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Stang

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[45] **May 20, 1975**

[54] **DRYING MACHINE FOR TEXTILE FABRIC WEBS**

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[21] Appl. No.: **423,763**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 208,713, Dec. 16, 1971.

[52] **U.S. Cl.** **34/153;** 28/62; 242/47.09

[51] **Int. Cl.** **F26b 13/12**

[58] **Field of Search** ..... 34/153; 242/47.01, 47.08, 242/47.09; 26/18 K, 51.3, 51.4, 63, 68; 28/61, 62

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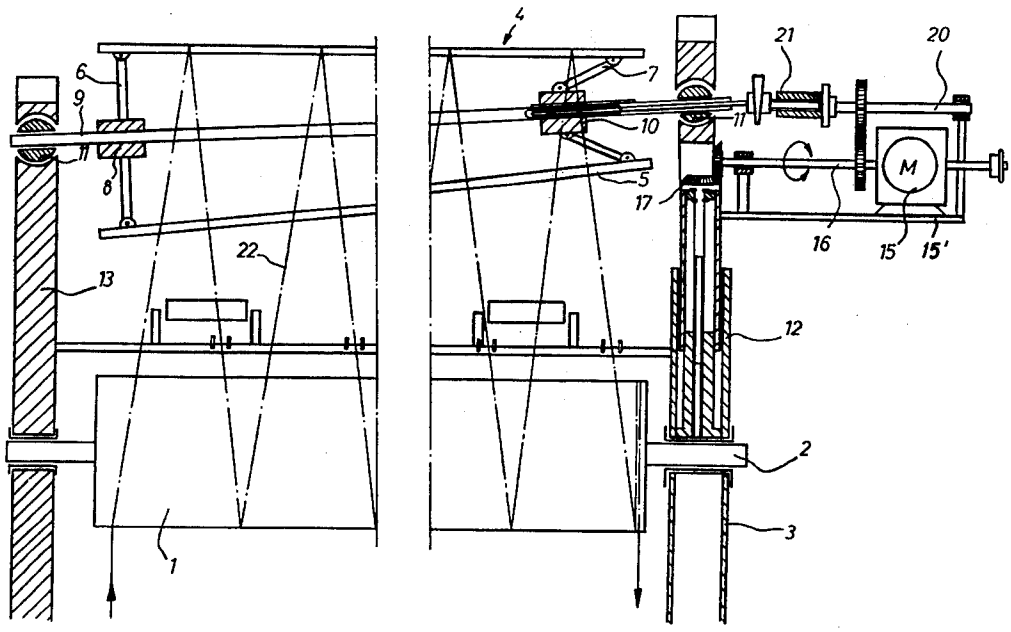
Primary Examiner—Charles J. Myhre
Assistant Examiner—Paul Devinsky
Attorney, Agent, or Firm—Robert W. Beach; R. M. Van Winkle

[57] **ABSTRACT**

A band of textile fabric is spirally wound around the remote peripheral portions of a drying cylinder and a guide roller and tensioned between them to the desired degree to effect stretching or permit shrinking of the band. The guide roller periphery is defined by circumferentially spaced rods connected by pivotably connected struts to a hub carried on and slidable along the roller axle. An adjusting motor connected by mechanical linkage to the hub effects displacement to change the angle of inclination of the struts relative to the axis and thereby to effect or change conicity of the roller to adjust tension on the band. Alternatively, the struts may be fluid-operated jacks which are variable in length. Mechanism including a tension sensor actuates the motor to correct changes in tension. The roller axle is tiltable conjointly with changes in conicity to maintain the upper peripheral portion parallel to the drying cylinder. If the rods are segmented, pivotably connected together and each segment is provided with its own strut and hub support, various combinations of conicity and cylindricity can be obtained along the roller length for different stretching and shrinking requirements.

