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(11)

**EP 0 881 329 A2**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**02.12.1998 Bulletin 1998/49**

(51) Int Cl.<sup>6</sup>: **D21F 7/00, D21F 3/00,  
D21H 23/56, D21H 23/78**

(21) Application number: **98303888.6**

(22) Date of filing: **18.05.1998**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

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(30) Priority: **30.05.1997 JP 141224/97**

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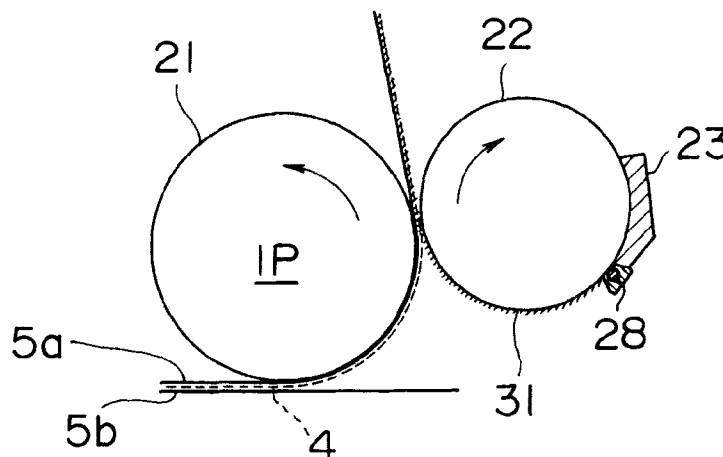
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**(54) Method and apparatus for adding minute fibers etc. at press section of a paper machine**

(57) After a film of a minute fiber suspension is formed on the surface of an applicator roll 22 disposed at a press section of a paper machine, the suspension is applied to at least one surface of a wet paper web 4. The weight concentration of minute fibers in the suspension used is set at 3.0 to 5.0%, the amount of minute

fibers applied to the surface of wet paper is set at 0.2 to 2.0 g/m<sup>2</sup> per one surface of the wet surface 4, and the amount of paper strength increasing agent is set at 0.5 to 2.0 g/m<sup>2</sup> per one surface of the wet surface 4. A paper strength increasing agent may be mixed with the suspension of minute fibers prior to forming the film on the roll 22.

**FIG. 6**



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## Description

### FIELD OF THE INVENTION AND RELATED ART STATEMENT

The present invention relates to a method and an apparatus for adding minute (fine) fibers or both of minute fibers and a paper strength increasing agent onto the surface of a wet paper at a press section of a paper machine for printing paper etc.

FIG. 11 shows a conventionally used paper machine for printing paper. On this paper machine, a pulp liquid 1 with a concentration of about 0.9% is ejected onto a wire 3 at a former section A from a head box 2 as a jet which is uniform in the width direction. At the former section A, the pulp liquid 1 is dehydrated through the meshes of the wire 3 by the gravity and negative pressure, and a wet paper 4 is formed on the wire 3. After the concentration is increased up to about 18% at the former section A, the wet paper 4 is conveyed to a press section B of the next process.

At the press section B, the wet paper 4 is held between felts 5a and 5b, or put on the felt 5b, and pressurized by rolls or the like to remove water. Further, after the concentration is increased up to about 40 to 50% through a plurality of press stages, the wet paper 4 is sent to a dryer section C.

At the dryer section C, the wet paper 4 is pressed against the surface of a dryer roll 6 heated by steam, by which water is removed from the wet paper 4 by evaporation to produce a dried paper. This paper is wound around a reel 7.

The above is a description of a general paper manufacturing process. FIG. 11 shows a paper manufacturing process in which minute fibers, paper force increasing agent, and the like are not added.

The quality items required for printing paper are smoothness and surface strength. If the smoothness is low, the ink sticking property is deteriorated. If the surface strength is low, fibers coming off from the paper surface accumulate on a plate cylinder, blanket, and the like, which causes whiteness.

Also, in recent years, the lightweight (low basis weight) of printing paper has been demanded strongly from the viewpoint of effective use of pulp resource. When a paper of a low basis weight is manufactured by the conventional paper making method, the paper thickness is decreased, leading to a decrease in paper rigidity.

To overcome these problems, a paper strength increasing agent such as starch or minute fibers are usually added inside or outside. The term "adding inside" means the addition of minute fibers or paper strength increasing agent to the pulp before a paper is formed, and the term "adding outside" means the addition of minute fibers or paper strength increasing agent to an already formed paper (wet paper or dry paper).

FIG. 12 shows a conventional manufacturing process

in which a paper strength increasing agent such as starch is added outside. In this case, the paper strength increasing agent such as starch is applied to the paper by using an applying apparatus such as a 2-roll size press 8 or a gate roll coater (not shown) installed at a size press section D on the downstream side of the dryer section C as shown in FIG. 12. and then the paper is dried at an after-dryer section E and wound around the reel 7.

FIG. 13 shows a conventional manufacturing process in which minute fibers are added outside. In this case, a minute fiber suspension 10 is added onto the surface of the wet paper 4 by being ejected from 1-fluid or 2-fluid minute fiber suspension supply sprays 9 installed at the former section A or press section B as shown in FIG. 13. Subsequently, the paper passes through the same processes as those shown in FIG. 11, and is wound around the reel 7.

As described above, the printing paper especially requires the smoothness, surface strength, and rigidity. To improve these quality items, a method in which a paper strength increasing agent such as starch or minute fibers are added inside or outside has so far been used. However, when these substances are added inside to the pulp liquid 1 in the head box 2, these substances flow out through the meshes of the wire 3 together with water when the paper is dehydrated at the former section A, and part of the substances is thrown away without being recovered. Therefore, the amount of the paper strength increasing agent or minute fibers added inside must be increased, resulting in an increase in the cost of added substances.

When these substances are added outside, a paper strength increasing agent such as starch and polyacrylamide must be applied to the paper by using an applying apparatus such as a 2-roll size press 8 (see FIG. 12) or a gate roll coater (not shown) installed following the dryer section C as described above. For this purpose, the applying apparatus and drying apparatus such as the after-dryer section E must be additionally installed, so that the equipment cost and the running cost of after-dryer section E is increased.

