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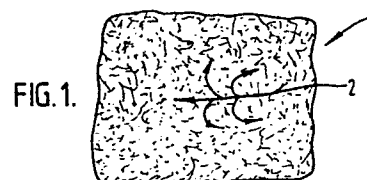
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54 Paper making machinery.

57 A paper making machine includes a dryer section which constitutes 50% or more of the length of the paper machine. It has been proposed to reduce or obviate this dryer section by subjecting the paper sheet simultaneously to high nip pressures and temperatures, but conventional wet press felts are not suitable in a press drying system.

The invention is concerned with an endless permeable belt for releasing moisture from fibrous paper making dispersions or sheets formed therefrom in which the belt is formed from a flexible corrosion and stretch resistant sheet having a high tensile strength and which is formed from metallic fibres laid randomly in a sheet and bonded together. Such a belt can be used in press drying or can also be used in other parts of the paper machine as well as the press drying section.



This invention relates to paper making machinery and in particular to foraminous elements for use in such machinery which support the paper sheet as it is drained and dried.

- 5 In a paper making machine, an aqueous dispersion of paper making fibres is initially drained on a Fourdrinier wire. After the paper sheet has acquired sufficient internal coherence to be self-supporting, it is lifted from the Fourdrinier wire as it passes over the couch roll
10 and is carried through a wet press section by absorbent press felts. The wet press section consists of one or more pairs of opposed rolls which subject the sheet and supporting felts to nip pressure whereby moisture is driven from the sheet and absorbed by the felts.
- 15 The partly dried sheet is then passed on further felts through a dryer section consisting of a substantial number of large rotating steam heated drying cylinders against which the sheet is held until the moisture content is reduced to that required in the finished sheet.
- 20 Although the dryer section accounts for a major proportion of the energy usage and physically constitutes 50% or more of the length of the paper machine, it removes a relatively small proportion of the water from the sheet, as compared with the Fourdrinier wire and press section. Operating,
25 capital and maintenance costs are therefore high in relation to the effectiveness of the dryer section.

Proposals have therefore been made to find more cost effective ways of drying the paper which will reduce the size of or obviate the dryer section. Such proposals
30 rely on subjecting the paper sheet simultaneously to high nip pressures and temperatures in excess of 100°C and expelling moisture as vapour. This technique is known as press drying and one arrangement based on the technique is described in

the United Kingdom published Patent Application No. 2052586A.

It is not however possible to use conventional wet press felts in a press drying system, since they are insufficiently permeable to water vapour and confer a poor surface finish on the sheet which cannot be rectified subsequently, even by substantial calendering. Attempts have been made to use both Fourdrinier wires and more open modern forms of wet press felts, but the result was the formation of wire marks more pronounced than those resulting from conventional paper making.

It is among the objects of the present invention to provide a novel form of permeable element for use in a paper machine which, in differing forms, can be used in a press drying assembly, or in a conventional dryer, forming part of a paper machine.

In one aspect therefore, the invention provides an endless permeable belt for releasing moisture from fibrous paper making dispersions or sheets formed therefrom, comprising a flexible, corrosion and stretch resistant sheet having a high tensile strength and formed from metallic fibres laid randomly in a sheet and bonded together. Preferably the bonds between the fibres are formed by sintering.

In another aspect, the invention provides a Fourdrinier paper machine having a press drying section incorporating a belt as above defined.

In a further aspect, the invention provides a paper machine having a machine glazing cylinder and incorporating a belt as above defined, the belt being arranged so as to bear against the outer surface of a paper sheet being dried on the cylinder during movement of the paper sheet around a substantial proportion of the circumference of the cylinder.



In a still further aspect the invention provides a paper machine having a dryer section incorporating belts as above defined.

According to yet another aspect of the present invention a
5 method of making an endless permeable flexible corrosion and stretch resistant belt with a high tensile strength, for releasing moisture from fibrous paper making dispersions or sheets formed therefrom comprises the steps of dry forming a layer of the belt from corrosion resistant metal fibres,
10 and supporting the so formed dry belt on a support, consolidating the metal fibres by sintering so as to form a web, and leading the thus formed web around a path which determines its length before returning it to join with the end of the first dry formed layer and subsequently applying a second
15 and subsequent layers of metal fibres whilst moving the belt around the path until a belt of the required thickness is obtained.

