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Remarks:

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(54) **Arrangement and method for processing a fibre web**

(57) An Arrangement for processing a paper or board web (1) or a similar fibre web is shown, by means of which arrangement a processing mixture is applied to the surface of the web (1). The arrangement comprises a nip formed by two moving surfaces, elements for taking the web (1) to said nip, and spray nozzles (11) arranged between a dryer-cylinder group (2) and said nip for feeding the processing mixture to at least one surface of the web (1) in such a way that wet processing mixture comes at least between one of the two moving surfaces and the web (1) to said nip, wherein at least one of the moving surfaces forming said nip is provided by a soft roll (8) or a belt.

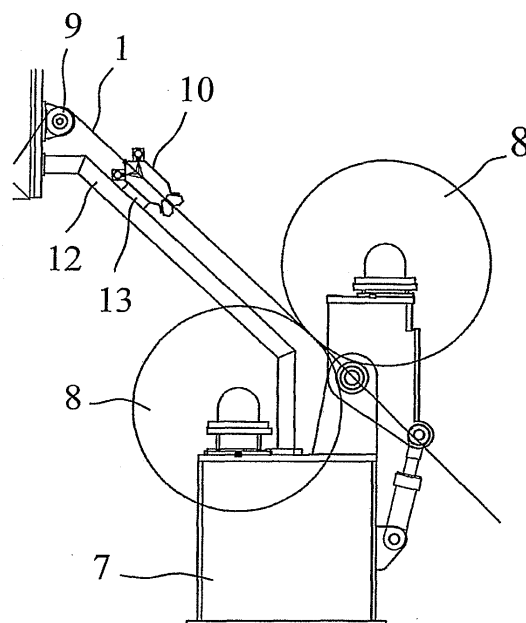


Fig. 2

Description

[0001] The present invention relates to an arrangement and a method for processing a fibre web, which include the spreading of a size mixture, a coating, or a corresponding processing mixture on a board web in particular. The invention can also be applied to paper webs and other similar fibre webs.

[0002] The application relates to sizing, pigmentation, and coating and the processing of a web by calendering. Hereinafter the invention is described using as an example sizing in particular, which is the most preferred application of the invention. The invention can, of course, also be applied to the other purposes referred to above.

[0003] The term size usually refers to a water-starch mixture, which is spread on the surface of board or paper and is pressed inside the web, for example, in a nip between rolls. Size is used to increase the strength of the web. Size also improves the surface properties and printability of paper. In addition to starch, the size mixture can also include many additives while in some cases latex can also be used as the binder in the size. In principle, the present invention can be applied to all size mixtures and to different kinds of fibre web. The strength of the product is one of the most important properties of some board grades, such as the liner and fluting used in the manufacture of corrugated board. Because the use of size can, among other things, considerably increase the bending and surface strengths, the aim is to use large amounts of size in these board grades. At present, a greater application amount is achieved using pond-application devices, but their greatest running speed is too low for modern requirements. Therefore in modern board machines film-transfer application is used to spread the size. In film-transfer application, the size is spread first of all on the surface of a film-transfer roll, by means of which it is transferred to the web. In board machines, simultaneous two-sided application is often used, in which case the web travels through a nip formed by two film-transfer rolls. Each roll has its own application beam. Using these devices, it is possible to achieve a reasonably large application amount on the surface of one web, expressed as wet film of 30 - 35 g/m².

[0004] The manner of using a coating mixture differs from sizing in that the aim is to make the solid particles of the coating mixture remain on the surface of the web.