Also, when minute fibers are added outside, 1-fluid or 2-fluid minute fiber suspension supply sprays 9 installed at the former section A or press section B are used as described above. However, the concentration of the minute fiber suspension 10 capable of being ejected by these sprays 9 is very low, being about 1.5% or less. Therefore, when the minute fiber suspension 10 is supplied to the surface of the wet paper 4 with the sprays 9, the dryness of wet paper is decreased, so that the dry load at the dryer section C of the subsequent process is increased significantly. If the existing dryer apparatus capacity cannot overcome the increase in dry load at the dryer section C, a dryer roll must be installed additionally.

## OBJECT AND SUMMARY OF THE INVENTION

The present invention was made in view of the above situation, and accordingly an object thereof is to provide a method and apparatus for adding minute fibers etc. at a press section of a paper machine, in which the smoothness, surface strength, and rigidity of paper can be improved by adding minute fibers or both of minute fibers and a paper strength increasing agent onto the surface of a wet paper, an increase in dry load of a dryer section can be restrained slightly, and the equipment cost and running cost can be reduced.

To achieve the above object, the present invention provides a method for adding minute fibers etc. at a press section of a paper machine, in which after a minute fiber suspension with a weight concentration of 3.0 to 5.0% is formed into a film shape on an applicator roll installed at the press section of the paper machine, the minute fiber suspension is applied onto the surface of a wet paper to add minute fibers of 0.2 to 2.0 g/m<sup>2</sup> per one surface on the paper surface.

Also, the present invention provides a method for adding minute fibers etc. at a press section of a paper machine, in which after a paper strength increasing agent, which has been added inside to pulp in a head box or added outside to paper on an applying apparatus such as a size press in the conventional apparatus and method, is added beforehand to a minute fiber suspension with a weight concentration of 3.0 to 5.0% and a mixed suspension of the minute fiber suspension and paper strength increasing agent is formed into a film shape on an applicator roll installed at the press section of the paper machine, the mixed suspension is applied onto the surface of a wet paper to add both of minute fibers of 0.2 to 2.0 g/m<sup>2</sup> per one surface and paper strength increasing agent of 0.5 to 2.0 g/m<sup>2</sup> per one surface.

Also, the present invention provides an apparatus for adding minute fibers etc. at a press section of a paper machine, comprising an applicator roll, which is disposed so as to face the surface of a press roll installed at the press section of the paper machine, for forming a minute fiber suspension film on the surface thereof and a minute fiber suspension supply box for supplying a minute fiber suspension to the surface of the applicator roll.

Also, according to the present invention, film thickness control means for controlling the thickness of suspension film formed on the surface of the applicator roll is provided at the suspension outlet of the minute fiber suspension supply box.

The gist of the present invention will be described below by summarizing the above description:

(a) After a film of a minute fiber suspension or a mixed suspension of minute fibers and a paper strength increasing agent is formed on the surface of an applicator roll 22 disposed at a press section

of a paper machine, the suspension is applied to at least one surface of a wet paper 4.

(b) The weight concentration of minute fibers in the suspension used is set at 3.0 to 5.0%.

(c) The amount of minute fibers applied to the surface of wet paper is set at 0.2 to 2.0 g/m<sup>2</sup> per one surface of the wet surface 4.

(d) When a film of mixed suspension of minute fibers and paper strength increasing agent is applied to the surface of wet paper, the amount of minute fibers is set at 0.2 to 2.0 g/m<sup>2</sup> per one surface of the wet surface 4, and the amount of paper strength increasing agent is set at 0.5 to 2.0 g/m<sup>2</sup> per one surface of the wet surface 4.

It should be understood that the ranges of coating rates of minute fibres and of strength increasing agent, and the concentration of fibres in the suspension given in the preceding five paragraphs are preferred ranges only, each end of which may each be individually varied beyond the preferred range.

In this specification, the term "minute (fine) fiber" means a minute size pulp fiber or pulp fiber chip with a length not more than about 300 μm. A specific example of this "minute fiber" is a fiber contained in water discharged through the meshes of the wire 3 at a former section IIII of the paper machine. Whereas, the term "paper strength increasing agent" means a chemical (starch, polyacrylamide, etc.) which is added to the pulp liquid 1 in the head box 2 or applied to the paper surface to increase the strength of paper. Although the minute fiber has an effect of increasing the paper strength, the terms "minute fiber" and "paper strength increasing agent" are used in distinction from each other in this specification because the term "paper strength increasing agent" does not generally include a pulp fiber.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view showing a configuration of a press section of a paper machine having a minute fiber suspension applying apparatus, showing a first embodiment of the present invention;

FIG. 2 is an enlarged arrangement view of a location where a minute fiber suspension applying apparatus is installed (paper machine press part 1P location) shown in FIG. 1;

FIG. 3 is a front view showing a configuration of a minute fiber suspension applying apparatus;

FIG. 4 is a sectional view showing a rod for a minute fiber suspension applying apparatus;

FIG. 5 is a schematic view showing a configuration of a press section of a paper machine having a minute fiber suspension applying apparatus in accordance with the present invention, showing a second embodiment of the present invention;

FIG. 6 is an enlarged arrangement view of a location where a minute fiber suspension applying appara-

tus is installed (paper machine press part 1P location) shown in FIG. 5;

FIG. 7 is an enlarged arrangement view of a location where a minute fiber suspension applying apparatus is installed (location in front of paper machine press part 4P) shown in FIG. 5;

FIG. 8 is a schematic view showing a configuration of a press section of a paper machine having a minute fiber suspension applying apparatus in accordance with the present invention, showing a third embodiment of the present invention;

FIG. 9 is an enlarged arrangement view of a location where a minute fiber suspension applying apparatus is installed (paper machine press part 2P location) shown in FIG. 8;

FIG. 10 is an enlarged arrangement view of a location where a minute fiber suspension applying apparatus is installed (paper machine press part 4P location) shown in FIG. 8;

FIG. 11 is a schematic view showing a configuration of a conventional general paper machine;

FIG. 12 is a schematic view showing a configuration of a conventional paper machine having a size press section and an after-dryer section; and

FIG. 13 is a schematic view showing a configuration of a conventional paper machine in which a minute fiber suspension is applied to a wet paper with a spray.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Embodiments of the present invention will be described below with reference to FIGS. 1 to 10. In these figures, the same reference numerals are applied to the same elements as those shown in FIGS. 11 to 13, and the explanation of these elements is omitted.