7 Claims, 9 Drawing Figures



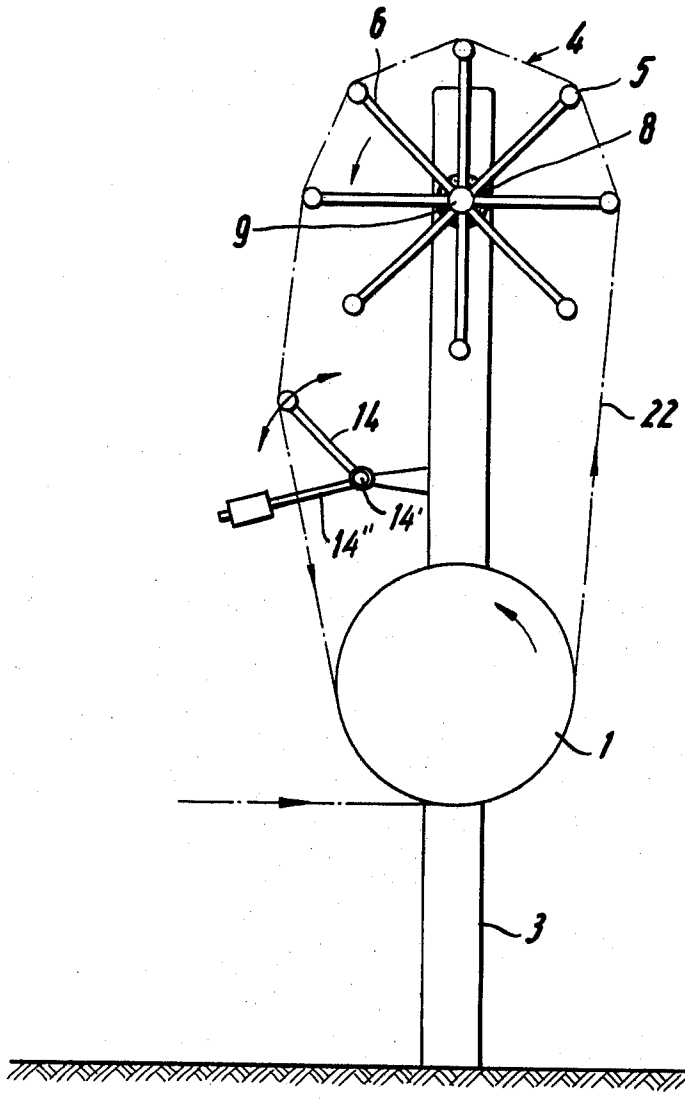


Fig. 1

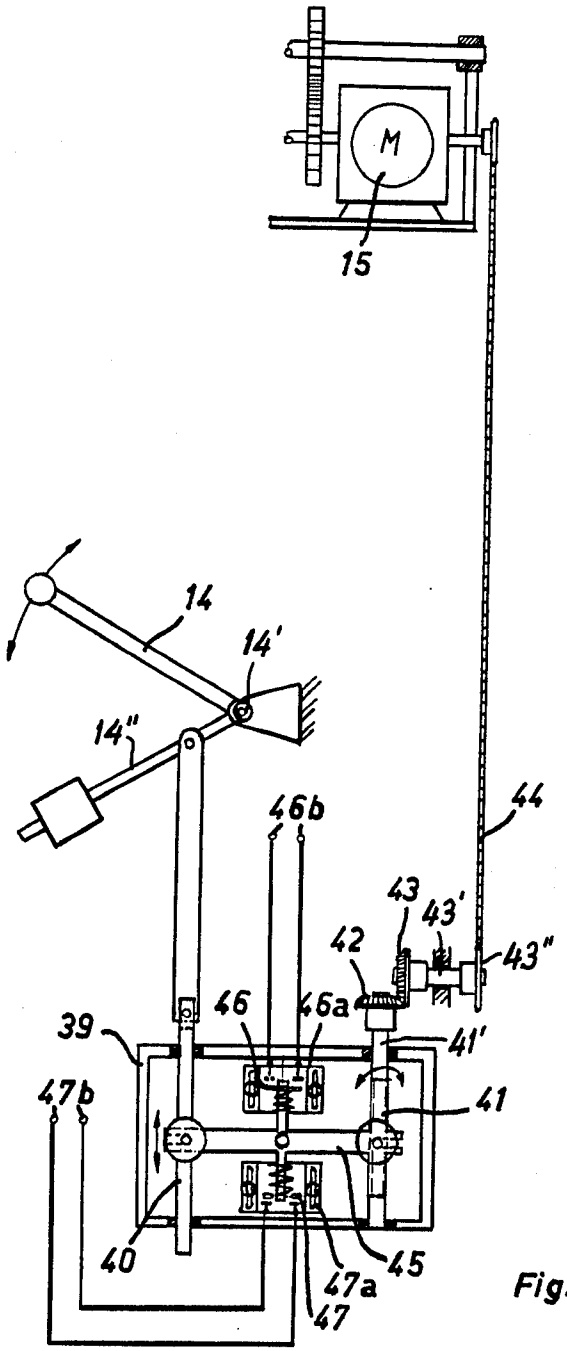


Fig. 1A

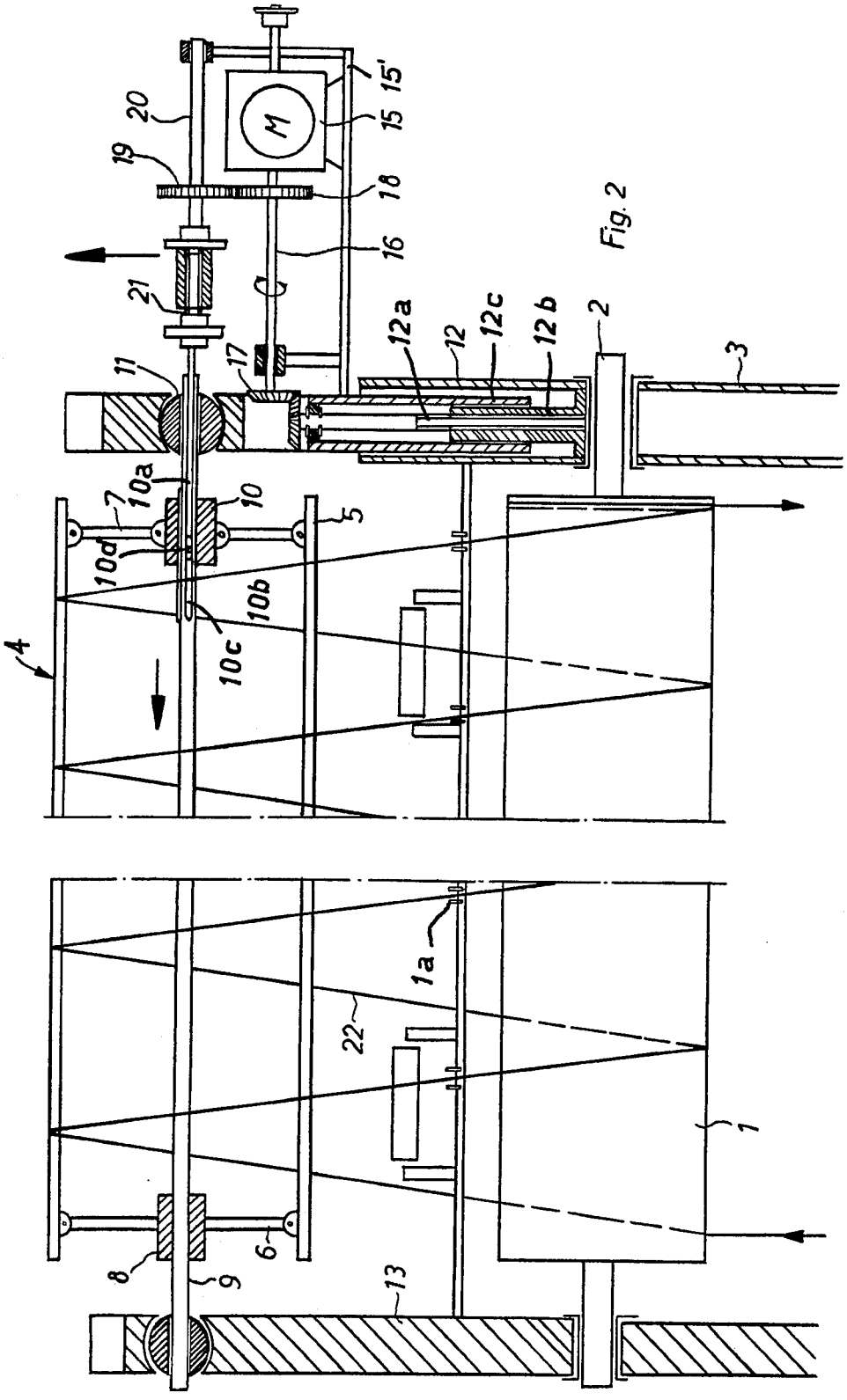

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Fig. 2

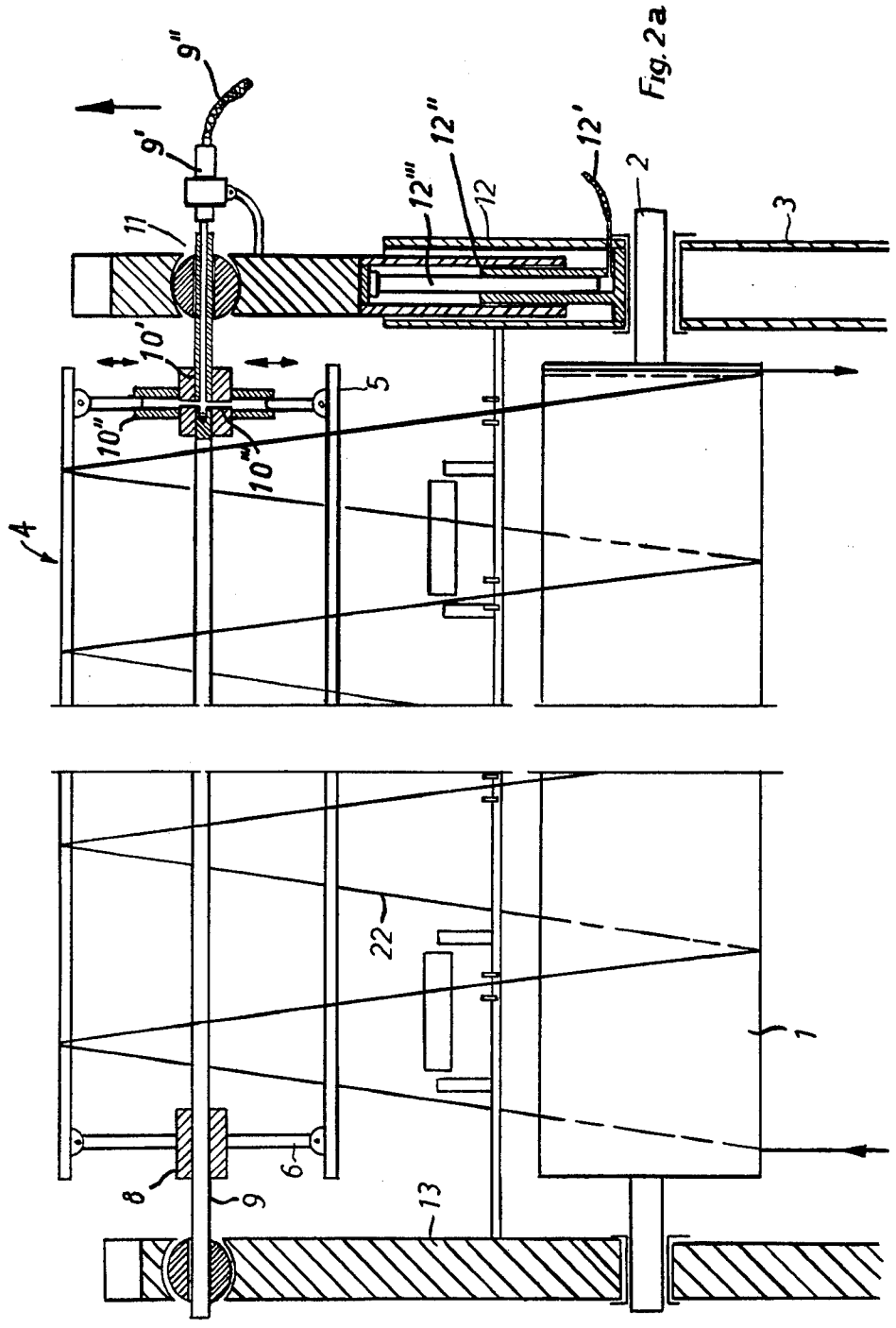

Fig. 2a

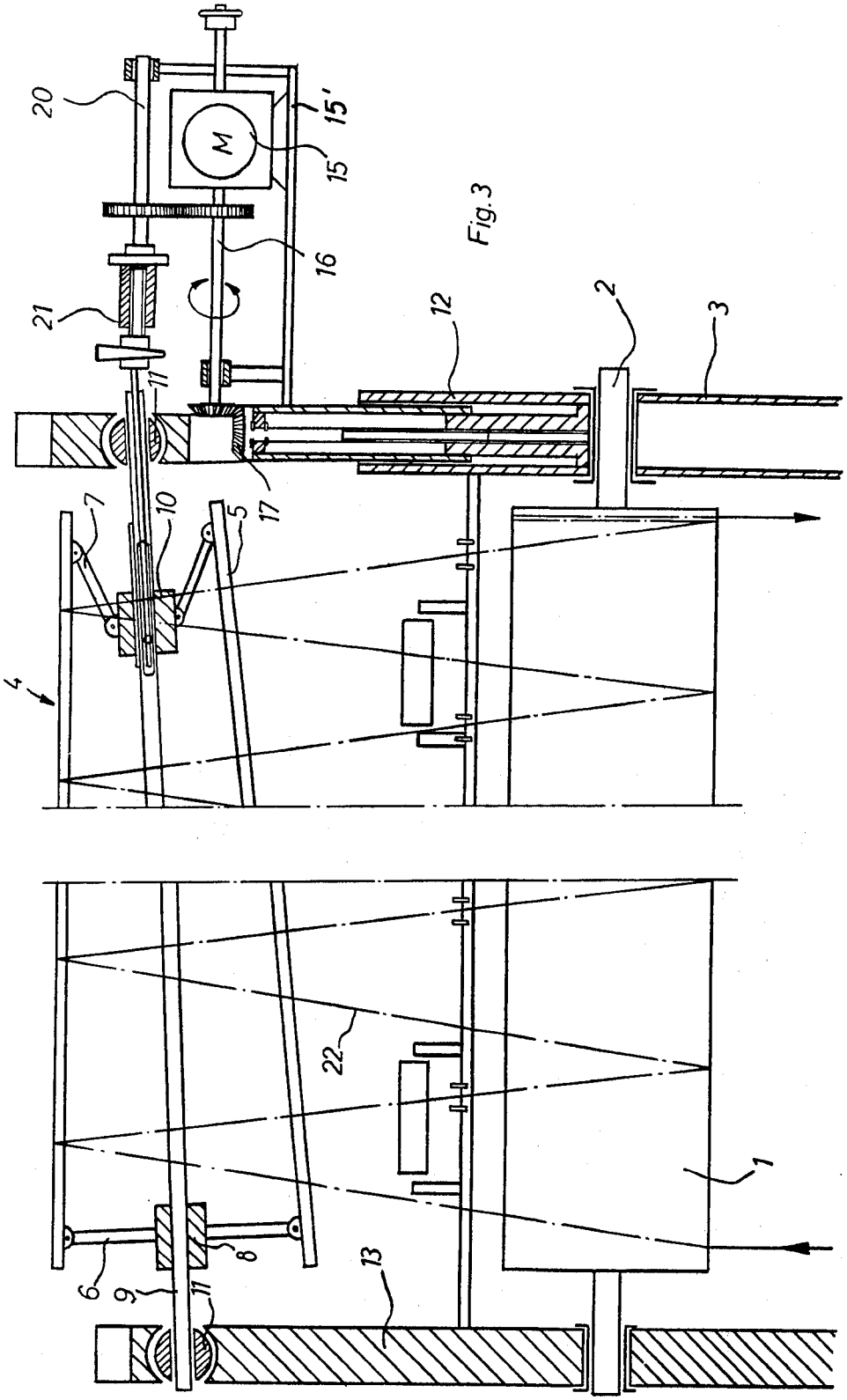

Fig.3

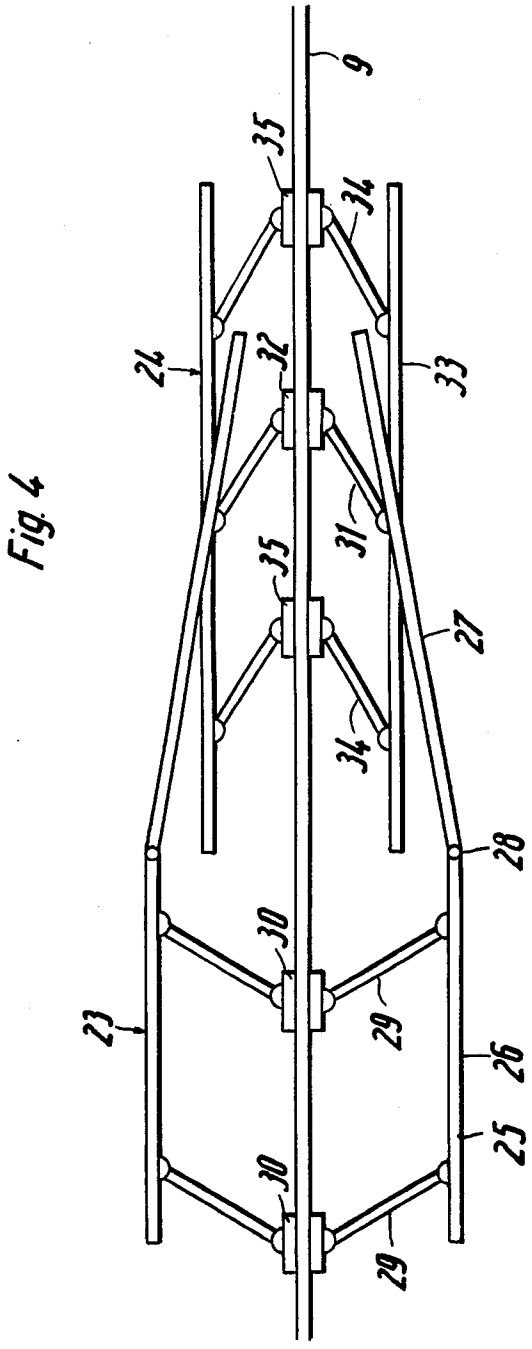

Fig. 4

Fig. 5c

Fig. 5b

Fig. 5a

DRYING MACHINE FOR TEXTILE FABRIC WEBS

This application is a continuation-in-part of my application Ser. No. 208,713, filed Dec. 16, 1971, on Drying Machine for Textile Fabric Webs.

The invention relates to a drying machine for textile fabric webs which are to be shrunk or stretched during the drying process.