Preferably the web is self supporting after it initially leaves the support. A magazine may be provided in the path
20 comprising adjustable rollers, adjustment of which determines the length of the belt. Means may also be provided for controlling the thickness, substance i.e. grammage and deckle of the belt.

The permeable belt of the invention is preferably made from a metal such as stainless steel since, when used in a press drying context, it will be required to withstand temperatures of 100° to 150°C with a stretch of less than 1%.

- 5 The sheet from which the belt is made requires to be sufficiently flexible to conform to rolls in the region of 15 centimetres in diameter whilst having a tensile strength of about 40 to 60 Newtons per 15mm. The random laid material of the invention has a smoothness of from 200 to
10 300 Bendsten (in paper terms). This is substantially smoother than the woven material from which Fourdrinier wires are conventionally made. Because of the absence of wire knuckles characteristic of Fourdrinier wires, the formation of a wire mark in the paper made using sheets
15 according to the invention is avoided.

For use in a press drying context, the sheet should have sufficient permeability to pass steam at a rate of at least 170 cubic metres per square metre per hour at atmospheric pressure.

- 20 The invention will now be further described with reference to the accompanying drawings, in which :-

Figure 1 is a plan view of a detail of a foraminous belt according to the invention,

- 25 Figure 2 is a diagrammatic side elevation of a first assembly embodying the invention for effecting press drying of the paper,

Figure 3 is a diagrammatic side elevation of a second assembly embodying the invention for effecting

press drying of paper.

Figure 4 is a diagrammatic side elevation of a conventional configuration of paper machine dryer but embodying the invention, and

3 Figure 5 is a diagrammatic side elevation of a device for forming a belt according to the invention.

Referring to Figure 1, the configuration shown consists of a sheet 1 formed from a mass of short stainless steel
10 fibres 2 laid randomly, in a manner somewhat similar to cellulose fibres in paper, and bonded together by sintering. A suitable material is sold under the Registered Trade Mark BEKIPOR, by N.V. Bekaert S.A. B 8550 Zwiévegem Belgium. The preferred grade is 10 BL 1 which has a steam permea-
15 bility at atmospheric pressure of about 600 cubic metres per square metre per hour.

The press drying assembly of Figure 2 comprises two heated drying cylinders 10 and 11 rotatable about parallel axes 12 and 13 respectively. The cylinders 10 and 11 may, for
20 example, be heated by steam and are movable towards each other, as indicated by the arrows 14, to form a nip at 15.

The assembly shown also comprises two endless metallic permeable belts 16 and 17 according to the invention. From a tensioning roll 18 the element 16 is led around a
25 lead in roll 25, under a pressure applying roll 19, around the cylinders 10 and 11 and a second pressure applying roll 20, and back to the tensioning roll 18. The belt 17 is led from a tensioning roll 21 around a guide roll 22. It is then taken around the cylinder 10, inside the belt 16, and
30 around the cylinder 11 outside the belt 16. It is then led around the pressure applying roll 20 inside the belt 16 and then, via a second guide roll 23, back to the

tensioning roll 21.

The paper sheet 24 to be press dried is fed into the assembly around the lead in roll 25 so as to be carried around the cylinder 10 between the belts 16 and 17. The
5 cylinders 10 and 11 are maintained at a temperature of from 100° to 150°C so that the sheet 24 is heated substantially before entering the nip between the cylinder 10 and roll 19. Subsequently, the sheet is trapped between the belts 16 and 17 as it passes around the cylinders 10 and 11, optionally
10 with nip pressure being applied between these cylinders. As the paper dries, water is released as vapour through the perforations in the belts 16 and 17. Due to the surface characteristics of these belts, "wire" marking occurs and both sides of the paper sheet exhibit substan-
15 tially the same surface characteristics. The tension and pressure applied during passage around the cylinders 10 and 11 also ensures that the paper does not shrink as it dries.

