Jan. 5, 1960 L. B. CUNDIFF 2,919,904

DRYER DRUM

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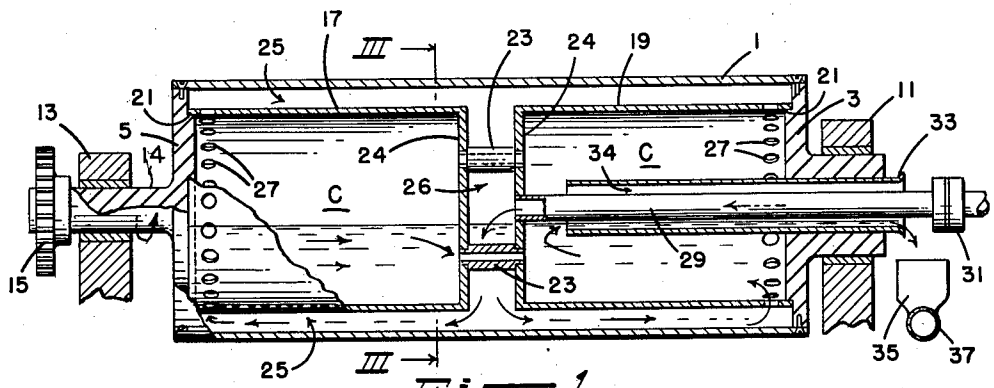


Fig. 1

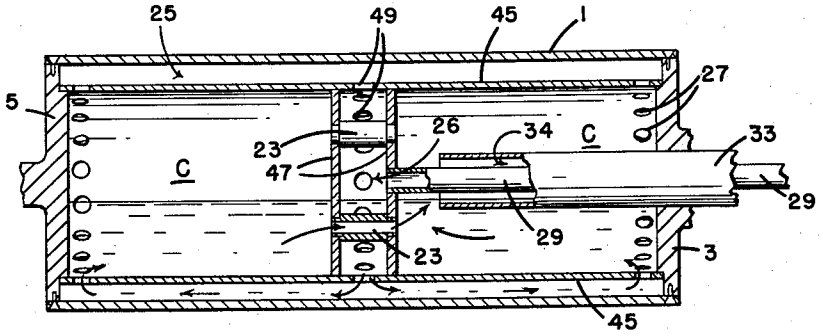


Fig. 2

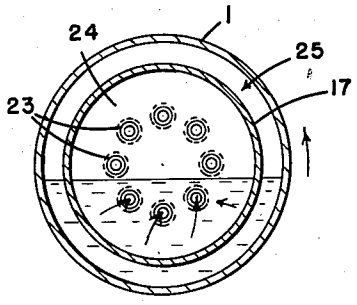


Fig. 3

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2,919,904

DRYER DRUM

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The present invention relates to a drying roll which is used for drying traveling sheets of flexible material such as cellophane. In particular, the invention relates to a drying roll which when in operation maintains a temperature differential between the end and more central surface portions of the roll. The invention also relates to a method for circulating the heating medium within the drying roll.

In the production of continuous flexible sheet material such as cellophane, the general practice is to dry the wet sheets by passing them over a series of rotating hollow rolls which are internally heated by a suitable heating medium such as steam or hot water. With these rolls, the entire roll surface is maintained at substantially uniform temperature. In view of this factor, many difficulties and disadvantages are encountered which tend to produce final sheet products of inferior quality.

When using the above-described uniform temperature rolls, it has been found that the edge portions of the film or sheet are dried more rapidly than the more central portions of the film whereby the final film has a non-uniform moisture content. The edge portions of the sheet are sometimes in brittle condition in view of the fact that they contain less moisture than the remainder of the sheet. In addition, the sheet edge portions shrink more rapidly than the central portions of the sheet whereby the final film or sheet has curly or floppy edges which tend to tear or rip at the slightest provocation; thus marring or damaging the entire sheet. Obvious difficulties are encountered when using such a sheet of non-uniform strength and moisture content in wrapping machines, packaging machines, multicolor printing machines, etc.

Various drying methods and apparatus have been experimented with in the past in an attempt to overcome these difficulties and disadvantages mentioned above. To date, none of these methods or apparatus has proved satisfactory. For example, efforts have been made to mechanically prevent uneven shrinkage of the film during the drying operation by clamping or gripping the sheet or film at the film edges to apply tension to the sheet away from the sheet center to counteract any rapid shrinkage of the sheet edge portions. It was found, however, that the clamps tend to tear or rip the edge portions of the sheet or film.

It is therefore one object of my invention to provide a novel and improved drying roll for traveling sheets of flexible material which can be used to produce final sheet products which have uniform moisture content and a uniform shrinkage pattern.

