# United States Patent [19]

**Parkes**

[11] **3,797,126**

[45] **Mar. 19, 1974**


[54] **DRUM DRYER**


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[52] **U.S. Cl.** ..... **34/114,** 34/164, 34/155, 34/131, 34/109, 26/59

[51] **Int. Cl.** ..... **F26b 11/02**

[58] **Field of Search** ..... 34/57 D, 57 E, 71, 78, 34/95, 95.3, 95.4, 108–110, 122, 112–115, 130–134, 138–139, 181, 185, 186, 124, 164, 155; 26/59, 60, 56



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,578,633 | 12/1951 | Mauffre | 34/155 |
| 3,149,004 | 9/1964 | Fleissner | 34/115 |
| 2,939,222 | 6/1960 | Svavar et al. | 34/122 |
| 2,950,540 | 8/1960 | Fleissner | 34/115 |

FOREIGN PATENTS OR APPLICATIONS

| | | | |
|---|---|---|---|
| 1,237,591 | 10/1959 | France | 34/114 |



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*Assistant Examiner*—Henry C. Yuen
*Attorney, Agent, or Firm*—Louis Necho



[57] **ABSTRACT**

A drum dryer incorporating a rotary drum which is peripherally perforated to receive heated air therethrough. A plurality of air nozzles are defined between a plurality of transverse return air ducts and are positioned to direct air toward the drum. The transverse air ducts are carried upon an arcuate arm which is peripherally positioned relative to the rotary drum. The return air ducts and the rotary drum define an arcuate annular space to receive textile materials therein for drying and stitch adjustment purposes. The arcuate arm is pivotally affixed at one end thereof to the dryer machine frame and has its other end vibrated for textile treatment purposes during the drying operation. The air ducts are provided with dampers which function to closely control the volume of air passing therethrough, so that the quantities of air passing through the textile materials and into the rotary drum can be regulated.


**14 Claims, 9 Drawing Figures**

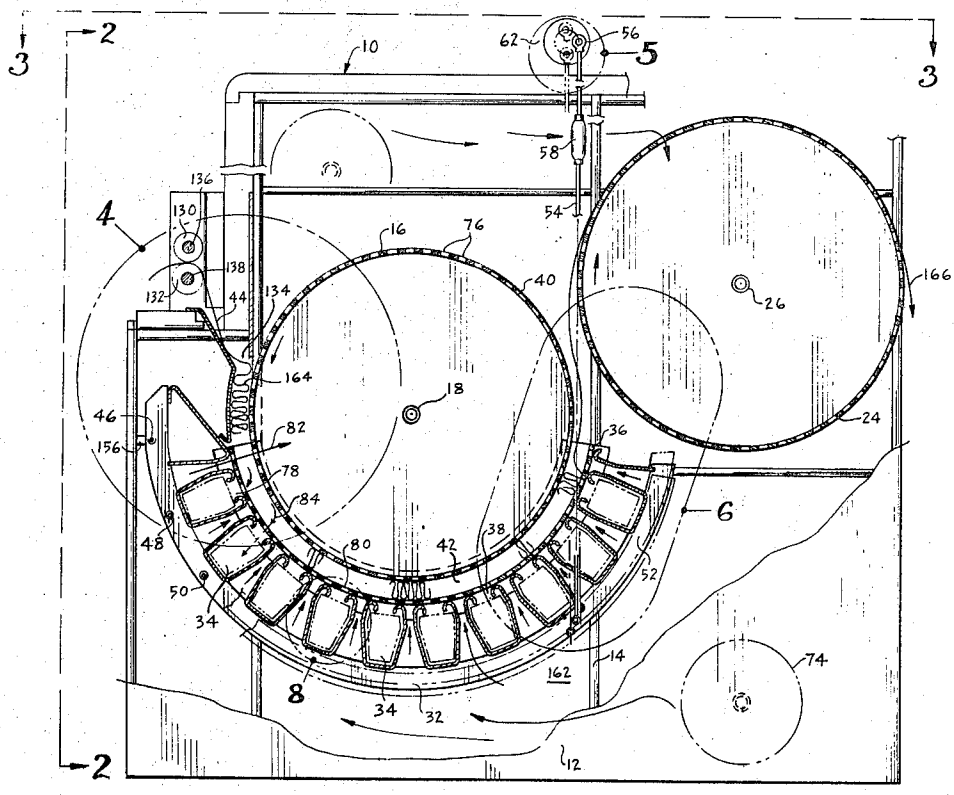
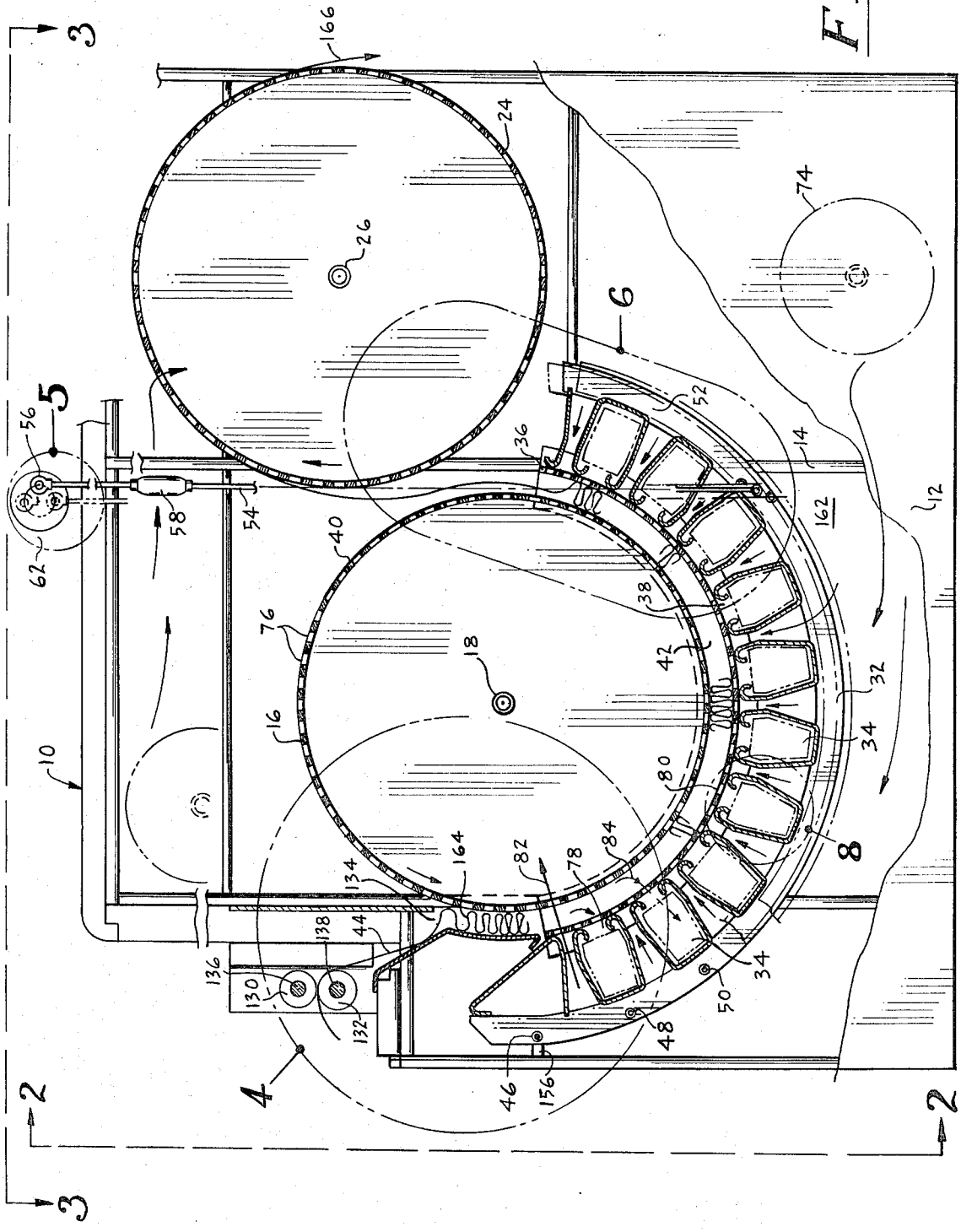


