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(54) FORMING SECTION FOR A MULTI-PLY FIBER WEB AND A METHOD FOR FORMING A MULTI-PLY FIBER WEB

(57) The invention relates to a forming section for a multi-ply fiber web comprising at least one twin-wire forming part formed between a wire (10) for the bottom layer of the multi-ply fiber web and a wire (20) for the top layer of the multi-ply fiber web, in which twin-wire part in the layers for the multi-ply fiber web are joined and treated layers combined. The forming section comprises a sleeve roll (50) for joining layers of the multi-ply fiber web in a sleeve roll nip between the sleeve roll (50) and the wire(10; 20). The invention also relates to a method for forming a multi-ply fiber web, in which at least part of the forming is done in a twin-wire forming part formed between a wire (10) for the bottom layer of the multi-ply fiber web and a wire (20) for the top layer of the multi-ply fiber web, in which the layers for the multi-ply fiber web are joined and treated layers combined in the twin-wire part. In the method the layers of the multi-ply fiber web are joined in a sleeve roll nip between a sleeve roll (50) and the wire (10; 20).

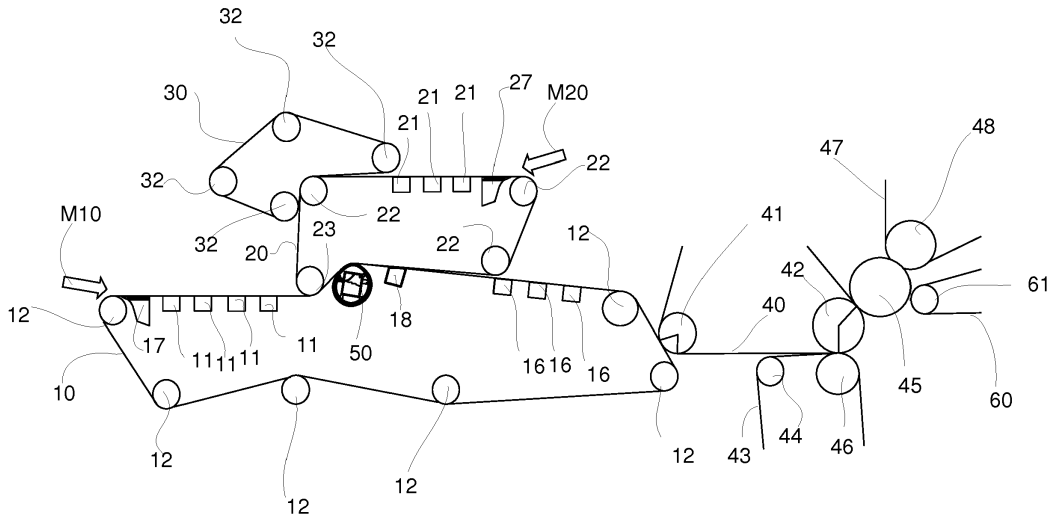

Fig. 5

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Description

[0001] The invention relates generally to producing multi-ply fiber webs. Particularly the invention relates to a forming section according to the preamble of the independent forming section claim and to a method for forming a multi-ply fiber web according to the preamble of the independent method claim.

[0002] As known from the prior art in fiber web machines, especially in paper and board machines, the fiber web is produced and treated in an assembly formed by a number of apparatuses arranged consecutively in a process line. A typical production and treatment line comprises a forming section comprising a headbox and a forming unit and a press section as well as a subsequent drying section and a reel-up. The production and treatment line can further comprise other devices and sections for finishing the fiber web, for example, a size press, a calender, a coating section. The production and treatment line also comprises typically at least one winder for forming customer rolls as well as a roll packaging apparatus. In this description and the following claims by fiber webs are meant especially container-board or cartonboard webs.

[0003] The task of a forming unit is to remove water from fiber suspension fed by the headbox. When the web is manufactured of watery fiber stock, water in the stock is removed on the forming section through a forming wire or forming wires for starting the formation of the web. Fibers remain on the forming wire or between the forming wires moving together. Depending on the grade of the web being manufactured, different types of stocks are used. The volume for which water can be removed from different stocks for achieving a web of good quality is a function of many factors, such as e.g. a function of the desired basis weight of the web, the design speed of the machine, and the desired level of fines, fibers and fill materials in the finished product. Many types of devices are known on the forming unit such as foil strips, suction boxes, turning rolls, suction rolls, and rolls provided with an open surface, which have been used in many different arrangements and arrays when trying to optimize the volume, time and location of water being removed when forming the web. The manufacturing a high-quality end-product of desired grade is a function of the volume of dewatering, the dewatering method, the duration of dewatering, and the location of dewatering. When it is desired to improve the water removal capacity and to maintain or improve the quality of the end-product, many times unforeseeable problems are created as the result of which either the water removal volume has to be decreased for maintaining the desired quality or the desired quality has to be sacrificed for achieving the greater water volume.

[0004] A commonly used method of making a multi-ply fiber web is based on the use of several separate web forming units in which the different layers of the web are caused to be drained in a layer by layer fashion either onto one another or onto separate wires, in which case they are combined with one another after partial dewatering. Typically in multi-ply / multilayer fiber web production i.e. when producing a fiber web having more than one layers term "multi-ply" is used when the layers are formed separately in the forming section and term "multilayer" is used when a multilayer headbox is used for feeding suspension layers to the forming section even though these terms multi-ply / multilayer are used very often synonymously and thus the difference can be defined by the context only.

[0005] In patent application publication WO9205310A1 is disclosed an apparatus for manufacturing multi-ply web in a paper or cardboard machine comprising a first wire provided for transporting a first web and a second wire, which is provided for transporting a second web, which apparatus comprises a reversing roll, at which the second wire is provided for travelling round the reversing roll for being set on top of the first wire for bringing the webs together to form the joined layers of a multi-ply web, and in the apparatus a member having a press surface, preferably an additional roll, is situated on the side of the first wire against the reversing roll, the rolls being so mounted that a press nip is formed, the apparatus further comprising means for loading said members with a desired force against each other for effecting a suitable line pressure influencing the bond between the webs, the members and wires having such constructions that the nip causes the movement of the water in the web layers and the movement of the fine substances therewith at the interface of the web layers towards one of the members. Joining of the layers in the press nip may cause break of the fiber web, especially in cases where the consistency of the stock for the layers is low.

[0006] In patent application publication US2002060037A1 is disclosed machine for the production of a multi-ply fiber stock web, comprising a first former including a first forming wire, said first former configured to form and convey a first fiber layer; a second former including a second forming wire, said second former configured to form and convey said second fiber layer; a couch element, said second forming wire being guided around said couch element, said first forming wire configured to convey said first fiber layer to a place of contact with said second fiber layer, said place of contact defining a couch zone, said couch element and said second forming wire being configured to be in contact prior to said couch zone; and a suction device configured to provide suction through said second forming wire to said second fiber layer in said couch zone.

