(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 103 376**
**A2**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number: **83304193.2**

(22) Date of filing: **19.07.83**

(51) Int. Cl.³: **D 21 F 1/10**, D 21 F 1/14, D 21 F 1/00

(30) Priority: **22.07.82 GB 8221233**

(43) Date of publication of application: **21.03.84 Bulletin 84/12**

(84) Designated Contracting States: **BE CH DE FR GB IT LI NL SE**

(71) Applicant: **The Wiggins Teape Group Limited, P.O. Box 88 Gateway House Basing View, Basingstoke Hampshire RG21 2EE (GB)**

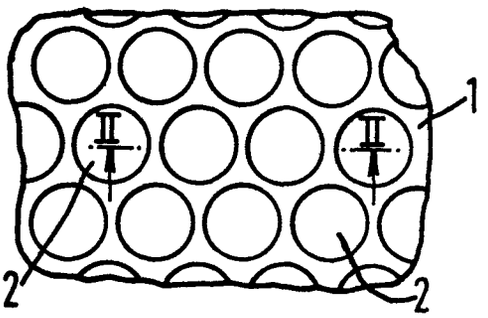
(72) Inventor: **Baker, Colin Francis, 113 Vale Road, Chesham Buckinghamshire (GB)**
Inventor: **Evans, Brian Edward, 30 Baronsmead Road, High Wycombe Buckinghamshire (GB)**

(74) Representative: **Carmichael, David Andrew Halliday et al, G.F. REDFERN & CO. High Holborn House 52/54 High Holborn, London WC1V 6RL (GB)**

## (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 provides an endless foraminous belt for releasing moisture from fibrous paper making dispersions or sheets formed therefrom which comprises a flexible corrosion and stretch resistant micro-perforated sheet having a high tensile strength. The belt can be used in press drying or in other parts of the paper machine.




EP 0 103 376 A2

# 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 consisting of an endless belt woven from corrosion resistant strands, for example of phosphor bronze or nylon. As the dispersion drains to form a paper sheet, the lower surface of the sheet conforms to the profile of the wire giving rise to a "wire mark" in the sheet when finally dried. Furthermore, the relative roughness of the wire, stemming from its woven character, causes wear of the foils and vacuum boxes over which it passes and also of the wire itself, necessitating relatively frequent replacement of these components.

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°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 open modern forms of wet press felt, but the result was the formation of wire marks more pronounced than those result-

ing 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 substitution for the Fourdrinier wire as 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 micro perforated sheet having a high tensile strength.

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

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

In a still 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 an additional 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 a metal sheet 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%. However, plastics sheeting may be used where the belt is to be used as a substitute for a Fourdrinier wire at relatively low temperatures.

The necessary perforation may be achieved by mechanical or laser punching, or by spark perforation techniques.

A perforated metallic sheet, for example of nickel, may alternatively be formed by electrode deposition on a matrix carrying projections dimensioned and spaced in accordance with the requirements for the perforations. The matrix is provided with a conductive release coating which both promotes the electro deposition and facilitates removal of the resulting sheet from the matrix after formation. Preferably the projections are frusto-conical in configuration so as to facilitate release of the sheet.

The sheet requires to be sufficiently flexible to conform to rolls in the region of 15 centrimetres in diameter whilst having a tensile strength of about 40 to 60 Newtons per 15mm. A nickel sheet of from .1 to .15mm in thickness has been found to meet these requirements. This material also has a smoothness of from 200 to 300 Bendsten (in paper terms). This is substantially smoother than the woven material from which Fourdrinier wires are conven-

tionally made. Because of the absence of wire knuckles characteristic of Fourdrinier wires, the formation of a 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. It is preferred to use an endless belt made from electro formed perforated nickel sheet having the following characteristics

| | |
|---|---|
| Thickness | .1mm |
| Perforation diameter | .1mm to .15mm |
| Perforation pitch | .25mm |
| Percentage open area of sheet | 32½% (giving a steam permeability at atmospheric pressure of 1200 cubic metres per square metre per hour). |

For use in substitution for a Fourdrinier wire, it is desirable to provide a belt having a larger open area than in the press drying contect in order to facilitate water drainage. In consequence, the sheet will need to be thicker (probably about 0.15mm in thickness for a metal sheet) in order to maintain the desired tensile strength. The particular configuration chosen will however depend upon the paper making furnish being handled and the various operating conditions under which the belt will be used including the speed of operation and the vacuum to which it will be subjected.

It will be appreciated that with the present invention it is also necessary, since the belt is endless to achieve a seamless belt to avoid marking the paper.

To this end the seamless joint between the ends of the belt may be formed by butt welding the ends and micro perforating the welds to produce even permeability across the sheet. In this case it may be necessary to reduce the thickness before perforation.

