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DRYER VENTILATION

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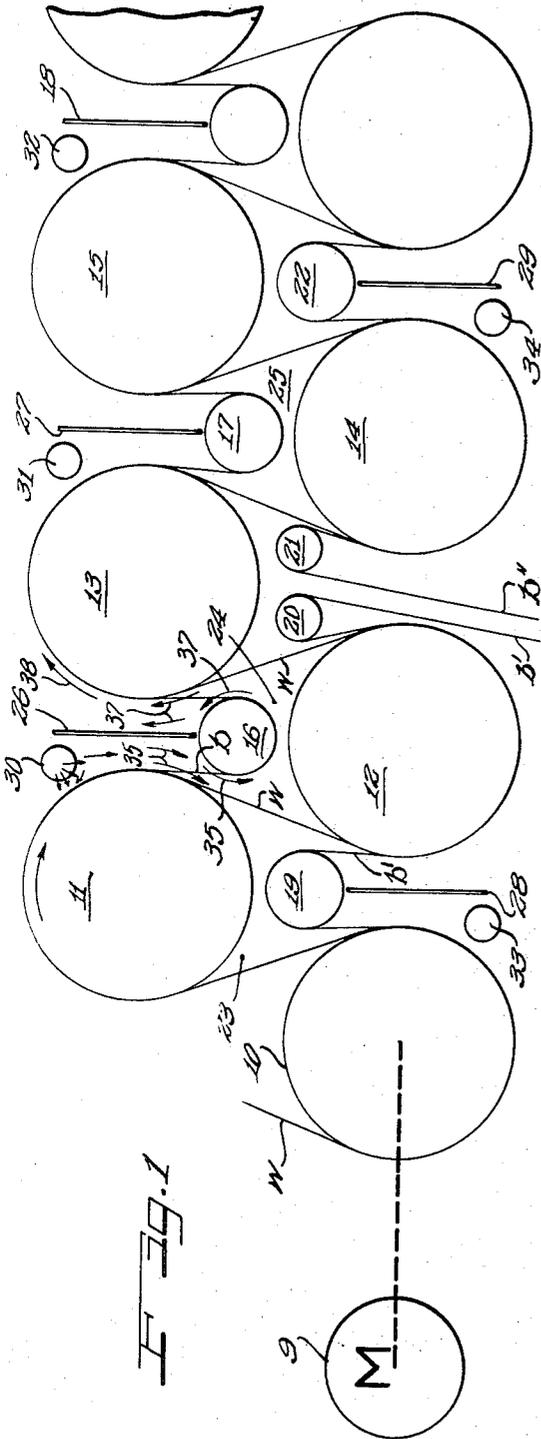


FIG. 1

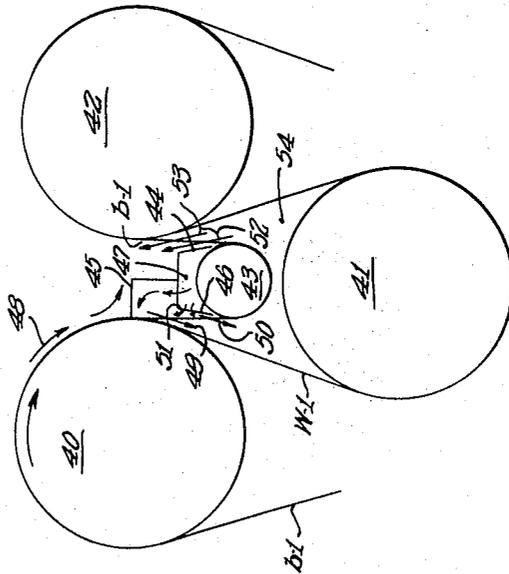


FIG. 2

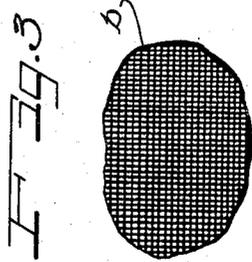


FIG. 3

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DRYER VENTILATION

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ABSTRACT OF THE DISCLOSURE

The mechanism or embodiment shown in the drawings has an upper tier of dryer drums such as 11 and a lower tier of drums such as 10 with a web W passing sinuously up and down between the drums and an upper belt B and a lower belt such as B' passing over the webs on the drums and being guided by belt guide rolls such as 16 and 19 positioned so that pockets such as 24 are formed which are filled with moisture. The drums are driven so that the web moves at a speed in excess of two thousand feet per minute and air is pumped along the surface of the roll 16 into the pocket 24 and moist air is pumped out of the pocket as shown by the arrow 37. Moist air is separated from the guide roll by a vane 26 and fresh dry air can be supplied at 30 with FIGURE 2 having a second vane 45 also for removing moist air.

