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

(11) EP 1 088 934 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
09.08.2006 Bulletin 2006/32

(51) Int Cl.:
D21F 3/02 *(2006.01)*

(21) Application number: **00121132.5**

(22) Date of filing: **28.09.2000**

(54) **Pressing apparatus with membrane**

Pressenvorrichtung mit einer Membrane

Dispositif de presse avec une membrane

(84) Designated Contracting States:
AT DE FI SE

(30) Priority: **30.09.1999 US 409287**
30.09.1999 US 409794

(43) Date of publication of application:
04.04.2001 Bulletin 2001/14

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Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

1. Field of the invention.

[0001] The present invention relates to an apparatus for processing a continuous web, such as a paper web, of the kind as defined in the preamble of claim 1.

2. **Description of the related art.**

[0002] For many years attempts have been made to use external air pressure to force water out of a paper web. Rather than compress a sheet at a press nip to the point where hydraulic pressure drives water out, as is the case in normal wet pressing, it was reasoned that more water could be removed, and sheet bulk could be maintained, if air pressure could be applied to supplement or replace roller nip generated hydraulic pressures. One such attempt involves providing a multi-roller structure forming a closed chamber, wherein air is circulated from the chamber through the roll surface to convect moisture out of the paper web that is wrapped over the roll.

[0003] Also, it has been recognized that conventional wet pressing methods are very inefficient in that only a small portion of a roller's circumference is used for processing the paper web. To overcome this limitation, some attempts have been made to adapt a solid impermeable band to form an extended nip for pressing the paper web to de-water the paper web. One problem with such an approach, however, is that the impermeable band prevents the flow of a drying fluid, such as air, through the paper web.

[0004] An apparatus of the above-reference kind is disclosed in US-A-4 675 079. With this known apparatus a chamber is defined by four rollers for providing a multi-nip suction press wherein the web is pressed only within roller nips and said web is subjected to suction by at least one hollow roller in its travel area within the chamber. The web can be trapped between two felts in order to obtain a double felted press.

[0005] Accordingly, a need exists for an improved pressing apparatus which provides enhanced de-watering of a continuous web by simultaneously effecting both a predetermined fluid flow through and a mechanical pressing force on a continuous web.

SUMMARY OF THE INTENTION

[0006] The apparatus according to the present invention is characterized in that said apparatus further comprises a semi permeable membrane positioned adjacent said first side of said continuous web to separate said continuous web from direct communication with said chamber, said membrane being structured and adapted to have a permeability greater than zero and less than about 0,14 m^3 per minute per 0,09 m^3 (about 5 cfm per square foot) as measured by FAPPI test method TIP 0404-20 which permeability permits a predetermined fluid flow there through to said continuous web, said membrane being structured and adapted for communicating with said pressurized chamber and said differential pressure source or said at least one void to apply a mechanical pressing force to said continuous web.

[0007] The present invention provides a pressing apparatus which provides enhanced de-watering of a continuous web by simultaneously effecting both a predetermined fluid flow through and a pressing force on a continuous web.

[0008] A first preferred embodiment of the invention comprises a plurality of rollers arranged for cooperative rotation, each of the plurality of rollers having a first circular end, a second circular end and a cylindrical middle surface, said plurality of rollers positioned to define a corresponding plurality of nips, the continuous web being processed through at least two of the plurality of nips, at least a first roller of the plurality of rollers having at least one void formed in the cylindrical middle surface provided as said support surface, first and second sealing panels engaging the first and second circular ends of each of the plurality of rollers, said first and second sealing panels and the plurality of rollers defining said pressurized chamber, and said membrane being, structured and adapted for communicating with the pressurized chamber and the at least one void to apply a mechanical pressing force to the continuous web.

[0009] According to another preferred embodiment of the invention, said continuous web and the membrane enter the chamber at the inlet and exit the outlet.

[0010] According to another preferred embodiment of the invention, first and second sealing panels and the plurality of rollers define a plurality of chambers. At least a first pressure source is fluidly coupled to each of the plurality of chambers to pressurize the plurality of chambers. The at least one semipermeable membrane is structured and adapted to engage a portion of a plurality of inlet roller nips, to engage the cylindrical middle surface of a portion of a plurality of main rollers and to engage a portion of the plurality of outlet roller nips to define a plurality of expanded nips.

[0011] An advantage of the present invention is that the invention simultaneously effects both a predetermined fluid flow through and a mechanical pressing force on a continuous web, such as a paper web, to promote enhanced de-watering of the continuous web.

[0012] Another advantage of the present invention, when multiple chambers are defined, is the ability to simultaneously effect both a predetermined fluid flow through and a mechanical pressing force on a continuous web in a first direction in a first chamber, and simultaneously effect both a predetermined fluid flow through and a mechanical pressing force on a continuous web in a second direction opposite to the first direction in a second chamber to effect de-watering through both major surfaces of the continuous web.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a partially schematic side view of an embodiment of the present invention;
Fig. 2 is perspective side view of the roller configuration of the embodiment of Fig. 1;
Fig. 3 is a partial front view of the roller configuration of the embodiment of Fig. 1;
Fig. 4 is a schematic illustration of a variant of an end sealing panel of the present invention;
Fig. 5 is a schematic illustration of a variant of another end sealing panel of the present invention;
Fig. 6 is an exaggerated side view of a variant of a main roller profile of the invention;
Fig. 7 is a schematic illustration of a variant of the single chamber embodiment of Fig. 1; and
Fig. 8 is a schematic illustration of an embodiment of the invention including two chambers.
Fig. 9 is a schematic illustration of another embodiment of the invention.
Fig. 10 is a schematic illustration of still another embodiment of the invention.

[0014] Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrates preferred embodiments of the invention, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION OF THE INVENTION

[0015] Referring now to the drawings and particularly to Fig. 1, there is shown a press arrangement 10 which is particularly useful in paper making. Press arrangement 10 includes a frame 12, a loading cylinder 14, a press roller assembly 16, a tensioning assembly 18, a membrane 20 and a control unit 21.

[0016] Frame 12 includes a main frame 22, an upper pivot frame 24, a lower pivot frame 26, an upper pivot arm 28 , a lower pivot arm 30 and a pair of side frames 32, 33. Side frame 32 is shown with a portion broken away to expose an interior portion of side frame 33. Pivot frames 24, 26 are fixedly attached, such as by welds or bolts, to main frame 22. Pivot arms 28, 30 are pivotally mounted to pivot frames 24, 26, respectively, by a plurality of pivot pins 34 in a conventional manner. Each of the pivot arms 28, 30 have a first end 36, 38, respectively, adapted to mount opposing ends 40, 42 of loading cylinder 14 via pins 44. Each of the pivot arms 28, 30 has a second end 46, 48, adapted to fixedly mount, such as by welds or bolts, bearing housings 50, 52, respectively. First and second side frames 32, 33 are mounted to opposing sides of main frame 22.

[0017] Pressing roller assembly 16 includes a plurality rollers 60, 62, 64, 66 (four rollers as shown) arranged for cooperative rotation in frame 12. By cooperative rotation, it is meant that a rotational velocity at the circumferential surface of each of the rollers 60, 62, 64, 66 together are substantially equal, with essentially no slippage between the roller surfaces. For convenience, sometimes rollers 60, 62 will be referred to as main rollers and rollers 64, 66 will be referred to as cap rollers.

[0018] As shown in Figs. 2 and 3, generally, each of the rollers 60, 62, 64, 66 are closed hollow cylinders having a first circular end 68, 70, 72, 74, respectively, a second circular end 76, 78, 80, 82, respectively, and a cylindrical middle circumferential surface 84, 86, 88, 90, all being radially symmetrical about an axis of rotation 92, 94, 96, 98, respectively. A set of seals 99 may be attached to first circular ends 68, 70, 72, 74 and second circular ends 76, 78, 80, 82. An axial extent of each of the main rollers 60, 62 and cap rollers 64, 66 together are arranged in parallel. Preferably, a circumference of either of cap rollers 64, 66 is smaller than a circumference of either of main rollers 60, 62. As shown in Fig. 1, the rollers 60, 62, 64, 66 are positioned to define a corresponding number of roller nips 100, 102, 104, 106.

[0019] Cap rollers 64, 66 are used to create a seal along the axial extent of main rollers 60, 62 at roller nips 100, 102, 104, 106. Each of rollers 60, 62, 64, 66 may include an elastic coating, such as rubber, to aid in sealing at the roller nips. Sealing at roller nips 100, 102, 104, 106 requires relatively uniform pressure along all roller nips 100, 102, 104, 106. With the likely deflection of main rollers 60,62, due to the exertion of force thereon by cap rollers 64, 66, some mechanism is needed to aid in providing uniform nip pressure at roller nips 100, 102, 104, 106. Accordingly, cap rollers 64, 66 can use hydraulic pressure and a series of pistons within the roller shell of rollers 64, 66 to press the roller shell of rollers 64, 66 into the roller shell of main rollers 60, 62 to provide uniform pressure at the associated nips. Alternatively, a crowned cap roller could be used.

[0020] As shown in Fig. 3, first and second side frames 32, 33 include first and second sealing panels 108, 110 respectively, mounted to an interior side thereof. First and second sealing panels 108, 110 are forced by side frames 32, 33 to engage a portion of first circular ends 68, 70, 72, 74 and a portion of second circular ends 76, 78, 80, 82 respectively, of rollers 60, 62, 64, 66 of pressing roller assembly 16 to define a chamber 112, and to effect end sealing of chamber 112. Optionally, at least one tension bar 113 is connected between first sealing panel 108 and second sealing panel 110 in chamber 112. In some embodiments, first and second sealing panels 108, 110 are flexible and are structured and adapted to substantially conform to the shape of first circular ends 68, 70, 72, 74 and second circular ends 76, 78, 80, 82 , re-

spectively, of rollers 60, 62, 64, 66. To further aid in the sealing of chamber 112, seals are formed between first and second sealing panels 108, 110 and first and second circular ends 68, 70, 72, 74 and 76, 78, 80, 82, respectively. Such seals can include mechanical seals and fluid seals.

[0021] Main rollers 60, 62 are fixedly rotatably mounted to side frames 32, 33 using conventional bearing mounting assemblies, such as those containing roller bearings or bushings. In this context, fixedly rotatably mounted means that the axes 92, 94 of rollers 60, 62 are not shifted in location with respect to main frame 22 and side frames 32, 33 following installation, but rotation about axes 92, 94 is permitted.

[0022] Preferably, main roller 60, which fluidly communicates with chamber 112 via membrane 20, includes at least one void in the form of a groove, a hole and a pore formed in its middle circumferential surface to facilitate a pressure differential across membrane 20 and any intervening material, such as continuous web 140. Also, it is preferred that main roller 62, which does not fluidly communicate with chamber 112 via membrane 20, not include any such void in its middle circumferential surface. Each of the rollers may include an elastic coating, such as rubber over all or part of their roller surface, to aid in the sealing of chamber 112 at roller nips 100, 102, 104, 106.

[0023] Cap rollers 64, 66 are rotatably mounted to bearing housings 50, 52, respectively. However, the axes of rotation 96, 98 of rollers 64, 66 are moveable with respect to main frame 22 via pivot arms 28, 30, respectively, to effect a loading of press roller assembly 16. Since a circumference, and a corresponding diameter, of either of cap rollers 64, 66 is preferably smaller than a circumference, and a corresponding diameter, of either of main rollers 60, 62, the forces generated on cap rollers 64, 66 are reduced, thus allowing smaller structures to contain the forces within chamber 112.

[0024] For example, cap rollers 64, 66, being relatively smaller, require lower actuating force than would a relatively larger counterpart cap roller. If the diameters of cap rollers 64, 66 are one-third the diameters of main rollers 60, 62, the forces exerted on cap rollers 64, 66 can be reduced by 40 percent compared to the forces on main rollers 60, 62.

[0025] In general, the closer the distance between main rollers 60 and 62, and the greater the difference in diameters between main rollers 60, 62 and cap rollers 64,66, the greater the difference in forces exerted on frame 12 by main rollers 60, 62 and cap rollers 64,66. This arrangement allows the support structure, e.g. frame 12, for press roller assembly 16 to become simpler. For example, with most of the force exerted by the relatively larger main rollers 60,62, main rollers 60,62 are mounted on bearings fixedly attached to side frames 32,33, which in turn are fixedly attached to main frame 22. By structurally tying main rollers 60 and 62 together, and fixing their relative positions, the major forces within the press arrangement 10 are contained within a relatively simple mechanical structure.

[0026] In order to maintain membrane 20 at a proper operating tension, tensioning assembly 18 is mounted to main frame 22. Tensioning assembly 18 includes a tension cylinder 114 and a tension roller 116. Tension roller 116 is rotatably coupled to tension cylinder 114, which moves tension roller 116 in a direction transverse to an axis of rotation of tension roller 116.

[0027] As shown in Fig. 1 in relation to Fig. 2, membrane 20 travels in the direction of arrow 118 and is routed over a portion of circumferential surface 88 of cap roller 64, passes into inlet roller nip 100, passes over a portion of circumferential surface 84 of main roller 60 within chamber 112, passes out of outlet roller nip 102, passes over a portion of circumferential surface 90 of cap roller 66, and passes around about half of the circumferential surface of tension roller 116. Preferably, membrane 20 is a continuous belt made of a semipermeable material structured and adapted to have a predetermined permeability which permits a predetermined fluid flow therethrough. Also, preferably semipermeable membrane 20 is both gas permeable and liquid permeable to a limited degree. Furthermore, membrane 20 is structured and adapted to aid in the sealing of chamber 112 at inlet nip 100 and outlet nip 102. In chamber 112, after being pressurized, the combined effect of inlet nip 100, membrane 20 passing circumferentially around main roller 60, and outlet nip 102 is to effectively form a single expanded nip 115 for applying a mechanical pressing force on main roller 60 and any intervening material placed between membrane 20 and main roller 60. Thus, membrane 20 communicates with pressurized chamber 112 and main roller 60 to simultaneously effect both a predetermined fluid flow through and a mechanical pressing force on the intervening material.

[0028] In preferred embodiments, membrane 20 is made of a rubberized fabric about 2,54 mm (0.1 inches) thick, or less, and is made semipermeable by forming a plurality of holes 117 (see Fig. 6) through the fabric having a size, shape, frequency and/or pattern selected to provide the desired permeability. Preferably, the plurality of holes are formed by a laser. The permeability is selected to be greater than zero and less than about 0,14 m^3 per minute per 0,09 m^2 (about five CFM per square foot) as measured by TAPPI test method TIP 0404-20, and more preferably, is selected to be greater than zero and less than about 0,06 m^3 per minute per 0.09 m^2 (about two CFM per square foot). Thus, semipermeable membrane 20 is both gas permeable and liquid permeable to a limited degree.

[0029] Control unit 21 includes a controller 120, a pneumatic source 122, a fluid source 124, a differential pressure source 125 and a sensor assembly 126.

[0030] Preferably, controller 120 includes a microprocessor and memory for storing and executing a control program, and includes an I/O device for establishing input/output communications and data transfer with exter-

nal devices. Controller 120 can be, for example, an industrial programmable controller of a type which is well known in the art.

[0031] Pneumatic source 122 includes a plurality of individually controllable outputs. Pneumatic source 122 is fluidly coupled to loading cylinder 14 via conduit 128. Pneumatic source 122 is also fluidly coupled to tension cylinder 114 via conduit 130. While the preferred working fluid to operate cylinders 14, 114 is compressed air, those skilled in the art will recognize that the pneumatic system could be converted to another fluid source using another gas, or a liquid working fluid.

[0032] Fluid source 124 is fluidly coupled to chamber 112 via conduit 132. The type of fluid is selectable by the user depending the type of material that press arrangement 10 is processing. For example, in some applications, it may be desirable to use compressed dry air to pressurize chamber 112 to a predefined pressure, which in preferred embodiments of the invention, is a pressure greater than $206{,}84 \cdot 10^3$ Pa (30 p.s.i.) above pressure the differential pressure of differential pressure source 125. In other applications, it may be desirable to use a pressurized gas, such as a heated gas, or a liquid, such as water, or a liquid solution.