[0005] Film-transfer coaters have, however, limitations, which reduce their efficiency and economy. Thanks to the nip pressure obtained in the nip of the film-transfer rolls, good size penetration into the fibre structure of the web is obtained, but the length of the nip is, however, quite short, so that the actual absorption of the size into the web only takes place after the nip. Because, in practice, the drying of the size must be started immediately after the nip, so that the web is made touch dry and can be controlled, the total absorption time remains short. Even though even large amounts of processing agent can be spread on the web using a film-transfer spreader

or spreaders, a pond can arise between the surface of the web and the surface of the film-transfer roll. The creation of the pond causes the detriment of splashing at high web speeds, but a pool can arise easily even at low speeds. The creation of this so-called mini-pond limits the greatest application amount, because the pond causes splashing, web vibration, and when it rapidly rotates even the penetration of air through the nip. In a film-transfer nip, the web becomes wet with the great amount of size, which leads to runnability problems. When it becomes wet, the web weakens so that it can tear more easily. In addition, the wetting and drying change the dimensions of the web and the changes in dimension must be taken into account by adjusting the web tension and possibly by using spreader rolls. The application chambers of film-transfer coaters are designed quite precisely, to ensure an even spread of size. However, material continually detaches from the surface of a fibre web, which can travel either directly on the surface of the film-transfer roll, or along with the machine circulation into the application chamber. This causes disturbances, particularly when it gets under the doctor rod and can even block the application chamber. Further, the doctor rods and their cradles bounding the application chamber, as well as the roll surfaces wear rapidly, which leads to short service intervals. This causes direct maintenance costs and a reduction in production due to service breaks. These problems are emphasized in machines using recycled fibre, because there are always foreign substances in the fibre that cause wear, the most important of which being sand and particularly abrasive pigment-coating particles. Because recycled fibre is an important raw material in the manufacture of board, these problems become emphasized especially in machines used in the manufacture of board. During application, air and impurities can easily enter the machine circulation of the coater, and must be removed by efficient air removers and filter devices. These devices are expensive and the necessary machine circulation becomes long and its capacity large.

[0006] The problems and limitations appearing in film-transfer application have different emphases in the manufacture of different products. It is obvious that the danger of a web break will not be as great in board grades as it will be with thinner papers, possibly made from recycled fibre. On the other hand, when making printing paper or board, there is less dirtying and wear of the devices.

[0007] The invention is intended to avoid the limitations present in application by conventional film transfer- or pond press sizer. This is achieved by an arrangement having the features of claim 1 and a method having the features of claim 11.

[0008] Considerable advantages are gained with the aid of the invention.

[0009] In particular, the large application amount makes the method according to the invention more advantageous than previous methods. Thanks to the long delay time, even a large amount of size mixture has time

to set on the surface of the web and inside the web. In principle, with the aid of the method it is possible to use as large an amount of size as desired, at least within the scope of the limitations of existing known sized products. If necessary, a large application amount permits the manufacture of new types of products. The amount of size and the profile can be adjusted with the aid of the feed amount of the nozzles or by changing the nozzle size. The final adjustment of the penetration of the size is made by altering the nip pressure of the press rolls' nip.

[0010] Preferably, application is performed simultaneously on both sides of the web, in which case only one application station and the dryers it requires will be needed. There is no problem in spreading different amount of size mixture on each side of the web or using different processing-agent mixtures on each side of the web. The method also permits double application directly onto the wet surface. This is carried out by the roll nip being formed in the normal film-transfer-unit manner, in such a way that the press rolls have conventional application beams, so that a second layer of size is transferred to the web in the roll nip. The processing-agent mixture can be spread hot on the surface of the web, in which case it will be more fluid than usual and dry and set more quickly on the surface of the web. The evaporation of water is also promoted by the fact that the web can brought hot to the application device directly from the dryer.

[0011] The calender nips can also be used as the roll nip, for example, in such a way that one of the rolls is a soft roll and the other a heated roll. Correspondingly, one or both of the rolls can be replaced with belts, or the nip can be formed from a shoe calender. Thanks to the heated roll or belt and the long, preferably adjustable delay, drying after pressing can be eliminated, if the drying effect transferred in the nip to the web is sufficient. In that case, it is possible with the aid of the invention to substitute application, nip pressing of the application, calendering, and drying with only application and a hot calender nip. In particular, the expensive floating or infrared dryers are then eliminated and the purchase cost of the system can be reduced and it can be fitted into a small space, which is advantageous particularly when rebuilding a manufacturing line. This solution is best suited to pigment application, because in the case of a size with a starch content the adhesion of the size to the hot roll or belt surfaces can prevent the use of the method. In connection with sizing, particular attention must be paid to the selection of the materials of the hot surfaces, so that adhesion will be avoided.

