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(71) Applicant : **VALMET PAPER MACHINERY INC.**
Punatontkonkatu 2
SF-00130 Helsinki (FI)

(72) Inventor : **Ilvespää, Heikki**
Voionmaankatu 13 C 50
SF-40700 Jyväskylä (FI)
Inventor : **Kuhasalo, Antti**
Välitie 1 as. 10
SF-40530 Jyväskylä (FI)
Inventor : **Yli-Kauppi, Jouko**
Hietalantie 1
SF-40950 Muurame (FI)

(74) Representative : **Rostovanyi, Peter et al**
AWAPATENT AB Box 5117
S-200 71 Malmö (SE)

(54) **Method and device in the drying section of a paper machine in the threading of the web.**

(57) Method and device in a multi-cylinder dryer of a paper machine in the threading of the paper web, said threading taking place substantially without a system of threading ropes. The web is passed along a meandering path, in twin-wire draw, over drying cylinders (10A,10B) and, in single-wire draw, on a drying wire (11), over drying cylinders (10;10') and leading suction cylinders (20,20') or rolls (20,20'). The leader (S) is guided by means of air blowings (F₁) extending across a substantial proportion or the whole of its width (L₁), said air blowings (F₁) being applied from the doctor beam (12) to the area (K) of the web by of its doctor blade (14) at a certain small angle (B) in relation to the plane of the doctor blade (14).

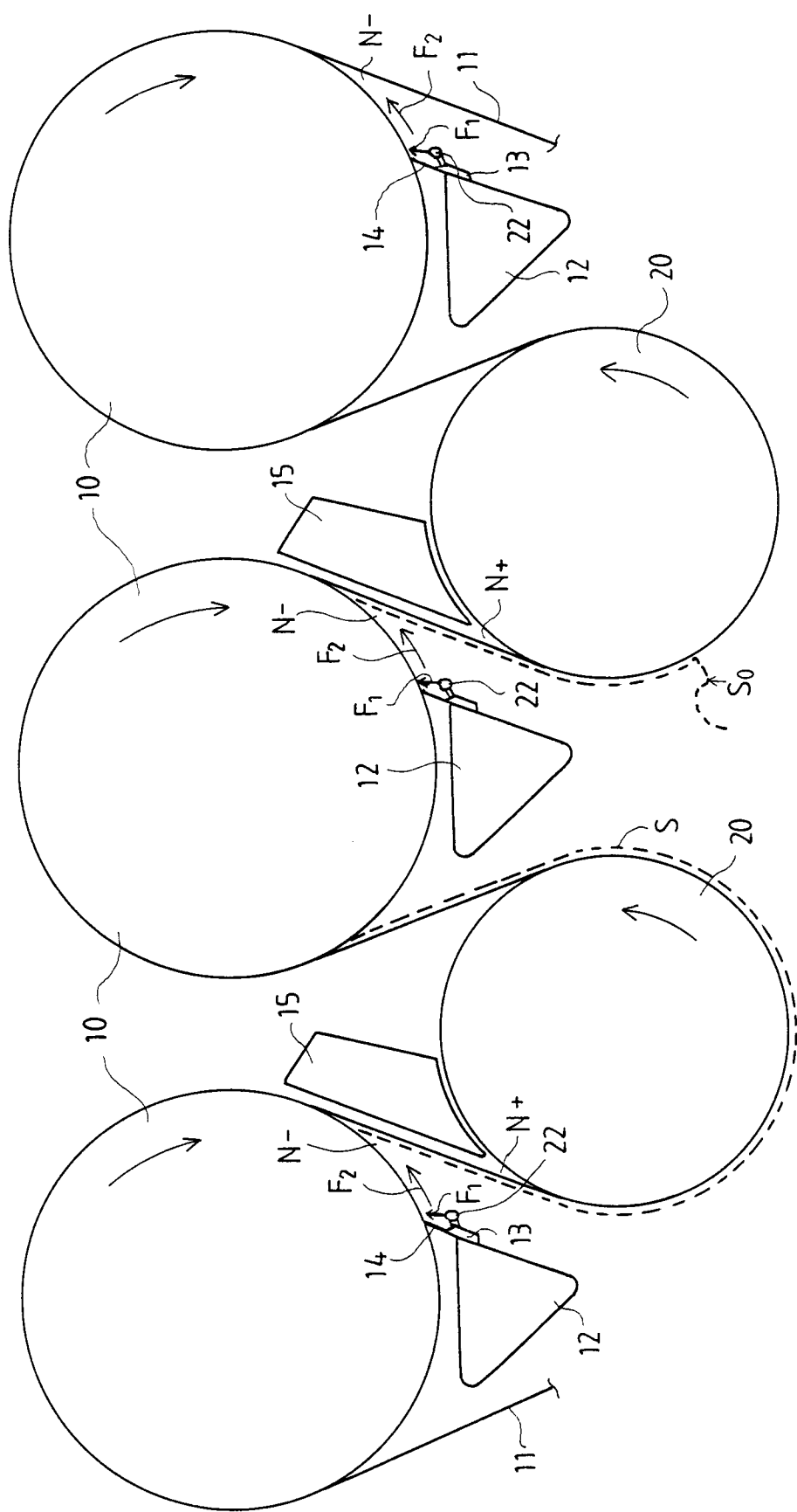


FIG.1

The invention concerns a method in a multi-cylinder dryer of a paper machine in the threading of the paper web, said threading taking place substantially without a system of threading ropes, in which method the web is passed along a meandering path, in twin-wire draw, over drying cylinders and, in single-wire draw, on a drying wire, over drying cylinders and leading suction cylinders or rolls.

Further, the invention concerns a device for carrying out the method.

As is known in prior art, in the drying section of a paper machine, so-called single-wire draw or twin-wire draw is employed. In such a case, for the threading of the web, as a rule, rope guide means are used, by whose means the leader, which has been cut out of a full-width web, is passed over the drying cylinders, whereupon the leader is widened to a web of full width. The system of threading ropes is quite a costly and complicated device, and disturbance occurs in its operation. This is why attempts have been made to arrange the threading without a set of threading ropes. Said modes of threading without ropes have been applied in particular with single-wire draw. In this respect, reference is made to the paper by Sam Palazzolo, "No-draw drying" in *Tappi Journal*, September 1990, pp. 225-228.