FIG. 1.


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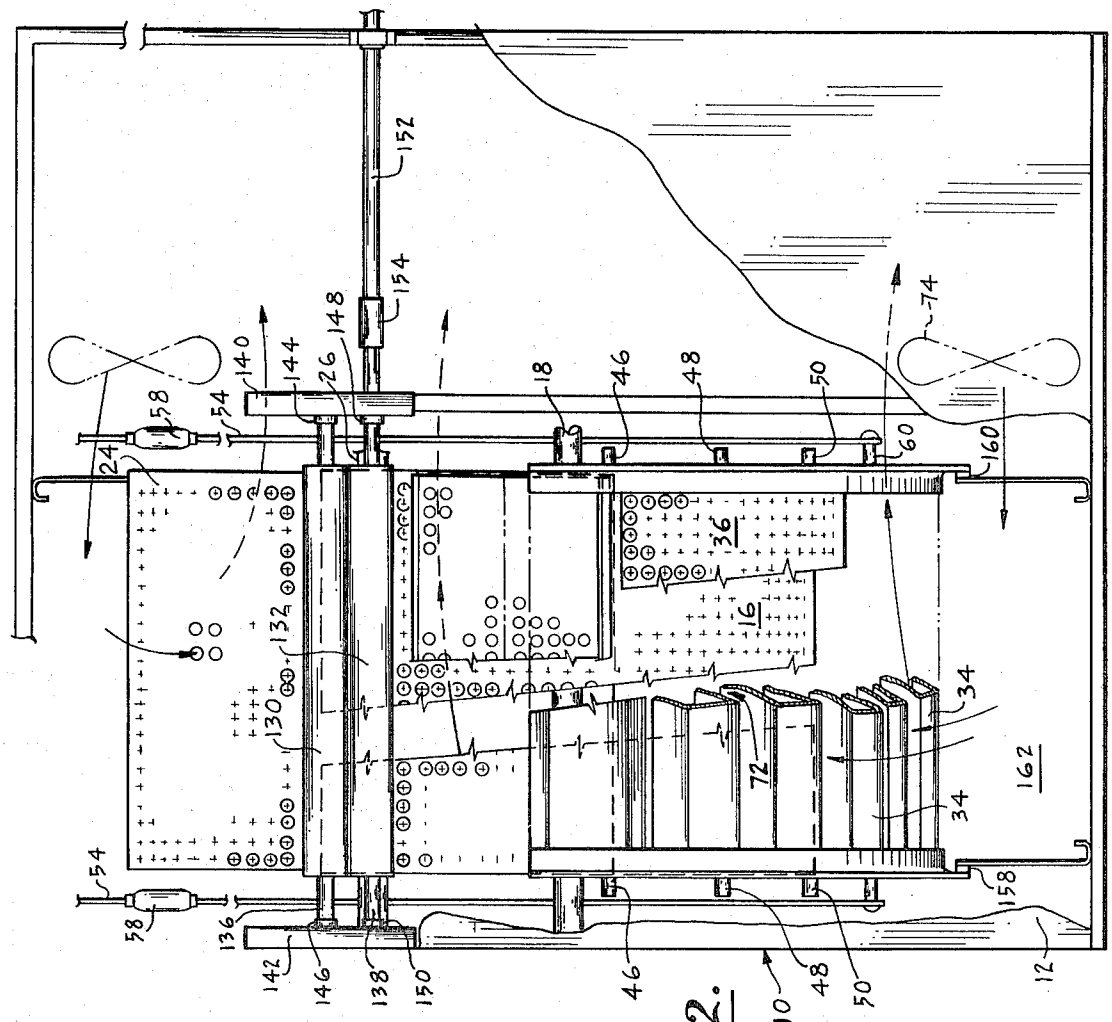

