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(54) A METHOD OF MAKING PAPERBOARD AND A MACHINE FOR MAKING PAPERBOARD

VERFAHREN ZUR HERSTELLUNG VON PAPPE UND MASCHINE ZUR HERSTELLUNG VON PAPPE

PROCEDE DE FABRICATION DE CARTON ET MACHINE DE FABRICATION DE CARTON

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(56) References cited:
EP-A1- 0 770 727
EP-A2- 1 072 721
WO-A1-99/60203
DE-A1- 10 050 847
US-A- 4 662 992
US-A1- 2002 053 415

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method of making paperboard. The invention also relates to a machine for making paperboard as well as to a press section in which a wet fibrous web may be dewatered.

BACKGROUND OF THE INVENTION

[0002] As indicated above, the present invention relates to the production of paperboard. Examples of paperboard grades include Solid Bleached Board, Liquid Packaging Board, Gypsum Board and White Lined Chipboard.

[0003] Solid Bleached Board - or SBB - is a grade that has a basis weight in the range of 160 g/m^2 - 400 g/m^2 and is made of 100% chemical pulp. This grade usually comprises more than one layer and is therefore made in a machine having more than one forming unit. However, SBB can also be made with only one layer. SBB is primarily used for making cigarette packets but can also used for other packaging purposes.

[0004] Liquid Packaging Board - or LPB - is a grade that has a basis weight in the range of 160 g/m^2 - 400 g/m^2. This grade comprises several layers. Usually, LPB is made of both chemical and mechanical pulp.

[0005] Gypsum Board is a grade that has a basis weight in the range of 140 g/m^2 - 300 g/m^2. Gypsum Board typically comprises several layers and is normally made from recycled fibers.

[0006] White Lined Chipboard is a board grade that has a basis weight in the range of 160 g/m^2 - 450 g/m^2. White Lined Chipboard is extensively used in the manufacture of cartons for all manner of articles. WLC has several layers of which a top layer is bleached and forms a white side that goes on the outside of the carton and carries the printing. The various gray layers are made from recycled fibers.

[0007] During the production of paperboard grades, special demands are placed on the press section. During dewatering of paperboard grades, large quantities of water must be removed from the wet fibrous web. One way of achieving a high degree of water removal in the press section is to use high linear loads in the press nips. However, high bulk and a high bending stiffness are desired qualities of the final product and a high linear load in the press nips may result in a web with higher density and less bulk. It has been suggested that, in order to preserve bulk, a shoe press can be used instead of a short roll nip.

[0008] It is also desirable that the press section does not require too much space and that the press section is easy to operate. Furthermore, it is desirable that web breaks can be taken care of efficiently and that web breaks in the press section do not cause harm to the machinery.

[0009] It has been suggested by H. Ilvespää ("Valmet Paper Machine Days" 1996, pages 60 - 61) that the press section of a paper machine can consist of one double-felted shoe press. According to Ilvespää, pilot trials have shown that the dewatering capacity of such a concept is high enough for many slower machines.

[0010] It has also been suggested that a suction roll can be used as a counter roll for a shoe press roll. Such a concept is disclosed in WO 99/60203 and it is stated that this concept can be used for a paper or board machine.

[0011] US patent No. 4,662,992 discloses a twin-wire papermaking machine having a wire section with a top wire and a bottom wire. A press nip is formed between a single pressing roll 14 a pressing or supporting shoe 17 with a flexible band 20. The single pressing roll 14 is a non-suction solid roll. The single pressing roll 14 and the pressing shoe form a single pressing nip in the form of an extended pressing zone. In one embodiment, the single pressing nip is a two-felted nip. In that embodiment, one felt 34 forms a loop around the pressing roll 14 and another felt 19 forms a loop around the pressing shoe 17 and the flexible band 20. The felt 34 that forms a loop around the single pressing roll 14 is guided conjointly with the paper web from the top wire to the single pressing roll 14. A drying section is located after the press section. In the Figure illustrating the embodiment with a two-felted nip, the web is shown as following a partially unsupported open draw to the drying section.

[0012] It is an object of the present invention to provide such a method for making paperboard that permits large quantities of water to be removed in the press section and yet preserves the bulk of the fibrous web (and of the final product). An additional object of the invention is to provide a machine and a press section that is easy to operate and where web breaks can be taken care of efficiently. It is also an object to provide a press section that requires a minimum of space.

DESCRIPTION OF THE INVENTION

[0013] According to the invention a fibrous web is formed on a foraminous wire. The web has a basis weight in the range of 140 g/m^2 - 500 g/m^2. The fibrous web is transferred from the wire to a first press felt in a press section. The first felt is an upper felt and the press section comprises a single dewatering nip formed between an upper shoe press roll and a lower suction roll. The first press felt forms a loop around the shoe press roll and a second press felt which is a lower felt forms a loop around the suction roll. The shoe press roll may be, for example, a SymBelt™ shoe press roll that can be obtained from Metso Paper Karlstad AB, Sweden. In the press section, the fibrous web is passed through the single dewatering nip. At the exit side of the single dewatering nip, the web has been sucked against the second press felt by the suction roll. However, as the fibrous web exits from the single dewatering nip, the web is separated from the lower press felt and passed in an at least partially open draw

to a drying section located downstream of the press section.

[0014] In an advantageous embodiment, the press section further comprises a smoothing press located between the single dewatering nip and the drying section. The rolls of the smoothing press can be operated at a higher peripheral speed than the peripheral speed of the rolls of the single dewatering nip. Thereby, the fibrous web can be pulled away from the lower press felt as the web exits from the single dewatering nip.

[0015] Advantageously, the fibrous web is formed in a forming section having at least two forming units so that the fibrous web is formed as a web with at least two layers. The web can have a basis weight in the range of 160 g/m^2 - 400 g/m^2 and the web can be formed either from a purely chemical pulp or at least partially from mechanical pulp.

[0016] In one embodiment of the invention, the web is passed through a dewatering nip on the foraminous wire before it is transferred from the wire to the press section. This is suitable in particular if the web is formed from mechanical pulp.

[0017] Preferably, the single dewatering nip applies a linear load on the web that is not higher than 200 kN/m. However, if the web is formed at least partially from mechanical pulp, it may be suitable to apply linear loads higher than 200 kN/m in the single dewatering nip. The speed of the web should preferably not exceed 1000 m/min in the press section. In the smoothing press, the linear load can suitably be in the range of 20 kN/m - 100 kN/m.

[0018] The invention also relates to a press section for pressing water from a wet fibrous web. The press section according to the present invention comprises a shoe press roll and a suction roll. The suction roll forms a dewatering nip against the shoe press roll. This dewatering nip is the only or single dewatering nip of the press section such that there is no other dewatering nip in the press section. A first press felt forms a loop around the shoe press roll and a second press felt forms a loop around the suction roll such that the fibrous web can be passed through the dewatering nip sandwiched between the first and the second press felt. The second press felt has a felt run after the single dewatering nip that diverges from the felt run of the first press felt. The shoe press roll is an upper roll in the dewatering nip and the suction roll is a lower roll.

[0019] The press section is provided with means for separating the fibrous web from the second press felt as the web exits from the single dewatering nip. Downstream of the dewatering nip, a smoothing press nip is formed by a pair of smoothing rolls arranged to come into direct contact with the surface of the fibrous web such that each side of a fibrous web passing through the smoothing press nip will be contacted by one of the smoothing rolls. The smoothing rolls can be driven at a peripheral speed that exceeds the peripheral speed of the shoe press roll and the suction roll. Between the single dewatering nip and the smoothing press, a guide roll for the fibrous web may placed so that a straight line from the dewatering nip to the point of contact between the guide roll and the web diverges from the felt run of the second press felt after the single dewatering nip. Alternatively, the smoothing press nip may be placed so that a straight line from the dewatering nip to the smoothing press nip diverges from the felt run of the second press felt after the single dewatering nip.

[0020] The pair of smoothing rolls preferably comprises one roll with a relatively hard cover having a hardness in the range of 0 - 1 P&J and one roll with a relatively soft cover having a hardness in the range of 10 - 40 P&J.

[0021] The invention also relates to a machine for making paperboard such as for example Solid Bleached Board or Liquid Packaging Board. The machine comprises a forming section having at least one foraminous wire on which a fibrous web may be formed. The machine further comprises a press section downstream of the forming section. The press section has a single dewatering press nip. In the press section, there is a shoe press roll and a suction roll that, together with the shoe press roll, forms the single dewatering nip of the press section. A first press felt forms a loop around the shoe press roll and the first press felt is arranged to pick up the fibrous web from the foraminous wire of the forming section. A second press felt forms a loop around the suction roll such that the fibrous web can be passed through the dewatering nip sandwiched between the first and the second press felt. The second press felt has a felt run after the single dewatering nip that diverges from the felt run of the first press felt. A drying section is located downstream of the press section and separated from the single dewatering press nip by a web run which is separate from the run of the second press felt downstream of the single dewatering nip.

