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(54) **Title**: FORMING SECTION

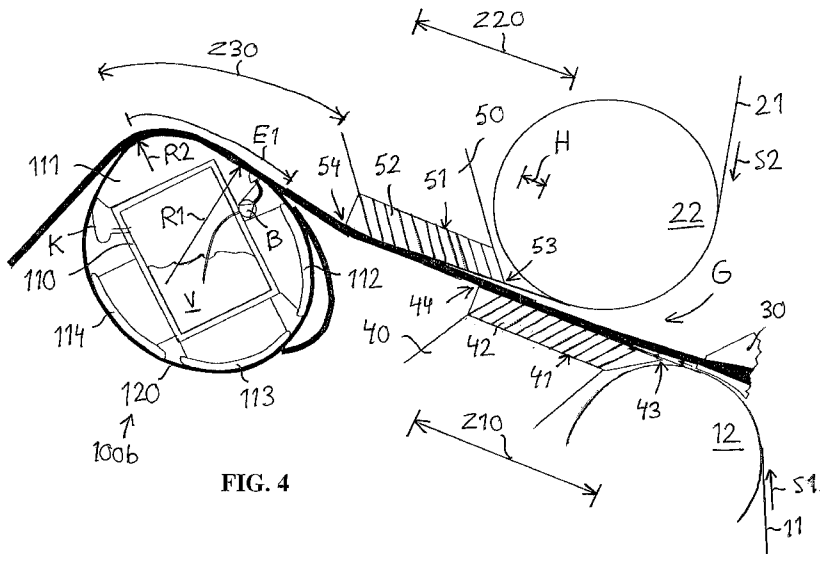

FIG. 4

(57) **Abstract**: The forming section comprises two wire loops (11, 21) which form a twin- wire zone which comprises a dewatering element (40) performing initial dewatering and a dewatering device (100b) following it. The dewatering device (100b) comprises a stationary support shaft (110) on which are supported support elements (111, 112, 113, 114) around which circles an impermeable belt loop (120). The dewatering device (100b) further comprises a curvilinear dewatering zone (Z30) over which the wires (11, 21) travel supported by the belt loop (120). The degree of curvature of the curve of the curvilinear dewatering zone (Z30) increases in the travel direction of the belt (120) such that increasing dewatering pressure is applied to pulp suspension travelling between the wires (11, 21) on the curvilinear dewatering zone (Z30).

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Forming section

FIELD OF INVENTION

The invention relates to a forming section according to the preamble of claim 1.

PRIOR ART

In this specification, a fibrous-web machine refers to paper, board, tissue and pulp-drying machines.

The task of a forming section is to remove water from fibre suspension fed by the headbox. The consistency of fibre suspension fed onto the forming section is usually 1% and, after the forming section, the consistency of the web formed on the forming section is again 18–20%.

When the web is manufactured of watery wood fibre stock, water in the pulp is removed on the forming section through a forming wire or forming wires for starting the formation of the web. Wood pulp fibres remain randomly distributed on the forming wire or between the forming wires moving together.

Depending on the grade of the web being manufactured, different types of stocks are used. The volume for which water can be removed from different stocks for achieving a web of good quality is a function of many factors, such as e.g. a function of the desired basis weight of the web, the design speed of the machine, and the desired level of fines, fibres and fill materials in the finished product.

Many types of devices are known on the forming section i.e. the former of the web, such as foil strips, suction boxes, hitch rolls, suction rolls, and rolls provided with an open surface, which have been used in many different arrangements and arrays when trying to optimise the volume, time and location of water being

removed when forming the web. The manufacture of the web is still part art and part science in simply that removing water as quickly as possible does not produce an end-product of best quality. In other words, manufacturing a high-quality end-product especially with great speeds is a function of the volume of dewatering, the dewatering method, the duration of dewatering, and the location of dewatering.

When it is desired to maintain or improve the quality of the end-product when transferring to higher production speeds, many times unforeseeable problems are created as the result of which either the production volume has to be decreased for maintaining the desired quality or the desired quality has to be sacrificed for achieving the greater production volume.

US patent 6342126 describes a forming section, a belt guidance device and a process for forming a fibrous web on the forming section. The forming section comprises two wire loops which form a twin-wire zone and a circling elastic support belt which supports at least one of said two wires in a support zone. Said elastic support belt has been principally led to travel along a path of at least substantially circular shape. Said support zone comprises a support section the average radius of curvature of which is greater than the radius of curvature of the path of the support belt being substantially circular. In said support zone, there are internal support elements by means of which the circling elastic belt is controlled. The support elements are located at a distance from each other in the travel direction of the support belt. The headbox feeds pulp suspension at the beginning of the support section where the wires form a convergent gap. The support section constitutes a forming section curvilinear with a great radius on which pulsating dewatering is applied on the pulp suspension travelling between the wires with dewatering strips. On the outer surface of the support belt, there can be grooves or blind bores receiving water.

The curvilinear dewatering zones of the forming section are usually formed with a roll, whereby loads applied to the roll set a minimum value for the diameter of the roll. The minimum value of the roll radius again limits the maximum value of dewatering pressure dependent on the roll radius. The only way to increase the dewatering capacity of the roll is to arrange underpressure in the roll by means of which water is sucked within the roll. However, building an underpressure system is expensive and its operation consumes a lot of power.

SUMMARY OF INVENTION

The forming section according to the invention provides a good dewatering capacity with low power consumption. Furthermore, a web having good quality and strength characteristics can be manufactured on the forming section according to the invention.

The principal characteristic features of the forming section according to the invention are presented in the characterising part of claim 1.

The other characteristic features of the invention are presented in the dependent claims.