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FIG. 2.

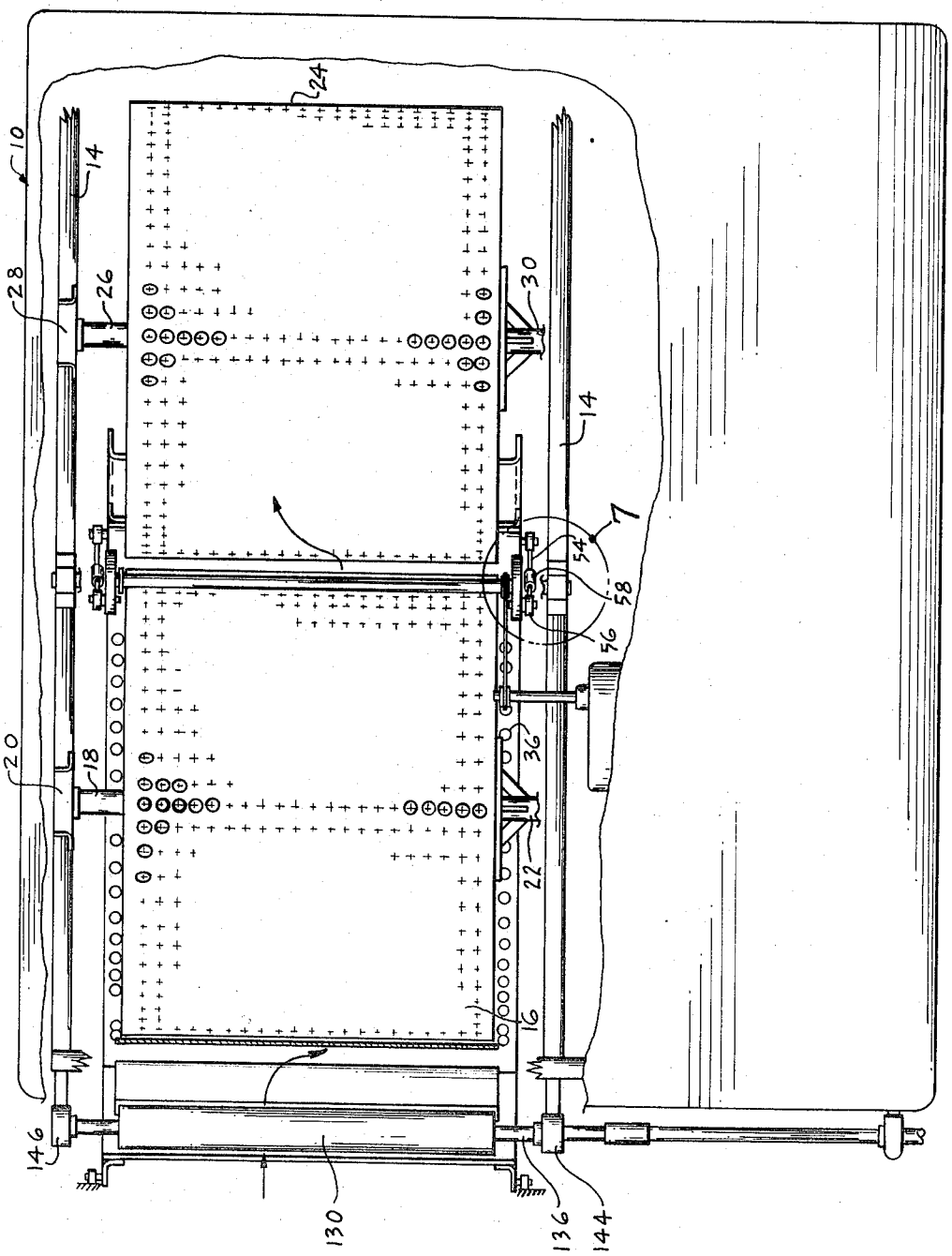



FIG. 3.

