SLITTING MECHANISM FOR WINDER

Inventor: Edgar J. Justus, Beloit, Wis.
Assignee: Beloit Corporation, Beloit, Wis.

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ABSTRACT

A method and mechanism for slitting and winding a traveling web such as paper into a plurality of adjacent rolls including a web supply and a slitter for cutting the traveling web including a pair of high velocity jets closely laterally spaced in substantial kissing contact with the web directing a high velocity water jet through the web to remove a narrow kerf therefrom and separate adjacent strips of the web and winding the adjacent strips and collecting the water jets and kerf removed from the web for reconstituting the kerf strip such as by pulping for a paper making machine.

16 Claims, 8 Drawing Figures
SLITTING MECHANISM FOR WINDER

BACKGROUND OF THE INVENTION

The invention relates to improvements in slitter winders and more particularly to a method and mechanism which may be used for slitting a broad width traveling paper web into a plurality of narrower strips removing a small kerf strip at each location where the web is slit so that the web strips are slightly separated to be able to wind into noninterfering adjacent rolls.

It will be appreciated from the teaching of the principles of the invention in connection with the disclosure that the features can be employed in the cutting of various types of material, but that the invention is particularly advantageous for use in slitter winders for paper making machinery wherein a broad wide web of paper is slit and wound into a plurality of adjacent rolls. In such slitter winders, it has been conventional to cut the width of the web by slitting knives usually are very sharp rotating disk knives that are positioned at predetermined locations across the width of the web to slit it into a plurality of strips. These strips are then wound simultaneously into a plurality of rolls which are formed on a common axis. To be able to operate at high speed, it is necessary to laterally separate the slit strips so that their edges will not interfere. Without such separation, the edges will bend up and the strips may shift an infinitely small amount laterally to interleave as they are being rolled onto their individual rolls and damage the web and form rolls of unequal thickness. This condition is aggravated by the fact that the rolls become very heavy as they enlarge in size causing their axis to bend down and the rolls to tilt slightly to increase the problem of interference between the rotating adjacent rolls. It has thus been necessary to provide spreaders which separate the adjacent sheets and amount so that this interference will be prevented.

Such spreaders will take the form of curved rotating rolls or curved stationary spreaders, an example of which is shown in U.S. Pat. No. 3,463,377, Lucas.

As the width of the paper webs becomes larger and larger with paper machines commonly having a width of over 30 feet, the problem of supporting the spreader bars and rolls becomes greater. There are also limitations in that a great amount of flexibility is not obtainable such as when the strips are to be slit in different widths, or as when it would be desirable to have the spreading effect be different across the width of the paper web. Also, it is not always desirable to have a rolling or rubbing surface in contact with the traveling web, and at high rates of speed, air currents have an effect on the stability of travel of the strips that are formed and also upon the slitting operation, and air currents will tend to have the strips make unstable contact with the roll or stationary surfaces which engage the strips for separating them. Additional problems are encountered in that paper dust or shavings are frequently formed from the slitters, and these pass through the machine to be incorporated in the rolls with the web. The knife slitters present additional problems in that they must be maintained fully sharpened and accurately positioned, and with wear or shifting, can turn up an edge on the paper as they slit it. It is difficult to obtain knife slitters which will act uniformly on paper webs of different width. Also, as the speed of travel of the web increases, the knives wear at increasing rates, and with rotating knives, speed limitations are encountered. Shut-down periods for replacement and sharpening of the knives are inconvenient and costly.

It is accordingly an object of the present invention to provide a method and mechanism for slitting a traveling paper web and removing a narrow kerf strip from the web to provide a separation between adjacent strips which is improved in operation and reliability over structures heretofore available and which provides more uniform edges on the adjacent web strips.

A further object of the invention is to provide an improved slitter winder which cuts a web into a plurality of strips, but does not require the use of rotating or stationary knives and which does not require the presence of separators or spreaders in engagement with the traveling paper web.

A still further object of the invention is to provide a slitter winder which eliminates the presence of dust and shreds from the traveling web and which is capable of completely satisfactory operation at a wide range of web travel speeds and with a wide variation of types and thicknesses of web material.

A still further object of the invention is to provide a slitter mechanism which is quickly and easily adjustable in being able to change the width of separation between adjacent strips either during operation or while the machine is at rest, and which has the dexterity of being able to readily accommodate slitting strips of different widths and is capable of forming separations of different widths between strips at different locations across the web.

