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(71) Applicant: **Pulp and Paper Research Institute of Canada**
**570 St. John's Boulevard Pointe Claire**
**Quebec H9R 3J9(CA)**

(72) Inventor: **Daunais, Robert**
**406 Avenue Phaneuf**
**Dorion Quebec J7V 1Z4(CA)**
Inventor: **Pikulik, Ivan I.**
**110 Ashington Road**
**Pointe Claire Quebec H9R 2Z2(CA)**
Inventor: **McDonald, J. David**
**Vaudreuil, Box 834 R.R. No.1**
**Hudson Quebec L0P 1H0(CA)**
Inventor: **Pye, Ian T.**
**126 Highgate Avenue**
**Pointe Claire Quebec H9R 2X4(CA)**

(74) Representative: **Archer, Philip Bruce et al**
**Urquhart-Dykes & Lord Trinity Court Trinity Street**
**Peterborough Cambridgeshire PE1 1DA(GB)**

## (54) Wet cellulosic web transfer.

(57) A transfer system for transferring a moving wet cellulosic web between two moving elements of a paper mill without excessive sheet flutter or breakage, supports the web and permits higher web speeds than presently used. The transfer system comprises a suction roll (18) that forms a nip (19) in contact with the web (12) on the surface of a roll (10) or web supporting belt, a doctor blade (26) is positioned in contact with the surface of the roll (10) or web supporting belt immediately after the nip (19) to ensure the web separates from the surface, and an air jet adjacent the doctor blade blows air in a direction substantially opposite the moving web, between the moving web and the surface and the roll or web supporting belt, to guide and support the web towards the suction roll.

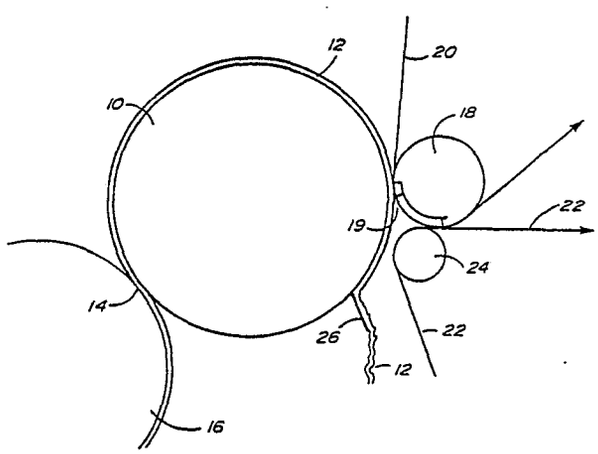


Fig.1

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# WET CELLULOSIC WEB TRANSFER SYSTEM

## Field and Background of the Invention

The present invention relates to the transfer and support of wet cellulosic webs between two moving elements in a paper machine. More specifically, the present invention relates to the detachment of moving wet cellulosic webs from a press roll or web supporting belt to another moving element in the press section or dryer section of a paper machine.

In the fabrication of paper, a suspension of cellulosic fibres, referred to as a furnish, is spread on one or more moving forming fabrics or carriers and the bulk of water drained away. This cellulosic web or sheet, which is initially weak and wet, is transferred onto a press felt which carries it into a press nip formed by two press rolls. The mechanical compression between the two press rolls compacts the web and eliminates part of the water form the wet web. The web usually leaves the press nip adhering to one of the press rolls, and must be peeled from the roll before it can be transferred to the next section of the paper machine. Paper machines generally have one to four presses in the press section followed by a dryer section with heated dryer rolls, to evaporate most of the water remaining in the pressed web. In the fabrication of some paper grades, the dry web is moistened by the application of an aqueous suspension of sizing agents. This occurs in a size press after a first drying stage, and the moist sized paper is then again transferred to a second dryer section where it is dried for a second time.

While in the different sections of the paper machine, the wet cellulosic web is usually supported by a pervious belt such as forming fabric, press felts, and drying fabric, or by other means such as a press roll. A mechanical support is often unavailable during web transfer between the individual moving elements of the machine. Thus during web transfer there is an increased danger of the web or sheet braking, especially if it is moist and the machine operates at high speed. To reduce the danger of sheet breaks it is sometimes necessary to reduce the machine speed, even though this leads to a decrease in production. The danger of sheet breaks is sometimes reduced by the addition of chemicals or be increasing the proportion of a stronger, but more excessive, component such as chemical pulp or long fibre pulp in the furnish or initial fibre mix.

The most critical areas of sheet transfer are from the forming section to the press section, between the consecutive presses in the press section, and between the last press in the press section and the first roll in the dryer section. In all of these transfer areas, the web or sheet is still wet and thus is comparatively weak. Several methods have been used for transferring the sheet at these areas. In one method the sheet is pulled unsupported from one element to the next through a so-called "open draw". The wet sheet in the open draw is unstable at high speeds and reacts to small variations in the process, sometimes having a tendency to oscillate or flutter. An excessive sheet flutter can cause deformations and wrinkling of the web and reduce the product quality or completely break the sheet and interrupt production. Thus, paper machines with an open draw between the former and the first press rolls usually operate at speed below 750 metres per minute.

