



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.11.2021 Bulletin 2021/47

(51) Int Cl.:
D21F 1/48 (2006.01) **D21F 1/50 (2006.01)**
D21F 2/00 (2006.01) **D21F 9/00 (2006.01)**
D21G 3/00 (2006.01)

(21) Application number: **20175686.3**

(22) Date of filing: **20.05.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
 Designated Extension States:
BA ME
 Designated Validation States:
KH MA MD TN

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(54) **SYSTEM FOR TURNING A FIBER WEB IN A FORMING SECTION OF A FIBER WEB PRODUCTION MACHINE**

(57) The invention relates to a turning system of a fiber web for a forming section of a fiber web production machine, which turning system (40) comprises a turning roll (46), which is a smooth roll and the turning system

(40) further comprises an underpressure device (41) providing underpressure at incoming side of the turning roll (46) and closing the incoming side of the turning roll (46).

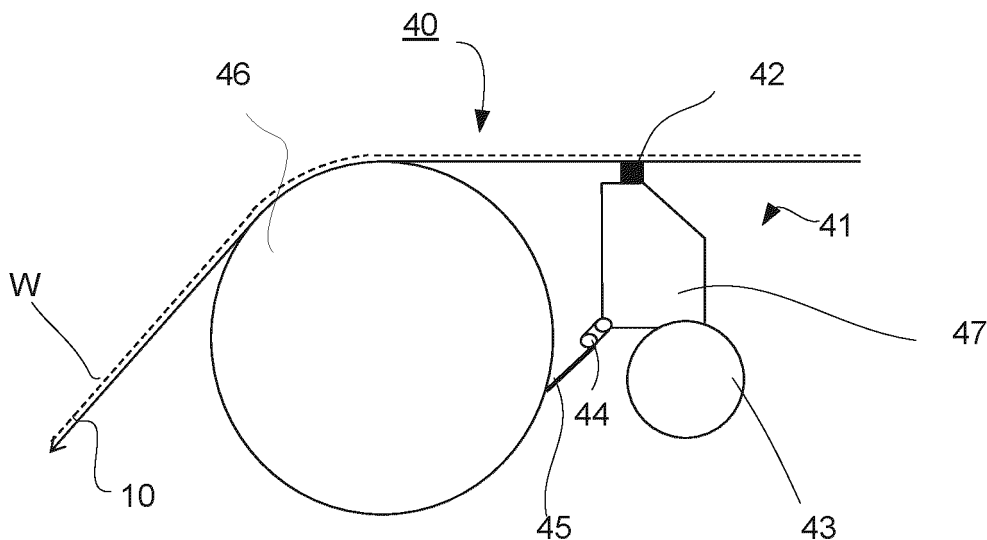


Fig. 2A

Description

Technical field

[0001] The invention relates generally to producing of fiber webs. Particularly the invention relates to a turning system of a fiber web according to the preamble of the independent claim 1.

Background

[0002] As known from the prior art in fiber web production 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 fiber web 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 comprise typically at least one winder for forming customer rolls as well as a roll packaging apparatus.

[0003] The task of the headbox is to supply fiber suspension for the fiber web production into the forming unit. In a multilayer headbox more than one fiber suspension flows are discharged from the headbox via flow channels for pulp suspension layers, each for forming one layer of a multiply fiber web.

[0004] 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. Many types of water removal 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.

[0005] The forming unit typically comprises wire parts: single wire parts, where the fiber web is supported on a wire forming a wire loop and guided by guide rolls, and the water devices are located on the other side of the wire, and twin-wire parts, where the fiber web travels between two wires and the water removal devices are located on the other sides of the wire forming respective wire loops, which are guided by guide rolls. The forming unit may comprise several wire parts, in which water is removed from the fiber web. Critical points in view of runnability of the forming unit are locations, where twin wire part has ended, and the fiber web is on

top of one wire loop and wire loop travel direction is changed on a turning roll area. Typically, in those positions the turning roll has been a suction roll and by suction the web is held on wire surface for ensuring the runnability. It is important, that the fiber web remains in all situations on the wire surface. In these points there exist limiting speed, that can be used in order the fiber web to stay on the wire. The capacity of the fiber web production line, thus, depends on functioning of the web runnability on highest possible speed and grammage of the fiber web / consistency of the fiber suspension.