Other objects, advantages and features, as well as equivalent structures and methods which are intended to be covered hereby, will become more apparent with the disclosure of the principles of the present invention in connection with the description of the preferred embodiments which are given in the following specification, claims and drawings, in which:

DRAWINGS

FIG. 1 is a side elevational view shown in somewhat schematic form of a slitter winder embodying the principles of the present invention;

FIG. 2 is an enlarged schematic more detailed elevational view of the slitter mechanism;

FIG. 3 is a vertical sectional view taken substantially along line III—III of FIG. 2;

FIG. 4 is a vertical sectional view taken substantially along line IV—IV of FIG. 3;

FIG. 5 is a side elevational view with parts broken away of an unwinder winder mechanism constructed and operating in accordance with the principles of the present invention;

FIG. 6 is a fragmentary somewhat schematic side elevational view showing a modification in enlarged detail of the structure of FIG. 5;

FIG. 7 is a fragmentary enlarged detailed view of the slitter mechanism in one form; and

FIG. 8 is a schematic plan view showing a form of the prior art.

DESCRIPTION

As illustrated in FIG. 1, a wide width of paper web W is supplied off an unwinding roll 10. The web passes under a guide roll 11 and passes through a slitting zone 12 to a winder. The winder is illustrated as being a two drum winder wherein a wind-up roll 14 is supported on winder drums 13 and 15. The wind-up roll 14 actually
comprises a plurality of side by side separate rolls such as illustrated in FIG. 3 at 38, 39 and 40 with the separate rolls being wound on a common axis 41 from the separately supplied strips 36, 26 and 27. The strips are separated by gaps formed from cutting out narrow portions which may be referred to as kerf strips. The present mechanism eliminates the need for spreader bars or spreader rolls and, therefore, the width of the kerf or kerf strip will determine the separation between the adjacent strips to be wound up.

Positioned in the slitting zone 12, are a plurality of slitter heads such as illustrated at 16 and 31 in FIG. 3. Each slitter head preferably has a first and second high velocity jet shown at 22 and 23 in FIG. 4. From these jets are emitted a high velocity working fluid which is directed normal to the web surface to cleanly cut through the web. The jets 22 and 23 are spaced apart laterally of the direction of web travel a distance to determine the width of the kerf strip. It is contemplated that in some circumstances, a single jet can be used for cutting so that the adjacent strips on each side of the slit will be separated by an amount equal to the width of the portion removed, but preferably two separate jets are employed to be able to remove a kerf strip of an adequate and controllable width.

The working fluid emitted from the jet is preferably water, and the kerf strip and working fluid will be received by a saveall 17, FIG. 1. The material received by the saveall will be carried away by a conduit 18, and in the case of paper web, this material will be constituted by being led back to a pulper to be mixed with the stock to be fed to a paper making machine. While in the illustration the web is shown as supplied from a pre-wound wide roll 10, in certain circumstances, the slitting can be an on-machine operation in a paper making machine so that the portions slit from the web can be directed down into the broke pit to be reconstituted with the other broke material and supplied to the paper making machine with the fresh stock.

The slitter heads, such as 16 and 31, are preferably brought into very close running contact with the traveling paper web. In the preferred operation they are brought into touching or kissing contact so that the high velocity working fluid jet immediately engages the web as it emerges from the jet opening. The web will be fairly accurately guided in its travel through the slitting zone, such as by the guide roll 11 and the winder drum 13, and vertical adjustment means may be provided to the guide rolls and/or to the jet heads to accurately locate the position relative to the surface of the traveling web.

As illustrated in FIG. 4, the jets are supplied with a high pressure supply of working fluid such as water from a pump 30 delivered through a delivery line 19. The line is shown connected to each of the jet orifices 22 and 23 and may be connected by a flexible line so that all of the heads are interconnected to the same fluid supply. This fluid pressure can be variable so as to obtain optimum slitting and so as to be able to accommodate webs of different thicknesses or to be varied in accordance with changes in speed of the web travel. Also, the orifices 22 and 23 are provided by orifice inserts which are interchangeable which may be necessary for different weights of paper or if fluids of different viscosity are employed. While water is a preferred cutting fluid, other liquids may be used, and the water can be modified by the addition of a water soluble long chain polymer dissolved in the water in accordance with the disclosure of U.S. Pat. No. 3,524,367, Franz.