[0022] A smoothing press nip is located between the press section and the drying section. The smoothing press nip is formed between a pair of smoothing rolls arranged to come into direct contact with the surface of the fibrous web such that each side of a fibrous web passing through the smoothing press nip will be contacted by one of the smoothing rolls. The smoothing rolls can be driven at a peripheral speed that exceeds the peripheral speed of the press rolls. A guide roll can be placed between the dewatering press nip and the smoothing press nip. The guide roll is preferably placed so that a straight line from the dewatering nip to the guide roll diverges from the felt run of the second press felt after the single dewatering nip.

[0023] In an advantageous embodiment of the invention, the forming section comprises at least two forming units such that the fibrous web is formed as a web with at least two layers. Preferably, the smoothing press comprises one roll with a relatively soft cover and one roll with a relatively hard cover.

[0024] The machine may further comprise a dewatering press nip in the forming section.

DESCRIPTION OF THE DRAWINGS

[0025]

Fig. 1 shows parts of a machine for making paperboard

Fig. 2 shows an embodiment of a press section according to the present invention.

Fig. 3 shows a second embodiment of a press section according to the present invention.

Fig. 4 shows an embodiment where the press section is preceded by a forming section where a dewatering nip has been arranged.

Fig. 5 shows an embodiment that is a variation of the embodiment showed in Fig. 4.

Fig. 6 shows yet another variation of the embodiment of Fig. 4.

Fig. 7 shows yet another possible embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0026] The method according to the present invention shall now be explained with reference to Fig. 1. A fibrous web **W** having a basis weight in the range of 140 g/m^2 - 500 g/m^2 is initially formed on the foraminous wire **5** of a forming section **2.** The forming section **2** may have more than one forming unit. In Fig. 1, two forming units **3, 4** are shown. In this way, the fibrous web **W** can be formed as a web **W** with at least two layers. Of course, it is possible to use more than two forming units **3, 4** and it is also conceivable that the forming section **2** has only one forming unit. The fibrous web **W** is transferred from the wire **5** to a first press felt **7** in a press section **6.** At this stage of the process, the wet fibrous web **W** may have a dry solids content of about 15% by weight - 20% by weight. The first press felt **7** is suitably an upper press felt. The press section **6** comprises a single dewatering nip **9** formed between an upper shoe press roll **10** and a lower suction roll **11.** The suction roll **11** can suitably be operated at a negative pressure of about 35 kPa. An example of a suction roll that could possibly be suitable for this purpose is disclosed in WO 98/0793 included herein by reference. The first press felt **7** forms a loop around the shoe press roll **10.** A second press felt **8,** suitably a lower press felt **8,** forms a loop around the suction roll **11.** When the web **W** has been transferred to the press section **6,** the fibrous web **W** is passed through the single dewatering nip **9.** The suction roll **11** is able to handle large quantities of water. This is very important for webs with a high basis weight such as paperboard grades that are heavy and contain large amounts of water as they enter the press section. In the dewatering press nip **9,** the fibrous web **W** is sucked against the second press felt **8** by the suction **roll 11.** Therefore, the web **W** will adhere to the second press felt **8.** Unless the web is prevented from doing so, the web **W** will follow the second press felt **8** after the dewatering nip **9.**

[0027] If it does, rewetting from the second press felt **8** will reduce the dryness of the fibrous web **W.** However, as the fibrous web **W** exits from the single dewatering nip **9,** the fibrous web **W** is separated from the lower press felt **8** and passed in an at least partially open draw to a drying section **13** located downstream of the press section **6.** Very often, it has been argued that there should be as few open draws as possible in a modern paper making machine and that closed draws are preferable. Consequently, it has been proposed that, in the press section, the web should be supported by felts all the way through the press section. However, web support is less important in the production of paperboard where machine speeds are relatively low. For such applications, it may be more important to counteract rewetting in the press section. When the web **W** reaches the first drying cylinder **20** of the drying section, the dry solids content of the web may be about 40% - 45%. The dryness should preferably be as high as possible when the web **W** reaches the drying section **13** since water that has not been pressed out in the press section must be removed by heat, which is expensive. It costs less to press out water than to evaporate water from the web.

[0028] The web **W** can be separated from the second press felt **8** in for example the following way. The press section **6** preferably comprises a smoothing press nip **14** formed between a pair of smoothing rolls **15, 16.** The smoothing press nip **14** is suitably located between the single dewatering nip **9** and the drying section **13.** The smoothing rolls **15, 16** can be operated at a higher peripheral speed than the peripheral speed of the rolls in the single dewatering nip **9** such that the smoothing rolls **15, 16** will exert a force on the web **W.** Thereby, the fibrous web **W** will be separated from the lower press felt **8** as the web **W** exits from the single dewatering nip **9.** The speed of the web **W** in the press section does not exceed 1000 m/min and the difference in peripheral speed between the rolls in the single dewatering nip **9** and the smoothing rolls **15, 16** may be in the range of 0,5 % - 2 %. It should be understood that many machines for paperboard are operated at speeds well below 1000 m/min. A normal machine speed may be in the range of 500 m/min - 800 m/min. Since an open draw is used in the method according to the present invention, speeds above 1000 m/min would probably be difficult to achieve. Since the fibrous web **W** is pulled away from the second press felt **8** as soon as the web exits from the dewatering nip **9,** rewetting can be avoided. Therefore, a high dryness can be achieved. Possibly, a guide roll **60** placed between the single dewatering nip **9** and the smoothing press nip **14** can also be used to guide the web **W** away from the second press felt **8.**

[0029] An alternative method for separating the web **W** from the second press felt **8** could be to apply a speed difference between the drying section **13** and the press section **6.**

[0030] The web **W** is preferably formed to have a basis weight in the range of 160 g/m^2 - 400 g/m^2 and the web **W** can be formed either from chemical pulp or at least

partially from mechanical pulp.

[0031] If the web **W** is formed from chemical pulp, the linear load on the web in the single dewatering nip should preferably not exceed 200 kN/m since a higher load could be detrimental to bulk. However, if the web **W** is formed wholly or partially from mechanical pulp, it may even be desirable to use a higher linear load than 200 kN/m since webs formed from mechanical pulp require a higher linear load and higher pressures in order to achieve adequate dewatering. For example, during the production of Liquid Packaging Board, a high linear load in the dewatering nip may be required, i.e. a linear load exceeding 200 kN/m.

[0032] If the web is formed from mechanical pulp, it can also be advantageous to pass the web **W** through a dewatering nip **17** on the foraminous wire **5** before it is transferred from the wire **5** to the press section **6.**

[0033] The linear load in the smoothing press is preferably in the range of 20 kN/m - 100 kN/m.

[0034] When the web **W** has been passed through the drying section, the web may be subjected to other operations such as coating and calendering. A calendering operation may be performed for example by means of an extended nip calender such as an OptiDwell™ shoe calender that is sold by Metso Paper Inc., Järvenpää, Finland. For example, if the web is a web with more than one layer and one of the layers is a bleached layer intended for printing, the bleached layer can be coated. After coating, the web **W** can be subjected to calendering, e.g. calendering with a shoe calender.

