



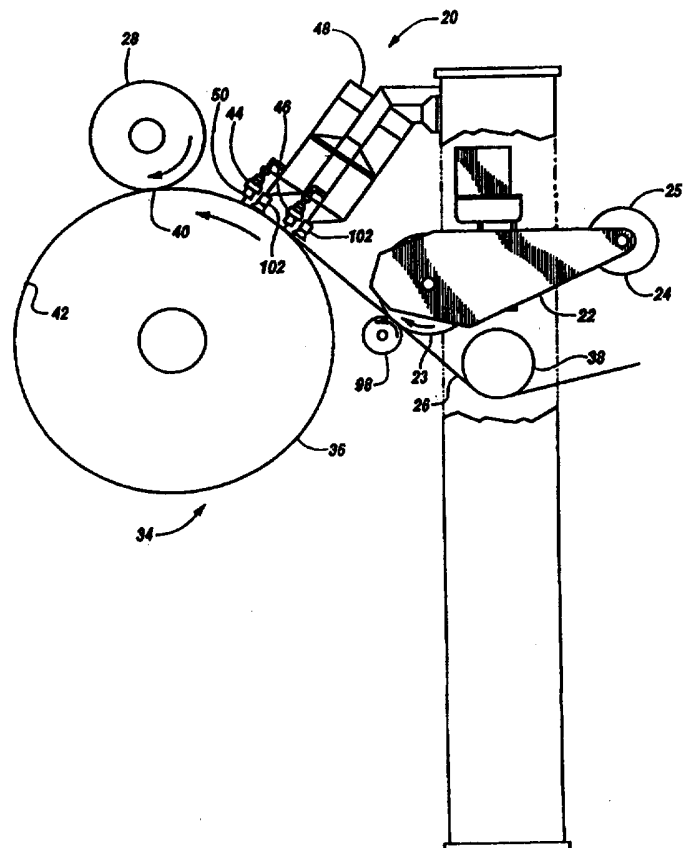
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(54) Title: REEL WEB TURN-UP DEVICE

(57) Abstract

Two water jets cut a paper web (26) as it is led over a winder drive roll (36). The water jets are angled with respect to the cut so the water used in the cutting action is entirely directed onto the portion of the web which is severed. An adhesive material, for example an automatically applied tape (24), is introduced between the upper surface of the web (26) and a spool (28) for forming a new reel (32) of paper. The use of an adhesive causes the paper leader to engage with the spool (28), thus assuring a tight, uniform and consistent initiation of the web wrapped onto the new spool (28). An automatic tape applicator (22), similar to that used for taping cardboard boxes, may be used to insert a double-sided adhesive tape (24) onto the web (26) or into the nip (40) formed between the spool (28) and the winder drum (36).



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PATENT APPLICATION
REEL WEB TURN-UP DEVICE

FIELD OF THE INVENTION

The present invention relates to paper winders in general and in particular to apparatus and methods for transferring a continuously formed web from a forming reel to a new spool.

BACKGROUND OF THE INVENTION

From the earliest days of the development of the Fourdrinier process for papermaking, the economical manufacture of paper has depended on forming the paper as a continuous web. The final step of winding the paper web onto a reel involves starting the formation of a new reel and stopping the winding of a reel which has reached a finished size. In a modern papermaking machine the web is often formed at speeds of up to 4,000-6,000 feet per minute or more. At the same time the speed at which the paper is made has been increased, the width of the paper web formed has been increased to up to 400 inches. The size and speed of reel production has led to a need for improved ways of changing spools.

A number of processes for changing over between a completed reel of paper and the new spool upon which the next reel of paper will start have been developed. One method employs a tape which rips across the paper web and directs it onto a new spool. Such a system is shown in U.S. Patent No. 2,461,264 to Weyenverg.

For some, usually very thin, grades of paper, including board grades, the forming reel is slowed down allowing a bubble of excess loose web to form which is then caught in the nip between the new roll and the drive roll. Thus caught, the web is torn free from the already formed roll.

Another method employs a slasher/gooseneck where a tail or leader of paper is ripped from the edge or center of the web. This tail or leader is then directed onto the new spool. The tail was often torn and formed or directed by jets of air. These systems relied on the mechanical properties of a typical paper web wherein a tear in a sheet will tend to propagate in the cross-machine direction to the edge of the web, thus completely severing it.

Slasher/gooseneck turn-up systems lack effectiveness for certain grades of paper where the web will not readily and rapidly tear from the tail or lead to the edges of the sheet. Also, on heavy grades, the slasher cannot penetrate the sheet to initiate the tear.

All the foregoing systems, the slasher, the bubble, or the tape, can result in an uneven thickness of paper being wound on the spool as a reel of paper is started. In the past, non-uniformity of the wound paper web caused by the paper building up on one edge or the middle of the spool has resulted in the paper close to the spool developing defects which require the central portion of the paper reel be scrapped. This scrapping of paper represents a cost or inefficiency and is contrary to the modern ideal of zero-defect manufacturing.

To overcome the resistance of some modern papers to tearing in the cross-machine direction and to insure a more uniform and speedy separation of the web, knives, as shown in U.S. Patent No. 4,445,946, or water jets, as shown in EP App. 0 543 788 A1, have been used to rapidly sever the web thus forming a tail or leader which is used to start a new reel.

In the past, water jets, when used to cut the paper web, have been positioned away from the winder drum which has resulted in an open draw where the tail or leader is unsupported. This lack of support has necessitated

air showers to attempt to keep the web in place until it is wound around the new spool.

What is needed is an apparatus and method for rapidly severing a paper web and directing the paper web to positively engage with a new spool so the spool starts out with a uniform tight wrap.

SUMMARY OF THE INVENTION

The web turn-up device of this invention employs two water jets or water knives which cut a paper web as it is led over a winder roll. Water jets are angled with respect to the cut so the water used in the cutting action is entirely directed onto the portion of the web which is severed and does not wet the paper being wrapped onto the newly formed roll. An adhesive material, either an automatically applied tape or a sprayed-on glue, can be introduced between the upper surface of the web and the spool of the new forming roll or reel of paper. The use of an adhesive means the paper leader or tail is instantly engaged with the spool, thus assuring a tight, uniform and consistent initiation of the web wrapped onto the new spool. If an adhesive is employed, it may be sprayed immediately upstream in the machine direction of the water knives used to sever the web. If tape is used, an automatic tape applicator, similar to that used for taping cardboard boxes, may be used to insert a double-sided sticky tape onto the spool, the web, or into the nip formed between the spool and the winder drum.

It is a feature of the present invention to provide a winder which produces rolls of more uniform wrap in order to reduce spoilage.

It is another feature of the present invention to provide an apparatus for rapidly severing a broad range of paper webs so that a new reel of paper may be started.

It is a further feature of the present invention to provide an apparatus for adhesively bonding a paper web to a spool.

It is yet another feature of the present invention to provide an apparatus which can produce one or more reels of paper suitable for use by end users.

It is still a further feature of the present invention to provide an apparatus and method for using a water knife to sever a paper web wherein the trailing end created is substantially free of wetting from the water knives.

Further objects, features and advantages of the invention will be apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view of the web cutting and reel turn-up apparatus of this invention.

FIG. 2 is a schematic side elevational view of an alternative embodiment of the web cutting and reel turn-up apparatus of this invention.

FIG. 3 is a schematic side elevational view of another alternative embodiment of the web cutting and reel turn-up apparatus of this invention.

FIG. 4 is a schematic side elevational view of a further alternative embodiment of the web cutting and reel turn-up apparatus of this invention.