The forming section according to the invention comprises a first and a second wire loop which form a twin-wire zone comprising at least one dewatering element by means of which initial dewatering is performed from pulp suspension fed by the headbox, and at least one dewatering device following said at least one dewatering element in the travel direction of the web which device comprises a stationary support shaft on which are supported support elements at a distance from each other, and an impermeable belt loop which is led to circle around the stationary support shaft supported by said support elements. Said at least one dewatering device further comprises at least one curvilinear dewatering zone which is formed on the path of the belt loop and over which the wires are led to travel supported by

the belt loop, whereby the degree of curvature of the curve of said at least one curvilinear dewatering zone increases in the travel direction of the belt such that increasing dewatering pressure is applied to the pulp suspension travelling between the wires in said at least one curvilinear dewatering zone, which increasing dewatering pressure is dependent on the tension of the wires and the radius of curvature of said at least one curvilinear dewatering zone. The surface of the belt loop is advantageously smooth.

The dewatering zone having an increasing degree of curvature provides increasing dewatering pressure on the area of the curve, whereby a greater dewatering capacity can be achieved compared to an equivalent dewatering zone having a uniform degree of curvature. It is possible that this arrangement based on increasing compression pressure provides even a 30-% dry content in the web after the wire section. It is then possible to omit power-consuming suction boxes and/or suction rolls from the forming section, whereby the amount of power required in manufacturing the fibrous web will decrease. The power saving thus acquired can be even 1–3 MW.

Changing the radius of curvature of the dewatering device can be chosen according to the fibrous web being manufactured. With pulps draining quickly, the radius of curvature of the dewatering device can decrease more rapidly than with pulps draining slower. The location of the dewatering device having a changing radius is after the initial dewatering, in a position in which the fibrous web has already drained and it endures compression. Advantageously, the dry content of the web is over 4% when it arrives at the dewatering device having a changing radius.

In an embodiment of the invention, it is possible to form onto the twin-wire section two dewatering zones prevailing in opposite directions before said at least one curvilinear dewatering zone. The first dewatering zone can be formed of a stationary forming shoe in which there are a substantially straight cover and holes

extending through the cover. The headbox feeds a pulp suspension jet at the beginning of the first forming shoe. The first forming shoe will not induce pulsating dewatering even when dewatering is intensified with underpressure.

When the pulp suspension jet of the headbox is controlled on top of the non-pulsating, substantially straight-covered first forming shoe provided with suction, the take-off and beading (stock jump) of the pulp jet can be substantially decreased, because the pulp jet lands on the non-pulsating surface having a large open surface. The immediate start of dewatering directly at the impact point damps impact energy. The head of the strip board does not doctor water and does not, for its part, cause stock jump. The direction of the jet is also flexible.

Also, the second dewatering zone can be formed of a stationary forming shoe in which there are holes extending through the cover. The cover of the second forming shoe can be at least partially curvilinear but, for other parts, the structure of the forming shoe is equivalent to the structure of the first forming shoe.

The invention will now be described with reference to the figures of the accompanying drawings.

BRIEF DESCRIPTION OF FIGURES

Fig. 1 shows a schematic side view of a forming section according to the invention.

Fig. 2 shows an enlargement of the dewatering device shown in Fig. 1 having a curvilinear dewatering zone.

Fig. 3 shows a schematic side view of a second forming section according to the invention.

Fig. 4 shows an enlargement of the beginning of the forming section shown in Fig. 3.

Fig. 5 shows a schematic side view of a third forming section according to the invention.

DESCRIPTION OF ADVANTAGEOUS EMBODIMENTS

Fig. 1 shows a schematic side view of a forming section according to the invention.

The forming section comprises a first wire loop 11, which circles over a forming roll 12a, and a second wire loop 21, which circles over a first guide roll 22a. The travel direction of the first wire 11 is designated with an arrow S1 and the travel direction of the second wire 21 is designated with an arrow S2. The first wire 11 and the second wire 21 form a convergent gap G such that the wires 11, 21 converge on the area of the forming roll 12a. The headbox 30 feeds a pulp suspension jet to the gap G between the wires 11, 21. After the point of convergence, the wires 11, 21 travel in a specified sector on the outer surface of the forming roll 12a on which is formed a first curvilinear dewatering zone Z1. This first curvilinear dewatering zone Z1 is followed by a substantially straight twin-wire section on which there are two dewatering zones Z2, Z3. The second dewatering zone Z2 is formed of a first suction box 40a provided with a strip cover within the first wire loop 11 and the third dewatering zone Z3 is formed of a second suction box 50a provided with a strip cover within the second wire loop 21. The third dewatering zone Z3 is followed by a fourth dewatering zone Z4 in which the wires 11, 21 travel over a dewatering device 100a provided with a curvilinear control surface. This is followed by a gently curvilinear twin-wire section on which water is removed from the web W travelling between the wires 11, 21 with a first suction box pair 60 being below the first wire 11. At the end of this gently curvilinear twin-wire section, the travel direction of the second wire 21

is diverted with a second guide roll 23 and led to the return cycle. At the point of the second guide roll 23, the second wire 21 is separated from the first wire 11 in a separation point S1, in connection with which the web W is bonded with a second suction box pair 70 to the first wire 11 and conveyed on the upper surface of the first wire 11 over a third guide roll 13 to a pick-up point P in which the web W is transferred onto a pick-up fabric 31 of the press section.

The dry content of the fibrous web W is over 4%, advantageously in the range of 6–12%, on the leading edge of the fourth dewatering zone Z4 on the forming section shown in Fig. 1.