[0033] In the embodiment of Fig. 1, fluid flows into chamber 112 via conduit 132 and flows out of chamber 112 via the voids, e.g. grooves, holes or pores, formed in middle circumferential surface 84 of main roller 60. The voids in main roller 60 communicate with differential pressure source 125 via a conduit 133. Differential pressure source 125 can be, for example, a vacuum source, a pressure source operating at a pressure lower than the pressure in chamber 112, or simply a vent to the atmosphere, which is coupled via conduit 133 to the interior of roller 60 to effect evacuation of the voids.

[0034] Alternatively, no venting via conduit 133 may be required if main roller 60 includes grooved voids, and the grooves communicate with atmospheric pressure. Similarly, venting via conduit 133 may be eliminated if the roller voids, such as blind holes, are large enough, and if they enter into the nip at a pressure lower than chamber pressure. In this case, the voids will act like a differential pressure source until the voids reach the chamber pressure. The void size can be selected to control the efficiency of the de-watering process.

[0035] The pressurized chamber 112 includes an inherent pressure relief, in that excessive pressure buildup in chamber 112 will result in one or more of rollers 60, 62, 64, 66 opening to bleed off the pressure, rather than undergoing catastrophic failure.

[0036] Controller 120 is electrically connected to pneumatic source 122 via electrical cable 134 to selectively control the fluid output thereof to independently control the operation of loading cylinder 14 to provide loading to press roller assembly 16 and to independently control the operation of tension cylinder 114 to provide a predetermined tension on semipermeable membrane 20.

[0037] Controller 120 is electrically connected to fluid source 124 via electrical cable 136. Controller 120 is further electrically connected to sensor assembly 126 via electrical cable 138. Sensor assembly 126 includes one or more sensing mechanisms to provide to controller 120 electrical feedback signals representing one or any combination of a pressure, a temperature or other environmental factor within chamber 112. Controller 120 processes the feedback signals to generate output signals which are supplied to fluid source 124 to selectively control the fluid output thereof.

[0038] In operation, controller 120 processes feedback signals received from sensor assembly 126 to control a pressure of pressurized chamber 112, preferably to a pressure greater than $206{,}84 \cdot 10^3$ Pa (30 p.s.i.) above the pressure of differential pressure source 125. Rollers 60, 62, 64, 66 are rotated with little or no slip between them, and membrane 20 is driven at the same velocity as the surface velocity of rollers 60, 62, 64, 66. A continuous web, or paper web, 140 and a web carrying layer 142 are started into inlet roller nip 100 in the direction of arrow 143 and is guided by membrane 20 through expanded nip 115 to outlet roller nip 102. Membrane 20 is positioned within roller assembly 16 to be adjacent a first side 144 of continuous web 140 to effectively separate continuous web 140 from direct communication with pressurized chamber 112. In other words, the fluid in chamber 112 cannot act on continuous web 140 except through membrane 20. Web carrying layer 142 is positioned to contact cylindrical middle surface 84 of main roller 60 and to contact a second side 146 of continuous web 140.

[0039] Membrane 20 is structured and adapted to have a permeability which permits a predetermined fluid flow therethrough to continuous web 140, and communicates with pressurized chamber 112 and at least one void of main roller 60 to generate a pressure difference across membrane 20 and continuous web 140. This pressure drop results in a mechanical pressing force being applied to continuous web 140, which helps to consolidate it. Thus, membrane 20 communicates with pressurized chamber 112 and main roller 60 to simultaneously effect both a predetermined fluid flow through and a mechanical pressing force on continuous web 140, in combination, to promote enhanced de-watering of continuous web 140.

[0040] The invention is particularly advantageous when the dry content of continuous web 140 prior to dewatering is higher than about 6 percent and lower than about 70 percent, and when the basis weight of continuous web 140 is higher than about 25 g/m

[0041] Web carrying layer 142 preferably has a thickness of about 2,54 mm (0.1 inches) or less, and may be a felt, or alternatively, may include a felt positioned adjacent a hydrophobic layer, wherein the hydrophobic layer is positioned adjacent second side 146 of continuous web 140. Preferably, web carrying layer 142 includes a felt layer 142A integral with a hydrophobic layer 142B, wherein hydrophobic layer 142B transports water via

capillary action away from continuous web 140 to be received by felt layer 142A (see Fig. 6). The hydrophobic layer 142B provides an anti-rewetting effect, thereby avoiding water flowing back into continuous web 140.

[0042] The relative amounts of mechanical pressure applied to continuous web 140 is effected by factors such as the chamber pressure in chamber 112, the permeability of semipermeable membrane 20, and the permeability of continuous web 140. The fluid flow, preferably air, through continuous web 140 is effected by factors such as the chamber pressure in chamber 112, the permeability of semipermeable membrane 20, and the size (e.g., length) of chamber 112. The dynamic fluid pressure in pressurized chamber 112 is controlled based upon the monitoring of the chamber pressure by sensor assembly 126. Sensor assembly 126 senses a pressure within chamber 112 and provides a pressure feedback signal to controller 120. Controller 120 processes the pressure feedback signal to generate a pressure output signal which is supplied to fluid source 124 to selectively control the fluid output thereof to control a pressure of pressurized chamber 112 to a predetermined pressure, preferably to a pressure greater than $206{,}84 \cdot 10^3$ Pa (30 p.s.i) above the pressure of differential pressure source 125. If a temperature in relation to pressure within pressurized chamber 112 is of concern, sensor assembly 126 may be adapted to sense a temperature within chamber 112 and provide a temperature feedback signal to controller 120. Controller 120 processes the temperature feedback signal, along with the pressure feedback signal, to generate output signals which are supplied to fluid source 124 to regulate the pressure and temperature in pressurized chamber 112.

[0043] Controller 120 also controls the loading of main rollers 60, 62 by cap rollers 64, 66 by controlling an amount of pressure that loading cylinder 14 applies to upper and lower pivot arms 28, 30. Preferably, the amount loading of main rollers 60, 62 is related to a pressure in pressurized chamber 112, which is monitored by a pressure sensor of sensor assembly 126. The loading may include a bias loading in addition to a loading proportional to the pressure in chamber 112.

[0044] Of course, variations of the embodiment described above are possible. For example, and referring to Fig. 4, to maintain the end sealing of chamber 112, and to prevent wear between sealing panels 108, 110 and rollers 60, 62, 64 and 66, a lubricating and sealing fluid like air or water, or some viscous fluid, can be forced into a plurality of seal ports 148 via a conduit ring 150 coupled to a fluid source 152 via conduit 153. Pressurized fluid source 152 is electrically coupled to controller 120 via electrical cable 155, and is controlled thereby. Seal ports 148 in sealing panels 108, 110 are located to face the ends of the rollers 60, 62, 64, 66 to pass the pressurized lubricating and sealing fluid between sealing panels 108, 110 and portions of the respective circular ends 68, 70, 72, 74 and 76, 78, 80, 82. Thus, due to the injection of the lubricating and sealing fluid, sealing panels 108, 110 float over the circular ends 68, 70, 72, 74 and 76, 78, 80, 82 at small controllable distances, with little or no physical contact between sealing panels 108, 110 and the circular ends 68, 70, 72, 74 and 76, 78, 80, 82 of rollers 60, 62, 64, 66. Although there is leakage around such a seal arrangement, the amount of leakage is controllable to be small by careful selection of distance tolerances and the lubricating and sealing fluid.

[0045] In addition, it is contemplated that main roller 62 also include venting to a differential source, and that continuous web 140, along with membrane 20, is routed to pass through all of the four nips, such as for example, into nip 106, out nip 104, into nip 100 and out nip 102 to increase the dwell time that membrane 20 interacts with continuous web 140.

[0046] Fig. 5 shows another variant of the invention, in which end sealing of chamber 112 is improved by locating fluid ports 154 in sealing panels 108, 110 to be near, but not located to face, the ends of the rollers 60, 62, 64, 66. A conduit ring 156 is coupled to ports 154, and is coupled to fluid source 152 via conduit 158, to supply a lubricating and sealing fluid, such as air or water, or some other viscous fluid, into chamber 112 through ports 154. Fluid source 152 is electrically coupled to controller 120 via electrical cable 155, and is controlled thereby. Pressure in chamber 112 forces the added fluid between circular ends 68, 70, 72, 74 and 76, 78, 80, 82 of rollers 60, 62, 64, 66 and sealing panels 108, 110, respectively, allowing sealing panels 108, 110 to float over the circular ends. In this embodiment, leakage is controlled by controlling the spacing between circular ends 68, 70, 72, 74 and 76, 78, 80, 82 of rollers 60, 62, 64, 66 and sealing panels 108, 110, respectively, so that excessive leakage doesn't occur in one area, and so as to prevent excessive wear between the sealing panels 108, 110 and rollers 60, 62, 64, 66.

[0047] Fig. 6 shows another variant of the invention, in which a main roller 160 having the profile shown would replace main roller 60. Main roller 160 includes a first circular end 162, a second circular end 164, a first cylindrical end surface 166 and a second cylindrical end surface 168, a first inclined annular surface 170, a second inclined annular surface 172 and a cylindrical middle surface 174. First cylindrical end surface 166 is located adjacent first circular end 162 and second cylindrical end surface 168 is located adjacent second circular end 164. Cylindrical middle surface 174 has a circumference smaller than a circumference of first and second cylindrical end surfaces 166, 168. First inclined annular surface 170 provides a transition from cylindrical middle surface 174 to first cylindrical end surface 166, and second inclined annular surface 172 provides a transition from cylindrical middle surface 174 to second cylindrical end surface 168.

[0048] A width of cylindrical middle surface 174 is selected to be approximately equal to a width of membrane 20. First and second inclined annular surfaces 170, 172 define a guide path for membrane 20, continuous web

140 and web carrying layer 142. Preferably, each of membrane 20, and web carrying layer 142 includes a pair of tapered outer edges which contact the first and second inclined annular surfaces 170, 172. Most preferably, permeable membrane 20 includes a pair of tapered impermeable longitudinal outer edges 20A, 20B formed adjacent a semipermeable portion 20C to enhance sealing along inclined annular surfaces 170, 172. Also, preferably, web carrying layer 142 includes felt layer 142A and hydrophobic layer 142B. Optionally, web carrying layer 142 may include a pair of impermeable longitudinal outer edges which contact first and second inclined annular surfaces 170, 172.

[0049] Fig. 7 schematically illustrates another variant of the invention, in which a press arrangement 200 includes a roller assembly 201 including a plurality of rollers 202, 204, 206, 208 arranged in a square pattern for cooperative rotation in processing a first continuous web 209, such as a paper web, riding on a web carrying layer 210 and a second continuous web 212, such as a paper web, riding on a web carrying layer 214. Web carrying layers 210, 214 may be, for example, felt layers.

[0050] Each of the rollers 202, 204 are of the type previously described above as main roller 60, and each of the rollers 206, 208 are of the type described above as cap rollers 64, 66, and thus, will not be described again in detail. Also, it is to be understood that sealing panels of the same general type as described above with respect to sealing panels 108 and 110 would be utilized in the manner described above with respect to Figs. 4 and 5 to define a chamber 216. Control and pressure source connections to chamber 216, and associated operation, are as described above with respect to Figs. 1-4, and thus will not be repeated here.

[0051] For purposes of this discussion, rollers 202 and 204 will be referred to as main rollers, and rollers 206, 208 will be referred to as cap rollers, although in the present embodiment, rollers 202, 204, 206, 208 are of approximately the same size. Main rollers 202, 204 and cap rollers 206, 208 are positioned to define a plurality roller nips 220, 222, 224, 226 of which based upon a rotation of main roller 202 in the direction depicted by arrow 230, roller nips 220, 224 constitute inlet roller nips of press arrangement 200, and roller nips 222, 226 constitute outlet roller nips.

[0052] First continuous web 209 and first web carrying layer 210 enter input nip 220 and are processed through chamber 216 around the circumference of main roller 202. Second continuous web 212 and second web carrying layer 214 enter inlet nip 224 and are processed through chamber 216 around the circumferential surface of main roller 204. First web carrying layer 210, continuous web 209, continuous web 212 and second web carrying layer 214 are processed through outlet nip 222 to form a laminated web 228 made up of continuous webs 209, 212. During processing, second continuous web 212 remains in contact with first continuous web 209 due to surface tension, or due to venting in main roller 202 by holes, grooves or pores formed in the cylindrical surface of main roller 202. It is contemplated that second continuous web 212 and second web carrying layer 214 could be replaced by a coating layer which would be applied to continuous web 209.

[0053] Fig. 8 is a schematic illustration of another embodiment of the invention in which a press arrangement 300 includes a roller assembly 301 including a plurality of rollers 302, 304, 306, 308, 310 and 312 arranged for cooperative rotation in processing a continuous web 314, such as a paper web. Each of the rollers 302 ,304 are of the type previously described as main roller 60 and/or 160, and are fluidly coupled to a differential pressure source in a manner as described above. Rollers 306, 308, 310, 312 are of the type described above with respect to non-vented main and cap rollers, such as main roller 62 and cap roller 64, and thus, will not be described again in detail. Also, sealing panel 316 is of the same general type as described above with respect to sealing panels 108 and 110, and can be utilized in the manner described above with respect to Figs. 4 and 5.

[0054] For purposes of this discussion, rollers 302 and 304 will be referred to as main rollers, and rollers 306, 308, 310 and 312 will be referred to as cap rollers based upon their respective primary function within a given chamber with respect to continuous web 314. In the present embodiment, rollers 302, 304, 306, 308, 310 and 312 are of approximately the same size. Main rollers 302, 304 and cap rollers 306, 308, 310, 312 are positioned to define a plurality of roller nips 320, 322, 324, 326, 328, 330, 332, of which based upon a rotation of main roller 302 in the direction depicted by arrow 334, roller nips 320, 326, 330 constitute inlet roller nips of press arrangement 300, roller nips 322, 328, 332 constitute outlet roller nips, and roller nip 324 is a chamber dividing nip. The orientation and/or size of rollers 302, 304, 306, 308, 310 and 312 may be modified to locate the roller nips at the desired locations and to optimize the efficiency of processing.

[0055] Sealing panels 316, together with rollers 302, 304, 306, 308, 310 and 312 define a first chamber 336 and a second chamber 338, wherein each chamber has associated therewith at least one inlet nip and at least one outlet nip.

[0056] A first pressure source 340 is fluidly coupled to chamber 336 via conduit 342, and a second pressure source 344 is fluidly coupled to chamber 338 via conduit 346. Conduits 342 and 346 extend from sealing panel 316 into chambers 336 and 338, respectively, to distribute a fluid flow therein. Controller 120 is electrically coupled to pressure source 340 via an electrical cable 348 and is electrically coupled to pressure source 344 via an electrical cable 350. A sensor assembly 352 is electrically connected to controller 120 via electrical cable 354. Sensor assembly 352 is adapted to monitor the pressure and temperature of each of chambers 336, 338.

[0057] Press arrangement 300 further includes a first semipermeable membrane 360 and a second semiper-

meable membrane 362. Membranes 360, 362 interact with the circumferential surfaces of main rollers 302, 304 to define a first expanded nip 364 and a second expanded nip 366. Expanded nip 364 is located in first chamber 336 and expanded nip 366 is located in second chamber 338.

[0058] Continuous web 314 includes a first side 370 and a second side 372. While in chamber 336, a fluid flows through continuous web 314 in a first direction from first side 370 to second side 372 at expanded nip 364. While in chamber 338, a fluid flows through continuous web 314 in a second direction, opposite from the first direction, from second side 372 to first side 370 at expanded nip 364. First membrane 360 communicates with first chamber 336 and main roller 302 to apply a mechanical pressing force to continuous web 314 in the first direction, i.e., from first side 370 to second side 372. Second membrane 362 communicates with second chamber 338 and main roller 304 to apply a mechanical pressing force to continuous web 314 in the second direction, i.e. from second side 372 to first side 370. Thus, membranes 360, 362 communicate with pressurized chambers 336, 338, respectively, and main rollers 302, 304, respectively, to simultaneously effect both a predetermined fluid flow and a mechanical pressing force on continuous web 314, in combination, in two directions, to promote enhanced de-watering of continuous web 314. In the present embodiment, main rollers 302, 304 each include at least one void, such as a hole, groove or pore, to effect a pressure differential across continuous web 314.