[0035] The invention also relates to a press section **6** for pressing water from a wet fibrous web **W.** With reference to Fig. 2, the press section comprises a shoe press roll **10** and a suction roll **11.** The shoe press roll **10** has a concave shoe **90.**

[0036] The suction roll **11** forms a dewatering nip **9** against the shoe press roll **10.** This dewatering nip is the single dewatering nip **9** of the press section **6** such that there is no other dewatering nip in the press section **6.** Preferably, the shoe press roll **10** is an upper roll in the single dewatering nip **9** and the suction **11** roll a lower roll. A first press felt **7** forms a loop around the shoe press roll and a second press felt **8** forms a loop around the suction roll **11** such that the fibrous web **W** can be passed through the single dewatering nip **9** sandwiched between the first **7** and the second press felt **8.** The second press felt **8** has a felt run after the single dewatering nip **9** that diverges from the felt run of the first press felt **7.** Inside the loop of the first press felt **7,** a suction roll **40** is arranged to pick up the wet fibrous web **W** from a foraminous wire **5** of a forming section. Means are provided for separating the fibrous web **W** from the second press felt **8** as the web exits from the single dewatering nip **9.** Downstream of the dewatering nip **9,** a smoothing press nip **14** is formed by a pair of smoothing rolls **15,16.** The smoothing rolls **15, 16** are arranged to come into direct contact with the surface of the fibrous web such that each side of a fibrous web passing through the nip of the smoothing press nip **14** will be contacted by one of the smoothing rolls **15,16.** A guide roll **60** is provided for guiding the web **W** along a path that diverges from the felt run of the second press felt **8.** In for example Fig. 3, a guide roll **60** is showed. A straight line from the single dewatering nip **9** to the guide roll **60** (or to the web-contacting part of the guide roll) diverges from the felt run of the second press felt **8** after the dewatering nip **9.** Alternatively, the smoothing press nip **14** may be placed so that a straight line from the dewatering nip **9** to the smoothing press nip **14** diverges from the felt run of the second press felt after the single dewatering nip **9.** The smoothing rolls **15,16** can be driven at a peripheral speed that exceeds the peripheral speed of the press rolls **10, 11** of the dewatering nip **9.** When the peripheral speed of the smoothing rolls exceed the peripheral speed of the press rolls (the suction roll and the shoe press roll), the fibrous web will be pulled away from the second press felt **8** so that the web run diverges from the web run of the second press felt after the dewatering nip **9** and rewetting can be reduced.

[0037] The first press felt **7** may be used to stabilize the fibrous web **W** during a part of the web run but the web does not adhere to the first press felt **7.** In for example Fig. 2, it can be seen how the fibrous web **W** has a web run after the single dewatering nip **9** that is very close to the first press felt **7.** In this way, the first press felt **7** can contribute to stabilizing the web **W** during part of the web run but the web **W** does not adhere and there is either no or only insignificant rewetting from the first press felt **7.**

[0038] It should be understood that, while the use of a smoothing press necessitates an open draw, parts of the web path between the single dewatering nip and the drying section could be equipped with various supports for the fibrous web. In fact, it is possible to envisage embodiments of the invention where only a small part of the web path is an open draw.

[0039] Preferably, the pair of smoothing rolls comprises one roll with a relatively hard cover having a hardness in the range of 0 - 1 P&J and one roll with a relatively soft cover having a hardness in the range of 10 - 40 P&J.

[0040] As indicated above, the shoe press roll is preferably an upper roll. Therefore, the shoe press roll is advantageously equipped with means for retracting the shoe. Such means are disclosed in, for example, US patent No. 5662777, US patent No. 5223100, US patent No. 5084137 and US patent No. 6083352. It should be understood that the shoe press roll that forms part of the present invention could suitably be designed according to the disclosure of one of the above indicated US patents (of course, other designs may also be possible). It should also be understood that, with regard to the design of the shoe press roll, the applicant reserves the right to further define the invention in terms taken from any one of the above indicated US patents. A suitable shoe length for the concave shoe of the shoe press roll is in the range of 200 mm - 400 mm. Preferably, the shoe length is about 290 mm.

[0041] The press felts should preferably have a high degree of water permeability.

[0042] In the case of a web break between the dewatering nip **9** and the smoothing press nip **14,** the following will happen. When the fibrous web **W** breaks, the smoothing rolls **15, 16** will no longer be able to pull the web away from the second press felt **8.** Therefore, the web will follow the second press felt **8** and be transferred downwards to the pulper. To ensure that the web **W** does not follow the loop of the second press felt **8,** a smooth-surfaced roll **51** is arranged to pick the web **W** from the second press felt **8**. A doctor **50** is arranged to act on the smooth roll **51.**

[0043] In Fig. 3, an alternative embodiment is disclosed that may be suitable for grades formed from mechanical pulp. In the embodiment according to Fig. 3, there is a dewatering nip **17** in the forming section. This nip is formed between a roll **31** and a suction roll **32.** The suction roll **32** is placed inside the loop of the foraminous wire **5** and the roll **31** is looped by a fabric **30** that may be a felt. This kind of press nip (a nip on the foraminous wire) is often referred to as a pre-press nip.

[0044] Fig. 4 shows an embodiment that is similar to the embodiment of Fig. 3 except that the dewatering nip **17** in the forming section is formed between a shoe press roll **31** and a suction roll **32** inside the loop of the foraminous wire **5.**

[0045] Fig. 5 shows an embodiment that is similar to the embodiment of Fig. 3 except that the first press felt **7** extends through the dewatering nip **17** in the forming section. In this embodiment, the pre-press has no separate fabric **30.**

[0046] Fig. 6 shows an embodiment that is similar to the embodiment of Fig. 5 except that a shoe press roll **31** is used for the dewatering nip **17** on the foraminous wire (the pre-press).

[0047] Fig. 7 shows an embodiment that is similar to the embodiment of Fig. 3 except that the pre-press employs a solid roll **32** instead of the suction roll **32** indicated in Fig. 3.

[0048] The invention also relates to a machine for making paperboard. With reference to Fig. 1, the machine comprises a forming section **2** having at least one foraminous wire **5** on which a fibrous web **W** may be formed. Downstream of the forming section **2,** there is a press section **6** having a single dewatering press nip **9.** The single dewatering nip **9** is formed between a shoe press roll **10** and a suction roll **11** which, together with the shoe press roll **10,** forms the single dewatering nip **9** of the press section **6.** In the press section **6,** a first press felt **7** forms a loop around the shoe press roll **10** and the first press felt **7** is arranged to pick up the fibrous web **W** from the foraminous wire **5** of the forming section **2.** A suction pick-up roll **40** is arranged within the loop of the first press felt **7** in order to pick up the fibrous web **W** from the wire **5.** A second press felt **8** forms a loop around the suction roll **11** such that the fibrous web **W** can be passed through the single dewatering nip **9** sandwiched between the first **7** and the second press felt **8.** The second press felt **8** has a felt run after the single dewatering nip **9** that diverges from the felt run of the first press felt 7. A drying section **13** is located downstream of the press section **6.** In Fig. 1, only two drying cylinders **20, 21** are indicated but it should be understood that the drying section **13** normally comprises a large number of drying cylinders and not just two drying cylinders. The drying cylinders **20, 21,** can be heated from the inside so that water can be evaporated from the fibrous web **W.** The drying section **13** is separated from the single dewatering press **9** nip by a web run which is separate from the run of the second press felt **8** downstream of the single dewatering nip **9.**

[0049] A smoothing press nip **14** is located between the press section **6** and the drying section **13.** The smoothing press nip **14** is formed by a pair of smoothing rolls **15, 16** arranged to come into direct contact with the surface of the fibrous web **W** such that each side of a fibrous web **W** passing through the smoothing press nip will be contacted by one of the smoothing rolls **15, 16.** Means are provided for separating the fibrous web **W** from the second press felt **8** after the single dewatering nip **9.** In Figs. 1 - 7, a guide roll **60** is showed. This guide roll **60** is located between the single dewatering nip **9** and the smoothing press nip **14.** A straight line from the single dewatering nip **9** to the part of the guide roll **60** where the guide roll **60** meets the web **W** diverges from the felt run of the second press felt **8** after the single dewatering nip **9.** The guide roll **60** will then contribute to separating the fibrous web from the second press felt **8.** Alternatively, the smoothing press nip **14** itself may be placed so that a straight line from the single dewatering nip **9** to the smoothing press nip **14** diverges from the felt run of the second press felt **8** after the single dewatering nip **9.** An additional guide roll **70** is located between the smoothing press nip **14** and the drying section **13.**

[0050] In the embodiment according to Fig. 1, the forming section **2** comprises two forming units **3, 4** such that the fibrous web **W** is formed as a web **W** with two layers. However, it should be understood that the forming section **2** could also comprise more than two forming units. For example, the forming section **2** could comprise three or four forming units so that the fibrous web **W** could be formed as a web with three or four layers.

[0051] One of the rolls that form the smoothing press nip **14** is a roll with a relatively hard cover and one is a roll with a relatively soft cover. Preferably, the hard cover has a hardness in the range of 0 - 1 P&J and the soft cover a hardness in the range of 10 - 40 P&J.

[0052] As explained previously, the machine may also comprise a dewatering press nip **17** in the forming section **2.**

[0053] The machine may suitably also include a coating unit after the drying section and a calender, for example a shoe calender such as an OptiDwell™ shoe calender.

[0054] By using a single dewatering nip in the press section, the following advantages are achieved. The press section can be made shorter so that it occupies

less space. This is important for example during rebuilds of existing press sections where space may be limited. Moreover, less equipment in the press section makes the press section easier to operate. An additional advantage of using a single dewatering press nip is that, for comparable dryness levels, higher bulk and bending stiffness can be obtained compared to what is possible in a press section with two or more dewatering press nips.