Another object of my invention is to provide a novel and improved drying roll wherein a temperature differential is maintained between the end and more central portions of the roll surface.

Still another object of my invention is to provide a novel and improved drying roll which has means for controlling the circulation of the heating medium within

the drum interior to provide cool ends for the drying roll.

Other objects and advantages of my invention will become more apparent from a study of the following descriptions and drawings wherein:

Figure 1 is a longitudinal section of my drying roll showing the internal structure of the roll;

Figure 2 is a longitudinal section of an embodiment of my drying roll which shows the internal roll structure; and

Figure 3 is a section taken along lines III—III of Figure 1.

Briefly, my invention comprises a drum with a pair of end closures. Within the drum interior are a pair of sealed-off and spaced-apart generally cylindrical compartments which lie in end-to-end relationship longitudinally of the drum. A central chamber is provided between the compartments. An annular channel between the inner surface of the drum and the cylindrical compartments connects with the chamber between the spaced-apart compartments. The annular channel extends the length of the drum. Means are provided for supplying a heating medium into the chamber between the compartments. A plurality of ports extend around and through each compartment at the outer ends thereof to permit the heating medium to pass into the compartment interiors. Discharge means are provided through which the heating medium is discharged from the compartment interiors and the drum itself.

Referring now to the drawings, and more particularly to Figure 1, my drying roll comprises a drum **1** having end closures **3** and **5** for sealing off the drum interior. The end closures **3** and **5** are supported for rotation in journal supports **11** and **13**. A drive gear **15** for rotating the drum is affixed to a shaft extension **14** of the end closure **5**.

As further seen in Figure 1, a pair of inner shells **17** and **19**, preferably of substantially cylindrical shape, are positioned endwise in spaced-apart relationship within the drum interior. The outer end of each shell is open and supported by shoulders **21**, **21** of the drum end closures **3** and **5** to substantially seal off the shell interiors from the drum interior to provide substantially sealed-off compartments C, C. To connect the sealed-off compartments C, C with one another, a series of connecting conduits **23**, **23** (also see Figure 3) are supported by and extend through the opposing inner end walls **24**, **24** of the shells **17**, **19**. Since, as seen in the drawing, the shells are of smaller diameter than the drum, an annular channel **25** is provided between the inner surface of the drum **1** and the shell surfaces. This channel extends for the full length of the drum **1** and lies in communication with a chamber **26** formed between inner end walls **24**, **24** of the shells **17**, **19** adjacent the mid-point of the drum **1**.

The interior of each shell **17**, **19** or compartment C is connected with the annular channel **25** at the outer end of each shell by a series of ports or openings **27**, **27** which extend around and through the shell peripheries at the outer end of each shell.

A heating medium supply conduit **29** extends through the drum end closure **3**, through the interior of shell **19** and into the chamber **26** between the opposing inner ends of shells **17**, **19**. The supply conduit **29** is mounted externally of the drum in a rotary type bearing assembly **31** whereby the supply conduit **29** may rotate with the drum.

A heating medium discharge conduit or outlet **33** is positioned concentrically around the supply conduit **29** and is supported in place as shown in the drawing. The discharge conduit **33** also rotates with the drum **1**. The interior end of the discharge conduit terminates at a

point within the interior of shell 19. The discharge conduit is of larger diameter than the supply conduit 29 whereby an annular pasage 34 is provided between the two conduits which passage opens at a point externally of the drum into a tank 35 which leads into a recirculation system 37 for the heating medium.

In operation, the heating medium such as steam or hot water passes through the supply conduit 29 and empties into the chamber 26 between the opposing inner ends of shells 17, 19. From this point, the drying medium passes outwardly to the annular channel 25 where it is divided into two streams. The streams then travel in opposite directions through the annular channel 25 toward the ends of the drum 1. The heating medium passing through the annular channel 25 heats the surface of drum 1 during its travel. As the medium approaches the extreme ends of the channel 25, it passes through the ports 27, 27 at the end of each shell 17, 19 whereupon the heating medium is collected within the shell interiors. As the drum continues to rotate, the heating medium from the interior of shell 17 passes through the connecting conduits 23, 23 for the shells and enters the interior of shell 19. From this point, the heating medium passes through the discharge conduit 33 and into the recirculation system 37. Simultaneously, the heating medium passing through ports 27, 27 of shell 19 also enters the discharge conduit 33 and is discharged in similar manner as described above to the recirculation system 37.

With this arrangement, it is obvious that the end surface portions of the drum surface will constantly be maintained at a lower temperature than the more central portions of the drum surface since the temperature of the heating medium will gradually decrease through heat transfer as it travels outwardly in opposite directions from the mid-point of the annular channel 25 toward the ends of the channel 25.