[0007] Further in the joining arrangements known from prior art the window of adjusting the consistency of the layers is very narrow, as too low consistency may cause web breaks and too high consistency leads to low joining forces (ply bond) between the layers and thus the joining of the layers of the multi-ply fiber web may be incomplete. One disadvantage often in arrangements known from the

prior art is that due to the need of high enough joining forces leads to joining the layers in low consistency, which then leads to high energy consumption of water removal from the multi-ply fiber web with layers combined as the drainage resistance is in relation higher than from the layers separately treated. This is problem especially in hybrid or gap forming sections which flushes fines from the surface of the combined layers and this reduces multi-ply web ply bond.

[0008] Often adherence substances, such as starch, are used to ensure the joining of the layers but the starch may cause disadvantages to the surface properties of the fiber web, especially in cases where the starch may drop unwantedly onto the fiber web. Additionally the starch addition requires corresponding equipment and typically also more cleaning of the surrounding equipment is needed.

[0009] In some cases there exists needs for one side of the multi-ply fiber web to have higher surface requirements, for example for color, and water removal direction towards that side has an adverse effect as with water also impurities etc. move towards this side. In state of the art solutions it is difficult dewater for example White top liner grades after the web layers has been combined in which white layer is on to bottom side of the multi-ply web.

[0010] In patent application publication WO 2010046527 A1 is disclosed a forming section comprising two wire loops which form a twin-wire zone which comprises a dewatering element performing initial dewatering and a dewatering device following it. The dewatering device comprises a stationary support shaft on which are supported support elements around which circles an impermeable belt loop. The dewatering device further comprises a curvilinear dewatering zone over which the wires travel supported by the belt loop. The degree of curvature of the curve of the curvilinear dewatering zone increases in the travel direction of the belt such that increasing dewatering pressure is applied to stock suspension travelling between the wires on the curvilinear dewatering zone. Said at least one curvilinear dewatering zone of said at least one dewatering device, consists of two partial curves such that the radius of curvature of a first partial curve is greater than the radius of curvature of a second partial curve following the first partial curve in the travel direction of the web.

[0011] An object of the invention is to create a forming section for a multi-ply fiber web and a method for forming a multi-ply fiber web, in which the disadvantages and problems of prior art are eliminated or at least minimized.

[0012] In order to achieve the above mentioned objects the forming section according to the invention is mainly characterized by the features of the characterizing clause of the independent forming section claim and the method according to the invention is mainly characterized by the features of the characterizing clause of the independent method claim. Advantageous embodiments and features are disclosed in the dependent claims.

[0013] According to the invention the forming section for a multi-ply fiber web comprises at least one twin-wire forming part, in which the layers for the multi-ply fiber web are joined and treated layers combined and a sleeve roll for joining layers of the multi-ply fiber web in a sleeve roll nip between the sleeve roll and the opposite wire of the twin-wire forming part, wherein the sleeve roll nip is located in the twin-wire forming part. Advantageously the sleeve roll is located in the joining position of the web layers i.e. in the beginning of the twin-wire forming part or at the beginning of the twin-wire forming part a combining roll is provided for joining together the web layers and the sleeve roll nip is located in the twin-wire forming part after the combining roll. Advantageously the sleeve roll is located in the bottom layer wire loop.

[0014] According to an advantageous feature of the invention the forming section comprises for each web layer a headbox for feeding stock to the forming section.

[0015] According to an advantageous feature of the invention substantial part of water removal of each web layer from the stock fed to the forming part is done by a one-wire and/or by a twin-wire forming part before the web layers are joined to form the multi-ply fiber web.

[0016] According to an advantageous feature of the invention the sleeve roll comprises a stationary support shaft, an belt loop, which is led to circle around the stationary support shaft, that the sleeve roll further comprises at least one curvilinear dewatering zone consisting of two partial curves such that the radius of curvature of a first partial curve is greater than the radius of curvature of a second partial curve following the first partial curve in the travel direction of belt loop.

[0017] According to an advantageous feature of the invention the sleeve roll comprises a support elements supported at a distance from each other on the stationary support shaft, the belt loop to circle around the stationary support shaft is supported by the support elements and the belt loop is impermeable.

[0018] According to an advantageous feature of the invention joining pressure of the web layers is pressure is adjustable by adjusting the radius of curvature of the partial curves of the dewatering zone of the sleeve roll.

[0019] According to an advantageous feature of the invention the water removal direction of the sleeve roll is towards the top web layer with lower surface property requirements.

[0020] By the forming section according to the invention many advantages are achieved: The use of the sleeve roll for joining of the web layers to the multi-ply fiber web and for water removal means provides the possibility of easily as desired to select the water removal direction as the sleeve roll position and water removal direction can easily be selected. The joining of the web layers to form the multi-ply fiber web by the sleeve roll in the nip between the sleeve roll and the forming wire of the twin-wire forming part provides a gentle and slow pressure increase in the nip, which advantageously is pressure is adjustable by adjusting the radius of curva-

ture of the partial curves of the dewatering zone of the sleeve roll. This is important especially in cases where the consistency of the stocks forming the layers of the multi-ply fiber web varies, as in case the consistency is low too high joining pressure may break the web and as in care the consistency is high higher joining pressure values are needed. When substantial amount of water removal is done before the joining of the layers, less water removal is needed after the joining, which provides energy savings as water removal from the multi-ply fiber web with the layers combined requires more energy as the drainage resistance is greater. Also due to the possibility of using higher joining pressure the joining of the layers may be done even without using adherence substances (for example starch) or at least with less adherence substance needed.

[0021] In the following the invention is explained in detail with reference to the accompanying drawing to which the invention is not to be narrowly limited.

In figure 1 is shown schematically an advantageous example of a forming section according to the invention.

In figure 2 is shown schematically an advantageous example of a forming section according to the invention.

In figure 3 is shown schematically an advantageous example of a forming section according to the invention.

In figure 4 is shown schematically an advantageous example of a forming section according to the invention.

In figure 5 is shown schematically an advantageous example of a forming section according to the invention

In figure 6 is shown very schematically a sleeve roll.

[0022] During the course of the following description like numbers and signs will be used to identify like elements according to the different views which illustrate the invention and its advantageous examples. In the figures some repetitive reference signs have been omitted for clarity reasons.

