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ROLL FOR PAPERMAKING MACHINERY

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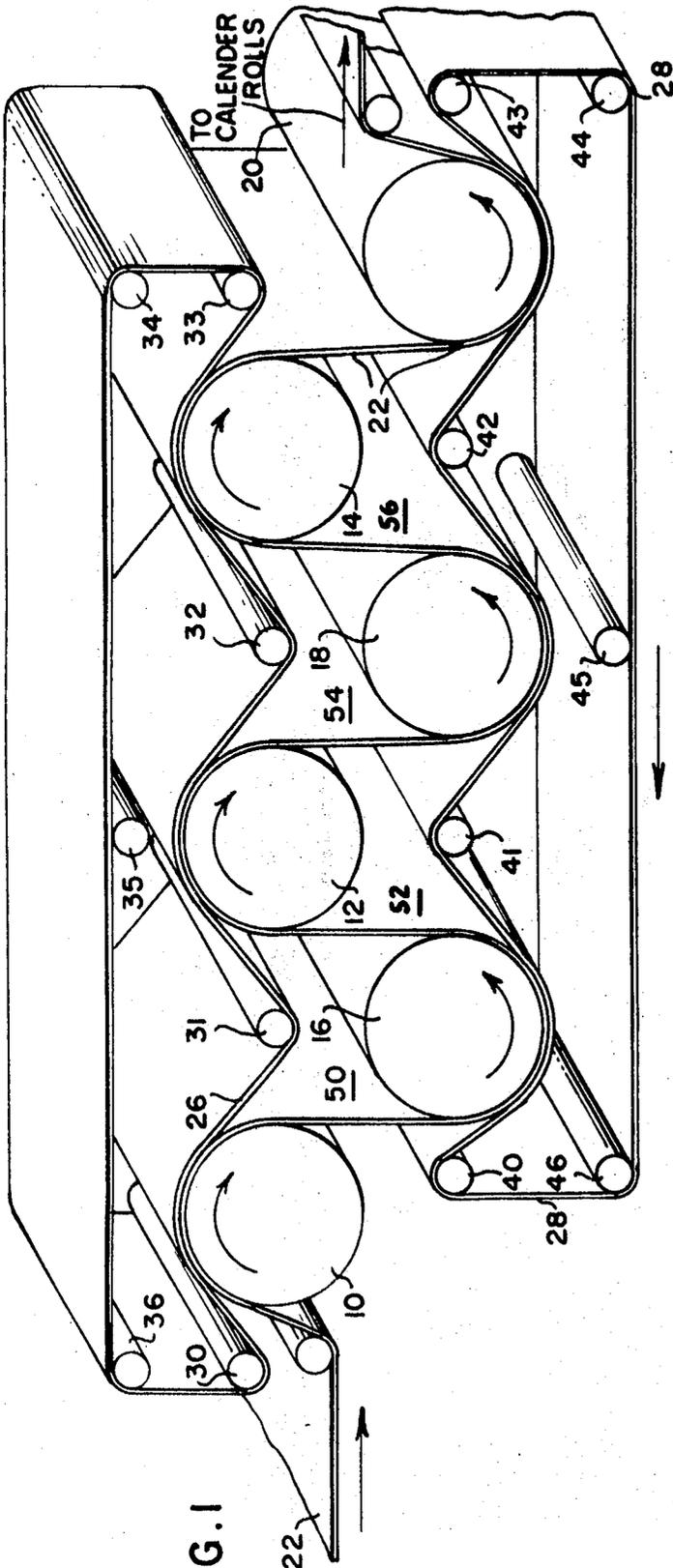
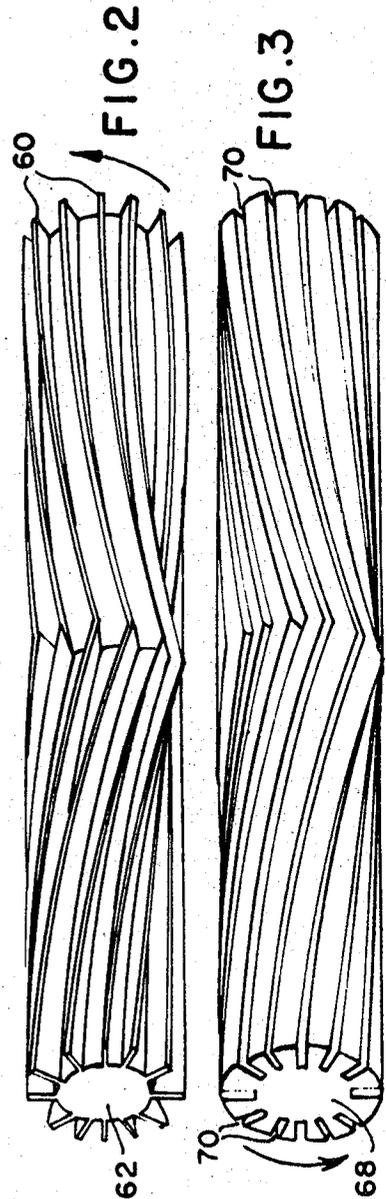