The previously known drying machines consist of one or more drying cylinders which are heated by steam, gas, or oil or electrically heated. Spaced above or behind each drying cylinder is a guide roller. The web that is to be dried passes about the guide roller and the drying cylinder several times in order to be dried thoroughly.

In the case of certain textile materials it is desirable to shrink or stretch the webs during the drying process. In this connection, it is to be borne in mind that the fabric web is not always uniform over its entire length and the individual webs are not always uniform with one another; therefore, during the travel of the web around the drying roller, variability in the intensity of the shrinking or stretching process has to be permitted.

An object of the invention is, therefore, to provide a drying machine which effects shrinking and stretching in accordance with the properties of the web that is to be dried.

To solve this problem, a drying machine of the type described is proposed which is characterized in that the diameter of at least part of the guide roller is variable. Advantageously the guide roller periphery is formed by several rods which are disposed in equiangularly spaced radial planes of the roller axis and therefore, are spaced evenly about the periphery. Each rod is spaced from the roller axle by a strut hinged to the rod adjacent each rod end. All the struts adjacent to one roller end are hinged to a mounting support which is displaceable along the roller axle.

Advantageously the inclination of the axis of rotation of the guide roller is variable. For automatic control of adjustment of the guide roller diameter and/or of the inclination of the guide roller axis, an adjusting motor operable by a compensating roller responsive to changes in web tension is arranged between the drying cylinder and guide roller.

In accordance with a further embodiment, each rod includes at least two segments which are joined by a hinged connection. In this regard each rod segment is associated with at least one strut and the strut of one rod segment can be adjusted independently of the strut of the other rod segment. The struts of corresponding rod segments are connected to a common holder slidable on the guide roller shaft.