[0059] Preferably, each of first semipermeable membrane 360 and second semipermeable membrane 362 is made of a rubberized fabric about 2,54 mm (0.1 inches) thick, or less, and is made semipermeable by forming a plurality of holes through the fabric having a size, shape, frequency and/or pattern selected to provide the desired permeability. Preferably, the plurality of holes are formed by a laser. The permeability of each of first semipermeable membrane 360 and second semipermeable membrane 362 is selected to be greater than zero and less than about 0,14 m^3 per minute per 0,09 m^2 (about five CFM per square foot) as measured by TAPPI test method TIP 0404-20, and more preferably, to be greater than zero and less than about 0,06 m^3 per minute per 0,09 m^2 (about two CFM per square foot).

[0060] In preferred embodiments, press arrangement 300 further includes a first web support layer 361 and a second web support layer 363 positioned, respectively, on opposing sides of continuous web 314. As shown in Fig. 8, first web support layer 361 is positioned between membrane 362 and rollers 302 and 312, and second web support layer 363 is positioned between membrane 360 and rollers 306 and 304. Alternatively, first web support layer 361 can be positioned to lie between continuous web 314 and membrane 362 and second web support layer 363 can be positioned to lie between continuous web 314 and membrane 360. Preferably, each of web support layers 361, 363 is an integral fabric having a felt layer and a hydrophobic layer with a total thickness of about 2,54 mm (0.1 inches) or less, and is oriented such that the hydrophobic layer faces continuous web 314.

[0061] As shown in Fig. 8, expanded nips 364 and 366 are substantially the same length. However, the nip lengths may be of different lengths, which can be effected, for example, by selecting main rollers with differing circumferences, and/or by changing the circumferential size of any one or more of the cap rollers, to effectively change the location of one or more of the roller nips 320, 324 and 328.

[0062] The internal pressure of each of first chamber 336 and second chamber 338 are individually controlled by controller 120, and may be pressurized to different pressures. Preferably, chamber 338 is pressurized to a greater pressure than the pressure of chamber 336. Also, in some instances it may be desirable to charge chamber 336 with a first material and charge chamber 338 with a second material different than the first material. Such materials may include dry air, steam, other gas, water, or other fluid.

[0063] In addition to controlling the pressures in chambers 336, in some instances it is desirable to control the temperatures of chambers 336, 338 to the same, or possibly different, temperatures. Fig. 8 further shows a temperature regulation unit 374 fluidly coupled via conduits 376, 378 to chambers 336, 338, respectively, to supply a heating or cooling fluid, such as air, to chambers 336, 338. Temperature regulation unit 374 is electrically coupled to controller 120 via electrical cable 380. Controller 120 receives temperature signals representing the temperatures of chambers 336, 338 from sensor assembly 352. Controller 120 then uses these temperatures to generate temperature output signals based upon predefined target temperatures, which are supplied to temperature regulation unit 374. Temperature regulation unit 374 then responds to the temperature output signals to regulate the temperatures of chambers 336, 338. Preferably, the temperature of chamber 338 is controlled to be greater than the temperature of chamber 336.

[0064] Alternatively, the temperature regulation of chambers 336, 338 can be effected by regulating the temperature of the fluids supplied by first pressure source 340 and/or second fluid source 344 to chambers 336, 338, respectively. In such a case, temperature regulation unit 374 can be eliminated.

[0065] Referring now to Fig. 9, there is schematically shown a press arrangement 450 including a pressing assembly 452 defining a chamber 454. Chamber 454 includes an inlet 456 and an outlet 458 which guide semipermeable membrane 20, continuous web 140 and web carrying layer 142 into and out of chamber 454.

[0066] Pressing assembly 452 includes a U-shaped housing 460 and roller 160 which is arranged to engage U-shaped housing 460 to partially define pressurized chamber 454, and to define inlet 456 and outlet 458. Roller 160, as more fully described above, includes cylindrical middle surface 174 which is in fluid communication

with a differential pressure source via conduit 133. Membrane 20, continuous web 140 and web support layer 142 are processed through inlet 456 and outlet 458 of chamber 454, with continuous web 140 being positioned between membrane 20 and web support layer 142.

[0067] A pressure source is fluidly coupled to chamber 454 via conduit 132 to pressurize chamber 454 with a fluid, such as a gas or a liquid, which may be heated above ambient temperature. The differential pressure source is coupled via fluid conduit 133 to chamber 454 to effect a flow of fluid through chamber 454 to semipermeable membrane 20. Membrane 20 is positioned adjacent first side 144 of continuous web 140. As more fully set forth above, membrane 20 is structured and adapted to have a permeability which permits a predetermined flow of the fluid therethrough to continuous web 140, and is structured and adapted for communicating with pressurized chamber 454 and the differential pressure source to apply a mechanical pressing force to continuous web 140.

[0068] While in pressurized chamber 454, cylindrical middle surface 174 of roller 160 directly supports web support layer 142, which in turn is in contact with second side 146 of continuous web 140. Semipermeable membrane 20 is positioned to be in direct communication with pressurized chamber 454. Cylindrical middle surface 174 includes at least one void in communication with the differential pressure source via conduit 133. Thus, a pressure differential acts on semipermeable membrane 20 and cylindrical middle surface 174 to effect a mechanical pressing force to continuous web 140, and simultaneously, a predetermined flow of fluid flows through semipermeable membrane 20 to, and through, continuous web 140.

[0069] Alternatively, no venting via conduit 133 may be required if main roller 160 includes grooved voids, and the grooves communicate with atmospheric pressure. Similarly, venting via conduit 133 may be eliminated if the roller voids, such as blind holes, are large enough, and if they enter into the nip at a pressure lower than chamber pressure. In this case, the voids will act like a differential pressure source until the voids reach the chamber pressure. The void size can be selected to control the efficiency of the de-watering process.

[0070] Fig. 10 shows a schematic illustration of a varient of the embodiment of Fig. 9. Shown is a press arrangement 470 including a pressing assembly 472 defining a chamber 474. Chamber 474 includes an inlet 476 and an outlet 478 which guide semipermeable membrane 20, continuous web 140 and web carrying layer 142 into and out of chamber 474.

[0071] Pressing assembly 472 includes U-shaped housing 460 and a support shoe 480 which is arranged to engage U-shaped housing 460 to partially define pressurized chamber 474, and to define inlet 476 and outlet 478. Support shoe 480 includes a support surface 482, and one or more passages 484 (depicted by dashed lines) which extend from support surface 482 to differential pressure conduit 133. Support surface 482 may be made up of a plurality of spaced apart support plates, or vertically arranged support blades, with passages 484 being formed between adjacent support plates, or support blades, respectively. Alternatively, support shoe 480 may be a unitary plate member having at least one void, and preferably a plurality of voids, such as pores, through holes, grooves, slots, etc., which are in fluid communication with the differential pressure source via conduit 133, or directly with the atmosphere.

[0072] A pressure source is fluidly coupled to chamber 474 via conduit 132 to pressurize chamber 474 with a fluid, such as a gas, a liquid or solution, which may be heated above ambient temperature. The differential pressure source is coupled via fluid conduit 133 to chamber 474 to effect a flow of fluid through chamber 474 to semipermeable membrane 20. Membrane 20 is positioned adjacent first side 144 of continuous web 140. As more fully set forth above, membrane 20 is structured and adapted to have a permeability which permits a predetermined flow of the fluid therethrough to continuous web 140, and is structured and adapted for communicating with the pressurized chamber 474 and the differential pressure source to apply a mechanical pressing force to continuous web 140.

[0073] Membrane 20, continuous web 140 and web support layer 142 are processed through inlet 476 and outlet 478 of chamber 474, with continuous web 140 being positioned between membrane 20 and web support layer 142. While in pressurized chamber 474, support surface 482 directly supports web support layer 142, which in turn is in contact with second side 146 of continuous web 140. Semipermeable membrane 20 is positioned to be in direct communication with pressurized chamber 474. As stated above, support surface 482 includes at least one void/passage which is in communication with the differential pressure source via conduit 133. Thus, a pressure differential is created between chamber 474 and support surface 482 to effect a mechanical pressing force to continuous web 140 via semipermeable membrane 20, and simultaneously, a predetermined flow of the fluid is provided through semipermeable membrane 20 to, and through, continuous web 140.

[0074] Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

Claims

1. An apparatus (10; 300; 450; 470) for processing a continuous web (140; 314) having a first side and a second side (144; 370) and a second side (146; 372), comprising:

a chamber (112; 336; 338; 454; 474) having at least one inlet (100; 320; 456; 476) and at least one outlet (102; 328; 458; 478), with said continuous web entering said chamber at said inlet and exiting said chamber at said outlet; a support surface (84; 174; 482) partly defining said chamber and extending from said inlet to said outlet for supporting said continuous web within said chamber; a first pressure source (124; 340; 344) fluidly coupled to said chamber to pressurize said chamber; said support surface being in fluid communication with a
differential pressure source (125) or at least one void formed in said support surface;
characterized in that
said apparatus further comprises a semi permeable membrane (20; 360) positioned adjacent said first side (144; 370) of said continuous web (140; 212; 314) to separate said continuous web from direct communication with said chamber (112; 336; 338; 454; 474); said membrane being structured and adapted to have a permeability greater than zero and less than about 0,14m^3 per minute per 0,09m^3 (about five CFM per square foot) as measured by TAPPI test method TIP 0404-20 which permeability permits a predetermined fluid flow there through to said continuous web, said membrane being structured and adapted for communicating with said pressurized chamber and said differential pressure source or said at least one void to apply a mechanical pressing force to said continuous web.

2. The apparatus of claim 1 further comprising:

a plurality of rollers (60-66; 160; 302-312) arranged for cooperative rotation, each of said plurality of rollers having a first circular end (68 - 74), a second circular end (76 - 82) and a cylindrical middle surface (174), said plurality of rollers positioned to define a corresponding plurality of nips, said continuous web being processed through at least two of said plurality of nips, and at least a first roller (60; 302) of said plurality of rollers having at least one void formed in said cylindrical middle surface, provided as said support surface; first and second sealing panels (108, 110) for engaging the first and second circular ends of each of said plurality of rollers, said first and second sealing panels and said plurality of rollers defining said pressurized chamber (112; 336); and
said membrane (20; 360) being structured and adapted for communicating with said pressurized chamber and said at least one void to apply a mechanical pressing force to said continuous web.

3. The apparatus of claim 2,
wherein said plurality of nips include an inlet nip forming said inlet (100; 320) and an outlet nip forming said outlet (102, 328), and wherein said membrane (20; 360) is structured and adapted to aid in sealing said chamber (112; 336) at said inlet nip and said outlet nip, and wherein said inlet nip, said membrane passing circumferentially around said first roller (60; 302), and said outlet nip combine to effectively form a single expanded nip (115; 364) for applying said mechanical pressing force to said continuous web.

4. The apparatus of claim 2,
wherein said at least one void comprises at least one of a groove, a hole and a pore.

5. The apparatus of claim 4,
wherein said differential pressure source (125) is fluidly coupled to said void to evacuate said void.

6. The apparatus of claim 2,
wherein said membrane (20; 360) has a thickness of 2,54 mm (0.1 inches) or less.

7. The apparatus of claim 1,
wherein said permeability is determined by at least one of a size, a shape, a frequency and a pattern of a plurality of holes in said membrane (20; 360).

8. The apparatus of claim 7,
wherein said holes are laser-formed holes.

9. The apparatus of claim 2,
further comprising a web support layer (142; 361) positioned to contact said cylindrical middle surface (174) of said first roller (60; 302) and to contact said second side (146; 372) of said continuous web (140; 314).

10. The apparatus of claim 9,
wherein at lease one of said plurality of rollers (60-66; 160; 302-312) further includes first and second cylindrical end surfaces (166, 168) adjacent the first and second circular ends (68-82), respectively, said cylindrical middle surface (174) having a circumference smaller than a circumference of said first and second cylindrical end surfaces, said cylindrical middle surface receiving a width of said web support layer (142; 361), said continuous web (140; 314) and said membrane (20; 360).

11. The apparatus of claim 9,
wherein said web support layer (142; 361) comprises a felt layer having a thickness of 2,54 mm (0.1 inches) or less.

12. The apparatus of claim 9,
wherein said web support layer (142; 361) comprises

a hydrophobic layer positioned adjacent a felt layer, and further positioned adjacent said second side (146; 372) of said continuous web (140; 314).

13. The apparatus of claim 9, wherein said web support layer (142; 361) comprises a felt layer integral with a hydrophobic layer.

14. The apparatus of claim 2, wherein at least one of said plurality of rollers (60-66; 160; 302-312) further includes first and second cylindrical end surfaces (166, 168) adjacent the first and second circular ends (68-82), respectively, said cylindrical middle surface (174) having a circumference smaller than a circumference of said first and second cylindrical end surfaces, said cylindrical middle surface receiving a width of said membrane (20; 360).

15. The apparatus of claim 14, wherein said at least two of said plurality of rollers (60-66; 160; 302-312) are cap rollers and at least two of said plurality of rollers are main rollers, wherein a diameter of said main rollers exceeds a diameter of said cap rollers.

16. The apparatus of claim 14, wherein said at least one of said plurality of rollers (60-66; 160; 302-312) further comprises a first inclined annular surface (170) which provides a transition from said cylindrical middle surfaces (174) to said first cylindrical end surface (166), and a second inclined annular surface (172) which provides a transition from said cylindrical middle surface (174) to said second cylindrical end surface (168), the first and second inclined annular surfaces defining a guide path for said continuous web (140; 314) and said membrane (20; 360),

17. The apparatus of claim 16, wherein said membrane (20; 360) includes a pair of tapered longitudinal outer edges (20A, 20B) which contact the first and second inclined annular surfaces (170, 172).

18. The apparatus of claim 16, further comprising a web support layer (142; 361) interposed between said continuous web (140; 314) and said at least one of said plurality of rollers (60-66; 160; 302-312), wherein said web support layer includes a pair of tapered outer edges (142A, 142B) which contact the first and second inclined annular surfaces (170, 172).

19. The apparatus of claim 2, wherein said plurality of rollers (60-66) comprises a first main roller (60), a second main roller (62), a first cap roller (64) and a second cap roller (66), wherein a first diameter of said first main roller (60) and a second diameter of said second main roller (62) is larger than a third diameter of said first cap roller (64) and a fourth diameter of said second cap roller (66).

20. The apparatus of claim 19, further comprising a frame (12), wherein said first and second main rollers (60, 62) are fixedly rotatably attached to said frame (12) and positioned opposite one another in a non-contacting relationship, and wherein said first and second cap rollers (64, 66) are movably rotatably mounted to said frame (12), said first cap roller (64) contacting said first and second main rollers (60, 62) to define a first inlet nip (100) and a first outlet nip (104), and said second cap roller (66) contacting said first and second main rollers (60, 62) to define a second inlet nip (106) and a second outlet nip (102).

21. The apparatus of claim 19, wherein an axial extent of each of said first and second main rollers (60, 62) and said first and second cap rollers (64, 66) together are arranged in parallel, and wherein at least one of said first and second cap rollers (64, 66) is movable to adjust a loading of at least one of said first main roller (60), and said second main roller (62).

22. The apparatus of claim 21, wherein an amount of said loading of said first and second main rollers (60, 62) is related to a pressure in said chamber (112).

23. The apparatus of claim 21, wherein said loading includes a bias loading and an additional loading proportional to a pressure in said chamber (112).

24. The apparatus of claim 2, wherein said plurality of rollers (302-312) together with said first and second sealing panels (108, 110), define a first chamber (336) and a second chamber (338).

25. The apparatus of claim 24, wherein said first chamber (336) is fluidly coupled to said first pressure source (340) and said second chamber (338) is fluidly coupled to a second pressure source (344), and wherein said first chamber (336) is pressurized to a first pressure and said second chamber (338) is pressurized to a second pressure different than said first pressure.

26. The apparatus of claim 25, wherein said continuous web (314) travels through said first chamber (336) and said second chamber (338) in a direction from said first chamber (336) to said second chamber (338), and wherein said second pressure is greater

than said first pressure.