FIG. 5 is a schematic plan view of a water knife used with the web cutting and reel turn-up apparatus of FIGS. 1-4.

FIG. 6 is a plan view of the cutting path created by the water knives employed in the apparatus of FIGS. 1-4.

FIG. 7 is a plan view of another cutting path created by the water knives employed in the apparatus of FIGS. 1-4.

FIG. 8 is a plan view of a further cutting path created by the water knives employed in the apparatus of FIGS. 1-4.

FIG. 9 is an isometric view partly cut away of the tape application wheel of the tape applicator of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring more particularly to FIGS. 1- 9 wherein like numbers refer to similar parts, a web turn-up apparatus **20** is shown in FIG. 1. The apparatus **20** employs a tape dispenser **22** which applies doubled-side adhesive tape **24** to a paper web **26**. The web **26** is formed on a papermaking machine and the apparatus **20** is employed to wind the web **26** onto spools **28** to form reels **32**. Papermaking is a continuous process which cannot be readily started and stopped without incurring considerable expense. Hence the reels of paper which are formed must be started and cut off of the continuously formed web **26** without interrupting the continuous production of paper.

There are two important steps which must be accomplished in order to start a new reel of paper forming. First, the web must be severed from the completed reel **32**, such as shown in FIG. 2. Second, the severed web must be wound on a new spool **28**.

The web turn-up apparatus **20** forms part of a paper winder **34** shown schematically in FIGS. 1-4. The winder **34** has a winder roll **36** onto which the paper web **26** is fed from a support roll **38** on the papermaking machine. In a typical winder, an arm or other mechanism, not shown in FIGS. 1-4 for clarity, positions a spool **28** over the top **40** of the winder roll **36** where the web **26** is caused to begin to wind around the spool **28**. The spool **28** is then guided in contact with the surface **42** of the winder roll **36** to a position downstream in the machine direction from the winder roll **36** as shown in FIG. 2.

The turn-up apparatus 20 employs two water knives 44, 46 to cut the web 26 against the winder roll 36 surface 42. As shown in FIG. 5, the water knife 44 is positioned on a cross beam 48 which extends across the web 26 in the cross machine direction. The water knife has a nozzle 50 normally constructed of a hardened jewel such as a diamond, ruby or emerald through which water is forced at very high pressure, a typical maximum being 60,000 psi. The water knife 44 has a relatively low flow rate of about one tenth of a gallon per minute. Water knives for cutting paper webs are well known. In the past, however, the typical application of water knives has not cut the web against the winder roll. Instead the web has been cut either against a rewinder support roll or during the open draw between the support roll and the winder roll. The typical application of water knives in a turnup device has usually resulted in the cut web being unsupported during part of its travel on the way to a new spool. In prior art devices the water knives have been directed normal to the surface of the web being cut. If the web is cut against a roll surface the water from the knife will wet both the paper forming the finished reel as well as the tail which is formed for threading the web onto a spool. Wetting the end of the completed reel is not a problem because only a small amount of paper is damaged by the water. However water on the tail can affect the integrity of the reel formed.

The uniform structural integrity of the formed paper reel is critical to avoiding defects in the paper wound into the reel. Recent studies of the causes of paper breaks in printing presses and rewinders has shown that as much as 80 percent of paper breaks are caused by paper which was originally wound closest to the spool on which the reel was formed. The paper which is first wound onto the spool is most susceptible to damage from an improperly formed roll.

The two water jets or water knives **44**, **46** of the apparatus **20** are angled 10 to 30 degrees away from the paper web tail being formed. The angling of the water knives **46**, **44** is in the cross machine direction towards the edges **58** of the paper web so that the water from the water knives will spray onto the paper that is being wound into the forming reel not onto the tail **52**, **54**, **56** that is the start of a new reel. The water knives also can be angled in the down machine direction or a combination of the down machine direction and towards the edges of the paper web.

There are several configurations of the apparatus of this invention. The apparatus shown in FIG. 1 applies an adhesive tape to the web against a support roll **98** ahead of the water knives. The apparatus of FIG. 2 applies the adhesive tape to the rotating surface **106** of the spool, such that the tape adheres to the tail which is applied thereover. The apparatus of FIG. 3 applies the adhesive tape to the stationary spool **28** prior to its moving into engagement with the winder roll. The apparatus of FIG. 4 applies the adhesive tape to the web as it travels over the winder roll between the water knives and the spool.

The water jets from the water knives will erode the surface **42** of the winder roll **36** if they are not kept in motion with respect to the surface **42**. A single water knife **44** is shown in FIG. 5. The knife **44** is mounted on a lateral transport means such as a pneumatic piston **60** for motion in the cross-machine direction. High pressure cables or hoses can be contained in a flexible cable tray **62**. Because of the rigidity of the high pressure water supply line **64** a cable tray may not be required in all circumstances.

Because the paper web **26** is advanced beneath the water knives **44**, **46**, if the water knives are held stationary they will cut a straight line **66** as shown in FIGS. 6-8. The combination of the web movement and the

substantially linear movement of the water knives in the cross machine direction causes the water knives to make diagonal curved cuts **68** across the web **26** as shown in FIGS. 6-8. The pneumatic drive **60** can move the water knife **44** at about 400 inches per second. Two knives moved from the center can thus cut the web in about a quarter of a second for a 200 inch wide web or one half second for a 400-inch web.

As shown in FIG. 1, the water knives **44** and **46** are spaced apart in the machine direction so they do not interfere with each others motion. As shown in FIG. 6, a somewhat triangular shaped leading edge tail **72** is formed when the water knives, which start out parallel, cross.

As shown in FIG. 7, the water knives **44**, **46** may begin on a common machine direction line **76** and then diverge such that a somewhat triangular shaped tail **78** is formed.

As shown in FIG. 8, water knives **44**, **46** may begin spaced apart and never cross to thereby form a thin rectangular tail **82** joined to a larger somewhat triangular shaped tail **84**. While the diagonal curved cuts **68** shown in figures 6-8 are created as a result of the combination of the web movement and the substantially linear movement of the water knives in the cross machine direction, it should be understood that various other cuts can be created by moving the water knives in a nonlinear, e.g., curved, manner, in the cross machine direction. Nevertheless, while the water knives can be used to make other cuts, the cuts illustrated in figures 6-8 are probably the most practical.

Once the web **26** has been severed from the completed reel, the turn-up apparatus **20** must direct the severed web onto a new spool **28** to begin a new reel. In the past this has been accomplished by directing the tail onto the spool **28** with a gooseneck and an air jet. In some cases the spool has been

precoated with an adhesive material. Precoating the spools **28** with adhesive can result in difficulties in handling and shipping the spools. On the other hand, failure of the web to be positively held on the spool **28** can result in a loose web at the start of reel, which leads to a structurally weak reel with resultant defects in the wound web. The turn-up apparatus **20** employs the tape dispenser **22** which dispenses double-sided adhesive tape **24**.

Tape dispensers have typically been developed by adhesive tape suppliers for use in specialty applications such as assembling cardboard boxes, for example see U.S. Patents Nos. 4,255,218 and 5,312,501 which are assigned to Minnesota Mining and Manufacturing Company ("3M") of St. Paul, Minnesota.

