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DRYING CYLINDER FOR DRYING THE WET MATERIAL WEB
FOR INSTANCE IN PAPER AND CELLULOSE MACHINES

Filed March 17, 1964

2 Sheets-Sheet 1

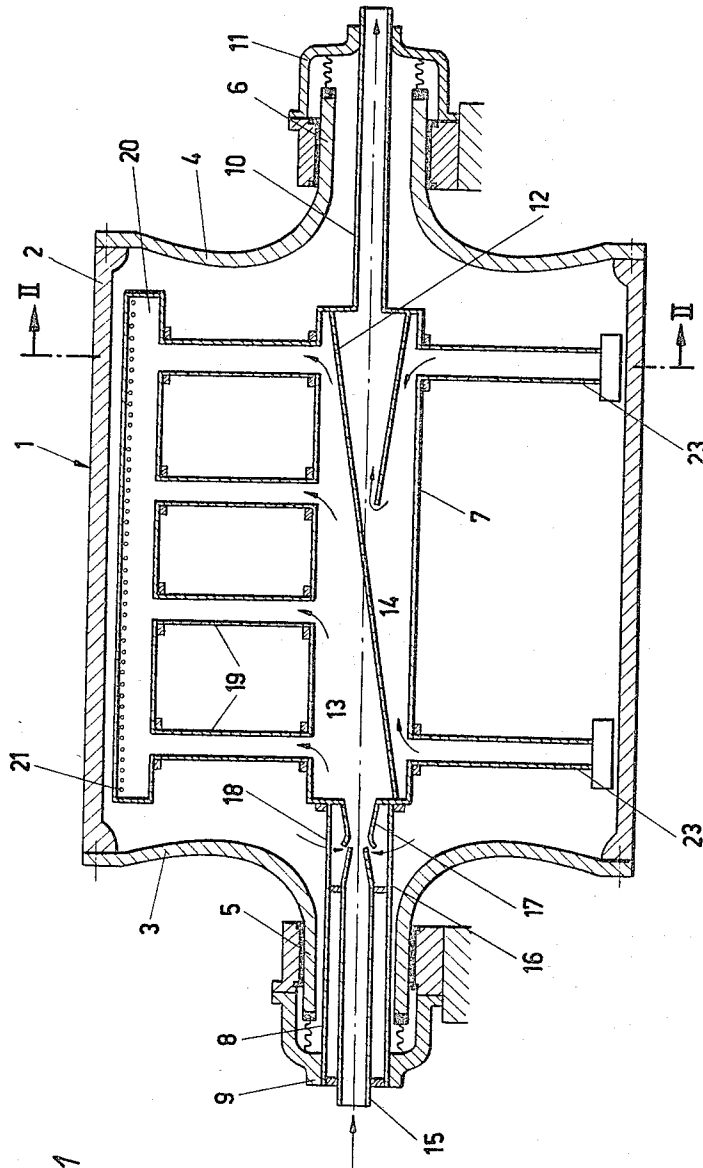


FIG. 1

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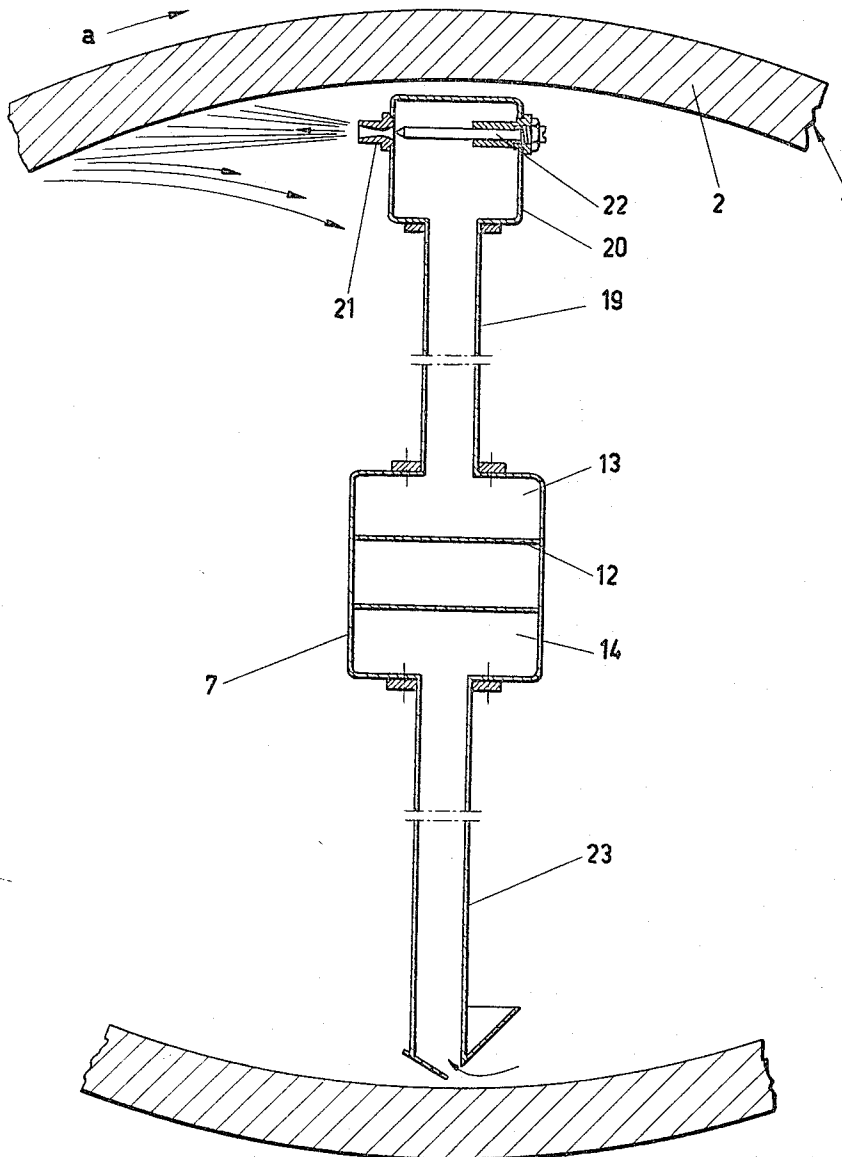


FIG. 2

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DRYING CYLINDER FOR DRYING THE WET MATERIAL WEB FOR INSTANCE IN PAPER AND CELLULOSE MACHINES

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This invention relates to a drying cylinder for drying a wet material web for instance in paper and cellulose machines whereby said cylinder is provided with devices for leading heating steam into the cylinder and other devices for discharging condensed steam therefrom.

As known, for instance paper and cellulose machines the drying is generally carried out by drying cylinders of cast iron, the diameter of which is 1–2 meters. Their inside wall may be rough and their external surface finished. The thickness of the mantle wall varies between 1.5–3 cms. Heating is generally arranged by steam supplied into the cylinder through a hollow axle journal.

Condensed steam is removed from the cylinder through a discharge outlet arranged at the other axle journal of the cylinder. The condensed steam exists inside the cylinder in different states depending on the diameter of the cylinder, its rotating speed and the quantity of condensed steam. At lower speeds and with greater amounts of condensed steam there is formed a water pool at the bottom of the cylinder, which pool moves contrary to the rotation of the cylinder, tending to remain at the lowest point of the cylinder. At higher speeds and with less condensed steam there is formed, due to the centrifugal force and the friction on the wall of the cylinder, a continual film of condensed moisture which rotates with the cylinder. In the final drying phase, during which the evaporation gradually becomes less, it has been observed that the humidity in the web is uneven. This is caused partly due to the unevenness appearing in the pulp-web and partly due to the varying drying conditions in the web.

Drying cylinders of the above stated type have several disadvantages.

So for instance when the working speed in a paper machine is accelerated the "waterpool," existing at the cylinder bottom, begins to change into a "water-ring." Thereby, the temperature of the cylinder mantle will be reduced. Unevenness and waves in the water-ring cause also irregular heat transmission.