[0012] In addition to the above advantages, the weaknesses of sizing with a film-transfer press are avoided, these being the insufficient penetration of the size to the web, i.e. limitations in the strength of the product, getting a large amount of size through the film-transfer nip, i.e. the avoidance of too great a pond forming in the roll nip, and the rapid wear of the application rods and rod cradles and roll surfaces, particularly in recycled-fibre machines. Because there are no application chambers, blockage of

the chambers with material detaching from the web is avoided. Material detaching from the web does not enter the machine circulation, so that the processing-agent mixture need not be filtered in order to remove impurities. A return circulation is usually not even needed, because all of the application mixture can be directed to the web. If excess processing agent must be collected from the rolls or the spray chamber, it can be led in a simple manner back to the feed tank. The amounts are then small and the necessary transfer devices cheap. In addition to these, a pond presses have the weakness of the speed limit imposed by splashing from the pond, which limits the possibility to use them at the web speeds demanded nowadays.

[0013] In the following, the invention is examined with the aid of examples and with reference to the accompanying drawings.

[0014] Figure 1 shows a schematic view of an explanatory example of the invention.

[0015] Figure 2 shows a schematic view of a second explanatory example of the invention.

[0016] Figure 3 shows a detail of Figure 2.

[0017] A sizing station is shown in Figure 1 fitted to a manufacturing line. In the direction of travel of the web 1, first comes a dryer-cylinder group 2, from which the web 1 is guided directly to the application device 3. After the application device 3, follow the press rolls 4 and an air dryer 5, from where the web 5 is guided to finishing. Between the dryer-cylinder group 2 and the application device 3 there are measuring devices 6, which are used to monitor the web 1.

[0018] The application device 3 comprises a press rolls 8 mounted in bearings in a frame 7, and which form a nip, through which the web 1 being processed travels. The rolls 8 and the frame 7 can be parts of a conventional film-transfer coater, so that in this respect the application device corresponds to a film-transfer coater, from which the application devices of the rolls 8 have been removed. The web 1 is guided to run directly downwards to the rolls 8 through web guide rolls 9. The area between the web guide rolls 9 and the press rolls 8 is enclosed by a casing 10 on both sides of the web. The web 1 thus travels in a space enclosed by the web guide rolls 9, the press rolls 8, and the casing 10. The edges of the web 1 and the possible gaps can be sealed using rubber or sheet-metal sealing strips. The necessary number of spray nozzles 11 for spreading a size mist on the surface of the web are located inside the casing 10. Pressure-dispersion nozzles are preferably used as the spray nozzles 11, by means of which an even coverage is obtained while there is no drying effect of a dispersing gas. The pressure of the nozzle can be quite low, usually less than 1 Mpa, usually about 1 - 10 bar. However, the water content of the sizing mixture is so great that, for example, the dispersing air is not able to detrimentally dry the size mixture inside the casing, in which the humidity is high. If necessary, water vapour can be used as the dispersing gas in the nozzles, in which case drying will not take place at

all while the size mixture can be simultaneously heated. In this example, a size recovery system is not required, because the size mixture than condenses in the chamber on the walls of the casing or the mist in the chamber will drop or flow onto the press rolls 8 and from there onto the web 1. The walls of the casing 10 can be heated, in which case the size mist that adheres to the walls will not dry. If the size mixture flowing onto the press rolls 8 causes faults in the web 1, the excess size mixture can be collected, for instance, using channels in the lower part of the casing 10 and led back to the machine circulation or to the pulper.

[0019] If the web is treated with a pigment coating, the drying of the coating mixture may be a greater problem when using air-dispersion nozzles. Thus it is even more advantageous to use pressure-dispersion nozzles with a coating mixture. It is then also preferable for the surfaces of the application chamber not to be heated, but on the contrary to be cooled, in order to prevent the drying of the pigment coating. The fluidity of a starch-size mixture increases as the temperature rises, whereas the drying of pigment coating containing a great amount of mineral-based solids is quite rapid, if water can evaporate from the mixture into the environment.