All the machines operating at high speeds, that is to say, in excess of 1,000 metres per minute provide a continuous support of the web from the former at least the first nip in the press section. On machines with multiple roll press arrangement, the web is continuously supported up to the second or third press nip. However, on all present paper machines, the sheet passes through an open draw as it is peeled from the roll of the last press.

In the open draw method of transfer, the reduction of excessive sheet flutter and stabilization of the web is sometimes achieved by increasing the tension in the web. The tension required to peel the web and to stabilize it in the open draw transfer may, in some instances, be sufficiently great to cause a break in the web and even if it does not break, a high tension can permanently stretch the web and, therefore, make it more susceptible to breaks during the subsequent operations on the paper machine. This reduced extensibility is preserved even in the finished product and can lead to an increased number of paper sheet breaks during converting or printing operations.

Another method of transferring a web from a pervious carrier or belt such as a forming fabric to another pervious carrier such as a press felt is with the assistance of a drilled roll equipped with a vacuum chamber. Most high speed paper machines use such a vacuum pick-up system to transfer the web from the former to the first press roll. In a vacuum pick-up system, however, a suction roll can only efficiently transfer a web from a pervious carrier to another pervious carrier. Press rolls are generally solid rolls and thus a vacuum system such as a suction roll cannot by itself initiate peeling of a web from a solid press roll or even an impervious belt. In the case of a press roll, the web normally adheres better to the smoother and less pervious surface.

Since separation of the leading edge of a wet web from a press roll or web supporting belt is difficult to achieve, paper machines are commonly initially threaded with only a narrow band of the web which is sometimes referred to as a "tail". When this narrow band has been successfully threaded through the length of the machine, it is gradually widened until the full width of the paper machine is achieved. This narrow band of paper is initially very weak because it is so narrow and air currants in fast running machines frequently cause the narrow strip to break, thus prolonging the start-up procedure. All the paper produced during machine start-up is unusable and must be recycled. If the machine threading time could be shortened and the machine threaded with the full width of the sheet or web, then production losses would be decreased and a higher efficiency achieved.

Undesirable materials, which generally represent fractions of cellulosic fibres, often adhere to various paper machine rolls such as press rolls, dryers or calender rolls, and are commonly removed by so-called "doctor blades" which have sharp edges positioned in close proximity to the surfaces of the machine rolls and peel off the web and fibres adhering to the roll. The web removed in this manner is generally densely crimped or creped and cannot be converted into a smooth paper. Creping of a web by a doctor blade may be applied commercially to produce soft and bulky tissue paper used primarily for hygienic products. For high bulk and softness, it is desirable that the tissue paper has regularly and densely spaced creped ridges. Good creping requires a sharp doctor blade and an optimal contact angle between the blade and the impinging web. Canadian Patent no. 1,044,459 and Japanese Patent No. 43160 disclose methods of creping by using a hollow doctor blade from which a flat jet of compressed air is blown from a location adjacent the blade. Both of these patents have as a primary objective, the reduction of the wear of the roll through a reduction or elimination of blade contact with the roll. These hollow doctor blades were designed for production of creped paper rather than for initiation of the transfer of a wet cellulosic web in the press section or immediately prior to the dryer section. Because creping occurs when a web is removed from a smooth surface, such as a press roll by a blade, doctoring has not been used as a means of transfer for wet cellulosic webs to produce paper which requires a smooth surface.

We have identified a requirement for :-

a) an apparatus and method for the detachment of a wet cellulosic web from a press roll or web supporting belt and continuously support this web during its transfer to a subsequent moving element; and/or

b) a transfer system which permits safe transfer of a tail or a full width sheet or web during the start-up of a paper machine; and/or

c) a transfer system to transfer a wet fibrous web at web speeds greater than 1,000 meters per minute; and/or

d) to transfer webs which are weaker than those transferred on existing paper machines without the necessity of having to increase wet web strength and to reduce the number of breaks that occur in conventional paper machines; and/or improvements generally.

An embodiment can be used to transfer a tail or a full width strip between a press roll or a web supporting belt to a following moving element and comprises a doctor blade to initially separate the web from the roll or carrier, an air jet that blows air in a direction opposite to the movement of the web, between the web and the roll or carrier, and a vacuum or suction roll that may have a pervious belt thereon to retain the web as it is transferred from the press roll or carrier.

