

Oct. 10, 1967

R. A. DAANE

3,345,757

DRYER VENTILATING ROLL

Filed Oct. 14, 1965

3 Sheets-Sheet 1

Fig. 1

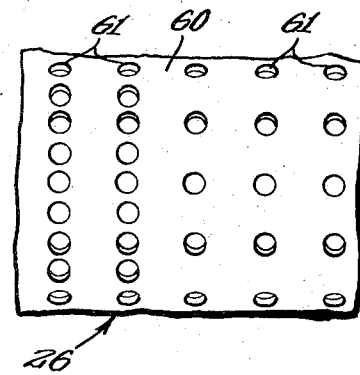
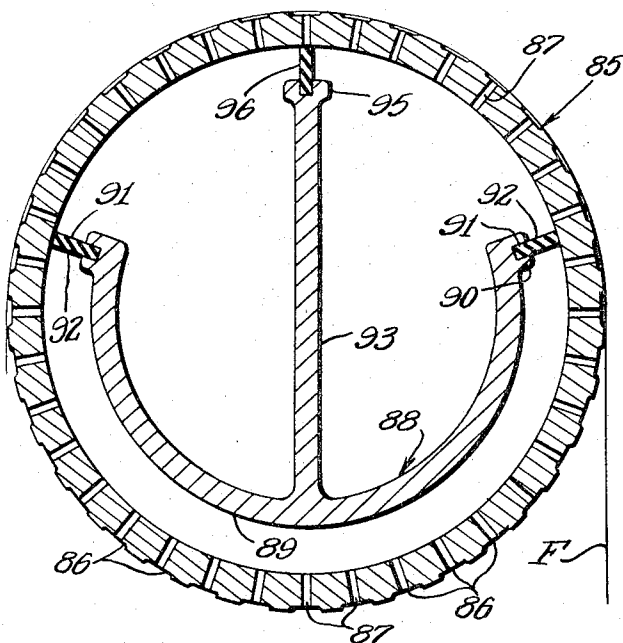
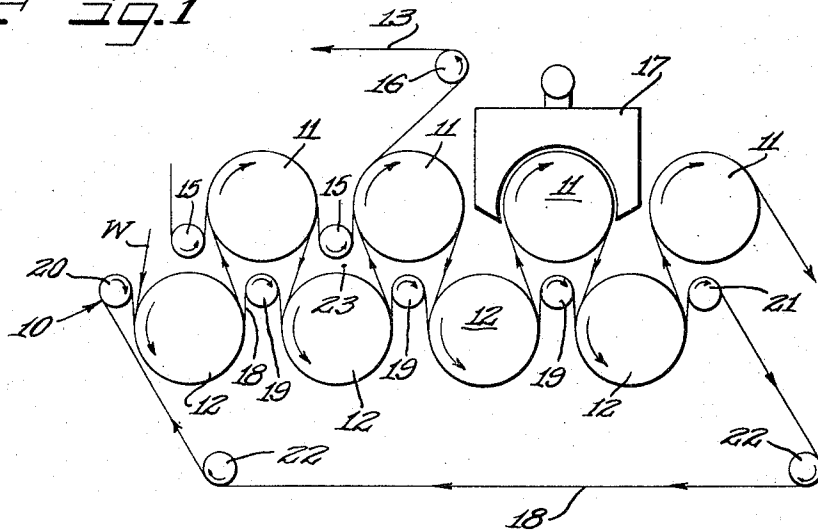