[0020] If necessary, several rows of spray nozzles can be used. In that case, if one nozzle row is out of operation, for example during washing, running can continue using the other nozzles. The device is most advantageous when used in two-sided coating, but naturally application on only one side can be used if desired. During web breaks and other production breaks, the nozzle beam turns away from the casing to the wash trough and if required, for example, through 180E or 90E, so that the nozzles can be checked, washed, or replaced. The walls of the casing can preferably be opened for washing.

[0021] In the example described above, the delay time can be adjusted by altering the position of the nozzle rows in the casing 10. In that case, however, the casing will become large and the adjustment distance usually short.

[0022] According to Figures 2 and 3, the entire nozzle casing 10 is moved relative to the press rolls 8. The web 1 is guided from the guide roll 10 directly to the nip of the press rolls 8, in such a way that both sides of the web come into contact with the press rolls 8 simultaneously. This makes the delay and distance between application and pressing the same on both sides of the web 1. The nozzle casing 10 is arranged on a base 13 in a guide 12 running parallel to the web 1 and can be moved along the guide, in order to change the distance between the size-mixture spreading point and the nip between the press rolls 8. The length of this guide 12 can even be quite great. In practice, the length of the guide 12 and the greatest delay are only limited by the available space and how long a free draw the web can be taken over while remaining under control.

[0023] The delay is adjusted in order to form the desired amount of processing agent on the web after the

nip. This adjustment can take place by altering at one time the amount of processing agent or other manufacturing or quality factors of the product, such as the web speed, the material of the base web, or similar. Alternatively, the adjustment can be made continuously on the basis of measurement. The adjustment can be based on the measurement of the amount of process agent after the nip, the profile, or the quality of the surface, or even on adjustment that takes place according to the web speed.

[0024] In the nozzle casing 10, there are nozzle beams 14 on both sides of the web 1. The teachings presented in the above examples apply to the operation, location, and maintenance of the nozzles 10. However the construction of the nozzle casing 10 is different, because the rolls 8, 10 do not seal the inside of the casing 10 from the environment. The web 1 comes to the casing 10 through a narrow entry gap 15. The air that is transported with the web 1 forms a high pressure in the narrow gap and prevents the size mist from entering the casing through it. Air does not significantly enter the casing through the narrow gap 15, nor is the operation of the nozzles disturbed. In this case, the nozzles 11 are oriented in the same direction as the web 1, so that the spray 16 of the nozzle will be pulled along with the air transported by the web 1 and will come onto the web 1. In the trailing direction of the direction of travel of the web 1 there is also a narrow exit gap 19. This gap 19 is bounded on both sides by heated chambers 17. The task of these chambers is to prevent the size mixture from drying in the area of the trailing direction of the web 1. Instead of chambers, a heated plate or even an unheated surface can be used. The excess processing-agent mist is removed through outlet channels 18 arranged in the sides of the heated chambers. If necessary, vacuum can be used to remove the mist, or a small excess pressure can be created inside the casing with the aid of the air brought by the web. Air can be blown into the exist gap on the trailing side of the web, for example, using a device like an air doctor, in order to prevent the mist from escaping. According to this example, the separate size-spreading device can be arranged to operate in any position of the web at all, so that the threading of the web 1 is quite free, as long as there is a sufficiently long straight section before the press rolls. The mixture spread on the web 1 should be wet when it arrives at the press-roll nip. In this case, the term wet refers to the fact that with the aid of the nip pressure it will still be possible to affect the penetration of the size into the web, i.e. the size mixture can be pressed inside the fibre layer. Otherwise there will be no benefit from the nip. With the aid of the distance between the spreading of the size mixture and the press nip and the press-nip pressure the penetration into the web 1 is adjusted as desired. The size mixture can of course also be spread on the web at a fixed distance from the nip, but in that case a substantial part of the adjustability will be lost. When it is made, the size mixture is usually hot, about 50 - 85°C, and the size can be heated

in order to maintain it at that temperature, either using a heat exchanger prior to the size being fed to the nozzles, or even electrically in the nozzle, or even with the air of a circulating heating medium in the nozzle beam. The heating of the size will reduce its viscosity, improve drop formation in the nozzle, and promote the evaporation of water on the surface of the web. Because the web comes from the final roll of the dryer-roll group, it is usually quite hot, so that the water will effectively be evaporated from the hot size mixture striking the hot web surface. When using pigment coatings, it is also possible to use a heated mixture and it is often preferably for water to be effectively evaporated from the coating mixture when it transfers to the hot web. The use of a hot coating mixture may, however, cause undesired drying of the coating mixture onto the walls of the application chamber, so that when using hot coating mixtures particular care must be taken to prevent drying and to keeping the application chamber clean.

[0025] Instead of the rolls of a film-transfer press being used in the method, it is possible to use for instance a calender nip, in which one roll has a soft surface and the other roll is a heated hard roll. Both rolls can also be soft or hard and one or more rolls can be heated. If the rolls are different to each other, two roll nips may be needed. In that case, however, the effect of the later roll nip on the penetration of the processing agent will be small, because the surface of the web may become too dry after the first roll nip. Instead of a roll nip it is possible to use a belt or shoe calender, which comprises one or two consecutive nips. If a metal belt is used in the calender, the belt can easily be heated or cooled to alter the surface properties of the web.

[0026] The invention is highly suitable for use in rebuilding or replacing an existing pond size press or a film-transfer press. In that case, the technology required to form the pond is removed, or correspondingly the application chambers and coating or size circulations. These application methods are replaced according to the invention by placing a spray application beam before the roll nip. A rebuild of this kind is relatively cheap and with its aid the running speed and amount of processing-agent used can be substantially increased. Thanks to the greater amounts of processing agent, the device can be used to manufacture a wider product range than previously.

[0027] This application is a divisional application of European patent application No. 05818072.0, also published under No. EP-A-1828475. The original claims of the parent application are repeated below in the present specification and form part of the content of this divisional application as filed.

1. Method for processing a paper or board web (1) or similar fibre web, which method comprises the application of a processing mixture to the surface of the web, and in which method:

- the web (1) to be processed is lead from the last

cylinder of a dryer-cylinder group (2) to run from a press nip (8) between two moving surfaces,

- the processing mixture is pressed into the web (1) in the press nip (8),
- before the web enters the nip, such an amount of processing mixture is spread onto at least one side of the web (1), that the processing mixture is still wet when it enters the nip,

characterized in that the processing mixture is spread on the surface of the web (1) in the area between the last cylinder of the dryer-cylinder group (2) and the press nip (8).

2. Method according to item 1, **characterized in that** the processing mixture is spread from spray nozzles (11) onto both sides of the web (1) before the web enters the press nip.

3. Method according to any of the above items, **characterized in that** at least the amount of processing agent remaining on the web (1) is altered by altering the distance between the spray nozzles (11) and the nip, in order to alter the delay time between them and the degree of setting of the processing agent spread on the web.

4. Method according to any of the above items, **characterized in that** the processing mixture is heated prior to being fed from the nozzles (11) onto the surface of the web.

5. Method according to any of the above items, **characterized in that** a size mixture is spread from at least one surface of the rolls (8) forming the press nip, in order to lead additional size to the press nip and onto the surface of the web (1).

6. Method according to any of the above items, **characterized in that** the processing mixture is spread onto the surface of the web using pressure-dispersion nozzles.

7. Method according to any of the above items, **characterized in that** the processing mixture is spread onto the surface of the web using gas-dispersion nozzles.

8. Method according to any of the above items, **characterized in that** the web (1) is guided to run from a nip between two rolls (8), preferably the rolls of a film-transfer press.

9. Method according to any of the above items 1 - 7, **characterized in that** the web (1) is guided to run from a nip between one roll and a belt.

10. Method according to either items 8 or 9, **characterized in that** the surface of at least one roll or belt is soft.

11. Method according to any of items 8 - 10, **characterized in that** the surface of at least one roll or belt is hard. 5

12. Method according to any of items 8 - 11, **characterized in that** at least one roll or belt can be heated. 10

13. Method according to any of items 8 - 12, **characterized in that** at least one roll or belt can be cooled. 15

14. Method according to items 11, **characterized in that** with the aid of the heated roll or belt such a large amount of heat is transferred to the web (1), that drying is not needed after the press nip (8). 20

15. Method according to any of items 1 - 14, **characterized in that** the web is calendered in a press nip (8) after the application. 25

16. Method according to any of items 1 - 15, **characterized in that** a shoe nip is used as the press nip (8). 30

17. Arrangement for processing a paper or board web (1) or a similar fibre web, by means of which arrangement a processing mixture is applied to the surface of the web (1), and which arrangement comprises: 35

- at least one press nip (8),
- elements for taking the web (1) to the press nip (8), and 40
- elements for spreading the processing mixture in such a way that wet processing mixture comes at least to the nip between the element (8) and the web (1), 45

characterized in that the elements for spreading the processing mixture are spray nozzles (11), which are arranged at an adjustable distance in the arrival direction of the web from the press nip (8), to feed the processing mixture to at least one surface of the web (1). 50

18. Arrangement according to item 17, **characterized in that** the spray nozzles (11) are arranged on both sides of the web (1). 55

19. Arrangement according to any of items 17 - 18, **characterized** by an element for heating the

processing mixture is heated prior to being fed to the web.

20. Arrangement according to any of items 17 - 19, in which at least one of the elements forming the nip is a roll (8), **characterized** by an element for spreading the processing mixture onto the surface of at least one roll (8) forming the press nip.

21. Arrangement according to any of items 17 - 20, **characterized in that** the spray nozzles are pressure-dispersion nozzles.

22. Arrangement according to any of items 17 - 20, **characterized in that** the spray nozzles are gas-dispersion nozzles.

23. Arrangement according to any of items 17 - 22, **characterized in that** the spray nozzles are located in a casing (10).

24. Arrangement according to any of items 17 - 23, **characterized in that** the spray nozzles are located in a casing, which can be moved relative to the press nip of the rolls (8).

25. Arrangement according to any of items 17 - 24, **characterized in that** the elements for forming the nip are two rolls (8), and the web (1) is guided to travel from the nip between these two rolls (8), preferably the rolls of a film-transfer press.

26. Arrangement according to any of items 17 - 25, **characterized in that** at least one of the elements forming the nip is a belt and the web (1) is guided to run from a nip between at least one roll and a belt.

27. Arrangement according to either item 25 or 26, **characterized in that** the surface of at least one roll or belt is soft.

28. Arrangement according to any of items 25 - 27, **characterized in that** the surface of at least one roll or belt is hard.

29. Arrangement according to any of items 25 - 28, **characterized in that** at least one roll or belt can be heated.

30. Arrangement according to any of items 25 - 29, **characterized in that** at least one roll or belt can be cooled.

31. Arrangement according to any of items 17 - 30, **characterized in that** the press nip (8) is a calender nip.

32. Arrangement according to any of items 17 - 30,

characterized in that the press nip (8) is a shoe nip.

Claims

1. Arrangement for processing a paper or board web (1) or a similar fibre web, by means of which arrangement a processing mixture is applied to the surface of the web (1), and which arrangement comprises:

a nip formed by two moving surfaces, elements for taking the web (1) to said nip, and spray nozzles (11) arranged between a dryer-cylinder group (2) and said nip for feeding the processing mixture to at least one surface of the web (1) in such a way that wet processing mixture comes at least between one of the two moving surfaces and the web (1) to said nip,

wherein at least one of the moving surfaces forming said nip is provided by a soft roll (8) or a belt.

2. Arrangement according to claim 1, wherein the spray nozzles (11) are arranged on both sides of the web (1).

3. Arrangement according to any one of claims 1 or 2, wherein the spray nozzles (11) are pressure-dispersion nozzles or gas-dispersion nozzles.

4. Arrangement according to any one of the preceding claims, wherein the spray nozzles (11) are located in a casing (10).

5. Arrangement according to claim 4, wherein the casing can be moved relative to said nip.

6. Arrangement according to any one of claims 1 to 5, wherein the moving surfaces for forming said nip are provided by said soft roll (8) or said belt and a further roll (8).

7. Arrangement according to any one of the preceding claims, wherein the surface of said belt is soft or hard.

8. Arrangement according to any one of the preceding claims, wherein the belt is a metal belt.

9. Arrangement according to any one of the preceding claims, wherein the roll(s) or the belt can be heated or cooled.

10. Arrangement according to any one of the preceding claims, wherein the nip is a calender nip.

11. Method for processing a paper or board web (1) or similar fibre web, the method comprising the following steps:

leading the web (1) to be processed to a nip formed by two moving surfaces, wherein at least one of said moving surfaces is provided by a soft roll (8) or a belt,

applying an amount of processing mixture onto at least one side of the web (1) by spray nozzles (11) arranged between a dryer-cylinder group (2) and said nip, such that the processing mixture on the web (1) is still wet when it enters said nip, pressing the processing mixture into the web (1) in said nip.

12. Method according to claim 11, wherein the processing mixture is applied from the spray nozzles (11) onto both sides of the web (1) before the web (1) enters said nip.

13. Method according to claim 11 or 12, wherein the processing mixture is applied onto the surface of the web

(1) using pressure-dispersion nozzles (11) or gas-dispersion nozzles (11).

14. Method according to any one of claims 11 to 13, wherein the moving surfaces for forming said nip are provided by said soft roll (8) or said belt, such as a metal belt, and a further roll (8).

15. Method according to any one of claims 11 to 14, wherein the web is calendered in said nip after the application of said processing mixture.