27. The apparatus of claim 24,
further comprising a temperature control device (374) coupled to said first chamber (336) and said second chamber (338), and wherein said first chamber (336) is controlled to a first temperature and said second chamber (338) is controlled to a second temperature different than said first temperature.

28. The apparatus of claim 27,
wherein said continuous web (314) travels through said first chamber (326) and said second chamber (328) in a direction from said first chamber (326) to said second chamber (328), and wherein said second temperature is greater than said first temperature.

29. The apparatus of claim 24,
wherein said first chamber (326) is charged with a first material and said second chamber (328) is charged with a second material different from said first material.

30. The apparatus of claim 2,
further comprising a conduit (158) which extends from at least one of said first and second sealing panels (108, 110) into said chamber (112) to distribute said fluid flow.

31. The apparatus of claim 2,
wherein said plurality of rollers (60-66) include a first main roller (60), a second main roller (62), a first cap roller (64) and a second cap roller (66) which are arranged to form four nips (100-106), and wherein said first main roller (60) does not contact said second main roller (62), and wherein said continuous web (140) is routed to pass through all of said four nips (100-106).

32. The apparatus of claim 2,
wherein said first and second sealing panels (108, 110) are flexible and conform to the shape of said first and second cylindrical ends (166, 188), respectively, of said plurality of rollers (60-66; 160; 302-312).

33. The apparatus of claim 2,
further comprising a first seal (99; 148, 150) positioned between said first circular end (68-74) of each of said plurality of rollers (60-64) and said first sealing panel (108), and a second seal (99; 148, 150) positioned between said second circular end (76-82) of each of said plurality of rollers and said second sealing panel (110).

34. The apparatus of claim 33,
wherein each of the first and second seals form mechanical seals (99).

35. The apparatus of claim 33,
wherein each of the first and second seals form fluid seals (148, 150).

36. The apparatus of claim 33,
wherein each of said first and second seals (148, 150) include pressurized cavities.

37. The apparatus of claim 33,
wherein said first seal (99; 148, 150) is mounted on the first circular end (68-74) of each of said plurality of rollers (60-64) and wherein said second seal (99; 148, 150) is mounted on the second circular end (76-82) of each of said plurality of rollers (60-64).

38. The apparatus of claim 2,
further comprising at least one tension bar (113) having a first end and a second end, said first end being connected to said first sealing panel (108) and said second end being connected to said second sealing panel (110).

39. The apparatus of claim 2, further comprising a temperature control device (120, 126; 374) coupled to said chamber (112; 336, 338) for controlling chamber temperature.

40. The apparatus of claim 2,
wherein said chamber (112; 336, 338) is pressurized to a level greater than $206{,}84 \cdot 10^3$ Pa (30 psi).

41. The apparatus of claim 1, further comprising:

said continuous web (140; 370) and said membrane (20; 360) entering said chamber (112; 336,338; 454; 474) at said inlet (100; 320; 456; 476) and exiting said chamber at said outlet (102; 328; 458; 478).

42. The apparatus of claim 41,
further comprising
said chamber (454; 474) being partly defined by a U-shaped housing (460) fluidly coupled to said first pressure source (124);
a support structure (160; 480) including said support surface (174; 482) in fluid communication with said differential pressure source which support structure is arranged to engaged said U-shaped housing (460) to partially define said chamber, and to define said inlet (456; 476) and said outlet (458; 478), said membrane (20) and said continuous web (140) being processed through said inlet (456; 476) and said outlet (458; 478), with said support surface (174; 482) of said support structure (160; 480) supporting said second side (146) of said continuous web (140).

43. The apparatus of claim 42,
wherein said support structure comprises a roller (160), and said support surface (174) including at least one void.

44. The apparatus of claim 42,
wherein said support structure comprises a supporting shoe (480).

45. The apparatus of claim 44, wherein said supporting shoe (480) comprises one of a plurality of support blades and a plurality of support plates.

46. The apparatus of claim 44,
wherein said support shoe (480) is a unitary structure.

47. The apparatus of claim 42,
further comprising a support layer interposed between said support surface (482) of said support structure (480) and said second side of said continuous web (140).

48. The apparatus of claim 41,
wherein said fluid is air.

49. The apparatus of claim 2 further comprising:

said plurality of rollers (302-312) including a plurality of main rollers (302, 304) and a plurality of cap rollers (306-312) positioned to define a plurality of inlet roller nips (320, 330) and a plurality of outlet roller nips (322, 328), and a portion of said plurality of rollers (302-312) having at least one void formed in said cylindrical middle surface (174);
said first and second sealing panels (108, 110) and said plurality of rollers (302-312) defining a plurality of chambers (336, 338);
at least a first pressure source (340, 344) fluidly coupled to each of said plurality of chambers (336, 338) to pressurize said plurality of chambers (336, 338); and
said at least one semi permeable (360) membrane structured and adapted to engage a portion of said plurality of inlet roller nips (320), to hydraulically communicate with said cylindrical middle surface (174) of a portion of said plurality of main rollers (302, 304) and to engage a portion of said plurality of outlet roller nips (328) to define a plurality of expanded nips (364, 366).

50. The apparatus of claim 49,
wherein a first expanded nip (364) of said plurality of expanded nips (364, 366) is located in a first chamber (336) of said plurality of chambers (336, 338) and a second expanded nip (366) of said plurality of expanded nips (364, 366) is located in a second chamber (338) of said plurality of chambers (336, 338).

51. The apparatus of claim 49,
wherein said plurality of expanded nips (364, 366) include at least two expanded nips which differ in length.

52. The apparatus of claim 49,
wherein said plurality of chambers (336, 338) include a first chamber (336) and a second chamber (338), and wherein said first chamber (336) is pressurized to a first pressure and said second chamber (338) is pressurized to a second pressure different than said first pressure.

53. The apparatus of claim 52,
wherein said at least one membrane (360) travels through said first chamber (336) and said second chamber (338) in a direction from said first chamber (336) to said second chamber (338), and wherein said second pressure is greater than said first pressure.

54. The apparatus of claim 49,
wherein said plurality of chambers (336, 338) include a first chamber (336) and a second chamber (338), and further comprising a temperature regulator (374) coupled to said first chamber (336) and said second chamber (338), and wherein said first chamber (336) is controlled to a first temperature and said second chamber (338) is controlled to a second temperature different than said first temperature.

55. The apparatus of claim 54,
wherein said at least one membrane (360) travels through said first chamber (336) and said second chamber (338) in a direction from said first chamber (336) to said second chamber (338), and wherein said second temperature is greater than said first temperature.

56. The apparatus of claim 49,
wherein said plurality of chambers (336, 338) include a first chamber (336) and a second chamber (338), and wherein said first chamber (336) is charged with a first material and said second chamber (338) is charged with a second material different from said first material.

57. The apparatus of claim 49,
wherein said plurality of main rollers (302, 304) includes a first main roller (302) defining a portion of a first chamber (336) and a second main roller (304) defining a portion of a second chamber (338), each of said first main roller (302) and said second main roller (304) having at least one void formed in said cylindrical middle surface (174), and wherein said at

least one semi permeable membrane includes a first membrane (360) and a second membrane (362), and said plurality of expanded nips (364, 366), including a first expanded nip (364) located in said first chamber (336) and a second expanded nip (366) located in said second chamber (338), wherein a fluid flows through said continuous web (314) in a first direction at said first expanded nip (364) and wherein said fluid flows through said continuous web (314) in a second direction opposite from said first direction at said second expanded nip (366), said first membrane (360) communicating with said first chamber (336) and said first roller (302) to apply a mechanical pressing force to said continuous web (314) in said first direction and said second membrane (362) communicating with said second chamber (366) and said second main roller (304) to apply a mechanical pressing force to said continuous web (314) in said second direction.

58. The apparatus of claim 57, wherein said continuous web (314) is positioned between said first membrane (360) and said second membrane (362) to be received in said first expanded nip (364) and said second expanded nip (366).

59. The apparatus of claim 58, further comprising a first web support layer (361) and a second web support layer (363), said first web support layer (361) being positioned between said continuous web (314) and said first main roller (302) and said second web support layer (363) being positioned between said continuous web (314) and said second main roller (304).

60. The apparatus of claim 59, wherein said first expanded nip (364) is associated with a first chamber (336) of said plurality of chambers (336, 338) and said second expanded nip (366) is associated with a second chamber (338) of said plurality of chambers (336, 338).

61. The apparatus of claim 49, wherein said at least one void comprises at least one of a groove, a hole and pore.

62. The apparatus of claim 49, wherein said plurality of rollers (302-312) comprises six rollers.

Patentansprüche

1. Vorrichtung (10; 300; 450; 470) zur Behandlung einer Endlosbahn (140; 314) mit einer ersten Seite (144; 370) und einer zweiten Seite (146; 372), die Folgendes umfasst:

eine Kammer (112; 336; 338; 454; 474) mit mindestens einem Einlass (100; 320; 456; 476) und mindestens einem Auslass (102; 328; 458; 478), wobei die Endlosbahn am Einlass in die Kammer eintritt und am Auslass aus ihr austritt; eine Stützfläche (84; 174; 482), die die Kammer teilweise definiert und sich von dem Einlass zum Auslass erstreckt, um die Endlosbahn in der Kammer abzustützen; eine erste Druckquelle (124; 340; 344), die mit der Kammer strömungsverbunden ist, um die Kammer mit Druck zu beaufschlagen; wobei die Stützfläche mit einer Differenzdruckquelle (125) oder mindestens einem in der Stützfläche ausgebildeten Hohlraum in Strömungsverbindung steht;

dadurch gekennzeichnet, dass

die Vorrichtung weiterhin eine semipermeable Membran (20; 360) umfasst, die neben der ersten Seite (144; 370) der Endlosbahn (140; 212; 314) angeordnet ist, um die Endlosbahn von direkter Verbindung mit der Kammer (112; 336; 338; 454; 474) zu trennen; wobei die Membran so strukturiert und ausgeführt ist, dass ihre Permeabilität größer als Null und kleiner als ca. 0,14 m^3 pro Minute pro 0,09 m^3 (ca. fünf CFM pro Quadratfuß), wie durch das TAPPI-Testverfahren TIP 0404-20 gemessen, ist, wobei diese Permeabilität einen vorbestimmten Fluidstrom durch sie hindurch zur Endlosbahn gestattet, wobei die Membran zur Verbindung mit der druckbeaufschlagten Kammer und der Differenzdruckquelle oder dem mindestens einen Hohlraum zum Anlegen einer mechanischen Druckkraft an die Endlosbahn strukturiert und ausgeführt ist.

2. Vorrichtung nach Anspruch 1, die weiterhin Folgendes umfasst:

mehrere Walzen (60 - 66; 160; 302 - 312), die zur zusammenwirkenden Drehung angeordnet sind, wobei jede der mehreren Walzen ein erstes kreisförmiges Ende (68 - 74), ein zweites kreisförmiges Ende (76 - 82) und eine zylindrische Mittelfläche (174) aufweist, wobei die mehreren Walzen zur Definition entsprechender mehrerer Pressspalte positioniert sind, wobei die Endlosbahn durch mindestens zwei der mehreren Pressspalte behandelt wird und wobei mindestens eine erste Walze (60; 302) der mehreren Walzen mindestens einen in der zylindrischen Mittelfläche ausgebildeten Hohlraum aufweist, der als Stützfläche vorgesehen ist;

eine erste und eine zweite Dichtungsplatte (108, 110) zur Ineingriffnahme des ersten und des zweiten kreisförmigen Endes jeder der mehreren Walzen, wobei die erste und die zweite Dich-

tungsplatte und die mehreren Walzen die druckbeaufschlagte Kammer (112; 336) definieren; und

wobei die Membran (20; 360) zur Verbindung mit der druckbeaufschlagten Kammer und dem mindestens einen Hohlraum zum Anlegen einer mechanischen Druckkraft an die Endlosbahn strukturiert und ausgeführt ist.

3. Vorrichtung nach Anspruch 2,
bei der die mehreren Pressspalte einen den Einlass (100; 320) bildenden Einlasspressspalt und einen den Auslass (102, 328) bildenden Auslassspalt umfassen und bei der die Membran (20; 360) zur Unterstützung der Abdichtung der Kammer (112; 336) am Einlasspressspalt und Auslasspressspalt strukturiert und ausgeführt ist, und bei der der Einlasspressspalt, die um den Umfang der ersten Walze (60; 302) verlaufende Membran und der Auslasspressspalt in Kombination praktisch einen einzigen ausgedehnten Pressspalt (115; 364) zum Anlegen der mechanischen Druckkraft an die Endlosbahn bilden.

4. Vorrichtung nach Anspruch 2,
bei der der mindestens eine Hohlraum eine Nut und/oder ein Loch und/oder eine Pore umfasst.

5. Vorrichtung nach Anspruch 4,
bei der die Differenzdruckquelle (125) mit dem Hohlraum strömungsverbunden ist, um den Hohlraum zu evakuieren.

6. Vorrichtung nach Anspruch 2,
bei der die Membran (20; 360) eine Dicke von 2,54 mm (0,1 Zoll) oder weniger aufweist.

7. Vorrichtung nach Anspruch 1,
bei der die Permeabilität durch eine Größe und/oder eine Form und/oder eine Frequenz und/oder ein Muster mehrerer Löcher in der Membran (20; 360) bestimmt wird.

8. Vorrichtung nach Anspruch 7,
bei der die Löcher lasergeformte Löcher sind.

9. Vorrichtung nach Anspruch 2,
weiterhin mit einer Bahnstützlage (142; 361), die zur Berührung der zylindrischen Mittelfläche (174) der ersten Walze (60; 302) und zur Berührung der zweiten Seite (146; 372) der Endlosbahn (140; 314) positioniert ist.

10. Vorrichtung nach Anspruch 9,
bei der mindestens eine der mehreren Walzen (60 - 66; 160; 302 - 312) weiterhin eine erste und eine zweite zylindrische Endfläche (166, 168) neben den ersten bzw. zweiten kreisförmigen Enden (68 - 82) enthält, wobei die zylindrische Mittelfläche (174) einen Umfang aufweist, der kleiner ist als der Umfang der ersten und der zweiten zylindrischen Endflächen, wobei die zylindrische Mittelfläche eine Breite der Bahnstützlage (142; 361), der Endlosbahn (140; 314) und der Membran (20; 360) aufnimmt.

11. Vorrichtung nach Anspruch 9,
bei der die Bahnstützlage (142; 361) eine Filzlage mit einer Dicke von 2,54 mm (0,1 Zoll) oder darunter umfasst.

12. Vorrichtung nach Anspruch 9,
bei der die Bahnstützlage (142; 361) eine hydrophobe Lage umfasst, die neben einer Filzlage positioniert ist und weiterhin neben der zweiten Seite (146; 372) der Endlosbahn (140; 314) positioniert ist.

13. Vorrichtung nach Anspruch 9,
bei der die Bahnstützlage (142; 361) eine mit einer hydrophoben Lage integrale Filzlage umfasst.

14. Vorrichtung nach Anspruch 2,
bei der mindestens eine der mehreren Walzen (60 - 66; 160; 302 - 312) weiterhin eine erste und eine zweite zylindrische Endfläche (166, 168) neben den ersten bzw. zweiten kreisförmigen Enden (68 - 82) enthält, wobei die zylindrische Mittelfläche (174) einen Umfang aufweist, der kleiner ist als der Umfang der ersten und zweiten zylindrischen Endflächen, wobei die zylindrische Mittelfläche eine Breite der Membran (20; 360) aufnimmt.

15. Vorrichtung nach Anspruch 14,
bei der mindestens zwei der mehreren Walzen (60 - 66; 160; 302 - 312) Kappenwalzen und mindestens zwei der mehreren Walzen Hauptwalzen sind, wobei ein Durchmesser der Hauptwalzen einen Durchmesser der Kappenwalzen übertrifft.