[0023] In figure 1 is shown an example of a forming section for a multi-ply fiber web, in this example for a two layer fiber web. The forming section comprises a headbox for each layer, from which the stock suspension M10; M20 is fed to the forming unit for each layer beginning as one wire part comprising a wire 10 for the bottom layer of the multi-ply fiber web and a wire 20 for the top layer of the multi-ply fiber web, each wire comprising rolls 12, 22 for guiding and driving the wire 10; 20 as an endless loop. The stock suspension M10; M20 is first fed onto the wire 10; 20 and onto the area of a forming shoe 17; 27 and thereafter the stock on the wire is guided past inside the loop of the wire 10; 20 located water removal means 11; 21, which can be for example forming shoes and/or suction devices. The run of the wire 10; 20 during this water removal on the one wire part is substantially horizontal. The beginning of the forming unit with a short, substantially horizontal one-wire section comprising the forming shoe 17; 27 removing water by suction provides for exact control of the headbox flow, so that water is sucked through the wires 10; 20. The stock forming the top layer of the multi-ply fiber web guided on the wire 20 is after the one-wire part guided onto a sleeve roll 53 for further removal of water. On the sleeve roll 53 the top layer is pressed against surface of the sleeve roll by a wire 30 comprising rolls 32 for guiding and driving the wire 30. On the sleeve roll 50 the run of the wire 20 for the top layer is turned to be substantially vertical. After this the runs of the wire 10 for the bottom layer and the wire 20 for the top layer are united by a combining roll 23 to form a twin wire part and the webs for the bottom layer and the top layer are guided into a gap formed between the wires 10; 20 forming the twin-wire part of the forming unit. Web layers has been joined together by a combining roll 23 at the beginning of the twin-wire forming part and the sleeve roll nip is located in the twin-wire forming part after the combining roll 23. So a sleeve roll 50 is located at a distance from the beginning of the twin-wire part for joining the top layer and the bottom layer to the multi-ply fiber web in a sleeve roll nip between the sleeve roll 50 and the upper wire 20 of the twin-wire forming part. Combining roll 23 is situated in the top layer wire loop 20 and wires 10, 20 forms wrap angle over the combining roll 23, which is advantageously 1-45 degrees. By a curved suction device 18 the wire 20 is guided to separate from multi-ply fiber web at a distance after the sleeve roll 50. After the joining of the layers on the sleeve roll 50 the multi-ply fiber web is guided on the wire 10 supporting the bottom side of the multi-ply fiber web as a one wire part during which run support foils 16 located inside the wire 10 loop. The support foils 16 do not deviate the run of the wire 10 only remove water from the bottom surface of the wire 10 and support the run of the wire 10 between the sleeve roll 50 and the following guiding or driving roll 12 as the multi-ply fiber web is guided towards a pick-up roll 41 for transferring the multi-ply fiber web to a first press fabric 40 of a press section. The distance between the gap between the wires 10; 20 i.e. the beginning of the twin-wire part and the sleeve roll 50 is only about 0,2 - 4 meters. The distance is measured between the point in which lower and upper wires 10, 20 wrap angle ends on the combining roll 23 and between the first point in which wires 10, 20 are in the contact on the sleeve roll 50 i.e. the point in which the contact of the wires 10, 20 begins on the sleeve roll 50. In this example water is removed upwards by the sleeve roll 50 after the web layers have been joined. In this example as the main water removal direction is thus upwards, when substantial

amount of water is removed through the upper layer of the multi-ply fiber web and thus the layer purity of the lower layer of the multi-ply fiber web are preserved making this example advantageous in cases where surface requirements of the bottom side of the fiber web have significance. Wires 10; 20 wrap angle over the sleeve roll 50 is advantageously 40 - 90 degrees.

[0024] This kind of web layer combining arrangement is especially advantageous for manufacturing White top liner, in which white layer of the liner is formed on bottom layer wire 10 and brown layer of the liner is formed on top layer wire 20. In this arrangement multi-ply web dewatering direction is towards top layer and white layer purity remains excellent. This is beneficial also in the cases where bottom side of the web forms printing surface of the multi-ply board.

[0025] In figure 2 is shown an example of a forming section for a multi-ply fiber web, in this example for a two layer fiber web. The forming section comprises a headbox for each layer, from which the stock suspension M10; M20 is fed to the forming unit for each layer beginning as one wire part comprising a wire 10 for the bottom layer of the multi-ply fiber web and a wire 20 for the top layer of the multi-ply fiber web, each wire comprising rolls 12, 22 for guiding and driving the wire 10; 20 as an endless loop. The stock suspension M10; M20 is first fed onto the wire 10; 20 and onto the area of a forming shoe 17; 27 and thereafter the stock on the wire is guided past inside the loop of the wire 10; 20 located water removal means 11; 21, which can be for example forming shoes and/or suction devices. The run of the wire 10; 20 during this water removal on the one wire part is substantially horizontal. The beginning of the forming unit with a short, substantially horizontal one-wire section comprising the forming shoe 17; 27 removing water by suction provides for exact control of the headbox flow, so that water is sucked through the wires 10; 20. The run of the wire 20 for the top layer is turned to be substantially vertical on a guiding or driving roll 22, on which roll 22 the top layer is pressed against surface of the roll by a wire 30 comprising rolls 32 for guiding and driving the wire 30. After this the runs of the wire 10 for the bottom layer and the wire 20 for the top layer are united to form a twin wire part and the webs for the bottom layer and the top layer are guided into a gap formed between the wires 10; 20 forming the twin-wire part of the forming unit. In the beginning of the twin-wire part is located a sleeve roll 50 for joining the top layer and the bottom layer to the multi-ply fiber web in a sleeve roll nip between the sleeve roll 50 and the upper wire 20 of the twin-wire forming part. Wires 10; 20 wrap angle over the sleeve roll 50 is advantageously 40 - 90 degrees. By a curved suction device 18 the wire 20 is guided to separate from multi-ply fiber web at a distance after the sleeve roll 50. After the joining of the layers on the sleeve roll 50 the multi-ply fiber web is guided on the wire 10 supporting the bottom side of the multi-ply fiber web as a one wire part during which run support foils 16 located inside the wire 10 loop. The support foils 16 do not deviate the run of the wire 10 only remove water from the bottom surface of the wire 10 and support the run of the wire 10 between the sleeve roll 50 and the following guiding or driving roll 12 as the multi-ply fiber web is guided towards a pick-up roll 41 for transferring the multi-ply fiber web to a first press fabric 40 of a press section. In this example of figure 2 the web layers are joined to form the multi-ply web by the sleeve roll 50. In this example the main water removal direction on the sleeve roll 50 is downwards and substantial amount of water is removed through the bottom layer of the multi-ply fiber web, which is advantageous in cases where the surface requirements of the bottom side of the fiber web are not significant or better quality fiber is on top side of the multiply web.

[0026] The forming sections of types presented in examples of figures 1-2 can also be used as a forming section in production of a fiber web with only one layer, in which case the headbox M20 for the upper wire 20 loop is not feeding any suspension onto the wire 20. By this way it is possible to manufacture only one ply fiber web with increased dewatering capacity. This also diversifies fiber web machine operation possibilities.

[0027] In figure 3 is shown an example of a forming section, which is a twin-wire forming unit type forming section and begins with a twin-wire part for each layer of a multiply fiber web, which in this example is a two layer fiber web. The forming sections for the web layers are thus gap formers, in which the stock is fed into the gap formed between two wires and after the web layers have been joined water is removed from the multi-ply fiber web upwards. The forming section comprises a headbox for each layer, from which the stock suspension M1020; M110120 is fed to the forming unit for each layer beginning as a twin-wire part comprising wires 10; 20 for the bottom layer of the multi-ply fiber web and wires 110;120 for the top layer of the multi-ply fiber web, each wire comprising rolls 12; 22 and 112; 122 for guiding and driving the wires 10; 20 and 110; 120 as an endless loop. The stock suspension M1020 for the bottom layer is first fed between the wires 10; 20 and onto the area of a forming shoe 17 located inside the lower wire loop 10 and thereafter the stock for the bottom layer between the wires 10; 20 is guided past water removal means 25 located inside the loop of the upper wire 20, which water removal means 25 can be for example forming shoes and/or suction devices. The stock suspension M1020 for the top layer is first fed between the wires 110; 120 and onto the area of a forming shoe 117 located inside the lower wire loop 110 and thereafter the stock for the top layer between the wires 110; 120 is guided past water removal means 125 located inside the loop of the upper wire 120, which water removal means 125 can be for example forming shoes and/or suction devices. The beginning of the forming unit with the twin-wire section comprising the forming shoe 17; 177 removing water by suction provides for exact control of the headbox flow, so that water is sucked through the wires 10; 20 After this the runs of the lower