A tape dispenser **22** useful for the present invention feeds a quantity of two-sided adhesive tape onto a vacuum wheel **23**, as shown in FIG. 2. The tape as wound on the tape reel **25** has a release liner **27** illustrated in FIG. 9. The release liner **27** prevents the tape from sticking to itself when wound in the tape reel. The tape **29** is dispensed onto the vacuum wheel **23** so that the release liner is held against the perforated surface **31** of the vacuum wheel **23**. The tape dispenser **22** cuts off a piece of tape which covers substantially **360** degrees of the surface **31** of the vacuum wheel **23**. The tape dispenser **22** then uses a servomotor (not shown) to bring the tape on the vacuum wheel **23** up to a selected speed. Where the tape is to be applied to a spool **28** the vacuum application wheel is driven so its surface speed is the same as the surface speed of the spinning spool **28**. The surface speed of the spool will be substantially the same as the speed of formation of the web **26**.

Application of the double-sided tape to the spool **28** is shown in FIG. 9. The applicator apparatus **89** is an improvement to the general design for a tape dispenser as shown in FIG. 2. The applicator apparatus **89** simplifies the

means by which the vacuum wheel **23** is driven so as to have a surface velocity identical to the surface velocity of the spool **28**.

A traction wheel **33** with a traction surface **31** is placed in frictional engagement with the spool **28** and is driven by the spool so that the surface **35** of the traction wheel **33** has the same direction and velocity as the spool. The traction wheel **33** drives the vacuum wheel **23** through a mechanical drive **37** which is configured to cause the surface **31** of the vacuum wheel **23** to match the velocity and direction of the surface of the spool **28**. The mechanical drive **37** is also configured to allow the vacuum wheel **23** to rotate into and out of engagement with the spool. Thus, to apply adhesive tape to the spool **28** a quantity of tape is loaded onto the vacuum wheel **23**, and positioned so the release liner is held by the vacuum which is drawn through the surface of the vacuum wheel **23**.

Once a length of tape is dispensed to the vacuum wheel **23** with the adhesive side facing up, the tape dispenser **89** is rotated down so the traction wheel **33** engages the spool surface and is thereby driven to match speeds with the spool surface. The traction wheel **33**, through the mechanical drive **37**, brings the tape of the vacuum wheel **23** up to the velocity of the spool **28**. The mechanical drive **37** is shown as three gears: a first gear **39** is axially mounted to the drive wheel **33**, a second gear **41** is mounted axially to the vacuum wheel **23**, and a transfer gear **45** transmits the rotation velocity of the drive wheel **33** to the vacuum wheel **23**. The gears **39**, **41**, **45** are chosen so that the surface velocity of the drive wheel **33** and the vacuum wheel **23** are the same. Other drive mechanisms could be used including two pulleys mounted on the vacuum wheel and the drive wheel with a belt connecting them; two sprockets connected by a chain; or a more complicated gear drive.

Preferably an angular sensor will be mounted on the vacuum wheel **23** so that the leading edge **47** of the tape **29** can engage the spool first. A pneumatic cylinder or similar hydraulic or mechanical actuator moves a lever arm **49** which brings the vacuum wheel **23** into engagement with the spool **28**. The pneumatic cylinder (not shown) is actuated so that the leading edge **47** of the tape engages the spool first and the vacuum wheel **23** is only engaged with the spool **28** during a single revolution of the vacuum wheel **23**. The force of the vacuum on the release liner is greater than the peel strength of the tape on the release liner, hence when the vacuum wheel **23** engages the web or the spool **28** the tape **29** is peeled off the release liner, and the release liner remains on the vacuum wheel. The tape as applied to the web thus presents an adhesive surface exposed to the fresh spool. The tape **29** is applied so that when the web **26** is cut by the water knives **44**, **46** it is picked up and wrapped around the spool **28**.

FIGS. 6-8 show the placement of a strip of tape **100** and its position on the paper web tails **52**, **54**, **56**. The tape **24** is applied in the machine direction and one or more tape dispensers **22** may be used. If multiple tape dispensers are employed they will be spaced across the web in the cross machine direction.

As shown in FIG. 5, the frame **48** and the pneumatic piston **60**, in addition to supporting and moving the water knife nozzles **50**, also support and move the adhesive dispensing nozzles **102** which are spaced from the water knife nozzles **50** in the up machine direction. The adhesive dispensed from the nozzles **102** forms adhesive regions **104** on the paper tails **52**, **54**, **56**, as shown in FIGS. 6-8, respectively. When the adhesive regions **104** make contact with the spool **28** they bind the web **26** to the spool **28**--assuring a uniform tight start on the reel **32** which results in a reel of structural uniformity with low defects. The adhesive regions **104** can be used independently from

the strip of tape **100** or in conjunction with the strip of tape **100**. Furthermore, the adhesive regions **104** can be used in place of the strip of tape **100**.

The adhesive must be fast acting in order to function in the extremely short time between the moment when the adhesive is applied and when it passes through the nip **40** between the winder roll surface **42** and the spool **28**. Contact adhesives or two part adhesives could be used but hot melt adhesives are preferred. The rapid quenching of the hot melt adhesive as it enters the nip and is spread out results in the needed rapid bond between the tails **52**, **54**, **56** and the spool **28**. An exemplary adhesive applicator machine is a Series 3100 applicator supplied by Nordson Corporation, 28610 Clemens Road, Westlake, Ohio 44145, which can be used with H201 modular hot melt guns. In one test, high-tack glue obtained from Findley Adhesives of Wauwatosa, Wisconsin, part #H2187-01 was applied from centrally positioned nozzles for one-half second just prior to traversing the water-jets towards the sheet edges. Another glue which was tested and is available from Findley Adhesives is part #H1231. For the relatively narrow test web a single centrally located application of glue was effective. For production papermaking machines where the width of the paper may be 400 inches, it may be necessary to continuously apply hot melt glue behind the water knives as they move toward the edges of the web.

As shown in FIG. 1, the tape **24** is applied against a support roll **98** in front of the winder roll **36**. FIG. 2 shows the tape dispenser **22** positioned about a reel spool **28** for applying double sided adhesive tape **24** to the spool surface **106**. Thus when the web tail **52**, **54**, **56** passes beneath the spool **28** it becomes adhesively bound to the spool **28**. As shown in FIG. 1, the tape dispenser **22** is only required at the start of a new reel, and may be retracted after it has applied tape to the spool **28** thus avoiding any mechanical

interference between the tape dispenser **22** and the mechanism controlling the formation of the reel **32**.

Timing of the application of the double sided adhesive tape **24** is critical in the turn-up apparatus **20** of FIG. 1, the turn-up apparatus **120** of FIG. 2 and the turn-up apparatus **320** of FIG. 4. The tape **24** as shown in FIG. 1 must be applied so that it is positioned on the tail of the web **26** as illustrated in FIGS. 6-8. The tape **24** as applied to the spool **28** in FIG. 2 must be timed so that the tape **24** is applied to the spool surface **106** so that it comes in contact with the tail **52, 54, 56** and not the uncut web **26**.

The tape **24** as shown in FIGS. 1 and 2 must be applied at a machine speed typically in the range of 2,000 to 6,000 feet per minute. The alternative embodiment turn-up apparatus **220** shown in FIG. 3 applies the double sided adhesive tape to the spool **28** before the spool is brought into contact with the winder roll **36**. In the turn-up apparatus **220** timing of the application of the tape is not critical and the tape can be applied before the spool **28** is spun up to the velocity of the paper web **26**. Motion of the spool **28** into contact with the web **26** on the winder roll **36** controls when the adhesive tape **24** makes contact with the tails shown in FIGS. 6-8.

