



(11) **EP 1 273 700 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
08.01.2003 Bulletin 2003/02

(51) Int Cl.7: **D21F 3/02**

(21) Application number: **02077509.4**

(22) Date of filing: **01.07.2002**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
IE IT LI LU MC NL PT SE SK TR
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **05.07.2001 FI 20011471**

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(54) **Extended-nip press**

(57) An extended-nip press is disclosed comprising a press roll (2) and a backing roll (1), wherein the press roll (2) comprises a rotating endless-loop blanket (3) of a flexible, liquid-impervious material, a rigid and advantageously stationary roll support beam (4) that extends axially through the interior of the endless blanket (3), at least one shoe element (8) resting on the roll support beam (4) and having a concave top face, and loading means (6) for loading the shoe element (8) by way of pressing the concave top face thereof against the flexible endless-loop blanket (3) so as to make the blanket (3) form a press nip zone (N) in cooperation with the backing roll (1), said loading means (6) comprising a linear array of loading units (6') aligned along the axial direction of the press roll (2), each one of the loading units

comprising a functionally cooperating piston-cylinder unit. The invention is implemented by way of providing the piston (13) of said at least one piston-cylinder unit with a first end (14) which is adapted to enter at least partially into the bore of the cylinder (12) and to tilt relative to the cylinder (12) and, further, by providing said piston (13) of said at least one piston-cylinder unit with a second end (18) which is adapted to enter the piston mount (19) and to tilt relative to the piston mount, and, still further, by adapting the cylinder (12) of said at least one piston-cylinder movable between glide rails (21) aligned in the axial direction of the press roll (2) and is connected so as to load the endless-loop blanket (3) when a pressurized medium is introduced into the cylinder displacement space (15) formed between the piston (13) and the cylinder (12).

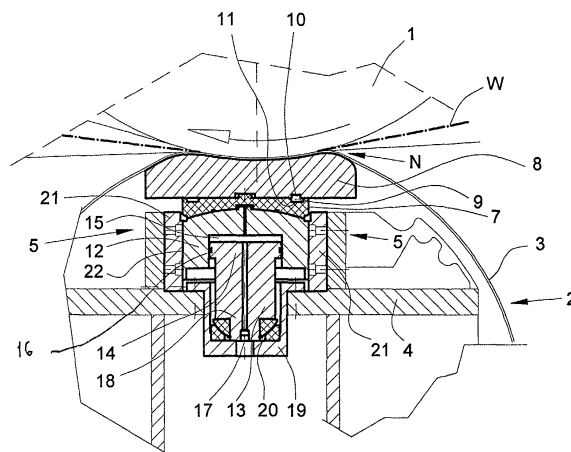


FIG 1

Description

[0001] The present invention relates to an extended-nip press according to the preamble of the appended base claim.

[0002] Generally an extended-nip press comprises a press roll cooperating with a backing roll. Typically, the press roll comprises a rotating endless-loop blanket of a flexible, liquid-impervious material, a rigid and advantageously stationary roll support beam that extends axially through the interior of the endless blanket, at least one press shoe resting on the roll support beam and having a concave top face, and loading means for loading the shoe so as to press the concave top face thereof against the flexible endless blanket in order to form a press nip zone in cooperation with the backing roll, whereby the loading means comprise a plurality of loading units adapted to operate as a linear array in the axial direction of the press roll, each one of the loading unit comprising a functionally cooperating piston-cylinder unit.

[0003] During the operation of an extended-nip press, the shoe is subjected to forces, typically occurring in the horizontal direction and chiefly oriented in the machine direction, that in this context are broadly called frictional forces inasmuch they are caused by the friction of the endless-loop blanket against the top face of the shoe when the blanket passes the press zone. These frictional forces tend to move and/or rotate the shoe in a manner that changes the mutual disposition between the shoe and the backing roll and, hence, the nip pressure profile of the press zone. In order to cancel the effect the the displacement and/or rotation of the shoe due to the frictional forces, the frictional forces imposed on the shoe must be transmitted to the support structures of the extended-nip press.