FIG. 1 is a view for illustrating a first embodiment of the present invention, showing a press section B of a paper machine having a minute fiber suspension applying apparatus 20 in accordance with the present invention. This minute fiber suspension applying apparatus 20, which is additionally installed at the press section of a conventional paper machine to apply minute fibers onto the surface of a wet paper 4 at the press section B of the paper machine, is installed behind (on the downstream side of) paper machine press part 1P as shown in FIG. 1.

As shown in FIG. 2, the aforesaid minute fiber suspension applying apparatus 20 is made up of an applicator roll 22 disposed so as to face a 1P top roll 21 composing paper machine press part 1P and a minute fiber suspension supply mechanism 23 disposed in relation to the applicator roll 22. As clearly shown in FIG. 3, the minute fiber suspension supply mechanism 23 includes a minute fiber suspension supply box 24 for supplying the minute fiber suspension to the surface of the wet paper 4 and a film thickness control unit (film thickness

control means) disposed at a minute fiber suspension outlet of the minute fiber suspension supply box 24. As shown in FIG. 3, the film thickness control unit 25 is made up of a plate spring 26 installed to the minute fiber suspension supply box 24, a rod holder 27 installed to the free end of the plate spring 26, a rod which is held by the rod holder 27 and disposed so as to face the applicator roll 22 with a small gap at the minute fiber suspension outlet, and an air tube 29 for giving an air pressure to the rod holder 27. By controlling the air pressure acting on the rod holder 27 from the air tube 29, the pressure for pressing the rod 28 against the applicator roll 22 is regulated, and accordingly the gap between the rod 28 and the applicator roll 22, and in turn, the film thickness of the minute fiber suspension 30 passing therebetween can be regulated.

Thus, the minute fiber suspension supply box 24 performs a function of distributing minute fibers wholly in the width direction of paper machine and bringing them into contact with the surface of the applicator roll 22. The rod 28 performs a function of controlling the thickness of minute fiber suspension film formed on the surface of the applicator roll 22 by the regulation of a pressing pressure against the applicator roll 22 or the gap between the rod 28 and the applicator roll 22. Also, the applicator roll 22 performs a function of transferring (applying) the minute fiber suspension film formed on the surface thereof to the wet paper 4.

The following is a description of the operation in the case where the applying method in accordance with the present invention is used by using the press section B of the paper machine additionally provided with the minute fiber suspension applying apparatus 20 thus configured.

First, a minute fiber suspension 30 (see FIG. 3) of a weight concentration of 3.0 to 5.0% is put into the minute fiber suspension supply box 24. The minute fiber suspension 30 is discharged through the minute fiber suspension outlet of the minute fiber suspension supply box 24, and is made to pass through a gap between the applicator roll 22 (300 to 1000 mm in diameter) and the rod 28 (10 to 50 mm in diameter). Accordingly, as shown in FIG. 2, a minute fiber suspension film 31 consisting of the minute fiber suspension 30 of a weight concentration of 3.0 to 5.0% is formed on the surface of the applicator roll 22. The minute fiber suspension film 31 on the surface of the applicator roll 22 is transferred to the back surface (wire surface) of the wet paper 4 at a nip portion between the 1P top roll 21 and the applicator roll 22 as shown in FIG. 2. Specifically, the wet paper 4 is conveyed to the 1P top roll 21 in a state such as to be held between a pair of felts 5a and 5b. After the wet paper 4 comes into contact with the 1P top roll 21, the wet paper 4 together with the felt 5a on the side of the wet paper top surface is conveyed to the nip portion between the 1P top roll 21 and the applicator roll 22, where the minute fiber suspension film 31 on the surface of the applicator roll 22 is transferred (applied) onto the back

surface of the wet paper 4 from the applicator roll 22. The minute fibers transferred onto the back surface of the wet paper 4 in this manner pass through a plurality of press nips subsequently, by which the minute fibers are integrated by entering a fiber network composing the wet paper surface layer. Thereupon, a paper to which minute fibers are added can be obtained.

In this case, the film thickness of the minute fiber suspension film 31, which is formed on the surface of the applicator roll 22 and transferred to the wet paper 4, is controlled appropriately by the film thickness control unit 25 (see FIG. 3). Specifically, the air pressure of the air tube 29 is controlled, and the pressure at which the rod 28 is pressed against the applicator roll 22 is regulated, whereby the required thickness of the minute fiber suspension film 31 being transferred to the wet paper 4 is controlled. The film thickness control means for the minute fiber suspension film 31 may be configured so that a small-diameter wire 34 is wound around the surface of the rod 28 of the film thickness control unit 25 shown in FIG. 3 as shown in FIG. 4, by which the amount of the minute fiber suspension 30 passing between the rod 28 and the applicator roll 22 is controlled.

FIG. 5 shows a second embodiment of the present invention. This figure shows an example in which a minute fiber suspension applying apparatus 20a, 20b having the same configuration as that of the above-mentioned minute fiber suspension applying apparatus 20 is additionally installed at two locations behind (on the downstream side of) paper machine press part 1P and in front of (on the upstream side of) paper machine press part 4P at the press section B of the conventional paper machine. Since the configuration and operation of the minute fiber suspension applying apparatus 20a disposed behind paper machine press part 1P are the same as described above as shown in FIG. 6, the explanation is omitted.