Fig. 6

Fig. 7

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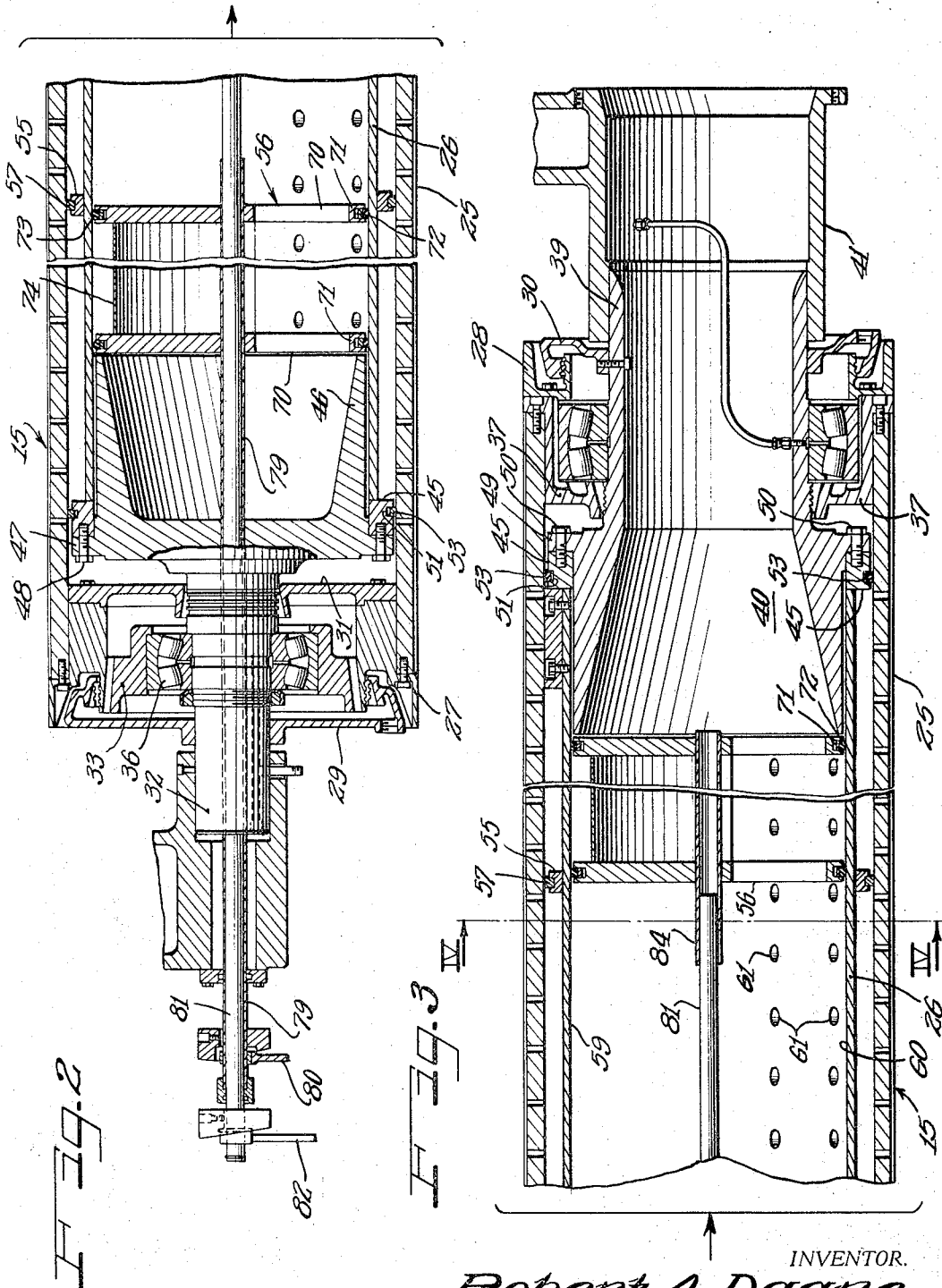
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3 Sheets-Sheet 2