The tape **24** can also be applied on an alternative embodiment turn-up apparatus **320**, shown in FIG. 4. In the apparatus **320**, the tape is applied where the web passes over the winder roll **336**. The tape applicator **22** positions a tape wheel **396** between the spool **338** and the water knives **44, 46**. The turn-up apparatus **320** positions the tape applicator **22** directly ahead of the spool **338**.

It should be understood that tape dispensers or applicators of various design and manufactured by various companies could be used, and that a

readily available source of tape applicators are those used in the fabrication of cardboard boxes.

It should also be understood that the double sided adhesive tape can be used together with a spray adhesive applicator or by itself.

It should be understood that the turn-up apparatus **20** when employed with multiple tape applicators can be used to facilitate the formation of multiple splits so that a single web **26** may be wound into a multiplicity of reels for removal from the papermaking machine.

It is understood that the invention is not limited to the particular construction and arrangement of parts herein illustrated and described, but embraces such modified forms thereof as come within the scope of the following claims.

We claim:

1. A reel turn-up apparatus for severing a web of paper and starting a new reel from a tail formed by severing the web, the apparatus comprising:
 - a water knife mounted for motion in a cross machine direction;
 - a winder roll positioned beneath the water knife and supporting the paper web, wherein the water knife is movable to cut the web to define a tail;
 - a spool positioned over the winder roll and engaged with the winder roll to rotate in a direction opposite the direction of rotation of the winder roll, wherein the tail extends between the winder roll and the spool and onto the spool; and
 - a means for applying an adhesive to the web tail for causing the web to adhesively attach to the spool, wherein there is no open draw of the web between the water knife and the spool.
2. The apparatus of claim 1 wherein there are two water knives mounted for motion in opposite cross machine directions.
3. The apparatus of claim 1 wherein the means for applying an adhesive to the web comprises a tape applicator.
4. The apparatus of claim 3 wherein the tape applicator is positioned between the water knife and the spool in the machine direction to apply double sided adhesive tape to the web after it has been cut by the water knife.
5. The apparatus of claim 3 further comprising a support roll positioned upmachine from the winder roll and spaced from the winder roll,

wherein the tape applicator is positioned over the support roll and applies double sided adhesive tape to the web before it is cut by the water knife.

6. The apparatus of claim 1 wherein the means for applying an adhesive to the web is a nozzle for applying adhesive, and wherein the nozzle is mounted upstream in the machine direction from the water knife.

7. The apparatus of claim 6 wherein the nozzle for applying adhesive is mounted to the water knife and moves with the knife.

8. The apparatus of claim 1 wherein there are two water knives and wherein the water knives are angled in the downmachine direction to avoid wetting the portion of the web forming a tail for starting a new reel.

9. The apparatus of claim 1 wherein there are two water knives and wherein the water knives are angled in the cross machine direction towards a portion of the web being cut off to avoid wetting the portion of the web forming a tail starting a new reel.

10. A method of separating a paper web from a reel being formed on a winder and initiating a new reel, the method comprising the steps of:

drawing a web of paper over a winder roll;

engaging the winder roll with a spool;

applying a quantity of adhesive double sided tape to the web of paper extending in the machine direction; and

moving at least one water knife in the cross machine direction to direct a stream of water against the winder roll to cut the web to form a tail before the adhesive tape reaches the position of the water knife; and

wrapping the formed tail around the spool to start a new reel of paper and engaging the applied tape with the spool.

11. The method of claim 10 wherein the step of cutting the web comprises directing the stream of water from the at least one water knife against the winder roll at an angle with respect to the roll surface, the stream of water being thereby directed toward a portion of the web which is being cut off so the formed tail is not wetted.

12. The method of claim 10 further comprising the step of winding a reel of paper onto the spool.

13. The method of claim 10 wherein two water knives are mounted for motion in the cross machine direction and wherein the knives start from a position at about a middle portion of the paper web and move in opposite directions in the cross machine direction towards the edges of the web thus substantially severing the web in the cross machine direction.

14. The method of claim 13 wherein the water knives are moved at a speed towards the edges of the web approximately equal to the machine speed of the paper web.

15. A method of accumulating a quantity of paper on a spool and removing it from a papermaking machine on a continuous basis, the method comprising the steps of:

directing a web of paper being formed on the papermaking machine over a winder roll;

applying an adhesive means onto the web;

cutting the paper web in the cross machine direction in a position downstream in the machine direction from the applied adhesive

means to form a tail, wherein the cutting is performed by at least one water knife directing a stream of water against the winder roll;

wrapping the tail around a spool positioned over the winder roll so the adhesive means on the web attaches the web to the spool; and

winding a reel of paper onto the spool.

16. The method of claim 15 wherein the step of applying the adhesive means includes spraying adhesive onto the paper web before the web reaches the at least one water knife.

17. The method of claim 15 wherein the step of applying the adhesive means comprises applying double sided adhesive tape to the paper web before the web reaches the water knife.

18. The method of claim 15 wherein the water knife is angled with respect to the surface of the winder roll to direct the stream of water towards a portion of the web being severed and away from the tail being formed.

19. A method of accumulating a quantity of paper on a spool and removing it from a papermaking machine on a continuous basis, the method comprising the steps of:

directing a web of paper being formed on the papermaking machine over a winder roll;

positioning a spool over the winder roll; applying double sided adhesive tape from a tape dispenser onto the spool;

cutting the paper web in the cross machine direction in a position upstream in the machine direction from the spool to form a tail, wherein the cutting is performed by at least one water knife directing a stream of water against the winder roll;

wrapping the tail around the spool positioned over the winder roll so the tape on the spool attaches the web to the spool; and winding a reel of paper onto the spool.

20. The method of claim 19 wherein the water knife is angled with respect to the surface of the winder roll to direct the stream of water towards a portion of the web being severed and away from the tail being formed.

21. The method of claim 19 wherein two water knives are mounted for motion in the cross machine direction and wherein the knives start from a position at about a middle portion of the paper web and are moved in opposite directions in the cross machine direction towards the edges of the web thus substantially severing the web in the cross machine direction.

22. The method of claim 21 wherein the water knives are moved at a speed towards the edges of the web approximately equal to the machine speed of the paper web.

23. A reel turn-up apparatus for severing a web of paper and starting a new reel from a tail formed by severing the web, the apparatus comprising:
a water knife mounted for motion in a cross machine direction;
a winder roll positioned beneath the water knife and supporting the paper web;
a spool positioned over the winder roll and having a surface engaged against the winder roll so the spool rotates in engagement with the winder roll; and
a means for applying an adhesive to the spool, wherein there is no open draw of the web between the water knife and the spool.

24. The apparatus of claim 23 wherein there are two water knives mounted for motion in opposite cross machine directions.

25. The apparatus of claim 23 wherein the means for applying an adhesive to the spool is a tape applicator.

26. The apparatus of claim 25 wherein the tape applicator comprises:
a traction wheel engageable with the spool;
a tape holding wheel which holds a quantity of double sided adhesive tape; and
a mechanical linkage between the traction wheel and the tape holding wheel, wherein the tape holding wheel is driven by the traction wheel through the mechanical linkage to move the quantity of tape at the same velocity as the surface of the spool, and wherein the tape holding wheel is rotatable into and out of engagement with the spool surface to thereby apply the quantity of tape.