As shown in FIG. 7, the aforesaid minute fiber suspension applying apparatus 20b is installed in relation to an applicator roll 37 disposed corresponding to a backup roll 36 in front of paper machine press part 4P. As in the case of the minute fiber suspension applying apparatus 20a installed behind paper machine press part 1P, a minute fiber suspension film 38 is formed on the surface of the applicator roll 37. Subsequently, the minute fiber suspension film 38 is transferred to the top surface (felt surface) of the wet paper 4 at a nip portion between the additionally installed applicator roll 37 and backup roll 36, and integrated by entering a fiber network composing the surface layer of the wet paper 4 when passing through a 4P press nip. Thereupon, a paper to which minute fibers are added can be obtained.

Although the thickness of the minute fiber suspension film 38 formed on the surface of the applicator roll 37 is controlled by a method in which the pressure at which the rod 28 is pressed against the applicator roll 37 is changed, like the aforesaid control of the thickness of the minute fiber suspension film 31 formed on the sur-

face of the applicator roll 22, the thickness of the minute fiber suspension film 38 may be controlled by winding the small-diameter wire 34 around the rod 28 as shown in FIG. 4.

FIG. 8 shows a third embodiment of the present invention. This figure shows a configuration in which a center roll 40 disposed at the press section is used as the aforementioned applicator roll 22, and a 4P top roll 41 disposed at the press section is used as the aforementioned applicator roll 37. Specifically, in this case, the center roll 40 is used as the applicator roll 22 for applying the minute fiber suspension to the back surface (wire surface) of wet paper, and the 4P top roll 41 is used as the applicator roll 37 for applying the minute fiber suspension to the top surface (felt surface) of wet paper. Even in the case of this configuration, like the above-described first and second embodiments, the minute fiber suspension 30 is applied to the wet paper 4 at the press section B, by which the minute fiber suspension film 31, 38 of a given thickness can be transferred to the surface of the wet paper 4 (see FIGS. 9 and 10).

Although the film 31, 38 of the minute fiber suspension 30 is applied onto the surface of the wet paper 4 in the above embodiments, a paper strength increasing agent such as starch may be put into the minute fiber suspension 30. In this case, an applying apparatus for applying a suspension containing both of minute fibers and paper strength increasing agent is configured. Thereupon, a paper to which both of minute fibers and paper strength increasing agent are added can be obtained.

The proper amounts of the minute fibers and paper strength increasing agent applied to the paper surface are 0.2 to 2.0 g/m<sup>2</sup> and 0.5 to 2.0 g/m<sup>2</sup> per one surface, respectively. The reason for this is as follows: If the adding amounts of the minute fibers and paper strength increasing agent are smaller than the above-mentioned proper amounts, the effect of improving the paper quality is not achieved. If the adding amounts are larger than the proper amounts, the effect of improving the paper quality is not achieved, only resulting in an increase in the cost of additive.

According to the above-described applying method and apparatus, by applying (adding) minute fibers or both of minute fibers and a paper strength increasing agent to the surface layer of the wet paper 4 at the press section B of paper machine, the smoothness, surface strength, and rigidity of printing paper etc. can be improved.

Also, a high-concentration suspension with a weight concentration not lower than 3.0% can be applied. Conventionally, the minute fibers are applied to the wet paper 4 by using sprays 9 (see FIG. 3) installed at the former section A or press section B. In this case, however, the minute fiber suspension cannot be supplied continuously because the minute fibers accumulate at the contracted portion near the spray jet and the spray 9 is clogged if the weight concentration of minute

fiber suspension exceeds about 1.5%. Contrarily, in the present invention, a roll-type applying apparatus (applying apparatus for the minute fiber suspension 30 or applying apparatus for the minute fiber suspension 30 and paper strength increasing agent) is configured so that an applied substance such as the minute fiber suspension 30 is formed as a film 31, 38 on the surface of the applicator roll 22, 37, and then it is transferred to the wet paper 4. Therefore, the contracting portion does not exist in the piping system for minute fibers (and paper strength increasing agent), so that the aforesaid "clogging" does not occur even if the weight concentration of the minute fiber suspension 30 is not lower than 3.0%, whereby the minute fiber suspension 30 can be supplied continuously. Thereupon, the minute fiber suspension 30 with a weight concentration not lower than 3.0% can be applied to the wet paper 4. As a result, by applying the high-concentration suspension 30 with a weight concentration not lower than 3.0% to the wet paper 4, an increase in dry load at the dryer section C can be restrained slightly.

On the applying apparatus in accordance with the first to third embodiments, unlike 2-roll size press 8 (see FIG. 12), gate roll coater (not shown), and the like, an after-dryer section E (see FIG. 12) is not needed, so that both of the equipment cost and running cost can be reduced.

The above is a description of the embodiments of the present invention. The present invention is not limited to these embodiments, and various changes and modifications can be made on the basis of the technical concept of the present invention. For example, when the minute fiber suspension or the mixed suspension of minute fibers and paper strength increasing agent is applied to the wet paper 4, the suspension may be applied to both of top and back surfaces of the wet paper 4 as described above, but sometimes it can be applied to one surface thereof only.

As described above, in the adding method of the present invention defined in claim 1, after a minute fiber suspension with a weight concentration of 3.0 to 5.0% is formed into a film shape on an applicator roll installed at the press section of the paper machine, the minute fiber suspension is applied onto the surface of a wet paper to add minute fibers of 0.2 to 2.0 g/m<sup>2</sup> per one surface on the paper surface. Therefore, the adding method in accordance with the present invention can achieve the following various effects described below. First, the minute fiber suspension applied to the surface of the wet paper enters voids between the fibers composing the surface layer of wet paper to bury the irregularities on the surface of wet paper, and strengthens the bonding between the fibers, so that the smoothness, surface strength, and rigidity of paper can be improved. Further, since the weight concentration of the minute fiber suspension applied to the surface of wet paper is high, being not lower than 3.0%, the increase in dry load of the dryer after application can be restrained slightly.