The present invention provides a system dedicated to transfer a fast moving web of flexible material from a surface of a first web supporting moving element to a second web supporting moving element while continuously supporting said web during the transfer thereof, comprising in combination:

a first web supporting moving element

a suction roll in contact with said web, defining a nip with said first moving element;

a doctor blade in contact with said surface immediately after said nip to cause separation of said web from said surface; and

means for producing an air jet adjacent said doctor blade, between said web and said surface and in a direction substantially opposite the direction of movement of said web, said air jets constituting means for supporting and guiding said web toward said suction roll.

In a preferred embodiment, a pervious belt moves through the nip, around the suction roll and the web is transferred to this pervious belt.

In another embodiment, the doctor blade and air jet comprise a unitary assembly with an air plenum connected to a tapered air chamber culminating in two lips with a gap between the lips forming an air jet. One of the two lips forming the doctor blade is positioned in contact with the surface of the roll or web supporting belt.

In yet another embodiment, the air plenum and air chamber form a unitary assembly, said assembly being movable between first and second positions, in said first position said assembly contacts the surface of the roll or web supporting belt so that the air jet therefrom is directed towards the nip formed by the press roll and suction roll, in said

second position said assembly being positioned so that it is in contact with said surface.

In a still further embodiment, there is provided in a method of forming a web of fibrous sheet material, including the steps of forming a wet web of cellulosic fibres, moving the web through a press section having a plurality of press rolls to a dryer section, the improvement of transferring the moving web from a press roll to a following moving element, comprising the steps of: feeding the moving web around the press roll through a nip formed between the press roll and a suction roll, detaching the moving web from the press roll immediately after the nip by a combination of a doctor blade and blowing a jet of air in a direction counter to the moving web between the press roll and the web, and guiding and supporting the moving web to the following moving element by a combination of the air jet and suction from the suction roll.

## Brief Description of the Drawings

FIG 1 is a schematic side elevational view of a solid roll with a suction roll forming a nip and a conventional doctor as provided in the prior art;

FIG 2 is a partial side elevational view of a combined doctor blade and air jet according to one embodiment of the present invention;

FIGS 3 and 4 are partial side views showing different shapes of air chambers for the combined doctor blade and air jet;

FIGS 5, 6 and 7 are detailed side views showing different edges for doctor blades;

FIG 8 is a partial side elevational view showing a combined doctor blade and air jet positioned adjacent a solid roll forming a nip with a suction roll;

FIG 9 is a schematic side elevational view of a paper machine showing the transfer system of the present invention positioned to transfer a web from the last nip of the press section; and

FIG 10 is a schematic side elevational view of yet a further embodiment of a transfer system according to the present invention wherein the transfer occurs between an impervious web supporting belt and a pervious dryer fabric.

## Description of the Preferred Embodiment

Referring now to the drawings, FIG 1 illustrates a solid roll 10, which is the last roll in a press section of a paper machine, with a web 12 of wet cellulosic fibres moving on the roll 10 from a nip 14 with the previous press roll 16. A suction roll 18 forms a nip 19 with the solid roll 10, and a pervious belt 20, in the form of fabric belt, moves around the suction roll 18 and through the nip 19. A second carrier belt 22, which is also pervious, is conveyed about a further roll 24 positioned beneath the suction roll 18 to provide a passage for the web 12 between the first carrier belt 20 and the second carrier belt 22. The suction roll 18 is to provide suction to separate the web 12 from the surface of the solid roll 10 and direct it between the carrier belts. However, because the solid roll 10 does not allow air to pass therethrough, the suction roll 18 has little effect in separating the web 12 from the solid roll 10. As can be seen in FIG 1, the web 12 passes down to a conventional doctor blade 26 which separates the web 12 and crimps or crepes the web as it is separated from the roll 10. FIG 1 illustrates a prior art arrangement which is not considered satisfactory.

A doctor blade and air jet assembly 30 are shown in FIG 2 which comprises an air plenum 32 in the form of a pipe with a slot or a series of holes 34. Air passes into an air chamber 36 formed by two tapered walls 38 which taper down to a first lip 40 and a second lip 42. FIG 2 shows the first lip 40 representing a doctor blade in contact with the surface of a press roll 10 so that the web 12 is shown to separate adjacent the doctor blade lip 40. The second lip 42 is shown to extend not so far as the first lip 40 and a gap 44 or slit between the two lips 40 and 42 provides a longitudinal air jet to eject a flat jet of air. Whereas the word "jet" has been used throughout the specification, this terminology includes a longitudinal stream of air as would be ejected by a gap or slit 44.

FIG 3 shows one embodiment of an air chamber 36 wherein the tapered walls 38 join to a first lip 40 and a second lip 42 which converge inwards to the gap 44 at the ends of the lips 40 and 42. FIG 4 shows another embodiment wherein the two lips 40 and 42 are parallel to each other, thus the gap 44 represents a parallel gap and provides a flat jet of air therefrom.