27. A reel turn-up apparatus for severing a web of paper and starting a new reel from a tail formed by severing the web, the apparatus comprising:
a water knife mounted for motion in a cross machine direction;
a winder roll positioned beneath the water knife and supporting the paper web;
a spool positioned over the winder roll and having a surface engaged with the winder roll so the spool rotates in engagement with the winder roll; and,
a tape applicator for applying a quantity of tape having adhesive on both sides to the spool surface, wherein the tape applicator has a traction wheel engageable with the spool, a tape holding wheel which holds a quantity of double sided adhesive tape, and a mechanical linkage between the traction wheel and the tape holding wheel, wherein the tape holding wheel is driven by the

traction wheel through the mechanical linkage to move the quantity of tape at the same velocity as the surface of the spool, and wherein the tape holding wheel is rotatable into and out of engagement with the spool surface to thereby apply the quantity of tape.

28. A reel turn-up apparatus for severing a web of paper and starting a new reel from a tail formed by severing the web, the apparatus comprising:
a knife mounted for motion in a cross machine direction for severing the paper web;
a winder roll positioned to receive and support the paper web;
a spool positioned over the winder roll and engaged with the winder roll to rotate in a direction opposite that of the winder roll; and
an adhesive applicator positioned over the winder roll and in front of the spool the applicator positioned to apply adhesive to the web for causing the web to adhesively attach to the spool.

29. The apparatus of claim 28 wherein there are two water knives mounted for motion in opposite cross machine directions over the winder roll upstream of the spool and downstream of the adhesive applicator.

30. The apparatus of claim 29 wherein the water knives are angled in the downmachine direction to avoid wetting the portion of the web forming a tail for starting a new reel.

31. The apparatus of claim 29 wherein the water knives are angled in the cross machine direction to avoid wetting the portion of the web forming a tail for starting a new reel.

32. The apparatus of claim 28 wherein the adhesive applicator is a hot melt glue gun.

33. The apparatus of claim 28 wherein the adhesive applicator is a nozzle for spraying adhesive, and the nozzle is mounted upstream in the machine direction from the knives.

34. The apparatus of claim 33 wherein the nozzle for spraying adhesive is mounted to the knife and moves with the knife.

35. A method of separating a paper web from a reel being formed on a winder and initiating a new reel comprising the steps of:
drawing a web of paper over a winder roll;
engaging the winder roll with a spool;
applying a quantity of hot melt adhesive to the web of paper in the upstream machine direction from the spool; and
cutting the web to form a tail with at least one water knife mounted for motion in a cross machine direction, the water knife directing a stream of water against the winder roll to form a tail before the adhesive reaches the position of the water knives; and
passing the web and the quantity of hot melt glue through a nip formed between the spool and the winder roll, the quantity of hot melt glue binding the web to the spool and wrapping the formed tail around the spool to start a new reel of paper.

