DRIER FOR PAPER WEBS

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ABSTRACT

Apparatus for continuously drying a web of paper sheet material having a pair of foraminous, thermally conductive, endless conveyor belts supported to receive a web therebetween and carry the same under tension around at least two closely spaced heater rolls, each roll in turn reversing the direction of travel of the belts and in contact therewith for greater than 180° of its cylindrical surface, thus providing adjacent zones of concentrated heat exchange in a dimensionally compact high speed drying operation. Blow-through heating rolls guide the belts at the web inlet and outlet for preheating each belt in advance of web contact therewith.

7 Claims, 1 Drawing Figure
DRIER FOR PAPER WEBS

BACKGROUND

This invention relates to apparatus for continuously drying webs of paper sheet material and the like at high speeds which comprises a pair of permeable or foraminous endless conveyor belts supported by guide rolls to convey the paper web between the belts in a tightly arranged conveyor path through the drier with preheating means for each belt in advance of initial web contact therewith, the guide rolls including heated rolls around which the web is tensioned against a substantial portion of the roll surfaces to maintain successive contact areas of concentrated high heat transference between the web and the preheated belts.

In the prior art, conventional drying apparatus for a continuously running web produced on standard paper making machinery, which operates at normal production speeds up to 2,000 ft. per minute and more, are extremely long and in normal installations typically on the order to 200 ft. in length. The web, in the conventional drier apparatus as widely used in the paper industry, is generally passed back and forth over a series of steam heated cylinders arranged in tandem for exposure of the web to the hot surfaces of the cylinders. While many variables determine necessary drying time, generally a high production speed means a long drier passage. A primary object of the present invention is therefore to provide a compact drier apparatus of greatly reduced length, capable of efficiently handling paper webs produced at the normal production operating speeds noted above and employing a pair of preheated endless conveyor belts to convey the web between them through the drier in a shortened path, heated guide rolls maintaining conditions of high heat transference and a high degree of efficient drying action.

Driers for paper sheet material utilizing endless conveyor belts to carry a web therebetween and through heating zones are also known in the prior art. Insofar as is known, however, such driers are to a large extent designed for various specialty operations and are incapable of efficient high speed drying action. Characteristically, also, many known driers of this type rely on supplying heated air to the conveyor belts after the web has been enclosed by the belts and as it passes between guide rolls. These areas being for the primary drying action and heat exchange. The apparatus of the present invention, in contrast, utilizes a combination of two extremely efficient processes: an individual preheating of the permeable belts by blow-through guide rolls immediately in advance of web contact, and providing zones of highly significant heat exchange by passing the preheated superimposed belts, carrying the paper web between them, around heated roll surfaces adjacent the web inlet and thus exerting controlled tension on the belts for squeezing action on the web. The drying rate is thus greatly increased in a relatively small space.

SUMMARY OF THE INVENTION

The present invention in its preferred form contemplates the use of two air permeable endless conveyor belts of highly conductive, closely woven wire mesh construction supported under tension by a plurality of guide rolls of the blow-through heater roll type, arranged not only to provide for individually preheating the belts, but also to carry the web through a conveyor path along which to the greatest extent possible the belts are in contact with heated roll surfaces in order to maintain suitable squeezing action and rapid heat exchange for drying the enclosed web. More specifically, the arrangement of blow-through rolls comprises matched sets of closely spaced upper and lower rolls. Each upper roll is vertically and forwardly offset above the corresponding roll of the lower set and the pairs of corresponding rolls provide, in sequence, belt return preheating rolls at the inlet end, primary drying rolls, and belt return rolls at the outlet end. The belt return runs are completed around the preheating rolls and brought together against the lower section of the upper preheating roll, where the superimposed belts initially receive the web. The enclosed web then passes upwardly around the upper drying roll, downwardly around the corresponding lower roll, and then upwardly against the upper section of the lower return roll for belt separation. The outlet rolls are mounted for axial displacement to adjust belt tension and impart the desired squeezing action on the web in the areas where the rolls engage the superimposed belts.

The features and advantages of the present invention will be apparent from the following description thereof as illustrated by the accompanying drawing.

THE DRAWING

The drawing is a diagrammatic showing of a longitudinal section of the new drier apparatus.

DESCRIPTION

The drier apparatus of the present invention is suitably housed in a hood enclosure, an upper section being indicated at 2 and a lower section at 4. An inlet opening for receiving a wet web from a paper making machine for drying is at 6 and a dry web discharge outlet at 8. At the top of the upper section is an exhaust fan as at 10 to conduct vapors and moisture from the hood interior.