In accordance with a further development, the roller axle carries at least two concentric guide rollers, which are formed from rods hinged to struts carried by the shaft. The rollers can be moved axially towards one another and their adjacent ends can project to be interdigitated or the rod ends of one roller can project into the cylinder formed by the rods of the adjacent roller.

Further details of the invention can be seen from the exemplary drawings of preferred embodiments, in which:

FIG. 1 is a diagrammatic side elevation of a drying roller and guide roller according to the invention.

FIG. 1*a* is a side elevation of the compensating roller and adjusting motor and the connecting mechanism therefor, with parts broken away.

FIG. 2 is a diagrammatic front elevation of the embodiment in accordance with FIG. 1 showing one form of actuating mechanism, with parts in section.

FIG. 2*a* is a view similar to FIG. 2, but showing a different form of actuating mechanism.

FIG. 3 is a view similar to FIG. 2 but with parts in different positions.

FIG. 4 is a diagrammatic front elevation of a segmented two-part guide roller.

FIGS. 5*a* to 5*c* are schematic representations of three adjusting possibilities of the guide roller in accordance with FIG. 4.

The drying machine includes a drying cylinder **1**, the shaft **2** of which is mounted in holders **3**. Above the drying roller **1** is a guide roller **4** which consists of several rods, bars or pipes **5** forming its periphery. Eight rods are shown in the example of FIG. **1**. These rods **5** are pivotably connected adjacent their opposite ends to struts **6** and **7**, respectively. The struts **6** project radially from a holder or hub **8** which is seated securely on a guide roller axle **9**. The struts **7** are pivotably connected to a holder or hub **10** which is displaceable along the roller axle **9**.

The roller axle **9** is mounted in ball bearings **11** which are arranged in supports **12** and **13**. The support or carrier **12** adjacent to the movable holder or hub **10** is vertically adjustable, so that the corresponding end of axle **9** can be raised or lowered to tilt the axle **9**, as is shown by way of example in FIG. **3**.

A tension-compensating roller **14** is located between the drying cylinder **1** and the guide roller **4** and is connected to an adjusting motor **15** as shown in FIG. 1A. As shown in FIG. **1**, the compensating roller at the end of arm **14** engages the fabric web or band, and the arm is freely swingable about its pivot **14'** in response to changes in the tension in the web **22**. A second arm **14''** is rigidly connected to arm **14** for swinging conjointly with the compensating roller arm. One end of stepped bar **40** is pivotably connected to arm **14''**. The portion of bar **40** at the side of its step remote from arm **14''** extends into a housing **39** and is pivotably connected to a substantially perpendicular bar **45**. The other end of bar or bridge **45** is pivotably connected to a nut **41** on threaded shaft **41'**. The upper end of shaft **41'** carries a bevel gear **42** which meshes with a bevel gear **43** on one end of shaft **43'**. The other end of shaft **43'** carries a sprocket **43''** driven through chain **44** by motor **15**. Rotation of shaft **41'** by motor **15** through chain **44**, sprocket **43''**, shaft **43'** and bevel gears **43,42** will effect movement of nut **41** axially along shaft **41'**.

Bridge **45** carries fingers **46** and **47** which project from opposite sides of the bridge respectively in the direction of movement of bar **40** and nut **41**. Fingers **46** and **47** are engageable to actuate switches **46***a* and **47***a*, respectively, which are connected to terminals **46***b* and **47***b* of motor **15** for actuating the motor to vary the conicity of guide roller **4** and vertically adjust support **12**, as described in detail below.

When the tension of band **22** decreases, allowing arm **14** to drop by gravitational force, switch **47***a* is actuated by finger **47** to drive motor **15** in a direction to spread rods **5** and lower support **12**. Actuation of motor **15** also drives chain **44** to move nut **41** upward along shaft **41'** and move bridge **45** to hasten breaking contact between finger **47** and its switch otherwise effected when the tension in band **22** increases again. This operation assists restoration of the dancing arm **14** to its original

position by preventing excessive increase in band tension causing arm 14 and bar 40 to swing past their original positions.

When tension in bands 22 increases sufficiently to lift arm 14 and thereby raise finger 46 to close switch 46*a*, motor 15 is actuated to turn in the opposite direction for contracting rods 5 and raising support 12. Simultaneously chain 44 is driven to assist restoration of contact finger 46, bar 40 and compensating roller arm 14 to their original positions.

In the guide roller mechanism shown in FIGS. 2 and 3, the support 15′ for motor 15 is carried by support 12 and is raised and lowered conjointly with support 12. Shaft 16 of motor 15 carries a gear wheel of bevel gear drive 17. The other bevel gear is carried on the end of spindle 12*a*, the opposite end of such spindle being threadedly engaged with a support tube 12*b*. Spindle 12*a* carries a sleeve 12*c* telescopically slidable relative to support tube 12*b*. Sleeve 12*c* includes a plug in its upper end having an opening through which spindle 12*a* extends. Spindle 12*a* and sleeve 12*c* are connected for conjoint vertical movement but have a bearing connection so that the spindle can rotate relative to the sleeve.