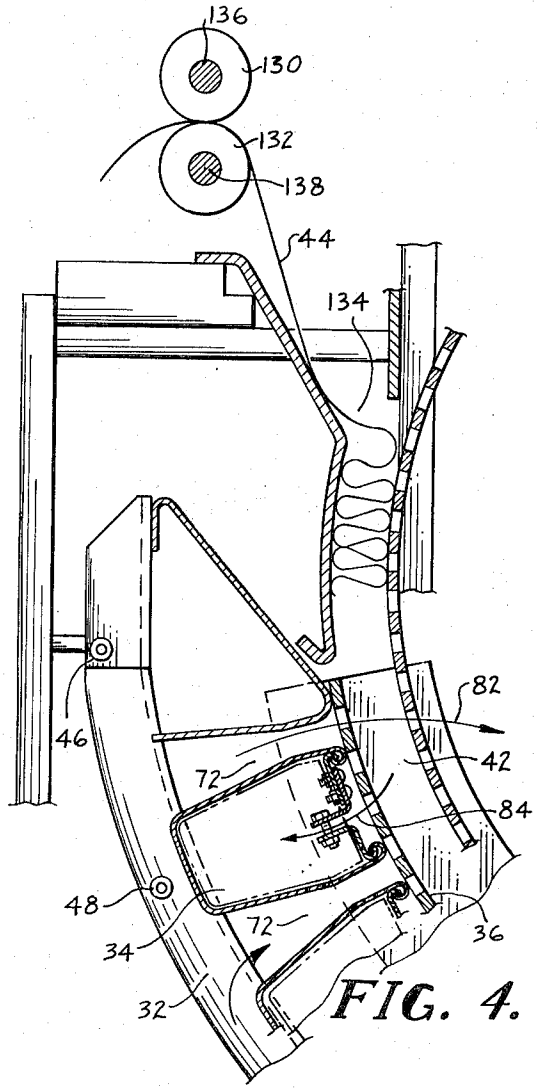



FIG. 4.

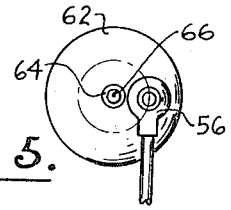



FIG. 5.

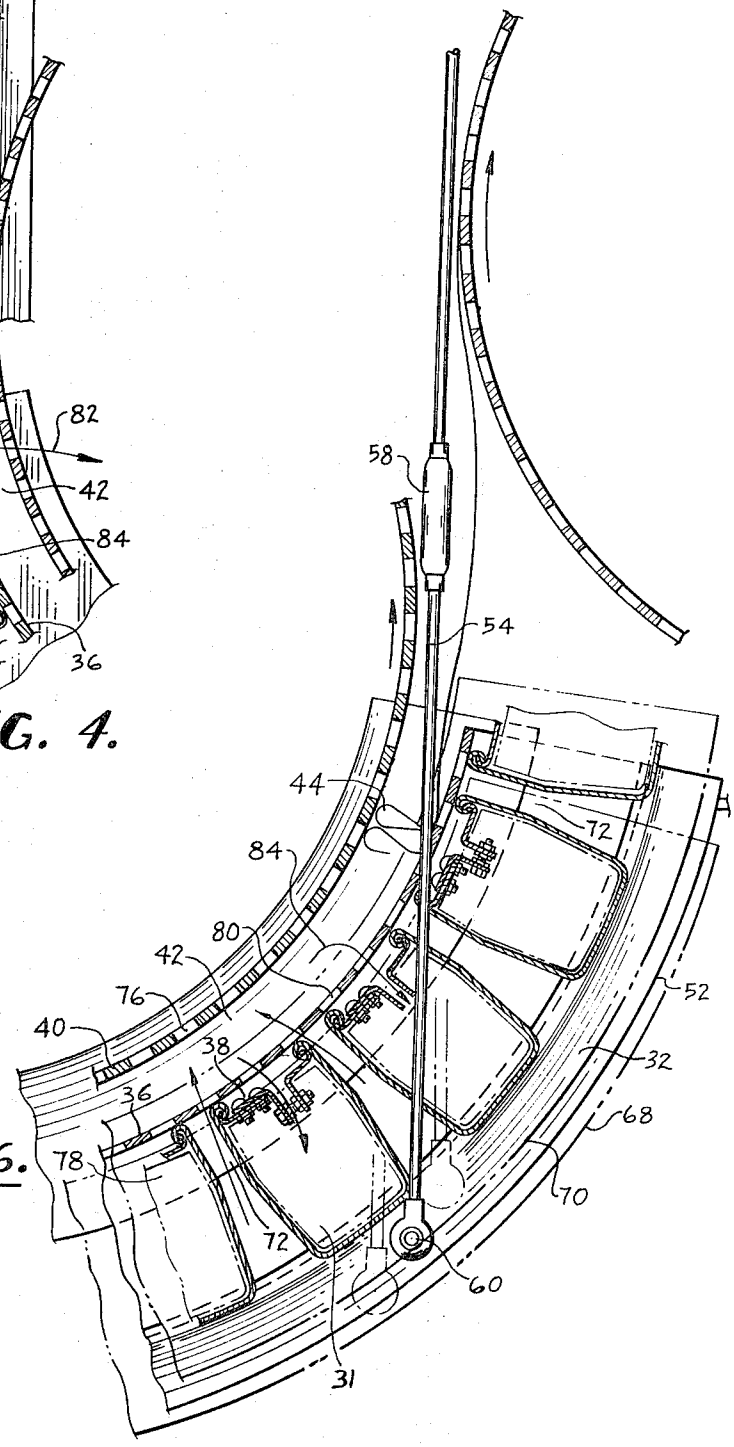



FIG. 6.

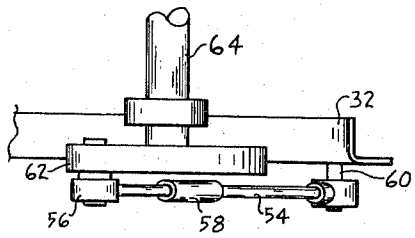



FIG. 7.