wire 10 for the bottom layer and the upper wire 120 for the top layer are united by a combining roll 123 to form a further twin wire part and the webs for the bottom layer and the top layer are guided into a gap formed between the wires 10; 120 forming the further twin-wire part of the forming unit. Web layers has been joined together by a combining roll 123 at the beginning of the twin-wire forming part and the sleeve roll nip is located in the twin-wire forming part after the combining roll 123. So a sleeve roll 50 is located at a distance from the beginning of the twin-wire part for joining the top layer and the bottom layer to the multi-ply fiber web in a sleeve roll nip between the sleeve roll 50 and the upper wire 120 of the twin-wire forming part. Combining roll 123 is situated in the top layer wire loop 120 and wires 10, 120 forms wrap angle over the combining roll 123, which is advantageously 1-45 degrees. After the joining of the layers on the sleeve roll 50 the multi-ply fiber web is guided on the wire 10 supporting the bottom side of the multiply fiber web as a one wire part during which run support foils 16 located inside the wire 10 loop. The support foils 16 do not deviate the run of the wire 10 only remove water from the bottom surface of the wire 10 and support the run of the wire 10 between the sleeve roll 50 and the following guiding or driving roll 12 as the multi-ply fiber web is guided towards a pick-up roll 41 for transferring the multi-ply fiber web to a first press fabric 40 of a press section. The distance between the gap between the wires 10; 120 i.e. the beginning of the twin-wire part and the sleeve roll 50 is only about 0,2 - 4 meters. The distance is measured between the point in which lower and upper wires 10, 120 wrap angle ends on the combining roll 123 and between the first point in which wires 10, 120 are in the contact on the sleeve roll 50 i.e. the point in which the contact of the wires 10, 20 begins on the sleeve roll 50. In this example water is removed upwards by the sleeve roll 50 after the web layers have been joined. In this example as the main water removal direction is thus upwards, when substantial amount of water is removed through the upper layer of the multi-ply fiber web and thus the layer purity of the lower layer of the multi-ply fiber web are preserved making this example advantageous in cases where surface requirements of the bottom side of the fiber web have significance. Typically in cases where bottom side of the web forms printing surface of the multiply board. This arrangement improves significantly ply bond of the multiply web in cases where hybrid or gap former is used.

[0028] In figure 4 is shown an example of a forming section for a multi-ply fiber web, in this example for a three layer fiber web. The forming section comprises a headbox for each layer, from which the stock suspension M10; M20; M30 is fed to the forming unit for each layer beginning as one wire part comprising a wire 10 for the bottom layer of the multi-ply fiber web and a wire 20 for the top layer of the multi-ply fiber web and a wire 30 the middle layer of the multi-ply fiber web, each wire comprising rolls 12, 22; 32 for guiding and driving the wire 10; 20; 32 as an endless loop. The stock suspension M10; M20 is first fed onto the wire 10; 20 and onto the area of a forming shoe 17; 27; 37 and thereafter the stock on the wire is guided past inside the loop of the wire 10; 20; 30 located water removal means 11; 21; 31, which can be for example forming shoes and/or suction devices. The run of the wire 10; 20; 30 during this water removal on the one wire part is substantially horizontal. The beginning of the forming unit with a short, substantially horizontal one-wire section comprising the forming shoe 17; 27; 37 removing water by suction provides for exact control of the headbox flow, so that water is sucked through the wires 10; 20. The runs of the wire 20 for the top layer and the wire 30 for the middle layer are turned to be substantially vertical at guiding or driving rolls 22; 32, from which rolls 22; 32 the top layer and the middle layer are guided between the wires 20; 30 during at least part of the substantially vertical run. After this the runs of the wire 10 for the bottom layer and the wire 20 for the top layer are united by a combining roll 23 to form a twin wire part and the webs for the bottom layer, the middle layer and the top layer are guided into a gap formed between the wires 10; 20 forming the twin-wire part of the forming unit. Web layers has been joined together by a combining roll 23 at the beginning of the twin-wire forming part and the sleeve roll nip is located in the twin-wire forming part after the combining roll 23. So a sleeve roll 50 is located at a distance from the beginning of the twin-wire part for joining the top layer and the bottom layer to the multi-ply fiber web in a sleeve roll nip between the sleeve roll 50 and the upper wire 20 of the twin-wire forming part. By a curved suction device 18 the wire 20 is guided to separate from multi-ply fiber web at a distance after the sleeve roll 50. After the joining of the layers on the sleeve roll 50 the multi-ply fiber web is guided on the wire 10 supporting the bottom side of the multi-ply fiber web as a one wire part during which run support foils 16 located inside the wire 10 loop. Combining roll 23 is situated in the top layer wire loop 20 and wires 10, 20 forms wrap angle over the combining roll 23, which is advantageously 1-45 degrees. The support foils 16 do not deviate the run of the wires 10, 20 only remove water from the bottom surface of the wire 10 and support the run of the wire 10, 20 between the sleeve roll 50 and the following guiding or driving roll 12 as the multi-ply fiber web is guided towards a pick-up roll 41 for transferring the multi-ply fiber web to a first press fabric 40 of a press section. The distance between the gap between the wires 10; 20 i.e. the beginning of the twin-wire part and the sleeve roll 50 is only about 0,2 - 4 meters. The distance is measured between the point in which lower and upper wires 10, 20 wrap angle ends on the combining roll 23 and between the first point in which wires 10, 20 are in the contact on the sleeve roll 50 i.e. the point in which the contact of the wires 10, 20 begins on the sleeve roll 50. In this example water is removed upwards by the sleeve roll 50 after the web layers have been joined. In this example as the main water removal direction is thus upwards, when substantial amount of water is removed

through the upper layer of the multi-ply fiber web and thus the surface purity of the lower layer of the multi-ply fiber web are preserved making this example advantageous in cases where surface requirements of the bottom side of the fiber web have significance. Typically in cases where bottom side of the web forms printing surface of the multiply board.

