal surface of the tube of the fabric, applied thereto undesirable marks.

Thus, the problem arises where in order to take advantage of heat treating fabric delivered in tubular form for easier handling during a subsequent dyeing procedure, the prior heat treating procedures were such as to affect the appropriateness for later use of the tubular fabric. The previous application of marks during the heat treating procedures in tubular form, reduced the value of the relatively easier handling of tubular fabrics during the subsequent dyeing procedure.

The same kind of a problem arises if dyeing is applied prior to heat treating in order to minimize the cracking of the dyed surface, because the subsequent heat treating procedures set final creases in the fabric thus making it undesirable from a commercial standpoint. Accordingly, whether or not the fabric was to be delivered finally in dyed or undyed form, it became appropriate from an economic standpoint to heat treat the fabric in open width form and deliver it in that form. This served to eliminate the usual marks applied to such fabric in such heat treating procedures even though, in many instances, it might be more practical from a labor and machinery cost standpoint in subsequent handling to deliver the fabric in tubular form from a heat treating operation.

By contrast, and quite unexpectedly, it has now been found in accordance with this invention that the advantages of heat treating tubular knitted fabrics in tubular form can be utilized for subsequent handling in tubular form. This is accomplished in the absence of the application of the undesirable contact marking to such tubular fabrics and in a manner whereby the customer can obtain delivery of the fabric either in open width form or tubular form utilizing the appropriateness of heat treating in tubular form, because the setting of the fabric during such treatment is done with the fabric spread in all directions.

The applicant herein has achieved this by utilizing a new spreader configured in a form to handle the tubular knitted fabric during the heat treating operations in a manner whereby contact with the internal surfaces of

the tubular knitted fabric is minimized. The spreader, in accordance herewith, is comprised of a series of cross-cross shaped frames along the longitudinal extent thereof with only the interconnection between the various segments providing sequential intermittent area contact with the internal surfaces of the tubular knitted fabrics being drawn thereover. Thus, there is only sequential area contact with the fabric surface sufficient to maintain the fabric in its spread tubular form as desired, but not to such a degree as to imparts marks to the internal surface of the tubular fabric.

In addition, the contact areas of the spreader frame are arranged to be absent in those areas of the heat treating zone having the highest degree of heat application and lowest distention of the moving fabric tube, thus further minimizing marking. In addition, included with the process herein is a cooling zone placed immediately in sequence after the heat treating zone to stop any further effects of the heat treating zone on the fabric after it exits from such heat treating zone. Further in sequence with the process, in accordance herewith, a cutter arrangement may be placed immediately after the cooling zone in order to deliver the heat treated tubular fabric in open width form, if desired. Obviously, if delivery is desired in tubular form, the cutter sequence can be withdrawn for that particular operation.

Accordingly, it is one object of this invention to provide methods and apparatus for heat treating tubular knitted fabric in a manner whereby contact marks on the internal surfaces thereof are substantially avoided. In addition, it is another object of this invention to heat treat tubular knitted fabric in tubular form in a manner which makes it appropriate for subsequent dyeing operations. It is a further object of this invention to provide methods and apparatus for heat treating tubular knitted fabric which may be delivered after treatment in either tubular or open width form, as desired.

It is a still further object of this invention to provide methods and apparatus for heat setting tubular knitted synthetic fabrics in which the fabrics are handled in such a manner during the heat setting operations that there is substantially no distortion of the fabric surface from contact with the heat treating procedures and apparatus involved.

With the foregoing and additional objects in view, this invention will now be described in more detail, and other objects and advantages thereof will be apparent from the following description, the accompanying drawings, and the appended claims.

Before describing this invention in more detail, it may be well to note that this invention has been found applicable for tubular knitted fabrics comprised of a wide variety of materials including natural fibers, such as wool and cotton, for example, as well as synthetic fibers such as nylon and polyesters, for example.

