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(54) Drying section in a paper making machine.

(57) The invention relates to a drying section in a paper making machine, comprising at least two drying cylinders (1) for running therearound an endless drying wire (3). Between successively mounted drying cylinders (1) is fitted a roll (2) around which said drying wire (3) is adapted to travel from a preceding drying cylinder to the next in the running direction of a web. Aligned with roll (2) is a guide surface (OP) or the like fitted with at least one nozzle element (7). This produces an air current in the direction of guide surface (OP) and thus the passage of a web (5) between the drying cylinders and based on coanda-effect and effected close to guide surface (OP) but spaced from drying wire (3).

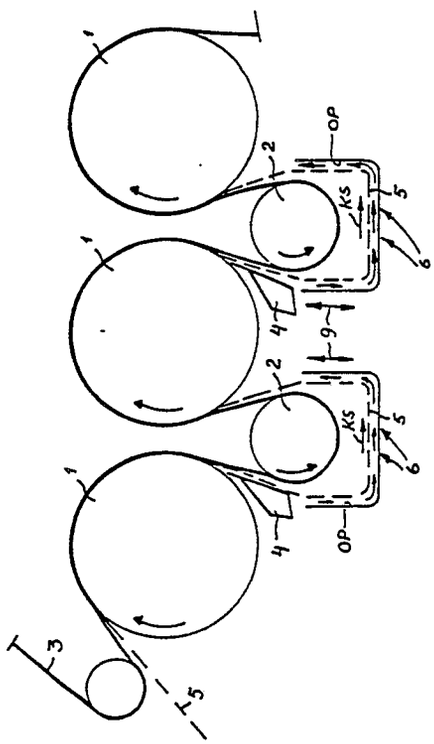

Fig 1

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DRYING SECTION IN A PAPER MAKING MACHINE

The present invention relates to a drying section in a paper making machine as defined in more detail in the preamble of claim 1.

The invention is particularly intended for a high-speed paper making machine, whereby a wet and weak web coming from a press is supported in a manner that it remains intact also at rates of production substantially higher than at present.

The rate of production in paper making machines has increased along with technological development. Its present level is 20-25 m/s in the manufacture of newsprint or corresponding paper grades. A high rate of production correlates directly with high output, i.e. reduced production costs. A condition for this is of course that a web to be produced remains undamaged. A break leads to interference and lower output. The forward end of the drying section in a modern high-speed paper making machine forms a point at which most breaks seem to occur.

A web couched with the wire section of a paper making machine still contains more than 80 % of water. It is removed from the web by compressing in a press section, usually down to a dry mater content of 40-45 %. The rest of the water must be removed by evaporation. This is effected by allowing the web to pass over hot drying cylinders. The web is pressed to the surface of a drying cylinder by means of a draining wire for maximum heat transfer contact. The amount of necessary thermal energy is great and, thus, a plurality of drying cylinders are required, in practice appr. 50 drying cyl inders. Those are usually provided as several operating arrays, generally 4-7 arrays. Problems occur particularly when the web passes from one drying cylinder to another. The first problem is so-called web flutter. The web coming from a press section is weak since the hydrogen bridges giving strength in a dry web have not developed as yet. Thus, the forces caused by speed, centrifugal force and air drafts bring about fluttering of a web which stretches it even more. A result may be a web folding into a pleat as it proceeds to the next felt gap resulting in a break.

One solution proposed to solve the problem has been so-called slalom passage. Here, the upper wire runs around the lower cylinders supporting the web all the time. The solution permits a somewhat higher output than other solutions. However, there are two drawbacks. First of all, on the lower cylinder, the drying wire lies between a drying cylinder and a web building a detrimental thermal insulation. In terms of drying effect the lower cylinders are useless. Secondly, at the lower cylinder, centrifugal force is applied to the web resulting in elongation and breaks if the rate of production is to be increased.