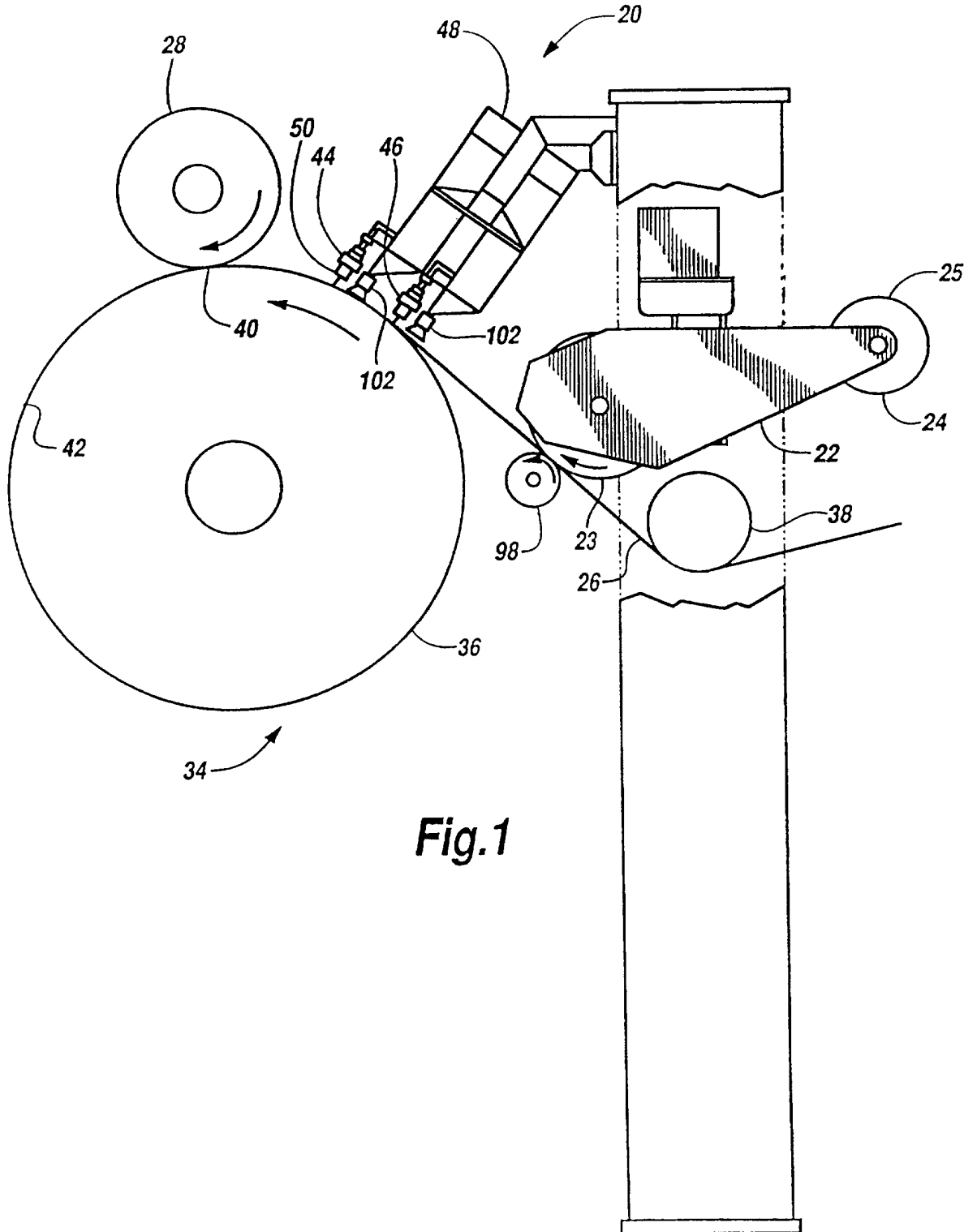


Fig.1

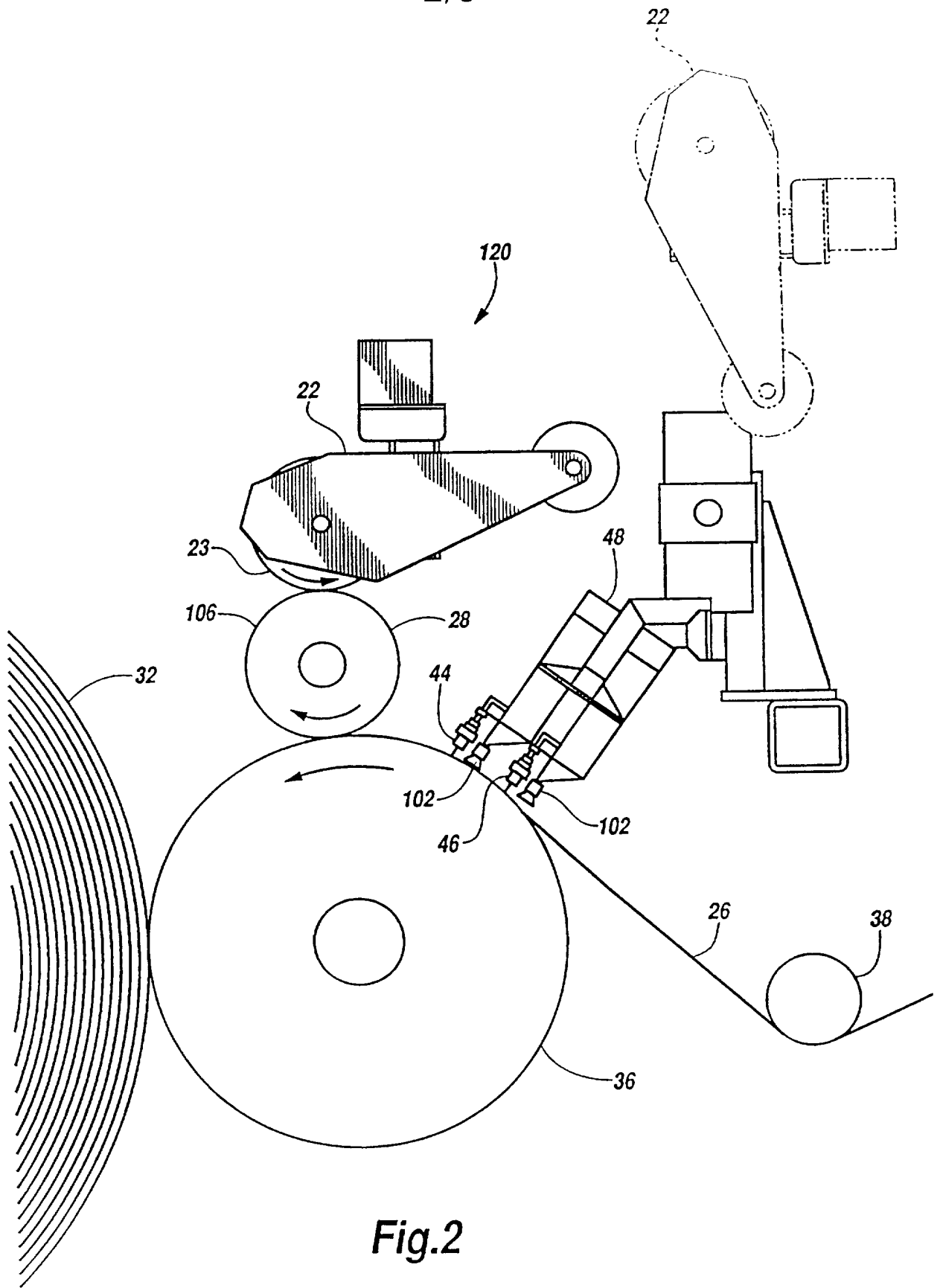


Fig.2

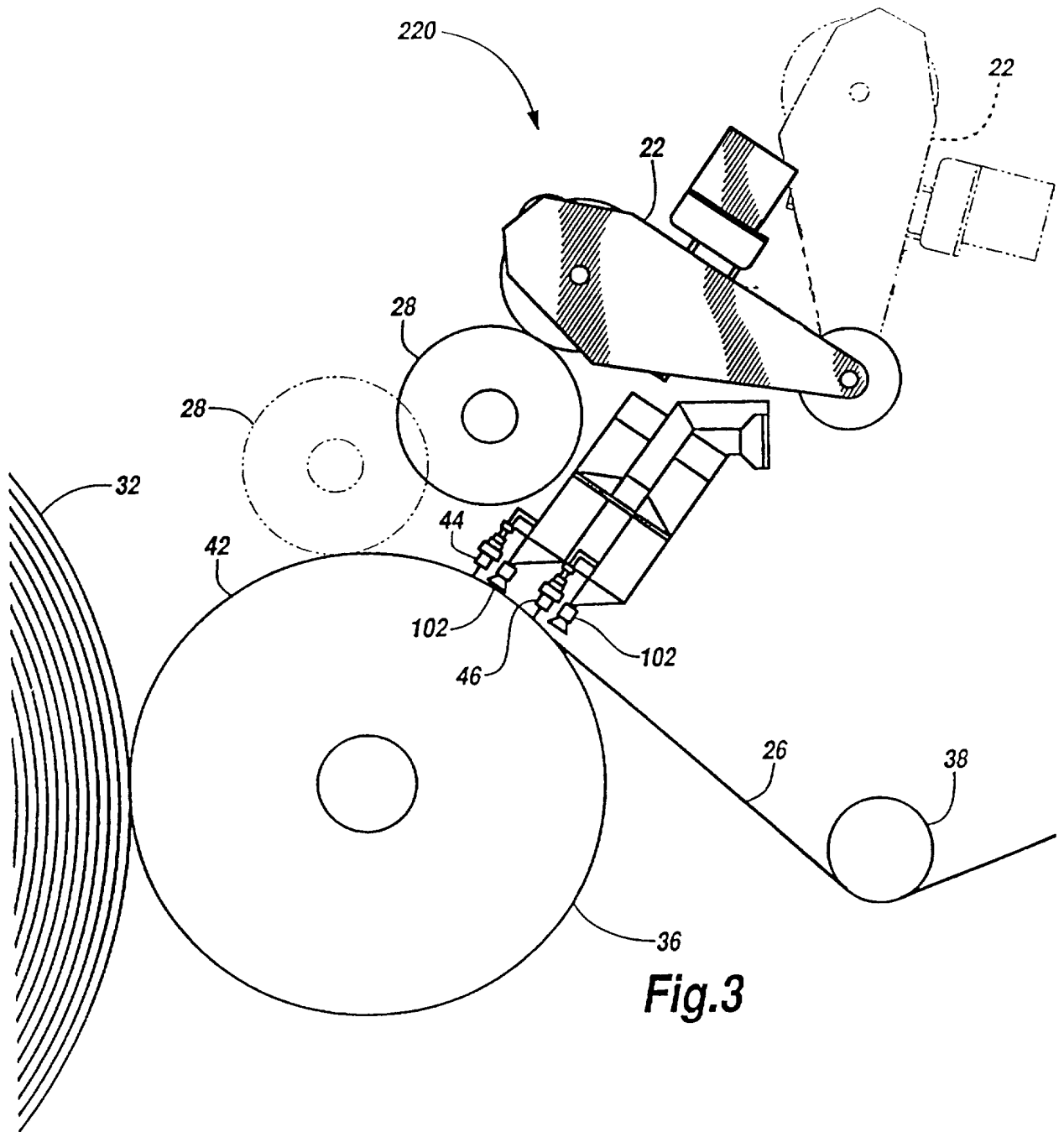


Fig.3

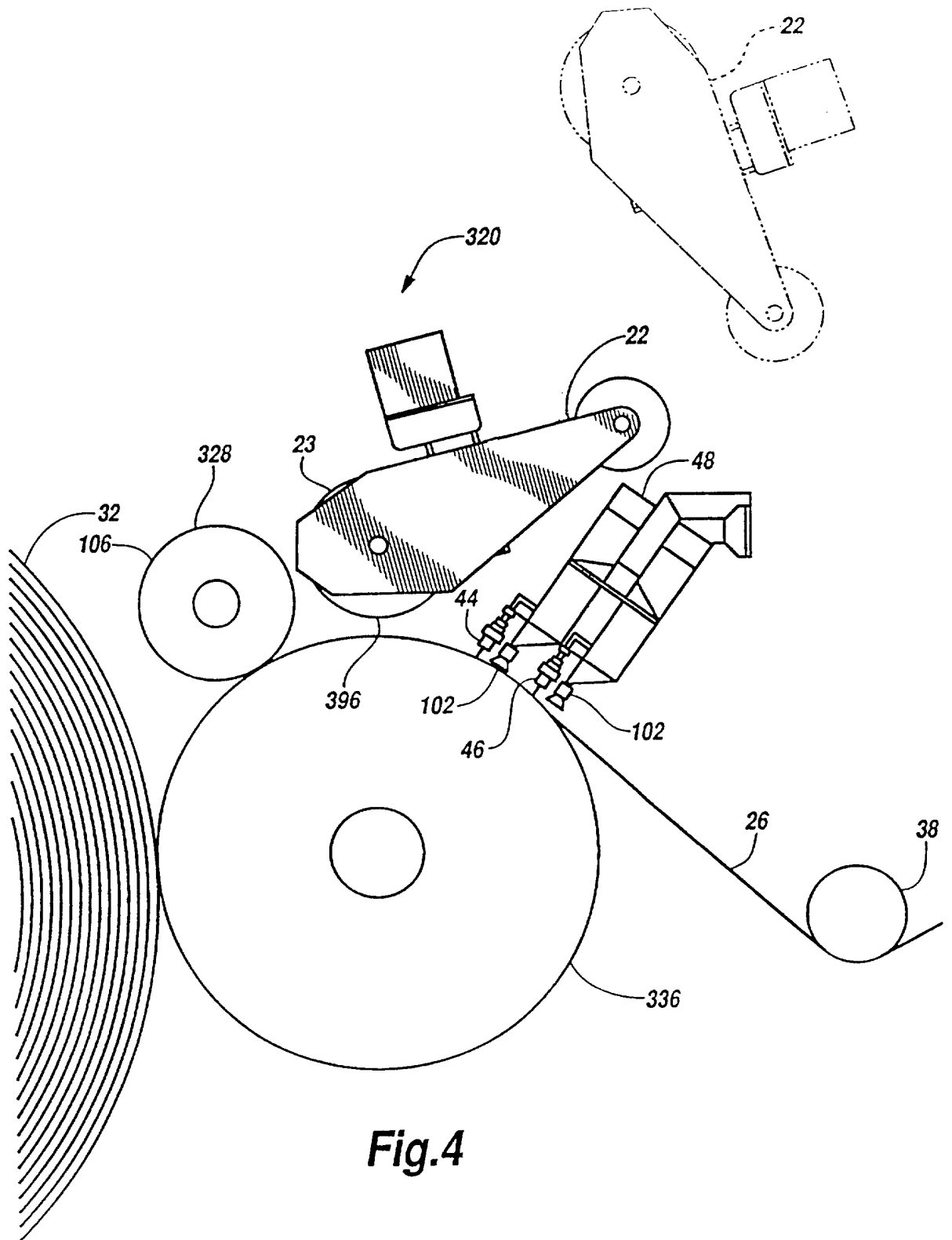


Fig.4

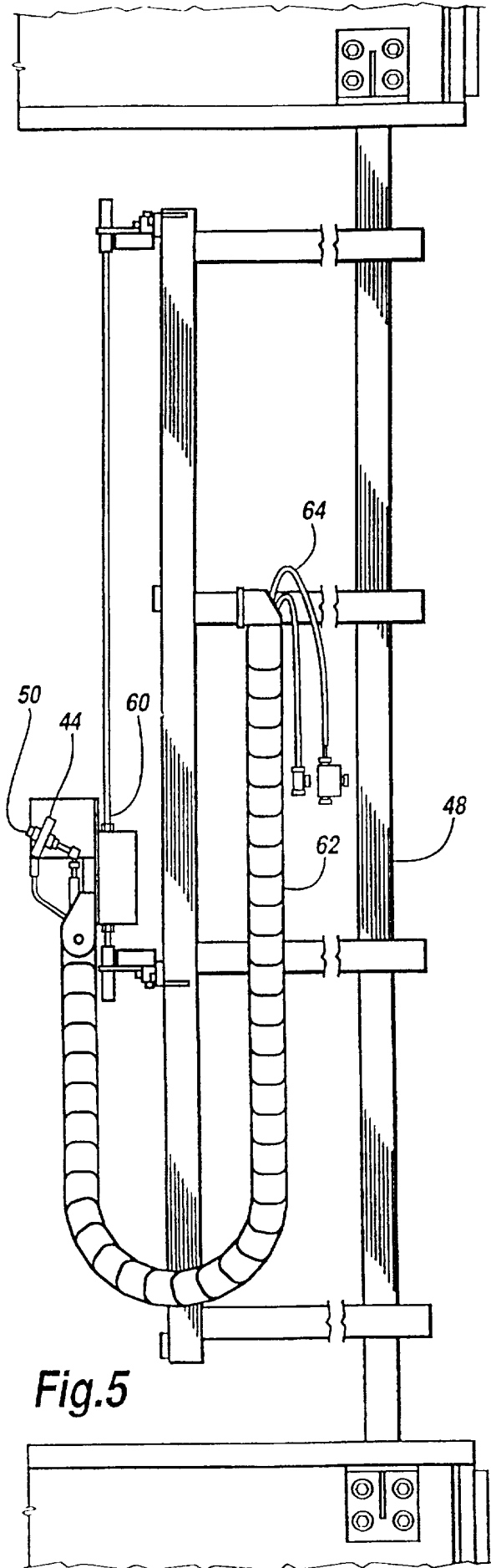


Fig.5

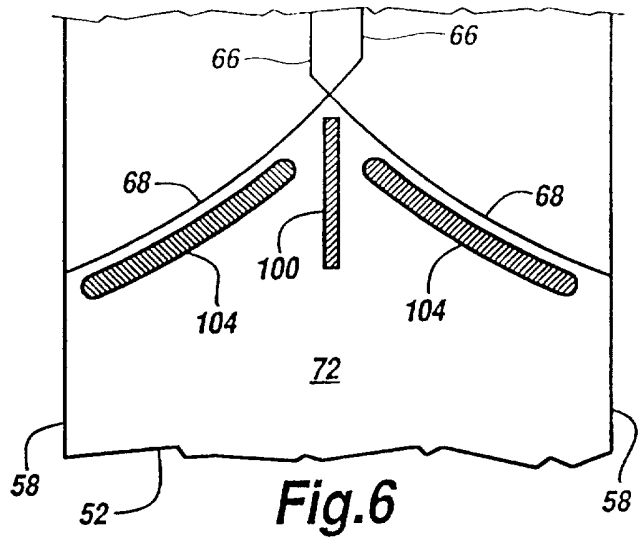


Fig.6

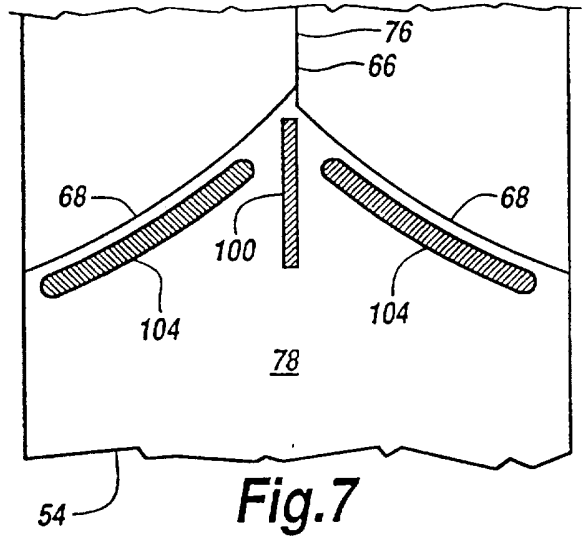


Fig.7

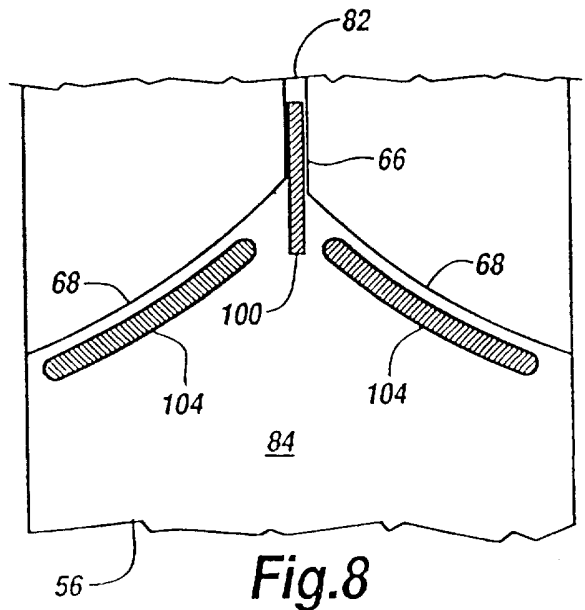


Fig.8

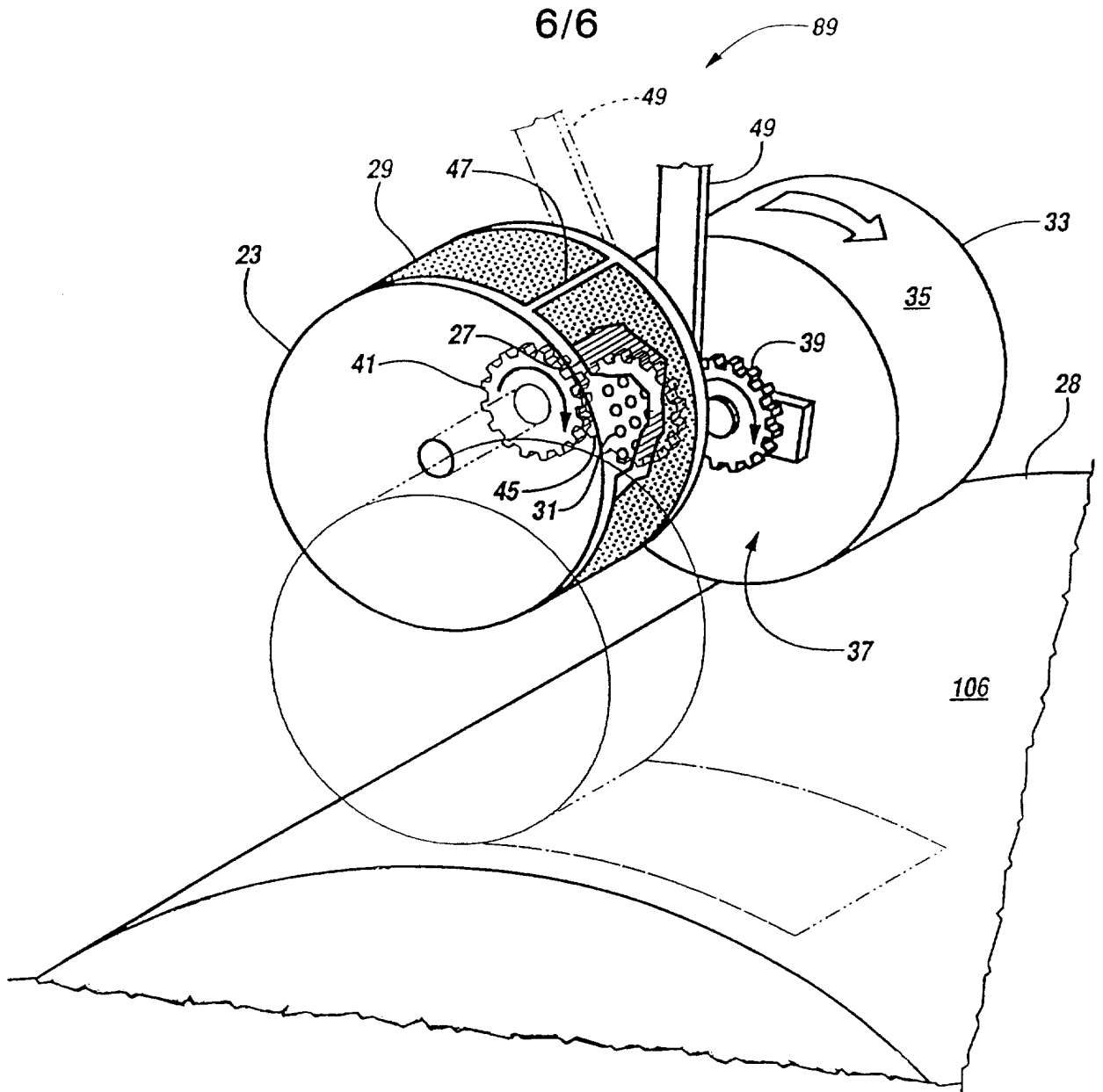


Fig.9

INTERNATIONAL SEARCH REPORT

In tional Application No
PCT/US 97/07615

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B65H19/26 B65H19/28 B26F3/00

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

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B65H B26F

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 314 132 A (ANDO ET EL) 24 May 1994 see column 2, line 5 - column 3, line 2 see column 4, last paragraph see column 6, line 30 - line 53; figures 1,2,6,12	28 1-4
Y	---	