FIG. 1



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ROLL FOR PAPERMAKING MACHINERY

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3 Claims

ABSTRACT OF THE DISCLOSURE

This invention is directed toward means for removing the moist air which tends to collect in tent-like pockets in the dryer section of a papermaking machine. Such removal is accomplished by providing guide rolls which have a plurality of grooves therein to supply fresh air into these pockets and force the moist air out. The construction of the grooves is such as to reduce substantially, if not eliminate entirely, the tendency of a dryer fabric to creep or "walk" off the machine rolls.

BACKGROUND OF THE INVENTION

In the typical papermaking machine such as the so-called fourdrinier machine, an aqueous suspension of fibers, called the "furnish," is flowed onto a travelling forming medium, generally an endless belt of woven metal wire and/or synthetic material, to form a continuous web of paper or paper-like material (such as board, pulp, asbestos sheet and the like). As the "furnish" travels through the forming section of the machine, much of its water content is removed and the continuous web is made self-supporting to some extent. This water removal is enhanced by the use of well-known devices such as hydrofoils, table rolls and/or suction boxes.

After leaving the forming section of the machine, the somewhat self-supporting web is transferred to the press section of the machine where still more of its water content is removed by passing it through a series of nips formed by cooperating press rolls. It should be noted that these press rolls also serve to compact the web as well as remove water therefrom.

The paper web is then transferred to the dryer section of the machine where it is passed about one or more arrays of heated, generally cylindrical rolls to remove still further amounts of water therefrom. In most instances, these dryer rolls are arranged in upper and lower parallel arrays with the continuous web being passed to and fro between the arrays in a serpentine manner about each of the rolls. Generally, the surface of the dryer rolls will be smooth and imperforate with the continuous web being held in intimate heat transfer relation therewith over at least a portion of the surface thereof by an endless backing fabric or belt (commonly referred to as a dryer felt or dryer fabric). However, recent technical advances in the papermaking art have shown that in some instances it may be desirable to construct the dryer roll surface so as to be pervious and blow steam or other suitable drying media therethrough in order to increase the amount of water removed from the web.

In the past, dryer fabrics have generally been made of a relatively impervious, blanket-like construction. However, a modern trend is to use a fluid permeable construction, generally of natural or synthetic fibers. Open weave fabrics generally have been found desirable for such purposes as they are readily permeable to such fluids; however, in some instances, non-woven structures such as perforated plastic belts or the like have also been found suitable.

In the dryer section of the machine, there is a tendency

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for the steam and/or moisture laden air which is liberated from the paper web to become trapped in "pockets" within the machine. Some of these pockets are formed by the dryer fabrics alone and comprise the areas enclosed by the dryer fabrics as they travel their endless paths. Other of these pockets are located between the upper and lower arrays of dryer rolls; these pockets being tent-like areas enclosed by a dryer roll surface, the paper web and the opposite dryer fabric. As the build-up of moisture in these pockets hinders the removal of water from the paper web and as this build-up may tend to create a non-uniform moisture profile in the web, it is desirable to provide means for exhausting the moist air from, or otherwise preventing it from building-up in, these pockets.