Two prior known solutions are employed for eliminating the above problem. In the first solution, the so-called vault surfaces of lower cylinders are grooved and blow boxes are used to create in the grooves a slight vacuum acting through the drying wire and thus keeping a web in contact with the drying wire. Due to the small cross-section of such grooves and air leaks this method only provides a marginal improvement to the problem. Another prior used solution is to replace the lower cylinders with such suction couch rolls that are pro vided with suction effect within the area of the winding angle of a web and which such a web within the area of its winding angle into contact with the drying wire. The solution is flawless as for its operation. Its drawback is nevertheless the high costs of both construction and operation. The suction couch roll is structurally complicated and includes wearing components. In addition, it requires constant maintenance.

An object of this invention is to overcome all the above problems. At the same time it will be unnecessary to use a so-called rope system which is required in the prior known solution for re-passing a web through the machine after a break. In order to achieve these objectives, a drying section of a paper making machine of the invention is mainly characterized by what is set forth in the characterizing clause of claim 1. Further advantageous features of the drying section according to the invention are evident from the dependent claims.

In a drying section set up according to the invention, the drying cylinders are preferably disposed in a single row. A draining wire runs over them in a traditional way. The lower cylinders are left out and replaced with a guide surface which is substantially of the same width as the web and based on coanda-effect. The guide surface is preferably a two-piece U-shape which is mountted symmetrically relative to the straight line running through the centre of a roll between the drying cylinders and perpendicular to the straight line connecting the centres of the drying cylinders in a manner that both pieces fold the web appr. 90°. Between the pieces remains a gap for allowing the chaff formed in a web break to fall into the basement of a machine.

The guide surface is preferably mounted to be carried by movable supporting arms or the like in a manner that its distance from the drying cylinders and a roll therebetween can be adjusted as the

machine is running. This is necessary for the reason that, due to said stretching tendency of a web, a possible excessive slack in a web loop can be eliminated by drawing the guide surface away from the drying cylinders. Furthermore, when starting a paper making machine or after a break, the edge trimming can be passed quickly and safely through the machine by using the guide surfaces without a risk of damage and unreliable leader ropes with their accessories.

In view of the above, the advantages gained by the invention are obvious. The guide surfaces are technically simple and inexpensive to manufacture as they can be made of e.g. thin shaped steel sheet provided with nozzle elements with air distributors. Being static elements, the guide surfaces do not include wheels or wearing components, so the need of maintenance is minimal and operating reliability is good. The heat compensation air necessary in a drying section is in fact partly blown through the nozzle elements on the guide surface to the surface of a web for more effective drying. It is true that a structure of the invention requires operating power since the velocity of air coming from the nozzle elements must be supercritical during the threading of a tail end but a lower air velocity is sufficient during normal running. Also due to the structure, the running of a web is all the time positively driven and thus there is no observable speed limit to restrict the operation or cause breaks.

The invention will now be described in more detail with reference made to the accompanying drawings in which

fig. 1 is a diagrammatic side view of a drying section in a paper making machine and

fig. 2 shows a guide surface in vertical section and in a larger scale.

Referring to the figures, the drying cylinders 1 of a paper making machine are mounted successively in the same plane. Therebetween are mounted rolls 2 which are necessary for the correct running of an endless drying wire 3. The drying wire 3 is tensioned upon drying cylinders 1 and rolls 2 so as to press a web 5 tightly against the face of a drying cylinder. The web running over a drying cylinder tends to stick to its face and to wind itself around the cylinder. This is prevented by using a blade 4 called a doctor blade which removes the web from a cylinder face and deflects the end of the web onto a guide surface OP. the guide surface OP is provided with nozzle elements 7 for blowing air in the running direction (arrow KS) of web 5. By virtue of so-called coanda-effect, the web travels extremely near the guide surface but without touching it.

The guide surface OP is designed for varying the running direction of a web as desired. The general shape of guide surface OP is a U-shape as viewed from the side of a drying section. This shape can be obtained e.g. by using a profiled piece 6, made of thin steel sheet and comprising a floor portion 6a and side portions 6b joining the floor portion and extending from floor portion 6a toward drying cylinders 1. The surface of profiled piece 6 facing the roll makes up a guide surface OP.