The present invention relates broadly to the art of papermaking and is more particularly directed to a new and improved means for removing moisture from pockets formed between runs of paper web formed in a dryer section.

In the dryer section of a paper machine the moisture bearing web is directed along a serpentine path in wrapping relation with drying cylinders which are arranged in tiers, with a typical arrangement having an upper and lower tier. As the web passes up and down pockets are formed between the surface of the web with the moist air in the pockets retarding the escape of moisture from the web. The presence of the vaporized moisture or high humidity in the pocket retards evaporation and if the humidity of the air in this pocket can be reduced the rate of drying and efficiency of the machine will be enhanced.

It is accordingly an important object of the present invention to provide an improved method and mechanism for removing moisture from pockets formed between runs of web in a drum type paper dryer.

A further object of the invention lies in the provision of a method and mechanism for removing vapor in pockets in a dryer section with the use of substantially less equipment than heretofore available requiring less space for operating mechanism and avoiding the necessity of complicated ducts, bores and other equipment heretofore employed.

A feature of the invention is the provision of the belt which passes over the web holding it against the dryer drums which is formed of a porous or pervious material accommodating the free passage of air and guiding the belt between the drums over a guide roll, driving the equipment at a surface speed in excess of two thousand feet per minute so that the guide roll pumps air through the belt into the pocket and pumps air out of the pocket through the belt to provide a continual exchange of air in the pocket during operation, with the moist air carried along the surface of the guide roll being removed by a vane means and replaced with dryer air.

Further objects, advantages and features of the invention will become more apparent with the disclosure of the preferred embodiments thereof in the specification, claims and drawings in which,

As shown on the drawings:

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FIGURE 1 is a schematic end elevational view showing a drier section embodying the principle of the present invention;

FIGURE 2 is a fragmentary schematic view illustrating another form of the invention;

FIGURE 3 is an enlarged fragmentary plan view showing a portion of the belt.

A paper web *w* such as is received from the press section of a paper machine passes into the dryer section to be carried over a series of cylindrical dryer drums illustrated in sequence at 10, 11, 12, 13, 14 and 15. While only a portion of the dryer section is shown the web will pass sequentially in a serpentine fashion over more drums until it is dry.

The drums are suitably heated such as by steam to increase the temperature of the moisture for rapid evaporation and the moisture vapor is carried away by ventilation systems. As is known to those versed in the art the more rapidly the humid air can be carried away from the surface of the web, the more rapidly the drying process will ensue.

As the web *w* travels up and down between the dryer drum arrangement pockets are formed between the runs of the web and since the moisture of the web is hot evaporation will continue and the humidity within the pockets is extremely high. If this humidity level can be reduced the evaporation rate within the pockets will increase thereby increasing the efficiency of the dryer and reducing the amount of dryer space necessary to provide in a mill.

As illustrated in FIGURE 1, the dryer drums are arranged in tiers with the upper tiers being represented by the drums 11, 13 and 15 and the lower tier represented by the drums 10, 12 and 14.

It has heretofore been practice to hold the web firmly against the surface of the dryer drum by a felt which engages the outer surface of the web during the time it passes over the drum. These felts or canvasses can accommodate movement of air but are relatively impervious requiring air to be forced therethrough. Attempts have heretofore been made to exchange the air within the pockets formed between the web to reduce the humidity therein but these devices have required provision of substantial equipment. An example of this type of structure is shown in the Patent 3,110,575 wherein means are provided by blowers directing air into a plenum chamber to force air through the felt on one side of the guide roll and to provide a suction to withdraw air through the felt on the other side of a guide roll.

In accordance with the present invention a belt formed of a highly pervious fabric is provided wherein the fabric is formed of a monofilament material accommodating the free passage of air, and illustrated generally in FIGURE 3, this fabric or screen used to form an upper belt *b* and lower belts *b'* and *b''*.