Reduced heat transmission at higher speeds requires greater drying surfaces. Irregular drying requires over-drying, in order to equalize the formed moisture differences. Additionally, over-drying also requires an extended drying area. The use of additional heat increases manufacturing costs. At the same time the quality of the product becomes inferior.

Efforts have been made to control irregular drying of the web by leading a flow of dry air into the space between the cylinders against those portions of the web which contain more moisture than the other portions of the web. However this airflow has only an influence on roughly 20–30% of the whole web area. Consequently it has a comparatively small effect. Therefore devices using great air quantities are required, but when placed between the drying cylinders they impede the working of the machine.

In order to eliminate irregular drying there is further constructed jackets, by which the outer surfaces of the cylinders are covered. In this case the paper web is not covered by felt. With these jackets the drying effect can be regulated by blowing variable quantities of air against the web on the cylinder surface. This method causes difficulties in practical use, for instance, if the web breaks and gets jammed between the cylinder and the jacket.

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For increasing the drying effect in these devices, attempts have been made to regulate the drying cylinder from the inside by arranging heat-isolating means on the inner wall of the cylinder at places where over-drying has been observed. This arrangement has to some extent proved to be practical, but it is fairly difficult to realize and may also reduce the drying effect.

An object of the present invention is to eliminate the above stated disadvantages and this is obtained by a drying cylinder for drying the wet material web for instance in paper and cellulose machines, said cylinder being provided with devices for introducing heating steam into the cylinder and with devices for removing condensed steam therefrom, said cylinder being also provided with at least one adjustable nozzle connected to the steam supply within the cylinder and arranged near the cylinder mantle, so as to discharge the steam against the inner wall of the cylinder mantle at great speed, and to obtain efficient transmission of heat to the mantle.

The cylinder according to the invention gives a strongly improved drying effect. By arranging several adjustable spraying nozzles longitudinally along the cylinder mantle, it is possible to adjust the drying effect according to the requirements at each part of the web. An exactly even humidity profile across the pulp-web without any over-dried portions may accordingly be obtained. The drying cylinder according to the invention produces consequently products of higher standard. By making over-drying unnecessary loss of heat is also eliminated.

Other details and features of the invention are described by reference to the accompanying drawings, in which FIGURE 1 is an axial longitudinal section of an embodiment of the drying cylinder according to the invention;

FIGURE 2 is a cross-section along line II—II of FIG. 1, shown in larger scale.

The end walls 3 and 4 of the drying cylinder 1 are at their central part so shaped to form axle journals 5 and 6. The heating steam for the cylinder is introduced through the axle journal 5 at the intake side. Condensed steam is removed through the pipe 10 at journal 6 on the outlet side. The internal surface of mantle 2 of the drying cylinder 1 may be rough or grooved, to make the heat transmitting surface greater. The outer surface of the cylinder is finished to provide a smooth surface.

Inside the drying cylinder is a central partition 7, which comprises guiding means for the steam and for the condensed moisture to be removed. This dividing partition is supported so as to be maintained stationary within the cylinder. The partition 7 is at its intake end supported by a pipe 8 fixed in a retainer part 9, and at its other end by a pipe 10 fixed in a retainer part 11.

The partition 7 comprises a dividing wall 12, extending from a lower point at the intake end of the partition to an upper point at the discharge end. The upper compartment 13 of the partition 7 is for the steam and its lower compartment 14 for the condensed moisture. The steam is supplied through the pipe 8 into the steam compartment 13 through the centrally arranged steam pipe 15. The inner end of this steam pipe tapers to a contracted mouth piece 16, adjacent which a separate inlet tube 17, of the partition 7 is directed. The pipe 8 is provided with openings 18 near the mouthpiece 16 and the tube 17, so that steam flowing from mouthpiece 16 to tube 17 produces an injector-effect.