A modification or embodiment of my drier roll is seen in Figure 2 of the drawing. The difference between the structures of Figure 1 and Figure 2 lies principally in the feature that a single unitary inner shell 45 is used instead of the pair of shells 17, 19 of Figure 1. With the embodiment of Figure 2, a pair of spaced-apart partition plates 47, 47 which form a seal fit with the inner surface of the shell 45 are supported in spaced-apart relationship within the inner shell 45 adjacent the shell center to provide a pair of sealed-off compartments C, C and to provide a central chamber 26 between the partition plates as with the embodiment shown in Figure 1. To permit the heating medium entering the chamber 26 defined by the plates 47, 47 to pass into the annular channel 25 provided between the interior surface of the drum 1 and the single inner shell 45, a series of ports 49, 49 extend around and through that portion of the periphery of shell 45 surrounding the chamber 26 defined by the plates 47, 47. The remainder of the structure shown in Figure 2 is essentially the same as that of Figure 1.

With the embodiment of Figure 2, the heating medium is circulated and discharged from the compartments and drum in the manner described with respect to the drum shown in Figure 1 of the drawing.

Although the difference in temperature between the central and end surface portions of the drum will remain substantially constant, the temperature of the central and end surface portions of the drum may be adjusted by varying the temperature of the drying medium introduced within the drum.

With both the embodiments described above, the temperature of the heating medium decreases as it travels outwardly through the annular channel 25 toward the ends of the drum since the more central surface portions of the drum absorb the heat from the medium. The end surface portions of the drum are therefore somewhat "cooler" than the more central surface portions of the drum.

It is to be understood that my invention is not necessarily limited to the embodiments set forth in the drawing. Changes and variations may be incorporated within the structure without departing from the spirit or scope of the present invention as defined in the appended claims.

I claim:

1. A drying roll comprising a drum, end closures for the drum, a pair of sealed-off and spaced-apart generally cylindrical compartments lying in endwise relationship within the drum interior whereby a chamber is formed between the compartments, said compartments having a smaller diameter than that of the drum and lying concentrically with the drum whereby a substantially annular channel is formed between the inner surface of the drum and the cylindrical compartments, said annular channel communicating with the chamber, conduits supported by and extending through the opposing ends of the compartments for connecting the compartment interiors, a conduit extending through one end of the drum and through one of the compartments which conduit terminates within the chamber between the compartments for introducing heating liquid into the chamber, a plurality of ports leading into the compartments which connect with the annular channel at the outer end of each compartment for collecting within the compartment interiors the heating liquid passing through the annular channel, a heating liquid exhaust conduit concentrically positioned around the heating medium supply conduit and terminating within the compartment housing the supply conduit, said exhaust conduit collecting both the heating liquid passing into the compartment interior from the other compartment through the connecting conduits for the two compartments and the heating liquid passing into the compartment housing the exhaust conduit through the compartment ports, and means affixed to one of the end closures of the drum for rotating the drum.

2. A drying roll according to claim 1 wherein the compartments comprise an inner shell supported in position by the drum end closures, and a pair of spaced-apart partition plates positioned within the inner shell of the drum adjacent the center thereof and forming a seal fit with the inner surface of the shell, said plates also defining the center chamber into which the heating liquid is introduced.

3. A drying roll according to claim 2 comprising a series of outlet ports extending through and around the shell surface surrounding the area between the plates whereby the heating liquid introduced within the chamber may pass into the annular channel.

4. A liquid heated drying roll comprising a drum, end closures for the drum, a pair of cylindrical shells mounted within said drum and coaxially therewith, said shells being closed at their outer ends by the end closures for the drum, closures for the inner ends of said shells, said shells being of smaller diameter than the drum whereby annular passages are formed between the shells and the drum, the closures for the inner ends of said shells being spaced apart so as to provide a chamber therebetween which is in open communication with said annular channels, a liquid conducting conduit extending through one of said end closures the interior of the adjacent shell and the closure closing the inner end of said shell and terminating in said chamber for supplying a heating liquid to said chamber, a plurality of ports through said shells near the outer ends thereof placing the interiors of the shells in communication with said annular channels whereby liquid supplied to said chamber flows through said annular channels from the central part of said drying roll toward the ends thereof and into the interior of said shells, a conduit extending through the closures for the inner ends of said shells and placing

the interiors of said shells in communication with one another, discharge means for discharging the heating liquid from one of said shells, and means for rotating the drum.

5. A drying roll as set forth in claim 4 wherein said liquid conducting conduit is coaxial with the axis of said drum.

6. The drying roll according to claim 4 wherein the discharge means is a conduit located coaxially and outside of said liquid conducting conduit and communicating with the interior of the shell through which said liquid conducting conduit passes.

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