Seated on the shaft 16 is a drive wheel 18 which drives, through a driven wheel 19, a shaft 20 which cooperates with a device 21 for adjusting the conicity of the guide roller 4. Device 21 may include a nut and screw or a cam drive or any other conventional device for converting the rotation of shaft 20 to translational movement of bar or rod 10*a*. Such rod extends axially into hollow axle 9 and is connected to hub 10 such as by a pin 10*d* extending through a slot 10*c* in axle 9. Axial movement of holder 10 erects or inclines struts 7.

When motor 15 is actuated in response to movement of compensating roller 14, the conicity of guide roller 4 is varied by contraction or spreading of rods 5 through adjustment of the angle between struts 7 and axle 9. Simultaneously support 12 is raised or lowered to maintain the uppermost rod 5 in parallelism with the lower periphery of the drying roller. As support 12 is adjusted guide roller axle 9 will be inclined more or less relative to the axis of drive shaft 20. For this purpose, a universal joint is provided in device 21, and balls 11 which support the opposite ends of axle 9 swivel correspondingly in their cages formed by supports 12 and 13, respectively.

The fabric to be dried could be a sheet having a width as great as the width of the drying cylinder 1 which would be passed over the cylinder, over tension-maintaining guide roller 4 and on to another drying cylinder in a continuously working plant having a series of drying cylinder and guide-roller combinations.

However, as is evident from the figures, the web is shown to be a fabric ribbon or band 22 which is spirally wound around the drying cylinder 1 and the guide roller 4. A guide comb having projections 1*a* for limiting lateral displacement of the band stretches is shown in FIG. 2. A particular stretch of band 22 is subjected to a number of sequential drying and stretching operations by the use of a single set of drying drum and guide roller. By decreasing the diameter of the guide roller on the righthand side in FIGS. 2 and 3, shrinking of the band can be effected, while by increasing the diameter stretching of the band is effected. It is also possible to allow the diameter on the right-hand side, by provision of correspondingly longer struts 7, to become greater than on the left-hand side. Simultaneously with the reduction of the diameter by lowering the struts 7, axle 9 of the guide roller is inclined so that the upper side of guide roller 4 maintains approximately the same position, and thus the distance between the lower edge of the drying cylinder and the upper edge of the guide roller does not vary, although the effective path of the web stretch between the lower side of the drying drum and the guide roller upper side is reduced.

Naturally, the adjustment of the diameter of the guide roller and/or of its axial inclination can also be effected via a hydraulic or pneumatic system, such as shown in FIG. 2*a*. In this case, motor 15 would be connected to operate a pump (not shown) to supply fluid to or evacuate fluid from connections 9″ and 12′ for operating the struts 10″ and support 12. Hub 10′ carries piston and cylinder struts 10‴. Passages 10‴ through the walls of hollow axle 9 and through hub 10 permit passage of fluid from the hollow of axle 9 to the cylinder of struts 10″ to extend the strut. An inlet valve 9′ is interposed between supply conduit 9″ and the axle hollow. Fluid is evacuated through the same path to contract the struts. Simultaneously with extension or contraction of struts 10″, fluid is evacuated from or supplied to the bottom of the support tube 12″, respectively, through conduit 12′ to lower or raise piston 12‴ for adjusting support 12 to compensate for changes in parallelism of the top rod 5 and drying drum 1 caused by varying the length of struts 10″.

The composite guide roller 4′ in accordance with FIG. 4 consists of a roller axle 9 and two guide rollers 23 and 24 seated thereon. The roller 23 is composed of several rods, bars or tubes 25, each rod consisting of two segments shown as a rod segment 26 and a rod segment 27 which are pivotably connected together by a hinge 28. The rod segments 26 are connected, via pivotably mounted struts 29, to hubs 30, while the rod segments 27 are similarly connected, via struts 31, to a hub 32. The hubs 30 and 32 are slidably seated on the axle 9. The guide roller 24 also consists of rods, bars or tubes 33 on its periphery. Rods 33 are connected, via pivotably mounted struts 34, to a hub 35 which is seated on the common axle 9.

FIG. 4 shows, by way of example, one composite roller configuration in which rod segments 26 are disposed substantially parallel to axle 9 so that this region of the guide roller 23 is approximately cylindrical. On the other hand, the rod segments 27 of the guide roller 23 are angled in relation to the rod segments 26, so that this region of the roller 23 is frustoconical. The rods 33 of the guide roller 24 extend parallel to the axle 9, but at a radially shorter distance from the axle than the rods 26. Rods 33 are offset circumferentially from, project between and, therefore, axially overlap the rod segments 27, so that rod segments 27 and the rods 33 of the guide roller 24 appear to intersect when viewed from a sight generally perpendicular to axle 9. Through such a positioning of the rod segments 26 and 27 and of the rods 33, a composite guide roller 4′ is formed which has, from left to right, firstly a cylindrical or prismatic section, then a conically tapering section and then, again, a cylindrical or prismatic section with a lesser diameter than the first cylindrical section. A fabric band running on such a guide roller is initially not shrunk or stretched until it reaches the conical roller section which is formed by the rod segments 27. Such

an arrangement can, for example, delay the shrinking process to begin only after the band has reached a specific degree of dryness.