[0004] A conventional arrangement for transmitting the frictional forces from the shoe to the frame of the extended-nip press is such that on the trailing edge of the shoe is provided a plurality of support members backing the shoe and giving the shoe a support against friction forces imposed on the shoe. For instance, in patent publication FI 89286 is disclosed an extended-nip press having a support bearing assembly adapted to the outgoing side of the shoe for receiving the frictional forces imposed on the shoe, the support bearing assembly including at least one stationary support member connected to a support beam. The disadvantages of this arrangement have arisen from the horizontal support of the shoe that may be problematic in regard to the position adjustment of the shoe by possibly restricting the degree of freedom in the range of positions adjustable for the shoe. Moreover, these kinds of constructions have frequently been complicated which in turn is reflected in high manufacturing and service costs of the embodiment. Furthermore, smoothness of shoe loading has been problematic so that the shoe tends to stick at its trailing edge and service end.

[0005] It is an object of the extended-nip press according to the invention to eliminate or at least reduce the above-described problems related to the prior art.

[0006] It is a further object of the present invention to provide an extended-nip press, wherein the frictional forces imposed on the shoe are transmitted via at least one loading unit pressing the shoe to the roll support beam of the extended-nip press.

[0007] It is still further another object of the invention to provide an extended-nip press, wherein the loading units pressing the shoe are arranged so that the thermal expansion of the shoe cannot cause substantial problems to the operation of the loading units.

[0008] To achieve the above-mentioned objects and others, the extended-nip press according to the invention is principally characterized by what is stated in the characterizing parts of the appended base claim.

[0009] The extended-nip press according to the present invention is characterized in that the piston of at least one piston-cylinder unit comprises a first end which is adapted to enter the bore of the cylinder and to tilt relative to the center axis of the cylinder. The piston of said piston-cylinder unit further comprises a second end which is adapted to enter the piston mount and to tilt relative to the center axis of the piston mount. The extended-nip press according to the invention is still further characterized in that the cylinder of said piston-cylinder unit is adapted movable between glide rails aligned in the axial direction of the press roll and connected so as to load the endless-loop blanket when a pressurized medium is introduced into the cylinder displacement space formed between the piston and the cylinder.

[0010] In a preferred embodiment of the extended-nip press according to the present invention, the above-mentioned first end of the piston is made at least partially globular. Such rounding of the piston's first end allows the cylinder to tilt relative to the piston. Advantageously, the second end of the piston is adapted into the piston mount by means of a spherical sliding bearing that allows the piston to tilt relative to the mount. Inasmuch the first end of the piston is globular and the second end of the piston is adapted to rest in the piston mount on a spherical sliding bearing, the cylinder can move relative to the piston mount irrespective of the tilting of the piston without a change (e.g., by tilting) in the cylinder alignment. Furthermore, the above-described piston construction is advantageous in that structural changes due to thermal expansion cannot tilt the cylinder which remains oriented upright in spite of the tilting of the piston in the cylinder bore.

[0011] In another preferred embodiment of an extended-nip press according to the present invention, the above-mentioned glide rails extend in a substantially contiguous fashion on both sides of the linear array of the piston-cylinder units. This arrangement provides a continuous glide surface that prevents the cylinder from moving in the machine direction, yet allowing the cylin-

der to move in the axial direction of the press, that is, in the cross-machine direction.

[0012] In still another preferred embodiment of an extended-nip press according to the present invention, key elements are adapted between at least one piston-cylinder unit and at least one of the glide rails in order to prevent said at least one piston-cylinder unit from moving in the axial direction of the extended-nip press. Such advantageous keyed guidance of a cylinder or plural cylinders located close to the center of the press allows thermal expansion of the shoe in either direction from the center line of the press during operation without causing problems from thermal expansion to the operation of the press. The unkeyed cylinders remain free to follow the movements of the thermally expanding/contracting shoe.