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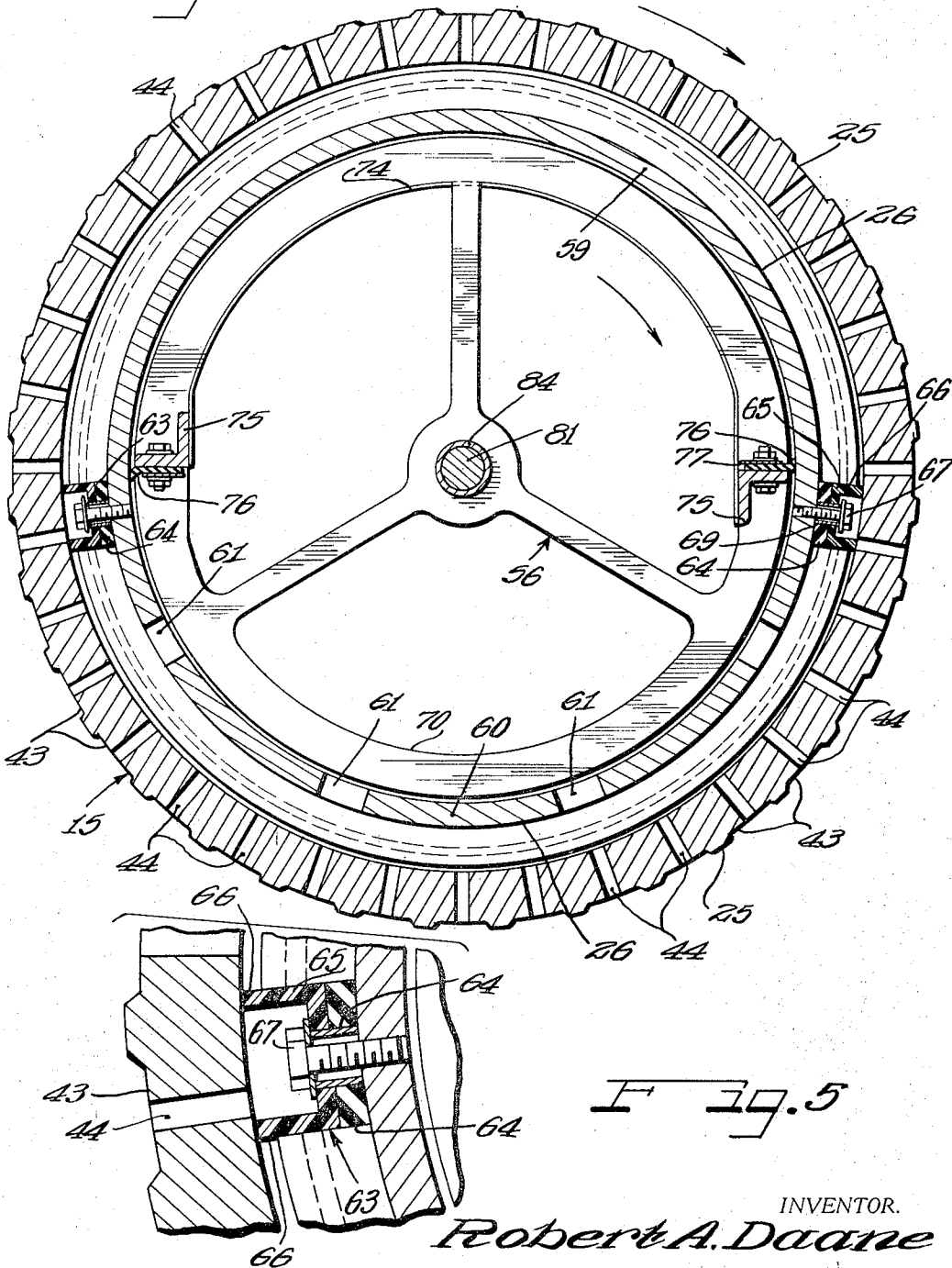
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DRYER VENTILATING ROLL

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3 Sheets-Sheet 3

F 19.4



F 19.5

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3,345,757

DRYER VENTILATING ROLL

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ABSTRACT OF THE DISCLOSURE

Ventilating felt roller, ventilating and purging the felt pocket of a web dryer from vapor. The felt roller has a perforate periphery with a central air distributing shell spaced inwardly of the periphery of the roller and sealed to the interior of the roller to direct air through the perforate periphery of the roller into the felt pocket. The flow of air through the distributor shell may be varied at each end portion of the shell through independently adjustable air modulating valves at opposite ends of the distributor shell.

This invention relates to improvements in felt dryers for the drying line of a paper machine and more particularly relates to an improved form of pocket ventilating felt roller.

A principal object of the present invention is to provide an improved form of ventilating felt roller arranged with a view toward more uniformly drying and conditioning of the felt as it passes from one drying cylinder to another.

A further object of the invention is to provide a ventilating system for the felt pockets of web dryers, uniformly purging the felt pockets from vapor, and thereby increasing the rate of drying of the web as the web passes from the outgoing side of one drying cylinder to the incoming side of a next adjacent drying cylinder.