The press drying arrangement of Figure 3 only utilizes
20 one metallic permeable belt according to the invention. The assembly shown comprises a drying cylinder, steam heated to between 100° to 150°C , 30 around which is led a permeable belt 31 according to the invention. The belt 31 is held in engagement with the cylinder 30 by a lead in
25 roll 32 and a lead out roll 33. The return path of the belt 31 is constrained by guide rolls 34 and a tensioning roll 35. Press rolls 36 A, B, C, D, E are arranged around the cylinder 30 so as to apply nip pressure against the cylinder as shown.

30 A paper sheet 37 to be dried is led around the roll 32 so as to lie between the permeable belt 31 and the cylinder 30. As the sheet moves around the cylinder 30, pressure is applied by the pressure applying rolls 36 A to E and moisture released as vapour through the permeable belt 31.

The cylinder 30 may also be of substantial size, highly polished so as to form an M.G. or Yankee cylinder and the pressure applying rolls 36 dispensed with. This will result in the production of machine glazed paper having a smoother reverse surface than is usual with such paper. The press rolls 36A and 36B may also be optionally retained as an M.G. press.

Figure 4 shows a conventional paper machine dryer section having an upper bank of steam heated drying cylinders 40 and a lower bank of similar cylinders 41. However, in substitution for the conventional dryer felt a permeable belt 42 in accordance with the invention is guided by means of rolls 43 so as to wrap around the upwardly facing surfaces of the cylinders 41, whilst a tensioning device shown diagrammatically at 44, maintains tension in the belt.

Similarly, a second permeable belt 45 in accordance with the invention is guided by rolls 46 and tensioned by tensioning device 47 so as to wrap around the lower surfaces of the cylinders 41.

A paper sheet 48 to be dried, is fed from the wet press of the paper machine (not shown and not forming part of this invention) between the first cylinder 41 and the permeable belt 45 and then alternately around the cylinders 40 and 41. As the paper sheet passes around the cylinders 40 and 41 it is held firmly in contact therewith by the permeable belts 44 and 45. This both resists the tendency of the sheet to shrink as it dries whilst readily releasing water vapour through the permeable belts.

As the sheet leaves the last cylinder 41, it may be reeled up or led through a size press and a further similar dryer section prior to being reeled up. Neither the size press nor reel up assembly form part of this invention.

Figure 5 shows a forming device 50 for a belt according to the invention. The device 50 comprises a conveyor 51 onto which stainless steel fibres are dry laid at 52 and bonded at 53 during passage through the high pressure nip of heated sintering rolls 54.

The layer of fibres deposited at 52 is substantially thinner than is required in the belt when formed. From the sintering rolls 54 the bonded sheet 55 is taken around guide rolls 56 to a length control assembly consisting of lead in and lead out rolls 57 and 58 between which spacing rolls 59 are located. The spacing rolls 59 can be adjusted in the direction shown by the arrows 60 to vary the path length of the sheet and thus precisely control the overall length of the belt as it is formed.

From the lead out roll 58 the sheet is taken around two further guide rolls 61 and back to the conveyor 51, where a further layer of stainless steel fibres is deposited thereon. As the belt 56 continues to move around the path above described the thickness progressively builds up essentially as a spiral laminate with each new layer being sintered to the last in the nip of the rolls 54.

Between the rolls 54 and the first guide roll 56, a substance gauge 62 and a caliper gauge 63 are located which provide feedback control via lines 64 and 65 to control respectively the quantity of fibres laid at 52 and the pressure at the nip 53.

CLAIMS :

1. An endless permeable belt for releasing moisture from fibrous paper-making dispersions or sheets formed therefrom comprising a flexible, corrosion and stretch resistant sheet having a high tensile strength characterised in that it is formed from metallic fibres laid randomly in a sheet and bonded together.
2. An endless permeable belt as claimed in claim 1 characterised in that the bonds between the fibres are formed by sintering.
3. An endless permeable belt as claimed in claim 1 or claim 2 characterised in that the belt is formed from stainless steel.
4. A paper-making machine having a press-drying section characterised in that it includes an endless belt as claimed in any one of claims 1 to 3.
5. A paper-making machine having a machine-glazing cylinder characterised in that it incorporates a belt as claimed in any one of claims 1 to 3, and in that the belts are arranged so as to bear against the outer surface of a paper-sheet being dried on the cylinder during movement of the paper sheet around a substantial proportion of the circumference of the cylinder.
6. A paper-machine as claimed in claim 5 having a dryer section characterised in that it incorporates belts as claimed in any one of claims 1 to 3.