[0013] In a further another preferred embodiment of an extended-nip press according to the present invention, the shoe is connected to at least one of the loading units in a fashion that allows the frictional forces imposed on the shoe to be transmitted to the loading unit. Herein, the frictional forces imposed on the shoe can be transmitted to the loading unit, e.g., using such a structure wherein the cylinder end loading the shoe is made at least partially spherical.

[0014] The frictional force received by the cylinder from the shoe is advantageously transmitted to the roll support beam by providing at least one of the piston-cylinder units with a force-transmitting surface facing the glide rail so as to transmit the frictional forces imposed on the shoe to the roll support beam of the extended-nip press. By means of this arrangement, the frictional force imposed on the shoe is transmitted to the roll support beam via at least one piston-cylinder unit loading the shoe.

[0015] In a yet another preferred embodiment of an extended-nip press according to the present invention, the linear array of loading units, advantageously their cylinders are adapted about each other at least partially. As a result, the adjacent cylinders support each other so as to prevent the cylinders from tilting in the axial direction of press.

[0016] One of the greatest benefits of the extended-nip press according to the invention is its simple, yet extremely functional construction allowing the press to be fabricated at a reasonable cost, whereby both its maintenance and servicing is easy and fast. Furthermore, the extended-nip press according to the present invention is very durable in use.

[0017] An additional benefit of the extended-nip press according to the present invention is its capability of transmitting the frictional forces imposed on the shoe to the press frame, particularly to the roll support beam.

[0018] A still further benefit of the extended-nip press according to the present invention is that it is not sensitive to malfunction or incorrect loading situations that may be induced by thermal expansion of the shoe during operation.

[0019] In the following, the invention is described in more detail by making reference to the appended drawings in which

5 FIG. 1 is a diagrammatic cross-sectional view of an extended-nip press as seen from the end of the press;

10 FIG. 2 is a diagrammatic cross-sectional view of an alternative embodiment of an extended-nip press as seen from the long side of the press, that is, a view taken in the machine direction of the press; and

15 FIG. 3 is a sectional view taken along plane A-A denoted in FIG. 2.

[0020] FIG. 1 shows in a diagrammatic view exemplary embodiment of the construction of an extended-nip press as seen from the end of the press, that is, in a view in the cross-machine direction of the press. The extended-nip press shown therein comprises an upper backing roll 1 and a lower press roll 2 that define therebetween a press zone, later called a press nip N. The backing roll 1 may be a heated roll or an unheated roll. The press roll 2 comprises an endless-loop blanket 3 made from a flexible and liquid-impervious material with a rigid, stationary roll support beam 4 extending axially through the interior of the endless-loop blanket. Furthermore, the press roll 2 comprises a plurality of loading means 5 that urge the blanket 3 toward the backing roll for forming the above-mentioned nip N in order to remove water from a web W passed through the nip. Herein, web refers to a paper or paperboard web. The travel direction of the web passed into the nip is denoted by an arrow in the diagram.

[0021] The loading means 5 include a loading unit 6 which is connected to a roll support beam 4 and a shoe 8 that in turn is connected to the loading element via a saddle element 7 and is aligned parallel to the center axis of the press roll. The shoe element 8 is connected to the saddle element by a key 9 inserted into both a keyway 10 made on the surface of the shoe element facing the saddle element and a keyway 11 made on the surface of the saddle element facing the shoe element. The key 9 transmits the frictional forces imposed on the shoe to the saddle element.

[0022] The loading means 6 comprise a linear array of loading units aligned in a row in the axial direction of the press roll 2, one of the loading units being illustrated in FIG. 1. Each one of the loading units comprises a cylinder 12 and a piston 13 adapted to enter partially into the bore of the cylinder so that at least the first end 14 of the piston enters the displacement space 15 formed in the bore of the cylinder.

[0023] The first end 14 of the piston includes a seal element 16 serving to seal the side wall of the piston over the gap to the wall of the pressurized-medium re-

ceiving cylinder displacement space. As shown in the diagram, the first end of the piston is partially rounded into a globular shape at its periphery thus allowing the piston to tilt relative to the cylinder when so required.

[0024] The other end 18 of the piston 13 is adapted by means of a spherical sliding bearing 20 into a piston mount 19 fitted on the roll support beam 4. The spherical sliding bearing facilitates the tilting of the piston relative to the piston mount.

[0025] As shown in the diagram, the cylinder-piston combination forms a functionally cooperative piston-cylinder combination, whereby the introduction of a pressurized medium, such as hydraulic oil, via a passageway 17 of the pressurized medium into the cylinder displacement space can be used for elevating the operating pressure of the cylinder displacement space so as to move the piston relative to the cylinder. Inasmuch the means for passing a pressurized medium to the pressurized-medium passageway as well as the means for elevating the pressure of the pressurized medium or for controlling the flow thereof are well known to a person skilled in the art, they are omitted from the diagram. Having the second end 18 of the piston backed by the piston mount 19, introduction of the pressurized medium into the cylinder displacement space will cause the cylinder to move outwardly relative to the piston so as to load the shoe.

[0026] As shown in FIG. 1, facing each cylinder 12 on the incoming and outgoing sides of the press are adapted glide rails 21 serving to support the cylinder in the machine direction of the press. The glide rails are connected by screws to the roll support beam 4. Being thus supported to the glide rails, the cylinder cannot tilt in the machine direction when the cylinder is being actuated by the pressurized medium introduced into the cylinder displacement space. The surface of the cylinder remaining on the outgoing side of the press is provided with a force-receiving surface 22 adapted to rest against the glide rail so as to transmit the frictional forces imposed on the shoe via the glide rail to the roll support beam. An additional feature of the cylinder is that its top surface is substantially spherical as drawn in the diagram.

[0027] The saddle element 7 is a planar component with its underside, that is, the surface facing the loading element, machined to incorporate a concave recess that after the saddle element is connected to the loading unit allows the spherical end surface of the loading unit and this concave recess of the saddle element to form a ball joint allowing the shoe element connected to the saddle element to rotate relative to the loading unit. Also the frictional forces imposed on the shoe are transmitted via this spherical end surface of the loading unit from the saddle element to the loading unit.

[0028] The shoe element 8 shown in FIG. 1 is made from a suitable metal such as aluminum. The top surface of the shoe element opposed to the backing roll has a concave cross section. The concave top surface may also be contoured to include a hydrodynamic pressure

pocket. Alternatively, the pressure pocket may be designed to perform as a hydrostatic pressure pocket, whereby the shoe would additionally comprise at least one line connection for feeding cooling/lubricating oil into the pressure pocket. When the shoe is pressed against the backing roll, the endless-loop blanket assumes a shape that is determined by the concave face of the shoe and by the curvature of the backing roll adapted to cooperate with the press roll, whereby the blanket together with the backing roll defines a press zone through which the paper or paperboard web can be passed to remove water from the web.

[0029] In addition to those described above, an extended-nip press includes other parts and elements omitted from the diagrams for greater clarity. These means are, e.g., means for feeding coolant and lubricant onto the top surface of the shoe, means for feeding pressurized medium into the cylinder acting as the loading element, etc. Furthermore, an extended-nip press may be implemented in an inverted fashion, whereby the press roll is located above the backing roll.

[0030] FIG. 2 shows diagrammatically a partially cross-sectional view of an extended-nip press as seen from the long side of the press. In FIG. 3 is shown a sectional view taken along plane A-A denoted in FIG. 2. The reference numerals used in FIGS. 2 and 3 are principally the same as those of FIG. 1.

[0031] As shown in FIGS. 2 and 3, the contiguous shoe 8 is loaded by nine loading units 6 to press the endless-loop blanket 3 against backing roll 1. Obviously, the number of loading units in an extended-nip press may be varied so as to be a larger or a smaller number than used in the exemplifying embodiment. In practice, the number of loading units required is dictated by the width of the press and the desired control precision of the cross-machine nip pressure profile.

[0032] In the linear array of loading units, the cylinders placed in the row are arranged to partially abut each other. Due to this arrangement, the adjacent cylinders support each other so as to prevent the cylinders from tilting in the axial direction of the extended-nip press.

[0033] As shown in FIG. 3, between the loading unit 6', which is located centermost so as to be situated at the center line of the press, and the guide rails 21 are adapted key elements 23 by means of which the respective loading unit is guided against tilting in the cross-machine direction. As a result, run-time thermal expansion of the shoe may take place in either direction from the center line of the press without causing problems in the operation of the press. The arrangement permits the unkeyed cylinders to move freely along with the expanding shoe. Obviously, even a greater number than one of the loading units may be keyed in this fashion. Furthermore, the clamping of the loading units may be accomplished by other means than using keys. For instance, at least one of the glide rails may be contoured to have a recess at the location of the loading unit to be clamped. A still further benefit must be appreciated therein that a deflec-

tion of the roll structure will not be reflected in the operation of the cylinders inasmuch the pistons thereof can tilt as required.

[0034] It must be understood that the invention is not limited by the exemplary embodiment described above, but rather may be varied within the inventive spirit and scope of the appended claims.

Claims

1. An extended-nip press formed by a press roll (2) and a backing roll (1), said press roll (2) comprising

- a rotating endless-loop blanket (3) of a flexible, liquid-imperious material,
- a rigid and advantageously stationary roll support beam (4) that extends axially through the interior of the endless blanket (3),
- at least one shoe element (8) resting on the roll support beam (4) and having a concave top face, and
- loading means (6) for loading the shoe element (8) by way of pressing the concave top face thereof against the flexible endless-loop blanket (3) so as to make the blanket (3) form a press nip zone (N) in cooperation with the backing roll (1), said loading means (6) comprising a linear array of loading units (6') aligned along the axial direction of the press roll (2), each one of the loading units comprising a functionally cooperating piston-cylinder unit,

characterized in that

- the piston (13) of said at least one piston-cylinder unit comprises a first end (14) which is adapted to enter at least partially into the bore of the cylinder (12) and to tilt relative to the cylinder (12),
- said piston (13) of said at least one piston-cylinder unit further comprises a second end (18) which is adapted to enter the piston mount (19) and to tilt relative to the piston mount, and
- the cylinder (12) of said at least one piston-cylinder unit is adapted movable between glide rails (21) aligned in the axial direction of the press roll (2) and is connected so as to load the endless-loop blanket (3) when a pressurized medium is introduced into the cylinder displacement space (15) formed between the piston (13) and the cylinder (12).

2. The extended-nip press of claim 1, **characterized in that** said first end (14) of said piston is at least partially globular.

3. The extended-nip press of claim 1 or 2, **character-**

ized in that said second end (18) of said piston is adapted to rest in the piston mount (19) on a spherical sliding bearing (20).

4. The extended-nip press of any one of foregoing claims, **characterized in that** said glide rails (21) extend in a substantially contiguous fashion on both sides of the linear array of the piston-cylinder units.

5. The extended-nip press of any one of foregoing claims, **characterized in that** key elements (23) are adapted between said at least one piston-cylinder unit and at least one of the glide rails (21) in order to prevent said at least one piston-cylinder unit from moving in the axial direction of the extended-nip press.