A very useful advantage is obtained in the arrangement which permits readily controlling the width of the kerf strip removed from the web. In the provision of dual orifices in each of the heads 16 and 31, as illustrated in FIG. 3, rotation of the heads will change the lateral width between the orifices. This rotation may be accomplished manually or by mechanical interconnecting devices to simultaneously rotate each of the heads. The mechanism for rotation of the heads is shown schematically by the arrowed lines 24 and 34. For example, each of the heads may be mounted to be rotatable about a vertical axis and be interconnected by gears on a common shaft 35 which mesh with gears on the heads to simultaneously rotate the heads and hold them in adjusted position. The heads may be mounted on a vertical axis extending midway between the jets, or the axis may be located coaxial with either of the jet openings. Thus, in the arrangement of FIG. 3, if the jets are rotated in a clockwise direction, the width of the spaces 25 and 37 between the strips will be increased. If the jets are rotated counter-clockwise so that the kerf strip becomes narrower, the spaces 25 and 37 will become narrower.

Also, the heads will be mounted on independent supports which are laterally adjustable to be able to independently control the location of the kerf. Thus, the strips 26 and 36 formed from the web may be made narrower or wider or can be of an equal width. These strips are wound into individual rolls 38, 39 and 40 for the strips 36, 26 and 27. The kerf strips may be adjusted so that they are no wider than necessary, but adequately wide to prevent the rolls from touching as they rotate at high speed and as the supporting axis 41 to bend with increasing weight of the rolls.

An air jet 21 may be positioned in a trailing position immediately after the working liquid jets to help carry the kerf strip downwardly into the saveall 17. The size of the jet and pressure employed will vary as a function of the working liquid, speed of web travel, thickness of the web and similar factors which affect the cutting ability of the jet, but an orifice size in the range of 0.001 to .1 inch will be satisfactory in most operating conditions. An orifice length of 0.003 to 0.5 will be satisfactory and normally an orifice length in the range of 3 to 30 times the diameter of orifice size may be employed. A pressure in the range of 10,000 to 100,000 psi will be supplied to the jets, and a variable control may be employed with the pressure supply pump 30 to vary the jet pressure sufficient to form a clean kerf during operation.

As shown in FIG. 5, an unwinding roll 45 is mounted on a support shown schematically at 44. The unwinding roll may be positioned on the support 44 so that the web W unwinds off the top of the roll as the roll rotates in a clockwise direction. As the roll 45 unwinds and becomes smaller, the web will travel along the dotted line path shown at W-1. The web travels over a guide roll 46 so that its location is stabilized, and the direction in which it approaches the slitter mechanism 47 in the slitting zone is stable. The web then passes over a tension control mechanism 48 which operates with a shoe having an air jet 49 opening through the face of the shoe. Measuring means shown schematically at 50 detects the back pressure in the air jet to register the pressure as a function of tension in the web. Control means may
be provided to regulate the drive for the winder, shown schematically at 60, to maintain uniform web tension. The web is wound onto a winding drum 59 which is supported on a pair of spaced twin winding drums 57 and 58.

Instead of measuring and controlling the tension by the mechanism 48, the guide roll 46 may be provided with a support which weighs the force on the guide roll and is indicated schematically by the support 46a. The guide roll 46 is shown positioned so that the web passes downwardly in a vertical run to the tension control mechanism 48, but may be located in position 46' so that the web passes in an inclined straightline of descent through the slider as shown by the dotted line position of the roll 46'. Variation in the angles of approach of the web to the guide roll 46 are shown at positions B, E and F with the angle of the web changing through angle A and through angle B as the roll 45 unwinds.

The slider mechanism is shown at 51 incorporating a pair of high velocity fluid jets as described above. The slider is vertically adjustable by supporting head 52 so that it can be moved down into kissing contact with the traveling web W. A support 53 is provided beneath the web to counteract the amount of force created as the cutting jet passes through the web which tends otherwise to push the web away from the nozzle. The supporting surface 53 not only holds the web in a stable condition for effective cutting, but also becomes an effective guard preventing physical contact with the jets. The jets issue from the openings at sufficiently high velocity that they could physically damage an operator such as by being capable of cutting off a finger.