16. Vorrichtung nach Anspruch 14,
bei der mindestens eine der mehreren Walzen (60 - 66; 160; 302 - 312) weiterhin eine erste geneigte ringförmige Fläche (170), die einen Übergang von der zylindrischen Mittelfläche (174) zur ersten zylindrischen Endfläche (166) bereitstellt, und eine zweite geneigte ringförmige Fläche (172), die einen Übergang von der zylindrischen Mittelfläche (174) zur zweiten zylindrischen Endfläche (168) bereitstellt, umfasst, wobei die erste und die zweite geneigte ringförmige Fläche eine Führungsbahn für die Endlosbahn (140; 314) und die Membran (20; 360) definiert.

17. Vorrichtung nach Anspruch 16,
bei der die Membran (20; 360) ein Paar sich verjüngender Längsaußenränder (20A, 20B) enthält, die die erste und die zweite geneigte ringförmige Fläche

(170, 172) berühren.

18. Vorrichtung nach Anspruch 16, weiterhin mit einer Bahnstützlage (142; 361), die zwischen der Endlosbahn (140; 314) und der mindestens einen der mehreren Walzen (60 - 66; 160; 302 - 312) angeordnet ist, wobei die Bahnstützlage ein Paar sich verjüngender Außenränder (142A, 142B) enthält, die die erste und die zweite geneigte ringförmige Fläche (170, 172) berühren.

19. Vorrichtung nach Anspruch 2, bei der die mehreren Walzen (60 - 66) eine erste Hauptwalze (60), eine zweite Hauptwalze (62), eine erste Kappenwalze (64) und eine zweite Kappenwalze (66) umfassen, wobei ein erster Durchmesser der ersten Hauptwalze (60) und ein zweiter Durchmesser der zweiten Hauptwalze (62) größer ist als ein dritter Durchmesser der ersten Kappenwalze (64) und ein vierter Durchmesser der zweiten Kappenwalze (66).

20. Vorrichtung nach Anspruch 19, weiterhin mit einem Rahmen (12), wobei die erste und die zweite Hauptwalze (60, 62) fest und drehbar am Rahmen (12) befestigt und in einer nicht berührenden Beziehung einander gegenüber positioniert sind, und wobei die erste und die zweite Kappenwalze (64, 66) beweglich und drehbar am Rahmen (12) angebracht sind, wobei die erste Kappenwalze (64) die erste und die zweite Hauptwalze (60, 62) berührt, um einen ersten Einlasspressspalt (100) und einen ersten Auslasspressspalt (104) zu definieren, und wobei die zweite Kappenwalze (66) die erste und die zweite Hauptwalze (60, 62) berührt, um einen zweiten Einlasspressspalt (106) und einen zweiten Auslasspressspalt (102) zu definieren.

21. Vorrichtung nach Anspruch 19, bei der die erste und die zweite Hauptwalze (60, 62) und die erste und die zweite Kappenwalze (64, 66) alle in ihrer Längserstreckung parallel angeordnet sind, und bei der die erste und/oder die zweite Kappenwalze (64, 66) beweglich ist, um eine Belastung der ersten Hauptwalze (60) und/oder der zweiten Hauptwalze (62) einzustellen.

22. Vorrichtung nach Anspruch 21, bei der eine Höhe der Belastung der ersten und der zweiten Hauptwalze (60, 62) mit einem Druck in der Kammer (112) in Verbindung steht.

23. Vorrichtung nach Anspruch 21, bei der die Belastung eine Vorbelastung und eine zu einem Druck in der Kammer (112) proportionale zusätzliche Belastung umfasst.

24. Vorrichtung nach Anspruch 2, bei der die mehreren Walzen (302 - 312) zusammen mit der ersten und der zweiten Dichtungsplatte (108, 110) eine erste Kammer (336) und eine zweite Kammer (338) definieren.

25. Vorrichtung nach Anspruch 24, bei der die erste Kammer (336) mit der ersten Druckquelle (340) und die zweite Kammer (338) mit einer zweiten Druckquelle (344) in Strömungsverbindung steht, und bei der die erste Kammer (336) auf einen ersten Druck und die zweite Kammer (338) auf einen zweiten Druck, der sich von dem ersten Druck unterscheidet, druckbeaufschlagt wird.

26. Vorrichtung nach Anspruch 25, bei der sich die Endlosbahn (314) durch die erste Kammer (336) und die zweite Kammer (338) in einer Richtung von der ersten Kammer (336) zur zweiten Kammer (338) bewegt, und bei der der zweite Druck größer ist als der erste Druck.

27. Vorrichtung nach Anspruch 24, weiterhin mit einer Temperatursteuervorrichtung (374), die mit der ersten Kammer (336) und der zweiten Kammer (338) verbunden ist, und bei der die erste Kammer (336) auf eine erste Temperatur und die zweite Kammer (338) auf eine zweite Temperatur, die sich von der ersten Temperatur unterscheidet, gesteuert wird.

28. Vorrichtung nach Anspruch 27, bei der sich die Endlosbahn (314) durch die erste Kammer (336) und die zweite Kammer (338) in einer Richtung von der ersten Kammer (336) zur zweiten Kammer (338) bewegt, und bei der die zweite Temperatur höher ist als die erste Temperatur.

29. Vorrichtung nach Anspruch 24, bei der die erste Kammer (336) mit einem ersten Material und die zweite Kammer (338) mit einem zweiten Material, das sich von dem ersten Material unterscheidet, geladen ist.

30. Vorrichtung nach Anspruch 2, weiterhin mit einer Leitung (158), die sich von der ersten und/oder zweiten Dichtungsplatte (108, 110) in die Kammer (112) erstreckt, um Fluidströmung zu verteilen.

31. Vorrichtung nach Anspruch 2, bei der die mehreren Walzen (60 - 66) eine erste Hauptwalze (60), eine zweite Hauptwalze (62), eine erste Kappenwalze (64) und eine zweite Kappenwalze (66) umfassen, die zur Bildung von vier Pressspalten (100 - 106) angeordnet sind, und bei der die erste Hauptwalze (60) die zweite Hauptwalze (62) nicht berührt, und bei der die Endlosbahn (140) so geführt wird, dass sie alle der vier Pressspalten

(100 - 106) durchquert.

32. Vorrichtung nach Anspruch 2, bei der die erste und die zweite Dichtungsplatte (108, 110) flexibel sind und sich der Form des ersten bzw. des zweiten zylindrischen Endes (166, 188) der mehreren Walzen (60 - 66; 160; 302 - 312) anpassen.

33. Vorrichtung nach Anspruch 2, weiterhin mit einer ersten Dichtung (99; 148, 150), die zwischen dem ersten kreisförmigen Ende (68 - 74) jeder der mehreren Walzen (60 - 64) und der ersten Dichtungsplatte (108) positioniert ist, und einer zweiten Dichtung (99; 148, 150), die zwischen dem zweiten kreisförmigen Ende (76 - 82) jeder der mehreren Walzen und der zweiten Dichtungsplatte (110) positioniert ist.

34. Vorrichtung nach Anspruch 33, bei der jede der ersten und zweiten Dichtungen mechanische Dichtungen (99) bilden.

35. Vorrichtung nach Anspruch 33, bei der jede der ersten und zweiten Dichtungen Fluiddichtungen (148, 150) bilden.

36. Vorrichtung nach Anspruch 33, bei der jede der ersten und zweiten Dichtungen (148, 150) druckbeaufschlagte Kavitäten enthalten.

37. Vorrichtung nach Anspruch 33, bei der die erste Dichtung (99; 148, 150) an dem ersten kreisförmigen Ende (68 - 74) jeder der mehreren Walzen (60 - 64) und die zweite Dichtung (99; 148, 150) an dem zweiten kreisförmigen Ende (76 - 82) jeder der mehreren Walzen (60 - 64) angebracht ist.

38. Vorrichtung nach Anspruch 2, weiterhin mit mindestens einer Zugstange (113), die ein erstes Ende und ein zweites Ende aufweist, wobei das erste Ende mit der ersten Dichtungsplatte (108) und das zweite Ende mit der zweiten Dichtungsplatte (110) verbunden ist.

39. Vorrichtung nach Anspruch 2, weiterhin mit einer Temperatursteuervorrichtung (120, 126; 374), die zur Steuerung der Kammertemperatur mit der Kammer (112; 336, 338) verbunden ist.

40. Vorrichtung nach Anspruch 2, bei der die Kammer (112; 336, 338) auf eine Höhe von über $206{,}84 \cdot 10^3$ Pa (30 psi) druckbeaufschlagt wird.

41. Vorrichtung nach Anspruch 1, bei der weiterhin die Endlosbahn (140; 370) und die Membran (20; 360) an dem Einlass (100; 320; 456; 476) in die Kammer (112; 336, 338; 454; 474) eintreten und am Auslass (102; 328; 458; 478) aus der Kammer austreten.

42. Vorrichtung nach Anspruch 41, bei der weiterhin
die Kammer (454; 474) teilweise durch ein U-förmiges Gehäuse (460) definiert wird, das mit der ersten Druckquelle (124) strömungsverbunden ist;
eine Stützkonstruktion (160; 480) die Stützfläche (174; 482) in Strömungsverbindung mit der Differenzdruckquelle enthält, wobei die Stützkonstruktion zum Eingriff mit dem U-förmigen Gehäuse (460) zur teilweisen Definition der Kammer und zur Definition des Einlasses (456; 476) und des Auslasses (458; 478) angeordnet ist, wobei die Membran (20) und die Endlosbahn (140) durch den Einlass (456; 476) und den Auslass (458; 478) behandelt werden, wobei die Stützfläche (174; 482) der Stützkonstruktion (160; 480) die zweite Seite (146) der Endlosbahn (140) stützt.

43. Vorrichtung nach Anspruch 42, bei der die Stützkonstruktion eine Walze (160) und die Stützfläche (174) mindestens einen Hohlraum umfasst.

44. Vorrichtung nach Anspruch 42, bei der die Stützkonstruktion einen Stützschuh (480) umfasst.

45. Vorrichtung nach Anspruch 44, bei der der Stützschuh (480) eines von mehreren Stützblättern und mehrere Stützplatten umfasst.

46. Vorrichtung nach Anspruch 44, bei der der Stützschuh (480) eine einteilige Konstruktion ist.

47. Vorrichtung nach Anspruch 42, weiterhin mit einer Stützlage, die zwischen der Stützfläche (482) der Stützkonstruktion (480) und der zweiten Seite der Endlosbahn (140) angeordnet ist.

48. Vorrichtung nach Anspruch 41, bei der das Fluid Luft ist.

49. Vorrichtung nach Anspruch 2, bei der weiterhin
die mehreren Walzen (302 - 312) mehrere Hauptwalzen (302, 304) und mehrere Kappenwalzen (306 - 312) umfassen, die zur Definition mehrerer Einlassspressspalte (320, 330) und mehrerer Auslassspressspalte (322, 328) positioniert sind, und ein Teil der mehreren Walzen (302 - 312) mindestens einen in der zylindrischen Mittelfläche (174) ausgebildeten Hohlraum aufweist;
die erste und die zweite Dichtungsplatte (108, 110) und die mehreren Walzen (302 - 312) mehrere Kam-

mern (336, 338) definieren;
mindestens eine erste Fluiddruckquelle (340, 344) mit jeder der mehreren Kammern (336, 338) in Strömungsverbindung steht, um die mehreren Kammern (336, 338) mit Druck zu beaufschlagen; und die mindestens eine semipermeable (360) Membran zum Eingriff mit einem Teil der mehreren Einlasspressspalte (320) strukturiert und ausgeführt ist, um mit der zylindrischen Mittelfläche (174) eines Teils der mehreren Hauptwalzen (302, 304) in hydraulischer Verbindung zu stehen und einen Teil der mehreren Auslasspressspalte (328) zwecks Definition mehrerer ausgedehnter Pressspalte (364, 366) in Eingriff zu nehmen.

50. Vorrichtung nach Anspruch 49,
bei der sich ein erster ausgedehnter Spalt (364) der mehreren ausgedehnten Pressspalte (364, 366) in einer ersten Kammer (336) der mehreren Kammern (336, 338) befindet, und sich ein zweiter ausgedehnter Pressspalt (366) der mehreren ausgedehnten Pressspalte (364, 366) in einer zweiten Kammer (338) der mehreren Kammern (336, 338) befindet.

51. Vorrichtung nach Anspruch 49,
bei der die mehreren ausgedehnten Spalte (364, 366) mindestens zwei ausgedehnte Pressspalte umfassen, die sich in ihrer Länge unterscheiden.

52. Vorrichtung nach Anspruch 49,
bei der die mehreren Kammern (336, 338) eine erste Kammer (336) und eine zweite Kammer (338) umfassen, und bei der die erste Kammer (336) auf einen ersten Druck und die zweite Kammer (338) auf einen zweiten Druck, der sich von dem ersten Druck unterscheidet, druckbeaufschlagt wird.

53. Vorrichtung nach Anspruch 52,
bei der sich mindestens eine Membran (360) durch die erste Kammer (336) und die zweite Kammer (338) in einer Richtung von der ersten Kammer (336) zur zweiten Kammer (338) bewegt, und bei der der zweite Druck größer ist als der erste Druck.

54. Vorrichtung nach Anspruch 49,
bei der die mehreren Kammern (336, 338) eine erste Kammer (336) und eine zweite Kammer (338) umfassen, und weiterhin mit einem mit der ersten Kammer (336) und der zweiten Kammer (338) verbundenen Temperaturregler (374), und bei der die erste Kammer (336) auf eine erste Temperatur und die zweite Kammer (338) auf eine zweite Temperatur, die sich von der ersten Temperatur unterscheidet, gesteuert wird.

55. Vorrichtung nach Anspruch 54,
bei der sich mindestens eine Membran (360) durch die erste Kammer (336) und die zweite Kammer (338) in einer Richtung von der ersten Kammer (336) zur zweiten Kammer (338) bewegt, und bei der die zweite Temperatur höher ist als die erste Temperatur.

56. Vorrichtung nach Anspruch 49,
bei der die mehreren Kammern (336, 338) eine erste Kammer (336) und eine zweite Kammer (338) umfassen, und bei der die erste Kammer (336) mit einem ersten Material und die zweite Kammer (338) mit einem zweiten Material, das sich von dem ersten Material unterscheidet, geladen ist.

57. Vorrichtung nach Anspruch 49,
bei der die mehreren Hauptwalzen (302, 304) eine einen Teil einer ersten Kammer (336) definierende erste Hauptwalze (302) und eine einen Teil einer zweiten Kammer (338) definierende zweite Hauptwalze (304) umfassen, wobei sowohl die erste Hauptwalze (302) als auch die zweite Hauptwalze (304) mindestens einen in der zylindrischen Mittelfläche (174) ausgebildeten Hohlraum aufweisen, und bei der die mindestens eine semipermeable Membran eine erste Membran (360) und eine zweite Membran (362) umfasst, und wobei die mehreren ausdehnten Pressspalte (364, 366) einen ersten ausgedehnten Pressspalt (364), der sich in der ersten Kammer (336) befindet, und einen zweiten ausgedehnten Pressspalt (366), der sich in der zweiten Kammer (338) befindet, umfassen, wobei ein Fluid in einer ersten Richtung am ersten ausgedehnten Pressspalt (364) durch die Endlosbahn (314) strömt und wobei das Fluid in einer zweiten Richtung, die der ersten Richtung entgegengesetzt ist, am zweiten ausgedehnten Pressspalt (366) durch die Endlosbahn (314) strömt, wobei die erste Membran (360) mit der ersten Kammer (336) und der ersten Walze (302) in Verbindung steht, um eine mechanische Presskraft an die Endlosbahn (314) in der ersten Richtung anzulegen, und die zweite Membran (362) mit der zweiten Kammer (366) und der zweiten Hauptwalze (304) in Verbindung steht, um eine mechanische Presskraft in der zweiten Richtung an die Endlosbahn (314) anzulegen.

58. Vorrichtung nach Anspruch 57,
bei der die Endlosbahn (314) zwischen der ersten Membran (360) und der zweiten Membran (362) positioniert ist, damit sie in dem ersten ausgedehnten Pressspalt (364) und dem zweiten ausgedehnten Pressspalt (366) aufgenommen werden kann.

