Oct. 18, 1960 G. F. MUELLER 2,956,348

DRYING ROLL

Filed Aug. 6, 1956

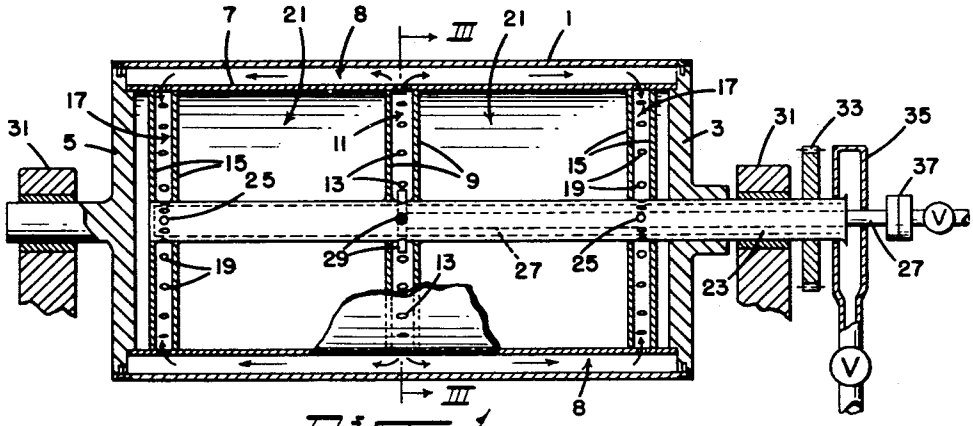

Fig. 1

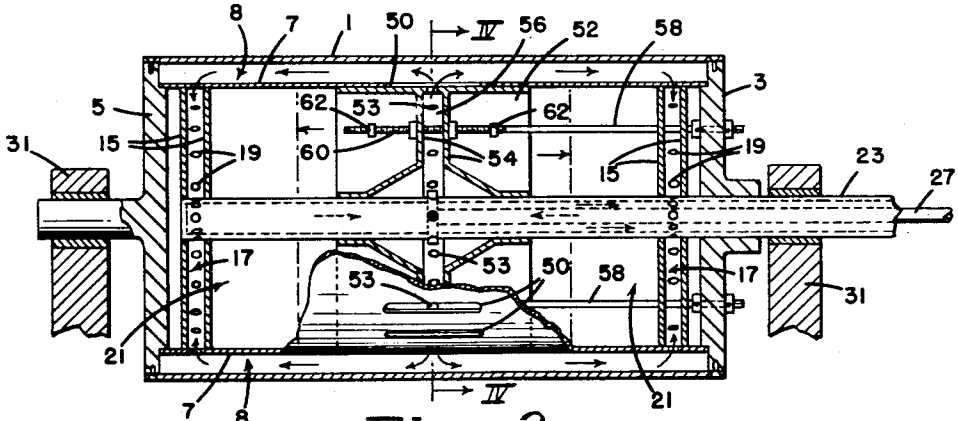

Fig. 2

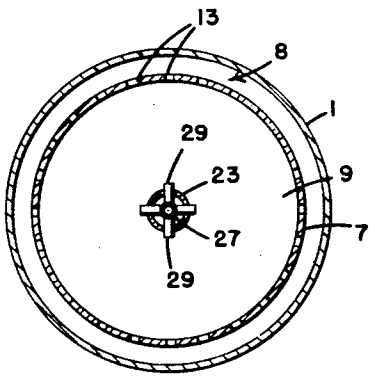

Fig. 3

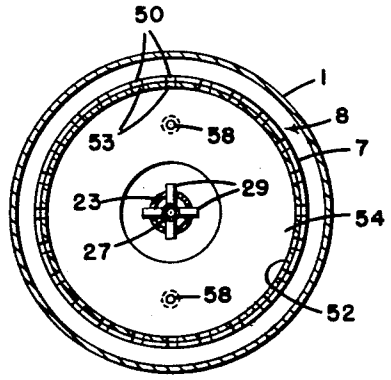

Fig. 4

United States Patent Office 2,956,348
Patented Oct. 18, 1960

2,956,348

DRYING ROLL

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Filed Aug. 6, 1956, Ser. No. 602,112

4 Claims. (Cl. 34—124)

The present invention relates to a drying roll for drying traveling sheets of flexible material such as cellophane. In particular, the invention relates to a drying roll which maintains a temperature differential between the end and central surface portions of the 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 rolls of uniform surface temperature, 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. As a result of the faster edge drying, the edge portions of the sheet are sometimes in brittle condition in view of the fact that their moisture content is less than that of the remaining portions 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 flopping 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, multi-color printing machines, etc.