[0006] In prior art arrangements also smooth rolls as turning rolls have been used but these have running speed limitations. With high speed air flows creates a pressure pulse when web is transferred on smooth turning roll area and it might detach web from the supporting wire.

[0007] In patent application publication DE 19728823A1, is disclosed a suction roll for a paper machine, with a roll shell, over which a wire for a fiber web to be dewatered is guided. The roll is provided with an external suction box, which partially encloses the suction roll from outside and thus the fiber web is subjected to negative pressure via grooves in the roll shell. The suction box is sealed transversely to the web running direction with a sealing element against the wire and with another sealing element against the roll shell. The fiber web is subjected to under pressure through the grooves in the shell, using blind drillings in the shell. Disadvantage of this known solution is that the suction roll with grooved shell and with blind drillings is expensive to produce and there is not many positions in the fiber web production line similar rolls could be used and thus, it also needs its own spare roll/-s to be produced. Further, this kind of arrangement has high energy consumption due to the need to provide the required under pressure levels.

[0008] An object of the invention is to create a turning system of a fiber web, in which the disadvantages and problems of prior art are eliminated or at least minimized.

[0009] An object of the invention is to create a turning system of a fiber web reliably and effectively with increased limiting running speed, grammage and/or consistency without compromising runnability.

Summary

[0010] In order to achieve the above-mentioned objects, the turning system according to the invention is mainly characterized by the features of the characterizing clause of the independent claim 1. Advantageous embodiments and features are disclosed in the dependent claims.

[0011] According to the invention the turning system of a fiber web for a forming section of a fiber web production machine comprises a turning roll, which turning roll is a smooth roll and the turning system further comprises an underpressure device configured to provide underpressure at incoming side of the turning roll and clos-

ing the incoming side of the turning roll.

[0012] According to an advantageous feature of the invention the underpressure device comprises means to create under pressure of about 0,1 - 15 kPa, advantageously 0,1 - 3 kPa.

[0013] According to an advantageous feature of the invention the means to create the underpressure are a blower or a connection to a vacuum system.

[0014] According to an advantageous feature of the invention the underpressure device comprises a suction box and an air channel.

[0015] According to an advantageous feature of the invention the suction box is formed of a longitudinally extending frame structure and comprising plates or corresponding elements at the ends of the frame structure closing the frame structure.

[0016] According to an advantageous feature of the invention the underpressure device comprises a doctor and a doctor holder for cleaning the turning roll.

[0017] According to an advantageous feature of the invention the underpressure device comprises a foil.

[0018] According to an advantageous feature of the invention the turning system is configured to be located inside a wire loop formed by a wire from which a fiber web is turned towards another wire of a forming section or to a press section of a fiber web production line.

[0019] According to an advantageous feature of the invention the underpressure device is configured to be sealed against the wire by the foil.

[0020] According to an advantageous feature of the invention the area of the incoming wire and the fiber web to the turning roll is configured to be closed by the underpressure device, advantageously by means of the foil against the wire and by means of the doctor against the turning roll and by means of the suction box between the foil and the doctor.

[0021] According to an advantageous feature of the invention the underpressure device extends in longitudinal direction over the substantial width of the wire and the fiber web.

[0022] According to an advantageous aspect of the invention the turning system comprises the smooth roll, i. e. the surface of the outer circumference of the roll is smooth and thus without grooves, recesses or like. The turning system further comprises the device providing the underpressure, which provides the possibility of using higher speeds as the pressure peak causing the detachment of the fiber web from the supporting wire in systems known from prior art is minimized and thus, detachment of the fiber web is prevented.

[0023] By the forming section according to the invention many advantages are achieved: Even though in the present arrangement a smooth roll is used in connection with turning of the fiber web the pressure pulse is decreased to the under pressure provided by the turning device of the turning system. This also provides for the possibility of increasing the limiting speed. Additionally, the smooth roll of the turning system is economically pro-

ducible, and it requires less energy than the suction roll arrangement known from prior art. Further, as the roll is a smooth roll, there are spare rolls easily available, as corresponding rolls are typically used in many other positions of the fiber web production line as well.

[0024] It should also be noted that the present invention is easily providable in connection of modernization of an existing fiber web line, as the smooth roll of the turning system already exists in many cases.

Brief description of the drawings

[0025] 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 turning system according to the invention in an example of a forming section.

In figures 2A-2B is shown schematically an advantageous example of a turning system according to the invention.

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

[0026] 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.

Detailed description

[0027] In figure 1 is shown an example of a forming section comprising a headbox 30 and in which the forming of the fiber suspension M fed from the headbox 30 begins in a forming unit with a twin-wire part followed by and a single wire part. The twin-wire forming part comprises a lower wire 10 and an upper wire 20, each comprising rolls 12, 22 for guiding and driving the wire as an endless loop. The stock suspension M is first fed into a gap formed between the lower wire 10 and the upper wire 20 forming the twin-wire part of the forming unit. The twin-wire part comprises first an inclined twin-wire section comprising water removal means 18, 28 inside each of the wire loops 10, 20 for removing water by suction provides, so that water is sucked through the wires 10, 20. There after a sleeve roll 50 is located at the point, where the run of the fiber web and the wires 10, 20 turn to be substantially horizontal. The sleeve roll 50 is a roll with decreasing radius, which comprises a stationary support shaft on which support elements are supported at a distance from each other, an impermeable belt loop which is led to circle around the stationary support shaft sup-

ported by the support elements. The sleeve roll further comprises at least one curvilinear dewatering zone via which the wires 10, 20 are led to 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 the stock suspension travelling between the wires 10, 20 on said at least one curvilinear dewatering zone. Radius of curvature of the curvilinear dewatering zone 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 belt loop. Radius of curvature of the curvilinear dewatering zone can contain several curves such that the radius of curvatures decreases in the running direction of the wires 10, 20. The sleeve roll is for example described in more detail in applicant's WO patent application publication WO 2010/046527. On the substantially horizontal run inside the lower wire loop 10 foilboxes 16 are located, which foilboxes 16 supports the lower wire 10 and dewateres the fiber web. At the single wire part, the fiber web is further guided towards a press section, where the fiber web is transferred to the press section by a pick-up roll 31. The forming unit of the forming section comprises at the end of the forming section a turning system 40 comprising the turning roll 46 inside the lower wire loop 10. In this example the turning roll 46, turns the horizontal run of the fiber web and the lower wire 10 to a substantially vertical, downwards run. The turning system 40 is in greater detail described with reference to the following figure 2.

[0028] In figures 2A-2B is shown an example of the turning system 40 comprising a turning roll 46 configured to be located inside a wire loop 10 formed by a wire 10 from which a fiber web W is turned towards another wire of a forming section or to press section of a fiber web production line. The turning system 40 comprises the turning roll, which is a smooth roll, i.e. the surface of the outer circumference of the roll 46 is smooth and thus without grooves, recesses or like. The turning system 40 further comprises a device 41 providing underpressure at incoming side of the turning roll 46, which provides the possibility of using higher speeds as pressure peaks typically causing detachment of the fiber web W from the wire 10 in systems known from prior art is minimized and thus, detachment of the fiber web W from the wire 10 is prevented. The underpressure device 41 extends in longitudinal direction over the substantial width of the wire 10 and the fiber web W, in cross-direction of the main running direction of the travelling fiber web W and underpressure effects to the fiber web in web running direction between foil 42 and incoming side of the turning roll 46. The underpressure device 10 comprises means to create under pressure of about 0,1 - 15 kPa, advantageously 0,1 - 3 kPa. The means to create underpressure can be a blower or a connection to a vacuum system. The underpressure device 41 also comprises a suction box 47

which is connected to an air channel 43. The suction box 47 is formed of a longitudinally extending frame structure. The underpressure device 41 further comprises means located at ends 46E of the turning roll 46 to close the space at the incoming side of the turning roll 46. These means comprised an end plate 48, which is located against the end 46E of the turning roll 46 and an edge foil 49, which is located against the wire 10 at the edge 10E of the wire. Additionally, the underpressure device 41 may comprise a doctor 45 and a doctor holder 44 for cleaning the turning roll 46. Doctor holder 44 is advantageously so-called DST-holder. The underpressure device 41 is sealed against the wire 10 by a foil 42, which also removes water from the corresponding surface of the wire 10. Thus, in the turning system 40 the area of the incoming wire 10 and the web W is closed by the underpressure device 41, especially by means of the foil 42 against the wire 10 and by means of the doctor 45 against the turning roll 46 and by means of the suction box 47 between the foil 42 and the doctor 45. By DST-holder is possible to adjust suction box 47 position so that foil 42 is in contact with wire 10 and doctor 45 is in contact to turning roll 46.

[0029] In figure 3 is shown of a forming section for a multiply fiber web, in this example for a two-layer fiber web. The forming section comprises a headbox 30, 50 for each layer, from which the stock suspension M is fed to the forming unit for each layer beginning as single wire part comprising a lower wire 10 for a first layer of the multi-ply fiber web and an upper wire 20 for a second 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 M 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 10;20 is guided past inside the loop of the wire 10; 20 located water removal means 16; 26, which can be for example foilboxes and/or forming shoes and/or suction devices. The run of the wire 10; 20 during this water removal on the single wire part is substantially horizontal. The fiber suspension forming the second layer of the multi-ply fiber web guided on the upper wire 20 is after the one-wire part guided to a twin-wire part formed between the upper wire 30 ja an uppermost wire 60 forming a wire loop and comprising guide and drive rolls 62. Inside the uppermost wire loop water removal means 66 are located, which can be for example suction devices. After the twin-wire part a short single wire forming part is located, after which the run of the second layer for the multiply fiber web is further guided down as a substantially vertical run by a turning roll 46. The forming unit of the forming section comprises at this turning location of the forming section a turning system 40 comprising the turning roll 46 inside the upper wire loop 20. In this example the turning roll 46 turns the horizontal run of the fiber web and the upper wire 20 to a substantially vertical, downwards run. The turning system 40 is in greater detail described with reference to the previous figure 2. When the substantially vertical run of

the second layer for the multiply fiber web meets the substantially horizontal run of the first layer for the multiply fiber web, the first and second layers are combined and the two layer fiber web continues its run on a substantially horizontal run in the single wire forming part formed by the lower wire 10 and the inside the lower wire loop 10 located foilboxes 16 support the lower wire 10 but do not participate in active dewatering, only remove water from the bottom surface of the wire 10 and support the run of the lower wire 10 towards the end of the forming unit. At the single wire part, the two-layer fiber web is further guided towards a pick-up roll 31 of a press section, where the fiber web is transferred to the press section from a turning roll 46. The forming unit of the forming section comprises at the end of the forming section a turning system 40 comprising the turning roll 46 inside the lower wire loop 10. In this example the turning roll 46 turns the horizontal run of the fiber web and the lower wire 10 to a substantially vertical, downwards run. The turning system 40 is in greater detail described with reference to the previous figure 2.

[0030] In the description in the foregoing, although some functions have been described with reference to certain features and examples, those functions may be performable by other features and examples whether described or not. Although features have been described with reference to the certain examples, those features may also be present in other examples whether described or not.

[0031] Above only some advantageous examples of the inventions have 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. Turning system of a fiber web for a forming section of a fiber web production machine, which turning system (40) comprises a turning roll (46), **characterized in that** the turning roll (46) is a smooth roll and that the turning system (40) further comprises an underpressure device (41) configured to provide underpressure at incoming side of the turning roll (46) and closing the incoming side of the turning roll (46).
2. Turning system according to claim 1, **characterized in that** the underpressure device (40) comprises means to create underpressure of about 0,1 - 15 kPa, advantageously 0,1 - 3 kPa.
3. Turning system according to claim 1 or 2, **characterized in that** the means to create the underpressure are a blower or a connection to a vacuum system.
4. Turning system according to any of the previous claims, **characterized in that** the underpressure device (41) comprises a suction box (47) and an air channel (43).
5. Turning system according to claim 4, **characterized in that** the suction box (47) is formed of a longitudinally extending frame structure and comprising plates or corresponding elements at the ends of the frame structure closing the frame structure.
6. Turning system according to any of previous claims, **characterized in that** the underpressure device (41) comprises a doctor (45) and a doctor holder (44) for cleaning the turning roll (46).
7. Turning system according to any of previous claims, **characterized in that** the underpressure device (41) comprises a foil (42).
8. Turning system according to any of previous claims, **characterized in that** the turning system (40) is configured to be located inside a wire loop (10) formed by a wire (10) from which a fiber web (W) is turned towards another wire of a forming section or to a press section of a fiber web production line.
9. Turning system according to claim 8, **characterized in that** the underpressure device (41) is configured to be sealed against the wire (10) by the foil (42).
10. Turning system according to claim 8 or 9, **characterized in that** the area of the incoming wire (10) and the fiber web (W) to the turning roll (46) is configured to be closed by the underpressure device (41), advantageously by means of the foil (42) against the wire (10) and by means of the doctor (45) against the turning roll (46) and by means of the suction box (47) between the foil (42) and the doctor (45).
11. Turning system according to any of claims 8 - 10, **characterized in that** the underpressure device (41) extends in longitudinal direction over the substantial width of the wire (10) and the fiber web (W).