[0029] In figure 5 is shown an example of a forming section for a multi-ply fiber web, in this example for a two layer fiber web. The forming section comprises a headbox for each layer, from which the stock suspension M10; M20 is fed to the forming unit for each layer beginning as one wire part comprising a wire 10 for the bottom layer of the multi-ply fiber web and a wire 20 for the top layer of the multi-ply fiber web, each wire comprising rolls 12, 22 for guiding and driving the wire 10; 20 as an endless loop. The stock suspension M10; M20 is first fed onto the wire 10; 20 and onto the area of a forming shoe 17; 27 and thereafter the stock on the wire is guided past inside the loop of the wire 10; 20 located water removal means 11; 21, which can be for example forming shoes and/or suction devices. The run of the wire 10; 20 during this water removal on the one wire part is substantially horizontal. The beginning of the forming unit with a short, substantially horizontal one-wire section comprising the forming shoe 17; 27 removing water by suction provides for exact control of the headbox flow, so that water is sucked through the wires 10; 20. The run of the wire 20 for the top layer is turned to be substantially vertical on a guiding or driving roll 22, on which roll 22 the top layer is pressed against surface of the roll by a wire 30 comprising rolls 32 for guiding and driving the wire 30. After this the runs of the wire 10 for the bottom layer and the wire 20 for the top layer are united by a combining roll 23 to form a twin wire part and the webs for the bottom layer and the top layer are guided into a gap formed between the wires 10; 20 forming the twin-wire part of the forming unit. Web layers has been joined together by a combining roll 23 at the beginning of the twin-wire forming part and the sleeve roll nip is located in the twin-wire forming part after the combining roll 23. So a sleeve roll 50 is located at a distance from the beginning of the twin-wire part for joining the top layer and the bottom layer to the multi-ply fiber web in a sleeve roll nip between the sleeve roll 50 and the upper wire 20 of the twin-wire forming part. Combining roll 23 is situated in the top layer wire loop 20 and wires 10, 20 forms wrap angle over the combining roll 23, which is advantageously 1-45 degrees. After the joining of the layers on the sleeve roll 50 the multi-ply fiber web is guided on the wire 10 supporting the bottom side of the multi-ply fiber web as a one wire part during which run support foils 16 located inside the wire 10 loop. By a curved suction device 18 the wire 20 is guided to separate from multi-ply fiber web at a distance after the sleeve roll 50. The support foils 16 do not deviate the run of the wire 10 only remove water from the bottom surface of the wire 10 and support the run of the wire 10 between the sleeve roll 50 and the following guiding or driving roll 12 as the multi-ply fiber web is guided towards a pick-up roll 41 for transferring the multi-ply fiber web to a first press fabric 40 of a press section. The distance between the gap between the wires 10; 20 i.e. the beginning of the twin-wire part and the sleeve roll 50 is only about 0,2 - 4 meters. The distance is measured between the point in which lower and upper wires 10, 20 wrap angle ends on the combining roll 23 and between the first point in which wires 10, 20 are in the contact on the sleeve roll 50 i.e. the point in which the contact of the wires 10, 20 begins on the sleeve roll 50. In the example of figure 5 the fiber web is guided to a SymPress™ -type press section from the forming section by a pick-up roll 41. In the press section first press nip is provided as the nip formed between a suction roll 42 and a deflection compensated roll 46, second press nip is provided as the nip formed between a suction roll 42 and a smooth middle roll 45 and third press nip is provided as the nip between the smooth middle roll 45 and a roll 48 with extended nip. After the press section the fiber web is guided at a guide roll 61 to a drying wire 60 of a drying section. This example is advantageous in production of so called White top liner type fiber web, in which white bottom surface of the fiber web is formed by the lower forming part using the wire 10 loop for the bottom layer and further this white bottom surface is in the press section against the smooth middle roll 45. Thus very good surface properties are achieved for the white surface, which will be the outer surface in the final product and will be used as printing surface. In this example as the main water removal direction is upwards, when substantial amount of water is removed through the upper layer of the multi-ply fiber web and thus the layer purity of the lower layer of the multi-ply fiber web are preserved making this example advantageous in cases where surface requirements of the bottom side of the fiber web have significance.

[0030] In figure 6 is schematically shown a sleeve roll 50 with decreasing radius, which comprises a stationary support shaft 51 on which support elements 52 are supported at a distance from each other, an impermeable belt loop 53 which is led to circle around the stationary support shaft 51 supported by the support elements 52. The sleeve roll 50 further comprises at least one curvilinear dewatering zone K via which the wires 10, 20 are led to travel supported by the belt loop 53. The degree of curvature of the curve of the curvilinear dewatering zone K increases in the travel direction of the belt 53 such that increasing dewatering pressure is applied to the stock suspension travelling between the wires 10, 20 on said at least one curvilinear dewatering zone K. Radius of curvature of the curvilinear dewatering zone K consists of two partial curves such that the radius of curvature K1 of a first partial curve is greater than the radius of curvature K2 of a second partial curve following the first partial curve K1 in the travel direction of belt loop 53. Radius of curvature of the curvilinear dewatering zone K can contain several curves such that the radius of curvatures decreases in the running direction of the wires.

[0031] Above only some advantageous examples of the inventions has been described to which examples the invention is not to be narrowly limited and many modifications and alterations are possible within the invention.

Claims

1. Forming section for a multi-ply fiber web comprising at least one twin-wire forming part formed between a wire (10) for the bottom layer of the multi-ply fiber web and a wire (20; 120) for the top layer of the multi-ply fiber web, in which twin-wire part in the layers for the multi-ply fiber web are joined and treated layers combined **characterized in that** the forming section comprises a sleeve roll (50) for joining layers of the multi-ply fiber web in a sleeve roll nip between the sleeve roll (50) and the wire (10; 20; 120).

2. Forming section according to claim 1, **characterized in that** the sleeve roll nip is located in the twin-wire forming part and that the sleeve roll (50) is located in the joining position of the web layers i.e. in the beginning of the twin-wire forming part.

3. Forming section according to claim 1, **characterized in that** at the beginning of the twin-wire forming part a combining roll (23, 123) is provided for joining together the web layers and the sleeve roll nip is located in the twin-wire forming part after the combining roll (23,123).

4. Forming section according to claim 3, **characterized in that** the sleeve roll (50) located in the bottom layer wire (10) loop.

5. Forming section according to any of claims 1 - 4, **characterized in that** the sleeve roll (50) comprises a stationary support shaft (51), an belt loop (53), which is led to circle around the stationary support shaft (51), that the sleeve roll (50) further comprises at least one curvilinear dewatering zone (K) consisting of two partial curves such that the radius of curvature (K1) of a first partial curve is greater than the radius of curvature (K2) of a second partial curve following the first partial curve (K1) in the travel direction of belt loop (53).

6. Forming section according to any of claims 1 - 4, **characterized in that** the sleeve roll (50) comprises support elements (52) supported at a distance from each other on the stationary support shaft (51), that the belt loop (53) led to circle around the stationary support shaft (51) is supported by the support elements (52), and that the belt loop (53) is impermeable.

7. Forming section according to any of claims 1 - 6, **characterized in that** the forming section comprises for each web layer a headbox for feeding stock to the forming part and at least one one-wire forming part or at least one twin-wire forming part for each layer before the sleeve roll (50) joining the web layers.

8. Method for forming a multi-ply fiber web, in which at least part of the forming is done in a twin-wire forming part formed between a wire (10) for the bottom layer of the multi-ply fiber web and a wire (20; 120) for the top layer of the multi-ply fiber web, in which the layers for the multi-ply fiber web are joined and treated layers combined in the twin-wire part, **characterized in that** in the method the layers of the multi-ply fiber web are joined in a sleeve roll nip between a sleeve roll (50) and the wire (10; 20; 120).

9. Method according to claim 8, **characterized in that** the sleeve roll (50) is located in the bottom layer wire (10) loop.

10. Method according to claim 8 or 9, **characterized in that** substantial part of water removal of each web layer from the stock fed to the forming section is done by a one-wire and/or by a twin-wire forming part before the web layers are joined to form the multi-ply fiber web.