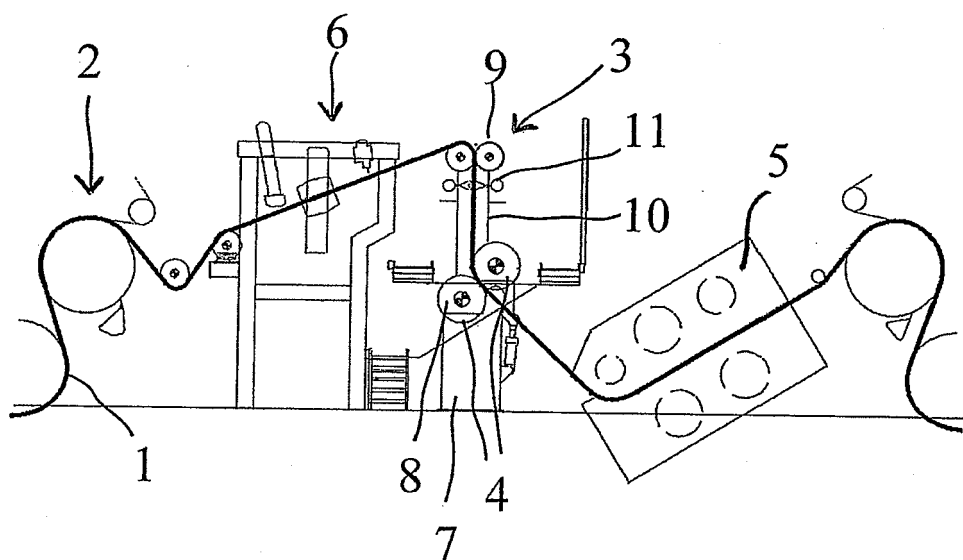


Fig. 1

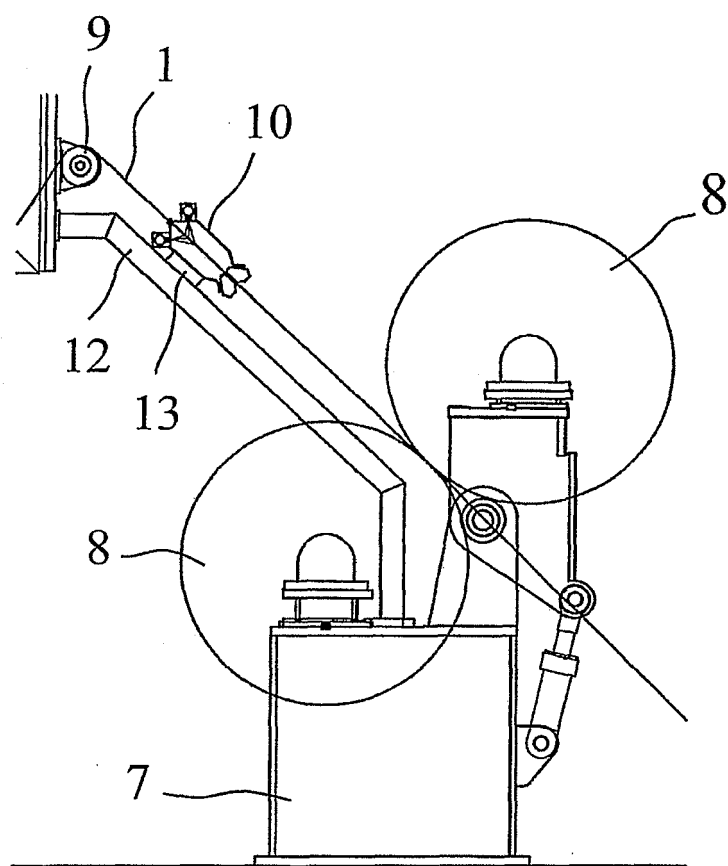


Fig. 2

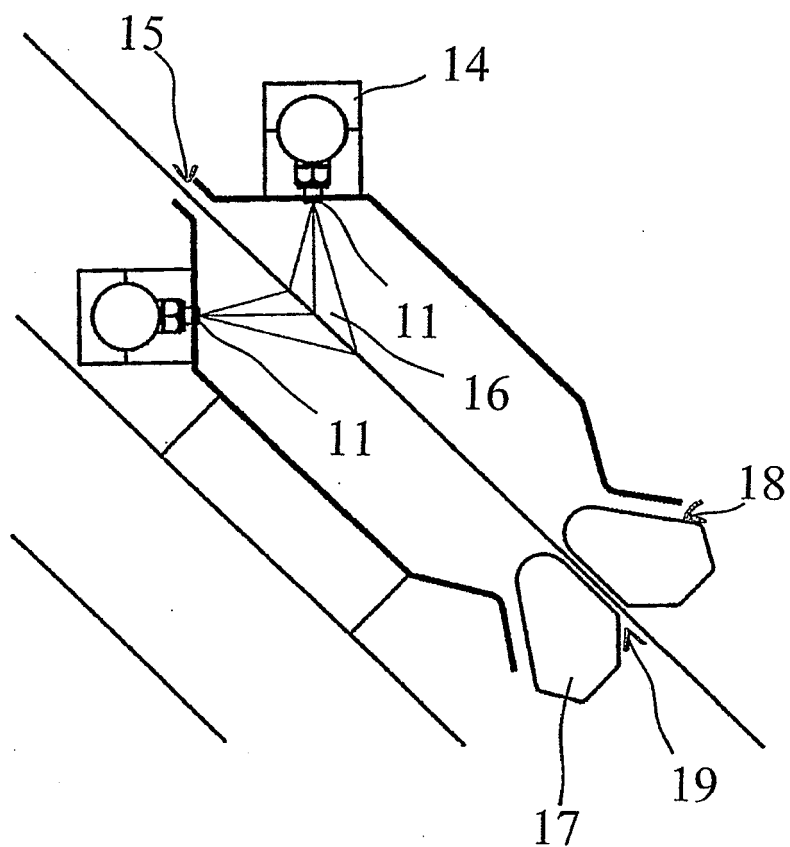


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 09 15 7956

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	DE 298 15 847 U1 (VIB APPARATEBAU GMBH [DE]) 26 November 1998 (1998-11-26) * the whole document *	1-6,9-15	INV. D21G1/00
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