Fig. 2 shows an enlargement of the dewatering device 100a shown in Fig. 1, which comprises a stationary shaft 110 around which is arranged a circling belt 120. The circling belt 120 forms a moving curvilinear surface. The shaft 110 advantageously consists of a hollow piece rectangular of its cross section on the outer surface of which are supported support elements 111, 112, 113, 114 which form the path of the belt loop 120. The path of the belt loop 120 forms a substantially elliptical path in which there is at least one curvilinear section E1 differing from the elliptical shape. The degree of curvature of the curve of the curvilinear section E1 differing from the elliptical shape increases progressively in the travel direction of the belt loop 120. It can be considered that the curvilinear section E1 consists of a large number of short partial curves such that the length of a radius R1, R2 of the partial curves decreases progressively in the travel direction of the belt 120, whereby the degree of curvature of the curve increases progressively.

The stationary, hollow shaft 110 of the dewatering device 100a shown in Fig. 2 simultaneously operates as a lubricant container from which a first lubricating pump B pumps lubricant V into a space between the circling transfer belt 120 and the support element 111. The dewatering device 100 further comprises a doctor blade K by means of which the lubricant V carried along by the transfer belt 120

is led back to the lubricant container. Because the dewatering device 100a is in the lower position, a second lubricant pump C is yet required by means of which the lubricant V collected by the doctor blade K is pumped into the hollow shaft 110 operating as the lubricant container. The belt loop 120 used in the dewatering device 100a is a smooth-surfaced, impermeable belt in which there can be grooves or blind bores receiving water. The surface of the belt loop 120 is designed such that it will not cause marking in the fibrous web W even at high compression pressures. Then, the degree of openness of the surface of the belt loop 120 is small and water exits the fibrous web mainly through the external forming wire 11, 21. Thus, the dewatering device 100a provides dewatering pressure increasing in the travel direction of the fibrous web W, whereby water also exits the fibrous web W at the end of the dewatering device 100a.

Fig. 3 shows a schematic side view of a second forming section according to the invention. The first wire 11 is led to travel over a first breast roll 12, the second wire 21 is led to travel over a second breast roll 22. The wires 11, 21 form on the section after the breast rolls 12, 22 a convergent gap G and a twin-wire zone following it. Within the first wire loop 11, immediately after the first breast roll 12 is located a first dewatering zone Z10 which consists of a first stationary, non-pulsating forming shoe 40. The headbox 30 feeds a pulp suspension jet to the gap G, on top of the first wire 11, at the beginning of the first forming shoe 40. Within the second wire loop 21, immediately after the second breast roll 22 is located a second dewatering zone Z20 which consists of a second stationary, non-pulsating forming shoe 50. After the second forming shoe 50, the first wire 11 and the second wire 21 travel over a third dewatering zone Z30 which consists of a first dewatering device 100b having a curvilinear surface. The third dewatering zone Z30 is followed by a straight twin-wire section directing obliquely downwards which is followed by a fourth dewatering zone Z40 which consists of a second dewatering device 100a having a curvilinear surface. At the end of the fourth dewatering zone Z4, the second wire 21 is led to the return cycle, whereby the web W follows on the upper surface of the first wire 11, on a section directing

obliquely upwards to a pick-up point P in which the web W is transferred onto the pick-up fabric 31 of the press section.

In the embodiment shown in Fig. 3, dewatering becomes symmetrical when the first dewatering device 100b removes water from the pulp suspension travelling between the wires 11, 21 through the second wire 21 and the second dewatering device 100a removes water from the pulp suspension travelling between the wires 11, 21 through the first wire 11.

Fig. 4 shows an enlargement of the beginning of the forming section shown in Fig. 3. In the first forming shoe 40, there are a leading edge 43 and a trailing edge 44 as well as a cover 41 provided with holes 42, which cover comes against the inner surface of the first wire 11. The first forming shoe 40 is advantageously connected with a source of underpressure (not shown in the figure), whereby an underpressure effect is applied to the web via the holes 42 in the cover 41 of the first forming shoe 40. The cover 42 of the first forming shoe 40 is advantageously straight at least on the section between the impact point of the pulp suspension jet fed by the headbox 30 and the trailing edge 44 of the cover 42. The first forming shoe 40 induces non-pulsating dewatering in the stock travelling on top of the first wire 11. With the first forming shoe 40, a lot of water can be removed from the stock. The open surface defined by the holes 42 of the cover 41 of the forming shoe 40 is 30–90%, advantageously 40–70% of the section with holes 42 between the leading edge 43 of the cover 41 and the trailing edge 44 of the cover 41.

The structure of the second forming shoe 50 is equivalent to the structure of the first forming shoe 40. In the second forming shoe 50, there are a leading edge 53 and a trailing edge 54 as well as a cover 51 provided with holes 52, which cover comes against the inner surface of the second wire 21. The second forming shoe 50 is advantageously connected to a source of underpressure (not shown in the figure), whereby an underpressure effect is applied to the web via the holes 52 in the cover 51 of the second forming shoe 50. The first part of the cover 51 of the

second forming shoe 50 is straight and the end is gently curvilinear. The second forming shoe 50 induces non-pulsating dewatering in the stock travelling between the first wire 11 and the second wire 21. With the second forming shoe 50, a lot of water can be removed from the stock. The open surface defined by the holes 52 of the cover 51 of the forming shoe 50 is 30–90%, advantageously 40–70% of the section with holes 52 between the leading edge 53 of the cover 51 and the trailing edge 54 of the cover 51.

There is an offset H between the first forming shoe 40 and the second forming shoe 50. The offset H is advantageously 0–200 mm, whereby the section with holes 52 of the second forming shoe 50 starts at the point where the section with holes 42 of the first forming shoe 40 ends. The sections with holes 42, 52 can also go slightly on top of each other. The first wire 11 and the second wire 21 do not advantageously converge on the surface of the cover 51 of the second forming shoe 50 until after the offset H.