A still further object of the invention is to increase the rate of drying of paper webs and the like by passing heated air through the felt and transferring the heat of the felt to the web as the felt passes over the web on the dryer.

A still further object of the invention is to provide an improved system for leveling the moisture profile of paper machine dryers by passing heated air through the felt, into the felt pockets and to so distribute the air as to uniformly dry the web throughout the width thereof.

A still further object of the invention is to improve upon the drying of paper webs and the like in the drying section of a paper machine, by passing a sufficient quantity of heated air through the felt roller into the felt pocket to purge the air from the pocket from where it passes out from both ends of the pocket.

A still further object of the invention is to provide a simple and improved form of felt roller, reducing and leveling felt pocket vapor pressure while heating and drying the felt, and thereby increasing the drying capacity of the dryer and flattening the sheet moisture profile.

Still another object of the invention is to provide an improved form of ventilating dryer roller in which the periphery of the roller has uniformly spaced indentations extending longitudinally therealong with air flow orifices opening into the indentations, to thereby support the felt free from the discharge ends of the air flow orifices and to provide a more efficient and increased air flow area through the felt.

A still further object of the invention is to provide an inner stationary air distributing shell for distributing air to flow through the perforated periphery of a felt roller having an air flow pattern of decreasing density toward the far end of the distributor, to compensate for high

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velocity pressure and low static pressure at the inlet end of the roll and to thereby uniformly distribute the air along the periphery of the felt roll into the felt pocket.

These and other objects of the invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

FIGURE 1 is a diagrammatic view of a part of a typical dry end section of a paper machine, incorporating a felt pocket ventilating system constructed in accordance with the principles of the present invention;

FIGURE 2 is a longitudinal sectional view taken through one-half of a modulated felt roller constructed in accordance with the principles of the present invention;

FIGURE 3 is a longitudinal continuation of the modulated ventilating felt roll illustrated in FIGURE 2;

FIGURE 4 is a transverse sectional view taken substantially along line IV—IV of FIGURE 3;

FIGURE 5 is an enlarged fragmentary detail sectional view, illustrating certain details of the longitudinal sealing arrangement between the distributor shell and the inner periphery of the felt roll;

FIGURE 6 is a diagrammatic view illustrating a pattern of the periphery of the distributor shell not having modulating valves at opposite ends of the shell; and

FIGURE 7 is a transverse sectional view of a modified form of felt roller constructed in accordance with the principles of the present invention.

In the embodiment of the invention illustrated in the drawings, I have shown in FIGURE 1, a paper machine dry end section 10 and including an upper tier of drying cylinders 11 arranged in a row, and a lower tier of drying cylinders 12 vertically staggered with respect to the upper tier of drying cylinders 11. The drying cylinders 11 and 12 have a web W trained thereabout in a serpentine path throughout the length of the dryer section.

The web is partially wrapped about a first and second of the top tier of drying cylinders by a felt 13, maintaining the web in close contact with its drying cylinders and partially wrapped to the web, passing about the drying cylinders, by felt rollers 15, 15. As shown in FIGURE 1 only a part of the tier of upper dryer cylinders is shown and the felt is trained from the second drying cylinder 11 from the left, upwardly about an idler 16 from which it is trained to a first drying cylinder of a series of drying cylinders. A dryer hood 17 is shown as extending partially about the third drying cylinder from the left of the upper tier of drying cylinders, for impinging heated air on the web prior to passing beyond the end of the dryer. The dryer hood, however, forms no part of the present invention and need not necessarily be in the upper tier of drying cylinders.

The web is partially wrapped around the bottom series of drying cylinders 12, 12 by a felt 18, partially wrapped about said cylinders by felt rollers 19, 19 between the drying cylinders and end felt rollers 20 and 21. The felt passes from the end felt roller 21 around spaced idlers 22, 22 turning the felt from the felt roller 21 beneath the drying cylinders 12, 12 to and around the felt roller 20, to an incoming drying cylinder 12.