In many instances, large blowers or exhaust fans have been used to move fresh air laterally through the dryer pockets in an attempt to exhaust this moist air and introduce fresh air therein. However, these arrangements generally require a fairly large capital expenditure and where large machine operating widths are encountered, such an arrangement may also create rather than prevent the creation of a non-uniform moisture profile in the paper web. Still further, should the air flow into these pockets be under too great a pressure, sheet flutter may occur causing wrinkling or possibly breaking of the paper web.

Other methods of introducing fresh air into the dryer pockets include mechanically blowing air through or around those fabric guide rolls disposed between adjacent dryer rolls and through the dryer fabric into the pockets. However, these methods entail the use of suitable and highly reliable sealing means in order to prevent escape of air therearound and also have practical limits as to the amount of pressure that may be used to force the air into the pockets.

Therefore, one object of the present invention is to provide an improved, simplified means for preventing the build-up of moist air in the pockets of the dryer section of a papermaking machine.

Another object of the present invention is to provide improved means for exhausting moist air from the dryer pockets in a papermaking machine without disturbing the paper web and without creating a tendency for the dryer fabric to creep or walk toward one edge of the machine.

Another object of the present invention is to provide a simplified means for maintaining a uniform moisture profile in a continuous paper sheet without creating a tendency for the dryer fabric to walk off the machine.

SUMMARY OF THE INVENTION

In accordance with the principles of this invention, in one embodiment thereof, there is included in a papermaking machine having at least one array of heated, generally cylindrical rolls for drying a continuous web of paper which is passed about and held in heat transfer relation therewith by means of associated fluid permeable backing fabric (dryer fabric); a plurality of guide rolls over which the backing fabric passes and which maintain the backing fabric on the machine. Some of these guide rolls will be disposed between adjacent dryer rolls with these guide rolls being referred to as "pocket rolls". At least one pocket roll is constructed to have at least one groove of a predetermined pattern in the surface thereof, which groove or grooves will contact the dryer fabric and extend from a point approximately mid-way between the ends of the roll toward the opposite ends of the roll in mirror image segments. This arrangement causes air to be introduced into the tent-like pockets of the machine and also substantially reduces, if not eliminates entirely, the tendency of the backing fabric to walk-off the machine. Preferably, the predetermined pattern will be a continuous helix with each roll having a plurality of such grooves.

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Additional objects and advantages of this invention together with a better understanding thereof may be had by referring to the following detailed description thereof together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cabinet view of the dryer section of a paper-making machine in which this invention may be incorporated;

FIG. 2 is a cabinet view of a pocket roll constructed in accordance with the principles of this invention; and FIG. 3 is a cabinet view of an alternate construction of the pocket roll of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, there is shown the dryer section of a papermaking machine comprising a first or upper array of dryer rolls including cylinders 10, 12 and 14 with a second or lower array of dryer rolls including cylinders 16, 18 and 20 being vertically spaced therefrom. The dryer rolls are preferably smooth, imperforate metal cylinders arranged for rotation upon suitable bearings (not shown) and supplied with steam which is introduced into the interior portions thereof at suitable temperatures. As previously mentioned, in some instances, the surface of one or more of the dryer rolls may be made gas pervious and heated air or steam blown therethrough to increase drying of the paper web. Preferably, the upper and lower arrays of the dryer rolls will be arranged in staggered rows, as shown in FIG. 1, with the rolls in one array being offset with respect to the corresponding roll in the other array.

A continuous web 22 of paper or other similar sheet-like material is shown as travelling from left to right in the drawing. The paper web 22 is received from the press section (not shown) of the machine and is guided upwardly and over the dryer roll 10, downwardly and around lower dryer roll 16, back up and around upper roll 12 and so forth until ultimately it is passed around each of the dryer rolls in a generally serpentine manner. When the paper web 22 leaves the dryer section of the machine, it is generally passed through a calendar stack (not shown) to provide it with a smooth finish and then collected on a suitable reel (not shown).