[0055] By using a suction roll in the single dewatering nip, one gains the advantage that the large quantities of water that must be taken care of for paperboard webs can be handled easier. If a solid roll were to be used as a counter roll for the shoe press roll, a lot of water would remain on the surface of the roll. However, the suction roll can remove water more efficiently. In addition, the suction roll ensures that the web will follow the lower felt in case of a web break. This makes it easier to deal with web breaks. Further, the web will follow the lower felt during threading and there is no risk for sheet stealing when the web is taken through the press section. A possible threading sequence may be as follows. Initially, the entire web width is taken through the single dewatering nip. The web will follow the lower felt. A tail is then passed to the smoothing press. A skilled operator using a tool connected to a source of pressurized air can do this manually. The tail can then be made wider until the entire web is passed through the smoothing press nip. Due to the speed difference between the smoothing press and the single dewatering nip, the web will now be separated from the second (lower) felt. A similar sequence can be used to take the web from the smoothing press to the drying section. Tail threading may also be achieved by such a tail threading device that is disclosed in US patent No. 6,131,784.

[0056] By separating the fibrous web from the second (lower) press felt after the single dewatering nip, one gains the advantage that rewetting from the second press felt is avoided or reduced to a minimum. Thereby, a higher dryness is obtained.

[0057] The use of a shoe press also contributes to the achievement of a high dryness.

[0058] While the invention has been explained above in terms of a method, a press section and a machine, it should be understood that these categories only reflect different aspects of the same invention. The machine is thus intended to be used for carrying out the inventive method and the various press sections described are all intended to be a part of the machine according to the invention. Therefore, it should be understood that the inventive method may comprise such steps that would be a natural consequence of operating the inventive machine, regardless of whether such steps have been explicitly explained or not.

Claims

1. A method of making paperboard, the method comprising the steps of:

a) forming a fibrous web (W) on a foraminous wire (5),
b) transferring the fibrous web (W) from the wire (5) to an upper press felt (7) in a press section (6), the press section (6) comprising a dewatering nip (9) formed between an upper shoe press roll (10) and a lower suction roll (11), the upper press felt (7) forming a loop around the shoe press roll (10), and a lower press felt (8) forming a loop around the suction roll (11),
c) passing the fibrous web (W) through the dewatering nip (9), and
d) passing the fibrous web to a drying section (13) located downstream of the press section,

characterized in that the fibrous web (W) is separated from the lower press felt (8) as the web (W) exits from the dewatering nip (9), **in that** the web is passed to the drying section (13) in an at least partially open draw, **in that** the web has a basis weight in the range of 140 g/m^2 - 500 g/m^2 and **in that** the dewatering nip (9) formed between the upper shoe press roll (10) and the lower suction roll (11) is the single dewatering nip of the press section (9).

2. A method according to claim 1, further comprising providing in the press section (6) a smoothing press nip (14) formed between a pair of smoothing rolls (15, 16), the smoothing press nip (14) being located between the single dewatering nip (9) and the drying section (13), and operating the smoothing rolls (15, 16) at a higher peripheral speed than the peripheral speed of the rolls in the single dewatering nip (9), thereby separating the fibrous web (W) from the lower press felt (8) as the web (W) exits from the single dewatering nip (9).

3. A method according to claim 1, further comprising forming the fibrous web (W) in a forming section (2) having at least two forming units (3, 4), said fibrous web (W) having at least two layers, a basis weight of 160 g/m^2 - 400 g/m^2, and said web (W) being formed at least partially from mechanical pulp.

4. A method according to claim 3, further comprising passing the web (W) through a dewatering nip (17) on the foraminous wire (5) before transferring it from the wire (5) to the press section (6).

5. A method according to claim 1, further comprising forming the web (W) to have a basis weight of 160 g/m^2 - 400 g/m^2, and forming the web (W) from chemical pulp.

6. A method according to claim 5, further comprising applying in the single dewatering nip (9) a linear load

on the web (W) which load is not higher than 200 kN/m.

7. A method according to claim 1, further comprising running the machine at a web speed, which does not exceed 1000 m/min in the press section (6).

8. A method according to any of claims 1 - 7, further comprising maintaining the linear load in the smoothing press in the range of 20 kN/m -100 kN/m.

9. A machine for making paperboard, the machine comprising:

a) a forming section (2) having at least one foraminous wire (5) on which a fibrous web (W) may be formed,
b) downstream of the forming section (2), a press section (6) having a single dewatering nip (9),
c) in the press section (6), a shoe press roll (10),
d) in the press section (6), a counter roll (11) which, together with the shoe press roll (10), forms the single dewatering nip (9) of the press section (6),
e) in the press section (6), a first press felt (7) forming a loop around the shoe press roll (10),
f) in the press section (6), a second press felt (8) forming a loop around the counter roll (11) such that the fibrous web (W) can be passed through the single dewatering nip (9) sandwiched between the first (7) and the second press felt (8), the second press felt (8) having a felt run after the single dewatering nip (9) that diverges from the felt run of the first press felt (7),
g) a drying section (13) located downstream of the press section (6),

characterized in that, downstream of the single dewatering nip (9), the machine comprises means for separating the fibrous web from the second press felt (8) as the web (W) exits from the dewatering nip (9), **in that** the counter roll (11) is a suction roll and **in that** the first press felt (7) that loops the shoe press roll (10) is arranged to pick up the fibrous web (W) from the foraminous wire (5) of the forming section (2).

10. A machine according to claim 9, ***characterized in that*** a smoothing press nip (14) is located between the press section (6) and the drying section (13) and **in that** the smoothing press nip is formed by a pair of smoothing rolls (15, 16) arranged to come into direct contact with the surface of the fibrous web (W) such that each side of a fibrous web (W) passing through the smoothing press nip will be contacted by one of the smoothing rolls (15, 16) and **in that** the smoothing rolls (15, 16) are arranged to be driven at a peripheral speed that exceeds the peripheral speed of the shoe press roll (10) and the suction roll (11).

11. A machine according to claim 10, ***characterized in that*** the forming section (2) comprises at least two forming units (3, 4) such that the fibrous web (W) is formed as a web (W) with at least two layers.

12. A machine according to claim 11, ***characterized in that*** one of the rolls that form the smoothing press nip (14) is a roll with a relatively soft cover and one is a roll with a relatively hard cover.

13. A machine according to any of claims 9 - 12, ***characterized in that*** it further comprises a dewatering press nip (17) in the forming section (2).

Patentansprüche

1. Verfahren zur Herstellung von Pappe, wobei das Verfahren die folgenden Schritte aufweist:

a) Ausbilden einer Faserbahn (W) an einem löchrigen Sieb (5),
b) Übertragen der Faserbahn (W) von dem Sieb (5) zu einem oberen Pressfilz (7) in einer Pressenpartie (6), wobei die Pressenpartie (6) einen Entwässerungsspalt (9) aufweist, der zwischen einer oberen Schuhpresswalze (10) und einer unteren Saugwalze (11) ausgebildet ist, wobei der obere Pressfilz (7) eine Schleife um die Schuhpresswalze (10) ausbildet, und ein unterer Pressfilz (8) eine Schleife um die Saugwalze (11) ausbildet,
c) Führen der Faserbahn (W) durch den Entwässerungsspalt (9), und
d) Führen der Faserbahn zu einer Trockenpartie (13), die sich stromabwärts der Presspartie befindet,

dadurch gekennzeichnet, dass
die Faserbahn (W) von dem unteren Pressfilz (8) getrennt wird, wenn das Bahn (W) den Entwässerungsspalt (9) verlässt,
die Bahn mit einem wenigstens teilweise offenen Zug zu der Trockenpartie (13) weitergeleitet wird,
die Bahn ein Basisgewicht in dem Bereich von 140 g/m^2 bis 500 g/m^2 aufweist, und
der Entwässerungsspalt (9), der zwischen der oberen Schuhpresswalze (10) und der unteren Saugwalze (11) ausgebildet ist, der einzige Entwässerungsspalt der Pressenpartie (9) ist.

2. Verfahren nach Anspruch 1, das des Weiteren Folgendes aufweist:

Vorsehen eines Glättungspressspalts (14) in der Pressenpartie (6), der zwischen einem Paar von Glättungswalzen (15, 16) ausgebildet ist, wobei sich der Glättungspressspalt (14) zwischen dem einzigen Entwässerungsspalt (9) und der Trokkenpartie (13) befindet, und
Betreiben der Glättungswalzen (15, 16) mit einer höheren Umfangsgeschwindigkeit als der Umfangsgeschwindigkeit der Walzen des einzigen Entwässerungsspalts (9), wodurch die Faserbahn (W) von dem unteren Pressfilz (8) getrennt wird, wenn die Bahn (W) den einzigen Entwässerungsspalt (9) verlässt.