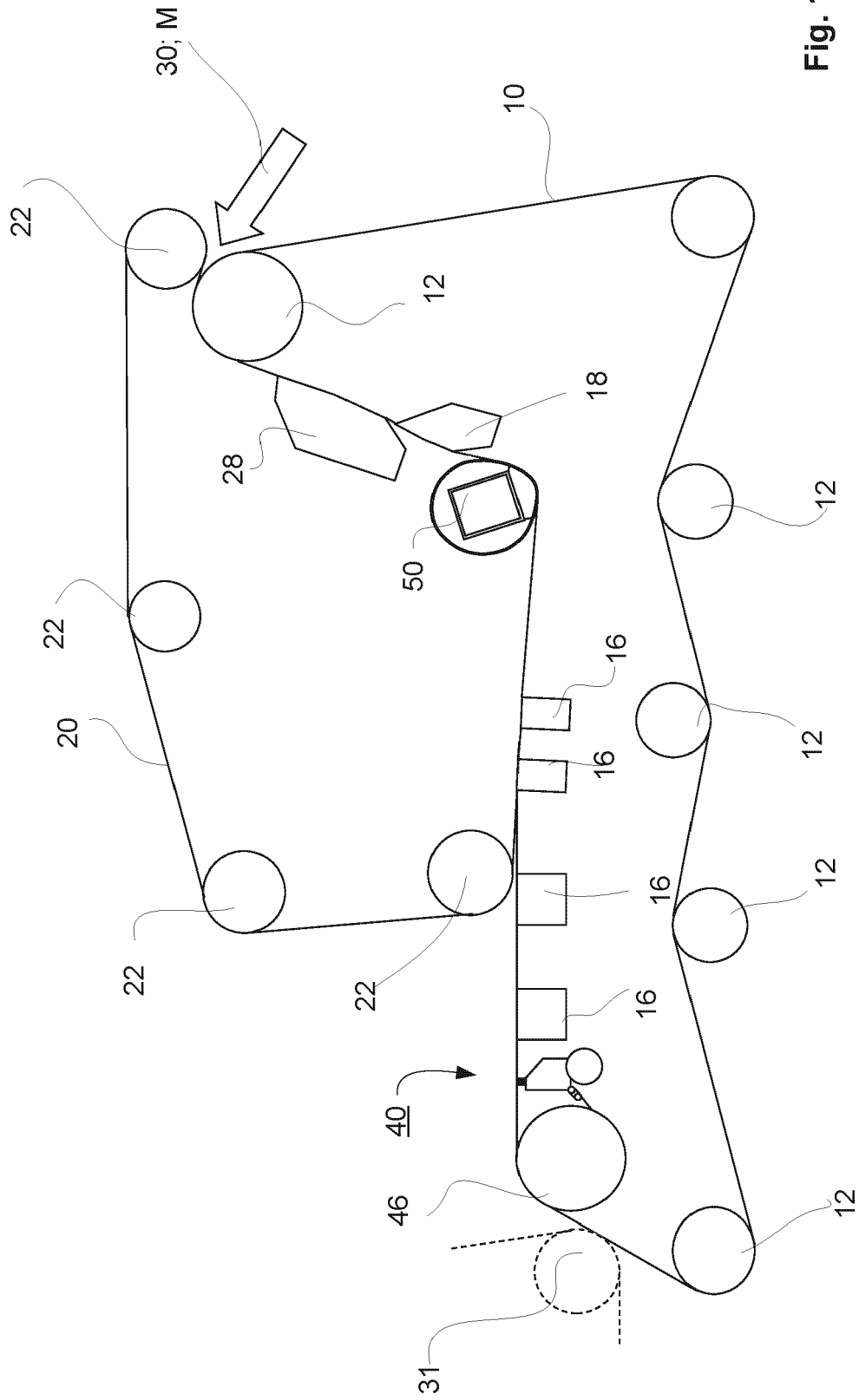


Fig. 1

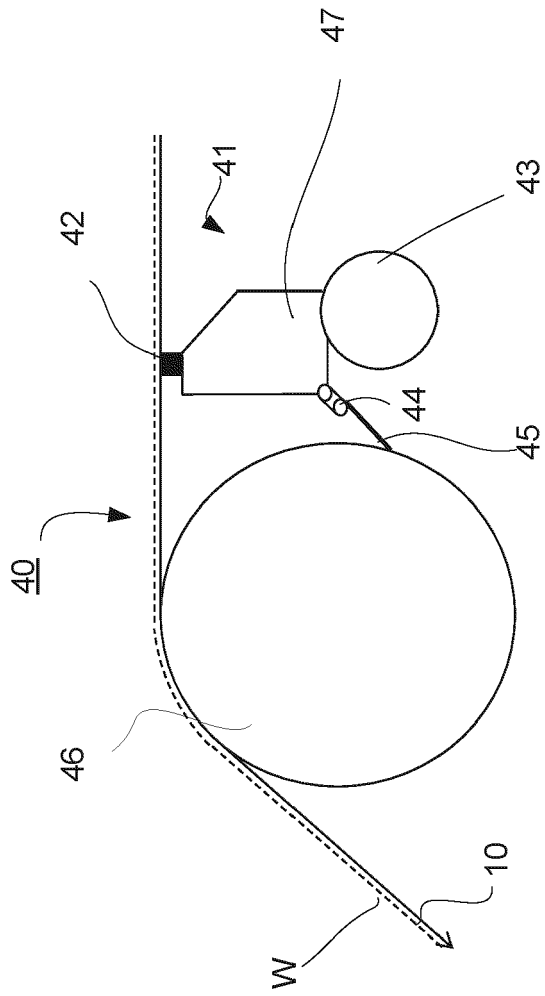


Fig. 2A

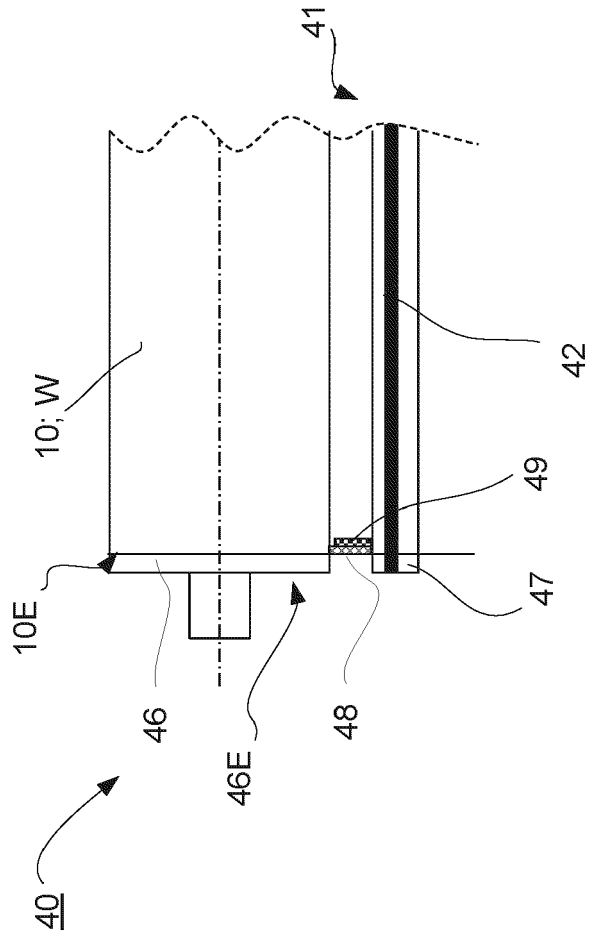


Fig. 2B

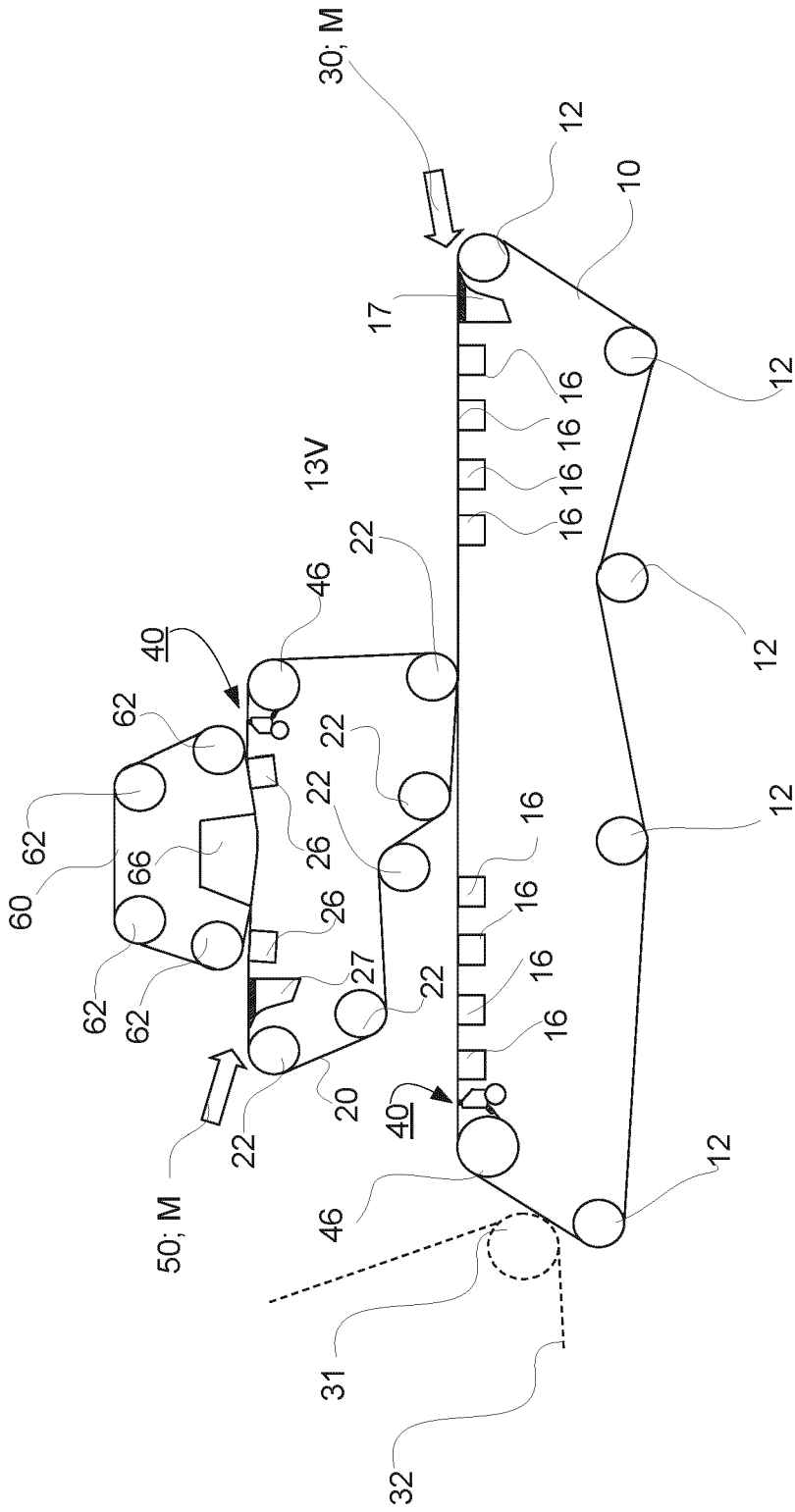


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 20 17 5686

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 362 952 A1 (VOITH PAPER PATENT GMBH [DE]) 19 November 2003 (2003-11-19) * paragraphs [0002] - [0009], [0016]; figure 2 * -----	1-11	INV. D21F1/48 D21F1/50 D21F2/00 D21F9/00 D21G3/00
			TECHNICAL FIELDS SEARCHED (IPC)
			D21F D21G
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 October 2020	Examiner Maisonnier, Claire
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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