Means are provided for guiding the paper web 22 through the dryer section and maintaining it in intimate heat transfer relation with each of the dryer rolls. Accordingly, a first fluid permeable backing fabric 26 is associated with the upper array of dryer rolls (10-14) and is arranged to contact the paper web 22 and maintain it in intimate heat transfer relation with the rolls in the upper array, in this instance by holding it against the rolls 10, 12 and 14. Similarly, a second fluid permeable backing fabric 28 is associated with the lower array of dryer rolls and is also arranged to contact the paper web 22 and maintain it in intimate heat transfer relation with the dryer rolls in the lower array, again in this instance holding it against the rolls 16, 18 and 20. Preferably, both dryer fabrics 26 and 28 will be identical in construction and can be made endless either by seaming or being woven as such.

According to the principles of this invention, each of the dryer fabrics 26 and 28 will be of a fluid permeable construction. Open weave fabrics and the like have generally been found desirable as they readily permit the passage of fluids therethrough; however, in some instances, non-woven structures such as perforated plastic belts and the like have also been found desirable. However, it is not the intention of this invention to be limited to a specific dryer fabric construction as they are set forth by way of example only. This invention only requires that the dryer fabrics readily permit the passage of fluids, such as air, water vapor and the like, therethrough.

Each dryer fabric travels about a predetermined closed or endless path which in this instance is defined by its

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associated array of dryer rolls and a plurality of fabric guide rolls which extend across the width of the fabric and which maintain sufficient tension thereon to ensure proper operation thereof. In the example shown in FIG. 1, the upper fabric 26 has associated therewith a plurality of guide rolls 30-36 which are disposed in a desired predetermined manner. In this arrangement, certain of the guide rolls 31, 32 will be disposed between adjacent dryer rolls (these guide rolls hereinafter being referred to as "pocket rolls"). As seen in FIG. 1, pocket roll 31 is disposed between dryer rolls 10 and 12 and preferably is positioned to have its center line disposed below the center line of the associated dryer rolls whereas pocket roll 32 is disposed between dryer rolls 12 and 14 and also is positioned to have its center line below the center line of the associated dryer rolls.

In like manner, the lower dryer fabric 28 has associated therewith a plurality of guide rolls 40-46 which are also disposed in a predetermined manner and which combine with the lower array of dryer rolls to define the path of travel of the lower dryer fabric 28. Certain of the lower guide rolls 41, 42 are disposed between adjacent associated dryer rolls, these guide rolls also hereinafter being referred to as "pocket rolls." Accordingly, pocket roll 41 is disposed between lower dryer rolls 16 and 18 and preferably is positioned to have its center line disposed above the center line of the associated dryer rolls whereas pocket roll 42 is disposed between dryer rolls 18 and 20 and also has its center line disposed above the center line of the associated guide rolls.

As can be seen in FIG. 1, tent-like pockets lie between the upper and lower arrays of dryer rolls. For purposes of convenience, and in order to facilitate discussion of this invention, these tent-like pockets are numbered 50, 52, 54 and 56 respectively. It should be noted that it is in these areas of the machine that there is a tendency for the moist air evaporated from the paper web to collect. As mentioned previously, if this moist air is not removed or otherwise prevented from building up, further removal of water from the paper web will be inhibited. Further, as greater amounts of moist air tend to accumulate in the central portions of the machine (as one looks across the width thereof), there is a danger that the rate of water removal from the paper web will vary across the width of the sheet and thus create a non-uniform moisture profile in the paper web 22.

In accordance with the principles of this invention, and referring now to FIGS. 2 and 3, means are provided for introducing air into these tent-like pockets to drive out or purge the moist air therefrom, but in such a way as not to create any danger of tearing the paper web or creating any force on the dryer fabric which will cause it to creep or "walk" toward one edge of the machine. Specifically, this invention contemplates constructing at least one pocket roll to have at least a single groove, and preferably a plurality thereof, therein which contacts the fabric. These grooves are constructed in such a manner as to extend substantially across the entire width of the roll and from a point approximately mid-way between the opposite ends thereof, each groove extends toward the opposite ends of the roll in predetermined mirror-image segments. Such a roll will substantially reduce the tendency of the fabric to creep or walk off the machine rolls because any force created on the fabric as it passes over the grooves will have equal and opposite directing components, due to the mirror-image grooves effectively dividing the roll into two halves. When the fabric is centrally located on the machine, these forces will tend to cancel one another so that there is no net force created which can cause creeping or "walking" of the fabric toward one or the other of the lateral edges of the machine. However, even where the fabric has already started to "walk" off the machine, such a roll as has hereinbefore been described will tend to force the fabric back onto the machine. This is due to the grooves in the roll creating a net force on the fabric which is in a direction opposite to that in which the fabric is