3. Verfahren nach Anspruch 1, das ferner ein Ausbilden der Faserbahn (W) in einer Siebpartie (2) mit wenigstens zwei Siebeinheiten (3, 4) aufweist,
wobei die Faserbahn (W) wenigstens zwei Schichten mit einem Basisgewicht von 160 g/m^2 bis 400 g/m^2 aufweist, und
wobei die Bahn (W) wenigstens teilweise aus mechanischer Pulpe ausgebildet wird.

4. Verfahren nach Anspruch 3, das ferner ein Führen der Bahn (W) durch einen Entwässerungsspalt (17) an dem löchrigen Sieb (5) aufweist, bevor sie von dem Sieb (5) zu der Pressenpartie (6) übertragen wird.

5. Verfahren nach Anspruch 1, das ferner ein Ausbilden der Bahn (W), so dass dieses ein Basisgewicht von 160 g/m^2 bis 400 g/m^2 aufweist, und ein Ausbilden der Bahn (W) aus chemischer Pulpe aufweist.

6. Verfahren nach Anspruch 5, das ferner ein Aufbringen einer linearen Belastung auf die Bahn (W) in dem einzigen Entwässerungsspalt (9) aufweist, die nicht höher als 200 kN/m ist.

7. Verfahren nach Anspruch 1, das ferner ein Betreiben der Maschine mit einer Bahngeschwindigkeit aufweist, die 1000 m/min in der Pressenpartie (6) nicht übersteigt.

8. Verfahren nach einem der Ansprüche 1 bis 7, das ferner ein Aufrechterhalten der linearen Last bei dem Glättungspressen in dem Bereich von 20 kN/m bis 100 kN/m aufweist.

9. Maschine zum Herstellen von Pappe, wobei die Maschine Folgendes aufweist:

a) eine Siebpartie (2) mit wenigstens einem löchrigen Sieb (5), an dem eine Faserbahn (W) ausgebildet werden kann,
b) eine Pressenpartie (6) stromabwärts der Siebpartie (2), die einen einzigen Entwässerungsspalt (9) aufweist,
c) eine Schuhpresswalze (10) in der Pressenpartie (6),
d) eine Gegenwalze (11) in der Pressenpartie (6), die zusammen mit der Schuhpresswalze (10) den einzigen Entwässerungsspalt (9) der Pressenpartie (6) ausbildet,
e) einen ersten Pressfilz (7) in der Pressenpartie (6), der eine Schleife um die Schuhpresswalze (10) ausbildet,
f) einen zweiten Pressfilz (8) in der Pressenpartie (6), der eine Schleife um die Gegenwalze (11) derart ausbildet, dass die Faserbahn (W) durch den einzigen Entwässerungsspalt (9) hindurch geführt werden kann, wobei sie zwischen dem ersten (7) und dem zweiten (8) Pressfilz zwischengelegt ist, wobei der zweite Pressfilz (8) nach dem einzigen Entwässerungsspalt (9) eine Filzführung aufweist, die von der Filzführung des ersten Pressfilz (7) abweicht,
g) eine Trockenpartie (13), die sich stromabwärts der Pressenpartie (6) befindet,

dadurch gekennzeichnet, dass
die Maschine stromabwärts des einzigen Entwässerungsspalts (9) eine Einrichtung zum Trennen der Faserbahn von dem zweiten Pressfilz (8) aufweist, wenn die Bahn (W) den Entwässerungsspalt (9) verlässt,
die Gegenwalze (11) eine Saugwalze ist, und
der erste Pressfilz (7), der um die Schuhpresswalze (10) eine Schleife ausführt, angeordnet ist, um die Faserbahn (W) von dem löchrigen Sieb (5) der Siebpartie (2) aufzunehmen.

10. Maschine nach Anspruch 9, **dadurch gekennzeichnet, dass**
sich ein Glättungspressspalt (14) zwischen der Pressenpartie (6) und der Trockenpartie (13) befindet, und
der Glättungspressspalt durch ein Paar von Glättungswalzen (15, 16) ausgebildet ist, die angeordnet sind, um in direktem Kontakt mit der Oberfläche der Faserbahn (W) zu treten, so dass jede Seite einer Faserbahn (W), die durch den Glättungspressspalt hindurchtritt, durch eine der Glättungswalzen (15, 16) berührt wird, und dass die Glättungswalzen (15, 16) angeordnet sind, um mit einer Umfangsgeschwindigkeit angetrieben zu werden, die die Umfangsgeschwindigkeit der Schuhpresswalze (10) und der Saugwalze (11) übersteigt.

11. Maschine nach Anspruch 10, **dadurch gekennzeichnet, dass** die Siebpartie (2) wenigstens zwei Siebeinheiten (3, 4) aufweist, so dass die Faserbahn (W) als eine Bahn (W) mit wenigstens zwei Schichten ausgebildet wird.

12. Maschine nach Anspruch 11, **dadurch gekenn-**

zeichnet, dass eine der Walzen, die den Glättungspressspalt (14) ausbilden, eine Walze mit einer relativ weichen Deckschicht ist, und dass eine eine Walze mit einer relativ harten Deckschicht ist.

13. Maschine nach einem der Ansprüche 9 bis 12, **dadurch gekennzeichnet, dass** die Maschine ferner einen Entwässerungspressspalt (17) in der Siebpartie (2) aufweist.

Revendications

1. Procédé de fabrication de carton, le procédé comprenant les étapes consistant à :

a) former une bande fibreuse (W) sur une toile sans fin (5),
b) transférer la bande fibreuse (W) de la toile sans fin (5) vers un feutre de presse supérieur (7) d'une section de presses (6), la section de presses (6) comprenant une ligne de contact essoreuse (9) formée entre un rouleau de presse supérieur à patin (10) et un rouleau aspirant inférieur (11), le feutre de presse supérieur (7) formant une boucle autour du rouleau de presse supérieur à patin (10), et un feutre de presse inférieur (8) formant une boucle autour du rouleau aspirant (11),
c) faire passer la bande fibreuse (W) à travers la ligne de contact essoreuse (9), et
d) faire passer la bande fibreuse dans une section de séchage (13) située en aval de la section de presses,

caractérisé en ce que la bande fibreuse (W) est séparée du feutre de presse inférieur (8) lorsque la bande (W) sort de la ligne de contact essoreuse (9), **en ce que** la bande passe dans la section de séchage (13) dans une zone de tirage au moins partiellement ouverte, **en ce que** la bande a un poids de base dans la gamme 140 g/m2 à 500 g/m2 et **en ce que** la ligne de contact essoreuse (9) formée entre le rouleau de presse à patin supérieur (10) et le rouleau aspirant inférieur (11) est l'unique ligne de contact essoreuse (9) de la section de presses.

2. Procédé selon la revendication 1, consistant en outre à mettre en oeuvre dans la section de presses (6) une ligne de contact de presse lisseuse (14) formée entre une paire de rouleaux lisseurs (15, 16), la ligne de contact de presse lisseuse (14) étant située entre la ligne de contact essoreuse (9) qui est unique et la section de séchage (13), à faire fonctionner les rouleaux lisseurs (15, 16) a une vitesse périphérique supérieure à la vitesse périphérique des rouleaux de l'unique ligne de contact essoreuse (9), séparant ainsi la bande fibreuse (W) du feutre de presse inférieur (8) lorsque la bande (W) sort de l'unique ligne de contact essoreuse (9).

3. Procédé selon la revendication 1, consistant en outre à former la bande fibreuse (W) dans une section de formation (2) ayant au moins deux unités de formation (3, 4), ladite bande fibreuse (W) ayant au moins deux couches, un poids de base de 160 g/m2 à 400 g/m2, ladite bande (W) étant formée au moins partiellement à partir d'une pâte mécanique.

4. Procédé selon la revendication 3, consistant en outre à faire passer la bande (W) à travers une ligne de contact essoreuse (17) sur la toile sans fin (5) avant de la transférer de la bande sans fin (5) à la section de presses (6).

5. Procédé selon la revendication 1, consistant en outre à former la bande (W) pour qu'elle ait un poids de base de 160 g/m2 à 400 g/m2, et à former la bande (W) à partir d'une pâte chimique.

6. Procédé selon la revendication 5, consistant en outre à appliquer dans l'unique ligne de contact essoreuse (9) une charge linéaire sur la bande (W), laquelle charge n'est pas supérieure à 200 kN/m.

