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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 foraminous belt for releasing moisture from fibrous paper making dispersions or sheets formed therefrom which comprises a flexible corrosion and stretch resistant sheet having a high tensile sheet and formed from fine woven metallic mesh in which the warp and weft filaments are bonded together at their points of intersection, as by sintering. The belts can be used in press drying or in other parts of the paper machine.

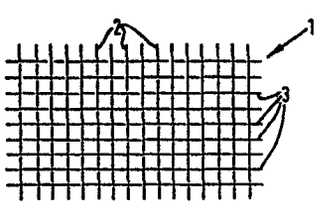

FIG.1.

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PAPER MAKING MACHINERY

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.

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 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.

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.

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, 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 rely on subjecting the paper sheet simultaneously to high nip pressures and temperatures in excess of 100^{o}C and expel 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 modern forms of wet press felt, 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 foraminous 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 foraminous 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 fine woven metallic mesh in which the warp and weft filaments are bonded together at their points of intersection. Preferably the bonds between the filaments 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.

The foraminous belt of the invention is preferably made from 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%. 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 woven mesh of the invention is substantially smoother than the woven material from which Fourdrinier wires are conventionally made. Because of the absence of the relatively large wire knuckles characteristic of conventional Fourdrinier wires, the formation of a noticeable wire mark in the paper made using sheets 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.

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,

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, and

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

Referring first to Figure 1, the configuration shown consists of a mesh sheet 1 formed from stainless steel weft filaments 2 with which similar warp filaments are interwoven on a "two over/two under" basis. The warp and weft filaments are sintered together at their intersections so as to define pores in the mesh which are preferably about 5 microns in size, with mesh being about 0.15 millimetres thick. A suitable material is the sintered stainless steel mesh, grade K, sold under the Registered Trade Mark "RIGIMESH", by Pall Process Filtration Limited, Europa House, Portsmouth. This material has a steam permeability at atmospheric pressure of 1320 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 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 foraminous belts 16 and 17 according to the invention. From a tensioning roll 18 the element 16 is led around a 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 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 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 belt 16 and 17 as it passes around the cylinders 10 and 11, optionally with nip pressure being applied between these cylinders. As the paper dries, water is released as vapour through the pores in the belts 16 and 17. The fineness of the pores in these belts is such that no significant "wire" marking occurs and both sides exhibit substantially 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 one metallic foraminous 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 foraminous belt 31 according to the invention. The belt 31 is held in engagement with the cylinder 30 by a lead in 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. A paper sheet 37 to be dried is led around the roll 32 so as to lie between the foraminous 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 pores in the 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 foraminous 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 foraminous 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 foraminous 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 foraminous belts 44 and 45. This both resists the tendency of the sheet to shrink as it dries whilst readily releasing water vapour through the pores in the belts.

As the sheet leaves the last cylinder 41, it may be reeled

up or led through a size press and a further similar drier section prior to being reeled up. Neither the size press nor reel up assembly form part of this invention. It is also desirable that the joint at the endsof the belt be seamless and to this end they may be joined by making a butt joint and welding the warps together to maintain the same permeability across the joint. Also the edges of the belt may be fused to form solidifed fibres so as to avoid tearing. Alternatively or in addition the edges may be beaded.

A particular advantage of a belt according to the invention is that the bonding prevents relative movement of the warp and weft and thus maintains the spacing of the filaments forming the belt, which assists in preventing blocking of the openings formed by the filaments.

CLAIMS:

1. An endless foraminous 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 fine woven metallic mesh characterised in that the warp and weft filaments are bonded together at their points of intersection.

2. A belt as claimed in claim 1 characterised in that the bonds between the filaments are formed by sintering.

3. A belt as claimed in claim 1 or claim 2 characterised in that the metallic mesh is stainless steel.

4. A belt as claimed in any one of claims 1 to 3 characterised in that the ends of the belt are joined by making a butt joint and the warps are welded together to maintain the same permeability across the joint.