The felt roller 15 between two dryer drums 11, 11 trains the felt to pass out of contact with the web from the outgoing side of one drying cylinder 11 to the incoming side of the next adjacent drying cylinder 11. The felt being out of contact with the web, moisture in the web is evaporated and proceeds outwardly of the web and collects in a pocket between the outgoing side of one drying cylinder 11 and the incoming side of the next adjacent drying cylinder 11 as well as the next downwardly spaced cylinder 12. This pocket is indicated by reference character

23 and is commonly termed a felt pocket. Additional pockets are formed between each outgoing and incoming dryer cylinder 11, 11 and 12, 12 for the length of the dryer line.

Moisture in the pockets inhibits evaporation from the web, requiring an increased dryer and web temperature and also increasing the drying time.

It should here be understood that the felts 13 and 18 are formed from a porous material and may be of any type fabric which will allow air to be passed through it. The felts also may be formed of plastic wire fabric such as used on fourdriniers, a suitable material being a foraminous plastic wire or fabric of the type known as Formex fabric, which permits moisture vapor to be driven through the fabric and out of the ends of the fabric, by heated air passing out through the periphery of a felt roller.

The upper felt rollers 15 and the lower felt rollers 19 are of similar constructions so the upper felt rollers 15 only need herein be shown and described.

As shown in FIGURES 2, 3, 4 and 5, the felt roller 15 includes a rotatable cylindrical perforate outer shell 25 and a stationary cylindrical inner air distribution shell 26, spaced radially inwardly of the inner periphery of the outer shell and extending for substantially the length of said outer shell and coaxial therewith.

The outer shell 25 has rings 27 and 28 bolted to the ends thereof and forming continuations of the periphery thereof to retain the felt from exposure to any non-rotating surfaces at each end of the shell and to shroud stationary oil collectors 29 and 30 respectively.

The ring 27 abuts the end of the shell 25 and extends inwardly therealong for a portion of the length thereof and has a plate 31 secured to its inner end and cooperating with a stationary hollow support shaft 32 to act as an oil collector to prevent oil from mixing with air within the shell 25. The ring 27 forms a mounting for a bearing support 33 rotatably supporting the front end of the shell 25 on a stationary hollow shaft 32 on suitable bearings, herein shown as being thrust types of roller bearings 36.

The ring 28 abuts the outer side of a radially flanged bearing support 37, supporting the back end of the shell 25 on a stationary air inlet member 39 having a flared discharge throat 40 to produce a venturi effect as heated air is supplied to the interior of the shell 26. The outer end of the air inlet member 39 extends within an air supply pipe 41 and may be slidingly fitted thereto. The air supply pipe 41 is connected with a source of supply of heated air and may be supported on the dryer frame in a suitable manner and form a support for one end of the air distributing shell 26. The air may preferably be hot dry air of a temperature of 250° F. with a maximum moisture content of 300 grams of water per pound of dry air at the distributor entrance.

The outer shell or roll 25 may be formed from a mild steel centrifugal casting, turned and bored and then grooved with a plurality of longitudinal extending grooves 43 extending for the length thereof and equally spaced thereabout. Air distributing passageways or orifices 44 may then be drilled through the grooved portions of the shell at equally spaced intervals along the grooved portions thereof. The drilling pattern is herein shown as being a uniform rectangular drilling pattern. The diameters of the passageways 44 and drilling pattern thereof is such as to give a minimum of 5% open area. Such a drilling pattern results in a very stiff roll of a deflection less than the conventional felt roll, the roll would replace. In order to increase the open area at the interface between the roll and the felt without weakening the rotating shell, the longitudinal grooves have been machined along the periphery of the shell. The grooves are relatively shallow and are flared at each side and make it possible to have an interface open area such that 80% of the felt is directly exposed to the air coming through the passageway 44.

The air distributing shell 26 is shown as abutting annular ring seats 45 at its opposite ends, which may be welded or otherwise secured to the end of the shell. The ring seat 45 at one end of the distributor shell 26 extends about a hollow drum 46, shown as being formed integrally with the stationary shaft 32. The ring seat abuts a radial flange 47 extending radially of said drum. Machine screws 48 are provided to secure the ring seat 45 and shell 26 to the drum 46. The drum 46 extends inwardly along the shell, for a short portion of the length thereof, and opens toward the interior of the shell and serves as an end frame member for the shell to retain air from passing through the end thereof.