As purely illustrative of apparatus which may be used for carrying out the process of this invention, one may note the attached drawings in which a tubular knitted fabric dryer is shown with a spreader having a frame consisting of a sequence of criss-crossed segments for providing support for the tubular knitted fabric during its course through the apparatus. In addition, means are provided for supplying heat in a forced manner through the internal cavity formed by the tubular fabric passing through the apparatus, with further means for supplying compressed cooling air against the surfaces of the fabric in order to quench the effects of the heat treating procedure immediately upon exiting of the tubular knitted fabric from the heat treating zone.

IN THE DRAWINGS

FIG. 1 is a longitudinal sectional view of a heat treating apparatus embodying aspects for carrying out this invention;

FIG. 2 is a perspective view of a fabric spreading device incorporated in the apparatus of FIG. 1;

FIG. 3 is a perspective view of an alternative form of spreading device which may be incorporated in the apparatus of FIG. 1; and

FIG. 4 is a somewhat simplified schematic side elevational view of a cutter device which may be incorporated in the apparatus of FIG. 1.

Referring to the drawings, in which like reference characters refer to like parts throughout the several views thereof, a heat treating device is shown designated generally at **10** with heat treating device **10** being defined by upstanding end walls **14** and **16** supported on a base **12.** It should be understood that the general arrangement of heat treating apparatus herein may be selected from any known and applicable prior art device such as, for example, that shown and described in U.S. Pat. No. 3,257,735 to F. Catallo, and reference may be made to that patent for further details of general construction. It should be understood that heat treating device **10** has longitudinal side walls, not shown for clarity, for enclosing the sides of the general heat treating zone **10.** Angled covers **18** and **20** serve to define the top of heat treating device **10** from the ends thereof to a central exhaust tower **64,** to be described below.

Longitudinally extending baffle **24** is disposed in heat treating device **10** to define an air heating area **23** and a heat treating area **36.** As can be seen in FIG. **1,** baffle **24** is in spaced relation from end walls **14** and **16** in order to allow circulation of air therearound. As can be seen in FIG. **1,** further, air is drawn from the heat treating area **36** into air heating zone **23** and through heaters **46** and **48** by the action of air blower **44** drawing the air into the opening **45** thereof. Heaters **46** and **48** may be of any desired design for providing heat transfer surfaces for heating the circulating air such as, for example, direct flame type gas or oil heaters, or radiant type heaters containing heat exchange tubes carrying hot water or stream. Also, electric heaters may be utilized, with the only requirement being that they provide proper heat exchange surfaces for heating the air being circulated by air blower **44.**

Heat treating area **36** is further defined by baffle plates **32** and **34** which extend generally horizontal and slightly downward from vertical walls **50, 52,** and which have downwardly curved outer end portions **33.** The end portions **33** of the baffles are spaced inwardly from the end walls of covers **18** and **20** to provide access to passages **28** above baffles **32, 34.** Passages **28,** in turn, communicate with openings **70** in side walls **50** and **52** which communicate with exhaust tower **64.** Exhaust tower **64** is comprised of a generally circular upstanding portion **54** having exhaust fan **58** disposed therein driven by motor **60** for exhausting a controlled amount of heated air from the heat treating device **10.** Openings **70** are controlled by sliding plates **72** for regulating the amount of air exhausted by exhaust tower **64.** Heat treating chamber **40** is segregated from the exhaust tower **64** by a plate **62.**

As is discussed in the above noted patent to Catallo, heat treating chamber or zone **40** has disposed therein a plurality of spaced-apart oval brackets **66** which are mounted in chamber **40** in spaced relation to define orifices **68** through which heat treating air is forced by the action of air blower **44.**

As can be seen in FIG. **1,** longitudinally extending spreader device **86** is disposed in heat treating device **10** and extends from the right hand entrance end **11** thereof through the left-hand exit end **115** thereof (as shown in FIG. **1**) and through a cooling chamber designated generally at **116.**