Also, in the adding method of the present invention defined in claim 2, after a paper strength increasing agent is added to a minute fiber suspension with a weight concentration of 3.0 to 5.0% and a mixed suspension of the minute fiber suspension and paper strength increasing agent is formed into a film shape on an applicator roll installed at the press section of the paper machine, the mixed suspension is applied onto the surface of a wet paper to add both of minute fibers of 0.2 to 2.0 g/m<sup>2</sup> per one surface and paper strength increasing agent of 0.5 to 2.0 g/m<sup>2</sup> per one surface. Therefore, according to the adding method in accordance with the present invention, by applying the paper strength increasing agent as well as the minute fibers to the wet paper, the effect of improving the surface strength and rigidity of paper can be further increased as compared with the invention defined in claim 1. Also, since the weight concentration of the mixed suspension of minute fibers and paper strength increasing agent is high, being not lower than 3.0% in this invention, the increase in dry load of the dryer after application can be restrained slightly as in the case of the invention defined in claim 1.

Also, in the adding apparatus of the present invention defined in claim 3, the adding apparatus comprises an applicator roll, which is disposed so as to face the surface of a press roll installed at the press section of the paper machine, for forming a minute fiber suspension film on the surface thereof and a minute fiber suspension supply box for supplying a minute fiber suspension to the surface of the applicator roll. Therefore, according to the adding apparatus in accordance with the present invention, the above-mentioned applying method of the present invention can be used, and the size press and after-dryer can be omitted, so that the equipment cost and running cost can be reduced.

Also, in the adding apparatus of the present invention defined in claim 4, film thickness control means for controlling the thickness of suspension film formed on the surface of the applicator roll is provided at the suspension outlet of the minute fiber suspension supply box. Therefore, according to the adding apparatus in accordance with the present invention, the suspension film of an appropriate thickness can be transferred (applied, added) to the surface of wet paper from the applicator roll depending on the material, type, and the like of wet paper by the operation of the film thickness control means.

By applying the applying method and apparatus of the present invention to printing paper etc. which especially require the smoothness, surface strength, and rigidity, a high-quality printing paper can be obtained, and the lightweight (low basis weight) of printing paper etc. can be attained without decreasing the rigidity.

## Claims

1. A method for adding minute fibers etc. at a press

section of a paper machine, in which after a minute fiber suspension with a weight concentration of 3.0 to 5.0% is formed into a film shape on an applicator roll installed at the press section of the paper machine, said minute fiber suspension is applied onto the surface of a wet paper to add minute fibers of 0.2 to 2.0 g/m<sup>2</sup> per one surface on the paper surface.

2. A method for adding minute fibers etc. at a press section of a paper machine, in which after a paper strength increasing agent is added to a minute fiber suspension with a weight concentration of 3.0 to 5.0% and a mixed suspension of said minute fiber suspension and paper strength increasing agent is formed into a film shape on an applicator roll installed at the press section of the paper machine, said mixed suspension is applied onto the surface of a wet paper to add both of minute fibers of 0.2 to 2.0 g/m<sup>2</sup> per one surface and paper strength increasing agent of 0.5 to 2.0 g/m<sup>2</sup> per one surface.
3. An apparatus for adding minute fibers etc. at a press section of a paper machine, comprising an applicator roll, which is disposed so as to face the surface of a press roll installed at the press section of the paper machine, for forming a minute fiber suspension film on the surface thereof and a minute fiber suspension supply box for supplying a minute fiber suspension to the surface of said applicator roll.
4. An apparatus for adding minute fibers etc. at a press section of a paper machine according to claim 3, wherein film thickness control means for controlling the thickness of suspension film formed on the surface of said applicator roll is provided at the suspension outlet of said minute fiber suspension supply box.
5. A method for adding minute fibers etc. at a press section of a paper machine, in which a minute fiber suspension is formed into a film on an applicator roll installed at the press section of the paper machine, and said minute fiber suspension is applied onto the surface of a wet paper to add minute fibers on the paper surface.
6. A method according to claim 5 wherein said suspension has a weight concentration of fibres of 3.0 to 5.0%.
7. A method according to claim 5 or claim 6 wherein the suspension is applied at a coating rate of 0.2 to 2.0 g/m<sup>2</sup> per surface coated.
8. A method according to any one of claims 5 to 7 wherein the suspension includes a paper strength increasing agent.
9. A method according to claim 8 wherein the paper strength increasing agent is applied onto the surface of a wet paper at a coating rate of 0.5 to 2.0 g/m<sup>2</sup> per coated surface.