FIGS 5, 6 and 7 represent different tips of the doctor blade lip 40. The contact angle alpha as shown in FIG 5 being similar so that used on conventional blades wherein the edge of the blade scrapes the roll surface. One or both lips of the assembly may be replaced if the lip or lips are damaged or worn.

The optimum gap width depends on production parameters such as machine speed, product grade, web adhesive force etc. The gap width between the two lips may be between 0.1 and 3.0 mm wide, and preferably is in the approximate range of 0.3 to 0.8 mm.

FIG 8 shows a suction roll 18 positioned above the doctor blade and air jet assembly 30. In the initial phase of the start-up procedure, the assembly 30 is in position A and the leading edge of the tail or full machine width of web 12 is detached

from the roll 10 by impact with lip 40 of the doctor blade. The web 10 is then forced by the air jet towards the suction roll 18 and is attracted to the roll surface by the vacuum within the suction roll 18. The web 12 is thus transferred to the felt 20. Once the moving web 12 has been transferred to the felt 20, the assembly 30 is no longer required and is switched to position B and the air supply shut off. If a web break occurs, the web is rethreaded with the assembly 30 in position A. During an operating period of anticipated web breaks, the assembly is left in position A.

The suction roll 18 is shown having three zones. The first zone 50, located nearest to the nip 19, has a high vacuum level to assist in establishing the initial contact between the web 12 and the felt covered suction roll 18. The second zone 52 downstream from the first zone 50 is a larger zone and acts as a holding zone with a lower vacuum level. For example, the first zone 50 may have a vacuum level in the range of about 10 to 80 kPa and the second zone 52 has a vacuum level in the range of from 0 to 50 kPa. The second zone 52 is sufficient to maintain and support the web 12 on the felt 20. The third zone 54 provides a small positive air pressure to ensure that the web 12 on the felt 20 is easily parted from the suction roll 18 as the felt 20 separates from the suction roll 18.

The air pressure in the air plenum 32 depends on production variables such as doctor gap, width, machine speed, product grade and the web adhesion to the roll, but preferably ranges from about 14 kPa to 600 kPa. The most convenient air pressure for an air blade with a gap width of 0.5 mm was found to be between 34 kPa and 100 kPa.

FIG 9 illustrates the transfer system of the present invention used to transfer the web from the plain roll 10 of the last press which is the central roll of a three- roll inclined press. FIG 10 illustrates two transfer systems, the second of which transfers from a pervious or impermeable web supporting belt 60 onto a dryer felt 70. The device could be used for the transfer of various flexible thin materials and is particularly suitable for the transfer of weak and extensible sheets such as wet paper or paperboard, dry creped hygienic paper or nonwoven products.

## EXAMPLE 1

A pilot paper machine was used to make paper in two different ways. Paper was first made with a direct transfer from the press section using the air doctor transfer roll arrangement of the present invention, and secondly, paper was transferred from the solid roll using the conventional open draw operation. The tensile properties of the paper so made were then compared.

The pilot machine consisted of a roll former with a suction pick-up, a three-roll inclined press and a sampler as illustrated in FIG 9. The transfer system was installed between the second press nip and the sampler as shown in FIG 9. The paper machine was producing a web 0.33 meters wide with a basis weight of about 50 grams per square meter at 800 meters per minute using a newsprint furnish. The first and second press nip loads were 60 and 120 kN/m respectively, and the solid contents of the paper after the second press was approximately 42%.

The wet paper used for the laboratory test was reeled with minimum draw (less than 1%) for the air doctor transfer roll experiments and at several draws between 2 and 4% for the open draw experiments. The experimental results are shown in the following table.

The wet stretch measurements were done on samples cut from the reel (2.5 x 10 centimetres) sealed in a bag, and handled in such a way to reduce moisture loss. Other samples were dried between blotters in a photographic dryer and cut in strips (1.5 x 10 centimetres). Both wet and dry samples were strained at 100 mm per minute in a laboratory tensile strength tester. The measurements on both the wet and dry paper demonstrate that the paper produced with a transfer arrangement according to the present invention had more stretch than that produced using the open draw system. These results indicate that the paper is less likely to break in subsequent open draws on the paper machine and in the converting or printing process.

## Example 2

Using the arrangement shown in FIG 9, a 45 gram per square metre web was transferred to the sampler at 1,000 metres per minute ten times for ten attempts. After sheet transfer was initiated by the transfer system of the present invention, it was maintained even when the air supply to the air jet was interrupted. Without the application of the present transfer system, the transfer of a web having the full machine width could not be accomplished by experienced machine operators.

## Example 3

Using the transfer system described herein, a web of full machine width was transferred from the press to the sampler of a pilot paper machine at its maximum speed of 1,200 metres per minute. Without this transfer system, this could not be accom-

plished.