The opposite ring seat 45 extends along the periphery of the air inlet member 40 and abuts a radially extending flange 49 of said air member, and is secured thereto as by machine screws 50. The annular ring seats 45, 45 have ring grooves 51 formed therein for receiving sealing rings 53, which may be cast iron piston rings, expanding out against the inner surface of the outer shell and rotating with said outer shell. Alternatively, the piston rings may be of a non-metallic material such as that known by the trade name "Pyrotex."

Ring seats 55 similar to the ring seats 45 encircle the shell 26 in inwardly spaced relation with respect to the ring seats 45 at the inner end portions of modulator valves 56, 56 at opposite ends of the shell. The ring seats 55 may be welded or otherwise secured to the periphery of the shell 26 and carry piston rings 57 like the piston rings 53, expanding out against the inner surface of the shell 25 and rotating therewith.

The air distributing shell 26 has an imperforate wall portion 59 on the opposite side of the shell from the felt and has a perforate wall portion 60 having a plurality of air flow passageways or orifices 61, 61 leading there-through.

Where the felt roller 15 is a non-modulating type of roller, the drilling pattern may be graduated as diagrammatically shown in FIGURE 6, to decrease the density of the holes toward the closed ends of the air distributing shell. This design relies on the fact that the total pressure is the sum of the static pressure and the velocity pressure, and at the inlet, where the velocity pressure is at a maximum, the static pressure is low. As the closed end of the shell is approached the velocity decreases, thus lowering the velocity pressure, while the static pressure increases, requiring less open area for the same rate of flow per foot of felt, to compensate for the reduced static pressure on the ends of the air distributor shell, because of the high velocity of the air, and to thereby provide a uniform discharge of air across the roll width.

Where, however, the shell has modulator valves therein, such as the modulator valves 56 shown in FIGURES 2, 3 and 4, the hole pattern may be uniform for the length of the roll.

The shell 26 has two longitudinally extending seals 63 extending radially from the outer periphery thereof at opposite ends of the imperforate face 59 of the shell. These longitudinal seals each include a resilient pad 64 extending along the periphery of the shell, and a generally U-shaped non-metallic seal 65 extending along the top of the pad 64 and having parallel spaced legs 66, 66 engaging the inner periphery of the outer shell 25. Spaced machine screws 67 extending through collars 69 extending through the base of the seal 65 and the rubber pad 64, are provided to retain the seal in position on the shell. The ends of the legs of the seal engage the inner periphery of the outer shell during assembly and compress the rubber pad 64, as shown in FIGURE 5. The seal is then allowed to run in after assembly and to wear until the play in the bolts or machine screws 67 is taken up, as shown in FIGURE 5.

Alternatively, the longitudinally extending seals may be mounted on hinges and lightly loaded with springs so

that they bear against the rotating shell with a small but definite pressure.

A suitable material from which the non-metallic seals may be made is known by the trade name of "Pyrotex." This material has a low coefficient of friction and can stand rubbing over long periods of time. Another material that may be used is known by the trade name of "Teflon."

The modulator valves 56 at each end of the air distributor shell 26 are shown in FIGURES 2, 3 and 4 as being spoked wheels 70, 70 spaced along the axis of the roller at each end thereof. The wheels 70 have cylindrical rims 71 having sealing grooves 72 in the peripheries thereof, having seals 73 carried therein and engaging the inner periphery of the air distributor shell 26. The wheels 70 are connected together by a shroud 74 welded or otherwise secured to the legs of angle brackets 75, secured to the sides of the rims of the wheels on the right angled legs thereof. The other legs of the angle brackets 75 have resilient seals 76 clamped thereto by clamping plates 77. The angle brackets 75 are connected between two adjacent wheels and extend in the space between the two adjacent wheels and the seals 76, mounted thereon, seal the space covered by the shroud 74.

