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(71) Applicant (for all designated States except US): **METSO PAPER, INC.** [FI/FI]; Fabianinkatu 9A, FI-00130 Helsinki (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **PIETIKÄINEN, Reijo** [FI/FI]; Puistotie 42B, FI-04420 Järvenpää (FI). **LIPPONEN, Juha** [FI/FI]; Röynänkatu 2, FI-04400 Järvenpää (FI). **LUOMI, Seppo** [FI/FI]; Retiisikuja 4, FI-04400 Järvenpää (FI). **LINNONMAA, Jukka** [FI/FI]; Jalavatie 19, FI-04480 Haarajoki (FI). **KETTUNEN, Heikki** [FI/FI]; Vahveropolku 12E, FI-02730 Espoo (FI).

(74) Agent: **LORENZ & KOLLEGEN**; Alte Ulmer Strasse 2, 89522 Heidenheim (DE).

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(54) Title: METHOD AND ARRANGEMENT FOR FIXING A COATING AND/OR PROCESSING AGENT ON A PAPER OR BOARD WEB

(57) Abstract: The present invention relates to a method for fixing a coating and/or processing agent (2) on a paper or board web (w), the coating and/or processing agent (2) having a dry solids content of at least 80%, in which the coating and/or processing agent is applied to the web (w) and fixed on the web with a fixing means (4). In the method, the surface energy of the fixing means (4) is chosen to be lower than the surface energy of the coating and/or processing agent (2). The invention also relates to an arrangement (100, 200, 300, 400, 500, 600) for fixing a coating and/or processing agent (2) on a paper or board web (w),



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Method and arrangement for fixing a coating and/or processing agent on a
paper or board web

The invention relates to a method for fixing a coating and/or processing agent on a paper or board web, the coating and/or processing agent having a dry solids content of at least 80%, according to the preamble of claim 1. The invention also relates to an arrangement for fixing a coating and/or processing agent on a paper or board web, the coating and/or processing agent having a dry solids content of at least 80%, according to the preamble of claim 14.

To improve the characteristics of a paper or board web, it is commonly known to apply a coating and/or processing agent to the web. While there are methods, in which a wet coating is applied to the web, such as in spray coating, curtain coating and jet coating, these methods employing wet coating agents have the disadvantage that the wet coating brings a certain amount of undesirable humidity into the web.

For this reason, so-called dry coating methods have been developed in which the coating and/or processing agent has a dry solids content of at least 80%. Concerning the prior art disclosing these methods, reference is made to the following documents: WO 2001/075229 A1, WO 2005/061126 A1, WO 2005/085524 A1, WO 2005/085525 A1 and WO 2006/003250 A1.

In the process of fixing the coating and/or processing agent to the web a problem is that the coating and/or processing agent tends to adhere to the surface of the fixing means resulting in a relatively poor coating result, since parts of the agent can not be fixed on the web.

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It is therefore an object of the present invention to provide a method and an arrangement for fixing a coating and/or processing agent on a paper or board web in which as much coating and/or processing agent as possible can be fixed to the web.

In order to attain the above mentioned object as well as those coming out later, the method according to the present invention is mainly characterized in what is stated in claim 1.

With the method according to the present invention, the fixing means has a lower surface energy than the surface energy of the coating and/or processing agent, whereby the coating and/or processing agent adheres better to the web than to the fixing means, thereby minimizing the amount of coating and/or processing agent adhering to the fixing means. With this preventing of the accumulation of coating and/or processing agent on the fixing means, a better result in coating the web can be achieved.

The adherence of the coating and/or processing agent can further be improved, if in a very advantageous embodiment of the method according to the invention the surface energy of the coating and/or processing agent is chosen to be lower than the surface energy of the web.

It has been found to be particularly advantageous, if the surface energy of the fixing means is chosen to be 8 - 40 mJ/m² and the surface energy of the coating and/or processing agent is chosen to be 8 - 100 mJ/m². In this respect, it is further advantageous if the surface energy of the web is cho-

sen to be 60 - 100 mJ/m². Of course, to the above mentioned magnitudes of the surface energies, the limitation that the fixing means has a lower surface energy than the surface energy of the coating and/or processing agent applies.

To achieve the above mentioned relation of the surface energies, the surface of the fixing means can comprise a material chosen from the group comprising nickel, chrome, polytetrafluoroethylene, silicone, ceramics, fluoro-elastomere, fluorine compounds, diamond, rubber, polymer or a combination thereof. Such a surface advantageously decreases the adherence of the coating and/or processing agent to the fixing means.

The surface energies can also be attained, when on the surface of the fixing means a release agent is applied.

A further possibility to influence the surface energy of the coating and/or processing agent is to treat it with a plasma treatment.

Alternatively or additionally a plasma treatment can also be applied to the web before the coating and/or processing agent is applied to the web and/or after the coating and/or processing agent has been applied to the web.

A further alternative or additional treatment is that the fixing means is treated with a plasma treatment.

In this respect, with all above mentioned plasma treatments of the coating and/or processing agent and/or the web and/or the fixing means, the surface energies of the elements in-

volved can be increased or decreased depending on the requirement. For example, if the surface energy of the coating and/or processing agent is too high, the surface energy of the web can be increased by means of a plasma treatment to be even higher.

In a still further embodiment of the invention, the surface of the fixing means can be cleaned during the method. With such a cleaning of the fixing means, the adherence of the coating and/or processing agent on parts of the web where the agent is not intended, can be avoided.

In this respect, the surface of the fixing means can be cleaned with a device which is in contact with the fixing means. With such a contact cleaning method, very good cleaning results can be achieved.

Alternatively it can also be advantageous, if the surface of the fixing means is cleaned contactless.

The arrangement according to the invention is mainly characterized in what is stated in claim 14.

With the arrangement of the present arrangement it is possible to carry out the method according to the invention in a simple and straight forward manner.

In an embodiment of the arrangement that is relatively simple to realize there can be provided fixing means consisting of steel with the material forming the surface of the fixing means having a thickness of 1 - 200 μm .

In order to keep the surface of the fixing means as clean as possible to avoid residues from the coating and/or processing agent and/or dirt adhering to the web, the arrangement can comprise cleaning means for cleaning the fixing means. These cleaning means can comprise a device which is in contact with the fixing means, the device for example being a rotating brush, a revolving belt or a wiping cloth.

The fixing means can for example contain a belt and a roll or it can contain two rolls.

The invention will now be described in more detail with reference to the figures of the accompanying drawing, to the details of which the invention shall however by no means be narrowly confined.

Fig. 1 shows a first embodiment of an arrangement for fixing a coating and/or processing agent on a paper or board web;

Fig. 2 shows a second embodiment of the arrangement according to the invention;

Fig. 3 shows an enlarged detail according to line III of Fig. 2;

Fig. 4 shows a third embodiment of the arrangement according to the invention;

Fig. 5 shows a fourth embodiment of the arrangement according to the invention;

Fig. 6 shows a fifth embodiment of the arrangement according to the invention; and

Fig. 7 shows a sixth embodiment of the arrangement according to the invention.

Fig. 1 shows an arrangement 100 for conducting a method for transferring a coating and/or processing agent 2 and for fixing the coating and/or processing agent 2 to a paper or board web w which travels in a direction indicated with "x". For the sake of simplicity, the coating and/or processing agent 2 is in the following mostly only referred to as agent 2. The arrangement 100 comprises means 3 to apply the agent 2 on the web w, which can also be referred to as application area or applicator 3.

The coating and/or processing agent 2 used in the methods described in the following is a very dry agent having a dry solids content of at least 80%. Since the chemical composition of the agent 2 can be any known and suitable composition for coating a paper or board web w, further details of the agent 2 can be omitted. The coating and/or processing agent 2 is usually in a powdery form.

After the agent 2 has been transferred to the web w, the web w is pressed in a nip N. The nip N is also used for fixing the coating and/or processing agent 2 on the paper or board web w. Therefore, the means forming the nip N are referred to as fixing means 4 in the following. In the embodiment of Fig. 1, the fixing means 4 contain a roll 5 and a belt 6. To ensure the transportation of the web w, the roll 5 is rotating and the belt 6, in the present case a metal belt, is revolv-

ing. To allow the revolving of the belt 6, it is wound around three guide rolls 7, the number of which can of course deviate from the number shown in Fig. 1. The fixing means shown in Fig. 1 is usually referred to as a metal-belt-calender with the nip N being referred to as a long nip or a ValZone.

To ensure that as much of the coating and/or processing agent 2 as possible adheres to the paper or board web w and as little as possible of the coating and/or processing agent 2 adheres to the fixing means 4, i.e. the roll 5 or the belt 6, the surface energy of the fixing means 4 is lower than the surface energy of the coating and/or processing agent 2 for all arrangements described herein. It is furthermore helpful, if the surface energy of the coating and/or processing agent 2 is lower than the surface energy of the web w.

It has turned out to lead to the best results concerning the adherence of the agent 2 to the web w, if the surface energy of the fixing means 4 is chosen to be 8 - 40 mJ/m² and the surface energy of the coating and/or processing agent 2 is 8 - 100 mJ/m². Furthermore, good results can be achieved, if the surface energy of the web w is 60 - 100 mJ/m². Of course, the above mentioned rule according to which the surface energy of the fixing means 4 is lower than the surface energy of the agent 2 applies, i.e. if the surface energy of the fixing means 4 is for example 20 mJ/m², the surface energy of the agent 2 has to be higher, i.e. between 20 - 100 mJ/m².

In the embodiment of an arrangement 200 for fixing the agent 2 on the paper or board web w, the fixing means 4 comprises two rotating rolls 8 and 9, which also form a nip N between themselves. All other features explained above with reference

to the arrangement 100 do also apply for this arrangement 200, especially concerning the relation of the surface energies of the fixing means 4, the agent 2 and, if applicable, the web w. According to the embodiment represented by arrangement 200, the fixing means 4 comprises a heating means 10 which can be a usual and as such known heating device, which is in the present case arranged in the roll 9. Of course, the heating means 10 could also be arranged in the roll 8 or in the roll 5 of arrangement 100. Furthermore, there could also be provided a heating means for the belt 6 of arrangement 100.

As an alternative to the fixing means 4 shown in Fig. 1 and Fig. 2, it is also possible to use a so-called shoe calender to fix the coating formed by the agent 2 on the web w.

To achieve the above mentioned value of the surface energy of the fixing means 4, the surface of the fixing means 4, i.e. the surface of the roll 5 and the belt 6 or the rolls 8 and 9, can comprise a material chosen from the group comprising nickel, chrome, polytetrafluoroethylene, silicone, ceramics, fluoro-elastomere, fluorine compounds, diamond, rubber, e.g. a heat-resistant silicon rubber, polymer or a combination thereof.

Of course, since these materials are very different in composition, characteristics and processing, there can be many different ways in attaching or applying the surface of these materials to the fixing means 4. For example, to apply a surface of nickel or chrome, an electro-plating method can be used, while other materials can be attached to the fixing means 4 by vacuum evaporation or similar techniques.

Fig. 3 shows an example of a surface of the fixing means 4, in which the fixing means 4 consists of steel and the material forming the surface of the fixing means 4 is nickel or chrome and has a thickness of 1 - 200 μm .

Further examples of easy applicable surfaces are composite chrome-polytetrafluoroethylene surfaces or composite chrome-silicone surfaces. To produce such surfaces, the basic material of the fixing means 4, for example steel, is first chrome plated with an electrolytic process. The chrome surface usually contains small cracks in the sub-micron scale and these cracks are opened or widened by etching using strong acids. The increased volume of these cracks as well as the whole surface is then finally coated with a polytetrafluoroethylene or a silicone coating and the polytetrafluoroethylene or silicone remains in the crack volume and is also spread over the complete surface of the fixing means 4 in a very safe and reliable way. With such a hybrid coating, the chrome layer gives the mechanical strength and the polytetrafluoroethylene layer is used to adjust the surface energy of the fixing means 4.

Especially when a ceramic layer is used for the surface of the fixing means 4, in the pores of this ceramic layer there can be deposited the material decreasing the adherence of the agent 2 to the fixing means 4, e.g. polytetrafluoroethylene.

A further possibility is to use a single layer of polytetrafluoroethylene or several layers of polytetrafluoroethylene (multilayer-PTFE) in which a coating layer of polytetrafluoroethylene is applied on the surface of the fixing means

4 in liquid form and the coating is hardened for several hours, e.g. in an oven in a temperature region of e.g. 300 - 400°C.

With such a surface coating as described above, the fixing means 4 has a much lower surface energy than it would be the case, if the fixing means 4 had a steel surface.

The arrangement 300 for fixing the agent 2 on the paper or board web w shown in Fig. 4 contains means 11 to apply a release chemical or release agent 12 on the surface of the fixing means 4. This release agent 12, which can be for example silicone oil, does also influence the surface energy of the fixing means 4 to become lower than the surface energy of the coating and/or processing agent 2. In the case of the two rolls 8 and 9 used as fixing means 4, both rolls 8 and 9 each comprise means 11 for applying the release agent 12 which are arranged over the whole width of the rolls 8 and 9. However, it is also possible to arrange the means 11 for applying the release agent 12 for only one of the rolls 8 or 9. The means 11 for applying the release agent 12 on the surface of the fixing means 4 can for example be in the form of a doctor blade.

Of course, the means 11 can also be used in the case of a fixing means 4 containing the roll 5 and the belt 6 or with other fixing means 4 not shown in the drawings. In the case of applying, e.g. by spraying a release agent like silicon oil on the surface of the fixing means 4, it can be possible to use steel as the material for the fixing means 4.

Similarly, the fixing means 4 can be covered with a material that contains the release agent 12 which is released in the nip contact. The release reaction of this chemical can be catalyzed e.g. by water which comes from the web w or the coating formed by the agent 2 or it can be sprayed for this purpose or otherwise for intensifying the fixing process on the surface of the web w or the fixing means 4.

Instead of a release agent, a sol-gel agent can also be applied to the fixing means 4. This sol-gel agent can be applied to the fixing means 4 as a very thin layer similar to the release agent or chemical.

The arrangement 400 shown in Fig. 5 is identical to the arrangement 200 shown in Fig. 2 with the difference that the arrangement 400 contains means for treating the coating and/or processing agent 2, the web w and the fixing means 4 with plasma. In the arrangement 400 there are shown altogether five means 13, 14, 15, 16, and 17 for treating the agent 2 and/or the web w and/or the fixing means 4 with plasma. Of course, it is not necessary to have all the means 13, 14, 15, 16, and 17 in one arrangement, but there can be any number and combination of these means 13, 14, 15, 16, and 17, depending on the requirements.

In general, by treating the agent 2 or the web w or the fixing means 4 or a combination thereof with plasma, the surface energy of these elements can be decreased or increased depending on the nature of the plasma used. By the plasma treatment, ions are transferred to the surface to be treated. These ions for example have an effect on the chemistry, the energy of the surface and other properties of the surface to

be treated. In this respect, the term "plasma" refers to a partially ionized gas, in which a certain proportion of electrons are free rather than being bound to an atom or a molecule.

The means 13, 14, 15, 16, and 17 can comprise a usual plasma chamber in which a gas is introduced and which works in a manner known per se which is therefore not described herein. Which such a plasma treatment, usually additional material is added to the agent 2, the web w and/or the fixing means 4.

According to arrangement 400, the means 13 is used for treating the web w with a plasma treatment before the agent 2 is applied to the web w, the means 14 is used for treating the agent 2 with a plasma treatment before the agent 2 is applied to the web w, and the means 15 is used for treating the web w after the agent 2 has been applied to the web w, but before it has been fixed in the nip N. Furthermore, the means 16 is used for treating the fixing means 4 with a plasma treatment and the means 17 is used for treating the web w with a plasma treatment after the agent 2 has been fixed by the fixing means 4. In the present case, the means 16 is only used for treating the roll 8 of the fixing means 4, but it is obvious that also the roll 9 or, in case of a metal-belt-calender, also the roll 5 and/or the belt 6 can be treated with the plasma treatment.

The plasma treatment can also be used to influence other properties of the web w, the agent 2 and/or the fixing means 4. For example, the gloss and/or the roughness of the coating finish can be manipulated with a plasma treatment, e.g. with the means 17.

With the arrangements 500 and 600 shown in Figures 6 and 7, the surface of the fixing means 4 can be cleaned substantially continuously during the method for fixing the coating and/or processing agent 2 on the paper or board web w. While, as explained in more detail in the following, both Figures 6 and 7 show the cleaning of the surface of the fixing means 4 by means of a device which is in contact with the fixing means 4, the surface of the fixing means 4 can also be cleaned contactless.

The arrangement 500 according to Fig. 6 corresponds to the arrangement 100 shown in Fig. 1, but additionally contains a cleaning means 18 for cleaning the fixing means 4. The cleaning means 18 used in arrangement 500 comprises a device 19 which is in contact with the fixing means 4. In the present case, the device 19 is a rotating brush which is arranged in a housing 20 to which a suction line 21 is connected. While the rotating brush is in connection with the belt 6, it cleans possible residues of the agent 2 from the belt 6 which residues are disposed by means of the suction line 21. Of course, the rotating brush forming the device 19 could also be used with any other fixing means 4 which can be used for fixing the agent 2 on the web w.

The cleaning means 18 furthermore contains electrodes 22 grounding the surface and accordingly discharging the surface charge in a controllably manner. With the electrodes 22, the surface of the fixing means 4 can for example be charged in the same way as the agent 2, whereby the agent 2 is repelled by the fixing means 4.

In Fig. 7 there is shown an arrangement 600 also containing cleaning means 18 which comprises the device 19 being in contact with the fixing means 4. In this case, the device 19 is a revolving belt arranged in contact with the roll 8 and placed in the housing 20 which is also provided with the suction line 21. Again, the revolving belt forming the device 19 can be used for any fixing means 4 useful for fixing the agent 2 on the web w.

By removing the residues of the agent 2 from the fixing means 4, it can be avoided that these residues come into contact with the web w again, which would deteriorate the coating result. Furthermore, if there is already residues of the agent 2 or other dirt on the fixing means 4, new residues of the agent 2 or dirt adheres more easily.

Instead of the revolving belt or the rotating brush, the device 19 can also be formed by a wiping cloth. With a cloth, better results are achieved, if the cloth is moistened.

If a contactless cleaning means 18 is used for cleaning the fixing means 4, it can be a blowing or suction device or a water jet.

The number of the heating means 10, means 11 for applying the release agent 12, means 13, 14, 15, 16, and 17 for plasma treatment and cleaning means 18 depends on whether the agent 2 is applied to only one or to both sides of the web w. In this respect, it can be advantageous, if these means are used on both sides of the web w if the agent 2 is applied to both sides of the web w. However, this is not absolutely necessary and, on the contrary, it may also be useful to arrange these

means on both sides of the web w even if the agent 2 is applied to only one side of the web w.

The different means described with reference to the arrangements 100, 200, 300, 400, 500 and 600 can be combined in any reasonable way as long as there does not exist a reason not to combine one or more of these means with any other of these means.

Patent Claims

1. Method for fixing a coating and/or processing agent (2) on a paper or board web (w), the coating and/or processing agent (2) having a dry solids content of at least 80%, in which the coating and/or processing agent is applied to the web (w) and fixed on the web with a fixing means (4),
characterized in that,
the surface energy of the fixing means (4) is chosen to be lower than the surface energy of the coating and/or processing agent (2).
2. Method according to claim 1,
characterized in that,
the surface energy of the coating and/or processing agent (2) is chosen to be lower than the surface energy of the web (w).
3. Method according to claim 1 or 2,
characterized in that,
the surface energy of the fixing means (4) is chosen to be 8 - 40 mJ/m² and the surface energy of the coating and/or processing agent is chosen to be 8 - 100 mJ/m².
4. Method according to claims 2 and 3,
characterized in that,
the surface energy of the web (w) is chosen to be 60 - 100 mJ/m².
5. Method according to any of claims 1 - 4,
characterized in that,

the surface of the fixing means (4) comprises a material chosen from the group comprising nickel, chrome, polytetrafluoroethylene, silicone, ceramics, fluoro-elastomere, fluorine compounds, diamond, rubber, polymer or a combination thereof.

6. Method according to any of claims 1 - 4, characterized in that, on the surface of the fixing means (4) a release agent is applied.
7. Method according to any of claims 1 - 6, characterized in that, the coating and/or processing agent (2) is treated with a plasma treatment.
8. Method according to any of claims 1 - 7, characterized in that, the web (w) is treated with a plasma treatment before the coating and/or processing agent (2) is applied to the web (w) and/or after the coating and/or processing agent (2) has been applied to the web (w).
9. Method according to any of claims 1 - 8, characterized in that, the fixing means (4) is treated with a plasma treatment.
10. Method according to any of claims 1 - 9, characterized in that, the surface of the fixing means (4) is cleaned during the method.

11. Method according to claim 10,
characterized in that,
the surface of the fixing means (4) is cleaned with a
device (19) which is in contact with the fixing means
(4).
12. Method according to claim 10,
characterized in that,
the surface of the fixing means (4) is cleaned contact-
less.
13. Method according to any of claims 1 - 12,
characterized in that,
the fixing means (4) is heated.
14. Arrangement for fixing a coating and/or processing agent
(2) on a paper or board web (w), the coating and/or
processing agent (2) having a dry solids content of at
least 80%, the arrangement comprising a fixing means (4)
for fixing the coating and/or processing agent (2) on
the web (w),
characterized in that,
the surface energy of the fixing means (4) is lower than
the surface energy of the coating and/or processing
agent (2).
15. Arrangement according to claim 14,
characterized in that,
the surface energy of the coating and/or processing
agent (2) is lower than the surface energy of the web
(w).

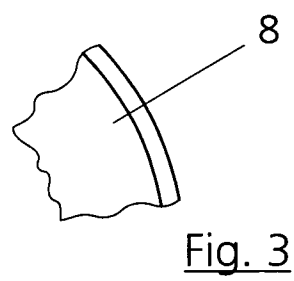
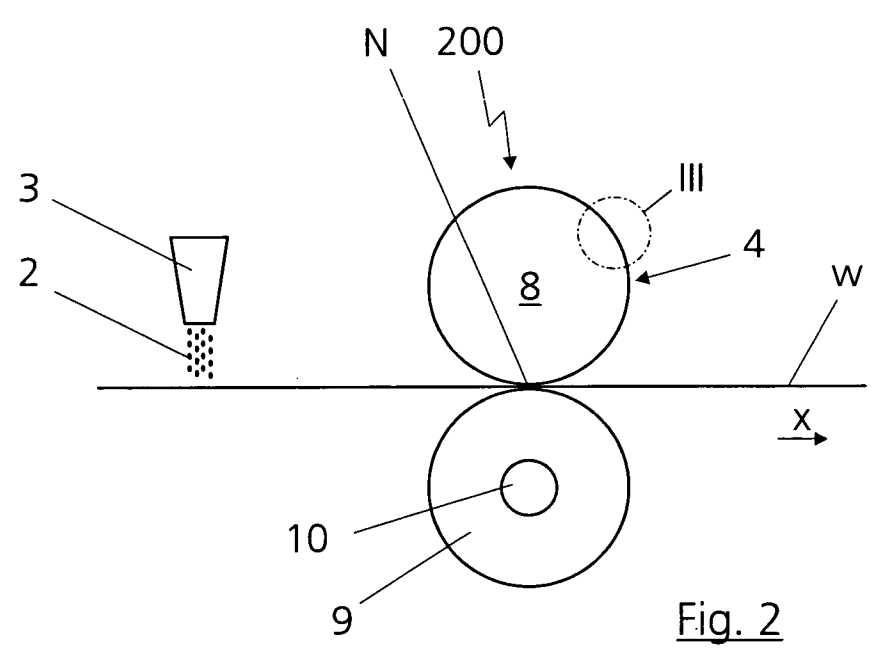
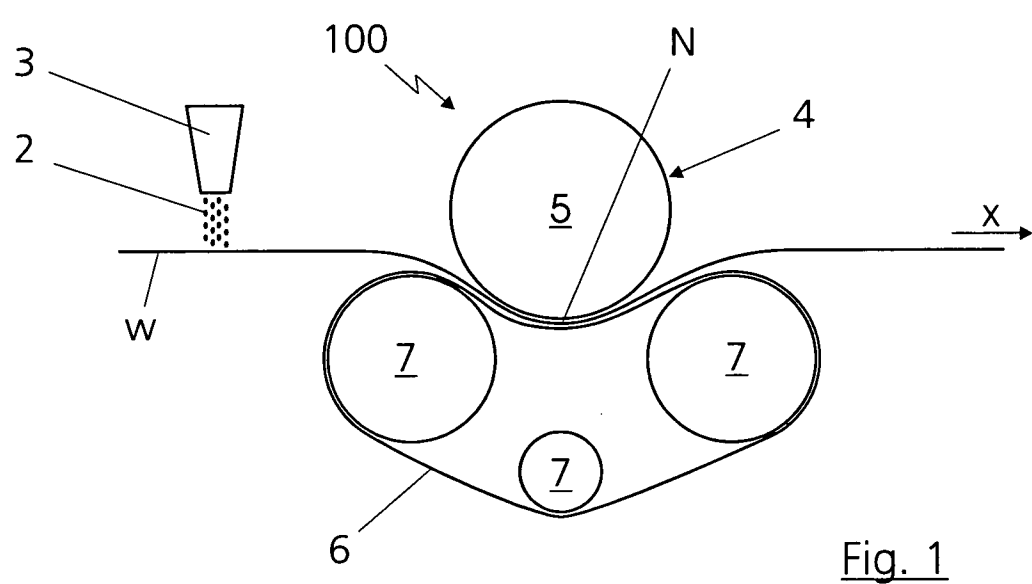
16. Arrangement according to claim 14 or 15, characterized in that, the surface energy of the fixing means (4) is 8 - 40 mJ/m² and the surface energy of the coating and/or processing agent (2) is 8 - 100 mJ/m².
17. Arrangement according to claims 15 and 16, characterized in that, the surface energy of the web (w) is 60 - 100 mJ/m².
18. Arrangement according to any of claims 14 to 17, characterized in that, the surface of the fixing means (4) comprises a material chosen from the group comprising nickel, chrome, polytetrafluoroethylene, silicone, ceramics, fluoroelastomere, fluorine compounds, diamond, rubber, polymer or a combination thereof.
19. Arrangement according to claim 18, characterized in that, the fixing means (4) consists of steel and the material forming the surface of the fixing means (4) has a thickness of 1 - 200 µm.
20. Arrangement according to any of claims 14 to 17, characterized in that, the arrangement (100, 200, 300, 400, 500, 600) contains means (11) to apply a release agent (12) on the surface of the fixing means (4).
21. Arrangement according to any of claims 14 to 20, characterized in that,

the arrangement (100,200,300,400,500,600) contains means (13,14,15,16,17) for treating the coating and/or processing agent (2) and/or the web (w) and/or the fixing means (4) with plasma.

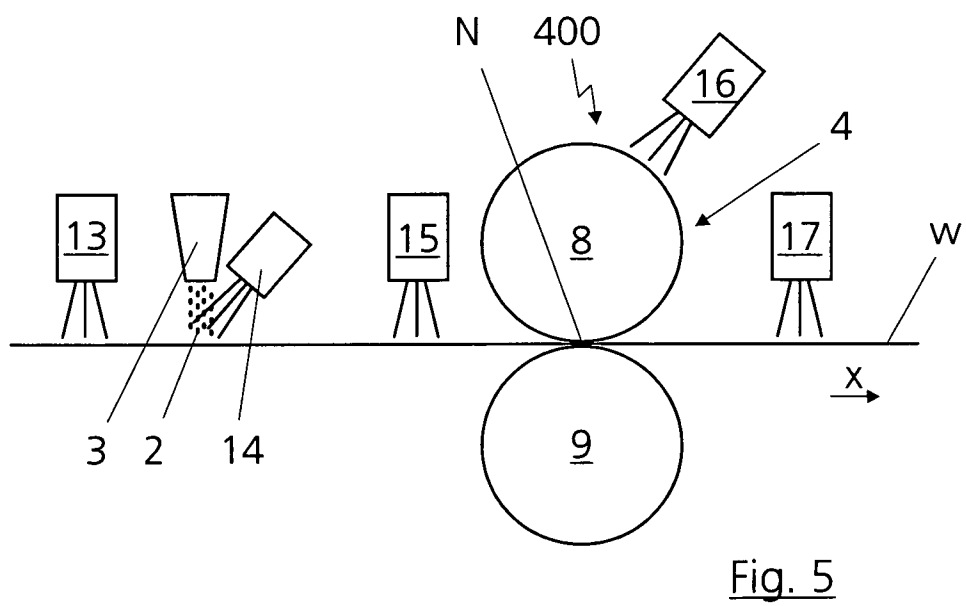
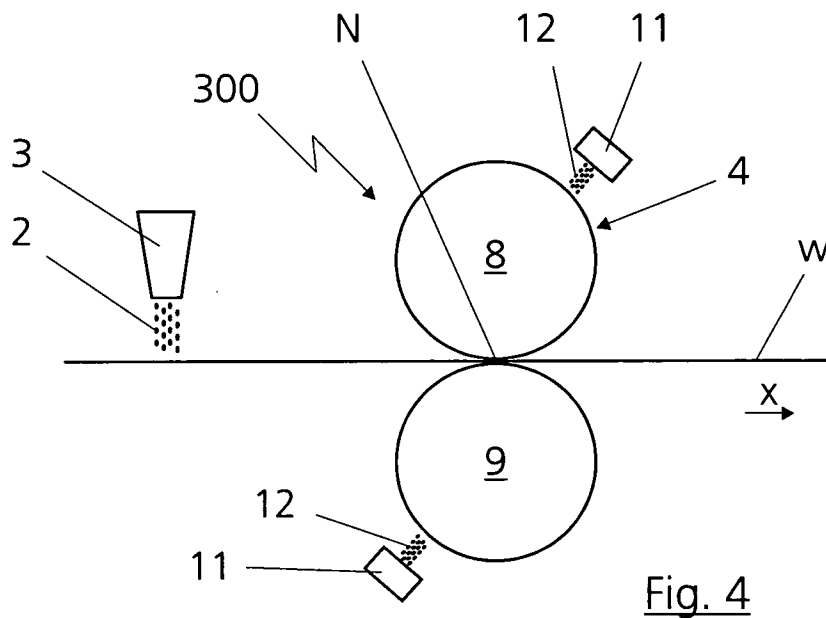
22. Arrangement according to any of claims 14 to 21, characterized in that, the arrangement (100,200,300,400,500,600) comprises cleaning means (18) for cleaning the fixing means (4).
23. Arrangement according to claim 22, characterized in that, the cleaning means (18) comprises a device (19) which is in contact with the fixing means (4).
24. Arrangement according to claim 23, characterized in that, the device (19) which is in contact with the fixing means (4) is a rotating brush, a revolving belt or a wiping cloth.
25. Arrangement according to claim 22, characterized in that, the cleaning means (18) comprises a blowing or suction device or a water jet.
26. Arrangement according to any of claims 14 to 25, characterized in that, the fixing means (4) contains a roll (5) and a belt (6).
27. Arrangement according to any of claims 14 to 25, characterized in that,

the fixing means (4) contains two rolls (8,9).