FIG. 7 illustrates in greater detail the relationship between a support 73 on the undersurface of the web and the jet 75, with the axis of the fluid shown at 76. The distance 74 between the trailing edge of the support and the jets should be small, that is, on the order of 1/64 to 1/8 inch. On the downstream side of the jet is a guard 77 for deflecting the kerf downwardly.

Returning to FIG. 5, a vertical tube 54 is provided for receiving the jet and guiding it downwardly into a container 55. The tube 54 forms an enclosure or protective means preventing physical contact with the jet. The kerf strip is carried into a guide 56.

With reference to FIG. 6, the web W is shown passing downwardly with a jet 62 positioned to direct fluid streams normal to the web of paper, as contrasted with the jet 51 which directs the streams at an angle to the traveling web. In the arrangement of FIG. 6, a supporting guard 63 is positioned immediately in advance of the jet 62 and an elongate tube 64 provides a protector means preventing physical contact with the jet. A container 65 at the end of the tube receives the fluid from the jet. The kerf strip is deflected forwardly in the direction of web travel to pass down a chute 66. The chute 66 and the guard 64 are mounted on a pivotal frame 67 which is pivotally mounted at 68 so that it can be positioned in a first operative position as shown in FIG. 6, or swung downwardly to a second or inoperative position away from the web. To prevent inadvertent damage to an operator, an interlock mechanism is provided which automatically turns off the jet when the protector means is swung downwardly. For this purpose, the supply of fluid such as water through a line 72 to the jet nozzle 62 is controlled by a valve 71. Electrical leads 70 connect to this valve and connect to an interlock switch 69 which opens the circuit to automatically close the valve whenever the protector 64 is moved downwardly away from the web.

FIG. 8 illustrates a traveling web 78 wherein the web is slit into a plurality of strips in accordance with the prior art. Slitter knives are positioned along the line 79 to separate the web into a plurality of strips. Spreader means such as spreader rolls or curved spreader bars are positioned downstream from the knives to spread the webs and provide slots therebetween so that the strips can be wound on rolls without interfering. 81 shows the axis of winding, and it will be observed from the drawing that the axis of the strip, such as indicated at 82, are at an angle to the axis of winding so that the strips will actually be wound onto the rolls of an angle. This creates a winding difficulty and nonuniform and unstable rolls. This disadvantage of the prior art is completely eliminated with the present arrangement wherein the separated strips maintain their straightline of travel and are at precise right angles to the axis of the rolls onto which they are wound.

1. A slitter winder for slitting and winding a web such paper into a plurality of rolls comprising in combination:
   - means supplying a traveling web;
   - guide means for the web guiding it through a slitting zone;
   - a slitting means in the slitting zone having first and second jets on one side of the web for directing high velocity working fluid streams through the traveling web surface spaced laterally for removing a narrow kerf portion from the web to separate adjacent web strips;
   - a winder positioned to receive and wind said strips into adjacent rolls;
   - and a receptacle means positioned on the opposite side of the web positioned for receiving the fluid of the jets and for receiving the narrow kerf portion removed from the web with the kerf carried toward the receptacle by the fluid streams.

2. A slitter winder for slitting and winding a web such paper into a plurality of rolls constructed in accordance with claim 1:
   - including a high pressure water supply means connected to said jets with the working fluid being water and the traveling web being paper.

3. A slitter winder for slitting and winding a web such paper into a plurality of rolls constructed in accordance with claim 1:
   - wherein the jet nozzle has an orifice diameter in the range of 0.001 to .1 inch and is supplied with fluid at a pressure to be emitted from the jet at a velocity in the range from 500 to 4,000 feet per second.

4. A slitter winder for slitting and winding a web such paper into a plurality of rolls constructed in accordance with claim 3:
   - wherein the length of the nozzle is in the range of 3 to 30 times the diameter of the nozzle and the liquid supplied is water at a pressure in the range of 10,000 to 100,000 pounds per square inch.

5. A slitter winder for slitting and winding a web such paper into a plurality of rolls constructed in accordance with claim 1:
   - including means for adjusting the lateral spacing of said first and second jets to adjust the width of the narrow portion removed therefrom.
6. A slitter winder for slitting and winding a web such as paper into a plurality of rolls constructed in accordance with claim 1:

wherein said jets are supported on a mount pivotal about an axis substantially normal to the web surface so that with rotation of the mount the lateral spacing between the jets will change for controlling the width of the narrow portion removed from the web.

