(12) UK Patent Application (19) GB (11) 2 050 458 A

(21) Application No **8015641**
(22) Date of filing **12 May 1980**
(30) Priority data
(31) **2918985**
(32) **11 May 1979**
(33) **Fed. Rep. of Germany (DE)**
(43) Application published
7 Jan 1981
(51) **INT CL³**
D21F 5/02
(52) Domestic classification
D2A 7B9
F4G 12A 18F 18M
(56) Documents cited
GB 1255920
GB 1199229
(58) Field of search
D2A
F4G
(71) Applicant
Wilhelm Wanke,
Doncauschwabenstr. 47,
7920 Heidenheim,
German Federal Republic
(72) Inventor
Wilhelm Wanke
(74) Agent
M. J. Stephens & Co.

(54) Web Drying Apparatus

(57) A web drying apparatus for use in paper-making or carton-making machines has a heated drying cylinder (1) and a fabric cover (3), the web (2) to be dried passing over part of the external surface of the cylinder beneath the cover (3). To increase the rate of evaporation of moisture from the web (2) and the fabric cover at least one static turbulence-inducing baffle (7) is mounted externally of the fabric cover (3) with a profiled leading edge (7.1) at least part of which is closely spaced from the external surface of drying cylinder and the fabric cover (3) within an angular sector (8).

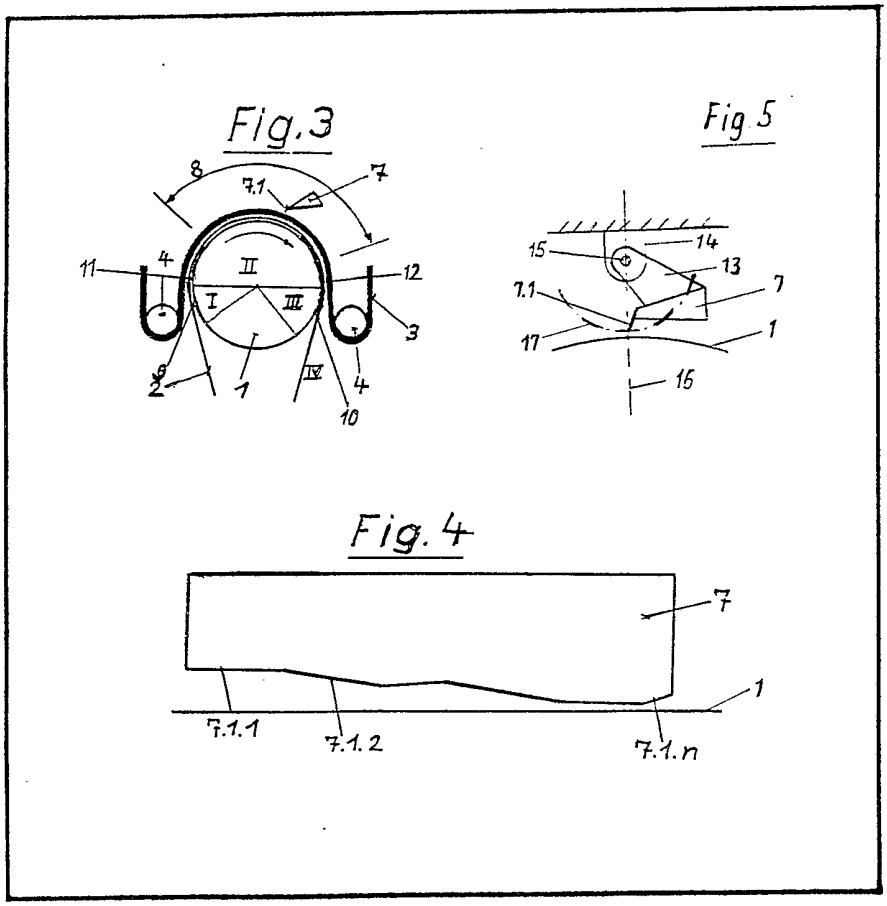

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Fig. 1

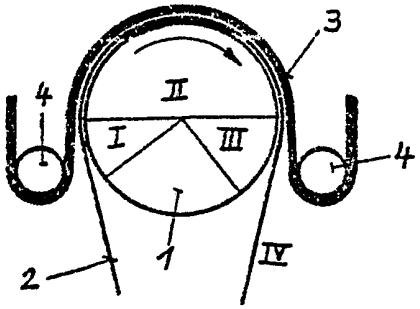


Fig. 2

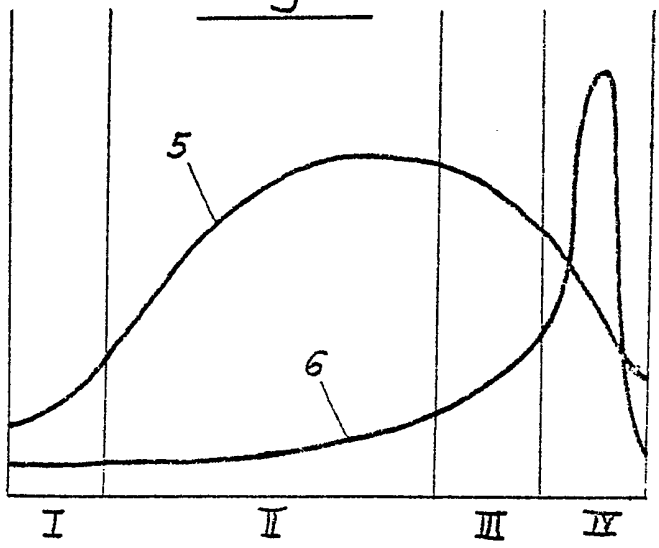
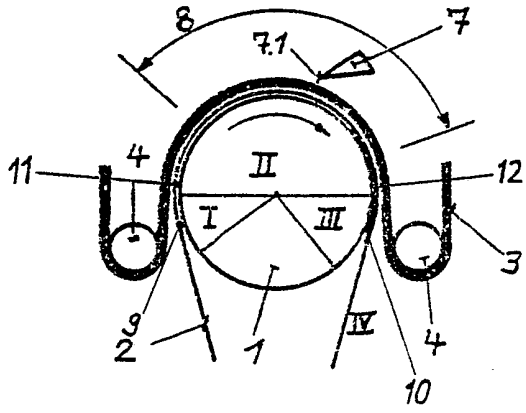


Fig. 3



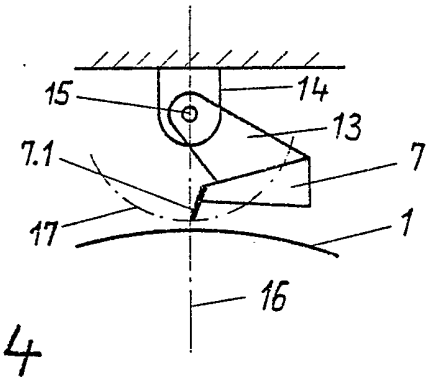
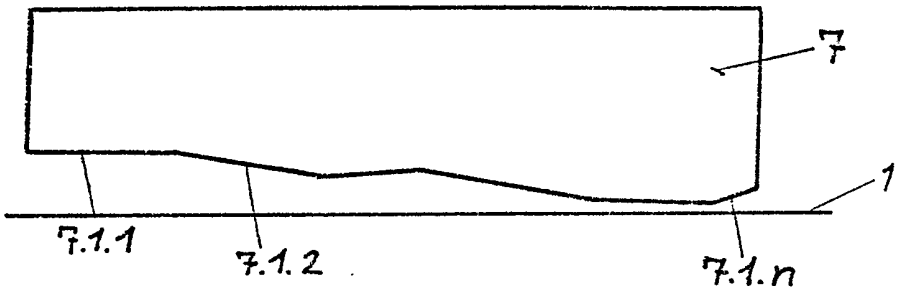


Fig. 5

Fig. 4



SPECIFICATION

Web Drying Apparatus

This invention relates to web drying apparatus, particularly for paper- and carton-making machines, of the kind in which a web to be dried passes between the surface of a drying cylinder and a cover fabric.

In the past an increase in demand for paper and carton has been met largely by increasing the specific performance of existing paper- and carton-making machines, a trend which is also desirable in the future. This, however, has resulted in limited advances being made in the field of contact drying by means of steam-heated drying cylinders, yet most existing paper- and carton-making machines are of this type, because of their low operating costs.

By developing a permeable fabric cover, for example, of felt or some other material with a mesh or permeable structure which moves over the drying cylinder simultaneously with the web to be dried, the specific drying performance has been improved. The same effect, although to a lesser degree, has been achieved by fitting doctor blades inside the drying cylinder to remove the laminar film of condensation from the inner cylinder wall, at a speed of approximately 400/min., thereby effectively increasing the heat transfer into the cylinder.

By using different numbers of internal doctor blades across the width of the drying cylinder, the transverse moisture profile of the sheet that has to be dried can be corrected. The effect of such internal blades is very slight due to the fact that the heat transfer into the cylinder is not the determining factor limiting the drying process: the drying process is in fact limited by the finite rate at which the evaporating moisture can be removed from the damp web to the outside.

The drying of a damp web by means of intercommunicating drying cylinders arranged in rows commonly takes place in stages: the damp web passes over a part of the circumference of each drying cylinder, with heat transfer by contact with the cylinder, and then spans across a free area onto the next drying cylinder, and so on, over successive drying cylinders. A large amount of the evaporating moisture is dispersed from these free areas into the surrounding atmosphere between the individual drying cylinders. As the damp web passes over part of the circumferential surface of each drying cylinder, it is pressed between the surface of the cylinder and the fabric cover in order to increase the heat transfer between the drying cylinder and the web. In travelling over a part of the circumference of each cylinder the web is heated and some moisture is expelled from the web. This, however, is possible only until such time as the surrounding atmosphere, which is in a laminar or near-laminar flow condition, is saturated with the evaporating moisture. The maximum capacity of the contact drying process is thereby considerably reduced.

It is generally known through United States Patent Specification No. 3 504 443 to locate on the outside of the fabric cover a turbulence-inducing baffle pressing against the cover. This baffle has an aerofoil effect, causing the moisture-laden boundary layer to be 'scraped off' the covering.

A disadvantage of this arrangement, however, is that the air which is trapped within the meshes of the fabric cover remains untouched by the above-mentioned process, thereby preventing a satisfactory removal of the moisture.

It is an object of the present invention to provide an external turbulence-inducing baffle or baffles for drying cylinders, particularly for paper- and carton-making machines, for the purpose of increasing the drying capacity and the moisture removal from a damp web.

According to the present invention there is provided a drying apparatus for use in drying a damp web, in which the web to be dried passes between the surface of a drying cylinder and a fabric cover, including at least one static turbulence-inducing baffle closely spaced from the outer surface of the fabric cover, the or each said baffle being provided with at least one leading edge which lies close to the external surface of the fabric cover.

The or each static baffle, being closely spaced from the surface, allows the saturated atmosphere to be removed from the vicinity of the drying cylinder by causing a turbulent air flow and/or vortex in the adjacent atmosphere. This achieves a partial or complete exchange of air resulting in a greatly increased drying capacity. Due to the vortex flow in the adjacent atmosphere and the impingement of the rebounding air even in the air in the mesh of the fabric cover is changed.

Advantageously, the turbulence baffle is mounted externally of the drying cylinder within an angular sector extending from a point 45° after the point at which the web runs onto the drying cylinder to a point 30° before the point at which the web runs off the cylinder. Alternatively the turbulence-inducing baffle may be mounted externally of the drying cylinder within an angular sector extending from a point 30° after the point at which the cover runs onto the cylinder to a point 25° before the point at which the cover runs off the cylinder. In practice it is advisable that more than one turbulence baffle lies within this angular sector at any one point.

Preferably the leading edge of the or each baffle has differently shaped segments across the width of the drying cylinder which are spaced at different distances from the surface of drying cylinder. Due to the changing profile of the external turbulence-inducing baffle or baffles the transverse moisture profile of the damp web, for example paper or carton, can be corrected across the width of the machine. For example, problems can in practice occur because the damp web does not always display a universal degree of dampness across its entire width. That is when the segmental baffles can prove useful, because

by adjusting their distance from the drying cylinder surface the removal of moisture can be controlled locally so that the transverse moisture profile of the web can be levelled out evenly across the whole width of the web. If necessary or desirable, some segments of the baffle can be removed altogether, at those points where little or no air is to be expelled.

In a preferred embodiment of the invention, the or each turbulence baffle is tiltable about a hinge axis which lies at least approximately in a plane containing the centre of the drying cylinder and at least part of the leading edge of the baffle. This enables the turbulence baffle to be swung out of the way without damaging the fabric cover or the drying cylinder, and also facilitates simple and rapid replacement of the fabric cover.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic end elevational view of a drying apparatus according to the known prior art;

Figure 2 illustrates graphically a drying process according to the prior art, using the apparatus illustrated in Figure 1;

Figure 3, is a diagrammatic end elevational view of apparatus according to one embodiment of the invention;

Figure 4 is an elevational view of a turbulence baffle for fitment to a drying apparatus according to the invention;

Figure 5 is a diagrammatic side view showing the suspension of the turbulence baffle.

In the drawings Figure 1 illustrates a known type of drying apparatus including a drying cylinder 1 one of a row of intercommunicating drying cylinders. The drying cylinder 1 is steam-heated internally. A web 2 to be dried passes over the drying cylinder 1 and is covered by a fabric cover 3 which extends between guide rollers 4 located on opposite sides of the drying cylinder 1.

The path of the damp web 2 over the drying cylinder 1 is notionally divided into successive zones I, II, III and IV in the direction of advance of the web 2.

Figure 2 illustrates the known prior art drying process graphically, the abscissa representing the position of the web 2 in its passage over the drying cylinder 1 and being subdivided into the successive zones I—IV. Curve 5 shows the variation of the temperature of the web 2 through the successive zones and curve 6 shows the rate of evaporation of moisture from the web. It will be seen that the temperature of the web 2 varies in a different manner from the evaporation rate. This is due to the fact that the saturated atmosphere surrounding the web 2 inhibits the drying process, causing the web temperature to increase.

The present invention seeks to increase the rate of moisture evaporation, particularly in zone II, by increasing the turbulence of the air surrounding the fabric cover 3 using one or more fixed external baffles.

Figure 3 shows a drying apparatus similar to that depicted in Figure 1, with the addition of an external fixed baffle 7 having a leading edge 7.1 which lies adjacent the external surface of the fabric cover 3. One or more such baffles 7 may be mounted within an angular sector 8 subtended by the axis of the cylinder 1. The sector 8 extends from a point situated at 45° after the run-on-point 9 of the sheet 2, that is, the point at which the sheet 2 first touches the drying cylinder 1 and is tangential thereto, to a point which is 30° in advance of the run-off point 10 at which the sheet 2 leaves the drying cylinder 1. Alternatively expressed, the sector 8 extends from a point which is 30° after the run-on point 11 of the fabric cover 3 to a point which is 25° in advance of the run-off point 12 of the fabric cover 3, the actual angular extent of the sector 8 being the smaller of these two angular spans, if they differ from each other.

Figure 4 shows the external fixed baffle 7 in plan, viewed in the circumferential direction of advance of the cylinder 1, indicated by the arrow in Figure 3. The leading edge 7.1 of the baffle has differently shaped segments 7.1.1, 7.1.2...7.1*n* of varying lengths and shapes. This allows corrections to be made to the rate of moisture evaporation from the web 2, by adjusting the spacings between the leading edge 7.1 of the baffle and the outer surface of the fabric cover 3.

By appropriate selection of the number baffles 7 and their individual leading edge profiles it is possible to effect a significant increase, in some cases as much as a two-fold increase, in the rate of evaporation of moisture from the external surface of the fabric cover 3.

Figure 5 shows diagrammatically one means of supporting the baffle 7. The baffle 7 is supported at each end by a support arm 13 which is angularly movable relative to a fixed support 14 by a pivot joint having a hinge pin 15 the axis of which lies in a plane 16 containing the axis of the drying cylinder 1 and at least part of the leading edge 7.1 of the baffle 7. This allows angular swinging movement of the baffle 7, causing its leading edge 7.1 to move in a circular arc 17, shown in ghost outline in Figure 5.

Claims

1. A web drying apparatus for use in drying a damp web, in which the web to be dried passes between the surface of a drying cylinder and a fabric cover, including at least one static turbulence-inducing baffle closely spaced from the outer surface of the fabric cover, the or each said baffle being provided with at least one leading edge close to the external surface of the fabric cover.

2. A drying apparatus according to Claim 1, in which the turbulence-inducing baffle is mounted externally of the drying cylinder within an angular sector extending from a point 45° after the point at which the web runs onto the drying cylinder to a point 30° before the point at which the web runs off the cylinder.

3. A drying apparatus according to Claim 1, in

which the turbulence baffle is mounted externally of the drying cylinder within an angular sector extending from a point 30° after the point at which the cover runs onto the cylinder to a point 25° before the point at which the cover runs off the cylinder.

4. Drying apparatus according to any one of Claims 1 to 3, in which the leading edge of the or each baffle has differently shaped segments across the width of the drying cylinder which are spaced at different distances from the surface of the drying cylinder.

5. Drying apparatus according to Claim in which the leading edge extends across some parts only of the width of the drying cylinder.

6. Drying apparatus according to any one of the preceding claims, in which the or each baffle is tiltable about a hinge axis which lies at least approximately in a plane containing the centre of the drying cylinder and at least part of the leading edge of the baffle.

7. A web drying apparatus substantially as herein described with reference to and as shown in the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.