FIG.1

B

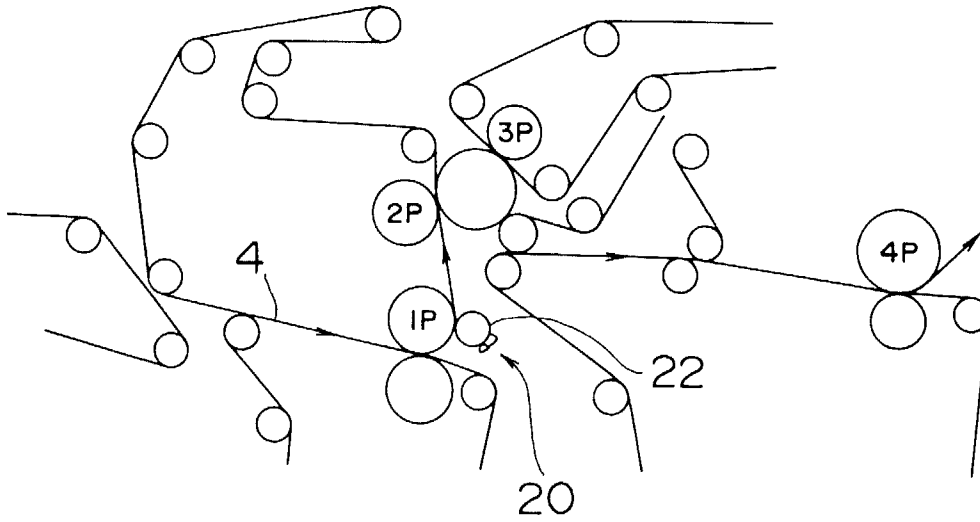


FIG.2

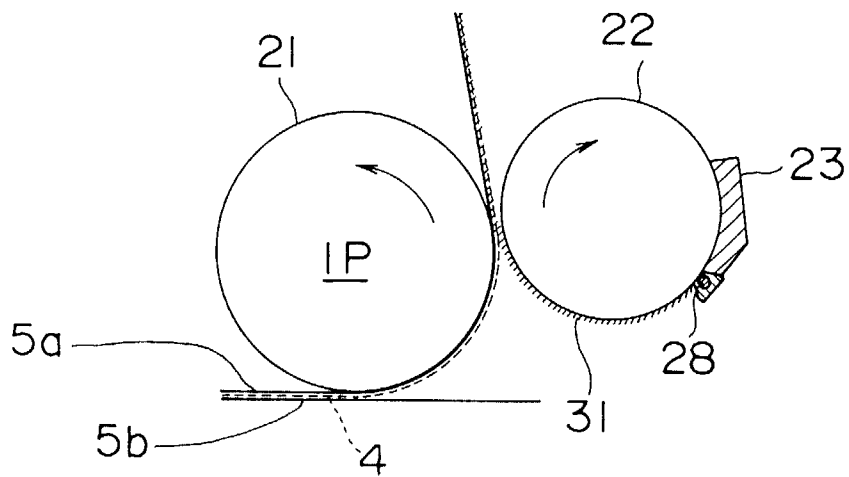


FIG. 3

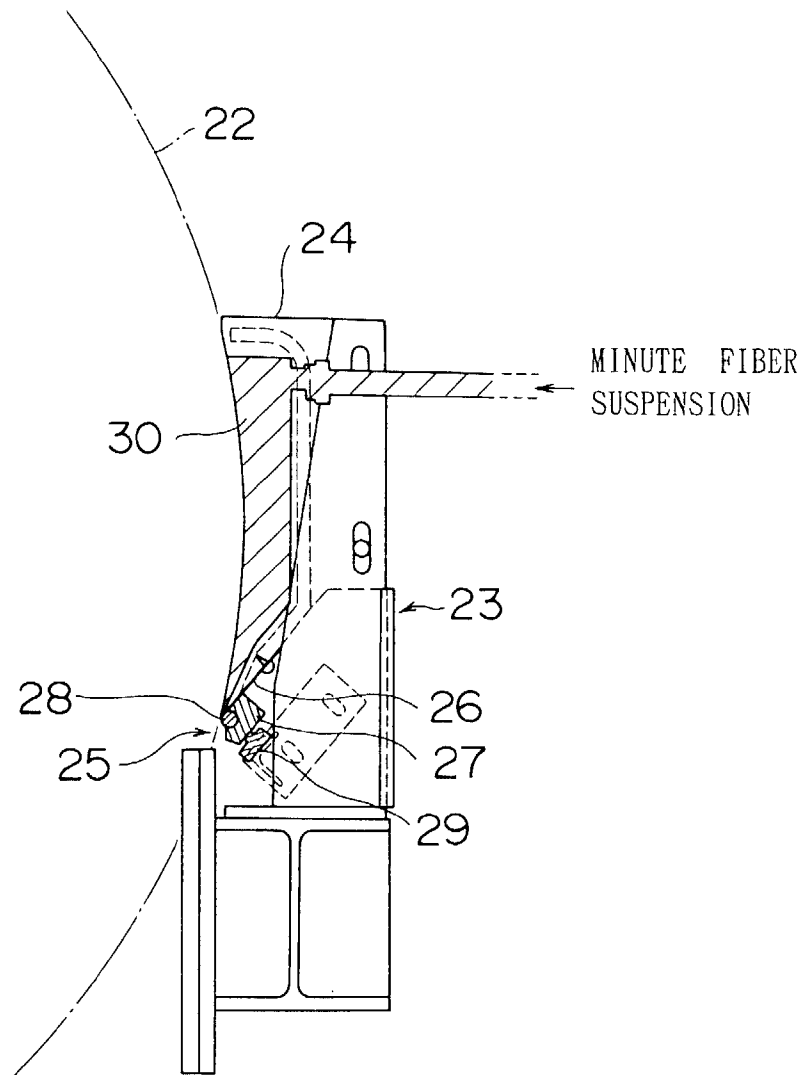


FIG. 4

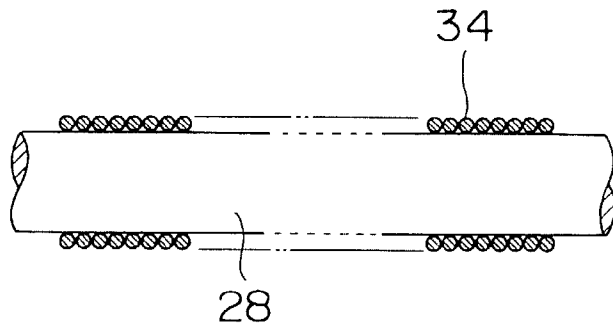


FIG.5