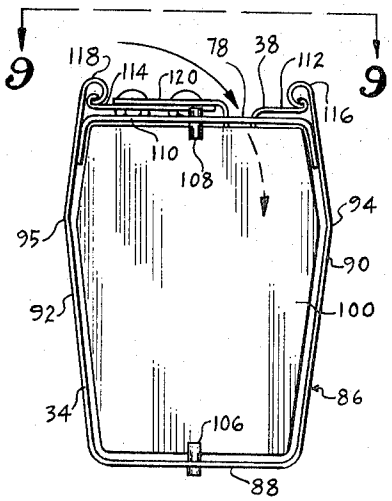



FIG. 8

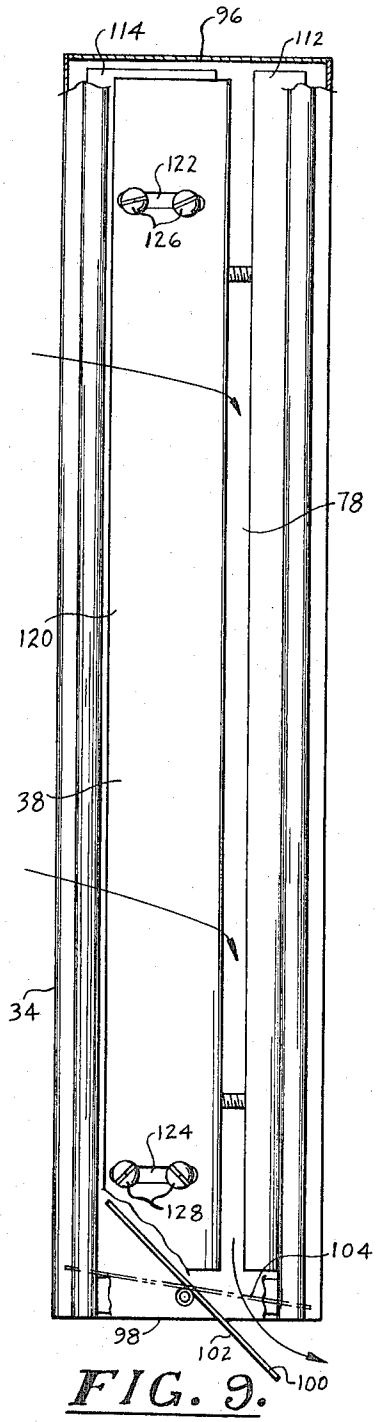



FIG. 9.

# DRUM DRYER

## BACKGROUND OF THE INVENTION

The present invention relates generally to drying apparatus, and more particularly, is directed to a drum type device suitable for drying and conditioning textile fabrics.

Prior workers in the art have found it both necessary and desirable to treat many textile materials such as tubular knit materials, woven materials and other forms of knit goods by drying operations such as passing the material through dry, heated air within automatic apparatus suitable for the purpose. Particularly, when the textile materials have been wet processed wherein the fibers may be stretched or otherwise distorted, it has been found necessary to condition the textile fibers prior to use.

It is the usual practice to introduce moist textile materials in elongate web form into the housing of a dryer wherein the material is processed by directing streams of heated air toward the exposed surface of the material so that any retained moisture is driven from the textile material and carried away by the heated air. One such device is shown in U. S. Pat. No. 1,963,672 to Parkes. It has been found that some materials are more easily dried than others and some material conditioning operations impart more moisture to the material then other such processes. It is therefore, necessary to provide dryer apparatus which is easily adjustable in nature to vary the speed of material travel and to vary the quantities of heated air to be directed upon the textile material. The adjustable speed and air volume controls accommodate varying amounts of moisture which may be present within the apparatus during any given run.

## SUMMARY OF THE INVENTION

The present invention relates generally to automatic dryers, and more particularly, is directed to a drum dryer having a rotary drum and peripheral air nozzles and which is suitable for continuous, automatic drying operation.

The apparatus of the present invention includes a drying enclosure within which is mounted a perforated drum for rotary operation. A plurality of return air ducts mount upon an arcuate arm and define a plurality of air nozzles therebetween. The arcuate arm and air nozzles position radially outwardly from the periphery of the drum and define an arcuate, partial, annular channel therewith for textile material receiving and treatment purposes.

A fan positions within the apparatus enclosure and pressurizes a plenum chamber to force air through the nozzles in the direction of the perforated drum. Each return air duct is provided with an individual damper to facilitate regulating air flow therethrough so that the volume of air exiting the apparatus through the return air ducts as opposed to the volume of air passing through the textile material into the perforated periphery of the rotary drum can be closely regulated and controlled. The volume of air passing through the textile material must be responsive to such conditions as the type of textile material being treated, the moisture retained within the material and sometimes, upon the type of material conditioning operation employed prior to introducing the textile material to the dryer.



The arcuate arm extends through an arc of somewhat less than one hundred and eighty degrees about the periphery of he rotary drum and pivotally connects to the dryer apparatus at one end thereof. The free end of the arcuate arm is vibrated by an eccentric drive to agitate the textile materials which have been introduced into the annular space defined between the rotary drum and the arcuate arm.