59. Vorrichtung nach Anspruch 58,
weiterhin mit einer ersten Bahnstützlage (361) und einer zweite Bahnstützlage (363), wobei die erste Bahnstützlage (361) zwischen der Endlosbahn (314) und der ersten Hauptwalze (302) und die zweite Bahnstützlage (363) zwischen der Endlosbahn (314)

und der zweiten Hauptwalze (304) positioniert ist.

60. Vorrichtung nach Anspruch 59,
bei der der erste ausgedehnte Pressspalt (364) einer ersten Kammer (336) der mehreren Kammern (336, 338) und der zweite ausgedehnte Pressspalt (366) einer zweiten Kammer (338) der mehreren Kammern (336, 338) zugeordnet ist.

61. Vorrichtung nach Anspruch 49,
bei der der mindestens eine Hohlraum eine Nut und/oder ein Loch und/oder eine Pore umfasst.

62. Vorrichtung nach Anspruch 49,
bei der die mehreren Walzen (302 - 312) sechs Walzen umfassen.

Revendications

1. Appareil (10 ; 300 ; 450 ; 470) pour traiter une nappe continue (140 ; 314) ayant un premier côté (144 ; 370) et un deuxième côté (146 ; 372),
comprenant :

une chambre (112 ; 336 ; 338 ; 454 ; 474) ayant au moins une entrée (100 ; 320 ; 456 ; 476) et au moins une sortie (102 ; 328 ; 458 ; 478), ladite nappe continue entrant dans ladite chambre au niveau de ladite entrée et sortant de ladite chambre au niveau de ladite sortie ; une surface de support (84 ; 174 ; 482) définissant en partie ladite chambre et s'étendant depuis ladite entrée jusqu'à ladite sortie pour supporter ladite nappe continue à l'intérieur de ladite chambre ; une première source de pression (124 ; 340 ; 344) en liaison fluidique avec ladite chambre pour pressuriser ladite chambre ; ladite surface de support étant en communication fluidique avec une source de pression différentielle (125) ou au moins un vide étant formé dans ladite surface de support ;
caractérisé en ce que
ledit appareil comprend en outre une membrane semi -perméable (20 ; 360) positionnée à côté dudit premier côté (144 ; 370) de ladite nappe continue (140 ; 212 ; 314) pour séparer ladite nappe continue d'une communication directe avec ladite chambre (112 ; 336 ; 338 ; 454 ; 474) ; ladite membrane étant structurée et adaptée pour avoir une perméabilité supérieure à zéro et inférieure à environ 0,14 m^3 par minute par 0,09 m^3 (environ cinq CFM par pied carré), mesurée par la méthode d'essai TAPPI TIP 0404-20, laquelle perméabilité permet un écoulement fluidique prédéterminé à travers elle jusqu'à ladite nappe continue, ladite membrane étant structurée et adaptée pour communiquer avec ladite chambre pressurisée et ladite source de pression différentielle ou ledit au moins un vide pour appliquer une force de pression mécanique à ladite nappe continue.

2. Appareil selon la revendication 1, comprenant en outre :

une pluralité de rouleaux (60-66 ; 160 ; 302 -312) agencés en vue d'une rotation coopérante, chacun de ladite pluralité de rouleaux ayant une première extrémité circulaire (68-74), une deuxième extrémité circulaire (76-82) et une surface intermédiaire cylindrique (174), ladite pluralité de rouleaux étant positionnée de manière à définir une pluralité correspondante de lignes de contact, ladite nappe continue étant traitée à travers au moins deux de ladite pluralité de lignes de contact, et au moins un premier rouleau (60 ; 302) de ladite pluralité de rouleaux ayant au moins un vide formé dans ladite surface intermédiaire cylindrique, prévue en tant que ladite surface de support ; des premier et deuxième panneaux d'étanchéité (108, 110) pour engager les première et deuxième extrémités circulaires de chacun de ladite pluralité de rouleaux, lesdits premier et deuxième panneaux d'étanchéité et ladite pluralité de rouleaux définissant ladite chambre pressurisée (112 ; 336); et
ladite membrane (20 ; 360) étant structurée et adaptée pour communiquer avec ladite chambre pressurisée et ledit au moins un vide pour appliquer une force de pression mécanique sur ladite nappe continue.

3. Appareil selon la revendication 2,
dans lequel ladite pluralité de lignes de contact comporte une ligne de contact d'entrée formant ladite entrée (100 ; 320) et une ligne de contact de sortie formant ladite sortie (102 ; 328), et dans lequel ladite membrane (20 ; 360) est structurée et adaptée pour faciliter le scellement de ladite chambre (112 ; 336) au niveau de ladite ligne de contact d'entrée et de ladite ligne de contact de sortie, et dans lequel ladite ligne de contact d'entrée, ladite membrane passant circonférentiellement autour dudit premier rouleau (60 ; 302), et ladite ligne de contact de sortie sont combinées pour former effectivement une ligne de contact unique prolongée (115 ; 364) pour appliquer ladite force de pression mécanique sur ladite nappe continue.

4. Appareil selon la revendication 2,
dans lequel ledit au moins un vide comprend au moins une gorge, un trou et/ou un pore.

5. Appareil selon la revendication 4,

dans lequel ladite source de pression différentielle (125) est en liaison fluidique avec ledit vide pour évacuer ledit vide.

6. Appareil selon la revendication 2, dans lequel ladite membrane (20 ; 360) a une épaisseur de 2,54 mm (0,1 pouce) ou moins.

7. Appareil selon la revendication 1, dans lequel ladite perméabilité est déterminée par au moins une dimension, une forme, une fréquence et/ou un motif d'une pluralité de trous dans ladite membrane (20 ; 360).

8. Appareil selon la revendication 7, dans lequel lesdits trous sont des trous formés au laser.

9. Appareil selon la revendication 2, comprenant en outre une couche de support de nappe (142 ; 361) positionnée de manière à venir en contact avec ladite surface intermédiaire cylindrique (174) dudit premier rouleau (60 ; 302) et à venir en contact avec ledit deuxième côté (146 ; 372) de ladite nappe continue (140 ; 314).

10. Appareil selon la revendication 9, dans lequel au moins l'un de ladite pluralité de rouleaux (60-66 ; 160 ; 302-312) comporte en outre des première et deuxième surfaces d'extrémité cylindriques (166, 168) adjacentes aux première et deuxième extrémités circulaires (68-82), respectivement, ladite surface intermédiaire cylindrique (174) ayant une circonférence inférieure à une circonférence desdites première et deuxième surfaces d'extrémité cylindriques, ladite surface intermédiaire cylindrique recevant une largeur de ladite couche de support de nappe (142 ; 361), de ladite nappe continue (140, 314) et de ladite membrane (20 ; 360).

11. Appareil selon la revendication 9, dans lequel ladite couche de support de nappe (142 ; 361) comprend une couche de feutre ayant une épaisseur de 2,54 mm (0,1 pouce) ou moins.

12. Appareil selon la revendication 9, dans lequel ladite couche de support de nappe (142 ; 361) comprend une couche hydrophobe positionnée à côté d'une couche de feutre, et positionnée en outre à côté dudit deuxième côté (146 ; 372) de ladite nappe continue (140 ; 314).

13. Appareil selon la revendication 9, dans lequel ladite couche de support de nappe (142 ; 361) comprend une couche de feutre intégrée à une couche hydrophobe.

14. Appareil selon la revendication 2, dans lequel au moins l'un de ladite pluralité de rouleaux (60-66 ; 160 ; 302-312) comporte en outre des première et deuxième surfaces d'extrémité cylindriques (166, 168) adjacentes aux première et deuxième extrémités circulaires (68-82), respectivement, ladite surface intermédiaire cylindrique (174) ayant une circonférence inférieure à une circonférence desdites première et deuxième surfaces d'extrémité cylindriques, ladite surface intermédiaire cylindrique recevant une largeur de ladite membrane (20 ; 360).

15. Appareil selon la revendication 14, dans lequel lesdits au moins deux de ladite pluralité de rouleaux (60-66 ; 160 ; 302-312) sont des rouleaux à capuchon et au moins deux de ladite pluralité de rouleaux sont des rouleaux principaux, un diamètre desdits rouleaux principaux dépassant un diamètre desdits rouleaux à capuchon.

16. Appareil selon la revendication 14, dans lequel ledit au moins un de ladite pluralité de rouleaux (60-66 ; 160 ; 302-312) comprend en outre une première surface annulaire inclinée (170) qui assure une transition entre ladite surface intermédiaire cylindrique (174) et ladite première surface d'extrémité cylindrique (166), et une deuxième surface annulaire inclinée (172) qui assure une transition entre ladite surface intermédiaire cylindrique (174) et ladite deuxième surface d'extrémité cylindrique (168), les première et deuxième surfaces annulaires inclinées définissant un chemin de guidage pour ladite nappe continue (140 ; 314) et ladite membrane (20 ; 360).

17. Appareil selon la revendication 16, dans lequel ladite membrane (20 ; 360) comporte une paire de bords extérieurs longitudinaux effilés (20A, 20B) qui viennent en contact avec les première et deuxième surfaces annulaires inclinées (170, 172).

18. Appareil selon la revendication 16, comprenant en outre une couche de support de nappe (142 ; 361) interposée entre ladite nappe continue (140 ; 314) et ledit au moins un de ladite pluralité de rouleaux (60-66 ; 160 ; 302 -312), ladite couche de support de nappe comportant une paire de bords extérieurs effilés (142A, 142B) qui viennent en contact avec les première et deuxième surfaces annulaires inclinées (170, 172).

19. Appareil selon la revendication 2, dans lequel ladite pluralité de rouleaux (60-66) comprend un premier rouleau principal (60), un deuxième rouleau principal (62), un premier rouleau à capuchon (64) et un deuxième rouleau à capuchon (66), un premier diamètre dudit premier rouleau principal (60) et un deuxième diamètre dudit deuxième

rouleau principal (62) étant plus grands qu'un troisième diamètre dudit premier rouleau à capuchon (64) et un quatrième diamètre dudit deuxième rouleau à capuchon (66).

20. Appareil selon la revendication 19, comprenant en outre un cadre (12), dans lequel lesdits premier et deuxième rouleaux principaux (60, 62) sont attachés de manière fixe et rotative audit cadre (12) et sont positionnés en face l'un de l'autre dans une relation sans contact, et dans lequel lesdits premier et deuxième rouleaux à capuchon (64, 66) sont montés de manière mobile et rotative sur ledit cadre (12), ledit premier rouleau à capuchon (64) venant en contact avec lesdits premier et deuxième rouleaux principaux (60, 62) pour définir une première ligne de contact d'entrée (100) et une première ligne de contact de sortie (104) et ledit deuxième rouleau à capuchon (66) venant en contact avec lesdits premier et deuxième rouleaux principaux (60, 62) pour définir une deuxième ligne de contact d'entrée (106) et une deuxième ligne de contact de sortie (102).

21. Appareil selon la revendication 19, dans lequel chacun desdits premier et deuxième rouleaux principaux (60, 62) et desdits premier et deuxième rouleaux à capuchon (64, 66) sont arrangés en parallèle dans leur étendue axiale, et dans lequel au moins l'un desdits premier et deuxième rouleaux à capuchon (64, 66) est déplaçable pour ajuster une charge d'au moins l'un desdits premier rouleau principal (60) et deuxième rouleau principal (62).

22. Appareil selon la revendication 21, dans lequel une quantité de ladite charge desdits premier et deuxième rouleaux principaux (60, 62) est associée à une pression dans ladite chambre (112).

23. Appareil selon la revendication 21, dans lequel ladite charge comporte une charge inclinée et une charge supplémentaire proportionnelle à une pression dans ladite chambre (112).

24. Appareil selon la revendication 2, dans lequel ladite pluralité de rouleaux (302-312) conjointement avec lesdits premier et deuxième panneaux d'étanchéité (108, 110), définit une première chambre (336) et une deuxième chambre (338).

25. Appareil selon la revendication 24, dans lequel ladite première chambre (336) est en liaison fluidique avec ladite première source de pression (340) et ladite deuxième chambre (338) est en liaison fluidique avec une deuxième source de pression (344), et dans lequel ladite première chambre (336) est pressurisée à une première pression et ladite deuxième chambre (338) est pressurisée à une deuxième pression différente de ladite première pression.

26. Appareil selon la revendication 25, dans lequel ladite nappe continue (314) se déplace à travers ladite première chambre (336) et ladite deuxième chambre (338) dans une direction allant de ladite première chambre (336) à ladite deuxième chambre (338), et dans lequel ladite deuxième pression est supérieure à ladite première pression.

27. Appareil selon la revendication 24, comprenant en outre un dispositif de commande de température (374) connecté à ladite première chambre (336) et ladite deuxième chambre (338), et dans lequel ladite première chambre (336) est commandée à une première température et ladite deuxième chambre (338) est commandée à une deuxième température différente de ladite première température.

28. Appareil selon la revendication 27, dans lequel ladite nappe continue (314) se déplace à travers ladite première chambre (336) et ladite deuxième chambre (338) dans une direction allant de ladite première chambre (336) à ladite deuxième chambre (338) et dans lequel ladite deuxième température est supérieure à ladite première température.

29. Appareil selon la revendication 24, dans lequel ladite première chambre (336) est chargée avec un première matériau et ladite deuxième chambre (338) est chargée avec un deuxième matériau différent dudit premier matériau.

30. Appareil selon la revendication 2, comprenant en outre un conduit (158) qui s'étend depuis au moins l'un desdits premier et deuxième panneaux d'étanchéité (108, 110) dans ladite chambre (112) pour distribuer ledit écoulement fluidique.

31. Appareil selon la revendication 2, dans lequel ladite pluralité de rouleaux (60-66) comporte un premier rouleau principal (60), un deuxième rouleau principal (62), un premier rouleau à capuchon (64) et un deuxième rouleau à capuchon (66) qui sont agencés de manière à former quatre lignes de contact (100-106), et dans lequel ledit premier rouleau principal (60) ne vient pas en contact avec ledit deuxième rouleau principal (62), et dans lequel ladite nappe continue (140) est acheminée de manière à passer à travers toutes les quatre lignes de contact (100-106).

32. Appareil selon la revendication 2, dans lequel lesdits premier et deuxième panneaux d'étanchéité (108, 110) sont flexibles et ont une forme adaptée à la forme desdites première et deuxième extrémités cylindriques (166, 168), respectivement, de ladite pluralité de rouleaux (60-66 ; 160 ; 302-312).

33. Appareil selon la revendication 2, comprenant en outre un premier joint d'étanchéité (99 ; 148, 150) positionné entre ladite première extrémité circulaire (68-74) de chacun de ladite pluralité de rouleaux (60-64) et ledit premier panneau d'étanchéité (108), et un deuxième joint d'étanchéité (99 ; 148, 150) positionné entre ladite deuxième extrémité circulaire (76-82) de chacun de ladite pluralité de rouleaux et ledit deuxième panneau d'étanchéité (110).

34. Appareil selon la revendication 33, dans lequel chacun desdits premier et deuxième joints d'étanchéité forme un joint d'étanchéité mécanique (99).

35. Appareil selon la revendication 33, dans lequel chacun des premier et deuxième joints d'étanchéité forme un joint d'étanchéité fluide (148, 150).

36. Appareil selon la revendication 33, dans lequel chacun des premier et deuxième joints d'étanchéité (148, 150) comporte des cavités pressurisées.

37. Appareil selon la revendication 33, dans lequel ledit premier joint d'étanchéité (99 ; 148, 150) est monté sur la première extrémité circulaire (68-74) de chacun de ladite pluralité de rouleaux (60-64) et dans lequel ledit deuxième joint d'étanchéité (99 ; 148, 150) est monté sur la deuxième extrémité circulaire (76-82) de chacun de ladite pluralité de rouleaux (60-64).

38. Appareil selon la revendication 2, comprenant en outre au moins une barre de tensionnement (113) ayant une première extrémité et une deuxième extrémité, ladite première extrémité étant connectée audit premier panneau d'étanchéité (108) et ladite deuxième extrémité étant connectée audit deuxième panneau d'étanchéité (110).

39. Appareil selon la revendication 2, comprenant en outre un dispositif de commande de température (120, 126 ; 374) connecté à ladite chambre (112 ; 336, 338) pour commander la température de la chambre.