The arrangement of the spreader device **86** can be best seen in FIG. **2.** Spreader device **86** is comprised of a series of criss-crossed braces **90** and **92** forming a sequential series of intermittent contact areas **94.** Upper and lower contact areas **94** are connected by vertical braces **88,** extending along the length of the spreader device **86.** At each end of spreader device **86,** the cross bars **90, 92** taper into a single end bar on each side of the spreader device with end bars **91** connected to a pair of recessed journal blocks **100** which are in turn connected by spacers **98.** Each of the journal blocks **100** has a pair of rollers **102** disposed therein, which rollers are rotatable and accommodate side rollers **84** (FIG. **1**) at the entrance end **11** of the heat treating device **10** and rollers **128** at the exit end **115** thereof.

Each pair of contact areas **94** at each end of vertical braces **88** are connected across the width of the spreader device by telescoping members **96** which accommodate the adjustments of the spacers **98** for varying the width of the spreader device **86,** as desired. A U-shaped opener **104** extends longitudinally from the entrance journal blocks **100** for initially opening incoming material.

As can be seen in FIG. **1,** tubular fabric **81** exits from conventional stripe straightener **74** and passes through a pair of spaced-apart entrance rollers **80, 82** into treating device **10.** As is shown in FIG. **1,** stripe straightener **74** is mounted on upstanding support **78** which is in turn mounted on base **12.** Stripe straightener **74** may be of any conventional design such as, for example, that taught in U.S. Pat. No. 2,222,794 to Samuel Cohen, et al. to which reference can be made for further details. Entrance rollers **80, 82** serve to guide the tubular knitted fabric **81** through the entrance end of heat treating device **10** and also to define a somewhat restricted opening for sealing the entrance from the passage of heated air therethrough so that the heated air either is forced into passage **28** or into air heating chamber **23,** without, however, pressing the fabric against the frame bars.

As can be seen in FIG. **1,** vertical walls **50, 52** serve to divide heat treating area **36** into a pre-heat treating zone **38,** a heat treating zone **40** and a post-heating treating zone **42.** It is a feature of this invention that fabric contact areas **94** of spreader device **86** are not disposed within the heat treating zone **40** and are spaced a substantial distance therefrom so that no contact is made on tubular knitted material **81** in the area of most severe heat application. As is obvious further, tubular knitted fabric **81,** as it passes through the heat treating device **10** is only supported and contacted in a sequential intermittent manner along contact areas **94** of spreader device **86** throughout the entire extent of treatment of the tubular knitted fabric **81.**

In this connection, it should be noted, also, that the fabric tube is somewhat less distended in zone **40** under the action of impinging treated air, and the absence of contact in this area, therefore, becomes even more important. Contrasting this, the fabric tube is somewhat more distended or ballooned in zones **38** and **42,** thus reducing contact with areas **94** in those zones. It should be understood, further, that the usual side supporting and driving belts, not shown here for clarity, will be arranged in pairs on each side of the spreader, and will be absent in the area of heat treating zone **40** to reduce, further, and contact in this zone where the fabric is most subject to marking, as well known. This combined arrangement serves to enhance the effect of the arrangement herein, of reducing to a very substantial degree of possibility of marking the fabric.

It is a further feature of this invention that immediately upon exiting from heat treating device **10,** the tubular knitted fabric is exposed to the application of cooling air in cooling device **116.** Circular manifold **118** distributes cooling air to orifices **120** which orifices impinge cooling air against the outer surfaces of the tubular knitted fabric **81.** The cooling air for manifold **118** may be in any appropriate form such as compressed air, for example, obtained from any well-known source such as a compressor and it is within the purview of this invention that the compressed air may be first refrigerated in order to obtain a proper temperature control depending upon the degree of heat applied to the tubular knitted fabric **81** in the heat treating device **10,** the nature of the fabric treated and the speed of treatment. Also, it should be understood that compressed air exiting from orifices **120** is under sufficient pressure in order to provide an air wall-like barrier at exit **115** of heat treating device **10** so as to prevent leakage of heated air from exit **115.**

The left-hand end of spreader device **86,** as viewed in FIG. **1,** may be supported in a bracket device **126** which also supports exit side rollers **128.** If it is desired to have a tubular knitted fabric delivered in tubular form at this point, the tubular knitted fabric as processed may then be wound on an appropriate batcher or folder device, all in well-known manner.