As is stated in said paper, with single-wire draw, the threading involves the drawback that the leader tends to follow the smooth face of the drying cylinder instead of the drying wire as the wire runs from the drying cylinder to the following leading suction cylinder or roll. To make sure that the leader follows expressly the drying wire, according to said paper, arrangements of air nozzles have been employed, of which nozzle arrangements one has been fitted before each leading suction cylinder and through which nozzle arrangements air jets are blown to guide the run of the leader. Hereby, attempts are made to make sure that the leader remains on the drying wire. After the leader has reached the suction zone on the leading cylinder, the leader is transferred on the wire onto the next drying cylinder.

It is a drawback of the blow arrangement described above that, if the leader has been carried in connection with the blade of the doctor operating against the drying cylinder, the leader cannot be passed forwards from the blade without manually operated auxiliary blowings. In threading, there is, however, a need to drop the leader from the lower faces of several or all of the drying cylinders by means of the doctor blade down into the broke processing system placed underneath. This has not been readily possible in the prior-art rope-free web threading arrangements.

On the other hand, in a drying section, it is known in prior art to employ air-blow devices fitted in connection with doctor beams, but these blow devices are usually used for air-conditioning of the drying section,

and their nozzles blow across the entire transverse width of the web. Also, in threading, blow devices operating in connection with a doctor have been used as an aid, but these have involved a number of drawbacks and they are not as such suitable for use in rope-free threading. In respect of said prior-art devices, reference is made, by way of example, to the FI Patents and Published Patent Applications Nos. 50,263, 54,954, and 62,571 and to the FI Patent Applications Nos. 833590 and 894609. In some of said publications, blow devices placed after the drying section are described, by whose means the leader is guided.

The principal object of the present invention is to provide novel solutions for the problems discussed above so that said drawbacks are largely avoided.

In view of achieving the objectives stated above and those that will come out later, the method of the invention is mainly characterized in that, in the method, the leader is guided by means of air blowings extending across a substantial proportion or the whole of its width, that said air blowings are applied from the doctor beam to the area of the tip of its doctor blade at a certain small angle in relation to the plane of the doctor blade.

On the other hand, the device in accordance with the invention is mainly characterized in that the blow device is integrated in connection with the doctor beams of the drying cylinders, that the blow device comprises a transverse nozzle pipe or an equivalent nozzle arrangement placed at the level of the leader at the proximity of the end of the doctor beam at the driving side of the machine, said nozzle pipe or equivalent comprising a number of nozzle openings placed side by side or an equivalent nozzle slot, and that the blow direction of said nozzles is directed at a certain small angle in relation to the plane of the blade of said doctor in the area of the tip of the blade operating against the face of the drying cylinder.

The invention can be applied both in drying cylinder groups provided with single-wire draw and in cylinder groups provided with twin-wire draw, if necessary, over the entire length of the drying section. In connection with single-wire draw, the invention is suitable for use both in normal groups and in inverted groups. According to the present-day knowledge, the invention is most advantageously applicable in connection with single-wire draw.

According to the invention, when the blow pipes with their nozzles are placed expressly in connection with the doctor beams, an advantageous and solid "base" is obtained for the blow devices without having to make use of separate support constructions. Fitting of such constructions in the narrow gaps between the cylinders is difficult. Thus, the construction of the auxiliary devices for threading is simplified and the maintenance and operation of said devices become easier.

According to the invention, when the air jets are directed expressly at the area of the tip of the doctor blade at a suitable small angle in relation to the plane of the blade, the blowings can be deflected along the cylinder face that precedes the blade so that the effect of the blowing extends into the opening nip. In this way the blowings obtain a sufficient support and transfer effect on the leader. Of course, in the blowings, a sufficiently high energy must be used to provide a reliable transfer and support effect.

In the following, the invention will be described in detail with reference to some preferred exemplifying embodiments of the invention illustrated in the figures in the accompanying drawing, the invention being not support to be confined to the details of said embodiments.

Figure 1 shows a drying section of a paper machine which is provided with single-wire draw and in which the method and the device of the invention are applied.

Figure 2 illustrates parameters that are of significance in the location and dimensioning of the method and the device in accordance with the invention.

Figure 3 is a side view of a first embodiment of equipment of the invention

Figure 4 shows the same device as Fig. 3, seen in the direction IV-IV.

Figure 5 shows a device in accordance with the invention as applied in an inverted cylinder group provided with single-wire draw.

Figure 6 shows an application of the invention in a gap between cylinder groups in which the operation is transferred from single-wire draw to twin-wire draw as well as in a cylinder group with twin-wire draw.

Figure 7 shows an application of the invention in cylinder groups with twin-wire draw and in the gaps between such cylinder groups.

Fig. 1 is a schematic illustration of a cylinder group with single-wire draw, in which, in the upper row, there are heated drying cylinders 10 and, in the lower row, leading suction cylinders 20 with perforated and grooved outer mantle. Fig. 5 shows a corresponding inverted group, wherein the drying cylinders 10' are placed in the lower row and, correspondingly, the leading suction cylinders 20' in the upper row.

As is shown in Fig. 1, the drying wire 11 of the single-wire draw runs meandering in contact with the drying cylinders 10 and the leading cylinders 20 so that, on the drying cylinders 10, the web to be dried enters into direct contact with the heated smooth faces of the cylinders 10 and, on the leading cylinder 20, the web is placed at the side of the outside curve on the outer face of the wire 11, where it is held by negative pressure acting from the interior of the cylinder 20 through the perforations and grooves (not shown) in its mantle. On the runs of the wire 11 and the web on which they run together from the drying cylinders 10 to the

leading cylinders 20, at the side of the wire 11, a blow box 15 is provided, for example a device marketed by the applicant with the trade mark "UNO RUN BLOW BOX", by means of which formation of a detrimentally high negative pressure in the pressurized nip N+ is prevented and a suitable negative pressure is maintained at the side of the wire 11, which negative pressure guarantees that the web remains on the face of the wire 11 on said straight runs.

As is shown in Fig. 1, doctors operate against the free lower sector of the cylinders 10, which doctors comprise a doctor beam 12 and a doctor blade 14, which is attached to said beam by means of a holder 13 and doctors and keeps the smooth faces of the cylinders 10 clean. In an inverted cylinder group as shown in Fig. 5, corresponding doctors are fitted above the cylinders 10' against their free sectors.