The transfer system described and claimed herein is capable of transferring weak wet webs, such as those made from 100% mechanical pulps. In the past, this has not been possible without forfeiting speed or having to add a percentage of chemical pulps. Thus the present invention permits the manufacture of paper from weaker and less expensive starting materials.

When practising the transfer system described herein, the number of web breaks is reduced and the speed of the paper machine can be increased above the highest speeds of conventional machines, in the order of about 1,400 metres per minute.

Whereas FIG 9 shows only a single transfer system, multiple transfer assemblies may be provided at different locations on the machine.

Various changes may be made to the embodiments described herein without departing from the scope of the present invention which is limited only by the following claims.

## Claims

1. A system dedicated to transfer a fast moving web of flexible material from a surface of a first web supporting moving element to a second web supporting moving element while continuously supporting said web during the transfer thereof, comprising in combination:
a first web supporting moving element;
a suction roll contact with said web, defining a nip with said first moving element;
a doctor blade in contact with said surface immediately after said nip to cause separation of said web from said surface; and
means for producing an air jet adjacent said doctor blade, between said web and said surface and in a direction substantially opposite the direction of movement of said web, said air jet constituting means for supporting and guiding said web towards said suction roll

2. The system according to Claim 1, wherein said first moving element is a solid press roll, said nip being defined between said solid press roll and said suction roll.

3. The system according to Claim 2 wherein a pervious belt moves through the said and around said suction roll, said web transferring to said pervious belt.

4. The system according to Claim 1, including an air plenum coupled to a tapered air chamber culminating in two lips with a gap between said lips forming said air jet, one of said two lips forming said doctor blade.

5. The system according to Claim 4 wherein said two lips have the same length.

6. The system according to Claim 4 wherein one of said two lips forming said doctor blade is longer than the other lip.

7. The system according to claim 4 wherein adjacent walls of said two lips are converging inwards to said gap.

8. The system according to claim 4 wherein adjacent walls of said two lips are parallel prior to said gap.

9. The system according to Claim 4 wherein the width of said gap (forming the air jet) is in the approximate range of from 0.1 to 3.0 mm.

10. The system as defined in Claim 9, wherein said means to produce an air jet constitute means to establish a pressure in said air plenum in the approximate range of from 14 to 600 kPa.

11. A system as defined in Claim 4, wherein said air plenum and said air chamber form a unitary assembly, said assembly being movable between first and second positions, in said first position said assembly contacts said surface, in said second position said assembly being positioned so that it is not in contact with said surface.

12. In a method of forming a web or fibrous sheet material, including the steps of forming a wet web of cellulosic fibres, moving the web through a press section having a plurality of press rolls to a dryer section, the improvement of transferring the moving web from a press roll to a following moving element, comprising the steps of:
feeding the moving web through a nip formed between the press roll and a suction roll, and around the press roll,
detaching the moving web from the press roll immediately after the nip by a combination of a doctor blade and blowing a jet of air in a direction counter to the moving web between the press roll and the web, and
guiding and supporting the moving web to the following moving element by a combination of the air jet and suction from the suction roll.

13. The method of Claim 12 wherein the following moving element comprises a pervious belt moving around the suction roll and through the nip, and the moving web is guided to the previous belt.

