PAPER MACHINE DRYER DRUM
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ABSTRACT OF THE DISCLOSURE

A dryer drum includes a cylindrical shell with a head at each end, and a plurality of axially spaced rings are positioned within each end portion of the shell to define corresponding axially spaced annular chambers. A radially movable siphon is positioned within each chamber, and shafts extend through the heads to provide for individual external adjustment of each siphon relative to the shell to select the depth of the annular layer of condensate within each chamber and thereby to control the heat transfer from each chamber to the outer drying surface of the shell.

Background of the invention

In the dryer section of a paper machine, the edge portions of a web of paper tend to dry more quickly than the center portion so that by the time the center portion is dried, the edge portions are overdried. The faster drying of the edge portions is due to several factors including better air circulation adjacent the edge portions of the web and the tendency of a dryer drum to be hotter at the ends as a result of the larger masses of metal in the shell flanges and the drum heads.

It has been found desirable to reduce the heat transfer through the end portions of a dryer drum to prevent over-drying of the edge portions of the web. To accomplish a reduction in heat transfer, axially spaced ribs have been formed internally within the shell to provide for deeper or thicker layers of condensate within the drum adjacent the heads than within the center portion of the drum, with the condensate overflowing from the outer chambers inwardly toward the inner chambers and eventually reaching the center portion where the condensate is removed by a siphon. The thicker layers of condensate provide more resistance to heat transfer to the outer surface of the drum adjacent the ends.

It is also possible to control the heat transfer by dividing the drum into several axially spaced compartments and controlling the steam temperature and pressure within each compartment with corresponding stem inlet and condensate outlet conduits for each compartment. Surface temperature can also be controlled by providing axially adjustable annular seals positioned between the inner surfaces of the shell and an inner drum to limit the proximity of the steam relative to the end portions of the shell.

Each of the above methods for reducing the temperature of the end portions of the outer drum surface relative to the central portion has certain disadvantages. For example, the use of axially spaced overflowing chambers does not provide for conveniently adjusting the resistance to heat transfer to change the surface temperature profile as is frequently necessary to provide for uniform drying of various grades of paper webs. Moreover, the overflowing chambers do not permit an appreciable change in the surface temperature profile, nor is it possible to remove completely the effect of the chambers without removing the entire rib assembly from the drum. On the other hand, dividing the drum into several compartments having corresponding steam inlet and outlet conduits or the use of axially adjustable annular seals requires rather complicated and impractical drum construction and adjusting means.

Summary of the invention

The present invention is directed to an improved dryer drum which provides a simplified structure for conveniently adjusting the temperature profile of the cylindrical outer drying surface in order to obtain uniform drying of a paper web. An important feature of the invention is that the adjustment can be made externally of the drum so that it is unnecessary to open the drum for making internal adjustments.

According to a preferred embodiment of the invention, a dryer drum includes an internal cage within each end portion of the drum, and each cage is constructed in sections for assembly within the drum. Each cage has a plurality of axially spaced rings which define a corresponding plurality of axially spaced annular chambers within each end portion of the drum. A siphon is positioned within each chamber for removing condensate and is supported by a radially telescoping tube which is infinitely adjustable between predetermined limits by a cam member mounted on the end of a shaft extending axially through the adjacent drum head. Thus the thickness of the annular layer of condensate within each chamber can be precisely controlled by rotating the shaft for the corresponding siphon. This adjustment can be performed externally of the drum with reference to a corresponding indicator after the drum is stopped.

Other features and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

Brief description of the drawings

FIG. 1 is an axial section of a dryer drum constructed in accordance with the invention;
FIG. 2 is an enlarged fragmentary section of one end portion of the drum shown in FIG. 1;
FIG. 3 is a fragmentary view taken generally on the line 3—3 of FIG. 2;
FIG. 4 is a fragmentary section taken generally on the line 4—4 of FIG. 2;
FIG. 5 is an axial section of one of the cages shown in FIG. 1; and
FIG. 6 is a fragmentary section of the cage shown in FIG. 5 as taken along the line 6—6.