	PATENT ABSTRACTS OF JAPAN vol. 010, no. 040 (M-454), 18 February 1986 & JP 60 191947 A (MITSUI TOATSU KAGAKU KK), 30 September 1985, see abstract	1-4
A	---	
	US 5 014 924 A (NOWISCH ET AL) 14 May 1991 see the whole document	1,2,8, 10,15, 19,23, 27,28,35

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Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

<p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p>	<p>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>*&* document member of the same patent family</p>
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Date of the actual completion of the international search 18 August 1997	Date of mailing of the international search report 25.08.97
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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Authorized officer Raven, P
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/07615

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 695 004 A (GROSSMANN ET AL) 22 September 1987 see the whole document ---	1,2,10, 15,19, 23,27, 28,35
A	EP 0 543 788 A (VALMET PAPER MACHINERY INC) 26 May 1993 cited in the application see the whole document ---	1,2,10, 15,19, 23,27, 28,35
A	WO 92 06913 A (BELOIT CORPORATION) 30 April 1992 see the whole document ---	1,2,10, 15,19, 23,27, 28,35
P,A	EP 0 765 832 A (VALMET CORPORATION) 2 April 1997 see the whole document -----	1,10,15, 19,23, 27,28,35

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 97/07615

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5314132 A	24-05-94	JP 5186109 A JP 5147786 A JP 5147788 A DE 4208746 A FI 921117 A	27-07-93 15-06-93 15-06-93 27-05-93 27-05-93
US 5014924 A	14-05-91	NONE	
US 4695004 A	22-09-87	DE 3515519 A	30-10-86
EP 543788 A	26-05-93	FI 915432 A CA 2083119 A US 5360179 A	19-05-93 19-05-93 01-11-94
WO 9206913 A	30-04-92	NONE	
EP 765832 A	02-04-97	FI 954631 A CA 2186811 A	30-03-97 30-03-97