However, if it is desired to have the heat treated tubular knitted fabric **81** delivered in open width form, then end support bracket **126** will be replaced by a cutter arrangement **124** (FIG. **4**) having a circular cutting blade **128** for slitting the tubular knitted fabric **81** into open width form. Cutter **124** may be driven in any known manner such as by motor **127** and is supported on bracket **122,** as is cooling device **116.** Bracket **122** is in turn supported on an upright **125** which is supported on base **12.**

Cutter **124** may be of any known arrangement for cutting tubular knitted fabric into open width form such as, for example, the arrangement taught in U.S. Pat. No. 3,551,969 to E. Cohn et al., which may be referred to for details of a cutting device arrangement. The fabric in open width form leaving cutting device **124** may be arranged to pass over tension rollers **130** and **132** for subsequent wind-up, all in well-known manner. As can be seen in FIG. **4,** tension roller **132** is a dancer roller connected over pulley **134** to a weight **136.**

FIG. **3** is an alternative arrangement **106** of a spreader for use in the heat treating apparatus of FIG. **1** with contact areas **108** on one side thereof alternating

with contact areas **110** on the opposite side thereof. Spreader device **106** is comprised on a series of longitudinally extending bars **135** interconnecting contact areas **108, 110** with alternating low or non-contact areas **114, 112,** respectively. Longitudinally extending bars **135** are arranged with vertical braces **111** in a series of interconnected diamond-shaped frames which are in turn connected at their non-contact areas **114, 112** with the opposite high contact areas **110, 108,** respectively, by cross braces **115.** With such arrangement of the spreader device, tubular knitted fabric passing over such a device is only contacted in alternating intermittent fashion from one side of the spreader device to the other, thus reducing further contact with the internal surfaces of the tubular knitted fabric as it passes through the treating zone.

It should be understood that the arrangement in accordance herewith utilizes a variable drive interconnecting the driving rollers for controlling the feed of the tubular knitted fabric through the treating device herein in a manner to maintain proper tensioning throughout the entire extent thereof by controlling the speed of the entrance rollers in relationship to the speed of the exit rollers all in well-known fashion, and as is described in the above noted Catallo U.S. Pat. No. 3,257,735, which may be referred to for further details.

The arrangement in accordance herewith is particularly appropriate for heat setting tubular knitted synthetic fabrics, such as polyester or nylon, for example, because the fabrics can be delivered in open width form with those fabrics having been heat set in tubular form because the heat setting is done with the fabric spread in all directions, thus eliminating set edges. As is apparent, the sequence of operation in accordance herewith provides for heat setting in tubular form with immediate cooling and thereafter slitting and opening the fabric by conventional apparatus, immediately and in conjunction with the removal of the fabric from the heat setting frame of the heat treating apparatus, in accordance herewith. It should be understood, further, that by placing the cooling device **116** immediately at the exit end of the heat treating device **10** and extending the spreader frame **86** (or **106**) through the cooling device **116,** the tubular knitted fabric is heat set and cooled in its desired spread form.

In operation, as can be seen in FIG. **1,** heated air is forced by air blower **44** into plenum chamber **47** around oval rings **66.** The heated forced air is then forced through orifices **68** and through the interstices in the surface of the tubular knitted fabric **81** where the air passes longitudinally in both directions internally of the spread tubular knitted fabric and outwardly through interstices at each end of spreader frame **86,** as shown by the arrows in FIG. **1.** It is within the purview of this invention, further, that live steam may be injected into plenum chamber **47** for aiding in heat transfer against the surface of the tubular knitted fabric **81,** particularly when synthetic fibers are used for making fabric **81,** which brings about more rapid heat-setting of the synthetic fabrics. After the air passes back through the tubular knitted fabric in preheating zone **38** and postheating zone **42,** a portion of the air may pass into passage **28** where it is drawn by fan **58** out through the top of exhaust tower **64.** Another portion of the air will be recirculated back into air heating chamber **23** where it passes in heat exchange fashion through heaters **46** and **48** to be drawn into the entrance **45** of air blower **44.** 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.