In accordance with the present invention, the doctors 12,13,14 are provided with blow devices, by whose means blowings F_1 are directed against the tip portions of the doctor blades 14, from which the blowings bounce and are "reflected" in the direction F_2 towards the opening nip N-. By means of the blowings F_1 and F_2 , such a situation is prevented that the leader S were detached from the drying wire 11 and followed the cylinder 10 face.

In Fig. 1, the end of the leader S is denoted with the reference S_0 , which represents the situation in which the end S_0 is transferred on the suction sector of the leading suction cylinder 20 to the next cylinder 10. Figs. 2, 3 and 4 show an embodiment of the device in more detail. According to Figs. 3 and 4, an air distribution pipe 22 has been attached to the side of the doctor beam 12, one end of said pipe 22 being a closed end 22, whereas the other end communicates with the blow-air supply duct 24. The blow pipe 22 is provided with a number of nozzle holes 23 across the width L_2 . The blow pipe is arched to its place by means of flanges 25 and 26.

Out of the nozzle holes 23, air jets F_1 are blown, which are directed precisely at the point K (Fig. 3) at the proximity of the tip of the doctor blade 14. Thus, in the invention, the blowings F_1 are not directed in the direction of the plane of the blade 14, but at a small angle B towards the blade.

By means of suitable choice of the angle B, the air jets F_1 can be directed at the area of the tip of the doctor blade 14 so that the air jets bounce and are "reflected" from the plane of the doctor blade and are deflected in a direction parallel to the outer face of the cylinder 10, being directed in the direction F_2 at the opening nip N-. In this way, a sufficiently high transfer and support effect is produced for the blowings F_1 , said effect being applied to the leader. Of course, the energy of the blowings F_1 must be high enough to achieve said objectives.

In a way in itself known, the doctor beams 12 are attached by their ends, by means of axle journals 16,

in connection with their pivoting and loading means (not shown).

In Fig. 4, the width of the leader S is denoted with the reference L_1 . The extension L_2 of the blowings F_1 in the transverse direction is of the same order (width L_2) as the width L_1 of the leader S. Air from the blowings F_1 is guided along the face of the cylinder 10 in the direction of the arrow F_2 into the opening nip N-. In this way, it is achieved by means of the blowings F_1, F_2 , that the leader S is pressed against the wire 11, in which position the suction effect of the blow box 15 keeps the leader S.

When the leader must be made to fall down onto the broke processing means (not shown) at a certain cylinder 10, the blowings F_1 of the doctor placed below said cylinder 10 are closed, whereby the leader S is carried by nature to the doctor blade 14, which detaches it from the cylinder 10, and the leader falls down onto the broke conveyor placed underneath, which conveyor carries the broke into the pulper. When the leader S has to be passed further from said cylinder 10, the blowings F_1 at this cylinder 10 are controlled to make them operative, whereby, owing to the direction of the blowings F_1 , they detach the leader from the doctor blade 14 and guide the leader S onto the support of the wire 11 placed facing it, which wire carries the leader S over the suction zone of the leading suction cylinder 20 onto the next cylinder 10.

Fig. 2 illustrates parameters significant in the dimensioning and alignment of the device in accordance with the invention. In the following, some typical preferred ranges of various parameters will be given, the invention being not confined to said ranges. When the diameter of the upper cylinders is of an order of 1800 mm, the angle A is typically $A = 35^\circ \dots 45^\circ$. The perpendicular distance of the doctor blade 14 from the adjacent wire 11 is $S = 160 \dots 200$ mm, and the distance of the nozzle holes from the tip of the doctor blade is $L \leq 200$ mm, and the angle $C > 0^\circ$. The angle B of the direction of the jets F_1 is, as a rule, in the range of $B = 5^\circ \dots 45^\circ$, preferably in the range of $B = 10^\circ \dots 30^\circ$. When the width L_1 of the leader is about 200 mm, the width L_2 of the blowings in the transverse direction is typically about 200...350 mm.

The energy of the blowings F_1 and F_2 must be sufficiently high to produce the desired effects. This is why the air pressure p used in the blow pipe 22 must be set at a sufficiently high level. As a rule, said pressure p is in the range of $p = 50 \dots 350$ kPa. Said pressure range is used advantageously in connection with the dimensioning of the nozzle holes 23 to be described later. In the invention, the blow width is, however, not equally critical as the angle B of the direction of the blowings F_1 .

As the blow pipe 22, it is possible to use a perforated pipe, in which the diameter of the nozzle holes is typically 3...4 mm and the spacing 30...50 mm. The blow width L_2 may be narrower than the width L_1 of the

leader, but, as a rule, the blow width L_2 should preferably not be very much larger than the width L_1 of the leader. For example, with blowings F_1 extending across a width of about 300 mm it is possible to guide a leader S even as wide as about 600 mm, but, as a rule, the width proportions cannot be reversed.

Fig. 5 shows the use of the blowings in an inverted cylinder group provided with single-wire draw, wherein the drying cylinders 10' are placed in the lower row and the leading suction cylinders 20' in the upper row. The operation of the blowings F_1 and F_2 is similar to that described above. Of course, from the upper face of the cylinder 10', the leader cannot be doctored onto the broke conveyor.

According to Fig. 5, in connection with the doctor beams 12, additional blowings F_3 and F_4 are provided, by whose means the leader S is held on the leading cylinder 20'. Moreover, between the leading cylinders 20', it is possible to employ additional blow pipes 17, from which blowings F_5 are directed against the leader S so as to guide the leader over the suction zones of the leading cylinders 20' onto the following drying cylinder 10'.

Fig. 6 shows an application of the invention in a group gap formed between a group with single-wire draw and a group with twin-wire draw. The web is transferred from the drying wire 11 of the group with single-wire draw by means of a suction box 32 after a guide roll 33a as a free draw W_p onto the lower wire 11B of the group with twin-wire draw. In the group with twin-wire draw, in the way known in prior art, there are two rows of steam-heated drying cylinders 10A and 10B, one row above the other, as well as an upper wire 11A and a lower wire 11B, which are guided by guide rolls 31A; 31B. In connection with the drying wires 11A and 11B, at the proximity of their guide rolls 31A; 31B, blow boxes 32 are placed, by whose means the support contact between the web and the wire is promoted.

