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(54) **Method in a finishing device of a fiber web machine**

(57) The invention relates to a method for preventing unwanted structures of a roll in a finishing device of a fiber web machine. In the method, by altering web tension by

inducing a sine oscillation in to the web tension, accumulating structures of a roll in a finishing device of a fiber web machine are prevented.

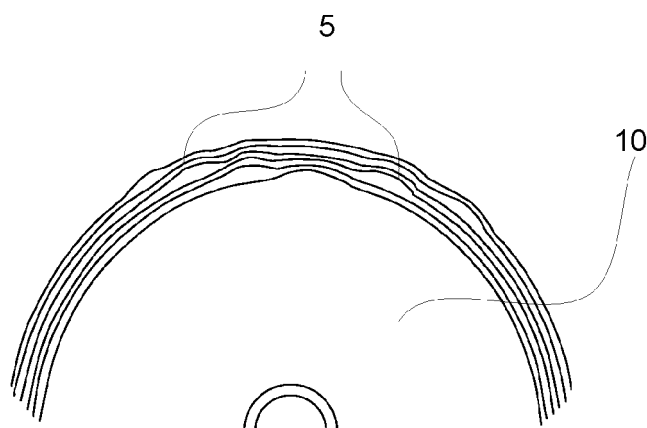


Fig. 1B

Description

[0001] Generally the invention relates to fiber web machines and specially to preventing unwanted structure/stuctures of a roll in finishing devices of a fiber web machine. More especially the invention to a method for preventing unwanted structure of a roll in a finishing device, especially in a calender or a calender roll and/or in a slitter-winder of a fiber web roll to be wound, of a fiber web machine according to the preamble of claim 1.

[0002] In manufacturing lines known from the prior art fiber web making takes place as continuous process. A fiber web completing in a machine is wound with a reel-up around a reeling shaft i.e. reel spool into a machine roll (a parent roll). The purpose of reeling is to modify the web manufactured as planar into a more easily processable form. In the reel-up the continuous process of the machine breaks for the first time and shifts into periodic operation. This periodicity is tried to be made with efficiency as good as possible in order to not to waste already done work in earlier process stages. The machine roll web produced in fiber web making is full- width so it must be slit into partial webs with suitable width and the partial webs are wound to partial web rolls (customer rolls) with suitable length and diameter for the customers. The slitting and winding take place as known from prior art in an appropriate separate machine i.e. in a slitter-winder. As known from the prior art, in the slitter-winder the machine roll is unwound, the wide web is slit on the slitting section into several narrower partial webs, into at least two partial webs, which are wound up on the winding section around winding cores, such as spools, into customer rolls.

[0003] The fiber web may have variations in caliber, in thickness and/or in tension in machine direction. These variations may cause non-wanted formations to the roundness of the fiber web roll to be wound especially when sequence length of variation or its multiple is even divided or close to that on the fiber web roll surface length. This causes accumulation if non-wanted structures i.e. formations of the fiber web roll roundness, so called accumulating formation (structure), as schematically shown in figure 1A, prior art. In the schematic example of figure 1A the variations 5 of thickness/caliber/tension have been evenly divisional on the roll surface length and caused a non-wanted formation 6 to the roundness of the fiber web roll 10.

[0004] Calendering is generally carried out in order to improve the properties, like smoothness and gloss, of a fiber web. In calendering the full width web is passed into a calendering nip, formed between rolls that are pressed against each other, in which nip the fiber web becomes deformed as by action of temperature, moisture and nip pressure. In the calender the nips are typically formed between a smooth-surfaced press roll such as a metal roll and a roll coated with resilient material such as a polymer roll. Many different types of calenders are known from prior art in which calenders the calendering nips are formed in various ways. In a fiber web machine the cal-

ender location is typically in the finishing section where the web is still full width i.e. after drying section but before the slitter-winder of the fiber web machine. In a fiber web production line there may be more than one calender.

[0005] In multiroll calenders calender unit has calend-
ering nips which are formed between a smooth surface
pressing roll, such as a metal roll, and a roll covered with
an elastic cover, such as a polymer roll located alternately
one after another. In multiroll calenders there is at least
one stack of rolls and typically at least two nips and three
rolls in each stack.

[0006] Both in winding and in calendering vibration oc-
curs in which part of phenomenon is un-roundness of a
fiber web roll to be wound or a calender roll. In winding
it is known that fiber web with high bulkiness and fiction
causes easily un-roundness or eccentricity of the fiber
web roll which limits the winding speed and may cause
bouncing of the fiber web rolls. In slitter-winder there have
been attempts to solve these problems by different types
of passive and active dampers that dampen natural fre-
quencies of frame structures of a slitter-winder. In de-
signing of frame structures the formation of un-roundness
during winding cannot be in all cases taken into account
in the designing stage and generation of this unwanted
effect cannot be eliminated to the full extent in the de-
signing stage. Even though resonance frequencies of
natural frequencies are important factors in generating
vibration, formation of a fiber web roll during winding can
occur in different frequencies depending on the winding
speed and depending on the multiple of winding frequen-
cy the formation presents. In multiroll / multinip calender
the fiber web may transfer the vibration from one nip to
another due to the uneven deformation in the preceding
nip.

[0007] DE patent publication 19601293 discloses a pri-
or art technique for processing web material in which web
is passed through nips formed between two rolls in an
arrangement in which there is a roll ahead a nip around
which the web is diverted and whose distance from the
nip is adjustable. By adjusting the distance of this roll
problems relating to variations in web thickness and un-
wanted form of a calender roll are to be avoided. This
prior art technique long travel changes in travel length of
the web which take time from a half hour to even several
hours.

[0008] EP patent application publication 2108606 dis-
closes a carrier-roll winder with at least one loading de-
vice. This prior art winder has at least one drive and a
control arrangement to control said at least one drive so
that the drive provides the roll/rolls to be wound with an
effect diminishing the bouncing phenomenon by exerting
moment.

[0009] An object of the present invention is to provide
for an improved method and device for preventing syn-
chronizing phenomenon causing accumulating forma-
tion structure on the roll surface.

[0010] A further non-obligatory object of the present
invention is to provide a method and a device for damp-

ening vibrations by preventing unwanted structure formation on the roll in winding and in calendering in which the disadvantages of prior art are eliminated or at least minimized.

[0011] A further non-obligatory object of the present invention is to provide the effect of achieving good roundness a fiber web roll 10 to be wound as shown schematically in figure 1 B.

[0012] A further non-obligatory object of the present invention is to provide fast changes to create active counter oscillations.

[0013] In view of achieving the objects stated above and those that will come out later the method for preventing unwanted structure/structures of a roll in winding and in calendering in a fiber web machine in accordance with the invention in mainly characterized by what is presented in the characterizing part of claim 1.

[0014] According to an advantageous embodiment of the invention preventing effect is achieved by which the forming of a roll (a fiber web roll to be wound or a calender roll) to un-round is prevented and even the un-roundness already formed is evened back to round surface form. The present invention does not utilize the dampening of frame structure vibrations but prevents the accumulating structure of a roll (a fiber web roll or a calender roll) by using web tension as an effecting element and advantageously by changing the length of web travel to create the desired roll surface form and roll structure. According to the invention a sine oscillation is induced to the web tension. The phase of the sine oscillation is opposite in relation to the forming of the roll reducing thus formation of the roll from one round / layer to next. Right frequency and phase for the tension oscillation is defined for example based on signals of acceleration sensor mounted on the roll / sensors mounted on the rolls, by which defining frequencies and their phases are measured, based on which counter oscillation frequency is determined.

[0015] Tension oscillation variation is based on causing a thickness variation to the web in machine direction, that when cumulating to the roll influences opposite to the thickness variation causing unwanted structure formation. The right frequency and phase of the sine oscillation prevents the cumulating un-roundness structure formation effect and also the uncontrolled vibration increase is simultaneously eliminated.

[0016] By the invention new means for preventing unwanted formation i.e. unwanted structure/structures is achieved in which the focus is controlling the form of the roll itself.

[0017] According to one advantageous example the invention is used in a two drum winder in which the sine oscillation is provided by a device placed in between unwinding and winding. The device for providing sine oscillation is for example a dancer roll or a guide roll. This device has low inertia for providing tension variation in high frequency, in a winder typically 10 - 50 Hz and in calender 100 - 1000 Hz, advantageously over 200 Hz. The amplitude is from 10 N/m to 70 N/m, advantageously

from 20 N/m to 50 N/m. Advantageously a dampening function of a frequency converter is used for providing sinusoidally oscillating moment, in which the frequency and phase are received from a higher control system.

[0018] According to an advantageous feature of the invention instead of even tension level into web tension a sinusoidal or corresponding signal is added to web tension. Phase length and / or amplitude of the signal is defined and / or continuously changed such that un-roundness caused by machine directional variation divides evenly around circumference of the roll. As signal for example a so called Dither-signal can be used by which signal variation of machine directional distribution and/or transition of static/dynamic friction of fiber web's surface layer is affected. Alternatively web tension is adjusted continuously by fast feedback for example based on tension measurement for example results such that effect of machine directional variation to roll structure is minimized. Measurement data of machine directional variation or its phase length and/or of web tension is advantageously from iRoll -tension measurement roll and/or from other measurement devices located in connection with the web either online or offline depending on the measurement application.

[0019] According to an advantageous feature of the invention the sinusoidal signal is created by a drive in connection with a winder, for example by a servo drive or by a digihydraulic drive that are capable of fast changes. In a winder the drive can be the drive of unwinder, of a pressure roll, of a carrier roll or of a separate guide roll.

[0020] Also by changing the length of web travel same effect to web tension is achieved when web length changes faster than the tension control of unwinding compensates it. This can be provided by linear motor, by electric servo, by digihydraulic control or by piezoelectric element.

[0021] According to an advantageous feature of the invention the changes are of zero average value and the change interval is from about 1 ms to about 100 ms and thus active counter oscillation is achieved.

[0022] In the following the invention is discussed in more detail by reference to figures of accompanying drawings.

Figure 1 A shows schematically a partial fiber web roll according to a prior art.

Figure 1 B shows schematically a partial fiber web achieved by utilizing the present invention.

Figure 2 shows schematically an example of the invention in connection with a slitter-winder.

Figure 3 shows schematically an example of the invention in connection with a slitter-winder.

Figure 4 shows schematically a further example of the invention in connection with a slitter-winder.

Figure 5 shows schematically a further example of the invention in connection with a slitter-winder.

[0023] In the following description same reference signs designate for similar components unless otherwise mentioned and it should be understood that the examples are susceptible of modification in order to adapt to different usages and conditions within the frames of the invention.

[0024] As schematically shown in figure 1A, prior art, fiber web may have variations 5 in caliber, in thickness and/or in tension in machine direction. These variations 5 may cause non-wanted formations 6 to the roundness of the fiber web roll 10 to be wound especially when sequence length of variation or its multiple is even divided or close to that on the fiber web roll surface length. This causes accumulation non-wanted formations of the fiber web roll roundness. In the schematic example of figure 1A the variations 5 of thickness/caliber/tension have been evenly divisional on the roll surface length and caused a non-wanted formation 6 to the roundness of the fiber web roll 10.

[0025] Figure 1 B shows schematically a partial fiber web roll 10 achieved by utilizing the present invention providing the effect of achieving good roundness a fiber web roll 10 to be wound. When utilizing the invention the variations 5 do not form non-wanted formations as the division of variations in machine direction is evened.

[0026] Figure 2 shows schematically a slitter-winder which comprises a two-drum winder. In the slitter-winder the fiber web W from machine roll i.e. parent roll 13 is unwound and is slit length-wise into parallel partial webs which are wound in the winder to a set of successive rolls 10. The winder shown in the figure is a two-drum winder which comprises two winding rolls, i.e. carrier rolls 11, 12. In two-drum winders one winding roll can also be a set of belt rolls depending on the type of two-drum winder in which in which an endless loop of belt/belts is arranged around two rolls. In the winder the longitudinally successive web rolls 10 are supported by the winding rolls 11, 12 from below thereof and typically by a pressing device (not shown) from above the web roll 10. The guide rolls 14 direct and support the travel of the web W / partial webs from unwinding of parent roll 13 to the winder. According to an advantageous feature of the guide roll 14 is oscillated based on the moment control 15. The sine oscillation S is thus provided by the oscillating guide roll 14 placed in between unwinding and winding. Instead of oscillating the guide roll also a dancer roll can be used for providing sine oscillation to web W tension.

[0027] In figure 3 a calender is schematically illustrated. The calender is a multiroll calender with alternating smooth surface pressing rolls, such as a metal rolls, and rolls covered with an elastic cover, such as polymer rolls forming the calendaring nips in between. The calender rolls are marked with reference signs 21, 22, 23, 24, 25, 26 which in this example are in one stack. In this schematic example a fly roll 20 ahead a nip between calender

rolls 22, 23 around which the web W is diverted and whose distance from the nip is adjustable. By the oscillating movement of the fly roll 20 as shown by arrow 27 a sine oscillation S is provided to prevent the accumulating formation.

[0028] In figures 4 and 5 schematic examples in winder are presented in which the slitter-winder is a two-drum winder. In the slitter-winder the fiber web W from machine roll i.e. parent roll 13 is unwound and is slit length-wise into parallel partial webs which are wound in the winder to a set of successive rolls 10. The winder shown in the figure is a two-drum winder which comprises two winding rolls, i.e. carrier rolls 11, 12. In two-drum winders one winding roll can also be a set of belt rolls depending on the type of two-drum winder in which in which an endless loop of belt/belts is arranged around two rolls. In the slitting section the web W is cut in longitudinal direction to partial webs between slitter blades, of which only above the web located set of blades is schematically shown and indicated by reference sign 18.

[0029] In the winder the longitudinally successive web rolls 10 are supported by the winding rolls 11, 12 from below thereof and typically by a pressing device (not shown) from above the web roll 10. The guide rolls 14, 16 direct and support the travel of the web W / partial webs from unwinding of parent roll 13 to the winder.

[0030] According to the invention in the examples of figure 4 and figure 5 sinusoidal signal S is combined to the web tension signal F to even out the accumulating formation causing un-roundness of the roll based on web tension measurement results, as shown in the diagraph of web tension in function of time. As shown in the partial enlargement of the measurement result diagraph the signal is modified by the sinusoidal signal to modify web tension signal F.

[0031] According to the example of figure 4 web W tension is changed by changing the moment of a drive / drives 31 of unwinding.

[0032] According to the example of figure 5 web W tension is changed by changing the web length by oscillating the guide roll 14 as indicated by arrow 15. A measuring device is located in connection with the guide roll 16 and based on measurement results 17 the sinusoidal signal S is provided by the oscillating guide roll 14.

[0033] Above the invention has been described with reference to some preferred exemplifying embodiments of the same only, and the invention is, however, by no means to be strictly confined to the details of said embodiments and many modifications and variations are possible.

[0034] Reference signs used in the drawing

- 5 variation of thickness/caliber/tension of web
- 6 non-wanted formation of fiber web roll
- 10 fiber web roll
- 11, 12 carrier roll
- 13 machine roll in unwinding
- 14, 16 guide roll

18 slitter blades
 15 moment control
 17 diagram of measurement results
 19 measuring device
 20 fly roll
 21, 22, 23, 24, 25, 26 calender roll
 27 oscillating movement
 31 moment change of a drive of the unwinder
 F web tension signal
 S sinusoidal signal
 W web

7. Method according to claim 6, **characterized in that** based on measurement results frequencies and their phases are defined and oscillation frequency of preventing sinusoidal signal is determined.

Claims

1. Method for preventing unwanted structure/stuctures of a roll in a finishing device of a fiber web machine, **characterized in that** in the method by altering web tension by inducing a sine oscillation in to the web tension accumulating structure/accumulating structures of a roll in a finishing device of a fiber web machine is/are prevented.
2. Method according to claim 1, **characterized in that** length of web travel is changed by controlling the web tension with a sinusoidal signal to achieve desired roll surface form and roll structure and to prevent an accumulating formation i.e. accumulating structure/structures on a roll surface.
3. Method according to claim 1, **characterized in that** in a calender location of a fly roll is oscillated sinusoidally to alter the web tension and to prevent unwanted structure formation of a calender roll due to an accumulating formation i.e. accumulating structure/structures on the roll surface.
4. Method according to claim 1, **characterized in that** in a slitter-winder location of a guide roll is oscillated sinusoidally to alter the web tension and to achieve a fiber web roll with desired roundness preventing an accumulating structure formation on the roll surface of the fiber web roll on the winder to be wound.
5. Method according to claim 1, **characterized in that** in a slitter-winder moment control of a drive of unwinding is oscillated sinusoidally to alter the web tension and to achieve a fiber web roll with desired roundness preventing an accumulating structure formation on the roll surface of the fiber web roll on the winder to be wound.
6. Method according to claim 1, **characterized in that** frequency and phase for the sinusoidal signal to be induced into the web tension is defined based on measurement results received from signals of acceleration sensor mounted on the roll / sensors mounted on the rolls.

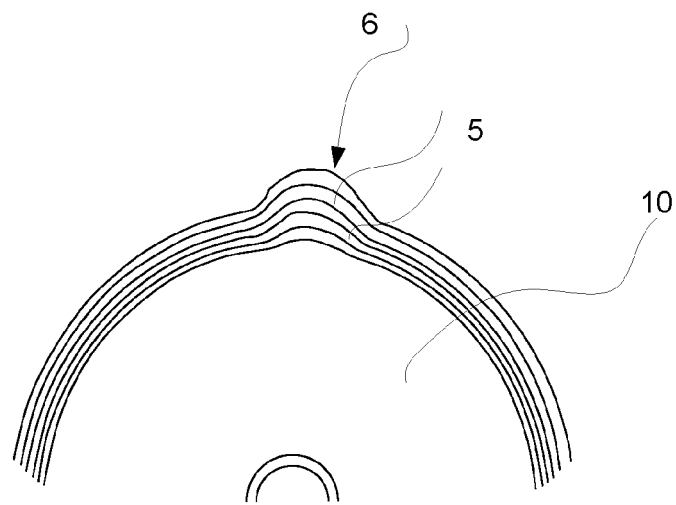


Fig. 1A
Prior art

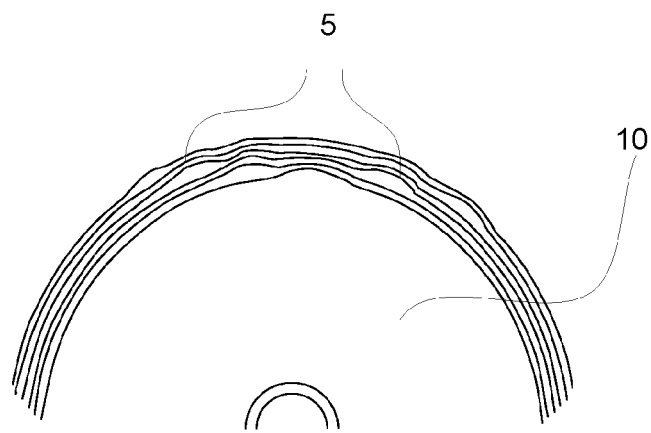


Fig. 1B

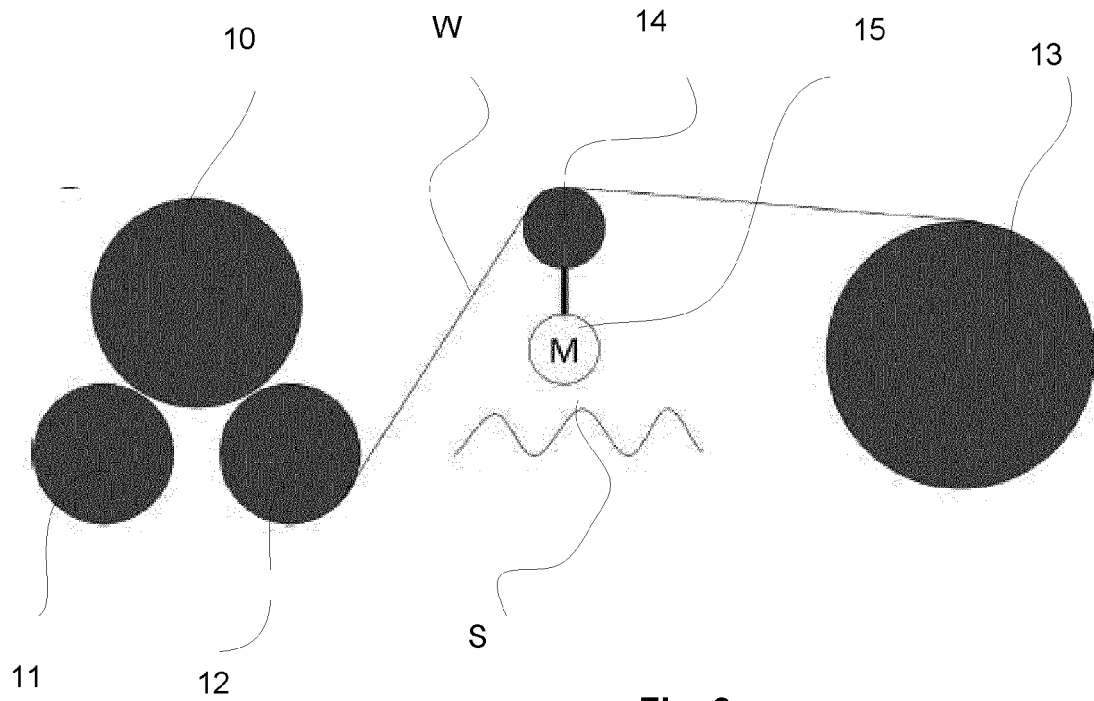


Fig. 2

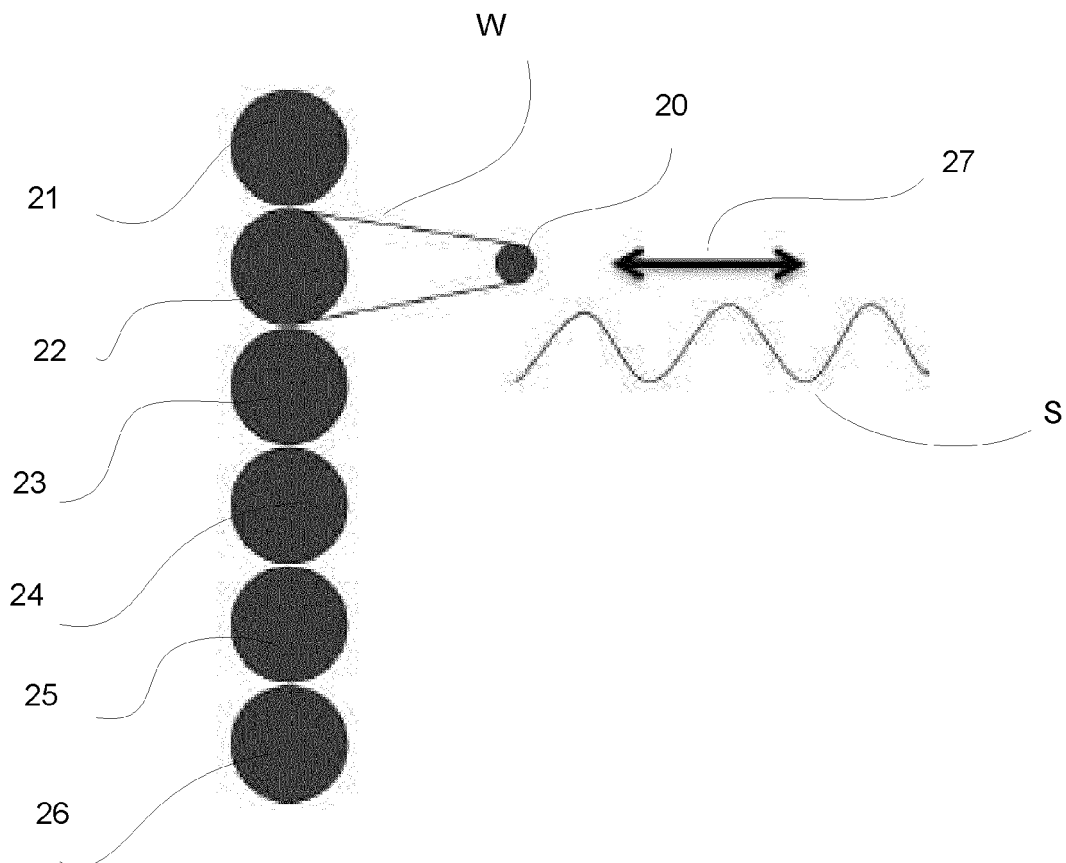


Fig. 3

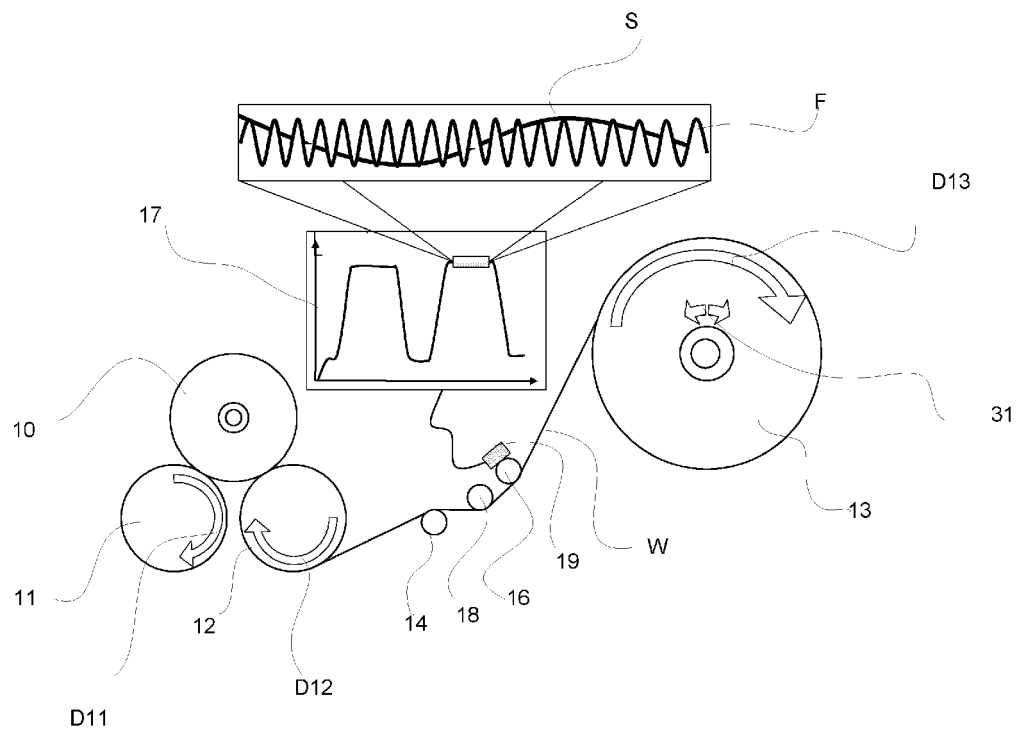


Fig. 4

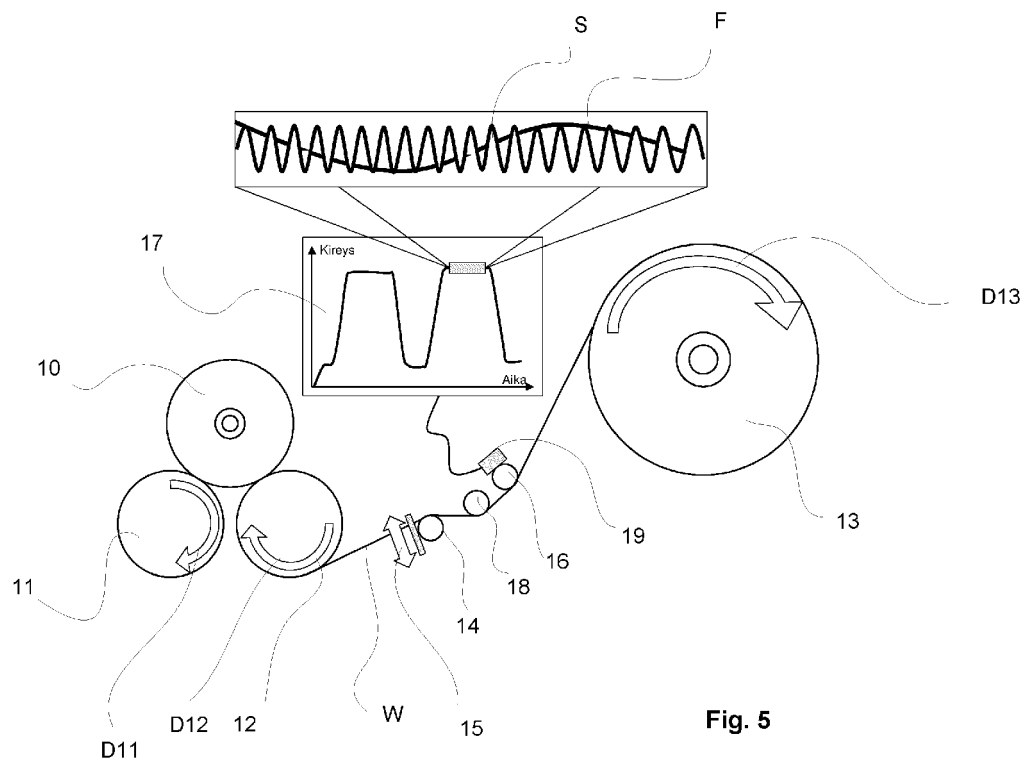


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 11 19 5844

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 2003/141405 A1 (KEEL DONALD WAYNE [US]) 31 July 2003 (2003-07-31) * paragraph [0002] - paragraph [0012] * * paragraph [0025] - paragraph [0030]; figure 2a *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			D21G D21F B65H
Place of search Munich		Date of completion of the search 19 April 2012	Examiner Sabatucci, Arianna
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 19 5844

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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REFERENCES CITED IN THE DESCRIPTION

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