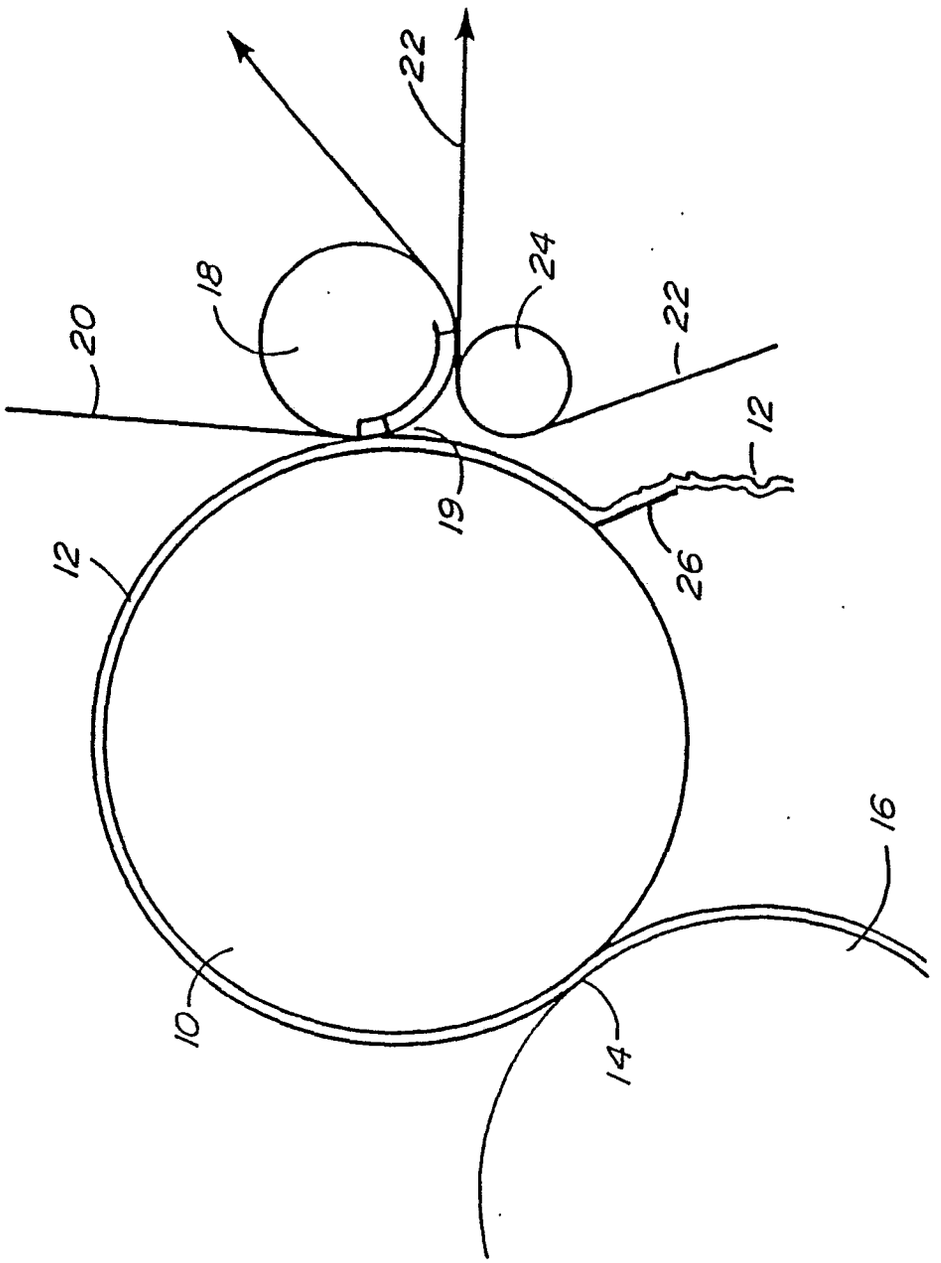


Fig. 1

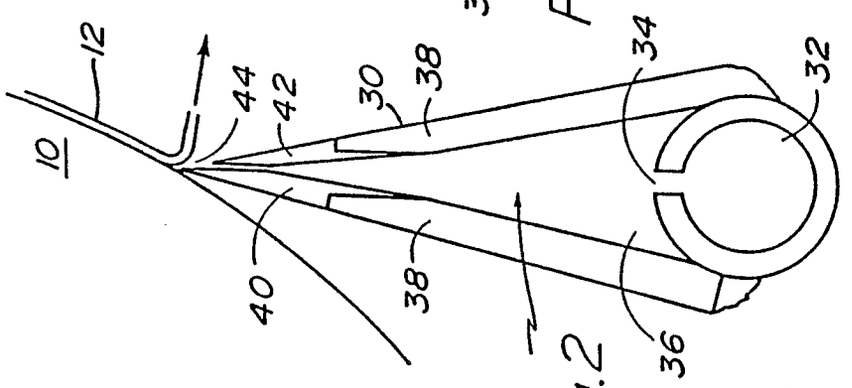


Fig.2

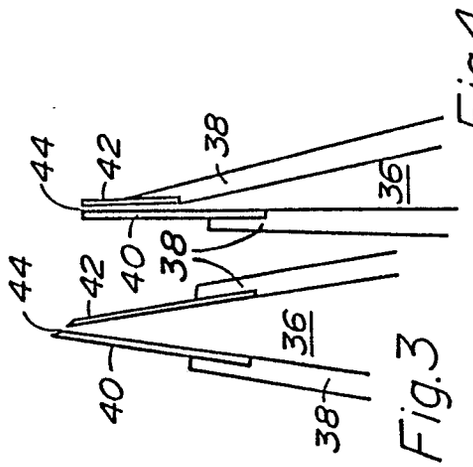


Fig.3


Fig.4

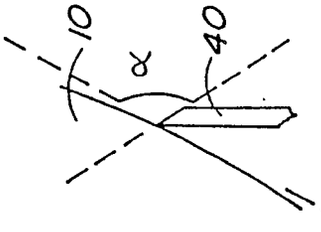


Fig.5

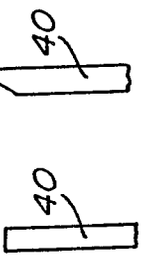


Fig.6 Fig.7

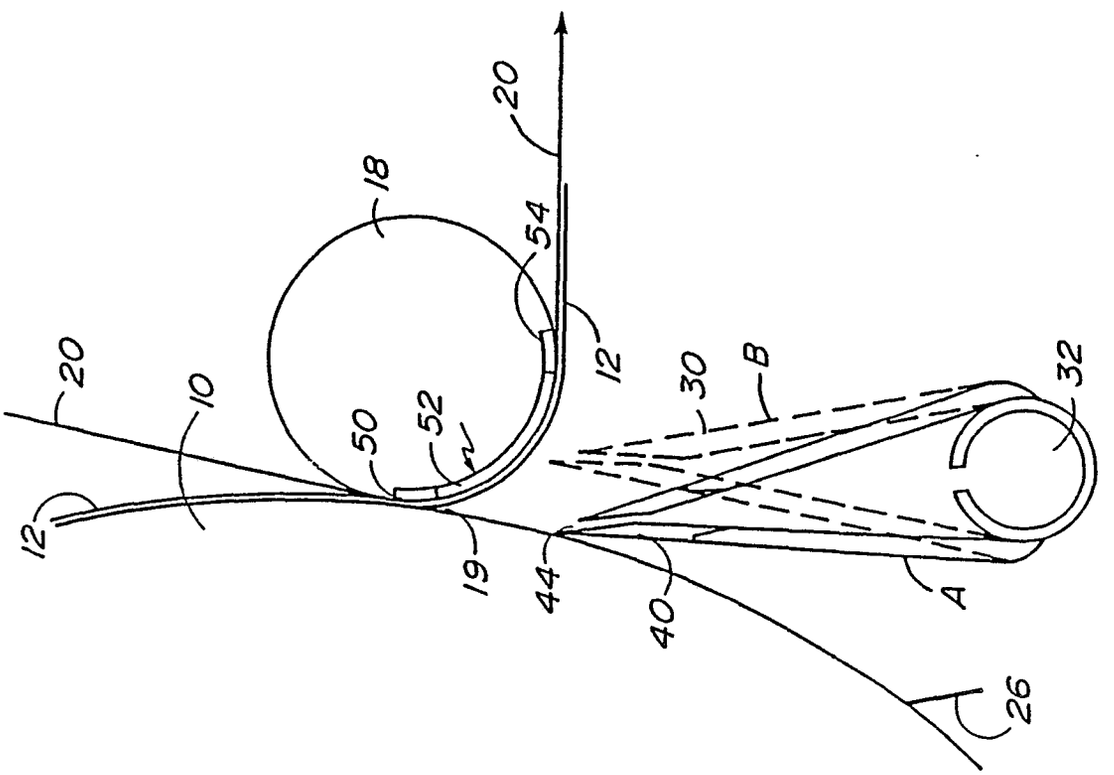


Fig.8

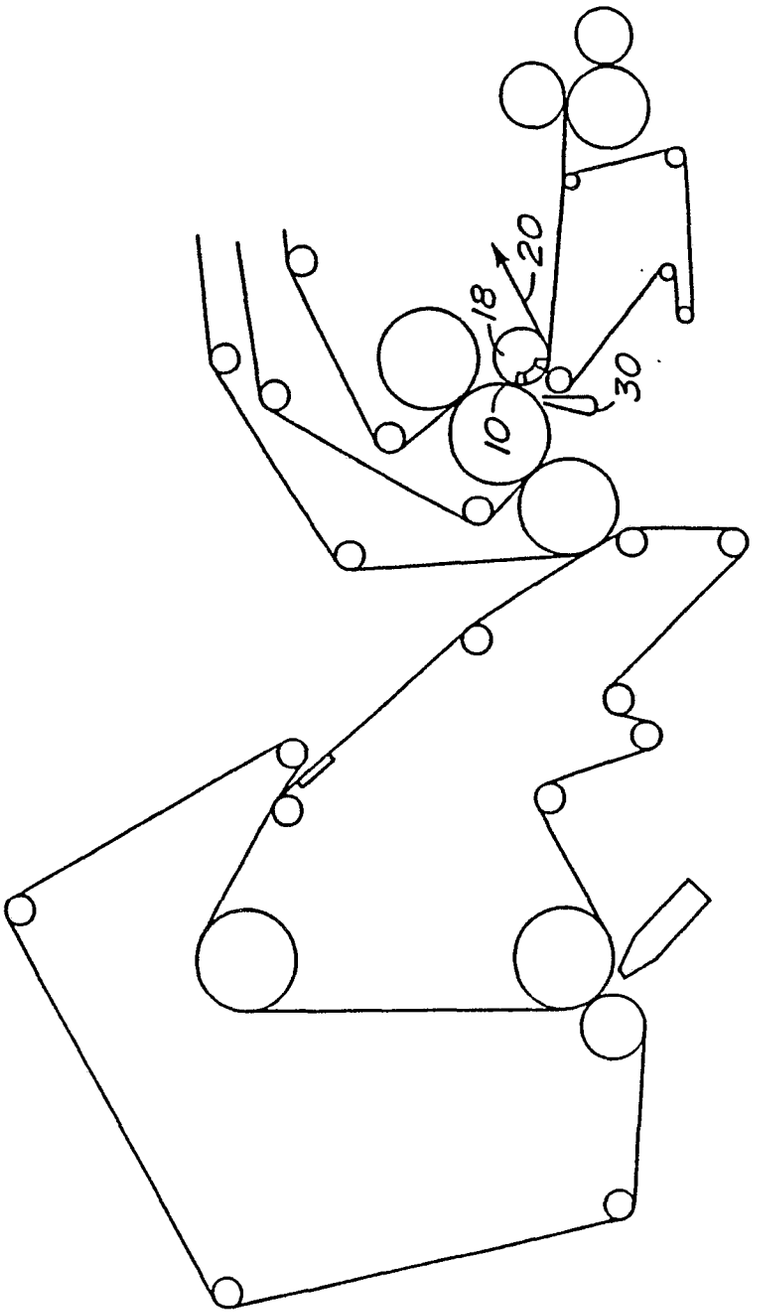


Fig.9