Description of the preferred embodiment

Referring to the drawings, FIG. 1 shows a dryer drum constructed in accordance with the invention including a cylindrical shell 16 having an inner surface 18 and an outer drying surface 20. A circumferential flange 22 (FIG. 2) projects inwardly from each end of the shell 16, and heads 24 and 25 are rigidly connected to the ends of the shell 16 by a series of circumferentially spaced screws 26 threaded into the flanges 22. The heads 24 and 25 have integrally formed journals 27 and 28, respectively, which are received within suitable bearings (not shown) for rotatably supporting the drum 15.

An annular cage 30 is positioned within each end portion of the shell 16, and each cage has an axial length A. (FIG. 1) which is approximately one quarter of the overall length B of the shell 16. It is to be understood, however, that the length A of each cage depends upon the circumstances involved and that this length may vary considerably from one quarter of the overall length B as illustrated. Referring to FIGS. 5 and 6, each cage 30 is formed in three arcuate sections 32 which are assembled within the shell 16 to form a plurality of axially spaced rings 35 rigidly connected by peripherally spaced
axially extending vanes 36. Each vane 36 is positioned at an angle relative to an adjacent axial plane and has an outer edge 36' which is spaced slightly inwardly from the outer peripheral edges of the rings 35.

As shown in FIG. 6, the adjacent vanes 36 at the ends of the arcuate cage section 32 are rigidly connected by screws 29 to a flange 38 which is formed on one end of each cage 30 for connection to the inner surface of the corresponding head 24 or 25 by a series of screws 39. When the cages 30 are assembled within the shell 16, the outer peripheral edges of the rings 35 contact the inner cylindrical surface 18 of the shell 16 and cooperate therewith to define a plurality of axially spaced annular chambers 40.

Steam is introduced into the drum 15 and chambers 40 through a passageway 43 formed within the journal 28 and connected to a rotary joint 45. A condensate removal line 48 extends centrally through the passageway 43 and the interior of the drum 15 and has an outer end connected to a discharge line 49 through the joint 45.

A plurality of T-fittings 54 are connected to the condensate line 48 with one fitting 54 located centrally within each of the annular chambers 40 and with one or more fittings 54 located within the central portion of the drum 15. A siphon member 55 is provided for each of the annular chambers 40 and includes a radially extending telescopic tube 56 having an inner end portion received within the corresponding fitting 54. The outer end portion of each tube 56 is slidably supported by a bearing secured to a member 58 (FIGS. 5 and 6) projecting from the adjacent ring 32.

A flared or scoop-like siphon head 60 is mounted on the outer end of each tube 56 and is positioned within the corresponding annular chamber 40 adjacent the inner surface 18 of the shell 16. Each siphon head 60 is individually adjustable within its corresponding chamber 40 relative to the inner surface 18 of the shell 16 by a mechanism which includes a shaft 62 extending axially through the adjacent head 24 or 25. The outer end portion of each shaft 62 is supported by a bearing 66 enclosed within a housing rigidly connected to the adjacent ring 32.

A cam 70 (FIG. 4) is mounted on the inner end of each shaft 62 adjacent the corresponding bearing 66 and engages a follower 72 which extends from a collar 73 mounted on the inner surface 18 of the shell 16. Thus by attaching a suitable wrenched to the square outer end 75 (FIG. 2) of each shaft 62 and rotating the shaft, the corresponding siphon head 60 may be infinitely adjusted radially between predetermined limits relative to the shell surface 18 for controlling the depth of the annular layer of condensate within the corresponding chamber 40.

Preferably, each siphon head 60 is movable between a radially outer position where projecting screws or tips 77 engage the inner surface 18 of the shell 16 to define a minimum clearance of approximately 3/8" and a radially inner position where the siphon head 60 is spaced approximately 3/4" from the inner surface 18 of the shell 16. A suitable compression spring 78 (FIG. 2) is mounted on each tube 56 for urging each follower 72 against the corresponding cam 70.