According to Fig. 6, the doctor beams 12 are provided with blow pipes 22, from which the blowings F_1 in accordance with the invention are directed at the area of the tip of the doctor blade 14. According to Fig. 6, in connection with the doctor beam 12 of the first lower drying cylinder 10B, a second blowing F_3 is also employed, which is directed towards the path of running of the leader S. The blowings F_1 are not necessarily always needed in an area of twin-wire draw, or the blowings F_1 may be very weak. On the contrary, the blowings F_3 are even more helpful. In a group with twin-wire draw, the web has free draws W_o , and the leader S also runs along the same route when it is passed through the group with twin-wire draw, being aided by means of the method and the device of the invention.

Fig. 7 shows two subsequent groups with twin-wire draw. The web is transferred as a free draw W_p from one group to the other and onto the first lower

cylinder 10B in the latter group between the guide rolls 31A and 31B. Both of the groups with twin-wire draw are provided with doctor beams 12, at which blow pipes 22 in accordance with the invention are placed at suitable locations, from which blow pipes blowings F_1 and/or F_3 in accordance with the invention are applied to produce the effects described above.

In the following, the patent claims will be given, and the various details of the invention may show variation within the scope of the inventive idea defined in said claims and differ from what has been stated above for the sake of example only.

Claims

1. Method in a multi-cylinder dryer of a paper machine in the threading of the paper web, said threading taking place substantially without a system of threading ropes, in which method the web is passed along a meandering path, in twin-wire draw, over drying cylinders (10A, 10B) and, in single-wire draw, on a drying wire (11), over drying cylinders (10; 10') and leading suction cylinders (20, 20') or rolls (20, 20'), **characterized** in that in the method, the leader (S) is guided by means of air blowings (F_1) extending across a substantial proportion or the whole of its width (L_1), that said air blowings (F_1) are applied from the doctor beam (12) to the area (K) of the tip of its doctor blade (14) at a certain small angle (B) in relation to the plane of the doctor blade (14).
2. Method as claimed in claim 1, **characterized** in that, by means of said blowings (F_1), the leader (S) is both detached from the doctor blade (14) and transferred onto the drying wire (11) to be carried further, and it is ensured that the leader (S) remains on the drying wire (11).
3. Method as claimed in claim 1 or 2, **characterized** in that in the method the blowings (F_1) applied from the nozzles of the nozzle pipe (22) placed in connection with said doctor beam (12) to the area of the tip of the doctor blade (14) are deflected into blowings (F_2) substantially parallel to the mantle of the drying cylinder (10) and are guided into the opening nip (N-) defined by the drying cylinder and the drying wire (11).
4. Method as claimed in any of the claims 1 to 3, **characterized** in that said angle of the direction of the blowings (F_1) is in the range of $B = 5^\circ \dots 45^\circ$, preferably in the range of $B = 10^\circ \dots 30^\circ$.
5. Method as claimed in any of the claims 1 to 4, **characterized** in that said blowings (F_1) are applied to the area of the tip (K) of the doctor

blade (14) from a distance of $L \leq 250$ mm at a pressure of $p = 50 \dots 350$ kPa when the diameters of the nozzle holes (23) of the blowings (F_1) are of an order of 3...4 mm.

6. Blow device intended for carrying out the method as claimed in any of the claims 1 to 5, **characterized** in that the blow device is integrated in connection with the doctor beams (12) of the drying cylinders (10; 10'; 10A, 10B), that the blow device comprises a transverse nozzle pipe (22) or an equivalent nozzle arrangement placed at the level of the leader (S) at the proximity of the end of the doctor beam (12) at the driving side of the machine, said nozzle pipe (22) or equivalent comprising a number of nozzle openings (23) placed side by side or an equivalent nozzle slot, and that the blow direction of said nozzles is directed at a certain small angle (B) in relation to the plane of the blade (14) of said doctor in the area (K) of the tip of the blade operating against the face of the drying cylinder.
7. Device as claimed in claim 6, **characterized** in that said nozzle pipe (22) and its nozzle openings (23) extend in the transverse direction substantially across the entire width (L_1) of the leader.
8. Device as claimed in claim 6 or 7, **characterized** in that said nozzle pipe (22) is fitted in such a way that its nozzles are placed at a distance of about 100...300 mm, preferably about 200 mm, from the tip of the doctor blade (14).
9. Device as claimed in any of the claims 6 to 8, **characterized** in that, in connection with the doctor beam (12), there are additional nozzles, from which additional air jets (F_3, F_4) are directed at the leader (S) by-passing the doctor beam when the leader is placed on support of the drying wire (11) or as a free draw.
10. Device as claimed in any of the claims 6 to 9, **characterized** in that the blow device is fitted in connection with a doctor beam (12) at which the perpendicular distance (S) of the doctor blade from the by-passing drying wire (11) or from a corresponding free draw (W_0) of the web is 150...500 mm while the distance (L) of the nozzle holes (23) from the tip of the doctor blade (14) is $L \leq 250$ mm.