The combination of the mechanical vibration of the arm by means of the eccentric and the agitation of the air which passes through the nozzles to impinge upon the materials vibrates the textile materials to properly seat the fibers of the material during the shrinking operation. The combination of mechanical and/or air agitation of the loose or compacted textile materials that have been wet processed and stretched prior to introduction into the dryer permits stitch adjustments and/or normal shrinkage in a compacted and/or completely relaxed and agitated condition on a continuous basis. The amount of air admitted to the system through the nozzles may be readily varied to control shrinkage by adjusting the nozzle dampers.

After the textile materials have been fully treated in a continuous manner within the annular space defined between the arm and the rotary drum, the treated and dried material is fed on to a takeup roll which may also be perforated to deliver the textile material in finished form exteriorly of the dryer.

It is therefore an object of the present invention to provide an improved drum dryer of the type set forth.

It is another object of the present invention to provide a drum dryer capable of providing both mechanical and air agitation to a textile material web that has been previously wet processed prior to introduction into the dryer.

It is another object of the present invention to provide a novel rotary dryer which includes a peripherally apertured rotary drum, an arm carrying a plurality of radially positioned air nozzles to direct air towards the drum, a plurality of radially positioned air ducts to receive return air therein and means to vary the volume of return air through the air ducts.

It is another object of the present invention to provide a novel rotary dryer which incorporates an apertured rotary drum, an arcuate arm peripherally positioned about a portion of the drum and defining an annular channel therewith, the said annular channel receiving textile material therein for textile material treatment purposes.

It is another object of the present invention to provide a novel rotary dryer which includes a rotary drum, an arm carrying a plurality of air nozzles and air ducts peripherally about a portion of a drum and defining a textile material receiving channel therewith, said arm incorporating means to vibrate the arm relative to the drum to seat the fibers of the textile material during the material drying process.

It is another object of the present invention to provide a novel rotary drum dryer which incorporates means to permit stitch adjustment of textile material and/or normal shrinkage in a compacted and/or completely relaxed and adjusted condition on a continuous basis.

It is a further object of the present invention to provide a novel rotary drum dryer which includes rotary drum means, and nozzle means directing heated air toward the drum, an arm carrying return air duct means about the periphery of the drum, said air duct means defining the said nozzles, means to vary the volume of the air returned within the air ducts and means whereby mechanical and air agitation of loose or compacted textile materials may be readily accomplished.

It is another object of the present invention to provide a novel rotary drum that is rugged in construction, trouble free in use and continuous in operation.

Other objects and a fuller understanding of the invention will be had by referring to the following description and claims of a preferred embodiment thereof, taken in conjunction with the accompanying drawings wherein like reference characters refer to similar parts throughout the several views and in which:

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a rotary dryer in accordance with the present invention, partially broken away to disclose details of interior construction.

FIG. 2 is a front elevational view taken along line 2—2 of FIG. 1, looking in the direction of the arrows and partially broken away to expose details of interior construciton.

FIG. 3 is a top plan view taken along line 3—3 of FIG. 1, looking in the direction of the arrows and partially broken away to expose internal construction details.

FIG. 4 is a partial, enlarged representation of the textile material feed of FIG. 1.

FIG. 5 is an enlarged, side elevational representation of the eccentric drive of FIG. 1.

FIG. 6 is an enlarged, side elevational representation of the discharge end of the arcuately curved arm of FIG. 1.

FIG. 7 is an enlarged, top plan representation of the eccentric drive of FIG. 3.

FIG. 8 is an enlarged, side elevational representation of a return air duct of FIG. 1.

FIG. 9 is a top plan view of a return air duct taken along line 9—9 of FIG. 8, looking in the direction of the arrows.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Although specific terms are used in the following description for the sake of clarity, these terms are intended to refer only to the particular structure of my invention selected for illustration in the drawings and are not intended to define or limit the scope of the invention.

Referring now to the drawings, I show in FIG. 1 a drum dryer 10 which incorporates a substantially air tight casing 12 and a supporting frame 14. A hollow rotary drum 16 affixes to the shaft 18, one end of which journals within a frame supported bearing 20 and the other end 22 of which is rotatively driven in well-known manner such as by a gear-motor drive (not shown). A takeup drum 24 positions rearwardly of the drum 16 within the casing 12 and is rotatively carried upon a shaft 26. One end of the shaft 26 journals within a frame affixed bearing 28 and has its other end 30 rotatively driven by a motor or other device (not shown) in conventional manner. The speed of rotation of the drum 24 can be varied relative to the speed of rotation of the hollow rotary drum 16 for textile material treatment purposes as hereinafter more fully set forth.

An arcuately curved arm 32 peripherally surrounds a portion of the outer periphery of the rotary drum 16 and carries a plurality of transversely disposed, similar return air ducts 34. A sheet of perforated material 36 positions radially outwardly of the outer periphery of the rotary drum 16 and covers the intake faces 38 of the plurality of transverse air ducts 34. The perforated sheet 36 and the outer periphery 40 of the rotary drum 16 define an annular channel 42 therebetween for processing an elongate web of textile material 44 therein in the manner hereinafter more fully set forth. The arm 32 pivotally connects to the dryer about the pivot pin 46 in a manner to allow the curved arm 32 to freely rotate about the pin 46. It will be noted in FIG. 1 that the arm 32 overlies a portion of the outer periphery of the rotary drum 16 through an arc of somewhat less than 180°. Should it be desired to shorten the arc of the angular channel 42 in response to particular textile material treatment needs, this arc of overlap may be shortened by employing the optional pivot points 48,50 which thereby serve to give a wide range of air adjustment.