It is preferable to design a profiled piece 6 making up said guide surface OP so as to comprise two separate elements 6′, 6″ whereby, when a break occurs and a web is torn to pieces, the space defined by roll 2 and guide surface OP can be cleaned through a gap 8 between elements 6′, 6″. The division of guide surface OP into two elements can be affected by designing the profiled piece so as to comprise elements that are substantially L-shaped as seen from the side of a drying section, said gap 8 between the elements being in alignment with the centre of roll 2 in the direction perpendicular to the straight line connecting the centres of drying cylinders 1.

Since web 5 is fastened to the face of drying cylinder 1 by means of a drying wire 3 which prevents the slipping of a web relative to cylinder 1, the length of a free loop in web 5 on guide surface OP must be adjustable due to the elongation of a web. This is why said guide surface OP (profiled piece 6) is mounted upon movable supporting arms (not shown in the figures) in a manner that its distance from drying cylinders 1 and a roll 2 therebetween can be adjusted as the machine is running. This movability is shown in the figures with an arrow 9. In addition, said elements 6′, 6″ of profiled piece 6 can be pivotable around horizontal axles secured to the outer edge of vertical sides 6b for facilitating maintenance operations. This movability is shown in the drawings with an arrow 10.

Nozzle elements 7 can be transversal slice nozzles to which are connected transversal air distribution pipes 11 fitted outside said profiled piece 6. According to its design and size, said guide surface OP is provided with a necessary number of nozzles 7 having a combined effect so as to achieve the passage of web 5 based on coanda-effect from a drying cylinder preceding roll 2 to the next cylinder, so that the web is always spaced from drying wire 3.

One advantage gained by the invention is that a moving drying wire 3 induces air currents passing through drying wire 3 and around roll 2. By taking advantage of these the passage of web 5 can be further stabilized at the guide surface.

Claims

1. A drying section in a paper making machine, comprising at least two drying cylinders (1) for running an endless drying wire 4 therearound as well as a roll (2) between successively arranged drying cylinders (1) around which said drying wire 3 is adapted to pass from a preceding drying cylinder to the next in the running direction of a web, **characterized** in that aligned with said roll (2) is a guide means providing a guide surface (OP) and being fitted with at least one nozzle element (7) for producing an air current in the direction of guide surface (OP) and thus achieving the passage of a web (5) between the drying cylinders (1) based on coanda-effect and proceeding close to guide surface (OP) but spaced from drying wire (3).

2. A drying section in a paper making machine as set forth in claim 1, **characterized** in that, as viewed from the side of a drying cylinder (1), said guide surface (OP) is substantially a U-shape comprising a floor portion (6a) aligned with roll (2) as well as side walls (6b) extending from the floor edges toward said roll (2).

3. A drying section in a paper making machine as set forth in claim 1 or 2, **characterized** in that said guide surface (OP) is provided with one or a plurality of gaps (8).

4. A drying section in a paper making machine as set forth in one of the preceding claims **characterized** in that said guide surface (OP) is designed to comprise two elements (6′, 6″) and that said gap (8) is between said elements.

5. A drying section in a paper making machine as set forth in claim 4, **characterized** in that said guide surface (OP) is made of a plate-structured profiled piece (6) comprising two elements (6′, 6″), which are substantially L-shaped as viewed from the side of a drying section and whose surfaces facing said roll (2) make up a substantially U-shaped guide surface (OP).

6. A drying section in a paper making machine as set forth in one of the preceding claims, **characterized** in that the distance of guide surface (OP) from drying cylinders (1) and roll (2) is made adjustable.

7. A drying section in a paper making machine as set forth in one of the preceding claims, **characterized** in that there are a plurality of nozzle elements (7) mounted in connection with guide surface (OP).

8. A drying section in a paper making machine as set forth in one of the preceding claims, **characterized** in that said nozzle element (7) are slice nozzles extending transversely of the drying section and provided with air distributors (11) outside a guide surface (OP) formed by a plate-structured profiled piece (6).