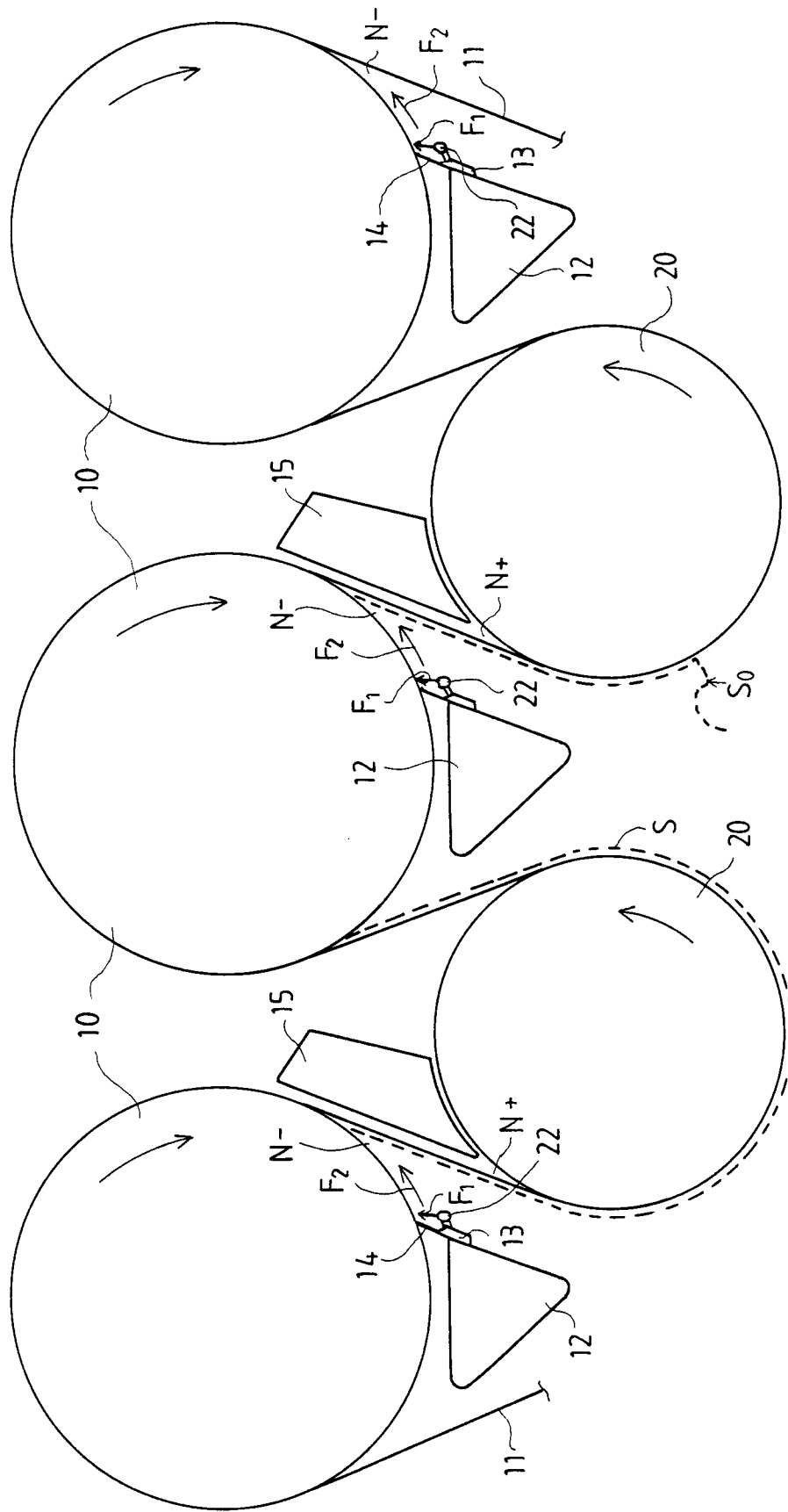


FIG. 1

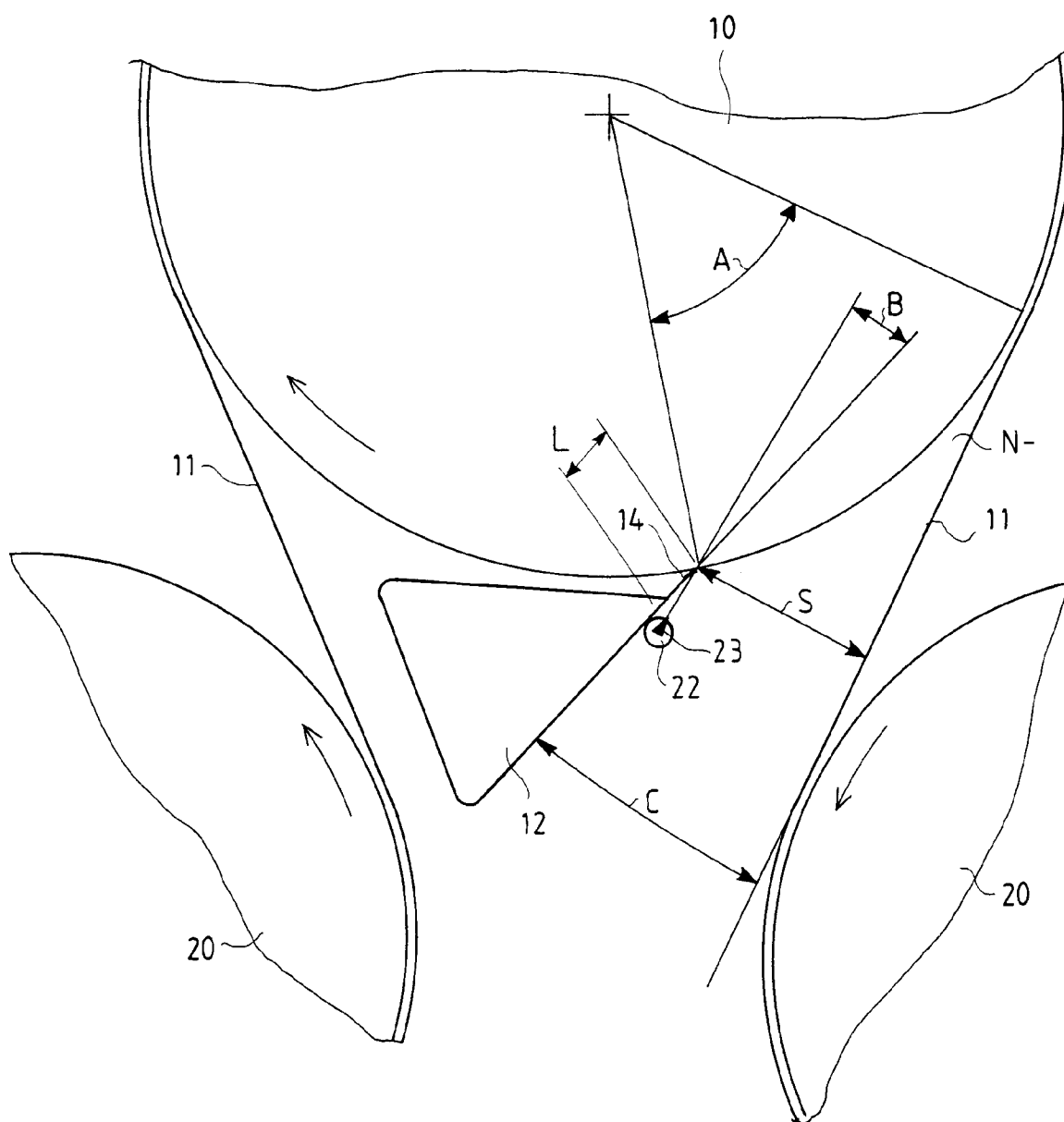