As FIGS. 5*a*, 5*b*, and 5*c* diagrammatically illustrate, it is possible, with the aid of the multi-part guide roller in accordance with FIG. **4**, to locate the conical section at any point on the guide roller unit and also to make this conical section of varying axial length.

In accordance with FIG. 5*a*, the section **36** of the guide roller unit has a relatively large constant diameter and is of comparatively short axial extent; the conical section **37** adjoining thereto is axially longer than section **36**; and the section **38** adjoining thereto, with a constant but smaller diameter than section **36**, is comparatively axially longer than either of sections **36** and **37**.

In accordance with FIG. 5*b*, the section **36'** is still shorter. The conical section **37'** is very long and there is no cylindrical section corresponding to section **38** in FIG. 5*a*. In accordance with FIG. 5*c*, the section **36''** is comparatively long, the conical section **37''** is shorter than section **36''** and the section **38''** having a small constant diameter is still shorter.

In order to achieve these exemplary setting possibilities and others, it is only necessary to straighten out or tilt the struts **29, 31** and **34** correspondingly, in which connection the struts can stand perpendicularly to the roller axle or can be inclined to the left or to the right. The hubs **30, 32** and **35** are displaceable along the axle. Such displacement may be effected by separate rods **10a** (FIG. 2) connected to respective hubs **30, 32** and **35**, one or more of which may be operable by one motor **15** and suitable gearing, separate motors, or manually.

I claim:

1. A drying machine for shrinking or stretching bands of textile fabric including a drying cylinder and a guide roller spaced from such cylinder, the band being spirally wound around the remote peripheral portions of the cylinder and roller and tensioned therebetween, the guide roller having an axle and a plurality of rods arranged in equiangularly spaced radial planes of said axle forming a guide roller periphery, characterized by a hub carried by the axle and being displaceable axially of the axle, a plurality of struts pivotably connected to said hub and projecting therefrom substantially radially of the axle and forming an angle of projection with the axis of the axle, each of the rods being pivotably connected to one of said struts, said struts being variable in effective length radially of the axle, and means for varying the effective length of said struts and thereby varying the diameter of said guide roller periphery including means for displacing said hub along the axle for changing the angle of projection of said struts and thereby varying the diameter of said guide roller periphery.

2. The drying machine defined in claim **1**, bearing support means, bearing means for the axle pivotably mounted in said support means, and means for shifting one end of the axle relative to the other axle end, thereby varying the angle of inclination of the guide roller axle relative to the drying cylinder axis.

3. The drying machine defined in claim **2**, and adjusting means for automatically effecting variation of the guide roller diameter and conjoint variation of the angle of inclination of the guide roller axle including adjusting motor means for operating the hub-displacing means, and band tension sensing means operable to actuate said motor means in response to variations in band tension.

4. The drying machine defined in claim **1**, and adjusting means for automatically effecting variation of the guide roller diameter including adjusting motor means for operating the hub-displacing means, and band tension sensing means operable to actuate said motor means in response to variations in band tension.

5. The drying machine defined in claim **1**, in which each rod includes a first rod segment and a second rod segment pivotably connected to said first rod segment, all of the first rod segments forming a first roller peripheral section and all of the second rod segments forming a second roller peripheral section.

6. The drying machine defined in claim **5**, in which the first segment of each rod is pivotably connected to one of the struts of the hub, a second hub carried by and displaceable axially of the axle, a plurality of struts pivotably connected to said second hub and projecting therefrom substantially radially of the axle and forming an angle of projection with the axis of the axle, the second segment of each rod being pivotably connected to one of the struts of said second hub, and second hub-displacing means for displacing said second hub along the axle for changing the angle of projection of said second hub struts and thereby varying the diameter of the second peripheral section independently of variation of the diameter of the first peripheral section.

7. The drying machine defined in claim **5**, and a second guide roller having an axle disposed with its axis common to the axis of the axle of the first guide roller, a plurality of rods arranged in equiangularly spaced radial planes of said common axis forming a guide roller periphery, a second hub carried by and displaceable axially of said common axis, a plurality of struts pivotally connected to said second roller hub and projecting therefrom substantially radially of said common axis and forming an angle of projection with said common axis, each of said second roller rods being pivotably connected to one of said second roller struts, and second hub-displacing means for displacing said second roller hub along said common axis for changing the angle of projection of said second roller struts and thereby varying the diameter of said second roller periphery, said second roller rods being offset circumferentially of the common axis from the rods of the first guide roller, and means for shifting the first and second rollers relatively axially to effect overlapping of adjacent end portions of the rods of the first and second guide rollers.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,883,960 Dated May 20, 1975

Inventor(s) Hans Stang

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Title page, insert Section 30, which should read:

Foreign Application Priority Data

December 23, 1970 Germany 2063355

Signed and Sealed this

fifth Day of *August 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks