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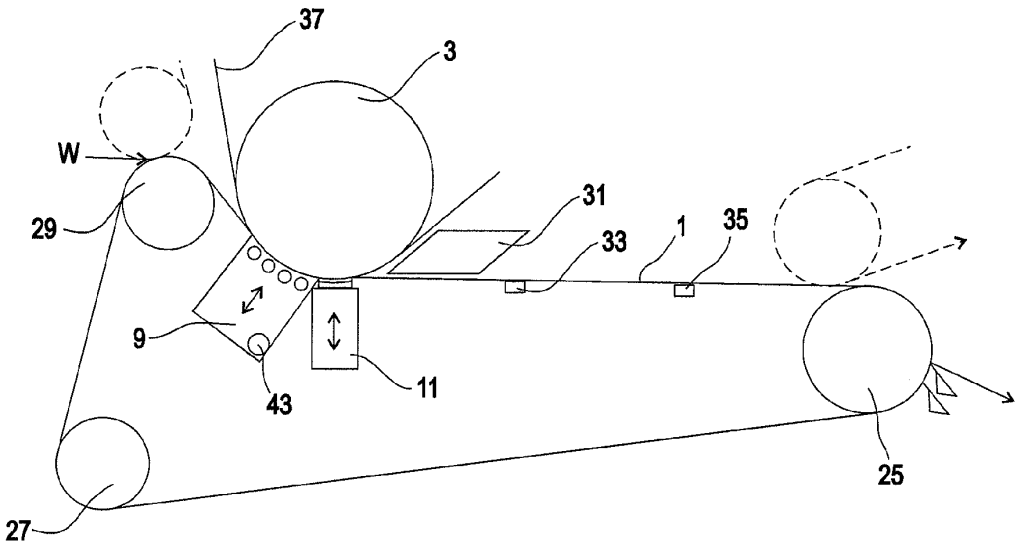
(54) Web pressing and dewatering method and pressing apparatus for a paper- or board-making machine

(57) The invention pertains to a web pressing and dewatering method using a pressing apparatus for a paper- or board-making machine for removing fluids from a web by pressing. The pressing apparatus comprises at least one belt (1) adapted to guide the web (W), wherein the belt (1) is impervious to fluids and forms an endless loop, a press roll (3) and a pressure means forming a press nip by wrapping the belt (1) about a circumferential portion of the press roll (3), through which press nip the guided web (W) is arranged to pass. The pressure means comprises a pressure chamber separated into at least two separating portions (9, 11) each of which comprising a particular pressure medium, the pressure chamber extending along the length of the press nip in the web (W) moving direction such that the particular pressure medium directly contacts the belt (1). The pressing is performed by using different pressure media in each of the at least two separating portions (9, 11) of the pressure chamber.

FIG. 1



EP 2 722 437 A1

Description

[0001] The invention pertains to a web pressing and dewatering method and to a pressing apparatus for a paper- or board-making machine for removing fluids from a web.

[0002] Document WO 2009 024 186 A1 discloses a pressing apparatus for a paper- or board-making machine for removing fluids from a web by pressing. The disclosed pressing apparatus comprises at least one belt which guides the web. The belt is impervious to fluids and forms an endless loop. At least one nip is formed between a press roll and a pressure means of the pressing apparatus. The guided web is arranged to pass through the nip. The pressure means comprises at least one pressure chamber containing a pressure medium and extending along the length of the nip in the web moving direction such that the pressure medium directly contacts the belt. The pressure chamber has a pressure-operated sealing member which cooperates with the belt, and the sealing operating pressure is adjusted in accordance with the pressure acting in the pressure chamber.

[0003] There is a need to provide a web pressing and dewatering method and a pressing apparatus for a paper- or board-making machine, respectively, which are capable to achieve a higher dryness content of a treated web than the prior art device.

[0004] According to the invention, a web pressing and dewatering method uses a pressing apparatus for a paper- or board-making machine for removing fluids from a web by pressing, and the pressing apparatus comprises at least one belt adapted to guide the web, and the belt is impervious to fluids and forms an endless loop; a press roll and a pressure means forming a press nip by wrapping the belt about a circumferential portion of the press roll, through which press nip the guided web is arranged to pass; the pressure means comprises a pressure chamber separated into at least two separating portions each of which comprise a particular pressure medium; the pressure chamber extends along the length of the press nip in the web moving direction such that the particular pressure medium directly contacts the belt; the pressing is performed by using different pressure media in each of the at least two separating portions of the pressure chamber.

[0005] Using the different pressure media in each of the at last two separating portions enables an accurate adaptation of the pressure in the respective section of the press nip.

[0006] Furthermore, in a web pressing and dewatering method according to the invention, one of the different media can be a gaseous fluid and another of the different media can be a liquid fluid.

[0007] Using a gaseous fluid enables to achieve a quite low pressure in a quite large area, while using a liquid fluid achieves a quite large pressure in a comparably small area of the metal belt.

[0008] Furthermore, in a web pressing and dewatering method according to the invention, a first separating portion in a running direction of the web can contain steam as pressure medium and a second separating portion in the running direction of the web can contain water as pressure medium.

[0009] Using steam as a pressure medium has the additional advantage that the heat of the steam can be also used for heating the metal belt. Furthermore, steam as well as water are readily available and can be easily handled.

[0010] Furthermore, in a web pressing and dewatering method according to the invention, the length of the press nip formed between the press roll and the belt wrapped by the pressure means, or the length of the press nip formed between the press roll and the portion of the belt corresponding to a first separating portion in a running direction of the web can be between 200 mm to 1000 mm or between 400 mm and 800 mm. Furthermore, the length of the press nip between the press roll and the portion of the belt corresponding to a second separating portion in a running direction of the web can be between 50 mm and 500 mm or between 100 mm and 500 mm. A diameter of the press roll can be between 1200 mm and 2200 mm.

[0011] A minimum length of the complete press nip is about 500 mm. Thereby, about a quarter of the circumference of the press roll is required for forming the press nip.

[0012] Furthermore, a pressure of the pressure medium in a first separating portion in a running direction of the web can be between 0.1 and 1 MPa, or between 0.4 and 1 MPa or between 0.4 and 0.6 MPa. Additionally or alternatively a pressure of the pressure medium in a second separating portion in a running direction of the web can be between 1 and 10 MPa or between 4 and 8 MPa.

[0013] Advantageously, the web can be exposed to warm air blown towards the belt, after having passed through the press nip. This improves a required dry content of the web.

[0014] Advantageously, the separation between the at least two separating portions can be effected by a pressure-operated sealing member cooperating with the belt. The sealing operating pressure can then be adjusted in accordance with the respective pressures acting in the at least two portions of the pressure chamber. Additionally or alternatively, pressures in the at least two separating portions can be different from each other and can be freely controlled.

[0015] Advantageously, the press roll can be a grooved roll.

[0016] Furthermore, advantageously, heating means can be used for maintaining a belt temperature within the press nip constant or for increasing the belt temperature within the press nip.

[0017] Furthermore, advantageously, a heat of the pressure medium in at least one of the separating portions can be used for heating the metal belt to maintain its temperature constant in the press nip or to increase

its temperature in the press nip. Additionally or alternatively the temperature of the belt in the press nip can be between 97° C and 115° C.

[0018] Furthermore, according to the invention a pressing apparatus for a paper- or board-making machine for removing fluids from a web by pressing, comprises at least one belt which guides the web, the belt being impervious to fluids and forming an endless loop, at least one nip, being formed between a press roll and a pressure means, and through which nip the guided web is arranged to pass. The pressure means comprises at least two pressure portions each of them containing a particular pressure medium and extending along the length of the nip in the web moving direction such that the each particular pressure medium is capable to directly contact the belt, and the pressure means has a sealing member which cooperates with the belt. One pressure portion of the at least two pressure portions is a steam chamber adapted to comprise hot steam as the particular pressure medium and having at least two steam pipes arranged in a cross direction of the belt, said steam pipes being capable to provide a steam flow directed towards the belt.

[0019] The apparatus according to the invention is in particular suitable for performing the above mentioned method steps.

[0020] Furthermore, doctors can be provided before the steam pipes, said doctors serving to remove remaining fluids from the belt. Thus, slipping of the belt (hydro planing) advantageously can be prevented.

[0021] Furthermore, advantageously, a second portion of the at least two pressure portions can be a hot water chamber adapted to comprise hot water as the pressure medium, and a pumping means being adapted to pump a condensate from the steam chamber to the hot water chamber via connecting means can be provided.

[0022] Furthermore, advantageously, a size of the steam chamber can be between one and ten decimal powers larger than that of the hot water chamber. Thus, in the area of the press nip affected by the steam chamber a comparably low pressure in a comparably large area can be provided. Furthermore, due to the heat of the steam the temperature of the belt can be accurately adjusted as needed. Thereby, the temperature of the web being at about 30° C to 40° C when entering the nip formed between the roll and the belt, can be suitable raised to a desired level. For instance, the temperature can be raised up to 100° C or more, in particular, if a metal belt is used. In this case, the metal belt temperature is raised to about 100° C to 120° C.

[0023] Furthermore, advantageously, at least one of the chamber walls arranged in parallel to a running direction of the belt can comprise a door or the chamber wall can be completely opened.

[0024] Furthermore, advantageously, friction heat caused by moving mechanical parts in one of the separating portions containing a liquid pressure medium can be transferred via the liquid pressure medium to the belt for heating the same. Thus, an effective use of waste heat is possible.

[0025] Furthermore, advantageously, the belt can be made of metal or synthetic or a ceramic material or of a combination of two or more of these.

[0026] Preferably, according to the method of the invention, a press felt is guided about the press roll in order to absorb/arrange void volume for water.

[0027] Further advantages of the invention will be readily appreciated by studying the presently preferred embodiment of the invention which is described by making reference to the attached figures.

FIG. 1 is a sectional view of a belt section of a paper or board making machine comprising a pressing apparatus according to the invention.

FIG. 2 is a schematically sectional view of a pressing apparatus according to the invention.

FIG. 3 is a schematically sketch showing to different pressure chambers in a press nip formed in a pressing apparatus according to the invention.

FIG. 4 is a diagram showing a pressure distribution in two different pressure chambers according to the invention.

[0028] A presently preferred embodiment of the invention will be described on basis of FIGS. 1 to 4.

[0029] FIG. 1 shows a sectional view of a pressing apparatus according to the invention. A press nip is formed by a belt 1 forming an endless loop between a press section (on the left side in FIG. 1) and a dryer section (on the right side in FIG. 1) of the paper or board making machine. A press roll 3 is arranged such that a portion of the belt 1 is wrapped about a circumference portion of the press roll 3 in order to form a press nip.

[0030] In FIG. 1 elements pertaining to the press section as well as to the dryer section but not directly related to the invention are drawn with dashed lines.

[0031] In order to guide a web W entering from a press nip formed between a roll 29 supporting the belt 1 and a second roll shown in dashed lines, the web is taken over by the belt 1 to be guided to the press nip formed between the press roll 3 and the belt 1. Furthermore, in order for sufficiently remove liquid contained in the web, such as water, a felt 37 is also guided about the press roll 3. Subsequent to the press roll 3, the web is further guided via a drying means 31 towards a first roll shown in dashed lines of a dryer section taking the web over from the belt 1 and guiding the web W further by means of a wire. Thereafter, the belt 1 is further guided about guiding rolls 25 and 27 to form the endless loop.

[0032] Preferably, a diameter of supporting roll 29 is between 800 mm to 1500 mm. An air dryer 31 is provided after the press nip in order to further reduce the moisture

content of the web W. Furthermore, support elements 33 and 35 arranged between the press nip and the dryer section of the paper or board making machine are provided within the closed loop of the belt 1 to reduce vibrations of the belt 1.

[0033] In order to adapt the pressure in the press nip formed between the belt 1 and the press roll 3, two pressure chambers 9 and 11 are provided inside of the closed loop of the belt 1 in order to affect a press force on the inner side of the belt 1.

[0034] According to the embodiment, a first pressure chamber 9 in the running direction of the belt/web is a steam chamber, while a second pressure chamber 11 is a water chamber. The terms steam chamber and water chamber pertain to the particular pressure medium used in the respective chambers. It is advantageous to arrange water medium temperature to be over 80° C to reduce thermal effects between the chambers. Furthermore, chambers can also be separated with thermal insulation, sliding joint or air chamber (with equivalent pressure) to reduce said structural changes at least with higher temperature difference.

[0035] The steam chamber as well as the water chamber can be guided to get into abutment with the inner side of the closed loop of the belt 1 as is schematically shown by double arrows in FIG. 1. For maintenance purpose etc. the two pressure chambers 9, 11 can be retracted. Therefore, the steam chamber 9 as well as the water chamber 11 is supported on respective supports 41, 39.

[0036] As can be taken from FIG. 2, the steam chamber comprises plural steam pipes 15 having respective outlets towards the inside of the closed loop of the belt 1. Thus, in order to increase the pressure in the press nip in the section covered by the steam chamber 9, steam is supplied from the steam pipes 15 towards the belt 1. Furthermore, each steam pipe 15 is provided with a doctor blade 17, which serves to remove the condensate steam from the inner side of the belt 1 in order to improve the effect of the steam applied onto the inner side of the closed belt loop from the subsequent steam pipe 15.

[0037] The condensate steam dropping to the floor of steam chamber 9 is removed via a condensate removal pipe 43 by means of a pump 19 pumping the condensate steam into the water chamber 11. Using the condensate steam in this manner leads to that the water temperature in the water chamber can be raised and enables saving of additional heating means in the area of the water chamber 11.

[0038] Furthermore, the steam chamber 9 is supported by a support beam 41. In a wall parallel to the running direction of the belt a door is provided (not shown in the figures), in order to enable access to the steam chamber for maintenance purpose etc.

[0039] Subsequent to the steam chamber 9 the already mentioned water chamber 11 is provided as a second pressure chamber. While in FIG. 2 water supplied to the water chamber 11 is merely shown by means of the condensate removal pipe 43 and pump 19, additional pumps and piping for supplying water to the water chamber 11 can be additionally provided.

[0040] By increasing the pressure of the water in water chamber 11, a remarkably high pressure can be applied on the metal belt, thus, increasing the pressure in the press nip section corresponding to the water chamber 11. Hydraulic seals 13 are provided at the boundaries of the water chamber 11 as well as on the boundaries of the steam chamber 9 in order to keep the pressure at the desired level. Preferably, these hydraulic seals 13 are made of PTFE or of carbon fiber reinforced plastics.

[0041] FIG. 3 is a schematic sketch showing the dimensional properties of the press nip formed between the press roll 3 and the belt 1. The section I corresponds to the steam chamber 9 and the section II corresponds to the water chamber 11. The length of the nip in section I is about 100 to 1000 mm, while the pressure achieved due to the steam pipes is between 1 and 10 bar (0.1 to 1 MPa). In section II, the length of the press nip is between 100 and 500 mm, while the pressure achieved due to the water pressure is between 10 bars to 100 bars (1 to 10 MPa). Depending on the length of the press nip, a diameter of the roll 3 is chosen such that an angle α of the roll segment forming the complete press nip is about 90°.

[0042] FIG. 4 shows a pressure distribution in the press nip of a preferred example of the embodiment. The length dimension l1 of the press nip in section I is 700 mm, while the length dimension l2 in section II is 500 mm. The pressure gained in section I is 4 bars to 6 bars, while the pressure gained in section II is 40 bars to 80 bars (section I 0.4 to 0.6 MPa; section II 4 to 8 MPa).

[0043] Since the seals 13 are provided as elastic seals, even comparably large particles up to 1600 g/m^2 present in the web do not cause a risk for damaging the press nip.

[0044] In case of quite short loops with metal belt length less than 20 m and a high degree of remaining dryness H between 0 - 60 % preferably a coated metal belt is used as belt 1 and especially with sticky furnishes (like fine paper, FBB, ...). Due to the provision of the steam chamber 9 in section I of the press nip a comparably high temperature of about 100° C instead of 75° C as known from the prior art can be provided. Preferably, the web temperature at the inlet of the press nip is about 30° C to 40° C, while the metal belt temperature in that area is about 100° C to 120° C. The arrangement according to the invention keeps the web 5 - 20° C warmer in the nip than prior art solution where a stream chamber is arranged before the press nip.

[0045] As mentioned above, belt 1 can be provided as coated and/or as heated belt.

[0046] In order to remove the water from the web, preferably felt 37 is used. In particular, it is advantageous to use felt 37 together with a grooved roll as press roll 3 or to use merely a grooved roll as press roll.

[0047] Wrapping a metal belt as belt 1 about the press roll 1 with a length of about 400 mm to 800 mm, a pressure of about 2 bars (0.2 MPa) can be achieved in such a press nip. Thus, a wrapped nip force of 80 kN/m to 160

kN/m showing good web heating properties can be achieved. Applying a steam chamber 9 exhibiting a steam pressure of about 4 bars to 10 bars (0.4 MPa to 1 MPa) against such a wrapped nip with a grooved counter roll, in comparison with a prior art shoe press (providing 350 kN/m by a load of 20 bars), leads to that an improved nip pressure distribution in respect of maximum pressure and bulk are achieved.

[0048] Furthermore, applying the steam chamber directly at the press nip, advantageously leads to that, depending on the required dry content, smoothness and evaporation the temperature of the belt can be kept steady or can be increased.

[0049] In particular, tests of the pressure apparatus according to the invention lead to that a dry content increase of 8 % compared to prior art roll nips can be achieved. Furthermore, since the seals of the steam chamber are flexible, a good resistance against paper webs of web brake can be achieved. Thus, the invention is in particular suitable for heavy grade webs.

[0050] Although the invention has been described on the basis of a presently preferred embodiment in connection with the figures, it is to be appreciated that the scope of the invention is merely defined by the attached claims. In particular, the arrangement and number of the pressure chambers is not limited to the description of the embodiment, but can be arbitrarily changed. Furthermore, the fluids or liquids used in the respective pressure chambers are not limited to steam and water, respectively, but suitable other media such as hydraulic oil, pressurized air or others can be used alternatively or additionally.

Claims

1. Web pressing and dewatering method using a pressing apparatus for a paper- or board-making machine for removing fluids from a web by pressing, the pressing apparatus comprising:

   at least one belt (1) adapted to guide the web (W), wherein the belt (1) is impervious to fluids and forms an endless loop,
   a press roll (3) and a pressure means (7) forming a press nip by wrapping the belt (1) about a circumferential portion of the press roll (3), through which press nip the guided web (W) is arranged to pass, wherein
   the pressure means comprises a pressure chamber (7) separated into at least two separating portions (9, 11) each of which comprising a particular pressure medium, the pressure chamber (7) extending along the length of the press nip in the web (W) moving direction such that the particular pressure medium directly contacts the belt (1), wherein the pressing is performed by using different pressure media in each of the at least two separating portions (9, 11) of the pressure chamber (7).

2. Web pressing and dewatering method according to claim 1, wherein one of the different media is a gaseous fluid and another of the different media is a liquid fluid.

3. Web pressing and dewatering method according to any of the preceding claims, wherein a first separating portion (9) in a running direction of the web contains steam as pressure medium and a second separating portion (11) in the running direction of the web (W) contains water as pressure medium.

4. Web pressing and dewatering method according to any of the preceding claims, wherein the length of the press nip formed between the press roll (3) and the belt (1) wrapped by the pressure means (7), or the length of the press nip formed between the press roll (3) and the portion of the belt (1) corresponding to a first separating portion (9) in a running direction of the web is between 200 mm to 1000 mm or between 400 mm and 800 mm, and/or
   the length of the press nip between the press roll (3) and the portion of the belt corresponding to a second separating portion (11) in a running direction of the web is between 50 mm and 500 mm or between 100 mm and 500 mm, and/or
   a diameter of the press roll (3) is between 1200 mm and 2200 mm.

5. Web pressing and dewatering method according to any of the preceding claims, wherein a pressure of the pressure medium in a first separating portion (9) in a running direction of the web (W) is between 0.1 and 1 MPa, or between 0.4 and 1 MPa or between 0.4 and 0.6 MPa, and/or wherein a pressure of the pressure medium in a second separating portion (11) in a running direction of the web (W) is between 1 and 10 MPa or between 4 and 8 MPa.

6. Web pressing and dewatering method according to any of the preceding claims, wherein the web (W) is exposed to warm air blown towards the belt, after having passed through the press nip.

7. Web pressing and dewatering method according to any of the preceding claims, wherein the separation between the at least two separating portions (9, 11) is effected by a pressure-operated sealing member (13) cooperating with the belt, and
   the sealing operating pressure is adjusted in accordance with the respective pressures acting in the at least two portions (9, 11) of the pressure chamber, and/or
   pressures in the at least two separating portions (9, 11) are different from each other and are freely con-

trolled.

8. Web pressing and dewatering method according to any of the preceding claims, wherein the press roll (3) is a grooved roll (3).

9. Web pressing and dewatering method according to any of the preceding claims, wherein heating means (15) are used for maintaining a belt temperature within the press nip constant or for increasing the belt temperature within the press nip.

10. Web pressing and dewatering method according to claim 9, wherein a heat of the pressure medium in at least one of the separating portions (9) is used for heating the metal belt (1) to maintain its temperature constant in the press nip or to increase its temperature in the press nip, and/or
the temperature of the belt (1) in the press nip is between 97° C and 115° C.

11. A pressing apparatus for a paper- or board-making machine for removing fluids from a web (W) by pressing, comprising:

at least one belt (1) which guides the web (W), wherein the belt (1) is impervious to fluids and forms an endless loop,
at least one nip, which is formed between a press roll (3) and a pressure means (7), and through which nip the guided web (W) is arranged to pass, wherein
the pressure means (7) comprises at least two pressure portions (9, 11) each of them containing a particular pressure medium and extending along the length of the nip in the web moving direction such that the each particular pressure medium is capable to directly contact the belt (1), and
the pressure means (7) has a sealing member (13) which cooperates with the belt (1), wherein one pressure portion (9) of the at least two pressure portions is a steam chamber (9) adapted to comprise hot steam as the particular pressure medium and having at least two steam pipes (15) arranged in a cross direction of the belt, said steam pipes (15) being capable to provide a steam flow directed towards the belt.

12. The pressing apparatus according to claim 11, wherein doctors (17) are provided before the steam pipes (15), said doctors serving to remove remaining fluids from the belt (1).

13. The pressing apparatus according to claim 11 or 12, wherein a second portion (11) of the at least two pressure portions is a hot water chamber (11) adapted to comprise hot water as the pressure medium, and a pumping means (19) being adapted to pump a condensate from the steam chamber (9) to the hot water chamber via connecting means (21) is provided.

14. The pressing apparatus according to claim 13, wherein a size of the steam chamber (9) is between one and ten decimal powers larger than that of the hot water chamber (11).

15. The pressing apparatus according to any of the preceding claims, wherein at least one of the chamber walls arranged in parallel to a running direction of the belt (1) comprises a door or the chamber wall can be completely opened.

FIG. 1

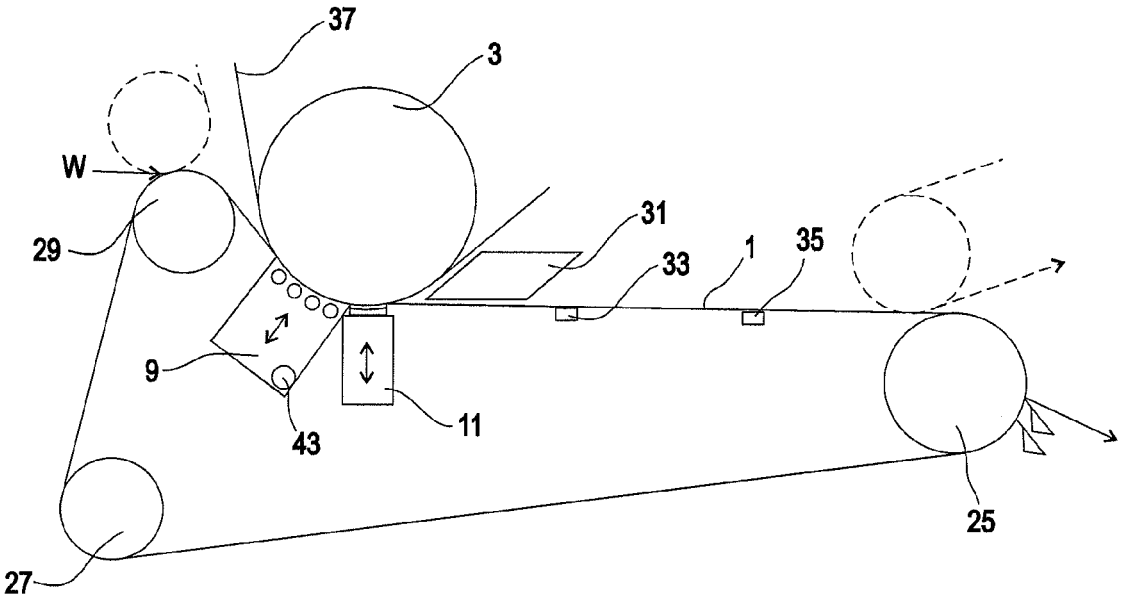

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FIG. 2

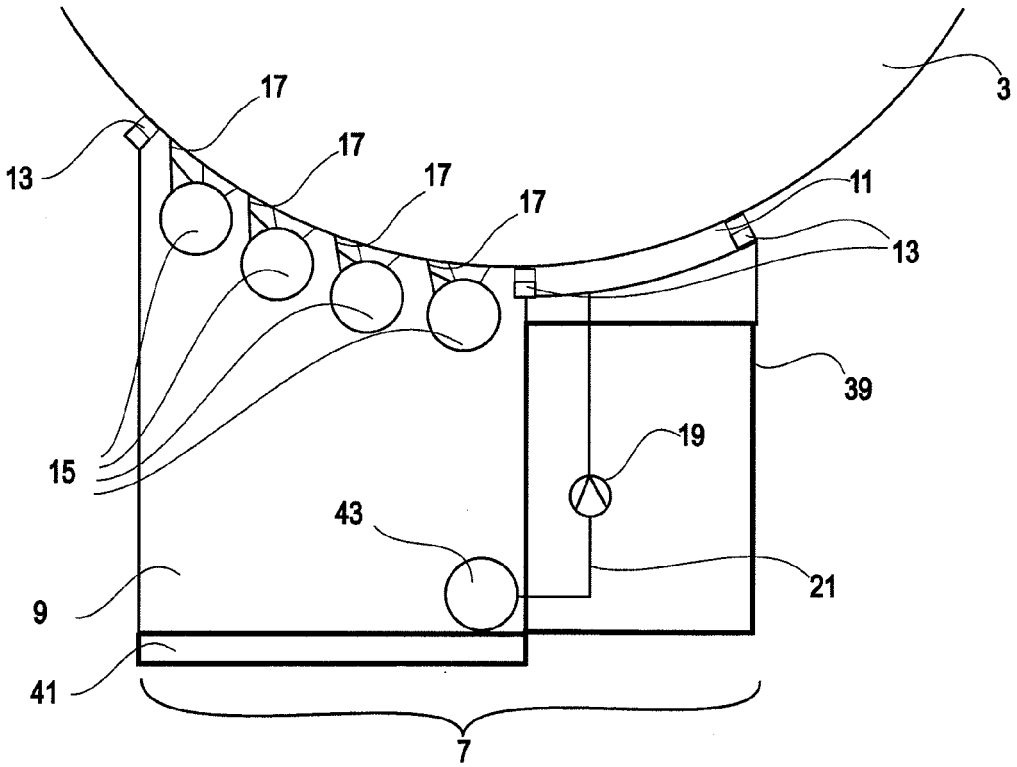
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FIG. 3

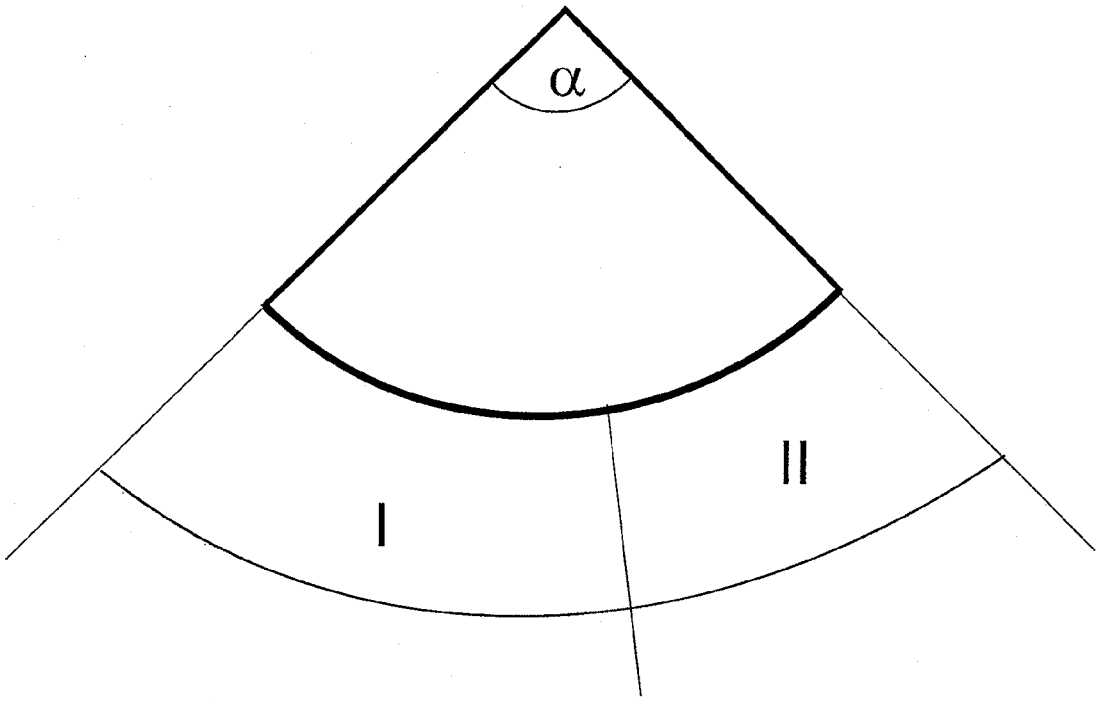
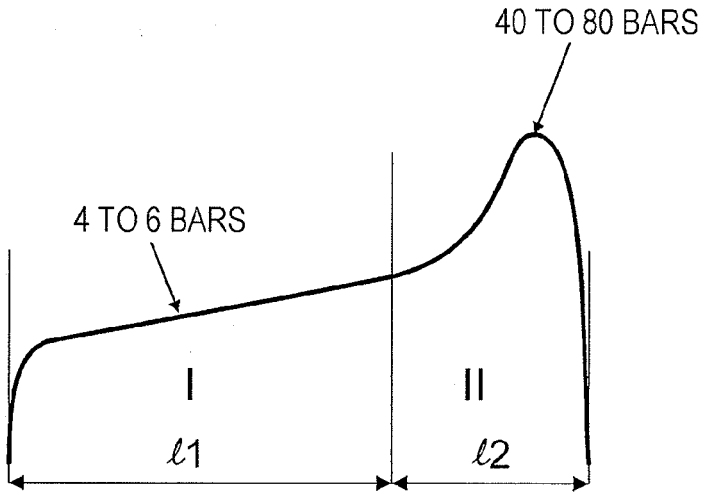


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 12 18 9019

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 31 05 276 A1 (ESCHER WYSS GMBH [DE]) 12 August 1982 (1982-08-12) * the whole document * -----	1-15	INV. D21F3/02
A	US 3 974 026 A (EMSON STEPHEN DEREK ET AL) 10 August 1976 (1976-08-10) * the whole document * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 December 2012	Gast, Dietrich

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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1

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 18 9019

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82