Between the drums belt guide rolls 16 and 17 are provided to guide the belts and maintain the tension thereon so that they function to hold the web against the drums 11, 13 and 15. In the lower tier of drums, the first belt *b'* is guided by the belt guide rolls 19 and 20 and a second belt *b''* passes over guide rolls 21 and 22. As will be seen in FIGURE 1 the pockets between the web runs are formed at 23, 24 and 25.

The web *w* travels at a speed determined by the speed of rotation of the drums and several means are provided for driving the drums illustrated schematically by the motor 9. Generally each of the drums are interconnected and driven at a controlled speed as will be appreciated by those skilled in the art and the mechanism need not be shown in detail.

It has been discovered that by utilizing the air pervious screen-like belt, and driving the web at a speed in excess

of two thousand feet per minute, air will be pumped through the belts by the pumping action of the guide rolls and the moving surfaces.

As illustrated for the pocket 24, a dryer is carried along the surface of the guide roll 16 and is pumped through the belt *b* in a direction indicated by the arrowed lines 35. This air flowing along the arrowed line 35 enters the pocket 24 and becomes moist during the evaporation of moisture from the web. The moist air is pumped out of the pocket as indicated by the arrowed lines 37, passing through the pervious belt *b*.

The air is skimmed to remove it from the surface of the guide roll 16 by a separation means shown in the form of a generally radially extending vane 26 which guides the moist air upwardly and out of the region of the roll 16. This permits dryer air to enter at the other side of the vane 26 to flow down into the space and be picked up by the travelling surface of the roll 16. A slight positive pressure is created in the nip formed between the felt *b* and the roll 16 and this positive pressure pumps the air through the pervious belt *b*.

In some instances it may be desired to provide a specific supply of dry air along the space opposite the belt *b* in advance of the belt guide roll 16, and this is provided by air supply duct 30 which has a plurality of openings on its lower surface to direct the flow of dry air into the space and onto the free surface of the belt guide roll 16. Other ducts 31, 32, 33 and 34 are provided for other pockets.

This arrangement accommodates the direct passage of air in a machine direction into and out of the pocket and eliminates cross machine flow which has heretofore been present in ventilation systems and which have caused flutter of the sheet or web. The arrangement also provides a simplified less expensive, less space consuming structure than heretofore used.

FIGURE 2 illustrates another form of the invention which provides for even more efficient action and in the arrangement shown upper and lower tiers of dryer drums are provided with a web *w-1* passing successively over dryer drums 40, 41 and 42. A porous or pervious belt *b-1* is provided which accommodates the free passage of air and is positioned to hold the web onto the drums 40 and 42. The belt *b-1* passes over a belt guide roll 43 between the drums and a moisture entrapping pocket 54 is formed between the web runs.

As the mechanism operates, air is pumped by the surface of the guide roll 43 through the belt as indicated by the arrow 50. Air is pumped out of the pocket 54 as indicated by the arrowed line 52. In addition to the pumping action of the guide roll 43 the flow of air into the pocket 54 is aided by the induced flow of air carried along the surface of the drum, as indicated by the arrowed line 49. Movement of air of the pocket is also aided by the induced flow of air carried along with the web as indicated by the arrowed line 53.

Air which carries along the surface of the guide roll 43 through the belt *b-1* is removed from the surface of the guide roll by a foil means 44 which is generally in the form of a foil or vane with an edge close to the outer surface of the roll 43. The vane 44 forms part of a box or compartment 47 which contains fresh air delivered along the roll to flow through a wall 46 of the compartment which is provided with openings as indicated by the arrowed flow lines 51. This fresh dry air then passes down through the belt along the path of the arrowed lines 49 and 50.

In addition to the first foil 44, a second foil 45 is provided which has an edge extending close to the surface of the belt *b-1* as it is carried along on the drum 40. Moist air induced to flow along with the belt is removed or skimmed from the surface of the belt as indicated by the arrowed line 48. This prevents this moist air from being carried down to pass into the pocket 54. Thus only

fresh dry air provided from the compartment 47 passes down through the previous belt *b-1*.

Thus it will be seen that I have provided an improved ventilation arrangement for a dryer which meets the objectives and advantages above set forth. The mechanism does not consume an excessive amount of space, greatly enhances the drying speed and thus the efficiency of the dryer and avoids the necessity of power and space consuming mechanism which has heretofore been thought necessary.