B

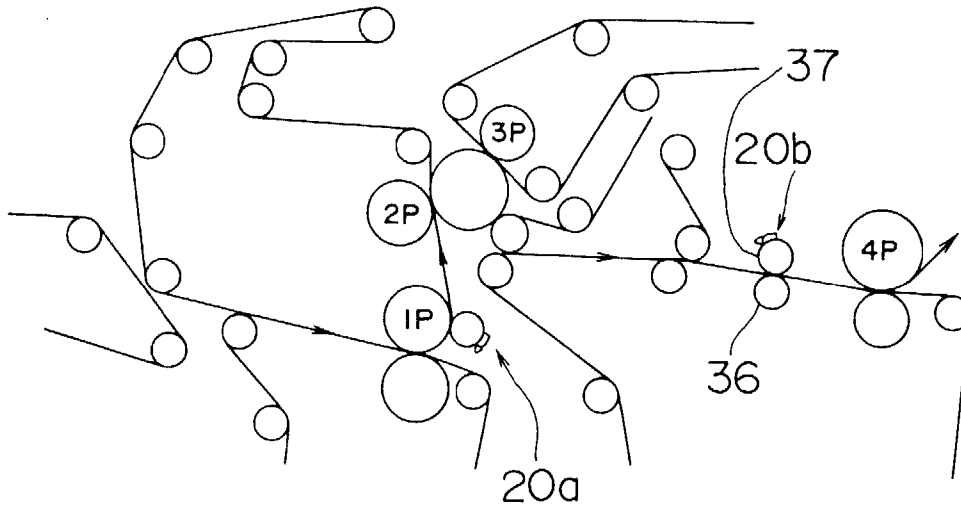


FIG.6

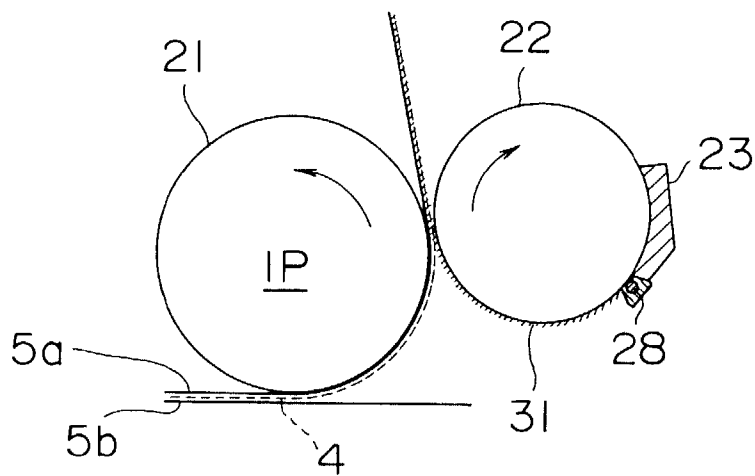


FIG. 7

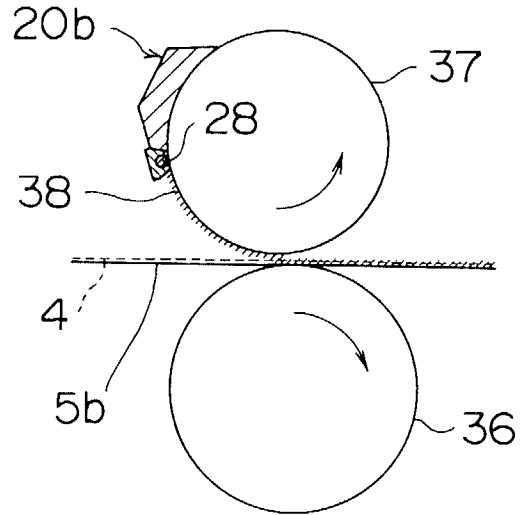


FIG. 8

B

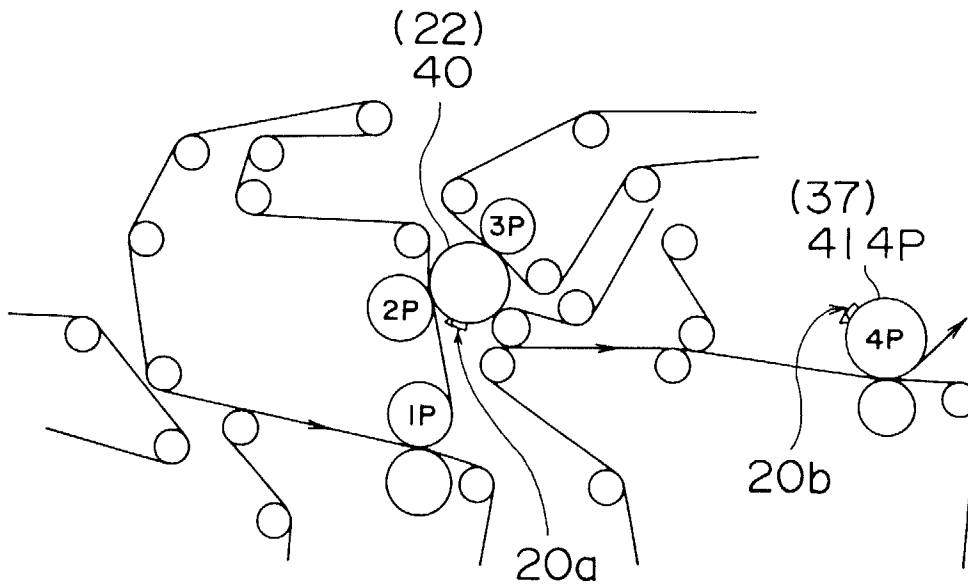


FIG.9