After the second forming shoe 50, the first wire 11 and the second wire 21 travel over the third dewatering zone Z30 which consists of the first dewatering device 100b having a curvilinear surface. The first dewatering device 100b is in the upper position, but its structure is in principle equivalent to the structure of the dewatering device 100a shown in Fig. 1 being in the lower position. The first dewatering device 100b thus comprises the stationary shaft 110 around which is arranged the circling belt 120. The circling belt 120 forms a moving curvilinear surface. The surface of the circling belt 120 is impermeable and its surface is advantageously smooth or grooved. The shaft 110 advantageously consists of a hollow piece rectangular of its cross section on the outer surface of which are supported support elements 111, 112, 113, 114 which form the path of the belt loop 120. The path of the belt loop 120 forms a substantially elliptical path in which there is at least one curvilinear section E1 differing from the elliptical shape. The degree of curvature of the curve of the curvilinear section E1 differing from the elliptical shape increases progressively in the travel direction of the belt

loop 120. It can be considered that the curvilinear section E1 consists of a large number of short partial curves such that the length of the radius R1, R2 of the partial curves decreases progressively in the travel direction of the belt 120, whereby the degree of curvature of the curve increases progressively. Thus, the first dewatering device 100b provides dewatering pressure increasing in the travel direction of the fibrous web W, whereby water also exits the fibrous web W at the end of the dewatering device 100b.

At the point of the third dewatering zone Z30, the forming wires 11, 21 are led to travel over the curvilinear section E1 in question on the outer surface of the belt 120. Dewatering pressure is applied to the stock travelling between the forming wires 11, 21 on said curvilinear section E1 the magnitude of which pressure is dependent on the ratio of a tension T of the wires 11, 21 and a radius R1, R2 of the curvilinear section of the path of the wires 11, 21, T/(R1, R2). When the radius R1, R2 of the curvilinear section E1 decreases progressively, progressively increasing dewatering pressure is applied to the stock travelling between the wires 11, 21. In a situation in which at the beginning of the curvilinear section E1 the radius R1 is 1 m and at the end of the curvilinear section E1 the radius R2 is 0.1 m, the dewatering pressure increases tenfold, e.g. from the value of 10 kPa to the value of 100 kPa. The dewatering pressure removes water mainly through the second forming wire 21.

The stationary, hollow shaft 110 of the dewatering device 100 simultaneously operates as the lubricant container from which the first lubricating pump B pumps lubricant V into the space between the circling transfer belt 120 and the support element 111. The dewatering device 100 further comprises the doctor blade K by means of which the lubricant V carried along by the transfer belt 120 is led back to the lubricant container.

The second dewatering device 100a shown in Fig. 4 is totally equivalent to the dewatering device 100a shown in Fig. 1.

Fig. 5 shows a schematic side view of a third forming section according to the invention. The figure shows the beginning of the forming section and it is totally equivalent to the situation shown in Fig. 4 with the difference that the second wire loop 21 is here diverged to the return cycle with a drawing roll 24 immediately after the first dewatering device 100b. Then, this embodiment includes only the first dewatering device 100b and the second dewatering device 100a has been omitted. This embodiment is thus a modification of the forming section shown in Fig. 3. The dewatering device 100a being farther behind in the travel direction of the web W is replaced by the drawing roll 24, whereby only one dewatering device 100b provided with a changing radius of curvature is in use. By setting the drawing roll 24 in this position, the tension of the wire is maximised at the point of the first dewatering device 100b and high dewatering pressure is achieved. In principle, the configuration of the forming section can be whichever after the first dewatering device 100b.

The embodiment shown in both Fig. 1 and Fig. 3 employs the dewatering device 100a, 100b provided with a changing radius of curvature on the twin-wire section immediately after the dewatering elements 40, 50, 40a, 50a performing initial dewatering. In Figs. 1 and 5, one dewatering device 100a provided with a changing radius of curvature is used and, in Fig. 3, two successive dewatering devices 100b, 100a provided with a changing radius of curvature are used.

Instead of a progressively increasing degree of curvature, the curvilinear section E1 of the support element 111 of the dewatering device 100a, 100b can consist of two partial curves, whereby the radius of curvature R1 of the partial curve first in the travel direction of the web is greater than the radius of curvature R2 of the partial curve second in the travel direction of the web. In another alternative, the curvilinear section E1 of the support element 111 can consist of three or more partial curves, whereby the radius of curvature of the partial curve next in the

travel direction of the web is always smaller than the radius of curvature of the partial curve preceding it.

Above were described only some advantageous embodiments of the invention and it is evident to those skilled in the art that several modifications can be made to them within the scope of the enclosed claims.

CLAIMS

1. A forming section comprises a first (11) and a second (21) wire loop which form a twin-wire zone, which comprises at least one dewatering element (12a, 40) by means of which initial dewatering is performed from pulp suspension fed by the headbox (30), and at least one dewatering device (100a, 100b) following said at least one dewatering element (12a, 40) in the travel direction of the web, which dewatering device (100a, 100b) comprises a stationary support shaft (110) on which support elements (111, 112, 113, 114) are supported at a distance from each other, an impermeable belt loop (120) which is led to circle around the stationary support shaft (110) supported by said support elements (111, 112, 113, 114), **characterised** in that said at least one dewatering device (100a, 100b) further comprises at least one curvilinear dewatering zone (Z4, Z30) over which the wires (11, 21) are led to travel supported by the belt loop (120), whereby the degree of curvature of the curve of the at least one curvilinear dewatering zone (Z4, Z30) increases in the travel direction of the belt (120) such that increasing dewatering pressure is applied to the pulp suspension travelling between the wires (11, 21) on said at least one curvilinear dewatering zone (Z4, Z30), which increasing dewatering pressure is dependent on a tension (T) of the wires (11, 21) and a radius of curvature (R1, R2) of said at least one curvilinear dewatering zone (Z4, Z30).