Referring to FIGS. 1 and 6, the free end 52 of the curved arm 32 is supported by a pair of transversely spaced vertical rods 54 which in turn are adjustably secured to eccentric connections 56 through adjusting turnbuckles 58. The lower ends of the vertical rods 54 are bolted or otherwise secured to the arm 32 in a pinned connection 60 for vibration of the curved arm 32 and consequently also the affixed air ducts 34 and perforated sheet 36. The eccentric wheels 62 are rotatively driven by a shaft 64 which conventionally receives its rotative power from a motor (not shown) or other conventional driving means. The eccentric connection 56 offsets from the center of rotation 66 a distance of one-half inch to thereby impart a reciprocating 1 inch stroke of travel to the vertical rods 54. As best seen in FIG. 6, the curved arm 32 is vibrated by the reciprocation of the rods 54 from a lower position 68 to an upper position 70 as indicated in broken lines. The vibration of the curved arm 32 agitates the textile material 44 as it passes through the annular channel 42 and functions in conjunction with air agitation in the manner hereinafter more fully set forth for textile material treatment purposes.

Referring now to FIGS. 1,4 and 6, it will be observed that the plurality of transverse air ducts 34 define transverse spaces therebetween which converge to form a plurality of peripherally spaced air nozzles 72 to direct air from the fan 74 into the annular channel 42 for textile material treatment purposes 44. It will be noted that the periphery 40 of the hollow rotary drum 16 is perforated over its entire outer surface to form a plurality of apertures 76 for air passage purposes. Each transverse air duct 34 is formed with an air intake slot 78 to permit the entrance of return air therein. Thus, forces generated by the fan 74 propel air through the nozzles 72 and through the apertures 80 in the perforated sheet 36 to pressurize the annular channel 42. Depending upon the operation desired, the air can then be directed to the interior of the drum 16 through the apertures 76 as indicated by the arrow 82

or the air may be turned to enter the air intake slots 78 of the transverse return air ducts 34 as indicated by the arrows 84.

As best seen in FIGS. 8 and 9, each transverse return air duct 34 is generally rectangularly formed in cross-section and includes a continuous sheet metal body 86 which incorporates a base 88 and contiguous opposed sides 90, 92. Each side 90, 92 is outwardly bent to form a throat section 94, 95 wherein the distance between the opposed throat sections 94, 95 is greater than the width of the base 88. In this manner, by arcuately positioning a plurality of return air ducts 34 upon the curved arm 32, a plurality of air nozzles 72 are defined between the adjacent throat sections 94, 95 of adjacent air ducts 34. One end 96 of each air duct 34 is closed and may be welded or otherwise affixed to the sides 90, 92 and to the base 88 in a substantially air tight manner. The opposite end 98 of each air duct is provided with volume damper 100 which is pivotal from an open position 102 as illustrated in solid lines in FIG. 9 to a substantially closed position 104 as illustrated in dotted lines in FIG. 9. The damper 100 is provided with upper and lower pivot pins 106, 108 which axially align to permit pivotal movement of the damper 100 thereabout. The lower pin 106 positions through the base 88 and the upper pin 108 pivots within a yoke 110 which stretches between the air duct sides 90, 92 near the air intake face 38.

The air intake face 38 includes the air intake slot 78 which is defined between a pair of spaced, transverse top members 112, 114. The top members 112, 114 respectively transversely affix to the rolled tops 116, 118 of the sides 90, 92. A transversely disposed damper 120 adjustably positions upon the top of the top member 114 and is arranged for relative movement to vary the width of the air intake slot 78. As shown, the top member 114 and the damper 120 are provided with cooperating, aligned, elongate slots 122, 124 to permit easy longitudinal adjustment. Pairs of adjusting bolts 126, 128 position within the slots 122, 124 to facilitate adjustment of the air intake slot 78. By loosening the bolts 126, 128, the transverse damper 120 may be moved relative to the top member 114 until the desired slot opening 78 is defined. Then, the bolts 126, 128 can be tightened to lock the damper 120 in the desired relative position. Thus, the movement of air within each air duct 34 can be very closely controlled both by adjusting the width of the air intake slot 78 and also by adjusting the relative position of the volume damper 100.

As best seen in FIGS. 1, 3 and 4, the web of textile material 44 feeds into the dryer 10 through a pair of vertically aligned feed rolls 130, 132 into the annular channel intake openings 134. The feed rolls 130, 132 rotate upon their respective transverse shafts 136, 138. The shafts 136, 138 journal within the right and left frame members 140, 142 in respective right and left bearings 144, 146, 148, 150. The lower roller shaft 138 extends transversely outwardly and is connected to a dryer shaft 152 through a suitable coupling 154. The dryer shaft 152 connects to a conventional source of rotative power such as a gearmotor drive (not shown) to drive the lower roller 132 at predetermined, adjustable speeds. The upper roller 130 is the driven roller and tangentially contacts the lower roller 132 to define a nip therebetween for textile material feeding purposes.

A plurality of seals of conventional, air resistant material such as rubber, seals 156,158 160 only being illustrated, cooperate to form a plenum chamber 162 which is pressurized by the forces generated by the fan 74. The only exit for air from plenum chamber 162 is through the plurality of air nozzles 72, as insured by proper positioning of the plurality of seals.