7. A method of making an endless permeable, flexible corrosion and stretch resistant belt with a high tensile strength, for releasing moisture from fibrous paper-making dispersions or sheets formed therefrom characterised in that the method comprises the steps of dry forming a layer of the belt from corrosion resistant metal fibres and supporting the so-formed dry belt on a support consolidating the metal fibres by sintering so as to form a web and leading the thus formed web around a path which determines its length before returning it to join with the end of the first dry-formed layer, and subsequently applying a second and subsequent layers of metal fibres whilst moving the belt around the path until a belt of the required thickness is obtained.
8. A method as claimed in claim 7 characterised in that the web is self supporting after it initially leaves the support.
9. A method as claimed in claim 7 or claim 8 characterised in that a magazine is provided in the path comprising adjustable rollers, adjustment of which determines the length of the belt.
10. A method as claimed in any one of claims 7 to 9 characterised in that means are provided for controlling the thickness, substances i.e. grammage and deckle of the belt.



FIG. 1.

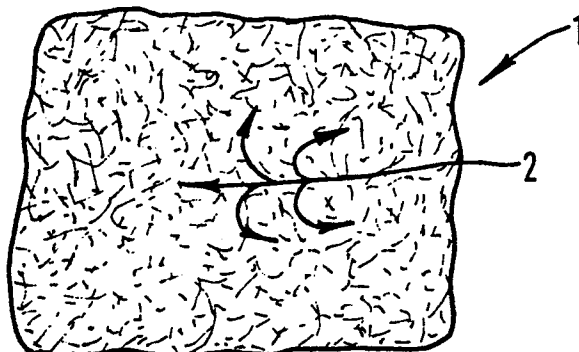


FIG. 2.

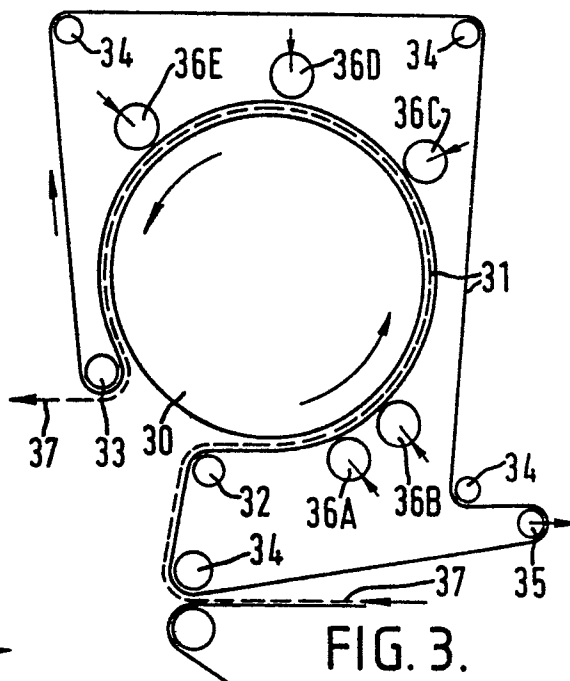
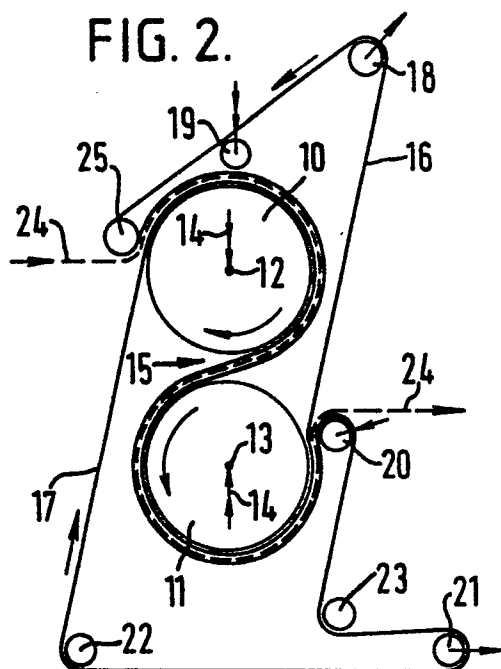


FIG. 3.

FIG. 4.