2. A forming section according to claim 1, **characterised** in that said at least one curvilinear dewatering zone (Z4, Z30) of said at least one dewatering device (100, 200) consists of two partial curves such that the radius of curvature (R1) of a first partial curve is greater than the radius of curvature (R2) of a second partial curve following the first partial curve in the travel direction of the web.

3. A forming section according to claim 1, **characterised** in that said at least one curvilinear dewatering zone (Z4, Z30) of said at least one dewatering device (100, 200) consists of three or more partial curves such that the radius of curvature of each

partial curve preceding in the travel direction of the web is greater than the radius of curvature of the partial curve following it.

4. A forming section according to any one of claims 1–3, **characterised** in that the stationary shaft (110) of said at least one dewatering device (100, 200) consists of a hollow piece rectangular of its cross section the inner part of which forms a lubricant container from which lubricant (V) is pumped with a first pump (B) between the support element (111) and the belt loop (120) forming said at least one curvilinear dewatering zone (Z4, Z30) for lubricating the belt loop (120).

5. A forming section according to any one of claims 1–4, **characterised** in that said at least one curvilinear dewatering zone (Z4, Z30) is preceded by two dewatering zones (Z2, Z3; Z10, Z20) prevailing in opposite directions.

6. A forming section according to claim 5, **characterised** in that the dewatering zones (Z10, Z20) prevailing in opposite directions consist of a first non-pulsating forming shoe (40) installed within the first wire loop (11), in which shoe there is a cover (41) provided with thorough holes (42) onto which the headbox (30) feeds a pulp suspension jet, and of a second non-pulsating forming shoe (50) installed within the second wire loop (21) in which shoe there is a cover (51) provided with thorough holes (52), whereby the wires (11, 21) converge on the area of the second forming shoe (50).

7. A forming section according to claim 6, **characterised** in that there is an offset (H) between the first forming shoe (40) and the second forming shoe (50).

8. A forming section according to claim 6 or 7, **characterised** in that the open surface defined by the holes (42) of the cover (41) of the first forming shoe (40) is 40–90 % of the section with holes (42) of the cover (41).

9. A forming section according to any one of claims 6–8, **characterised** in that the open surface defined by the holes (52) of the cover (51) of the second forming shoe (50) is 40–90 % of the section with holes (52) of the cover (51).

10. A forming section according to claim 5, **characterised** in that the dewatering zones (Z2, Z3) prevailing in opposite directions consist of a first strip-covered suction box (40a) installed within the first wire loop (11), and of a second strip-covered suction box (50a) installed within the second wire loop (21), which are preceded by a dewatering zone (Z1) formed on a forming roll (22a) within the second wire loop (21).

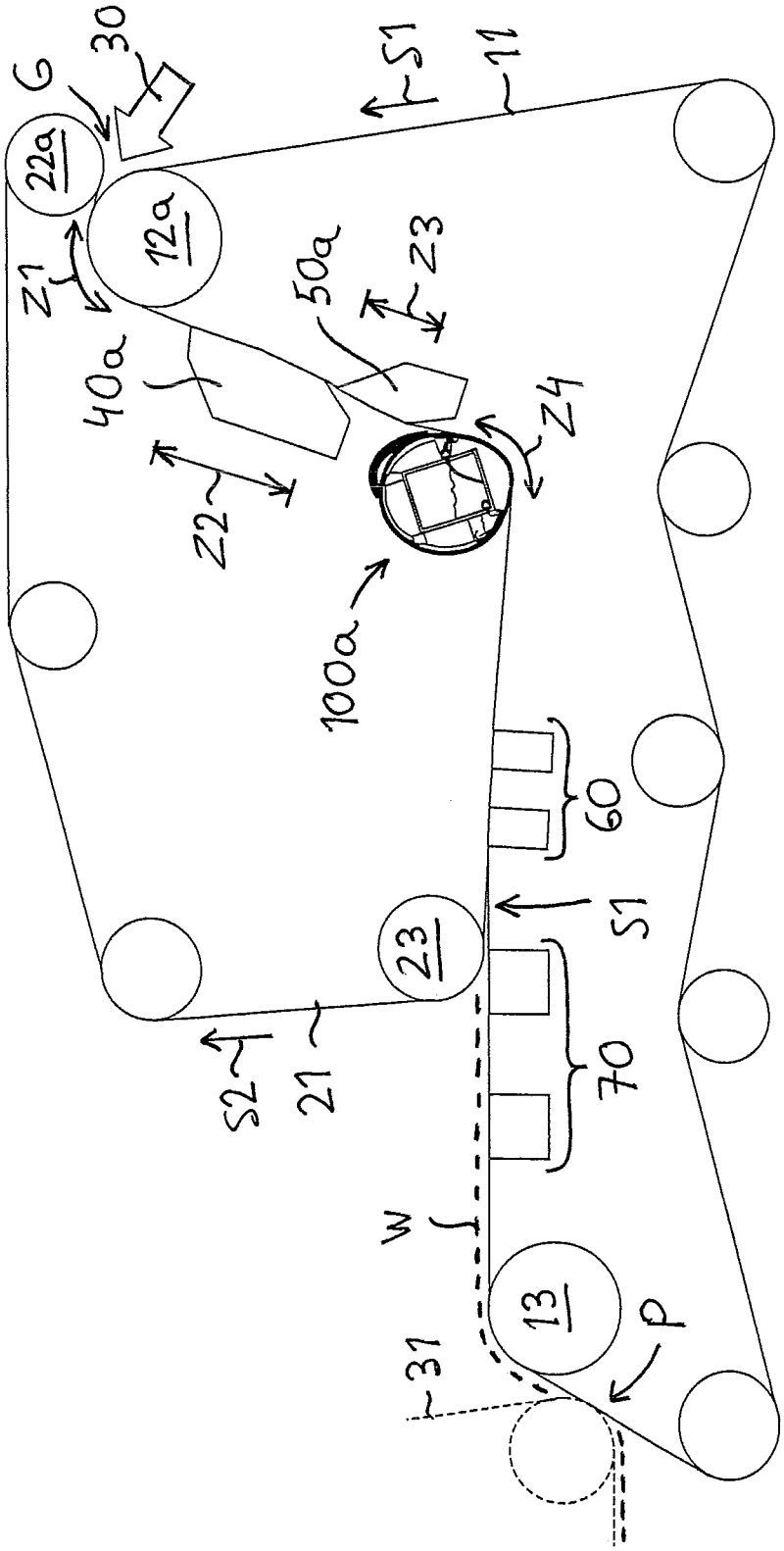

FIG. 1

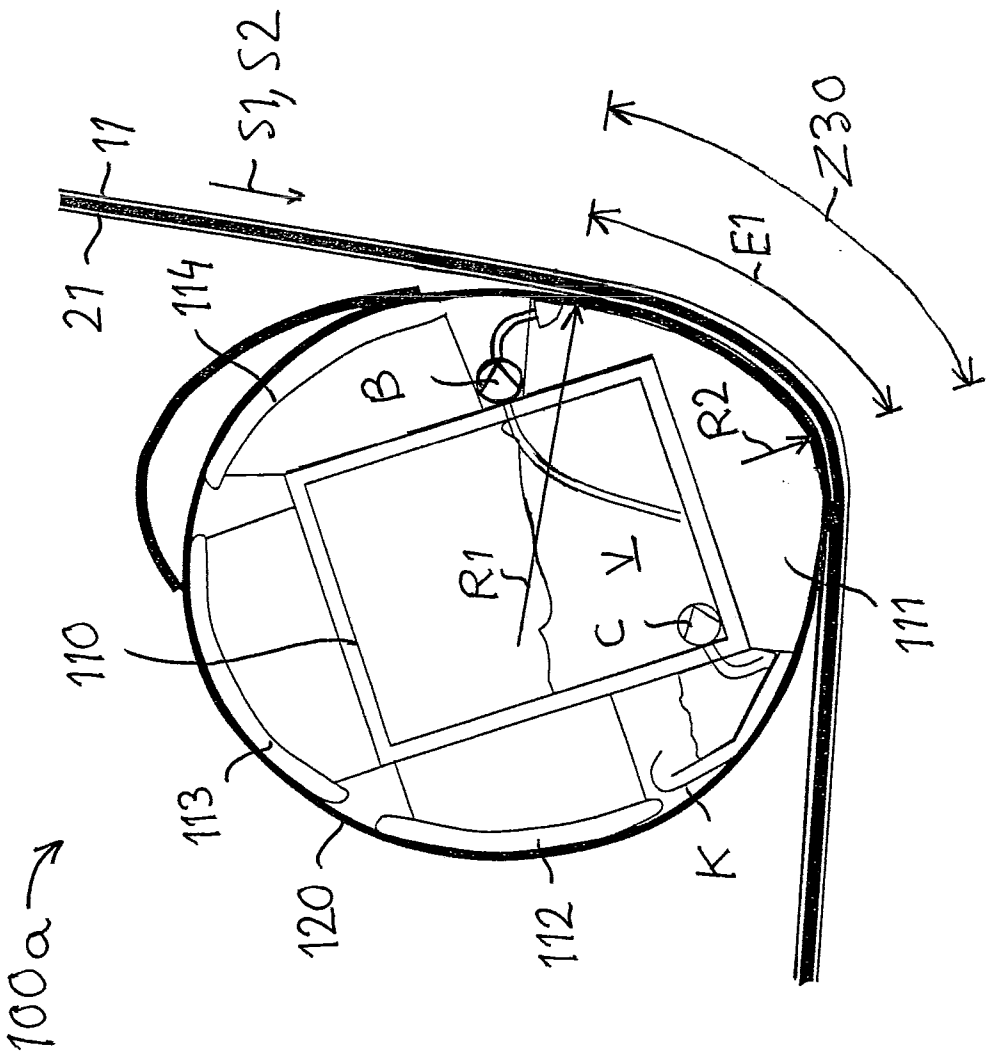

FIG. 2

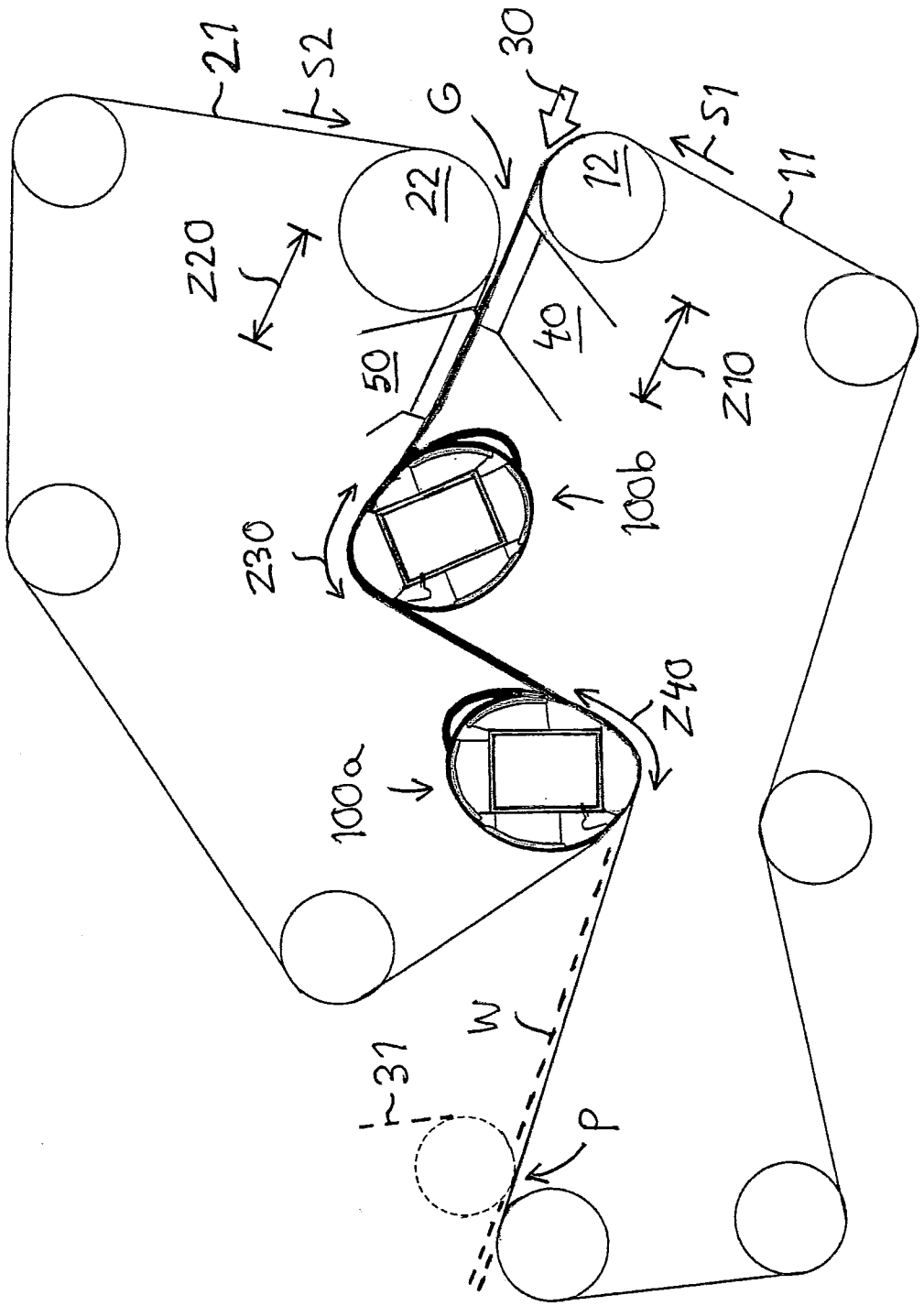

FIG. 3