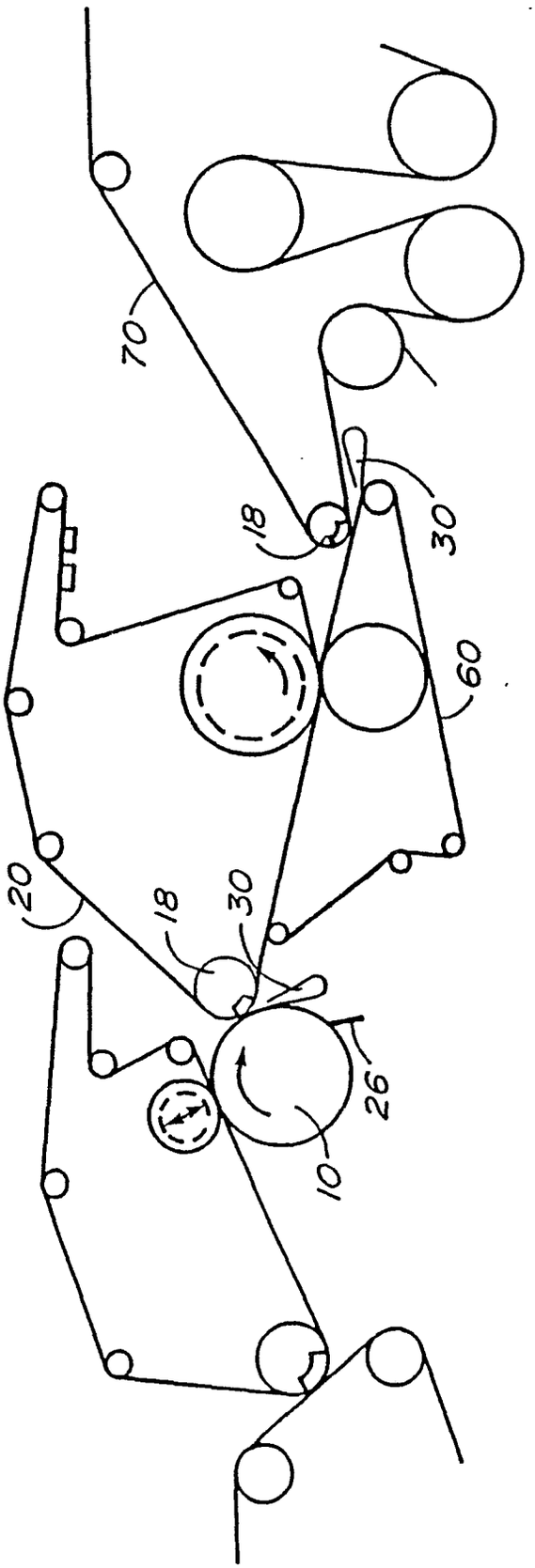


Fig.10

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number

EP 89 30 9514

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5 ) |
|---|---|---|---|
| A | FR-A-1572200 (LA CELLULOSE DU PIN)<br>* the whole document * | 1, 12 | D21G9/00<br>D21F3/04 |
| A | GB-A-2158047 (VALMET OY)<br>* the whole document * | 1, 12 | |
| A | DE-A-3435308 (VALMET OY)<br>* the whole document * | 1, 12 | |
| A | DE-C-234713 (SCHAAF)<br>* the whole document * | 1, 4, 12 | |

TECHNICAL FIELDS SEARCHED (Int. Cl.5 )

D21G
D21F

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 15 JANUARY 1990 | DE RIJCK F. |

CATEGORY OF CITED DOCUMENTS

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