Accordingly, and as will be apparent from the foregoing, there are provided in accordance herewith, methods and apparatus for heat treating tubular knitted fabrics, and particularly for heat setting synthetic fabrics such as polyesters or nylon, for example, in a manner whereby contact marks on the internal surfaces of such tubular knitted fabric are substantially avoided during such heat treating and/or heat setting. This is achieved by the utilization of a unique frame configuration for a spreader in the heat treating and/or heat setting zone therefor which frame reduces substantially the contact along the longitudinal extent of the fabric being treated. In addition, cooling arrangements are provided in combination with the heat treating methods and apparatus, in accordance herewith, for defining the end of the heat treating zone and for quenching the effects of the heat treatment while the fabric being treated is spread in appropriate fashion.

Moreover, the arrangements, in accordance herewith, provide for delivery of the treated fabric in either tubular or open width form, as desired, and either before or after dyeing, thus making the invention here particularly appropriate for a variety of production techniques and the products obtained therefrom highly advantageous commercially.

While the methods and apparatus herein disclosed form preferred embodiments of this invention, this invention is not limited to those specific methods and apparatus, and changes can be made therein without departing from the scope of this invention which is defined in the appended claims.

What is claimed is:

1. In apparatus for heat treating tubular knitted fabric and having a heat treating chamber with an entrance opening and an exit opening for said fabric and means for conveying said fabric through said chamber; a blower in said chamber for forcing treating air into and through the tubular knitted fabric conveyed therethrough; baffle means in said chamber for controllably directing said treating air against the fabric to be treated; and a source of heat for heating said treating air; the combination which comprises a spreader disposed in said chamber along the flow path of said fabric to be treated for engaging said fabric and distending it into tubular distended form; said spreader extending longitudinally along said chamber and through the entrance and exit openings thereof, and comprised of a plurality of segments placed end to end therealong; and with each of said segments being comprised of pairs of bars defining the sides of said spreader, and a plurality of braces connecting said sides; the interconnection between each of said segments defining upper and lower intermittent contact areas of said spreader, with said upper contact areas and said lower contact areas defining substantially the upper and lower extent of distention of and contact with said fabric to be treated; and a source of cooling air disposed adjacent said exit opening for impinging said fabric to be treated; said spreader extending through said source of cooling air.

2. Apparatus as recited in claim **1,** in which said bars forming the sides of said spreader are disposed in mirror fashion to define said upper and lower contact areas in equal spaced relationship therealong.

3. Apparatus as recited in claim 1, in which said bars defining the sides of said spreader are disposed in alternating fashion along said sides to define said upper and lower contact areas which alternate between said sides; and with said plurality of braces connecting said upper and lower contact areas of one side of said spreader with an intermediate point between said upper and lower contact areas on the opposite side thereof.

4. Apparatus as recited in claim 1, in which said source of cooling air includes a manifold disposed around said spreader frame and cooling air impinging means connected to said manifold for impinging the surface of said fabric as it passes through said manifold, and for providing an air curtain preventing said heat treating air from passing through said exit opening.

5. Apparatus as recited in claim 1, which also includes a fabric cutter disposed adjacent the exit end of said spreader for slitting the treated tubular fabric into open width form.

6. Apparatus as recited in claim 1, in which each of said braces are telescopingly adjustable for adjusting the width of said spreader.

7. Apparatus as recited in claim 1, in which said fabric contact areas are absent on that portion of the said spreader extending through the path of the heat treating air impinging against the fabric to be treated.

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