40. Appareil selon la revendication 2, dans lequel ladite chambre (111 ; 336, 338) est pressurisée à un niveau supérieur à $206{,}84 \cdot 10^3$ Pa (30 psi).

41. Appareil selon la revendication 1, comprenant en outre le fait que :

ladite nappe continue (140 ; 370) et ladite membrane (20 ; 36 0) entrent dans ladite chambre (112 ; 336, 338 ; 454 ; 474) au niveau de ladite entrée (100 ; 320 ; 456 ; 476) et sortent de ladite chambre au niveau de ladite sortie (102 ; 328 ; 458 ; 478).

42. Appareil selon la revendication 41, comprenant en outre le fait que :

ladite chambre (454 ; 474) est partiellement définie par un boîtier en forme de U (460) en liaison fluidique avec ladite première source de pression (124) ;
une structure de support (160 ; 480) comporte ladite surface de support (174 ; 482) en communication fluidique avec ladite source de pression différentielle, laquelle structure de support est prévue pour s'engager avec ledit boîtier en forme de U (460) pour définir partiellement ladite chambre, et pour définir ladite entrée (456 ; 476) et ladite sortie (458 ; 478), ladite membrane (20) et ladite nappe continue (140) étant traitées à travers ladite entrée (456 ; 476) et ladite sortie (458 ; 478), ladite surface de support (174 ; 482) de ladite structure de support (160, 480) supportant ledit deuxième côté (146) de ladite nappe continue (140).

43. Appareil selon la revendication 42, dans lequel ladite structure de support comprend un rouleau (160) et ladite surface de support (174) comporte au moins un vide.

44. Appareil selon la revendication 42, dans lequel ladite structure de support comprend un sabot de support (480).

45. Appareil selon la revendication 44, dans lequel ledit sabot de support (480) comprend l'une parmi une pluralité de lames de support et une pluralité de plaques de support.

46. Appareil selon la revendication 44, dans lequel ledit sabot de support (480) est une structure unitaire.

47. Appareil selon la revendication 42, comprenant en outre une couche de support interposée entre ladite surface de support (482) de ladite structure de support (480) et ledit deuxième côté de ladite nappe continue (140).

48. Appareil selon la revendication 41, dans lequel ledit fluide est de l'air.

49. Appareil selon la revendication 2, comprenant en outre le fait que :

ladite pluralité de rouleaux (302-312) comporte une pluralité de rouleaux principaux (302, 204) et une pluralité de rouleaux à capuchon (306-312) positionnés de manière à définir une pluralité de lignes de contact de rouleaux internes (320, 330) et une pluralité de lignes de contact de rouleaux externes (322, 328) et qu'une portion de ladite pluralité de rouleaux (302-312) a au moins un vide formé dans ladite surface intermédiaire cylindrique (174) ;
lesdits premier et deuxième panneaux d'étanchéité (108, 110) et ladite pluralité de rouleaux (302-312) définissent une pluralité de chambres (336, 338) ;
au moins une première source de pression (340, 344) est en liaison fluidique avec chacune de ladite pluralité de chambres (336, 338) pour pressuriser ladite pluralité de chambres (336, 338) ; et
ladite au moins une membrane semi-perméable (360) est structurée et adaptée pour engager une portion de ladite pluralité de lignes de contact de rouleaux d'entrée (320), pour communiquer hydrauliquement avec ladite surface intermédiaire cylindrique (174) d'une portion de ladite pluralité de rouleaux principaux (302, 304) et pour engager une portion de ladite pluralité de lignes de contact de rouleaux externes (328) pour définir une pluralité de lignes de contact prolongées (364, 366).

50. Appareil selon la revendication 49, dans lequel une première ligne de contact prolongée (364) de ladite pluralité de lignes de contact prolongées (364, 366) est située dans une première chambre (336) de ladite pluralité de chambres (336, 338) et une deuxième ligne de contact prolongée (366) de ladite pluralité de lignes de contact prolongées (364, 366) est située dans une deuxième chambre (338) de ladite pluralité de chambres (336, 338).

51. Appareil selon la revendication 49, dans lequel ladite pluralité de lignes de contact prolongées (364, 366) comporte au moins deux lignes de contact prolongées de longueurs différentes.

52. Appareil selon la revendication 49, dans lequel ladite pluralité de chambres (336, 338) comporte une première chambre (336) et une deuxième chambre (338), et dans lequel ladite première chambre (336) est pressurisée à une première pression et ladite deuxième chambre (338) est pressurisée à une deuxième pression différente de ladite première pression.

53. Appareil selon la revendication 52, dans lequel ladite au moins une membrane (360) se déplace à travers ladite première chambre (336) et ladite deuxième chambre (338) dans une direction allant de ladite première chambre (336) à ladite deuxième chambre (338), et dans lequel ladite deuxième pression est supérieure à ladite première pression.

54. Appareil selon la revendication 49, dans lequel ladite pluralité de chambres (336, 338) comporte une première chambre (336) et une deuxième chambre (338), et comprenant en outre un régulateur de température (374) connecté à ladite première chambre (336) et à ladite deuxième chambre (338), et dans lequel ladite première chambre (336) est commandée à une première température et ladite deuxième chambre (338) este commandée à une deuxième température différente de ladite première température.

55. Appareil selon la revendication 54, dans lequel ladite au moins une membrane (360) se déplace à travers ladite première chambre (336) et ladite deuxième chambre (338) dans une direction allant de ladite première chambre (336) à ladite deuxième chambre (338), et dans lequel ladite deuxième température est supérieure à ladite première température.

56. Appareil selon la revendication 49, dans lequel ladite pluralité de chambres (336, 338) comporte une première chambre (336) et une deuxième chambre (338) et dans lequel ladite première chambre (336) est chargée avec un première matériau et ladite deuxième chambre (338) est chargée avec un deuxième matériau différent dudit premier matériau.

57. Appareil selon la revendication 49, dans lequel ladite pluralité de rouleaux principaux (302, 304) comporte un premier rouleau principal (302) définissant une portion d'une première chambre (336) et un deuxième rouleau principal (304) définissant une portion d'une deuxième chambre (338), chacun desdits premier rouleau principal (302) et deuxième rouleau principal (304) ayant au moins un vide formé dans ladite surface intermédiaire cylindrique (174), et dans lequel ladite au moins une membrane semi-perméable comporte une première membrane (360) et une deuxième membrane (362), et ladite pluralité de lignes de contact prolongées (364, 366) comportant une première ligne de contact prolongée (364) située dans ladite première chambre (336) et une deuxième ligne de contact prolon-

gée (366) située dans ladite deuxième chambre (338), un fluide s'écoulant à travers ladite nappe continue (314) dans une première direction au niveau de ladite première ligne de contact prolongée (364) et ledit fluide s'écoulant à travers ladite nappe continue (314) dans une deuxième direction opposée à ladite première direction au niveau de ladite deuxième ligne de contact prolongée (366), ladite première membrane (360) communiquant avec ladite première chambre (336) et ledit premier rouleau (302) pour appliquer une force de pression mécanique à ladite nappe continue (314) dans ladite première direction et ladite deuxième membrane (362) communiquant avec ladite deuxième chambre (366) et ledit deuxième rouleau principal (304) pour appliquer une force de pression mécanique à ladite nappe continue (314) dans ladite deuxième direction.

58. Appareil selon la revendication 57, dans lequel ladite nappe continue (314) est positionnée entre ladite première membrane (360) et ladite deuxième membrane (362) de manière à être reçue dans ladite première ligne de contact prolongée (364) et ladite deuxième ligne de contact prolongée (366).

59. Appareil selon la revendication 58, comprenant en outre une première couche de support de nappe (361) et une deuxième couche de support de nappe (363), ladite première couche de support de nappe (361) étant positionnée entre ladite nappe continue (314) et ledit premier rouleau principal (302) et ladite deuxième couche de support de nappe (363) étant positionnée entre ladite nappe continue (314) et ledit deuxième rouleau principal (304).

60. Appareil selon la revendication 59, dans lequel ladite première ligne de contact prolongée (364) est associée à une première chambre (336) de ladite pluralité de chambres (336, 338) et ladite deuxième ligne de contact prolongée (366) est associée à une deuxième chambre (338) de ladite pluralité de chambres (336, 338).

61. Appareil selon la revendication 49, dans lequel ledit au moins un vide comprend au moins une gorge, un trou et/ou un pore.

62. Appareil selon la revendication 49, dans lequel ladite pluralité de rouleaux (302-312) comprend six rouleaux.

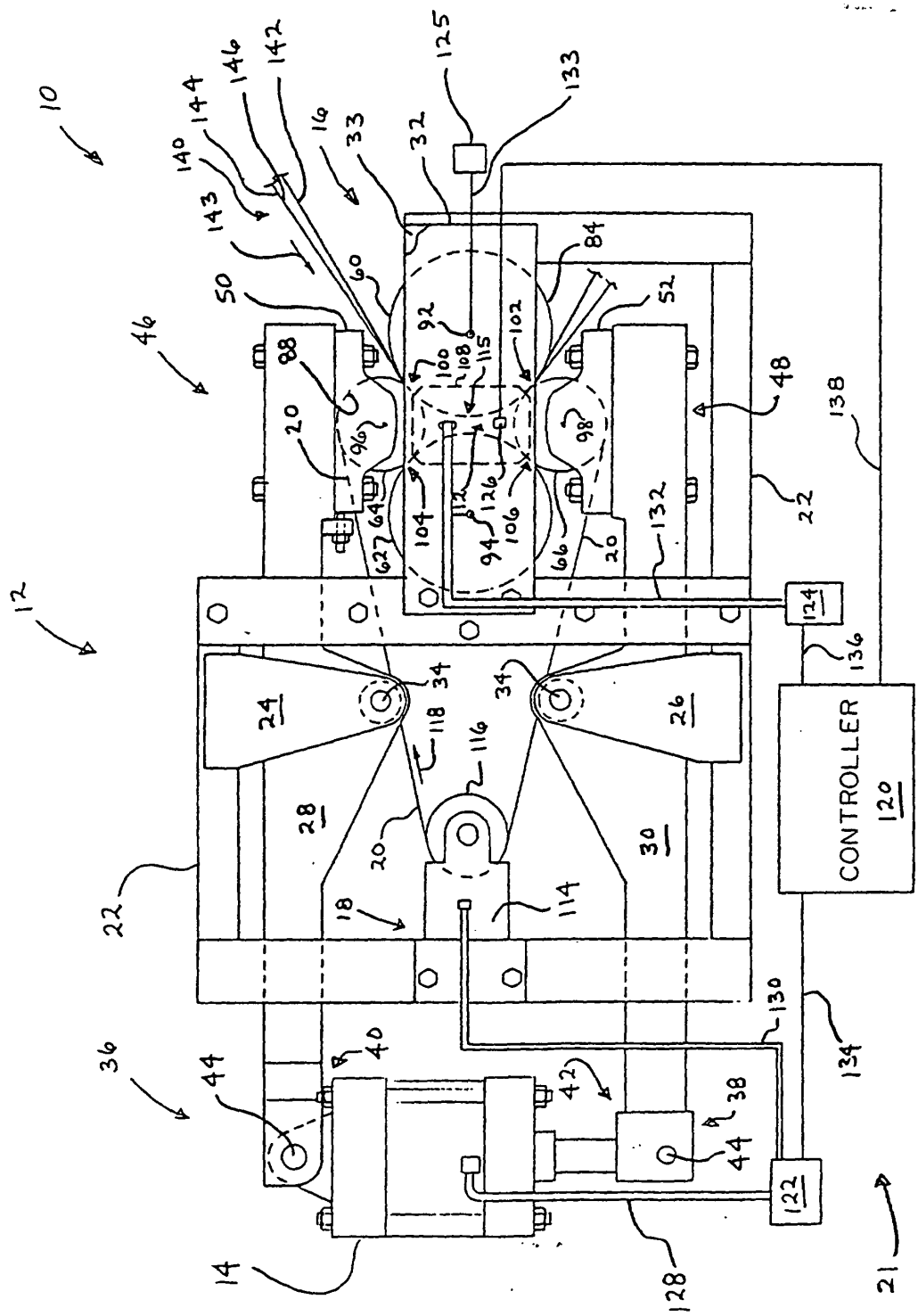

Fig. 1

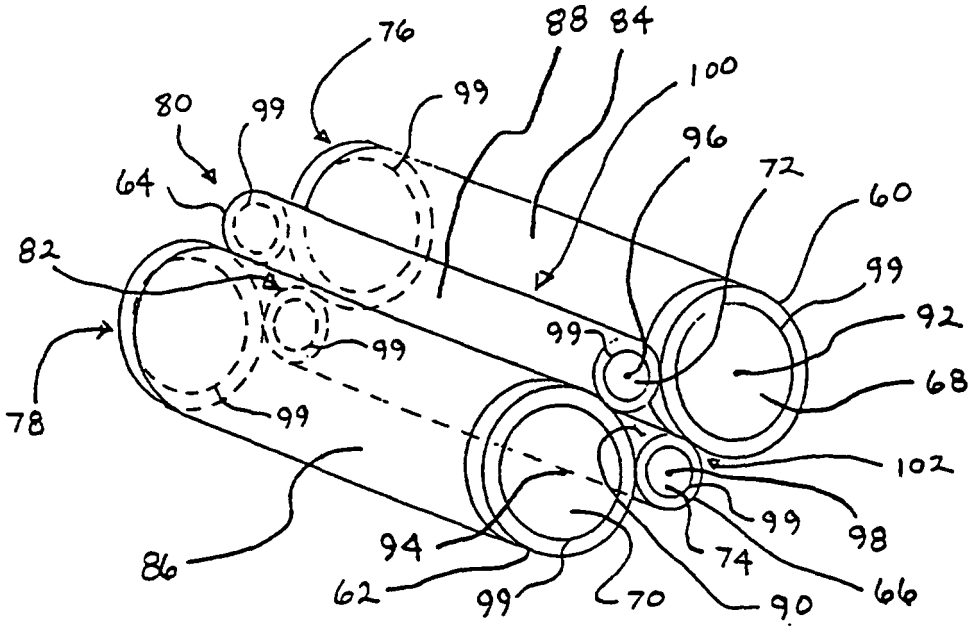
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Fig. 2

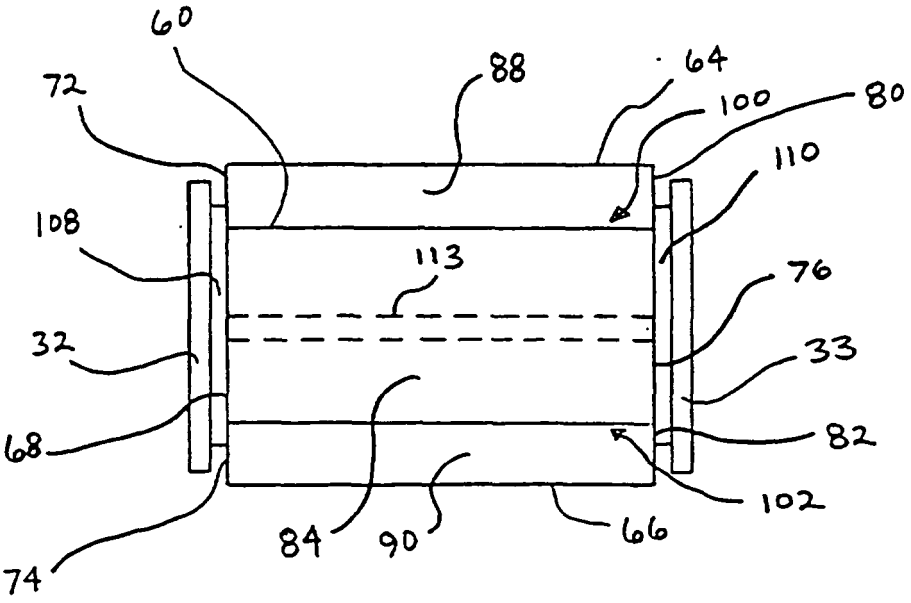
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Fig. 3

