



EUROPEAN PATENT APPLICATION

Application number : **92850184.0**

Int. Cl.⁵ : **D21F 5/04**

Date of filing : **30.07.92**

Priority : **31.07.91 FI 913648**

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Date of publication of application :
03.03.93 Bulletin 93/09

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Designated Contracting States :
AT DE FR GB IT SE

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Grouping of cylinders in the drying section of a paper machine.

The invention concerns a grouping of cylinders in the drying section of a paper machine, in which drying section the paper web (W) and the wire (H) are carried meandering from a heated, preferably steam-heated, drying cylinder (K) onto a leading cylinder (V) and from the leading cylinder (V) further onto the next heated drying cylinder (K). A drying group (R) consists of a number of subsequent groupings of cylinders, whereby, in a grouping of cylinders, the drying cylinders (K_{n-2}, K_{n-1}, K_n) and the leading cylinders (V_{n-1}, V_n) are placed, in relation to one another, substantially at three different height levels, so that the drying cylinders (K_{n-2}, K_n) with larger diameter are placed at the height level (Y_1) and the drying cylinder (K_{n-1}) that has a diameter smaller than said larger diameter is placed at the height level (Y_2). In the grouping of cylinders the leading cylinders (V_{n-1}, V_n) are placed at the third height level (Y_3).

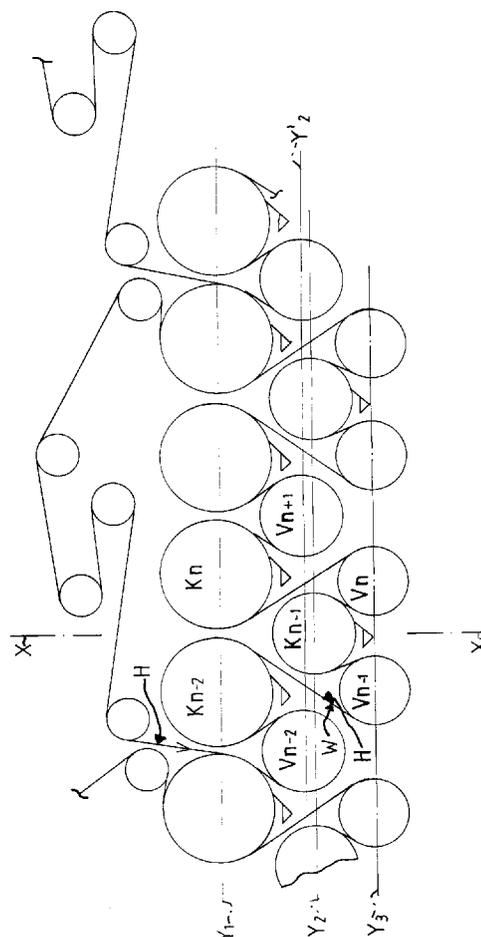


FIG. 3

The invention concerns a grouping of the cylinders in the drying section of a paper machine.

In the prior-art constructions of drying sections in paper machines, the drying section consists of drying groups. Each drying group comprises heated drying cylinders and cold leading cylinders placed in a level different from the level of the drying cylinders. Being supported by the wire, the paper web is passed meandering from a drying cylinder onto a leading cylinder and further from the leading cylinder onto the next drying cylinder. The drying cylinders are placed in the same level in relation to one another and in a level different from the level of the leading cylinders. In the prior-art constructions of drying sections, the overall length of the drying section becomes remarkably long. On the other hand, the overall length of the drying section affects the requirement of the building area of the paper mill. If it is possible to reduce the length of the drying section, it is also possible to lower the building cost required by the paper machine in the same proportion.

Thus, the object of the invention is to provide a drying section of a novel type for a paper machine, which is considerably shorter than a prior-art drying section with an equivalent drying capacity and with an equal number of cylinders.

The object of the invention has been achieved by means of a novel grouping in accordance with the invention of the heated drying cylinders and the cold leading cylinders in the drying section of the paper machine. As a result of the grouping, the overall length required by the drying section can be reduced considerably. However, the drying section in accordance with the invention has a drying capacity equal to that of a prior-art drying section with the same number of cylinders.