A pair of foraminous or air permeable endless conveyor belts are provided by upper belt 12 and lower belt 14, the belts preferably being of known closely woven wire mesh construction with the wire having a high degree of thermal conductivity. The upper belt 12 and lower belt 14 are brought together in superimposed relation adjacent the enclosure inlet to carry a wet web w between them along a conveyor path section, as will be described, for discharge at the outlet 8.

The rolls guiding the “sandwiched” web along the conveyor path section are arranged to convey the wet paper sheet through zones of extremely high heat transfer and to concentrate the drying action in a manner requiring a relatively small amount of floor space and at the same time having the capability of handling a web delivery at high rates of speed.

As shown in the drawing an upper set of guide rolls comprises the cylindrical rolls 16, 18, 20 and a return guide roll at 22. A lower set comprises the rolls 24, 26, 28 and a return guide at 30. Belts 12 and 14, for forward travel through the web conveyor section, are first brought together around rolls 16 and 24 to lie in superimposed relation against the underside of the upper roll 16. At this location the web is inserted between the belts and then conveyed upwardly around the upper in-
The intermediate roll 18, the belt contact therewith as shown being greater than 180°. The direction of travel is thus reversed to direct the belts downwardly around the lower intermediate roll 26 which is vertically and rearwardly offset relative to roll 18. Contact with roll 26 is also greater than 180°, the direction of travel being again reversed. From roll 26 the belts are directed upwardly against the upper side of the lower roll 28. From roll 28 upper belt 12 is directed upwardly to the roll 20 for return to the inlet end. Lower belt 14 is carried around roll 28 to commence its return run and the web is thus released by separation of the belts at the top of roll 28 for discharge through the outlet 8.

Upper belt 12 on return to the inlet roll 16 passes over guide roll 22 which is also preferably a "tracking" roll to correct belt "creeping" as will be readily understood. Lower guide roll 30 similarly directs the return of belt 14 to lower inlet roll 24. Rolls 20 and 28 are axially adjustable, as indicated, for tensioning purposes and roll 26 may suitably serve as a drive roll for the belts.

Rolls 16, 18 and 20 and rolls 24, 26, and 28 are preferably, as indicated, of substantially the same overall dimensions. In representative installations the rolls will be on the order of 5 to 20 ft. in length and 1 to 6 ft. in diameter. The upper and lower inlet rolls 16 and 24 are of a suitable blow-through type characterized, as is well known, by a cylindrical perforated wall structure designed to freely pass heated air from the interior through to the outer surfaces. Upper rolls 18, 20 and lower rolls 26, 28 are also preferably of the blow-through type. As shown each of the lower set of rolls is on an axis offset rearwardly, with reference to the outlet end, from the axis of the corresponding roll of the upper set. As will be noted this provides at the inlet end for guidance and control over the insertion of a wet web between the belts; and at the outlet end for the efficient discharge of the dry web. More importantly, the vertical offset of the intermediate blow-through rolls 18 and 26 enables the double reversal of the direction of travel in a compact arrangement and thus will afford a high degree of efficient heat exchange for the drying operation. As indicated the belts encircle each roll for arcuate travel in contact with the cylindrical surfaces for greater than 180° of the circumference. Thus, closely adjacent zones for concentrated heat exchange between web and belts enable rapid and efficient drying action. As will be noted, heated air at desired temperatures may be introduced into the interior of rolls 18 and 26 in order to maintain favorable temperature conditions and prevent a loss of belt heat by reason of the belt contact with the roll surfaces. Additionally, heated air will be blown against the web to accelerate drying action, particularly when the web itself is air permeable. Blow-through air can be introduced from either or both ends of a roll after the usual fashion. Single blower nozzle openings are shown in each of the rolls for illustrative purposes as indicated at 32 and it will be appreciated that any suitable blower devices may be utilized to introduce the heated air.

It will be particularly noted that the primary source of heat for drying action during passage of the web through the apparatus is that heat imparted to the web by the superimposed belts carrying the web between them. Belt preheating means are provided to maintain the most efficient drying action at the moment the web first contacts the belts. Roll 16, as shown, is fitted with an interior partition as at 34 to concentrate heated blow-through air against the wall section over which the belt 12 travels and in the area closely adjacent the web entrance between belts 12 and 14. Inlet guide roll 24 is likewise provided with a partition at 36 for preheating belt 14. Thus initial web contact between the superimposed belts, which are tensioned against the underside of roll 16, will take place when the belts are as nearly as possible at a desired heating temperature. Suction chamber and air recirculating means may also be provided at the preheating zones. An exterior suction plenum chamber is shown at 38 facing roll 16, and at 40 facing roll 24. Each chamber may be connected to the preheating zone by a recirculating passage having a filter as at 42, a fan at 44 and a heater at 46, all as indicated between the chamber 40 and roll 24.