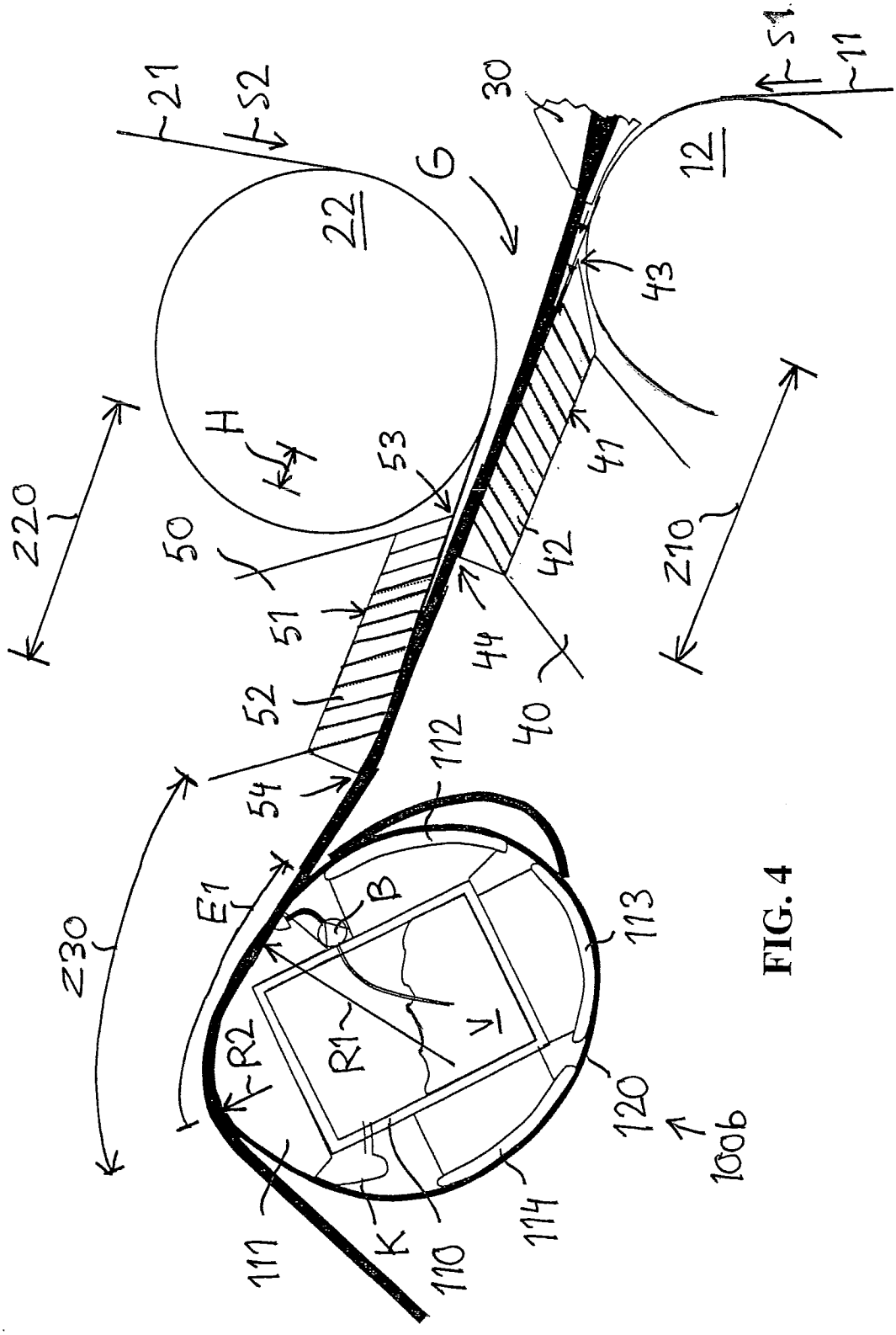
21
S2
22
G
30
S1
11
12
43
H
53
41
220
50
51
42
210
52
44
40
112
54
E1
B
113
Z30
R2
R1
V
120
1006
111
K
110
114