According to the invention, the drying section has been formed so that it comprises heated, in particular steam-heated, drying cylinders of two sizes. The drying cylinders of larger diameter are fitted to be placed at a height level of their own, and, in a corresponding way, the drying cylinders of smaller diameter are fitted to be placed at a height level of their own. Further, the drying section comprises cold leading cylinders, which are placed at two different height levels, i.e. at a height level Y_3 and at a height level Y_2' , the latter height level being substantially the same as that of the drying cylinders of smaller diameter. The paper web and the wire are passed meandering from a drying cylinder of larger diameter onto a leading cylinder and from the leading cylinder onto a drying cylinder of smaller diameter. From the drying cylinder of smaller diameter the paper web and the wire are passed onto a second leading cylinder and from the leading cylinder onto a second heated drying cylinder of larger diameter. By means of the above grouping of cylinders and choice of diameters of drying cylinders, it is possible to form, for example, a drying sec-

tion whose overall length is, compared with a prior-art 71-cylinder Sym-Run drying section, 18 metres shorter.

The grouping in accordance with the invention of the cylinders in the drying section of a paper machine is mainly characterized in what is stated in claim 1.

The invention will be described in the following with reference to some preferred embodiments of the invention illustrated in the figures in the accompanying drawings, the invention being, yet, not supposed to be confined to said embodiments alone.

Figure 1 shows a prior-art drying section.

Figure 2 shows a drying section in accordance with the invention.

Figure 3 is a more detailed illustration of the grouping of the cylinders in a drying section in accordance with the invention.

As is shown in Fig. 1, a prior-art drying section consists of groups R_1, R_2, \dots, R_n of drying cylinders. Each group $R_1, R_2, R_3, R_4, \dots, R_n$ of drying cylinders comprises hot, preferably steam-heated drying cylinders of larger diameter and smaller cold, so-called leading cylinders placed at a level different from the level of the drying cylinders. In each group R_1, R_2, \dots , the paper web is passed, being supported by the wire H, from a drying cylinder K onto a leading cylinder V placed at a different level and further from the leading cylinder V back to the upper level onto a heated drying cylinder placed at said level.

The leading cylinders are preferably perforated Uno-Vac cylinders, into which an internal negative pressure is introduced and which negative pressure is allowed to act upon the entire space in the interior of the drying cylinder, whereby the web is kept in contact with the wire also in the web draws in which the web W is not supported by a wire. Fig. 1 shows a construction of a drying section that comprises seven groups of drying cylinders, of which the second group from the end is an inverted group, in which the steam-heated drying cylinders K are placed at a lower level and the cold leading cylinders V are placed at a higher level above them.

Fig. 2 shows an improvement over the prior art illustrated in Fig. 1. In the construction, it has been possible to reduce the length of the drying section by forming the drying groups by means of a novel grouping of the drying cylinders and leading cylinders. In the solution shown in Fig. 2, there are six drying groups $R_1 \dots R_6$, the second group R_5 from the end being a so-called inverted group, in which the steam-heated drying cylinders K are placed at the lowest levels and the leading cylinders V at a higher level above them.

The groups $R_1 \dots R_4$ and R_6 are provided with a grouping of the heated drying cylinders K and of the leading cylinders V in accordance with the invention. The whole drying section comprises 28 steam-heated drying cylinders K and 29 cold cylinders, i.e. leading

cylinders V. In the way shown in Fig. 2, the heated drying cylinders K in a drying group R are placed in such a way in relation to one another that a drying cylinder K of smaller diameter is placed at a height level Y_2 , which is a height level different from the height level Y_1 of the drying cylinders K of larger diameter. The leading cylinders V are placed at the height level Y_2' and at the height level Y_3 . The paper web W is passed, e.g. in the drying group R_1 , from the leading cylinder V_1 placed at the height level Y_2' onto the drying cylinder K_2 placed at the height level Y_1 and from the drying cylinder K_2 onto the leading cylinder V_2 placed at the height level Y_3 , and from said leading cylinder onto the heated drying cylinder K_3 of smaller diameter placed at the height level Y_2 . From the heating cylinder K_3 the web R is passed onto the leading cylinder V_3 placed at the height level Y_3 and from the leading cylinder V_3 onto the drying cylinder K_4 placed at the height level Y_1 . From the drying cylinder K_4 the web R is again passed onto the leading cylinder V_4 placed at the height level Y_2' .