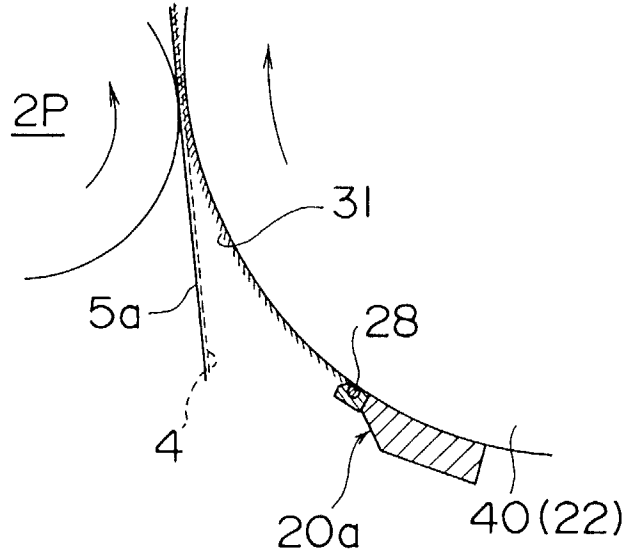


FIG.10

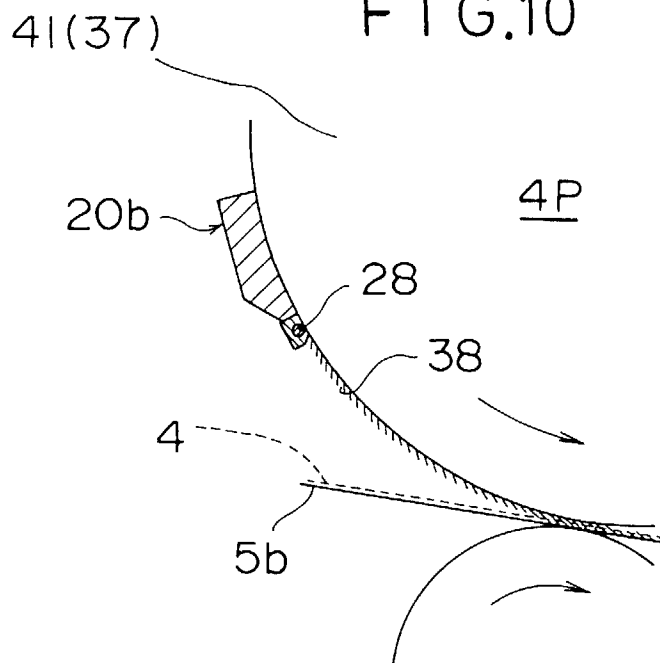
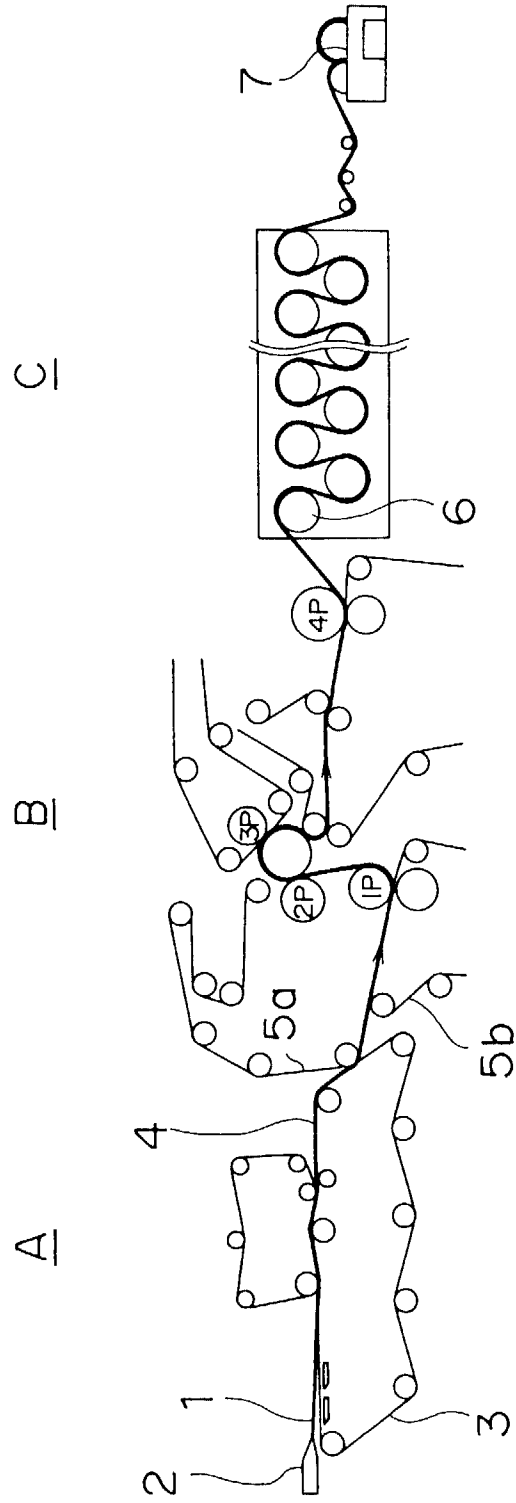


FIG.11



F I G.12

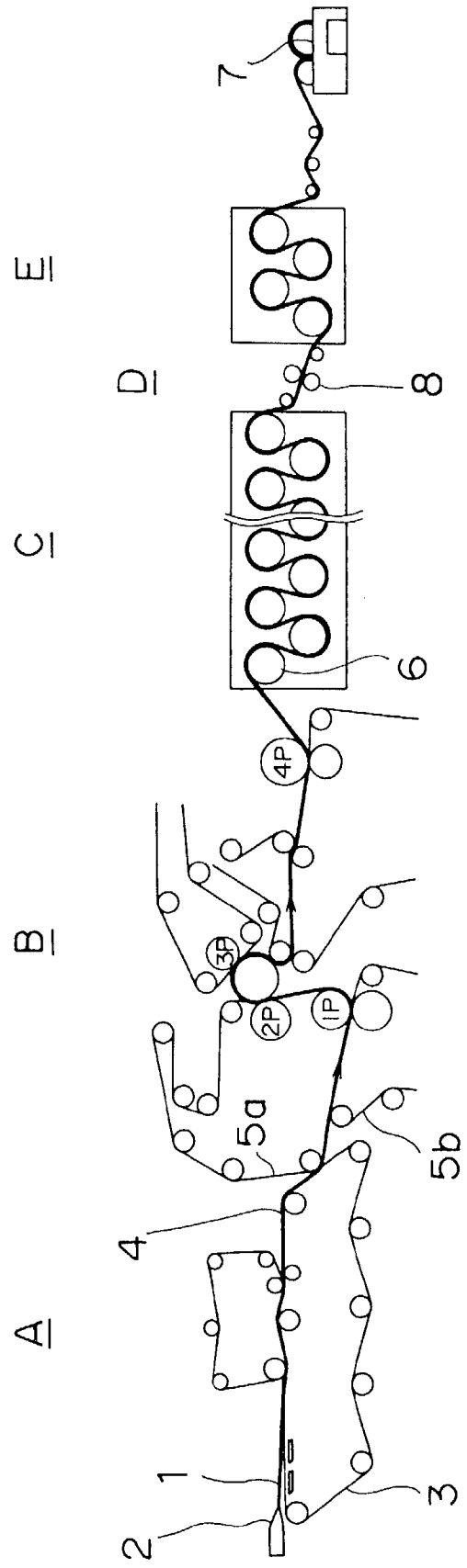


FIG. 13