11. Method according to any of claims 8 - 10, **characterized in that** joining pressure of the web layers is pressure is adjustable by adjusting the radius of curvature of the partial curves of the dewatering zone of the sleeve roll (50).

12. Method according to any of claims 9 - 11, **characterized in that** water is removed at the sleeve roll (50) is towards the top web layer with less surface property requirements.

Fig. 1

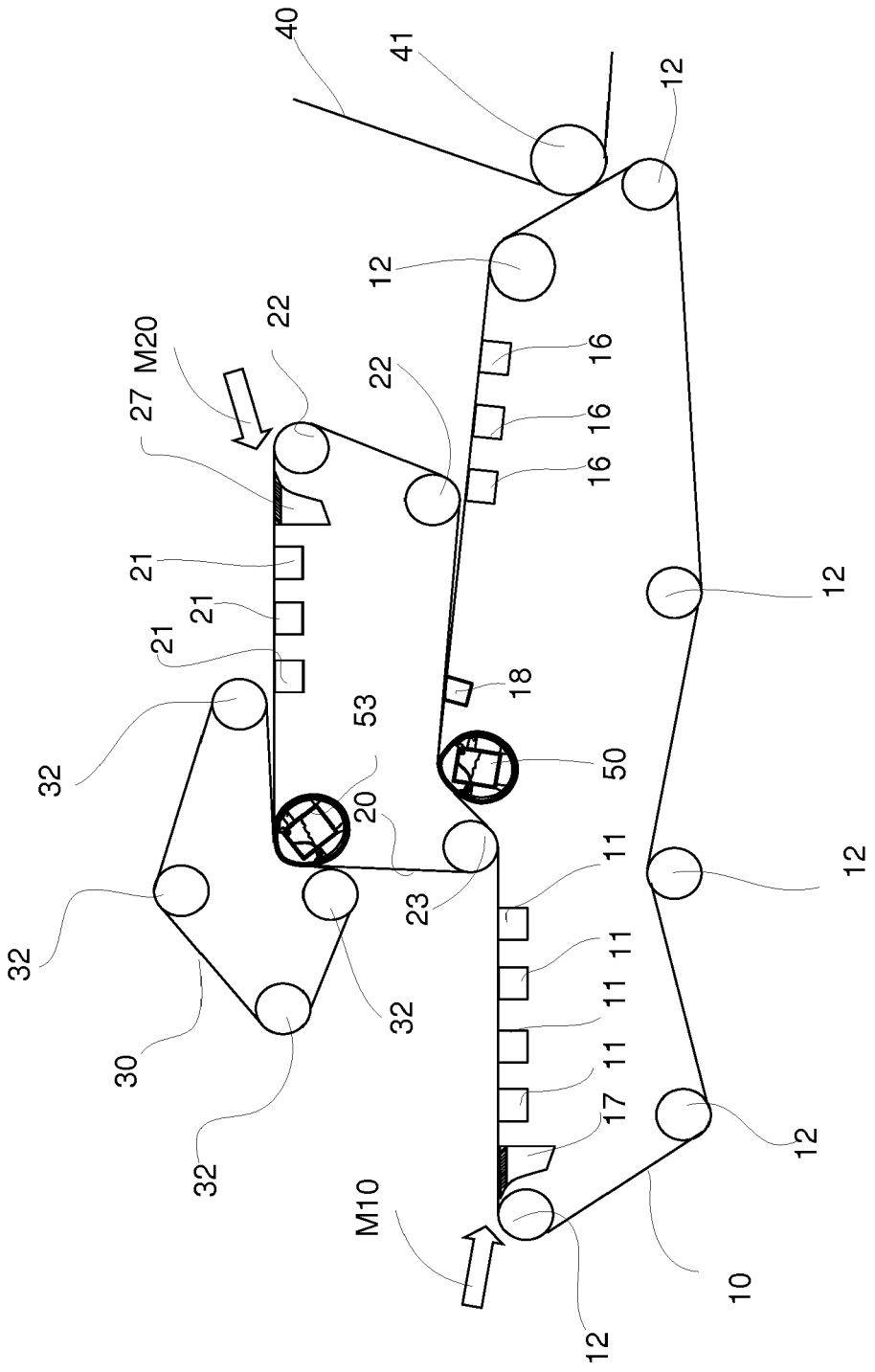
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Fig. 2

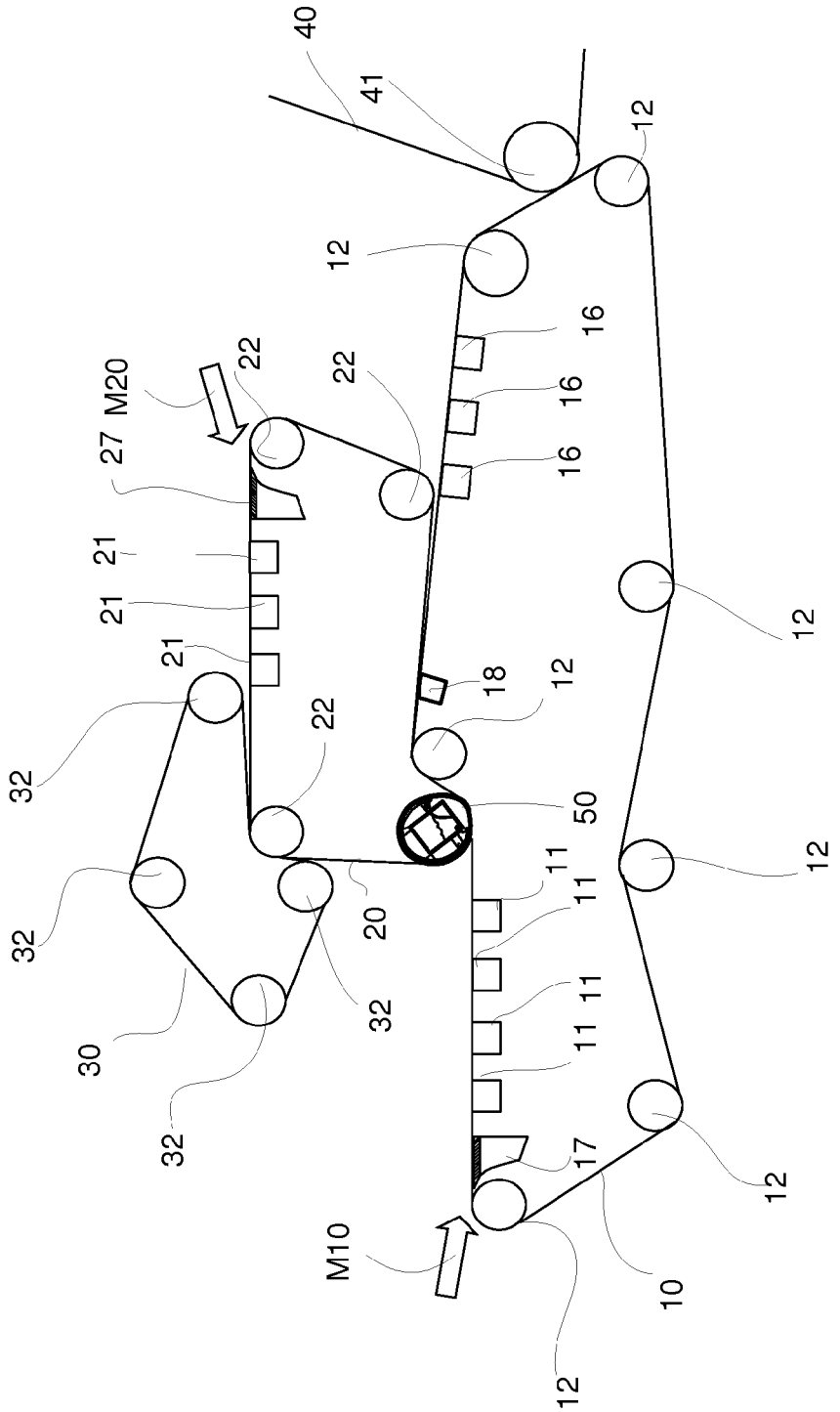
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Fig. 3