In a corresponding way, the wire H_1 is passed so that in connection with the heated drying cylinders K_2 and K_4 the paper web W runs between the wire H_1 and the face of the drying cylinder K_2 and K_4 , and in connection with the leading cylinders V_2 and V_3 the web W runs outermost. Correspondingly, in connection with the drying cylinder K_3 with smaller diameter the paper web W runs between the drying cylinder K_3 and the wire H_1 .

Thus, in the groups R_1, R_2, R_3, R_4 and in the group R_6 the hot drying cylinders K and the leading cylinders V are placed at four different height levels Y_1, Y_2, Y_2', Y_3 so that the hot drying cylinders K are placed at two different levels Y_1, Y_2 and the leading cylinders V at the level Y_2' and at the level Y_3 . The height levels Y_2 and Y_2' are levels substantially equal to one another. The level Y_2' is placed slightly higher than the level Y_2 . The diameter dimensions of the leading cylinders V placed at the levels Y_2' and Y_3 are just slightly different from one another. The leading cylinders V at the level Y_2' have a slightly larger diameter than the leading cylinders V at the level Y_3 . The diameters of both of the leading cylinders V placed at the levels Y_3 and Y_2' are slightly smaller than the diameters of the heated drying cylinders K placed at the height level Y_2 . The diameter of the drying cylinder K placed at the middle height position Y_2 is smaller than the diameter of the drying cylinders K placed at the first height level Y_1 . In this way, between the drying cylinders K and the leading cylinders V, a novel grouping has been provided which results in considerable economies of space in the machine direction. The drying capacity is good and corresponds to that of a prior-art drying section of equal number of cylinders and larger length.

Fig. 3 is a more detailed illustration of the grouping in accordance with the invention between the

heated drying cylinders and the cold cylinders, i.e. the leading rolls. In the way shown in Fig. 3, each drying group R_1, R_2, \dots consists of cylinder groupings in which the heated drying cylinders are placed at two height levels, the levels Y_1 and Y_2 . The leading cylinders are placed at the height level Y_2' and at the height level Y_3 . Moreover, the diameter of the heated drying cylinder placed at the middle height level Y_2 is smaller than the diameter of the drying cylinder placed at the level Y_1 .

Together with the wire H, the paper web W is passed from the leading cylinder V_{n-2} of the height level Y_2' onto the drying cylinder K_{n-2} , of the level Y_1 . From the drying cylinder K_{n-2} , the web W is passed onto the leading cylinder V_{n-1} , and from the leading cylinder V_{n-1} further, with the wire H, onto the middle heated drying cylinder K_{n-1} . From the heated drying cylinder K_{n-1} the paper web W and the wire H are passed onto the second leading cylinder V_n of the level Y_3 . From the leading cylinder V_n the paper web W is passed onto the second heated drying cylinder K_n of larger diameter, placed at the height level Y_1 . From the drying cylinder K_n the web W is passed onto the leading cylinder V_{n+1} of the height level Y_2' . In a corresponding way, the wire H is passed from one cylinder onto the other. The paper web W runs in contact with the faces of the drying cylinders on the heated drying cylinders K. On the leading cylinders V the paper web W runs outermost, and the wire H is placed in contact with the cylinder V face. The leading cylinders V_{n-1} , and V_n are placed symmetrically at the same distance from the vertical plane X drawn through the centre point of the heated drying cylinder K_{n-1} , of smaller diameter. The heated drying cylinders K_{n-2}, K_n of larger diameter are also placed symmetrically at equal distances from the vertical plane. In a corresponding way, the leading cylinders V_{n-2}, V_{n+1} of the height level Y_2' are placed symmetrically to the centre plane X and at equal distances from same.