At the upper portion of the steam compartment 13 are connected branching pipes 19, through which the steam passes to a horizontal nozzle beam 20, connected to the upper ends of the branch-pipes. This nozzle beam extends substantially over the whole length of the drying cylinder mantle, i.e., substantially along the entire width

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of the web running over the cylinder. The nozzle beam 20 has a series of nozzles 21, which are dimensioned and formed so that the discharge spray of steam has a great speed. The direction of the steam sprayed through the nozzles 21 is contrary to the rotating direction of the drying cylinder, which latter is indicated by arrow *a*. The quality of steam discharged through each nozzle can be adjusted or the nozzle may be altogether closed by means of the adjustable regulating and closing spindle 22 (FIG. 2).

According to another embodiment, not shown, there may be used instead of several nozzles one single so called "split" nozzle in which the split continues over the whole width of the drying cylinder, and by means of which the discharged steam spray can be controlled in the same way as with the adjustable regulating and closing spindle 22 used for nozzles 21.

In order to discharge the condensed moisture formed on the cylinder mantle 2 there is arranged at the lower portion of the moisture compartment 14 of the partition 7 in the downward direction syphon-pipes 23, in spaced relation from one another. The condensed steam is discharged from the compartment 14 through the pipe 10. In order to use uncondensed steam within the cylinder this is led through the holes 18 and the steam injector 16, 17 back into the steam circulation,

According to still another embodiment of the invention, the supporting of the devices for the steam and the condensate inside the drying cylinder 1 may be arranged by means of a one-sided support placed outside the cylinder and by a supporting bearing arranged at the opposite end of the support inside the cylinder. The devices may also be arranged in such a way that the steam-intake and the outflow for the condensed steam takes place through the same axle journal.

When the drying cylinder 1 rotates, the condensed steam, in trying to follow the circulation of the mantle 2 meets the steam-spray from nozzles 21 and become skimmed off from the inner wall of the mantle. The heat from the steam-sprays is transmitted partly directly to the cylinder mantle and partly to the loosening condensed steam. The closing and opening of the nozzles is performed after the obtained drying result, when the variations in the web can be corrected. If the nozzles are equipped with remote-control devices, the correction may be made while the machine is running, whereas the nozzles working with fixed control system can be adjusted only while the machine is stopped.

The invention is of course not limited to the hereinabove embodiments. Its various details may vary within the limits and scope of the claims. This particularly concerns the construction of the nozzles and the manner of support of the devices inside the drying cylinder.

What I claim is:

1. A drying cylinder for drying the wet material web for instance in paper and cellulose machines, said cylinder being provided as well with devices for introducing heat-

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ing steam into the cylinder as with devices for removing condensed steam therefrom, said cylinder being provided with at least one adjustable nozzle, connected to the steam supply within the cylinder and arranged near the cylinder mantle, so as to discharge the steam against the inner wall of the cylinder mantle at great speed, and so obtaining efficient transmission of heat to the mantle, and in which the heating steam supplying pipe arranged inside the cylinder axle journaled is formed at its inner end to a contracting mouth piece at such a distance from the receiving opening of the central partition of the cylinder that an injector effect is obtained here by the steam blown into said central partition, said injector being adapted to draw uncondensed steam in the cylinder back into said central partition.

2. Apparatus for drying wet web material, said apparatus comprising a cylinder, means for introducing heating steam into the cylinder, means for removing condensed steam from the cylinder, at least one adjustable nozzle connected to the steam introducing means and located within and near the cylinder so as to discharge the steam against the inner wall of the cylinder at great speed thereby obtaining efficient transmission of heat to the cylinder; said steam introducing means including a steam supplying pipe having a tapered end and means to receive steam from the pipe and lead the steam to said nozzle, the latter said means including a receiving opening for the steam, said tapered end being spaced from the receiving opening so that an injector effect is caused by steam blown into said opening from said tapered end, the interior of the cylinder being in communication with said receiving opening so that said injector effect draws uncondensed steam in the cylinder into said receiving opening.

3. Apparatus as claimed in claim 2 in which the nozzle is directed to spray the steam against the inner wall of the cylinder in a direction opposite to that of the rotation of the cylinder.

4. Apparatus as claimed in claim 2 comprising a nozzle beam adjacent the inner wall of the cylinder and parallel to the axis of the cylinder, and branch pipes coupling the steam introducing means to said beam.

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