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travelling. This latter effect is due to the fabric being in contact with a greater surface on one side of the roll than the other and thus the rotation of the roll together with the grooved surface thereof tends to cause the fabric to position itself correctly on the machine.

While not wanting to be bound by a theory of operation, it is believed that the improved air movement in the dryer pocket is the result of the centrifugal forces acting on the air within the grooves of the pocket roll. In other words, air entrained in the grooves of the pocket roll will be forced to the outer portions thereof and through the dryer fabric as the pocket roll rotates thus causing the air to be forced into the tent-like pockets.

In the preferred embodiment of the invention, and referring now to FIG. 2, the pocket roll will be constructed by attaching a plurality of mirror-image, helically-shaped vanes 60 to a suitable hub or support 62. The vanes 60 can be secured to the hub 62 in any number of satisfactory methods as by dovetailing them in suitable slots on the hub, bonding them thereto with a suitable adhesive, welding, brazing or any other suitable method of attachment. Preferably, the hub 62 will be a generally cylindrical body which is mounted to the machine structure (not shown) for rotation about its longitudinal axis. The hub, vanes or both may be constructed of aluminum, sheet-metal, a suitable plastic or any other suitable material and preferably the vanes and the hub will both be constructed of the same material.

An alternate construction for the specially designed pocket rolls of this invention and referring specifically to FIG. 3 is to provide a generally cylindrical body 68 having predetermined mirror-image grooves 70 cut therein, as by machining. Again, the groove or grooves will extend from the center of the roll toward the opposite ends thereof in mirror-image segments, preferably helical. The material from which the roll is constructed may be any suitable material which is generally resistant to the compression forces of the fabric as it passes over the surface thereof in order that the grooves in the roll remain substantially incompressible as the fabric passes thereover.

As can be seen from the above discussion, fresh air will be supplied to the dryer pockets of a papermaking machine while actively deterring any tendency of the dryer fabric to creep laterally or walk off the machine. Still further, such an arrangement requires only minor modification to existing papermaking machinery and does not entail extensive or elaborate designing of new machinery.

Thus, having described only a particular embodiment of the present invention, it will become obvious to those

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skilled in the art that various changes and modifications may be made thereto without departing from its scope in its broader aspect. As such, it is the intention of the appended claims to cover all such changes and modifications which fall within the true spirit and scope of the present invention.

What I claim as new and novel and desire to secure by Letters Patent of the United States is:

1. Apparatus for removing moisture from a continuous web of sheet material comprising:

At least one array of heated, generally cylindrical rolls for removing moisture from a continuous web of sheet material which is passed about and held in heat transfer relation therewith,

an endless, fluid permeable belt for guiding said continuous web of sheet material about said array of dryer rolls and for maintaining said continuous web in heat transfer relation with said array of rolls, and

A plurality of fabric guide rolls for maintaining said endless belt in guiding relation with said continuous web of sheet material, at least one of said fabric guide rolls being disposed between adjacent dryer rolls and having at least one groove of a helical pattern therein extending from a point approximately mid-way between the opposite ends of said roll toward the opposite ends thereof in substantially mirror-image segments of one another, said helical groove extending in the direction in which said roll rotates when in use.

2. Apparatus as described in claim 1 wherein said grooved fabric guide roll comprises a generally cylindrical member having at least one groove in the peripheral surface thereof.

3. Apparatus as described in claim 1 wherein said grooved fabric guide roll comprises a generally cylindrical member having a plurality of spaced vanes attached to the peripheral surface thereof to form a plurality of grooves therebetween.

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