The drawings and specification present a detailed disclosure of the preferred embodiments of the invention, and it is to be understood that the invention is not limited to the specific forms disclosed, but covers all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by the invention.

I claim as my invention:

1. A drying mechanism for a paper machine comprising

a plurality of tiers of drying drums including an upper tier and a lower tier for having a web trained therethrough with a web passing sinuously between the upper and lower tiers,

upper and lower belts formed of a pervious material accommodating the free passage of air therethrough and being positioned against the web in the upper and lower tiers respectively while the web is trained over the drums,

belt guide rolls between the dryer drums in each of the tiers carrying the belts between rolls with pockets being formed between the web and belt between the tiers containing moisture evaporated from the web, means driving the drums at a surface speed in excess of two thousand feet per minute so that the travelling surface of the rolls pumps a flow of air through the pervious belts,

means positioned adjacent the surface of the guide rolls in an area free of belt engagement causing separation of moisture laden air pumped through the belt from the pocket whereby dryer air replaces the moist air against the surface of the roll to be pumped through the belt into the pocket.

2. A drying mechanism for a paper machine in accordance with claim 1 wherein said separation means includes a vane extending generally radially away from the guide roll between dryer drums so that moist air is pumped by the guide roll along a surface of the vane and dryer air is pumped along the other surface of the vane by movement of the guide roll surface.

3. A drying mechanism for a paper machine comprising

a plurality of cylindrical dryer drums positioned to lead a travelling web to be dried through a drying path, means for driving said drums at a surface speed in excess of two thousand feet per minute,

a web carrying belt positioned to engage the surface of the web on the drums for maintaining the web in heat transfer engagement and being pervious to the free passage of air therethrough,

belt guide rolls between the drums carrying the belt between adjacent drums as the web is separated therefrom,

said guide roll surfaces and the surface of the belt inducing a flow of air through said pervious belt, and

means deflecting the moist air passing through the belt off the free surface of the roll so that the moist air flows radially outwardly and dry air follows the roll surface and flows through the belt.

4. A drying mechanism for a paper machine in accordance with claim 1 wherein means are provided for delivering a supply of dry air along the length of the guide roll opposite the surface free of the belt after the

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moisture laden air has been removed therefrom by said separation means.

5 5. A drying mechanism for a paper machine in accordance with claim 1 wherein said separation means includes a first vane means positioned adjacent the surface of the guide roll moving moisture laden air therefrom after it has been pumped through the belt and includes a second vane means positioned adjacent the surface of the belt as it is carried by a drum prior to passing over the guide roll so that moisture laden air is deflected off the surface of the belt before it passes onto the surface of the guide roll.

6. A drying mechanism for a paper machine in accordance with claim 5 wherein means is provided supplying dry air between said first and second vane means.

7. A drying mechanism for a paper machine in accordance with claim 1 wherein said separation means includes an air supply compartment having a wall forming a first vane means separating air from the guide roll after it is pumped through the pervious belt with said compartment adapted to contain a supply of dry air and having openings for delivering air to the nip formed between the oncoming porous belt and the guide roll, and said separation means including a second vane means extending close to the surface of the drum in advance of the guide roll so that moisture laden air is separated from the belt before it passes onto the guide roll and wherein said second vane means joins the compartment so as to provide a closed area for receiving the dry air.

8. In the method of drying a travelling web passing 30 sinuously between upper and lower tiers of drying drums with upper and lower belts for holding the webs onto the drums and having guide rolls positioned between the

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drums of each tier for guiding the belts with pockets being formed between the belts and the runs of web as they pass between the tiers, the method including the steps of providing a pervious belt capable of accommodating a free passage of air, driving the drums at a speed so that the web and roll surface will move at a speed in excess of two thousand feet per minute and so that the surface of the roll will pump air through the belt into and out of the pocket, and removing air from the surface of the roll where it is exposed and free of the belt so that moist air is removed from the roll surface as it is pumped through the belt out of the pocket and dryer air will form on the surface of the roll to be carried through the belt into the pocket.

9. In the method of drying a travelling web in accordance with claim 8 including the steps of furnishing a supply of dryer air into the nip between the roll and belt in advance of the belt moving into the pocket.

10. In the method of drying a travelling web in accordance with claim 8 and including the step of removing moist air from the surface of the belt on a drum in advance of the roll and carrying the moist air away so that it will not mix with the dryer air entering the pocket.

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