The two wheels at one end of the air distributing shell 26 are mounted on a sleeve 79 extending through the hollow shaft 32 and outwardly beyond the end thereof. A suitable securing connection may be provided between the sleeve and the two wheels to rotate the wheels together and vary the number of the air distribution passageways 61 in communication with the passageways 44, 44, upon the turning of a hand lever 80 on the outer end portion of said sleeve. A shaft 81 extends along the sleeve 79 from a position disposed outwardly of said sleeve and has a hand lever 82 mounted thereon. The shaft 81 extends beyond the modulator valve 56, operated by the sleeve 79, to and through a sleeve 84 extending along and connected to the hubs of the wheels 70, 70 of the modulator valve 56, at the opposite end of the air distributor shell, and is suitably secured thereto to be turned upon turning movement of a hand lever 82, to vary the number of the air distributor passageways 61 in the space between the wheels 70, 70.

The two modulator valves 56, 56 therefore provide two sealed cylinder halves in the air distributor shell 26, one being at each end of the shell, to block off or selectively open certain air passageways 61, 61, to thereby vary the supply of air to the face of the roll 15, at the ends of said roll. The two valves 57 are independently operated, so the air flow can be blocked off at the front end portion of the roll or the back end portion of the roll or at both end portions of the roll as required. The air passageways at each end of the roll may also be fully opened.

Although only two modulator valves are herein shown, any number of valves may be used.

Suitable dampers (not shown) may be provided in the supply line to the pipe 41 to regulate the entire air supply required. Such dampers may be well known forms of manually operable butterfly dampers, and are no part of the present invention so need not herein be shown or described further.

In FIGURE 7 I have shown a cross section of a modified form of non-modulating felt roll and air distributor therefor. In this form of the invention the felt roller is in the form of a shell 85 having parallel grooves 86 extending longitudinally therealong and having rows of air passageways 87 opening therethrough, as in the form of the invention illustrated in FIGURES 2, 3, 4 and 5. A stationary air distributor 88 is mounted within the shell 85 and includes a generally hemi-cylindrical wall portion 89 having lugs 90, 90 extending radially outwardly from each end thereof and having grooves 91 extending therealong receiving seals 92, having sealing engagement with the inner face of the roll shell 85. The air distributing member also has a central diametral spoke 93 extending from the inner side of the hemi-cylindrical wall portion 89 and

having a widened free end portion 95 having a seal 96 recessed therein and engaging the inner periphery of the roll shell.

Air entering the shell from an end thereof, on opposite sides of the diametral spoke 93, will thus be discharged through the air passageways 87 in the periphery of the shell and through a felt trained thereabout to uniformly dry the felt and also to provide an air supply to drive the moisture vapor from the ends of the felt pockets. The air distributor 88 may be adjusted about the axis of the roll shell 85 to vary the distribution of air to the felt, and if desired air may be admitted to one side or the other of the spoke 93 to vary the volume of air passing through the felt.

It may be seen from the foregoing that a new and improved felt roller has been provided supplying heated air through the felt to not only purge the felt pockets of moist air but to also uniformly dry and condition the felt as it passes from the outgoing side of one drying cylinder to the incoming side of the next adjacent drying cylinder and that the felt roll of the present invention, not only increases the drying capacity of the dryer line, but also improves the moisture profile and eliminates the need for separate felt dryers for the felt as it leaves the outgoing drying cylinder of a tier of drying cylinders and passes to the incoming drying cylinder of the same tier of drying cylinders.

While I have herein shown and described one form in which the invention may be embodied, it may readily be understood that various variations and modifications in the invention may be attained without departing from the spirit and scope of the novel concepts thereof.

I claim as my invention:

1. In a felt roller for paper machine dryers comprising:
 - a cylindrical roll shell mounted for free rotation about a horizontal axis and having a plurality of air passageways leading through the periphery thereof from the hollow interior thereof for passing heated air therethrough,
 - a hollow non-rotatably cylindrical air distributor shell spaced radially inwardly of the inner periphery of said roll shell and extending therealong and having a perforate area having air distributor passageways leading therethrough for supplying heated air to said air passageways leading through the periphery of said roll shell,
 - circumferentially and axially spaced sealing means sealing said area of the interior of said roll shell.
 - and modulator valve means rotatably mounted at each end of said distributor shell for adjustable movement about the inner periphery of said distributor shell,
 - said modulator valve means having circumferentially and axially spaced seals having sealing engagement with the interior of said distributor shell and being movable to seal off the opposite end portions of the passageways leading through said distributor shell and to vary the flow through said passageways,
 - and adjustment means connected with each modulator valve means for adjustably moving said modulator valve means independently of each other.
2. The structure of claim 1,
 - wherein the modulator valve means comprise imperforate shrouds sealed by said sealing means to the interior of said distributor shell along the ends and opposite sides of said shrouds.
3. In a drying apparatus for fibrous webs,
 - a rotatable felt roller partially wrapping a felt to a web trained about spaced drying cylinders in a serpentine path,
 - said roller being hollow and having a plurality of air passageways leading through the periphery thereof from the hollow interior thereof for passing heated air through the felt passing thereabout,
 - a hollow cylindrical air distributor shell spaced radi-

ally inwardly of the inner periphery of said roller and extending therealong and having air distributor passageways leading through a portion of the periphery thereof, for supplying heated air to said air passageways of said roller,

and modulator valves at opposite ends of said shell for varying the flow rate of air through the opposite end portions of said shell,

said modulator valves comprising:

spaced wheels disposed adjacent each end portion of said shell and accommodating the flow of air through said shell,

and arcuate shrouds disposed between said wheels and positionable to shroud certain air passageways leading through said shell, at the selection of the operator of the machine.

4. In a drying apparatus for fibrous webs,

a hollow rotatably mounted felt roller partially wrapping a felt to a web trained about spaced drying cylinders in a serpentine path,

a plurality of air passageways leading through said roller from the interior to the exterior thereof, for forcing heated air through the felt passing thereabout,

a hollow cylindrical air distributing shell spaced radially inwardly of the interior of said roller and having a perforate peripheral portion and an imparate peripheral portion forming a continuation of the perforate peripheral portion of said shell,

longitudinal seals extending along the outside of said air distributor shell, along opposite sides of the perforate peripheral portion thereof, for substantially the length thereof, and having sealing engagement with the hollow interior of said roller,

circumferential sealing means sealing the ends of said shell to said roller,

means admitting heated air to said shell through one end thereof,

and modulator valve means at opposite ends of said shell, to vary the volume of air supplied to opposite end portions of said felt roller,

said modulator valve means comprising:

two wheels rotatably mounted at each end of said shell,

shrouds extending between said wheels for a portion of the circumference thereof and positionable to shroud a portion of the perforate peripheral portion of said shell,

and means operable from the outside of said roller for independently moving said valve means at each end of said shell, at the selection of the operator of the dryer.

5. A felt roller comprising,
a roll shell having a cylindrical wall,

bearing means supporting said shell for free rotation about a horizontal axis,

said wall having a plurality of uniformly spaced air passageways leading therethrough,

a cylindrical air distribution shell disposed within said roll shell and extending therealong for substantially the length thereof in inwardly spaced relation with respect thereto,

said air distributor shell having air distribution passageways leading therethrough for a portion of the periphery thereof,

means admitting heated air to one end of said shell, circumferential sealing means sealing opposite ends of said air distributor shell to the interior of said roll shell,

and rotatable valve means within said air distributor shell at each end thereof and selectively operable from the outside of said shell to vary the flow of air through the opposite end portions of said roll shell.

6. A felt roll in accordance with claim 5,

wherein the rotatable valve means at opposite ends of the air distributor shell are in the form of wheels rotatably mounted within said shell,

wherein shrouds extend between said wheels,

and wherein the air passageways open through the adjustably moving said modulator valves at opposite ends of the shell, independently of each other, to vary the distribution of air through opposite ends of the roll shell.

7. A felt roll in accordance with claim 5,

wherein the roll shell is uniformly and longitudinally grooved throughout the periphery thereof at spaced intervals,

and wherein the air passageways open through the bases of said grooves

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,345,757 Dated October 10, 1967
Inventor(s) Robert A. Daane

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

Column 7, line 26, correct spelling of "imperforate".

Column 8, line 26, change "the air passageways open through the" to
--coaxial operating means are provided for--.

SIGNED AND
SEALED

NOV 4 1969

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents