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(54) **A moisturising device for a web of sheet material, in particular paper.**

(57) The device serves to moisturise uniformly in a transverse direction a web of paper translating at high speed, and consists of first and second counter-rotating cylinders between which the paper web passes in such a way as partly to wrap over a lateral surface of a first cylinder, cooling means disposed within the first cylinder, and a condensation chamber within which the first cylinder is partially

housed in such a way as to delimit the interior thereof with its lateral surface, the said chamber being subdivided in the direction of the axis of rotation of the first cylinder into a plurality of compartments each of which is provided with means for directing saturated steam against the said first cylinder.

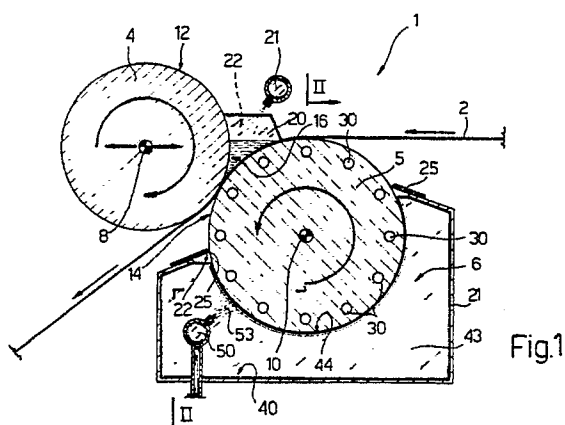


Fig.1

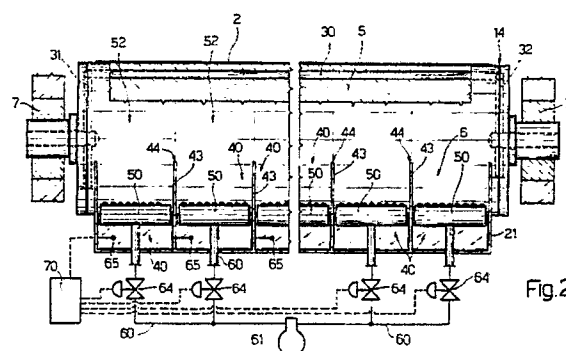


Fig.2

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A MOISTURISING DEVICE FOR A WEB OF SHEET MATERIAL, IN PARTICULAR PAPER

The present invention relates to a moisturising device for wetting a web of sheet material, in particular a web of paper, translating at high speed, in such a way as to obtain a uniform moisturisation of a desired magnitude, in particular in the transverse direction of the web itself.

In the paper industry it is known that before certain working operations it is necessary to moisturise the previously formed web of paper, or paper being formed (in which case it is supported on an underlying permeable web); in particular, in the field of paper manufacture for the support of self-adhesive labels it is necessary to obtain webs of paper having an absolutely smooth and compact surface whereby to permit the spreading thereon, with minimum cost, of anti-adhesive substances (principally silicone) adapted to avoid adhesion between the web and the labels which are already spread with adhesive and which are subsequently deposited onto the web itself. For this purpose paper webs wound in rolls coming from normal paper manufacturing processes are subject to a so-called "super-calendering" treatment, in which the web, after moisturising to values greater than 10%, is calendered between a number of groups of counter rotating cylinders newly dried to normal values. The result of this treatment depends in strict measure on how the moisturising stage is conducted; if at the end of this stage the web of paper is successfully uniformly moisturised a perfectly smooth surface will be obtained which is therefore suitable for the spreading process; if, on the other hand, the moisturisation of the paper is not uniform, in particular in the direction transverse that of advance of the web, irregular surfaces are obtained.

Since the super calendering operation also involves high speed of translation of the web of paper between the cylinders it is a necessary consequence that to permit the continuous supply of the calendering machines it is necessary to have available a moisturising device which can operate at the same speed thereas, or else to have available several moisturising devices in parallel and a stacking zone between these and the super calender. Known moisturising devices based on the use of atomised jets of water directed against the paper web are not, in fact, effective when the web translates at high speed in that the motion of the web causes the creation of a boundary layer on the surface of the web itself which repels the water droplets; this disadvantage is partially overcome by so called "cloud chambers", long tunnels through which the web is translated and within which a cloud of water droplets in suspension is created. It

is clear, however, that the use of such a device, like the use of several slow devices serving a stacking zone, presents numerous disadvantages among which are their bulk and the high costs of construction and management. Finally, the known moisturising devices do not give sufficient guarantee of uniformly moisturising the paper web.

The object of the present invention is that of providing a moisturising device capable of operating at high speed and, by contrast, of obtaining a very precise control of the moisturisation of the web of sheet material, all with low dimensions and low construction and management costs.

The said object is achieved by the invention, which relates to a moisturising device for uniformly moisturising a web of sheet material, in particular paper, characterised by the fact that it comprises in combination: a first rotary cylinder cooperating with the said web; means to permit translation of the said web partly wrapping the lateral surface of the first cylinder; cooling means disposed within the first cylinder; and a condensation chamber within which the first cylinder is partially housed over the whole of its length on the side opposite that cooperating with the said web, in such a way as to define an internal wall of the said chamber with its lateral surface, over an arc of predetermined angle; this chamber being subdivided, in the direction of the axis of rotation of the first cylinder, into a plurality of compartments each of which is provided with means for directing steam towards the said first cylinder.

For a better understanding of the invention a non-limitative description of an embodiment thereof is now given, with reference to the attached drawings, in which:

Figure 1 schematically illustrates a sectional side view of the moisturising device for webs of sheet material, formed according to the principles of the invention; and

Figure 2 schematically illustrates a section taken on the line II-II of the device of Figure 1.

With reference to the said drawings, the reference numeral 1 generally indicates a moisturising device for treating a web of sheet material 2, for example paper, wound on rollers not illustrated for simplicity and which are unrolled in a known way upstream of the device 1, caused to translate with a predetermined speed within the device itself and, for example, rewound on rollers downstream of the device 1 (or else directly fed into a subsequent working stage); the device 1, which is formed in a way such as to guarantee an absolutely uniform moisturising of the strip 2, essentially comprises a pair of counter-rotating cylinders 4 and 5 disposed

parallel to and adjacent one another, and a condensation chamber 6 within which substantially half the external diameter of the cylinder 5 is housed over the whole of its length; in particular the cylinders 4 and 5 are driven in a known way, not illustrated for simplicity, and are rotatable on respective known supports 7 (of which only that of the cylinder 5 is illustrated for simplicity) about respective axes 8 and 10 disposed parallel to one another and at a distance such as to cause respective outer lateral surfaces 12 and 14 thereof to cooperate with one another with the web 2 interposed between them; the arrangement of the cylinders 4, 5 is such as to permit translation of the web 2 between the cylinders themselves with the web 2 partially wrapped over the lateral surface 14 of the cylinder 5; translation of the web 2 is ensured by drawing it in the direction of the arrows (Figure 1) by the effect of the rotation, in the direction of the arrows, of the cylinders (4, 5) or, equally, by the effect of the rotation of respective known traction cylinders not illustrated for simplicity, positioned downstream from the cylinders 4, 5; in either case the cylinder 4 is disposed above and to one side of the cylinder 5, offset in the direction of rotation of this latter, and in a position such as to delimit, together with the cylinder 5, between the surfaces 12, 14, a space 16 through which the web 2 passes; this space 16 preferably has an adjustable width in that the cylinders 4, 5 are mounted relatively displaceably in a direction perpendicular to the axis of rotation thereof; for example, the axis of rotation 8 of the cylinder 4 is movable in the direction of the arrows in such a way that the interaxial distance between the axes 8 and 10 can be adjusted to a desired value.

According to the invention, moreover, the space 16 is utilised to obtain a first wetting, poorly distributed but of significant magnitude, utilising the principle of the so-called known "gluing press" machinery utilised in the primary working of the paper; for this purpose the device 1 includes a pair of side walls 20 (of which only one is illustrated in Figure 1) disposed in correspondence with the cylinders 4, 5 in such a way as substantially to close the ends of the space 16 themselves with a liquid-tight seal, as well as one or more nozzles 21 acting to feed a jet of water 22 into the space 16; in use, the space 16, being closed from below by the web 2 passing through it, behaves as a vessel in which the water supplied by the jet 22 accumulates, forming a head of predetermined height capable of causing impregnation of the paper sheet 2 notwithstanding that this is moving at a high speed; however this impregnation, as is well known from practical experience derivable from gluing presses, is very non-uniform, and in particular is not regular in a direction transverse the paper web,

that is along the axis of rotation of the cylinders 4, 5.

The opposite side of the cylinder 5 from that which cooperates with the web 2 is housed in the chamber 6 and delimits with its lateral surface 14, over an arc of predetermined angle, equal to about 180° , an upper internal wall of the chamber 6 itself; in particular, the condensation chamber 6 is delimited by a casing 21 disposed with its longitudinal axis parallel to the axis of rotation of the cylinder 5 and provided with an upper opening 22, preferably inclined downwardly towards the cylinder 4, into which the cylinder 5 is inserted and closes, being disposed with its axis of rotation 10 substantially level with the plane of the aperture 22. For the purpose of regulating the layer of air which is drawn in rotation with the cylinder 5 the longitudinal edges of the opening 22 are preferably provided with respective blades 25 projecting obliquely with respect to the lateral surface 14 and cooperating therewith at a predetermined distance therefrom, adjustable by transverse translation of the blades 25 which can be effected in a known way not illustrated for simplicity.

According to the invention, the cylinder 5 is provided internally with a cooling device comprising a plurality of tubes 30 disposed axially through the cylinder 5 immediately beneath the lateral surface 14 thereof, which are connected to respective supply manifolds 31 and discharge manifolds 32 formed on the head ends of the cylinder 16 which can be supplied in a known way not illustrated for simplicity through the supports 7 in such a way as to define an hydraulic circuit through which flows a stream of coolant fluid, for example water, made to circulate by a pump, not illustrated for simplicity. Moreover, the condensation chamber 6 is subdivided, in the direction of the axis of rotation 10 of the cylinder 5, into a plurality of compartments 40 delimited within the casing 21 by respective transverse U-shape walls 43 disposed parallel to one another and spaced by predetermined distances, respective curved edges 44 of which cooperate with a minimum clearance with the lateral surface 14 in such a way as to form a labyrinth seal and ensure a substantial fluid-tight sealed subdivision of the compartments 40 from one another.

Finally, still according to the invention, each compartment 40 is provided internally with means for directing steam towards the cooled cylinder 5; such means comprise at least one associated nozzle 50 for each compartment 40, orientated in such a way as to be able to direct a jet 53 of saturated steam against a corresponding respective annular portion 52 (two adjacent portions 51 being shown in broken outline in Figure 2) of the lateral surface 14 of the cylinder 5 facing the respective compartment 40 and of width substantially equal thereto.

The device 1 also includes means for adjusting the rate of flow of steam from the nozzles 50 of each compartment 40 independently of the rate of flow of steam emitted by the nozzles 50 of the other compartments; such means comprise, for example, a steam induction tube system 60 illustrated only schematically, connected to a source of saturated steam 61 under pressure and a series of steam flow rate adjustment valves 64 disposed in series along the tubes 60 one for each compartment 40; preferably, moreover, the valves 64 are controlled in an automatic manner by "feedback" from respective known sensors 65 detecting the moisture content of the web 2, only some of which are illustrated and each of which is mounted in correspondence with one of the portions 52, in such a way as to be able to detect the moisture of the corresponding longitudinal portion of the web 2 passing past this portion 52 or rather, more precisely, through each compartment 40; the sensors 65 are connected in a known way to a central control unit 70 by which, in a known way, the valves 64 are controlled.

In use, the steam emitted from the nozzles 50 condenses on the surfaces of the portions 52 in that the cylinder 5 is cooled by the effect of the passage of the coolant liquid in the tubes 30; consequently there forms on the lateral surface 14 a film of moisture which is drawn into rotation together with the cylinder 5 and which, consequently, is carried into contact with the lower face of the web 2 advancing between the cylinders 4 and 5, that is with the face of the web 2 which cooperates with the cylinder 5; this film of moisture is consequently absorbed by the web 2 during its transit between the cylinders 4 and 5 and is continually reformed on the surface 14, on the part thereof which progressively passes through the chamber 6, by the effect of the condensation of new steam; thanks to the fact that the cylinder 5 rotates at a relatively high speed and, above all, to the fact that the compartments 40 are separated from one another by the walls 43, which extend close to the surface 14 and each of which receives a separate flow of steam, on each portion 52 of the surface 14 there forms a film of moisture obtained from the condensation of the steam the water content of which depends strictly on the rate of flow of steam supplied to the respective nozzle 50; therefore, the sheet 2 absorbs quantities of water different from region to region, according to the quantity of moisture transported from each portion 52, that is to the rate of flow of steam emitted from each nozzle 50; therefore it is clear that it is possible to control precisely the moisture content of the sheet 2 in a direction transverse its direction of translation, that is in the direction of the length of the cylinders 4, 5, by suitably controlling, through

the valves 64, the flow of steam emitted from each nozzle 50; this control can be obtained in a manual and less precise manner having, on the basis of experience, an idea of the normal distribution of moisture transversely of the web 2 and therefore correcting this distribution to render it uniform by arranging for a greater flow of steam from those nozzles 50 which are located at regions of the web 2 which in normal conditions (that is with all the nozzles 50 delivering the same steam flow rate) would be less moist; alternatively control of the moisture can be effected in real time and with high precision through the automatic system constituted by the sensors 65 and the central control unit 70; the sensors continually detect the moisture rate of each longitudinal portion of the web 2 and send to the central control unit 70 a signal which, once suitably processed, produces greater or lesser opening of the valve 64; in the case of paper sheets 2 with the device of the invention a control of the transverse moisture rate of the web 2 lying between about 0.25 and 2% can be obtained, which values are enough to ensure a sufficient surface uniformity in the subsequent super calendering treatment.

From what has been described the advantages associated with the invention are evident; on the one hand the device constituted by the cylinder 5 with coolant tubes 30 and condensation chamber 6 with its separate compartments 40, each of which is independently supplied with steam from one or more nozzles 50, makes it possible to obtain a very good control of the transverse moisture rate of the paper sheet 2; on the other hand, the moisturising operation which, if it is necessary to provide a large increase in moisture to the sheet 2 (for example 10% or more) would be relatively slow if only water which condenses on the surface 14 were relied on, is accelerated by the use of the space 16 as a vessel for the formation of a head of water directly in contact with the sheet 2 in that the moisturising operation can proceed with the sheet 2 translating at the same speed as that required by the supercalendering so that the device 1 can advantageously be coupled to a supercalender or be inserted in the terminal part of a continuous paper producing machine, eliminating dead times and the necessity for storing moist webs typical of known processes. It is finally to be noted that the sheet 2, in its passage between the device 1, receives moisture on both its faces (the lower face absorbs moisture from the cylinder 5, the upper face from the water which lies in the space 16); so that a better distribution of moisture throughout the thickness of the web 2 is also ensured.

Claims

1. A moisturising device for uniformly moisturising a web of sheet material, in particular paper, characterised by the fact that it comprises in combination: a first rotary cylinder cooperating with the said web; means for permitting translation of the said web partly wrapping a lateral surface of the said cylinder; cooling means disposed within the first cylinder; and a condensation chamber within which the first cylinder is partially housed over the whole of its length on the side opposite that cooperating with the said web, in such a way as to define an internal wall of the said chamber with its lateral surface over an arc of a predetermined angle; this chamber being subdivided, in the direction of the axis of rotation of the first cylinder, into a plurality of compartments each of which is provided with means for directing steam towards the said first cylinder.

2. A device according to Claim 1, characterised by the fact that the said steam-directing means comprise at least one associated nozzle for each said compartment, orientated in such a way as to be able to direct a jet of steam against an annular portion of the lateral surface of the first cylinder facing the respective said compartment and of width substantially equal thereto.

3. A device according to Claim 2, characterised by the fact that it includes means for adjusting the rate of flow of steam from the nozzles of each said compartment independently of the rate of flow of steam emitted from the nozzles of the other compartments.

4. A device according to Claim 3, characterised by the fact that the said steam flow rate adjustment means include an associated steam flow rate adjustment valve for each said compartment, a respective sensor for detecting the moisture content of the said web of sheet material at an associated longitudinal portion thereof in transit through each said compartment, and a central processing control processing unit for the said valves connected to the said sensors.

5. A device according to any preceding Claim, characterised by the fact that the said condensation chamber is delimited by a casing disposed with its longitudinal axis parallel to the axis of rotation of the said first cylinder and provided with an upper opening closed by the said first cylinder, this latter being disposed with its axis of rotation substantially level with the plane of the said aperture in such a way as to be housed within the said chamber by one half of its diameter.

6. A device according to Claim 5, characterised by the fact that associated longitudinal edges of the said upper aperture are provided with respective adjustable blades disposed obliquely with respect to the said lateral surface of the said first cylinder

and cooperating therewith at a predetermined distance therefrom.

7. A device according to Claim 5 or Claim 6, characterised by the fact that the said compartments are delimited internally of the said casing by associated U-shape transverse walls disposed parallel to one another and spaced by predetermined distances, respective curved edges thereof cooperating with a minimum clearance with the said lateral surface of the said first cylinder.

8. A device according to any preceding Claim, characterised by the fact that the said means for permitting translation of the web comprise a second cylinder counter-rotating with respect to the first and which is disposed parallel to the first cylinder, above and to one side thereof, displaced in the direction of rotation of the first cylinder at a position such as to delimit, together with this latter, a space of adjustable width, the said counter-rotating cylinders being relatively displaceable in a direction perpendicular to the axes of rotation thereof, in such a way as to adjust the interaxial distance between them.

9. A device according to Claim 8, characterised by the fact that it further includes a pair of lateral walls acting to close the ends of the said space between the counter-rotating cylinders and means for supplying water to the interior of the said space.

10. A device according to any preceding Claim, characterised by the fact that the said cooling means comprise a series of tubes disposed axially through the said first cylinder immediately beneath the said lateral surface and traversed by a flow of refrigerating fluid.