FIG. 4

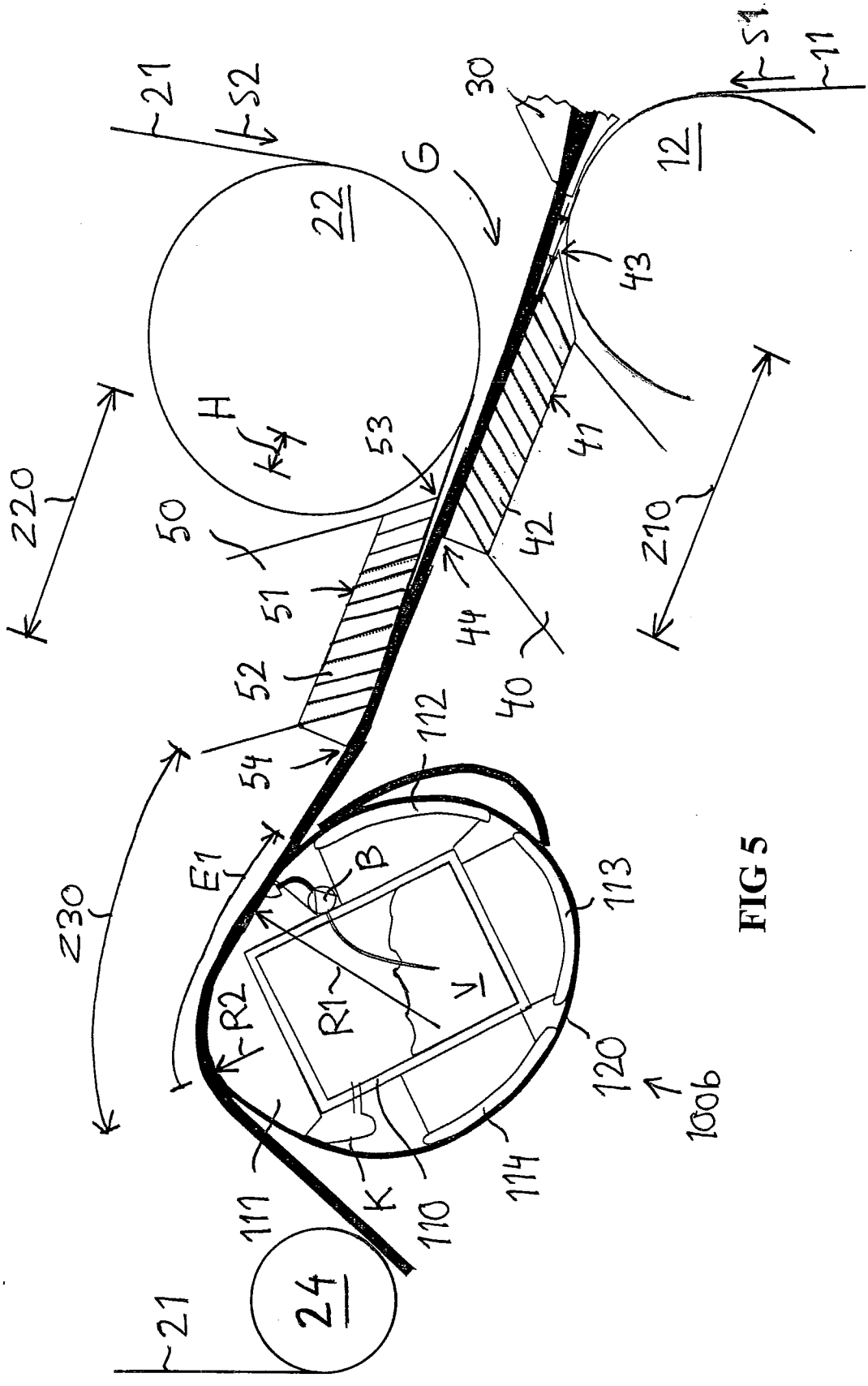
21
52
30
51
11
22
G
12
43
H
53
41
220
50
210
51
42
52
44
54
40
112
E1
B
230
113
R2
R1
V
120
100b
111
K
110
114
24
21

FIG 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2009/050814

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-internal, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6342126 B1 (GRABSCHEID JOACHIM et al.) 29 January 2002 (29.01.2002) abstract; figures 1 and 2; column 5, line 27 – column 7, line 12	1-10
A	WO 9950498 A1 (VALMET CORP et al.) 07 October 1999 (07.10.1999) abstract; figures 1 and 2, page 3, line16 – page 6, line 5	1-10
A	US 2002056532 A1 (JUUTINEN VESA et al.) 16 May 2002 (16.05.2002) figures 1, 3 and 4; paragraphs 20, 22-23, 26-27	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 December 2009 (11.12.2009)	08 January 2010 (08.01.2010)

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI2009/050814

Patent document cited in search report	Publication date	Patent family members(s)	Publication date
US 6342126 B1	29/01/2002	EP 1022382 A2	26/07/2000
		AT 259446T T	15/02/2004
		DE 19902274 A1	27/07/2000
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		FI 981974 A	15/03/2000

INTERNATIONAL SEARCH REPORT

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CLASSIFICATION OF SUBJECT MATTER

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