7. Procédé selon la revendication 1, consistant en outre à faire tourner la machine à une vitesse qui ne dépasse pas 1000 m/mn dans la section de presses (6).

8. Procédé selon l'une quelconque des revendications 1 - 7, consistant en outre à maintenir la charge linéaire dans la presse de lissage dans la gamme de 20 kN/m à 100 kN/m.

9. Machine de fabrication de carton, la machine comprenant :

a) une section de formation (2) ayant au moins une toile sans fin (5) sur laquelle une bande fibreuse (W) peut être formée,
b) en aval de la section de formation (2), une section de presses (6) ayant une seule ligne de contact essoreuse (9),
c) dans la section de presses (6), une rouleau de presse à patin (10),
d) dans la section de presses (6), un contre - rouleau (11) qui, conjointement avec le rouleau de presse à patin (10), forme l'unique ligne de contact essoreuse (9) de la section de presses (6),
e) dans la section de presses (6), un premier feutre de presse (7) formant une boucle autour du rouleau de presse à patin (10),
f) dans la section de presses (6), un deuxième feutre de presse (8) formant une boucle autour du contre - rouleau (11) de façon à pouvoir faire

passer la bande fibreuse (W) à travers la seule ligne de contact essoreuse (9) en la prenant en sandwich entre le premier (7) et le deuxième (8) feutre de presse, le deuxième feutre de presse (8) ayant une course au-delà de la seule ligne de contact essoreuse (9) qui diverge de la course du premier feutre de presse (7),
g) une section de séchage (13) située en aval de la section de presses (6),

caractérisée en ce qu'en aval de la seul ligne de contact essoreuse (9), la machine comprend un moyen pour séparer la bande fibreuse du deuxième feutre de presse (8) lorsque la bande (W) sort de la ligne de contact essoreuse (9), **en ce que** le contre - rouleau (11) est un rouleau aspirant et **en ce que** le premier feutre de presse (7) qui boucle sur le rouleau de presse à patin (10) est agencé de manière à saisir la bande fibreuse (W) sur la toile sans fin (5) de la section de formation (2).

10. Machine selon la revendication 9, **caractérisée en ce qu'**une ligne de contact de presse lisseuse (14) est située entre la section de presses (6) et la section de séchage (13) et **en ce que** la ligne de contact de presse lisseuse est formée par une paire de rouleaux lisseurs (15, 16) agencés de manière à venir en contact direct avec la surface de la bande fibreuse (W) de façon à ce que chaque côté d'une bande fibreuse (W) passant à travers la ligne de contact de presse lisseuse soit au contact d'un des rouleaux lisseurs (15, 16) et **en ce que** les rouleaux lisseurs (15, 16) sont agencés pour être entraînés à une vitesse périphérique qui dépasse la vitesse périphérique du rouleau de presse à patin (10) et du rouleau aspirant (11).

11. Machine selon la revendication 10, **caractérisée en ce que** la section de formation (2) comprend au moins deux unités de formation (3, 4) de façon à ce que la bande fibreuse (W) soit formée comme une bande (W) comportant au moins deux couches.

12. Machine selon la revendication 11, **caractérisée en ce qu'**un des rouleaux qui forme la ligne de contact de presse lisseuse (14) est un rouleau avec un revêtement relativement doux et un autre est un rouleau avec un revêtement relativement dur.

13. Machine selon l'une quelconque des revendications 9 - 12, **caractérisée en ce qu'**elle comprend en outre une ligne de contact de presse essoreuse (17) dans la section de formation (2).