5. A Fourdrinier paper machine having a press drying section characterised in that it incorporates a belt as claimed in claim 1, claim 2, claim 3 or claim 4.

6. A paper machine having a machine glazing cylinder characterised in that it incorporates a belt as claimed in any one of claims 1 to 4 the belt being arranged so as to bear against the outer surface of a paper sheet dried

on the cylinder during movement of the paper sheet around a substantial proportion of the circumference of the cylinder.

7. A paper machine having a dryer section characterised in that it incorporates belts as claimed in claim 1, claim 2, claim 3 or claim 4.

FIG.1.

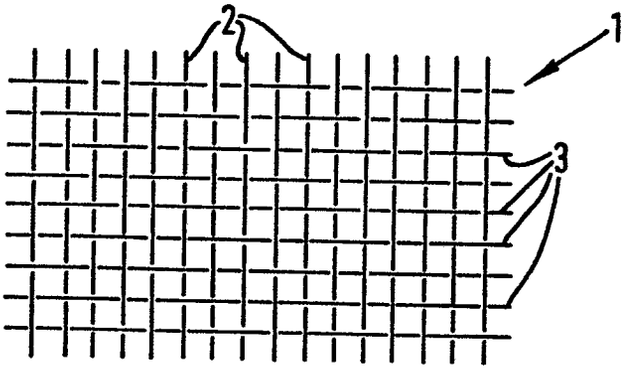
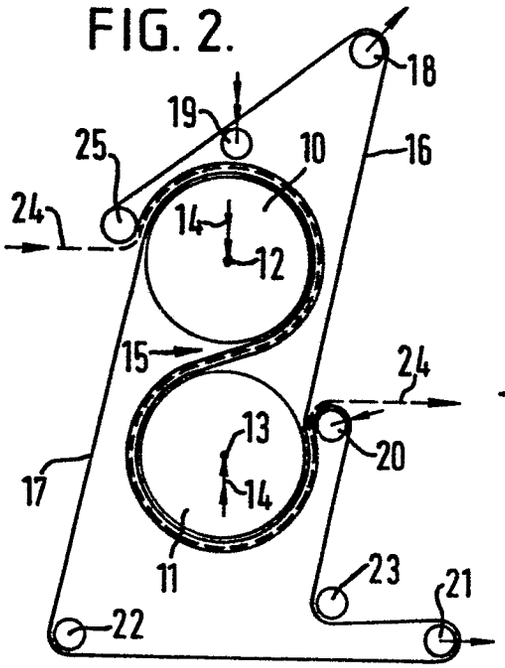


FIG. 2.



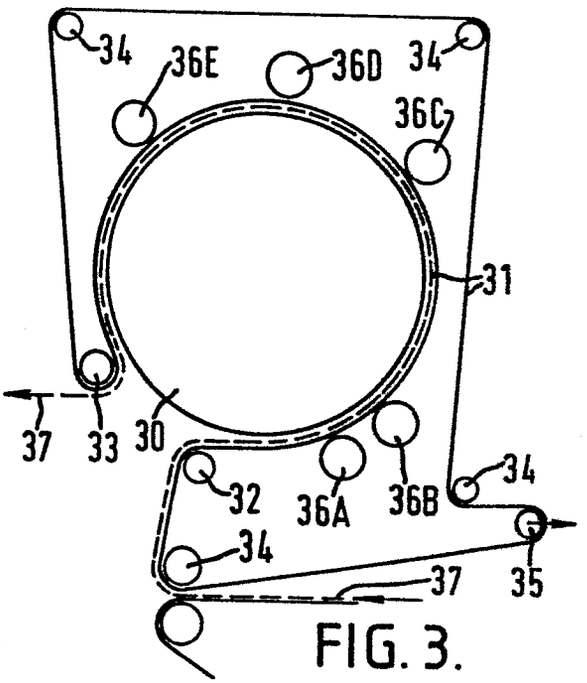


FIG. 3.

FIG. 4.