7. A slitter winder for slitting and winding a web such as paper into a plurality of rolls comprising in combination:

means supplying a traveling web;

guide means for the web guiding it through a slitting zone;

a slitting means in the slitting zone having first and second jets for directing high velocity working fluid streams through the traveling web surface spaced laterally for removing a narrow kerf portion from the web to separate adjacent web strips;

and a winder positioned to receive and wind said strips into adjacent rolls;

said jets being positioned in kissing contact with the surface of the traveling web.

8. A mechanism for slitting a traveling web comprising in combination:

unwinder means for supporting an unwinding roll supplying a web traveling at a high speed;

guide means for guiding the web through a slitting zone;

a winder for supporting a rotating winding roll receiving the web from the unwinder means;

a slitter means in said slitting zone including first and second laterally spaced jets for each directing a high velocity working fluid against the surface of the web for removing a kerf of very narrow width to separate the web into adjacent noninterfering web strips and a tension indicating means positioned in advance of said slitting zone and responsive to tension in the web.

9. A mechanism for slitting a traveling web constructed in accordance with claim 8:

wherein said tension indicating means includes an air jet directing a stream of air against the traveling web with means for measuring the air pressure as a function of web tension.

10. A mechanism for slitting a traveling web constructed in accordance with claim 8:

wherein said tension indicator includes a guide roll in engagement with the web with means for measuring the force exerted by the web upon said guide roll.

11. A slitter winder for slitting and winding a web such as paper into a plurality of rolls comprising in combination:

means supplying a traveling web;

guide means for the web guiding it through a slitting zone;

a slitting means in the slitting zone having first and second jets for directing high velocity working fluid streams through the traveling web surface spaced laterally for removing a narrow kerf portion from the web to separate adjacent web strips;

a winder positioned to receive and wind said strips into adjacent rolls;

and protecting means for said fluid streams barring physical contact with the streams.

12. A slitter winder for slitting and winding a web such as paper by a plurality of rolls comprising in combination:

means supplying a traveling web;

guide means for the web guiding it through a slitting zone;

a slitting means in the slitting zone having first and second jets for directing high velocity working fluid streams through the traveling web surface spaced laterally for removing a narrow kerf portion from the web to separate adjacent web strips;

a winder positioned to receive and wind said strips into adjacent rolls;

a protector means preventing physical contact with said fluid streams and movable between a first operative position protecting the streams and a second inoperative position;

means for terminating said fluid stream;

and means interconnecting said terminating means with said protector terminating the streams as the protector moves to said inoperative position.

13. A slitter winder for slitting and winding a web such as paper into a plurality of rolls comprising in combination:

means supplying a traveling web;

guide means for the web guiding it through a slitting zone;

a slitting means in the slitting zone having first and second jets for directing high velocity working fluid streams through the traveling web surface spaced laterally for removing a narrow kerf portion from the web to separate adjacent web strips;

a winder positioned to receive and wind said strips into adjacent rolls;

a protector movable between a first position for barring physical contact with said fluid stream and a second position;

a valve controlling said stream; and

means interconnecting said valve and said protector means operating said valve to terminate the streams at said second position.

14. The method of slitting and winding a web such as paper to form a plurality of adjacent rolls comprising the steps:

supplying a continuous web of material traveling at a high speed guiding the web of material through a slitting zone;

removing a narrow kerf from the traveling web by directing spaced high velocity jets of working fluid against the web at one side thereof and winding the adjacent strips at each side of the kerf;

receiving the fluid of the jets and the narrow kerf removed from the web at the side of the web opposite the high velocity jets in a receptacle means carrying the kerf toward the receptacle means by the fluid streams of the jets.

15. The method of slitting and winding a web such as paper into a plurality of adjacent rolls in accordance with the steps of claim 14:

wherein the separate jets are directed at the web spaced laterally of each other relative to the direction of web travel and the spacing between jets is adjusted for determining the width of the kerf.

16. The method of slitting and winding a web such as paper into a plurality of adjacent rolls in accordance with the steps of claim 14:

wherein the working fluid is water and the kerf and water are retained for being reconstituted to form further web material.