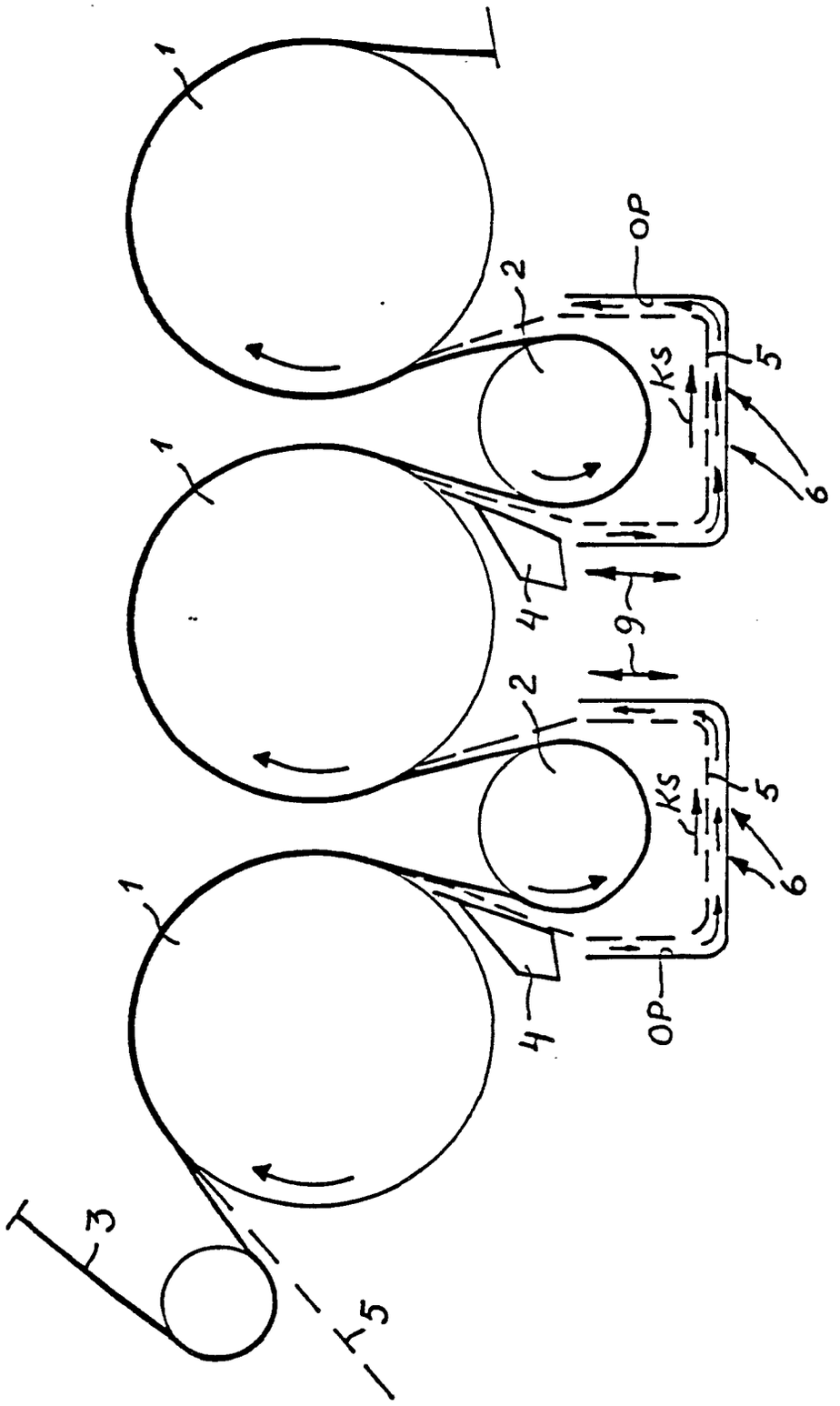

Fig 1

Fig 2