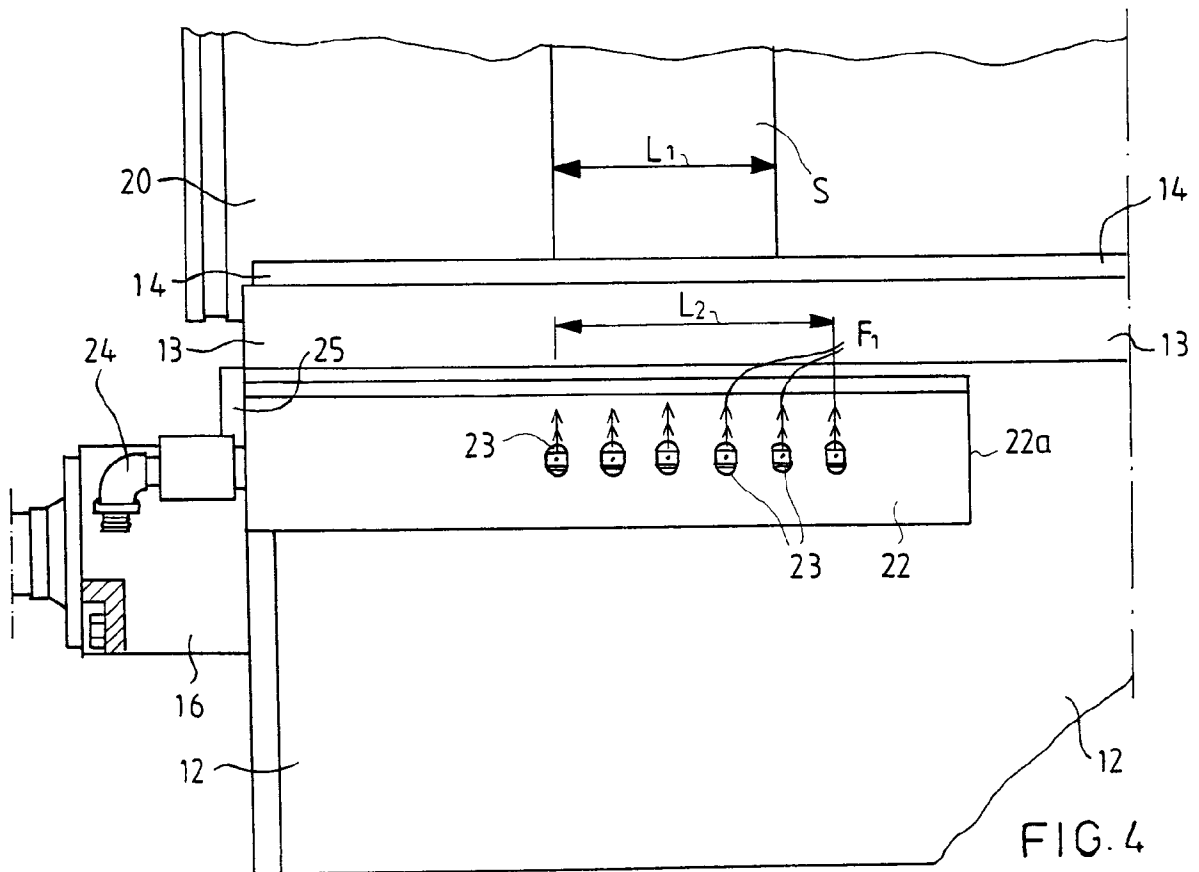
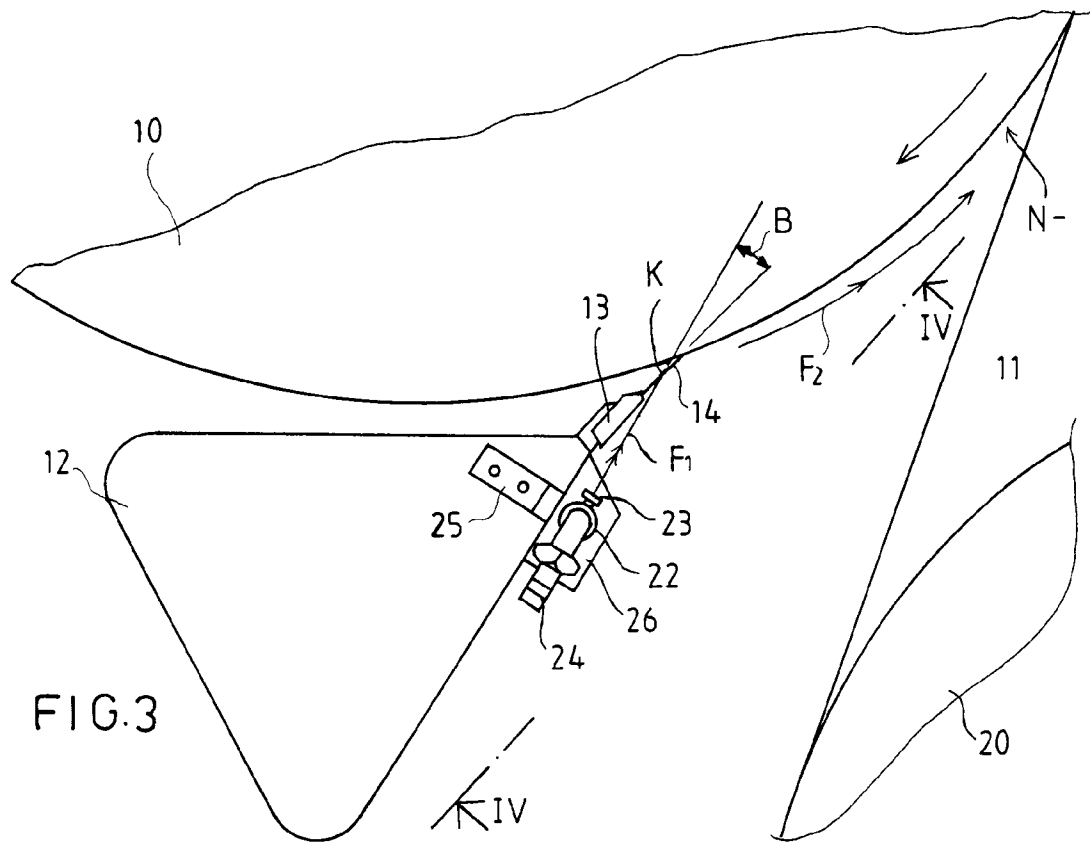