Alternatively the seamless joint may be formed by electro-deposition between the ends of the belt and subsequently micro perforating the electro-deposited portion to produce even permeability across the sheet.

In an alternative method of making the belt the electro-deposition may be carried out on an endless matrix.

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 sectional detail on the line II-II of Figure 1;

Figure 3 is a sectional detail of a variant configuration similar to that of Figure 2;

Figure 4 is a plan view of a detail of a different form of foraminous belt according to the invention;

Figure 5 is a diagrammatic side elevation of the wet end of a paper machine embodying the invention;

Figure 6 is a diagrammatic side elevation of a first assembly embodying the invention for effect-

ting press drying of the paper; and,

Figure 7 is a diagrammatic side elevation of a second assembly embodying the invention for effecting press drying of paper.

Figure 8 is a diagrammatic side elevation of a conventional configuration of paper machine dryer but embodying the invention.

Referring first to Figures 1 and 2, the configuration shown consists of an electro formed nickel sheet 1 having circular perforations 2 therein of the same dimensions and regularly spaced. As best seen in Figure 2, the holes 2 are tapered in a direction perpendicular to the plane of the sheet 1, having been formed by projections on an electro forming matrix. The process of electro forming such sheets is itself well known and forms no part of this invention.

Figure 3 is a sectional detail similar to that of Figure 2 but showing a sheet 3 having perforations 4 with parallel sides. Perforations of this kind may be formed in metal or plastics sheets by known methods of mechanical or laser punching. Figure 4 shows a sheet 5 made of plastics material and having perforations 6 of an irregular size and spacing formed by well known methods of spark perforation.

In order to provide a seamless joint between the ends of the belt they may be formed by butt welding and micro perforating the welds to produce even permeability across the sheet. In this case it may be necessary to

reduce the thickness before perforation.

Alternatively the seamless joint may be formed by electro-deposition between the ends of the belt and subsequently micro perforating the electro-deposited portion to produce even permeability across the sheet.

In an alternative method of making the belt the electro-deposition may be carried out on an endless matrix.

Figure 5 shows diagrammatically the wet end of a paper machine having a Fourdrinier "wire" 8 in a conventional arrangement including a headbox 9, foils 10, vacuum boxes 11, a breast roll 12 and couch roll 13. The "wire" 8 consists of a perforated sheet of metal or plastics material according to the invention.

The press drying assembly of Figure 6 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°C 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 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. The fineness of the perforations in these belts is such that no significant "wire" marking occurs and both sides of the paper sheet 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 7 only utilizes one metallic foraminous belt according to the invention. The assembly shown comprises a drying cylinder, steam heated to between 100°C 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 ten-

sioning 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 perforations 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 8 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 perforations 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 dryer section prior to being reeled up. Neither the size press not reel up assembly form part of this invention.

CLAIMS:

1. An endless foraminous belt for releasing moisture from fibrous paper-making dispersions or sheets formed therefrom characterised in that it comprises a flexible corrosion and stretch-resistant micro-perforated sheet having a high tensile strength.

2. A belt as claimed in claim 1 characterised in that it is made of metal sheet.

3. A belt as claimed in claim 2 characterised in that the metal sheet is formed by electro-deposition on a matrix carrying projections spaced in accordance with the requirements for perforations.

4. A belt as claimed in claim 3 characterised in that the matrix is provided with a conductive release coating which both promotes the electro-deposition and facilitates the removal of the resulting sheet from the matrix after formation.

5. A belt as claimed in claim 3 or claim 4 characterised in that the projections are frusto-conical in configuration so as to facilitate the release of the sheet.

6. A belt as claimed in claim 5 characterised in that the sheet is formed of nickel of from 0.1 to 0.15 mm in thickness.

7. A belt as claimed in any one of the preceding claims characterised in that it is made from electro-formed nickel sheet having the following characteristics:

Thickness 0.1 mm

Perforation diameter 0.1 - 0.15 mm

Perforation pitch 0.25 mm

Percentage open area of sheet 32.5%

8. A belt as claimed in any one of claims 1 to 7 characterised in that a seamless joint between the ends of the belt is formed by butt welding and spark perforating the welds.

9. A belt as claimed in any one claims 1 to 7 characterised in that a seamless joint is formed by electro-deposition between the ends of the belt and subsequently spark perforating the electro-deposited portion to produce even permeability across the sheet.

10. A belt as claimed in claim 1 characterised in that it is made of plastics material.

11. A Fourdrinier paper-machine having a press drying section characterised in that it incorporates a belt as claimed in any one of claims 1 to 9.

12. A paper-machine having a machine glazing cylinder characterised in that it incorporates a belt as claimed in any one of claims 1 to 9, the belt being arranged so as to bear against the outer surface of a paper-sheet around a substantial proportion of the circumference of the cylinder.