28. Arrangement according to any of claims 14 to 27,
characterized in that,
the arrangement (100,200,300,400,500,600) comprises
heating means for the fixing means (4).



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3/3

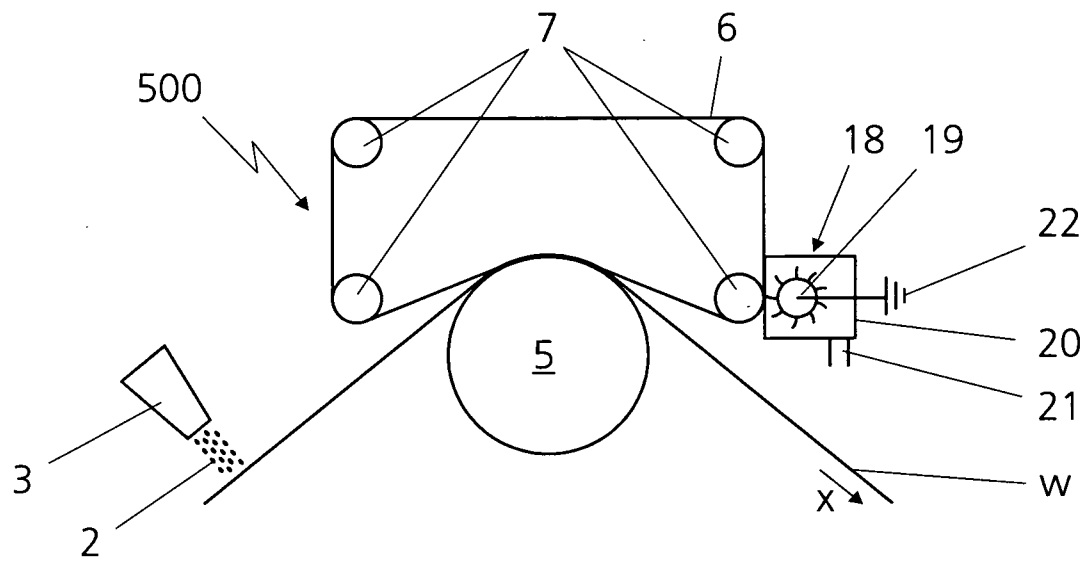


Fig. 6

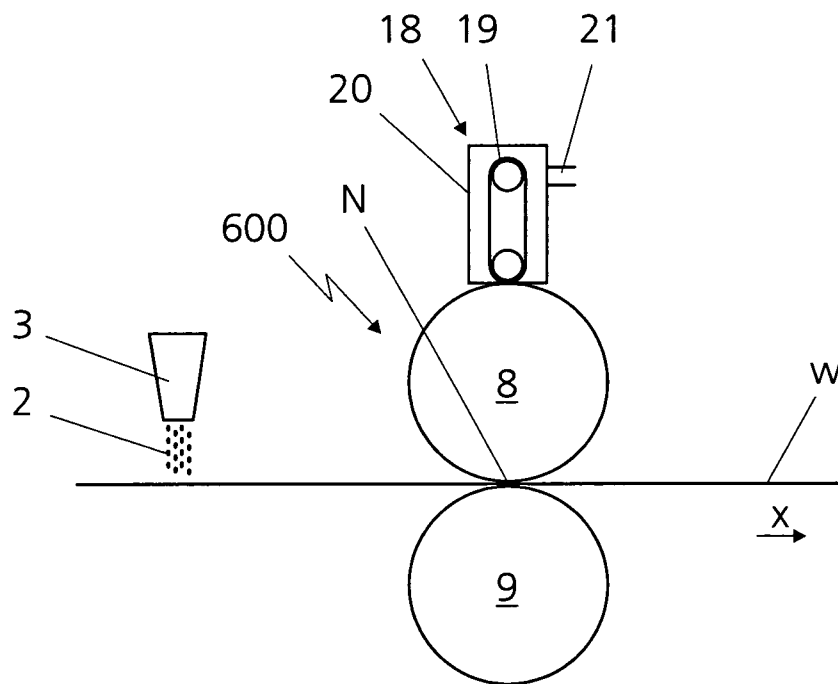


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/004464

A. CLASSIFICATION OF SUBJECT MATTER
INV. D21H23/52 D21H25/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D21H B05D B05C F26B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 01/75229 A (METSO PAPER INC [FI]; NISSINEN VILHO [FI]; RETULAINEN ELIAS [TH]; GROE) 11 October 2001 (2001-10-11) cited in the application page 1, line 5 - line 8 page 3, line 8 - page 5, line 13 page 9, line 3 - line 21; claims 1-14	1-28
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

10 March 2010

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Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

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Hindia, Evangelia

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/004464

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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