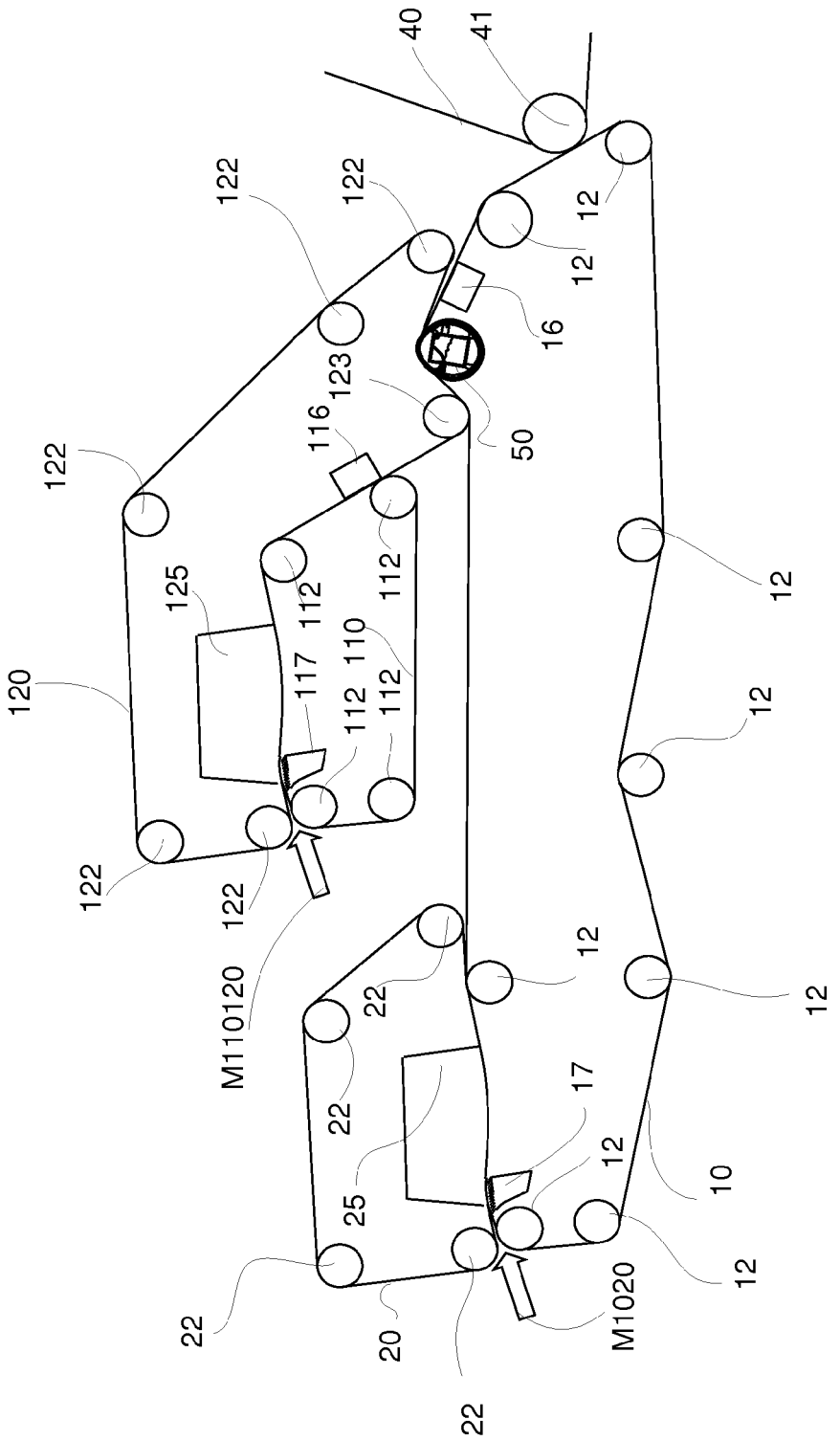
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Fig. 4