Various drying methods and apparatus have been devised in the past in an attempt to overcome these difficulties and disadvantages mentioned above. To date, none of these methods or apparatus has proved entirely 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 thereby applying tension to the sheet away from the sheet center and counteracting 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 sheets 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 during operation 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 description and drawing wherein:

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

Figure 2 is a longitudinal section of my drying roll showing an embodiment of the roll;

Figure 3 is a partial section taken along lines III—III of Figure 1; and

Figure 4 is a partial section taken along lines IV—IV of Figure 2.

Briefly, my drying roll comprises a drum having a pair of sealed-off airtight spaced-apart compartments of substantially cylindrical shape within the drum interior. These compartments lie in a spaced, end-to-end relationship longitudinally of the drum whereby a central chamber within the drum interior is provided between the compartments. A substantially annular channel lying between the compartment outer surfaces and the inner surface of the drum extends for the length of the drum and communicates with the chamber between the compartments. Means are provided for introducing a heating medium into the central chamber between the compartments, and heating medium collecting means which communicate with the annular channel are provided at each end of the drum to collect the heating medium passing through the annular channel from the chamber. Discharge means communicate with the collecting means for discharging the collected heating medium from the drum.

Referring now to the drawings, and more particularly Figure 1, my drying roll comprises an open end drum **1** having end closures **3** and **5** which seal off the drum ends. Within the drum **1** there is supported an inner shell **7** of substantially cylindrical shape and of somewhat smaller diameter than the drum **1**. The shell **7** extends for the full length of the drum **1** and is supported in position within the drum interior by the end closures **3** and **5**. Since the shell is of smaller diameter than that of the drum, an annular channel **8** lies between the inner surface of the drum **1** and the outer surface of shell **7** and extends the full length of the drum. As seen in the drawing, a pair of partition plates **9, 9** are positioned within and form a seal fit with the inner shell **7** to equally divide the interior of the shell **7**. The partition plates **9, 9** are supported in spaced-apart end-to-end relationship whereby a central chamber **11** is provided within the shell interior. This central chamber **11** communicates with the annular channel **8** through a plurality of ports **13, 13** extending around and through that portion of the shell **7** surrounding and lying between the partition plates **9, 9** (see Figure 3).

Adjacent each end of the shell **7** and positioned within the shell interior are a pair of end plates **15, 15** which also lie in spaced-apart relationship and form a seal fit with the inner surface of the shell **7**. The spaced-apart end plates **15, 15** define a collecting chamber **17** at each end of the shell which communicates with the annular channel **8** through a series of ports **19, 19** which extend through the end portions of the shell surrounding and lying between each pair of end plates **15, 15**. The innermost end plates **15, 15** seal off the outer ends of each compartment mentioned above to provide a pair of sealed-off compartments **21, 21** within the shell interior. Extending through the end closure **3** is a discharge conduit **23** which extends through the drum interior for substantially the length of the drum, including the end plates **15, 15** and the central partition plates **9, 9**. The collecting chambers **17, 17** are in communication with the discharge conduit through a plurality of ports **25, 25** extending through and around those portions of the discharge conduit which pass through the collecting chambers **17, 17**.

A heating medium supply conduit **27** also extend through the end closure **3** and is concentrically supported

within the discharge conduit **23**. The inner end of the supply conduit **27** terminates at a point adjacent the middle of the shell **7** and has a plurality of radially extending nozzles **29, 29** (see Figure 3) leading off therefrom which extend through the wall of the discharge conduit **23** into the central chamber **11** between the partition plates **9, 9**.

The drum is supported for rotation by the end closure **5** and the discharge conduit **23** which are mounted in supporting journal assemblies **31, 31**. A drive gear **33** is secured to the discharge conduit **23** for rotating the drum **1**.

As seen in the drawing, the outer end of the discharge conduit **23** opens into a collecting basin **35** which leads into a recirculation system (not shown) for the heating medium. The supply conduit **27** is supported for rotation with the drum by a rotary joint assembly **37**. Both the discharge conduit **23** and the supply conduit **27** for the heating medium rotate with the drum **1**.