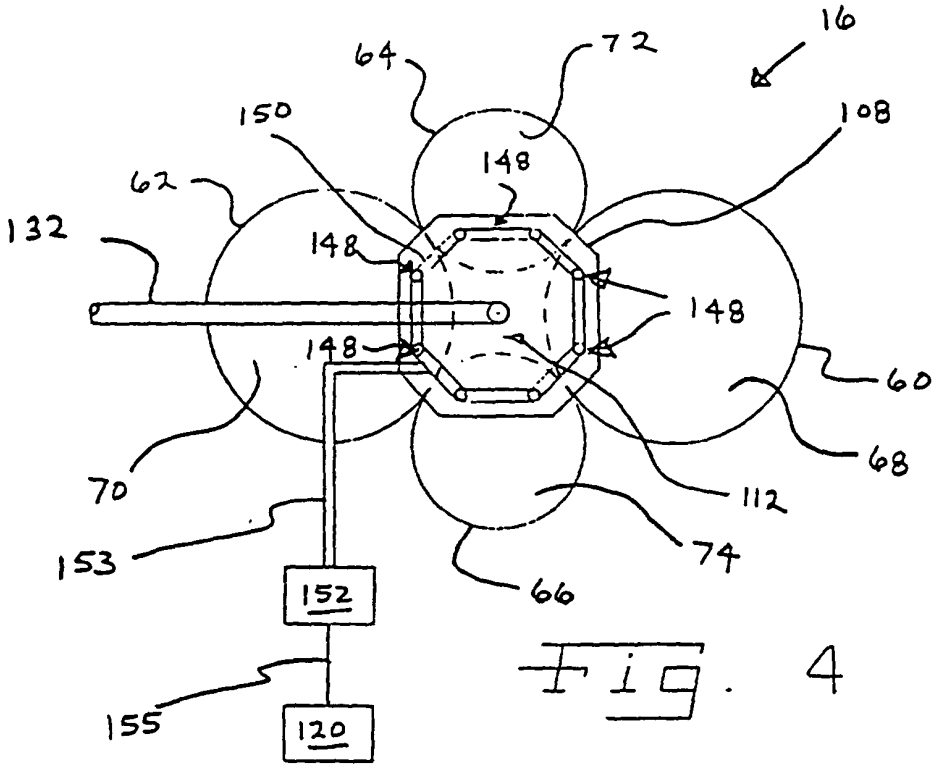
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Fig. 4

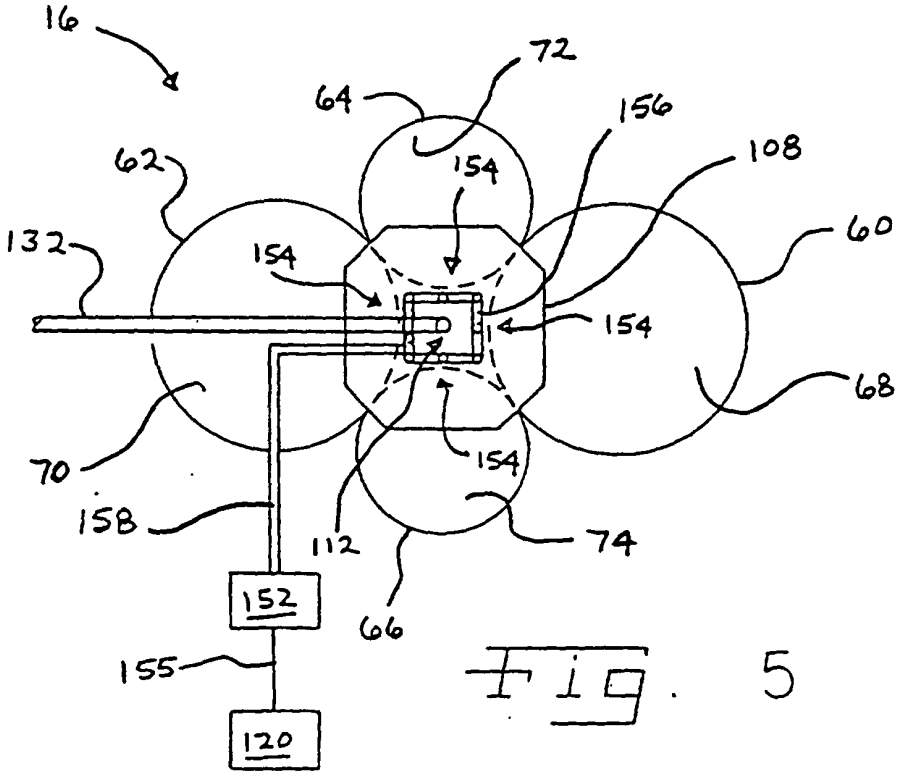
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Fig. 5

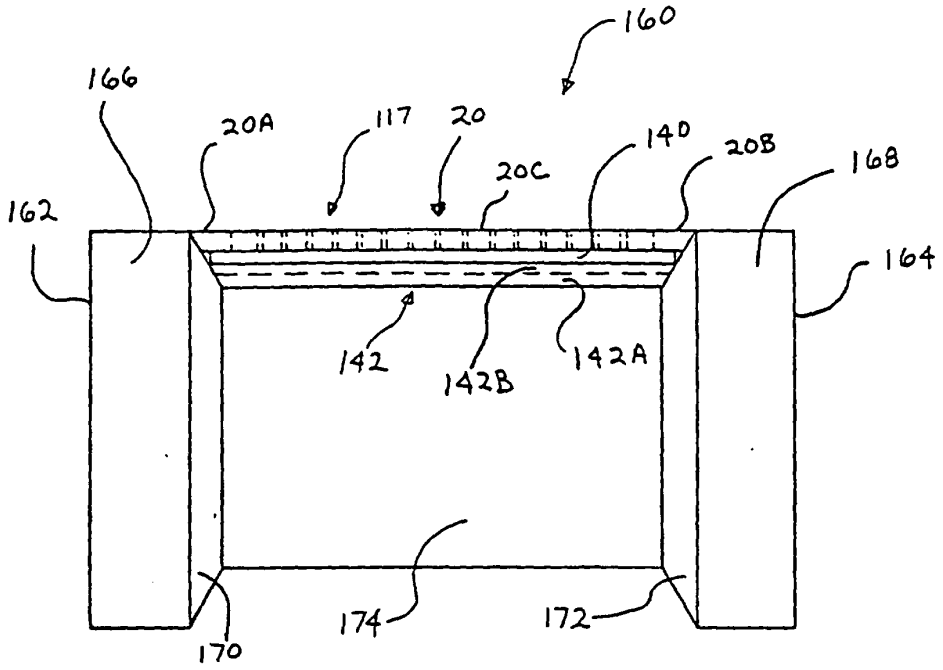
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Fig. 6

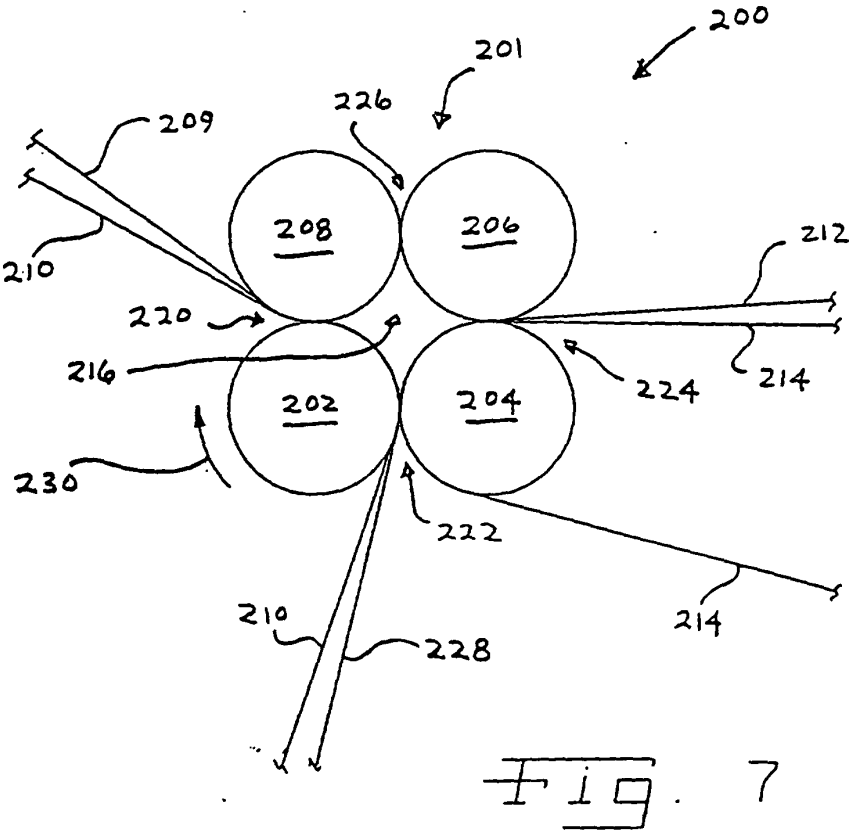
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Fig. 7

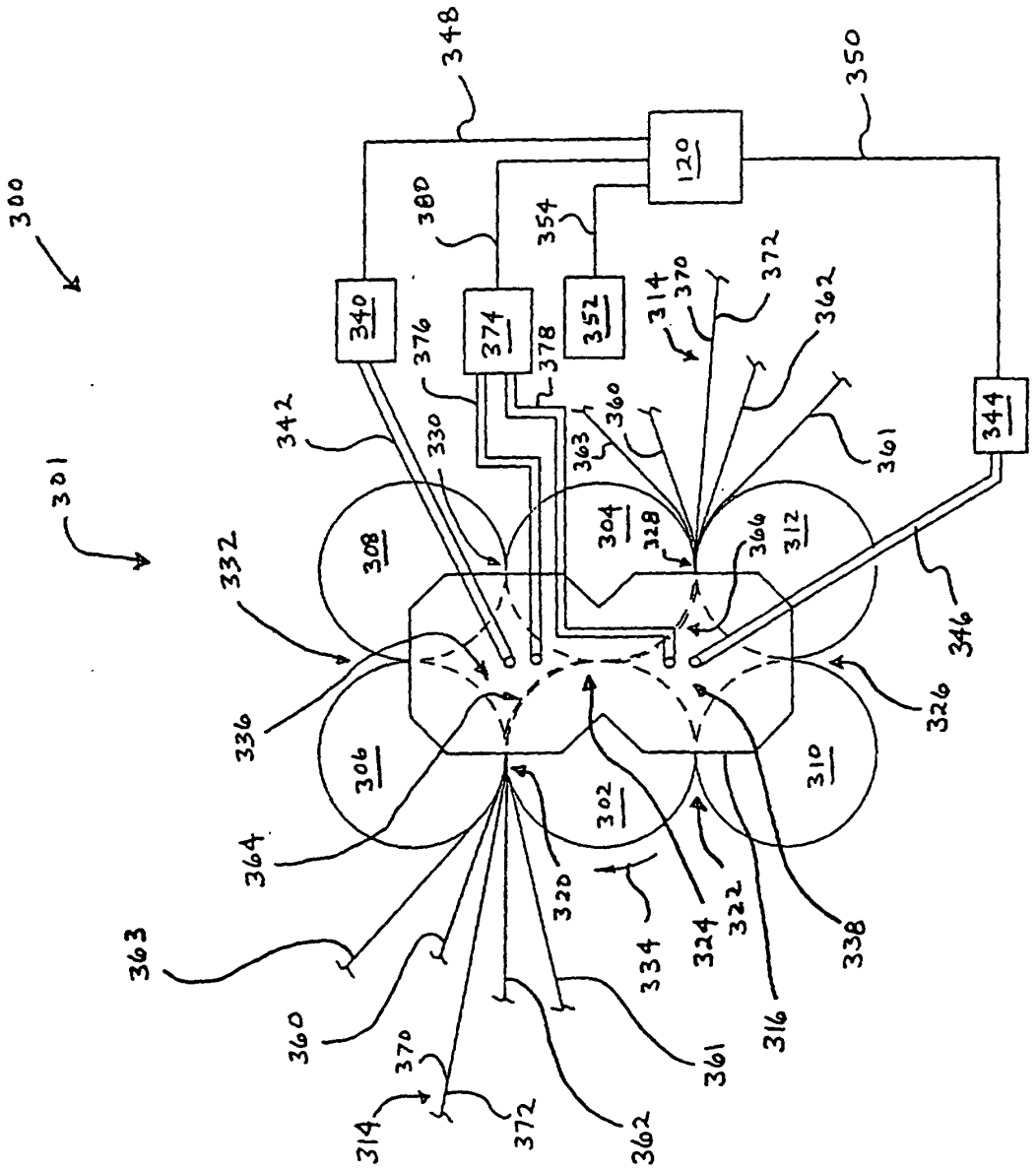
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Fig. 8

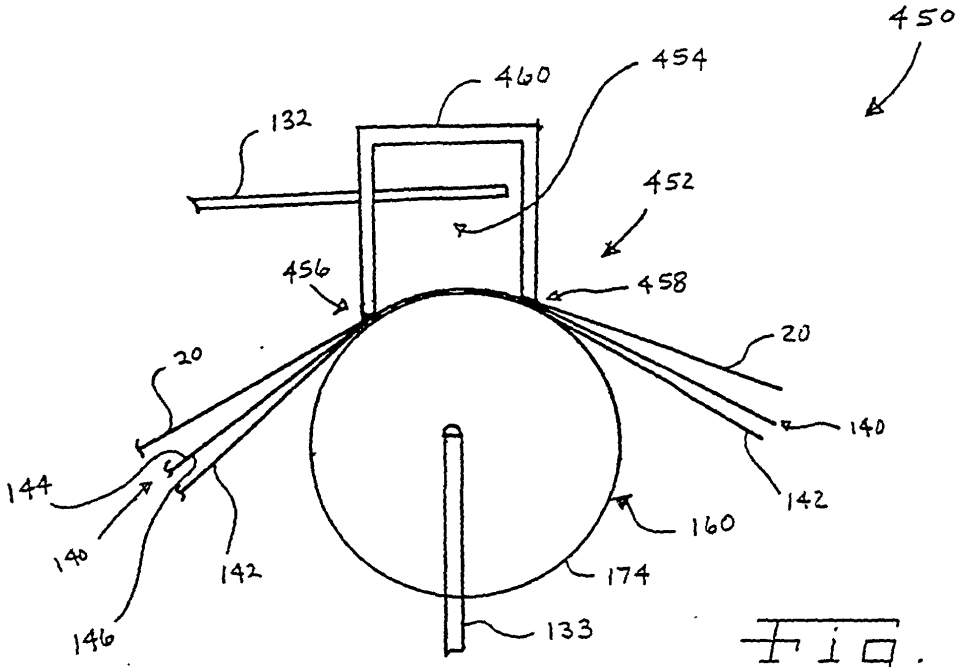
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Fig. 9

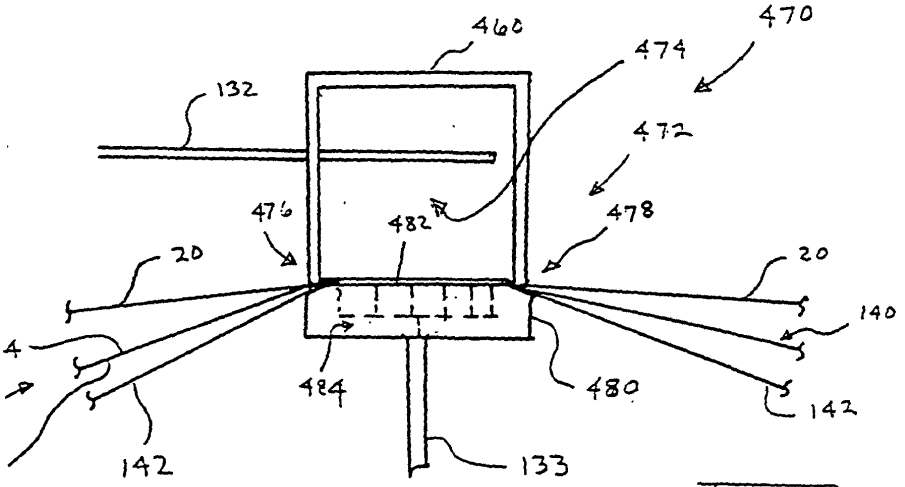
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Fig. 10