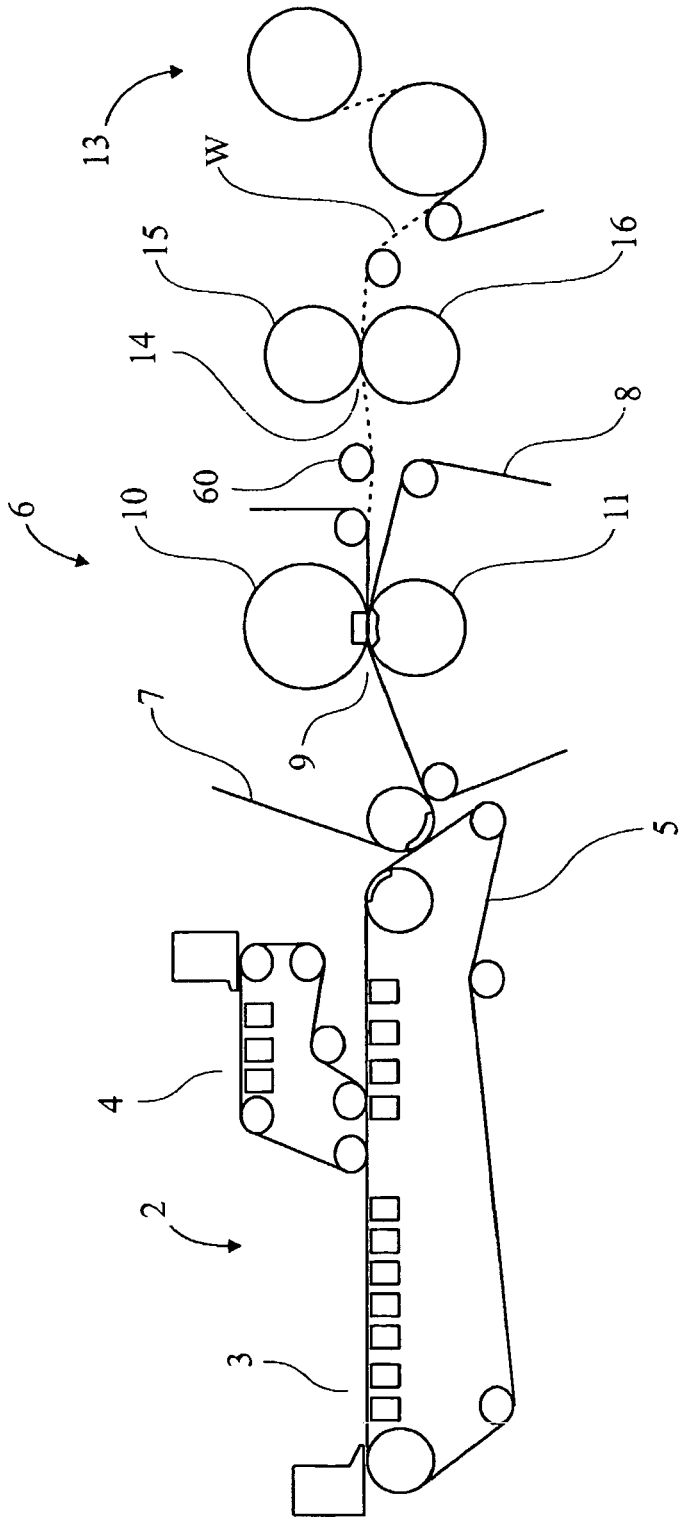

Fig. 1

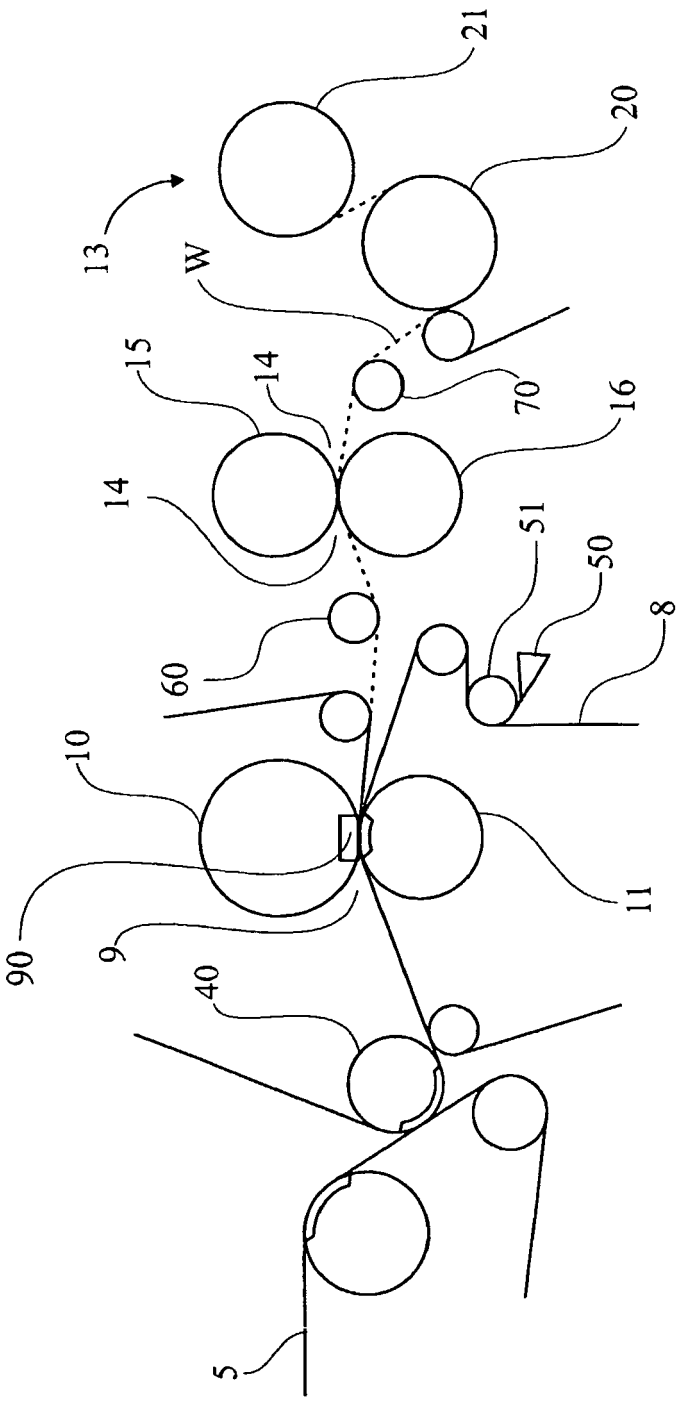

Fig. 2

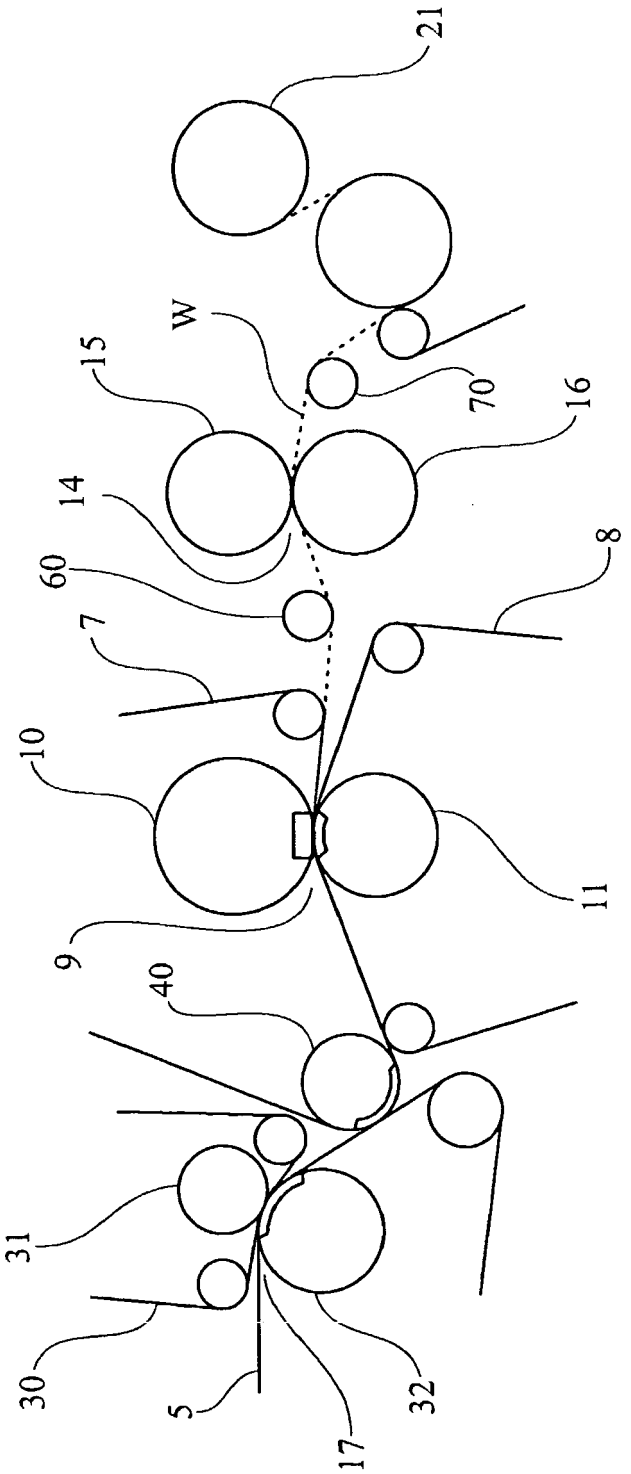

Fig. 3

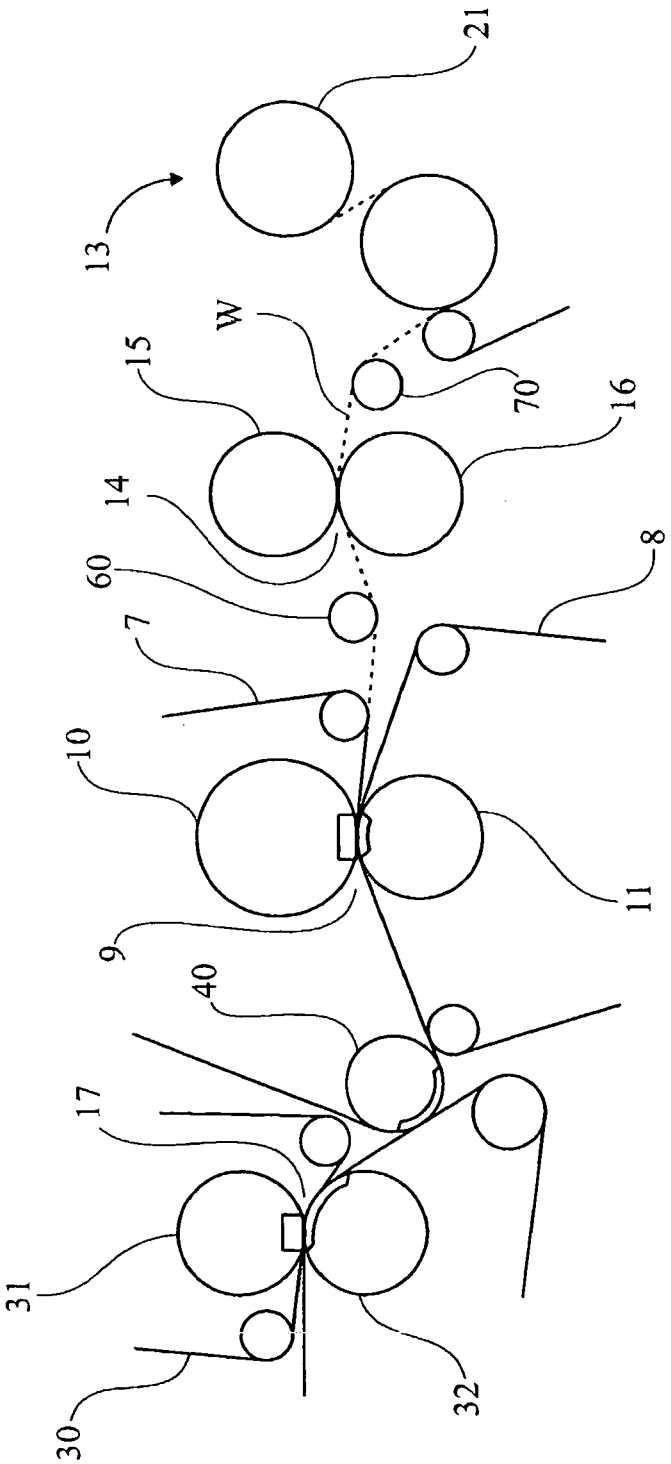

Fig. 4

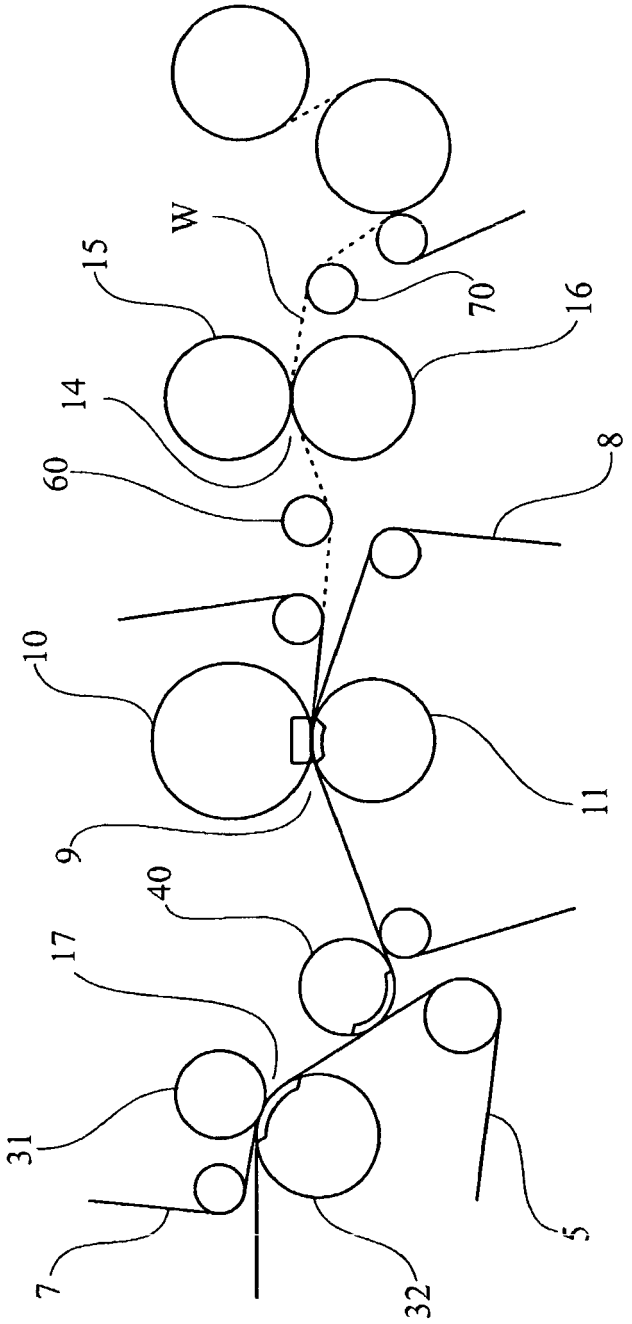

Fig. 5

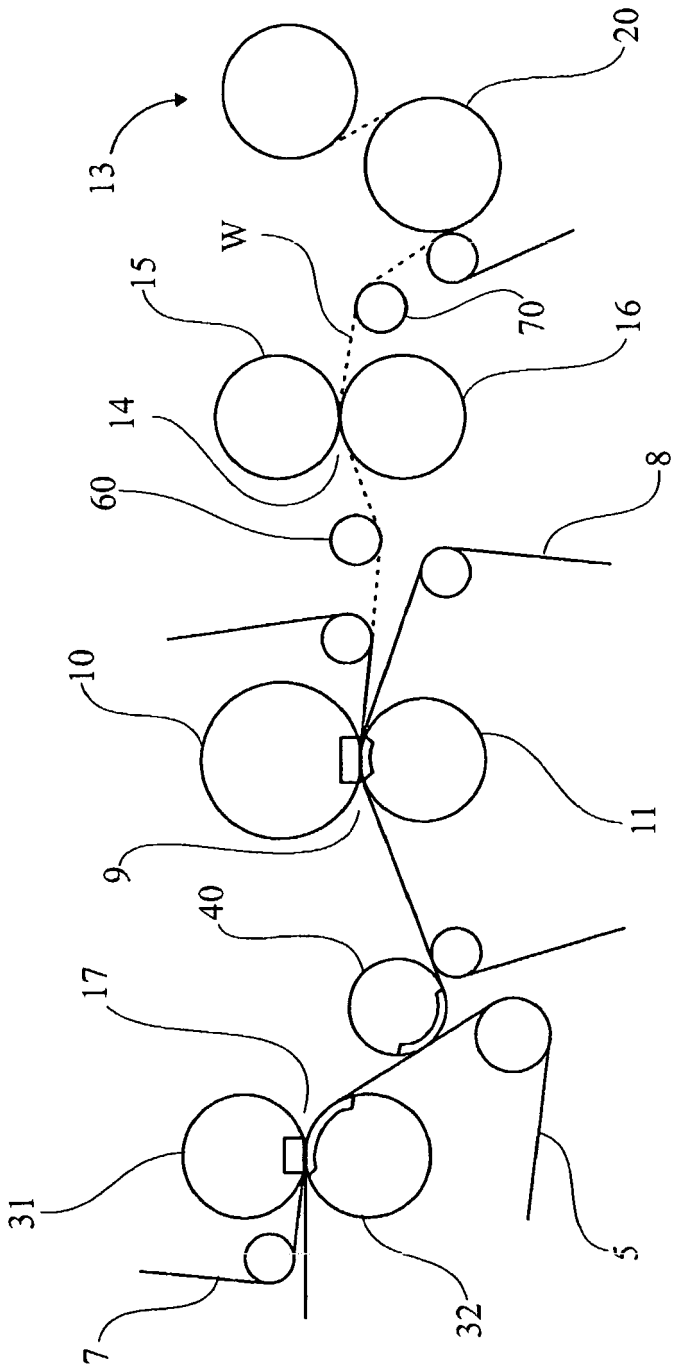

Fig. 6

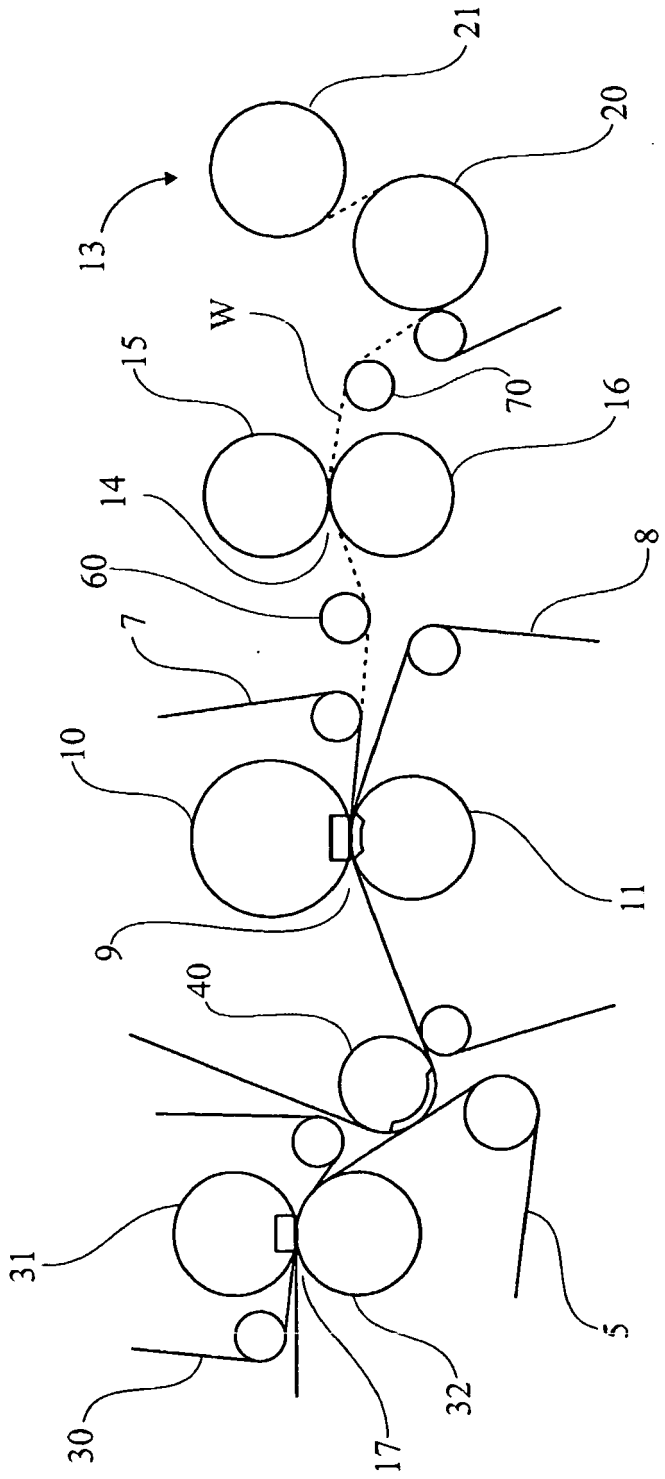

Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 9960203 A **[0010]**
- US 4662992 A **[0011]**
- WO 980793 A **[0026]**
- US 5662777 A **[0040]**
- US 5223100 A **[0040]**
- US 5084137 A **[0040]**
- US 6083352 A **[0040]**
- US 6131784 A **[0055]**

Non-patent literature cited in the description

- **H. ILVESPÄÄ.** *Valmet Paper Machine Days,* 1996, 60-61 **[0009]**