With the above arrangement, the heating medium passes through the supply conduit **23** into the chamber **11** between the partition plates **9, 9**, through the ports **13, 13** of the shell **7** and into the annular channel **8** extending longitudinally of the drum **1**. The heating medium is then divided into two streams which pass in opposite directions toward each drum end at which point the streams pass through the ports **19, 19** of the collecting chambers **17, 17**. From the collecting chambers, the medium passes into the discharge conduit **23** through the discharge conduit ports **25, 25**. The medium then passes into the collecting basin **35** from which point it is recirculated through the drum interior.

As the heating medium travels outwardly through the channel **8** toward each end of the drum **1**, it, of course, decreases in temperature 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.

Another embodiment of my drier roll is shown in Figure 2 of the drawing. With the arrangement shown in Figure 2, the "hot point" of the drum surface may be varied adjacent the center point of the drum surface by laterally adjusting the point at which the heating medium strikes the inner periphery of the drum. Such adjustability is desirable since different types of sheet material, or even the same type of sheet material, exhibit different drying characteristics or patterns.

With this embodiment, the inner shell **7** has a plurality of elongated slots **50, 50** extending through and around the shell adjacent the mid-point thereof instead of the ports **13, 13** of the shell of Figure 1. Supported within and forming a seal fit with the inner surface of the shell **7** is a second inner shell **52** which is substantially shorter than the shell **7**. The second shell **52** lies immediately adjacent the slots **50, 50** of the shell **7** and extends for a short distance beyond either side of the slots. Within the second shell **52** are positioned and secured, to form a seal fit with the inner surface of shell **52**, a pair of spaced-apart partition plates **54, 54** which define a central chamber **56** therebetween. The plates **54, 54** have a convex hub portion which fits around and forms a seal fit with the discharge conduit **23**. A plurality of rods **58** (see Figure 4 also) extend through the drum end closure **3** and through the partition plates **54, 54** supported within the second inner shell **52**. The interior end of the rods **58, 58** are threaded as at **60** and cooperate with tapped holes cut through the partition plates **54, 54**. By rotating the rods **58, 58** simultaneously in either a clockwise or counter-clockwise direction, the inner shell **52** may be moved laterally of the shell **7** in either a backward or forward motion. This action will, of course, change the position of the ports **53, 53** extending through and around that portion of the second inner shell **52** surrounding and lying between the partition plates **54, 54** with respect to the elongated slots **50, 50**. The stops **62, 62** at the end of each threaded section **60** of the rods **58, 58** prevent the ends of the shell **52** from passing beyond the range of the slots **50, 50** so that the seal fit between the first and second shells **7** and **52** may be maintained. With this adjustable feature, the heating medium may be directed through the slots **50, 50** at various points along the slot length to vary the point at which the medium first contacts the inner surface of the drum or, in other words, to adjust the hot point of the drum surface.

The heating medium is circulated in the same manner as described above with respect to the structure of Figure 1.

While preferred embodiments of the invention have been shown and described, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A drying roll comprising a drum, end closures for the drum, a cylindrical inner shell within the drum extending the length of the drum and providing an annular channel between the inner surface of the drum and the outer surface of the shell, a pair of spaced-apart partition plates positioned within and adjacent the center of the inner shell and forming a seal fit with the inner surface of the inner shell to separate the shell interior into two compartments and provide a central chamber between the plates, a plurality of ports extending through and around that portion of the shell lying over and between the partition plates whereby the central chamber communicates with the annular channel, means for introducing heating medium within the central chamber, heating medium collecting chambers integrally incorporated within the interior of each compartment, said collecting chambers each being defined by a pair of spaced-apart plates at each end of the shell which form a seal with the inner surface of the shell, means defining a plurality of ports extending through that portion of the shell lying over and between said last-mentioned spaced-apart plates whereby the collecting chambers communicate with the annular channel, a heating medium discharge conduit extending longitudinally of the drum through one of the drum end closures into and through the spaced-apart plates of the collecting chambers and the partition plates forming the central chamber, and means for rotating the drum.

2. A drying roll according to claim 1 wherein those portions of the discharge conduit which lie within the collecting chambers are provided with a plurality of ports whereby the collecting chambers are in communication with the discharge conduit.

3. A drying roll according to claim 1 wherein the means for introducing heating medium comprises a supply conduit concentrically positioned within the discharge conduit, said supply conduit terminating within said central chamber, and a plurality of radially extending nozzles extending from the supply conduit through the wall of the discharge conduit to place the supply conduit in communication with the central chamber.

4. A drying roll according to claim 1 wherein means is provided for moving said partition plates as a unit toward the ends of the drum whereby the location of said central chamber may be varied.

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