Claims

1. Grouping of cylinders in the drying section of a paper machine, in which drying section the paper web (W) and the wire (H) are carried meandering from a heated, preferably steam-heated, drying cylinder (K) onto a leading cylinder (V) and from the leading cylinder (V) further onto the next heated drying cylinder (K), and in which construction of drying section the drying section consists of a number of drying groups (R_1, R_2, R_3, \dots), characterized in that a drying group (R) consists of a number of subsequent groupings of cylinders, whereby, in a grouping of cylinders, the drying cylinders (K_{n-2}, K_{n-1}, K_n) and the leading cylinders (V_{n-1}, V_n) are placed, in relation to one another, substantially at three different height levels, so

that the drying cylinders (K_{n-2}, K_n) with larger diameter are placed at the height level (Y_1) and the drying cylinder (K_{n-1}) that has a diameter smaller than said larger diameter is placed at the height level (Y_2), and in which grouping of cylinders the leading cylinders (V_{n-1}, V_n) are placed at the third height level (Y_3), whereby the paper web (W) and the wire (H) are passed from the drying cylinder (K_{n-2}) with larger diameter onto the leading cylinder (V_{n-1}) and further, from the leading cylinder (V_{n-1}), onto the heated drying cylinder (K_{n-1}) with smaller diameter, placed at the middle height level (Y_2), from which the web (W) and the wire (H) are passed onto the second leading cylinder (V_n), and from the leading cylinder (V_n) further onto the second heated drying cylinder (K_n) with larger diameter, placed at the height level (Y_1).

2. Grouping of cylinders in the drying section of a paper machine as claimed in claim 1, **characterized** in that the paper web (W) is passed onto the heated drying cylinder (K_{n-2}) of larger diameter, placed at the height level (Y_1), from the leading cylinder (V_{n-2}), which is placed substantially at the same height level (Y_2') as the heated drying cylinder (K_{n-1}) of smaller diameter, and that, in the grouping of cylinders, the paper web is passed from the heated drying cylinder (K_n) of larger diameter, placed at the height level (Y_1), onto the leading cylinder (V_{n+1}), which is placed substantially at the same height level (Y_2') as the heated drying cylinder (K_{n-1}) of smaller diameter.
3. Grouping of cylinders in the drying section of a paper machine as claimed in claim 1 or 2, **characterized** in that, in the grouping, the leading cylinders (V_{n-1}, V_n) are placed symmetrically in relation to the vertical plane (X) drawn through the centre point of the drying cylinder (K_{n-1}) of smaller diameter at equal distances from the vertical plane (X) and that, in the grouping of cylinders, the heated drying cylinders (K_{n-2}, K_n) of larger diameter are also placed symmetrically in relation to the vertical plane (X).
4. Grouping of cylinders in the drying section of a paper machine as claimed in any of the preceding claims, **characterized** in that, in the grouping of cylinders, the heated drying cylinders (K_{n-2}, K_n) of larger diameter are placed at the highest height level, the drying cylinder (K_{n-1}) of smaller diameter is placed at the middle height level (Y_2), and the leading cylinders (V_{n-1}, V_n) are placed at the lowest height level (Y_3).