The outlet rolls 20 and 28 are also supplied with heated blow-through air. In roll 28 such heated air assists the web drying action as the web is passed under tension over roll 28 prior to discharge. In roll 28 and in roll 20, respectively, the belts 14 and 12 may furthermore be heated to raise the temperature level as the belts commence their return runs. Accordingly, the temperature of each belt can be suitably maintained for entrance into the inlet roll preheating zones. It will be noted that the heating of the belts individually is accomplished when hot air may pass freely through the perforations and thus the metal is quickly restored to the level desired.

Typically, the temperature of air introduced into the blow-through rolls may be up to 900°-1,000° F. The sheet material of the web is thus immediately enclosed between extremely hot belts for efficient drying action at the inlet end and continued high level temperature maintenance as the web is passed around the intermediate rolls 18 and 26. It will also be noted that the tension level of the wire belts may be controlled. Suitable controlled squeezing action may thus be exerted on a web in the areas where the superimposed belts are in surface engagement with the respective rolls thus effecting high heat exchange. The primary heat exchange and drying action takes place along such areas of roll engagement as indicated above, because of intimacy of contact between web and belts. Relatively less heat exchange occurs during web passage from roll to roll.

While the above description of a preferred embodiment of the apparatus has been with reference to drying a paper web, it will be understood that the apparatus is adapted as well for thermally treating a web of paper sheet material for other than drying purposes.

What is claimed is:

1. Apparatus for the high speed continuous thermal treatment of webs of paper sheet material and the like comprising

a pair of air permeable endless metallic conveyor belts of high thermal conductivity, means for supporting said endless belts in mutually engaged superimposed facing relationship along a portion of the length of said belts, said portion defining a common path of belt travel and constituting a web treating section having an inlet end and an outlet end to convey a web of material through said section while in sandwiched relation between said belts;
each belt having a separate return path between said outlet and inlet ends and means along each return path for thermally pretreating each belt immediately in advance of mutual engagement of the belts at the inlet end of the web treating section
said supporting means including a pair of closely spaced thermally controllable rolls in said web treating section adjacent said inlet end, the rolls in turn engaging the superimposed belts over an arcuate contacting area of greater than 180°.

2. A drier apparatus as in claim 1, in which, blow-through heater rolls guide said belts on said return runs to the inlet end of said conveyor section, said inlet lies against one of said heater rolls, and the blow-through area of each of said rolls is confined to form a preheating zone facing the area of single belt engagement therewith and comprises said means for thermally pretreating the belts.

3. The apparatus of claim 2, in which, said thermally controllable rolls are blow-through heater rolls positioned in vertically offset relation.

4. The apparatus of claim 3, in which, guide rolls at the outlet end of said conveyor section are vertically offset and engage the belts for the return run thereof back to the inlet end, and one of said outlet rolls urges said superimposed belts against the periphery of the other outlet roll.

5. The apparatus of claim 4, in which, said pair of outlet guide rolls are blow-through rolls, each being axially adjustable to apply tension on the belts and in the area of single belt engagement therewith providing means to apply heat to the belt at the start of return travel.

6. The apparatus of claim 5, in which,

a suction chamber is positioned opposite the area of said confined heating zone of each inlet guide roll and recirculating means are provided to reheat air drawn from said chamber and returned to said heating zone.

7. Apparatus for continuously drying a high speed running paper web comprising
a pair of woven wire mesh endless conveyor belts of high heat conductivity,
a series of guide rolls supporting travel of the belts in endless paths and bringing said belts together in superimposed relation along a conveyor path section to convey the web therebetween, certain of the rolls being adjustable for belt tension and to exert squeezing action on a paper web between the belts in the areas of superimposed belt contact with the rolls,
said series of rolls including matched sets of opposed closely spaced upper and lower blow-through heater rolls, each upper roll being vertically and forwardly offset above the corresponding roll of the lower set, such pairs of corresponding upper and lower rolls, respectively, providing return preheating rolls at the inlet end of said conveyor path section, intermediate rolls, and belt return rolls at the outlet end,
said belts being arranged for travel on the rolls with said conveyor path section commencing at the forward undersurface of the upper inlet return roll, continuing upwardly around the upper intermediate roll, and then downwardly and rearwardly around the lower intermediate roll for passage to the outlet against the upper surface of said lower return outlet roll.

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