Referring to FIG. 5, the radial position of each siphon head 60 is indicated by a pointer 80 secured to the outer end portion of the corresponding shaft 62 adjacent a radial circular scale 82 which is mounted on the corresponding packing gland 64. Referring to FIG. 1, additional siphon members 85 are connected to the fittings 54 within the central portion of the drum 15, but these siphon members are shown adjustable and are preset to maintain a layer of condensate of minimum thickness within the central portion of the drum.
defining a plurality of axially spaced annular chambers adjacent said inner surface of said shell, a siphon member positioned within each said chamber for removing condensate therefrom, and means for individually adjusting the radial position of each said siphon member relative to said inner surface of said shell for separately controlling the depth of the layer of condensate within each said chamber and thereby controlling the heat transfer from each said chamber to said outer surface of said shell to select the optimum surface temperature profile.

2. A dryer drum as defined in claim 1 wherein said means for individually adjusting the radial position of each said siphon member include an adjusting member extending through one of said heads for convenient external adjustment of each said siphon member.

3. A dryer drum as defined in claim 2 including means mounted on said head for receiving said adjusting member to indicate the relative radial position of each said siphon member relative to the inner surface of said shell.

4. A dryer drum as defined in claim 2 wherein said adjusting member comprises a shaft extending axially through one of said heads for each said member, means associated with the outer end of each said shaft for rotating said shaft, and means within said shell for moving the corresponding said siphon member radially in response to rotation of said shaft.

5. A dryer drum as defined in claim 4 wherein said means for moving each said siphon member comprises a cam mounted on each said shaft, and follower means mounted on each said siphon member for engaging the corresponding said cam.

6. A dryer drum as defined in claim 1 wherein said ring means defines a plurality of said annular chambers adjacent each end portion of said shell and each said head, and said adjusting member for each said siphon member extends through the adjacent said head.

7. A dryer drum as defined in claim 1 wherein said ring means comprises at least one cylindrical cage mounted within said shell and including a plurality of axially spaced rings, and means rigidly connecting said rings.

8. A dryer drum as defined in claim 7 wherein said cage includes a plurality of arcuate sections, and means for rigidly connecting said sections to form an annular cage.

9. A dryer drum as defined in claim 7 wherein said means connecting said rings comprises a plurality of circumferentially spaced vanes rigidly connecting adjacent said rings, and each said vane being angularly positioned relative to an adjacent axial plane for quickly distributing the condensate within each chamber into a layer of uniform thickness adjacent the inner surface of said shell.

10. An improved paper machine dryer drum comprising a shell having a cylindrical outer drying surface and an inner surface defining a chamber, a head mounted on each end of said shell and having means for rotatably supporting the drum, means for introducing steam into said chamber, at least one siphon member positioned adjacent said inner surface of said shell for removing condensate therefrom, means supporting said siphon member for movement generally within a radial plane and relative to said inner surface of said shell, a shaft extending axially through one of said heads and positioned radially outwardly from the rotational axis of said drum, means associated with the outer end of said shaft for rotating said shaft, and means within said shell for moving said siphon member within said plane in response to rotation of said shaft to provide for external selection of the depth of the condensate layer adjacent said inner surface of said shell and thereby to provide for convenient control of the heat transfer from said chamber to said outer surface of said shell.

11. A dryer drum as defined in claim 10 wherein said moving means comprises a cam mounted on said shaft within said chamber, and a follower connected to said siphon member and movable by said cam.

12. An improved paper machine dryer drum comprising a shell having a cylindrical outer drying surface and an inner surface defining a chamber, a head mounted on each end of said shell and having means for rotatably supporting the drum, means for introducing steam into said chamber, a plurality of siphon members positioned adjacent said inner surface of said shell for removing condensate therefrom, means supporting each said siphon member for movement relative to said inner surface of said shell, and a plurality of adjusting means extending through one of said heads for individually moving each said siphon member to provide for external selection of the depth of the condensate layer adjacent said inner surface of said shell and thereby to provide for convenient control of the heat transfer from said chamber to said outer surface of said shell.

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