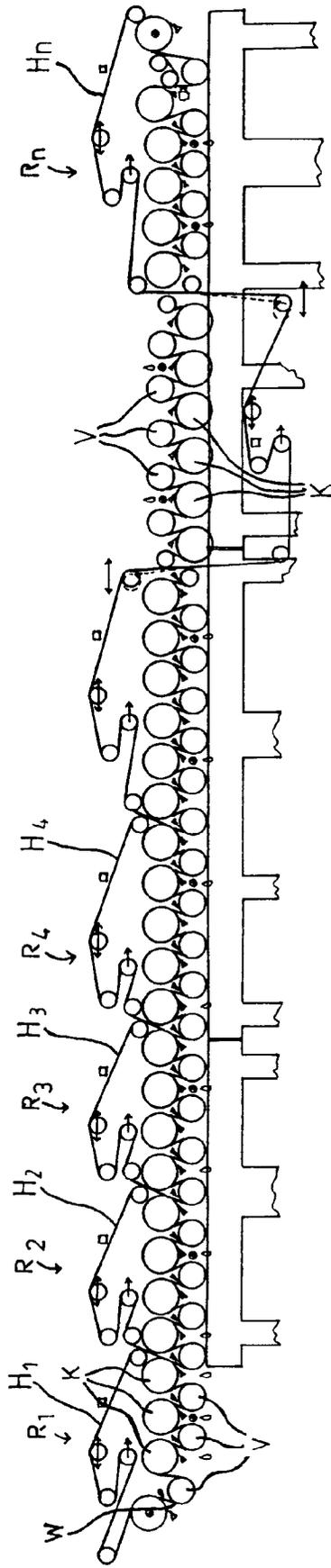


FIG.1

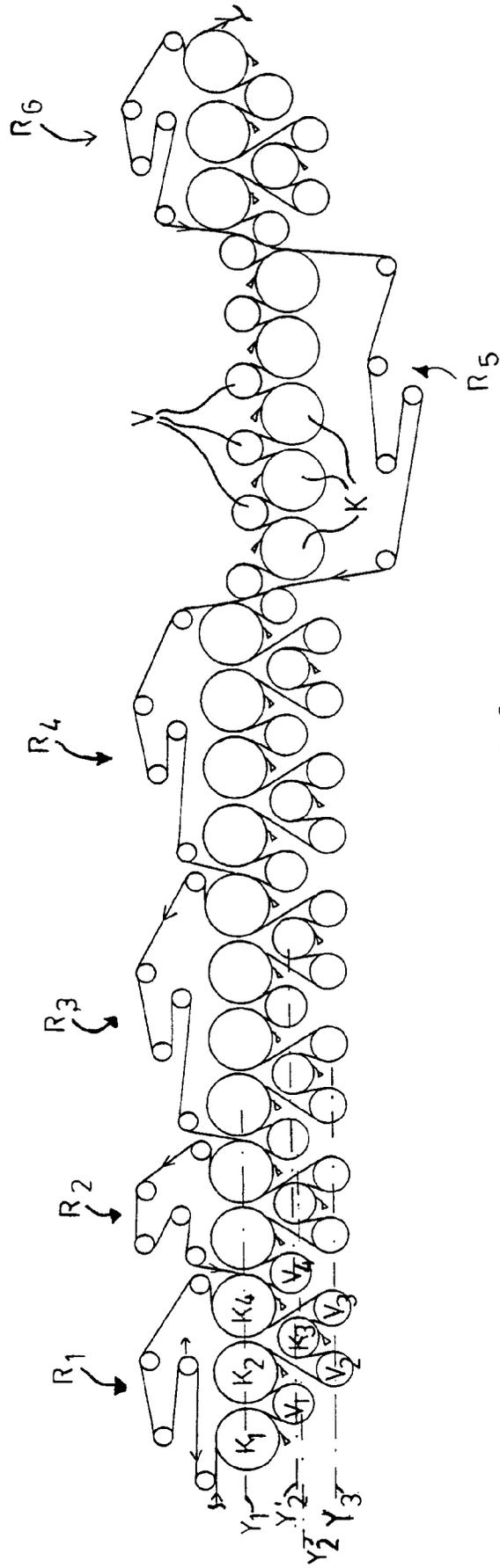


FIG. 2

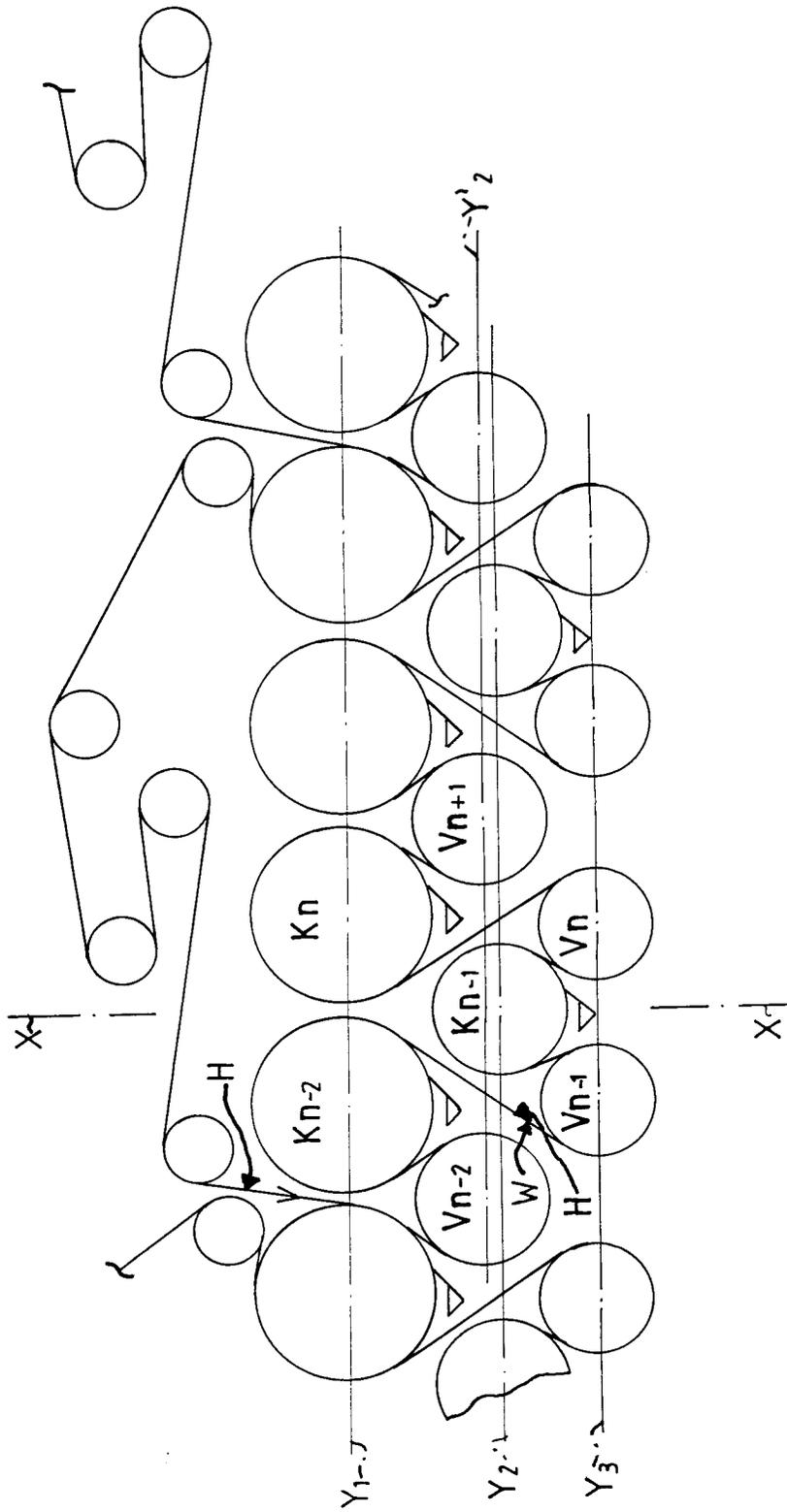


FIG. 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 85 0184

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-9 012 150 (VOITH) * the whole document * ---	1, 3, 4	D21F5/04
A	WO-A-8 706 635 (ELY) * the whole document * ---	1, 3	
A	DE-A-1 931 922 (VOITH) * the whole document * ---	1-4	
A	GB-A-513 538 (ECCLES AND JENNINGS) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D21F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30 NOVEMBER 1992	Examiner DE RIJCK F.
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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