FIG. 2



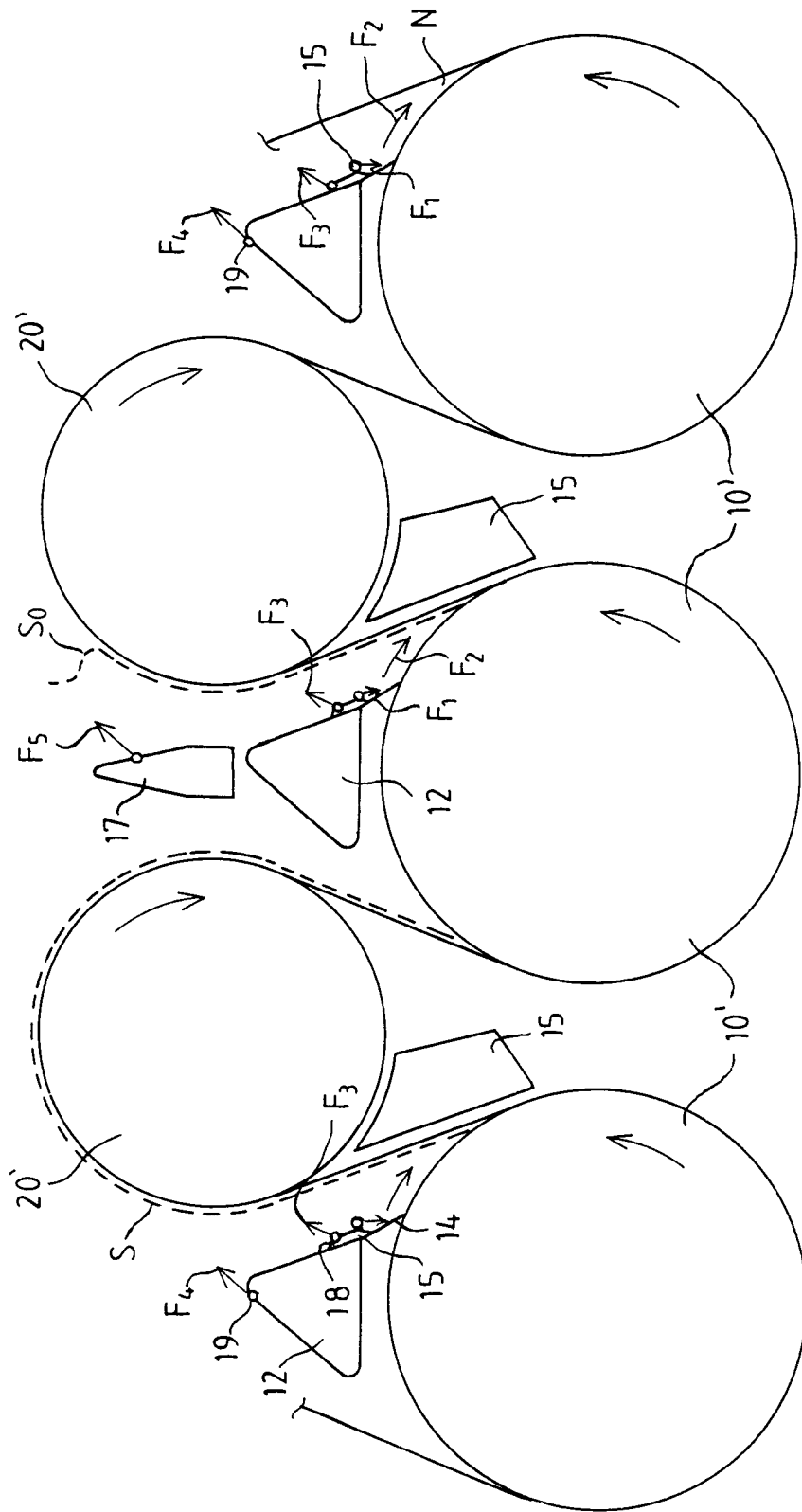


FIG. 5

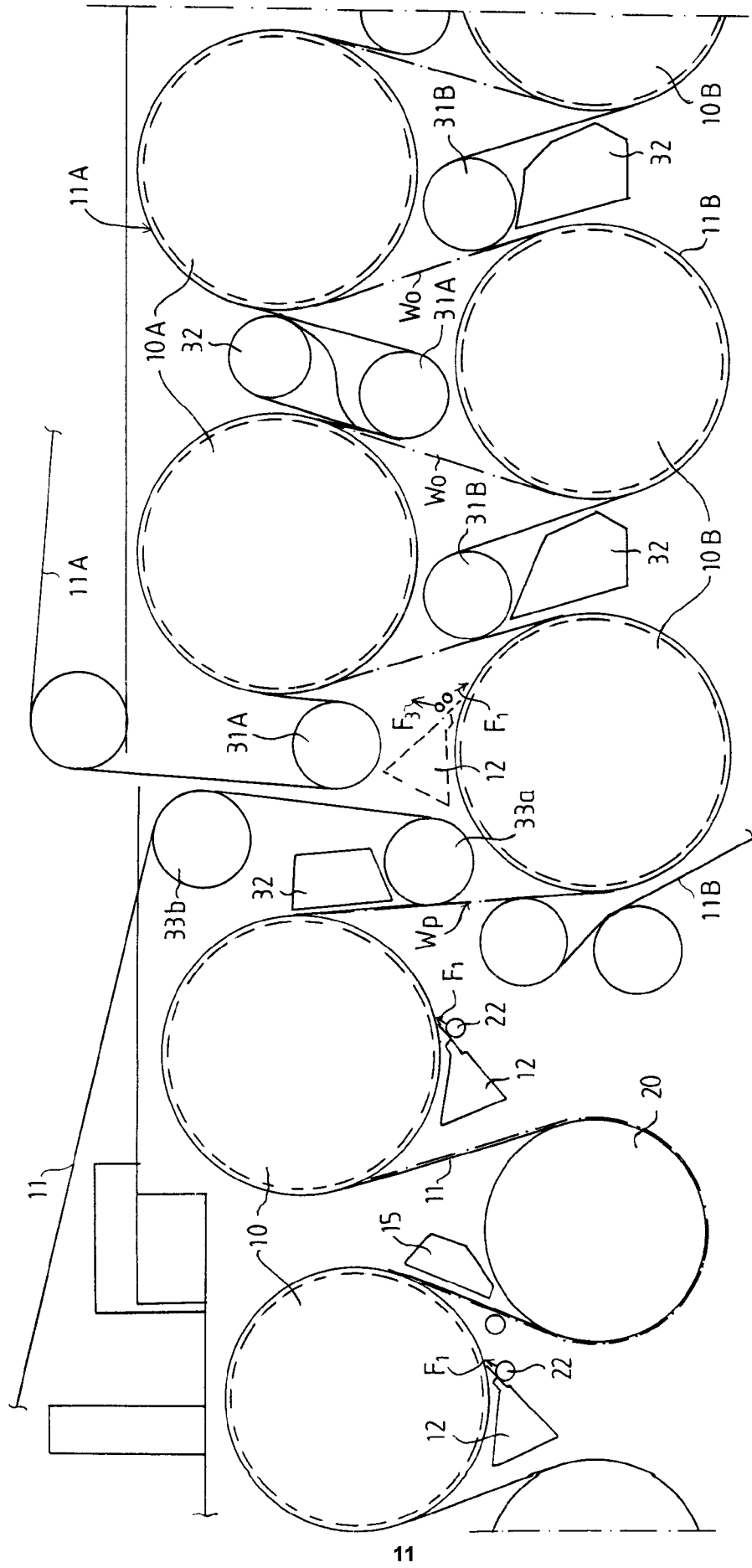


FIG. 6

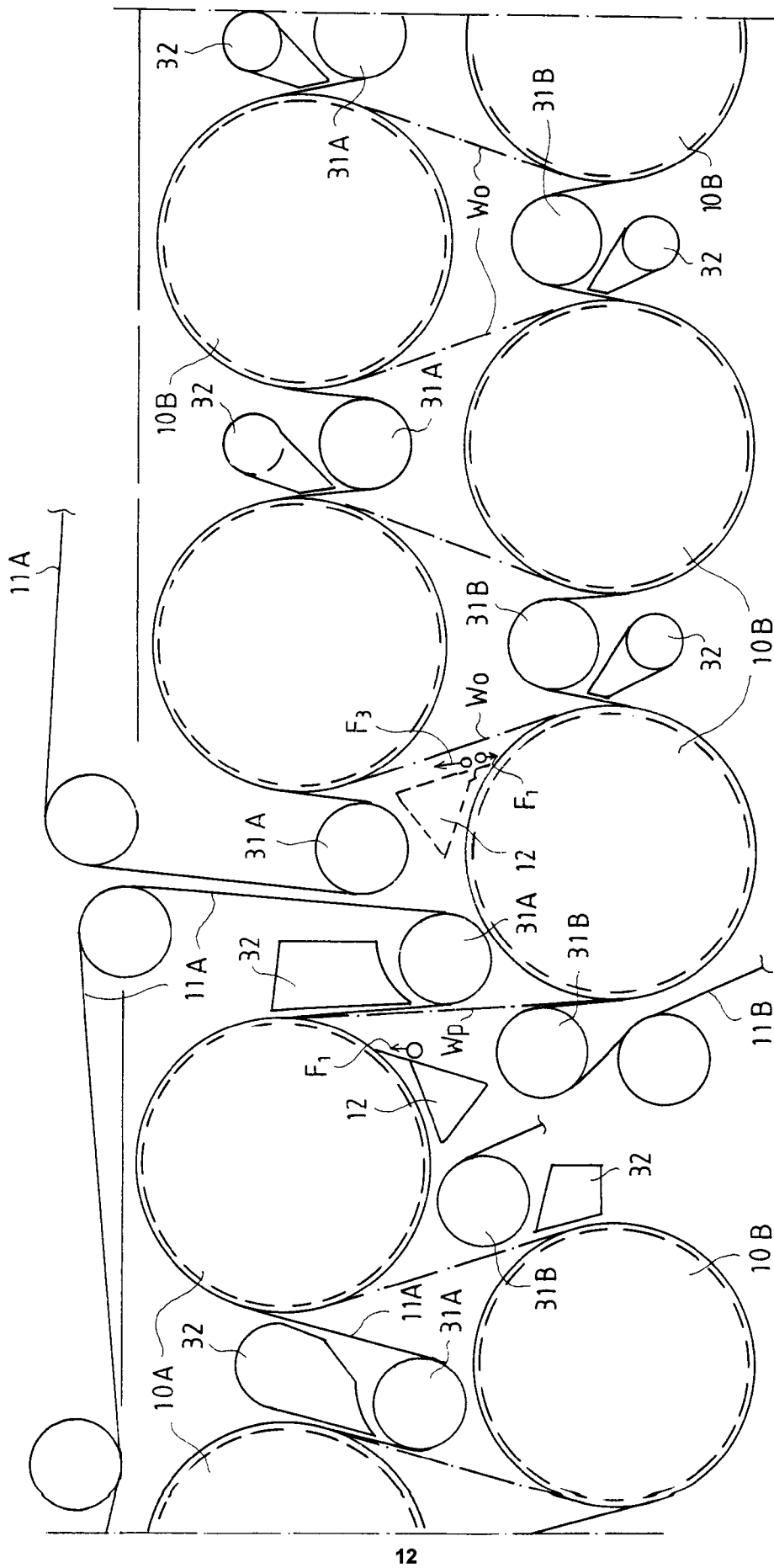


FIG. 7



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 91850239.4
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
P, X	<u>DE - A - 3 941 242</u> (VOITH) * Totality * --	1, 3, 6, 7	D 21 F 5/04
A	<u>DE - A - 3 524 006</u> (VOLMET OY) * Totality * --	1, 2, 3, 6, 7	
A	<u>GB - A - 2 158 047</u> (VALMET OY) * Totality * --	1, 2, 3, 6, 7	
A	<u>WO - A - 90/02 225</u> (BELOIT) * Totality * --	1, 6	
D, A	<u>DE - A - 3 435 308</u> (VALMET OY) * Totality * --	1, 6	
D, A	<u>EP - A - 0 364 114</u> (PULP AND PAPER RESEARCH INSTITUTE) * Totality * --	1, 6	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
D, A	<u>FI - B - 62 571</u> (VALMET OY) * Totality * --	1, 6	D 21 F 1/00 D 21 F 2/00 D 21 F 3/00 D 21 F 5/00 D 21 F 7/00 D 21 G 9/00 B 65 H 19/00 F 26 B 13/00 F 26 B 25/00
D, A	<u>FI - B - 54 954</u> (VALMET OY) * Totality * ----	1, 6	
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
VIENNA		27-11-1991	KRUMPSCHMID
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