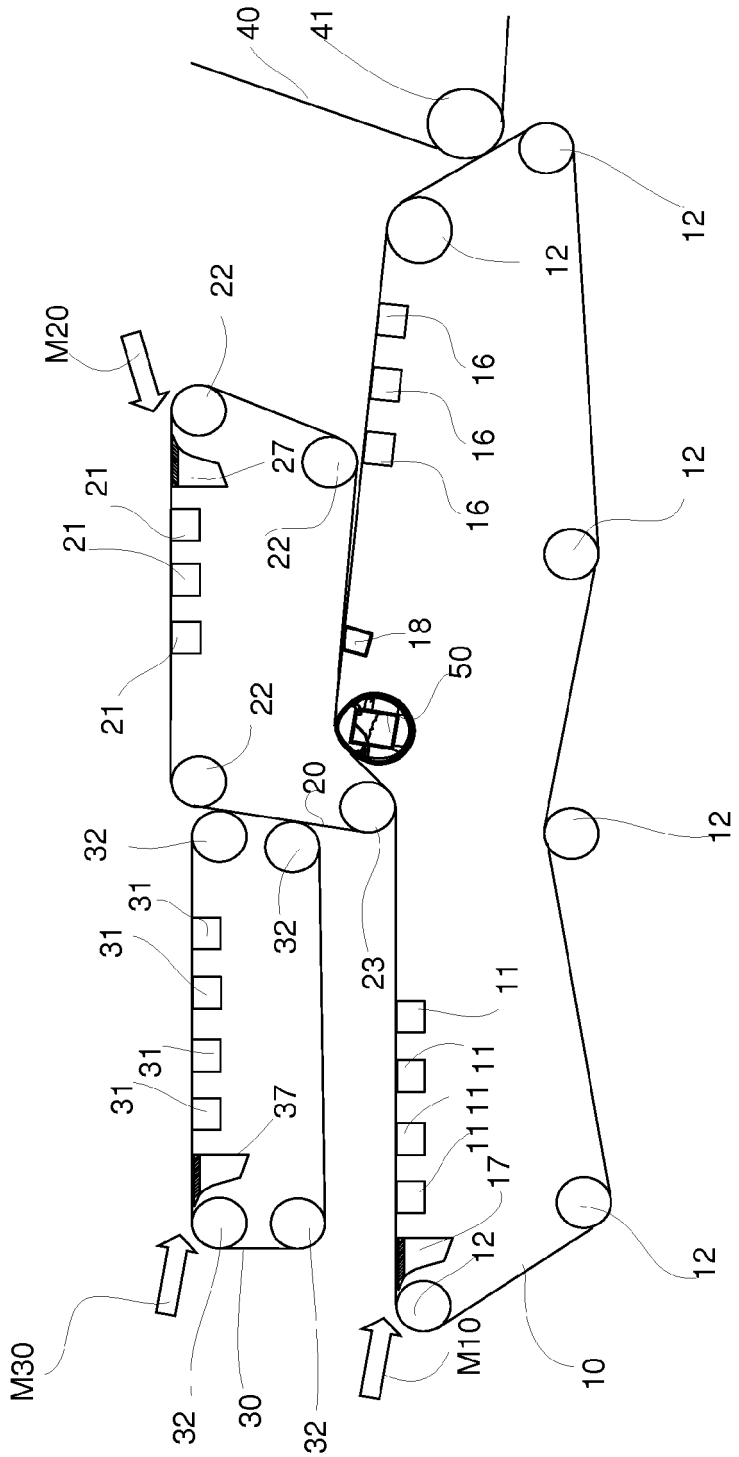
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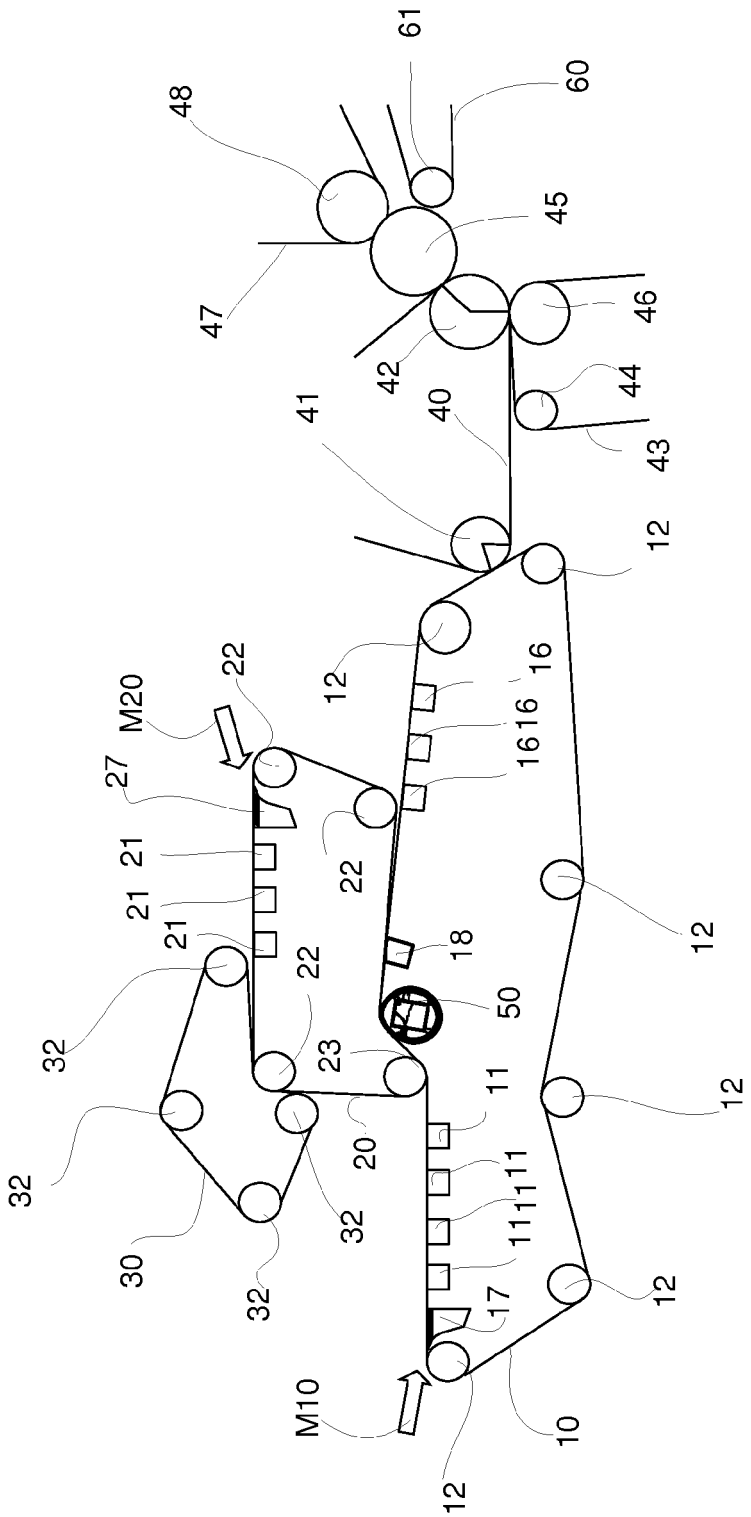
Fig. 5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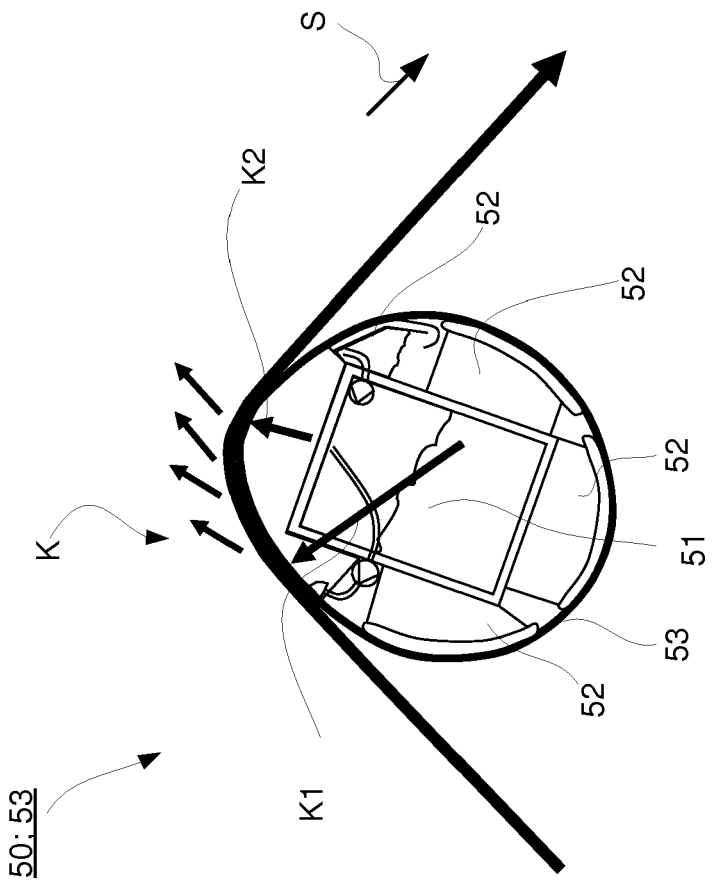

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 17 16 4069

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Place of search	Date of completion of the search	Examiner
Munich	17 August 2017	Maisonnier, Claire

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