In operation, a web of textile material 44 which has been previously wet processed in accordance with procedures well known to those skilled in the art is introduced to the nip between the feed rolls 130, 132. The driving roll 132 drives the material web interiorly of the machine and urges the web into the channel intake 134 of the annular channel 42. In the illustration shown, the surface speed of rotation of the take up drum 24 is less than the surface speed of the feed rolls 130, 132 so that the material web 44 undulatingly folds within the channel 42 to form a continuous interfolded pattern 164 as the material web is fed through the annular channel 42. It will be appreciated that by adjusting the relative speeds of the takeup drum 24, the rotary drum 16 and the feed rolls 130, 132, the material web pattern formed within the annular channel 42 can be relatively adjusted. Also, by functioning the takeup drum 24 at the same speed as the feed rolls 30, 132, interfolding of the material web 44 within the channel 42 can be completely eliminated so that a single thickness of material is presented by the web 44 as the material passes through the annular channel. Thus, a wide range of material configurations can be achieved by speed variation.

The position of the transverse dampers 120 and the volume dampers 100 which are associated with each transverse air duct can be adjusted to meet the particular drying characteristics of the material being treated by admitting more or less air into the return air ducts 34 from the annular channel 42. By substantially closing the dampers 100 and the air intake slots 78 of the air ducts 34, most of the air can be directed through the perforated sheet 36 and the apertures 76 into the interior of the rotary drum 16. Under such conditions, the material web 44 would be pressed against the outer periphery of the drum 16 by pressure of the air forces as the air passes into the drum interior.

During the passage of the textile materials 44 through the annular channel 42, the eccentric wheels 62 rotate to reciprocate the vertical rods 54 to thereby vibrate the arcuate arm 32. It will be appreciated that portions of the textile materials 44 will contact the perforated sheet 36 during the travel through the annular channel 42 and thus the sheet 36 will be vibrated when the arm 32 is vibrated. Accordingly, vibration of the arcuately curved arm 32 serves to agitate the textile materials as the material web passes through the channel 42. The combination of mechanical vibration as caused by vibration of the arm 32 and air agitation as generated by the fan forces which are directed through the nozzles 72 and thence through the textile materials 44, permits "stitch adjustment" on a continuous basis as the material web winds about the outer periphery of the takeup drum 24 for delivery from the machine in the direction indicated by the arrow 166 (FIG. 1). The machine functions to seat the fibers of the textile materials 44 by vibration and agitation for normal shrinkage in a compacted and/or completely relaxed and agitated condition. It is noteworthy that the apparatus operates continuously and within a wide latitude of operating condi-

tions which are easily adjusted. As hereinbefore stated, more or less drying air may be directed completely through the textile material **44** by varying the amount of return air which enters the return air ducts. The undulations of the material web within the annular channel **42** can also be controlled by varying the speed of the various rolls and drums. Thus, I have provided a complete, automatic and widely adjustable drum dryer suitable for various treatments of web materials.

I claim:

**1.** In a drum dryer for treating a traveling web of elongate textile material of the type including a supporting frame, a fan and a casing enclosing the frame, the combination of

A. a peripherally perforated rotary drum rotatively carried upon the frame,

B. an arcuate arm having a first end and a second end and being positioned to radially overlie a portion of the periphery of the rotary drum;

1. said arm and said rotary drum defining an annular channel therebetween;

C. a plurality of return air ducts transversely carried by the arm,

1. said air ducts having respective air intake slots in communication with the annular channel to receive air from the said fan;

D. vibration means associated with the arcuate arm and being connected to vibrate the arcuate arm;

E. feed roll means directing the textile material into the said annular channel; and

F. take up roll means to urge the textile material through the annular channel for delivery exteriorly of the drum dryer.

**2.** The invention of claim **1** and a plurality of air nozzles, said air nozzles being defined between adjacent air ducts and said air nozzles being positioned to pressurize the annular channel.

**3.** The invention of claim **1** wherein the arm pivotally connects to the frame at its said first end and wherein the vibration means connect to the second end.

**4.** The invention of claim **3** wherein the vibration means include an eccentric drive and a vertical rod interconnected between the eccentric drive and the second end of the arm.

**5.** The invention of claim **1** and means to vary the speed of the feed roll means and the take up roll means.

**6.** The invention of claim **5** and means to vary the quantity of air entering the return air ducts.

**7.** The invention of claim **6** wherein the means to carry the quantity of air includes a transverse damper associated with each return air duct, said transverse damper ahving movement relative to the return air duct, said transverse damper being movable to vary a dimension of the air intake slot.

**8.** The invention of claim **7** and a vertical damper associated with each return air duct, said vertical damper having pivotal movement relative to its associated return air duct.

**9.** The invention of claim **1** wherein the said fan pressurizes a plenum chamber positioned within the casing, the said nozzles intercommunicating between the plenum chamber and the said annular channel, whereby air propelled by the said fan is directed in spaced locations into the said annular channel.

**10.** The invention of claim **1** wherein the vibration means include means to vibrate the textile material in a relaxed position while receiving drying air from the fan on a continuous basis.

**11.** The invention of claim **10** wherein the textile material may travel through the apparatus along either a straight path or a curved path.

**12.** In a drum dryer for treating a web of textile material, the combination of

A. a frame;

B. a drum rotatively carried by the frame,

1. said drum being peripherally perforated to allow the passage of air;

C. return air means overlying a portion of the periphery of the drum to receive air from within the drum,

1. said return air means and a portion of the drum defining a channel therebetween;

D. vibration means to vibrate the return air means; and

E. feed roll means to feed the textile material through the channel.

**13.** The invention of claim **12** wherein the return air means include a plurality of return air ducts.

**14.** The invention of claim **13** and damper means associated with the return air means to control the volume of air entering the return air ducts.

* * * * *