13. A paper-machine having a dryer section characterised in that it incorporates a belt as claimed in any one of claims 1 to 9.

FIG. 1.

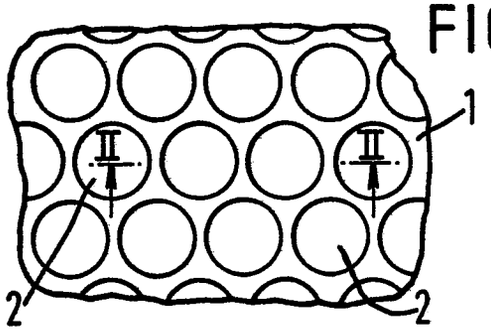



FIG. 2.

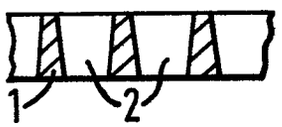
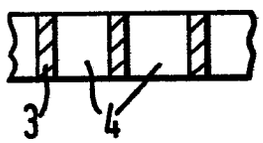



FIG. 3.



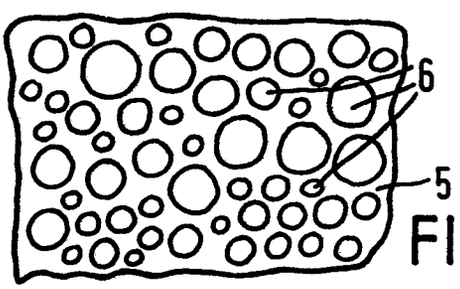




FIG. 4.

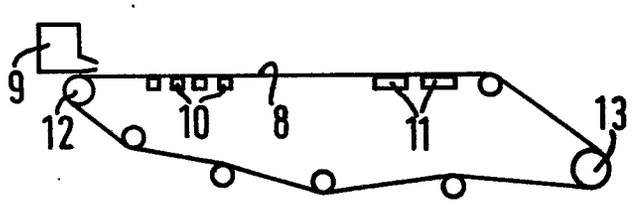
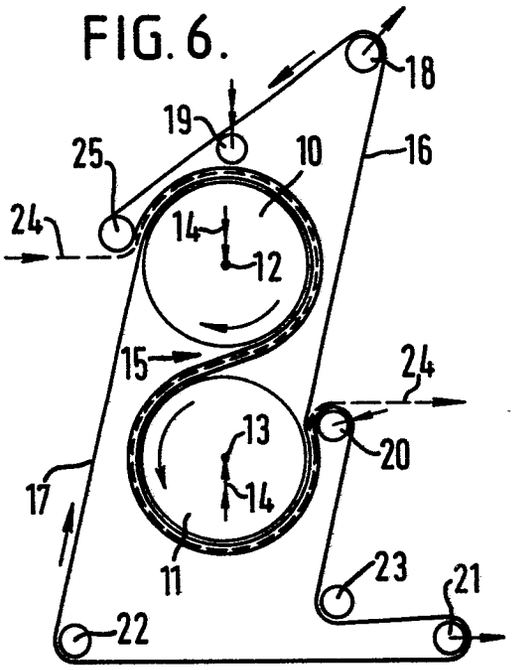



FIG. 5.

FIG. 6.



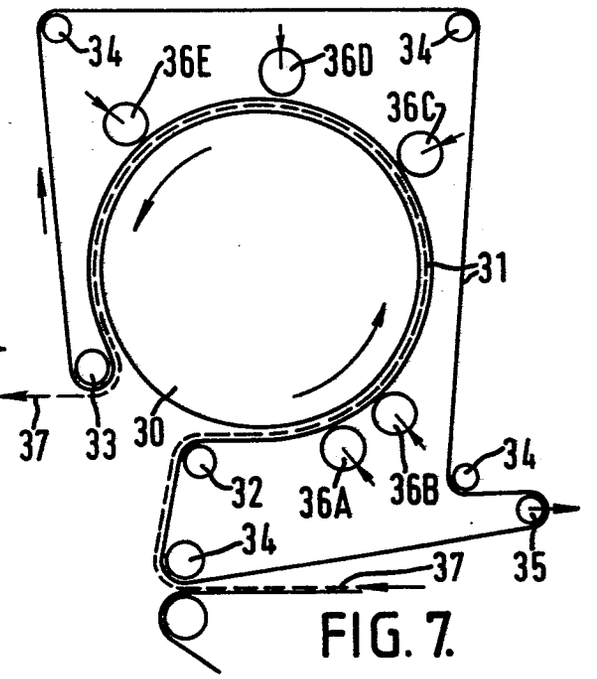




FIG. 7.

FIG. 8.