6. The extended-nip press of claim 5, **characterized in that** key elements (23) are adapted between said at least one piston-cylinder unit of the five centermost piston-cylinder units, advantageously the selected piston-cylinder unit being the centermost of them all, and at least one of the glide rails (21) in order to prevent said at least one piston-cylinder unit from moving in the axial direction of the extended-nip press.

7. The extended-nip press of any one of foregoing claims, **characterized in that** the shoe (8) is connected to at least one loading unit (6') so that the frictional forces imposed on the shoe (8) are transmitted to said at least one loading unit (6').

8. The extended-nip press of any one of foregoing claims, **characterized in that** the end of the cylinder (12) loading the shoe is made at least partially spherical.

9. The extended-nip press of any one of foregoing claims, **characterized in that** the cylinder (12) of said at least one piston-cylinder unit includes a force-receiving surface (22) adapted to rest against the glide rail (21) so as to transmit the frictional forces imposed on the shoe (8) of the extended-nip press to the roll support beam (4) of the extended-nip press.

10. The extended-nip press of any one of foregoing claims, **characterized in that** in said linear array of loading units (6'), advantageously their cylinders (12) are adapted about each other at least partially.

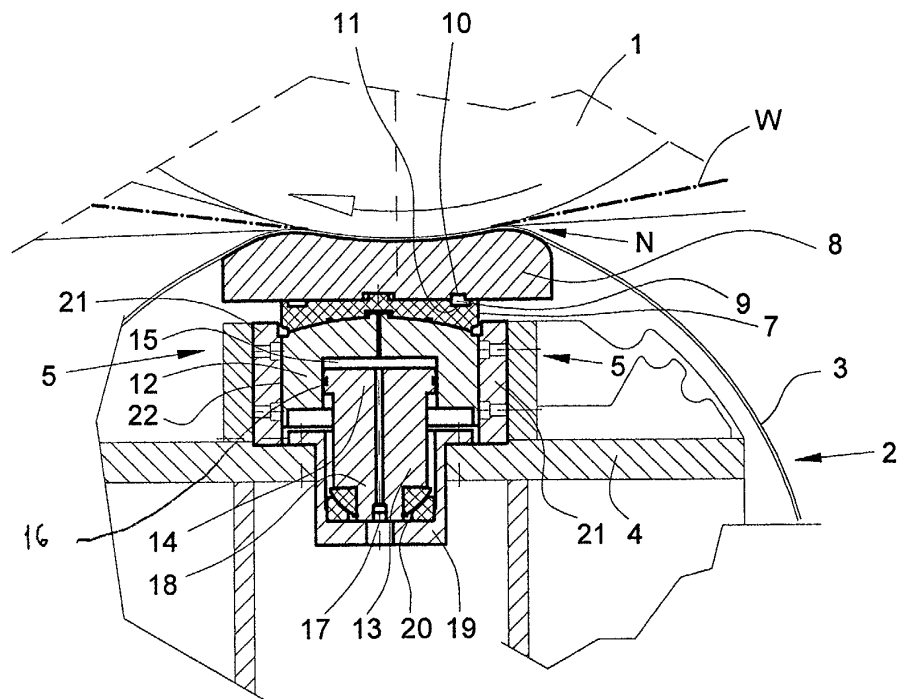


FIG 1

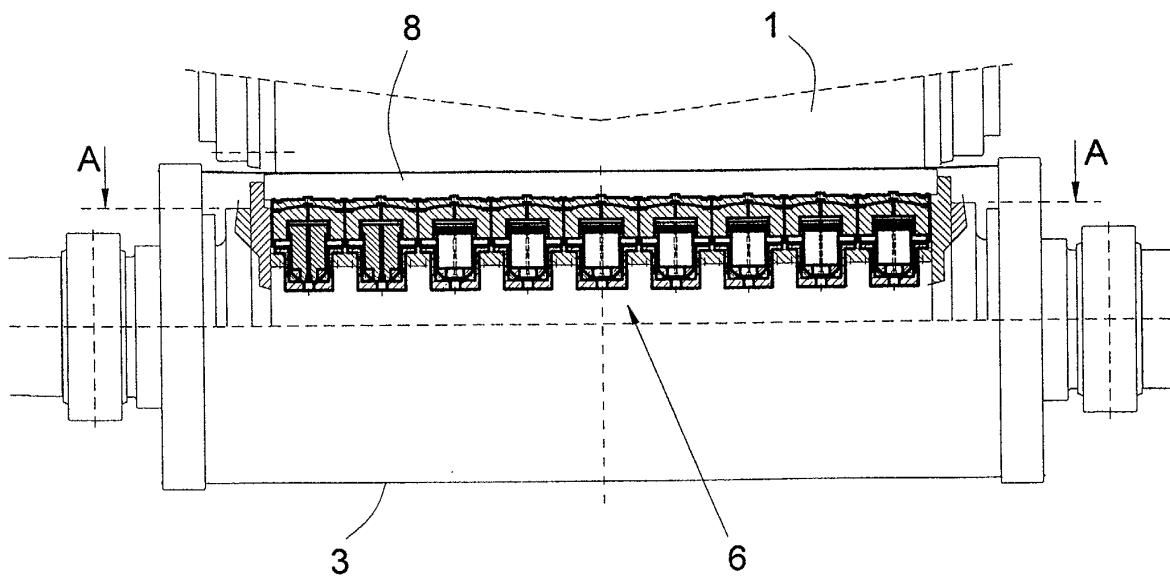
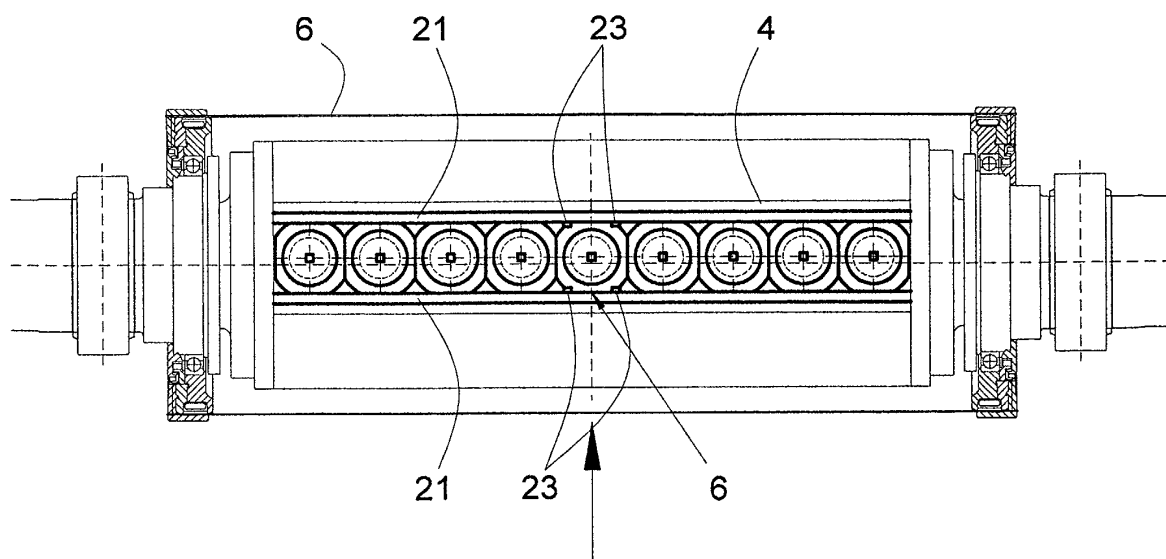


FIG 2



A - A
FIG 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 07 7509

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7) D21F D21G F16C
Place of search MUNICH		Date of completion of the search 24 October 2002	Examiner Maisonnier, C
CATEGORY OF CITED DOCUMENTS 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 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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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