United States Patent

Frye et al.

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[54] **SLITTER BLADE MOUNTING ASSEMBLY**

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[52] **U.S. Cl.** **83/482,** 83/497, 83/499, 83/502, 83/503

[51] **Int. Cl.**.....**B26d 1/16,** B26d 1/24

[58] **Field of Search**.....83/482, 497, 498, 502, 503, 83/504, 500, 676, 428, 675, 665, 499

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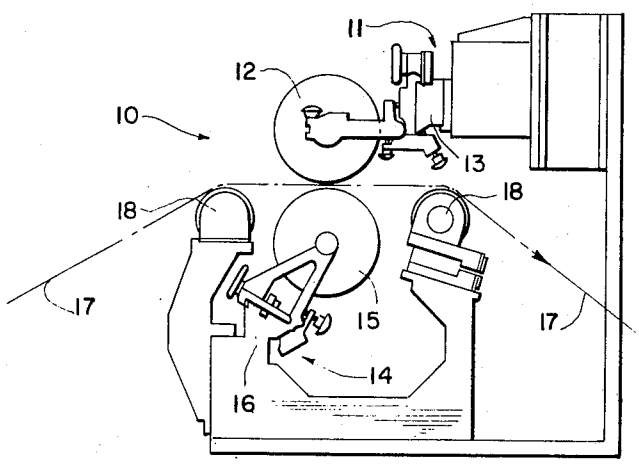
[57] **ABSTRACT**

A web slitter assembly of the type including a pair of rotating engaging slitter blades between which passes the web to be cut. The assembly includes a low friction blade mounting and special devices for accurately positioning the blades for cutting and loading the blades against each other. The accuracy of the positioning and loading is such that the blades can be driven solely by the web being cut without any external driving source.

12 Claims, 5 Drawing Figures



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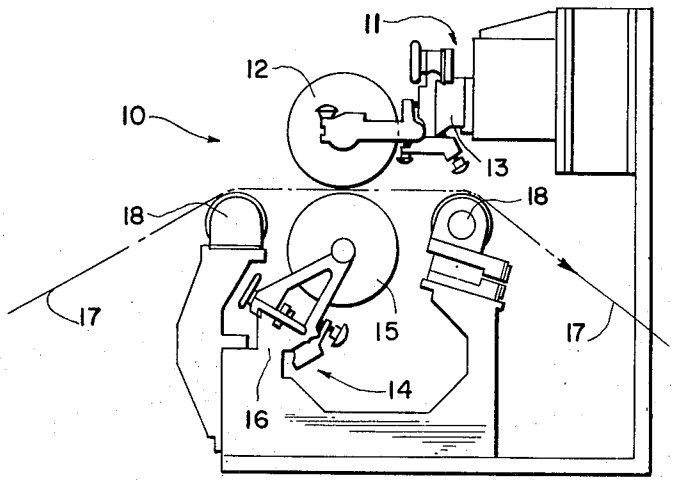

FIG. 1

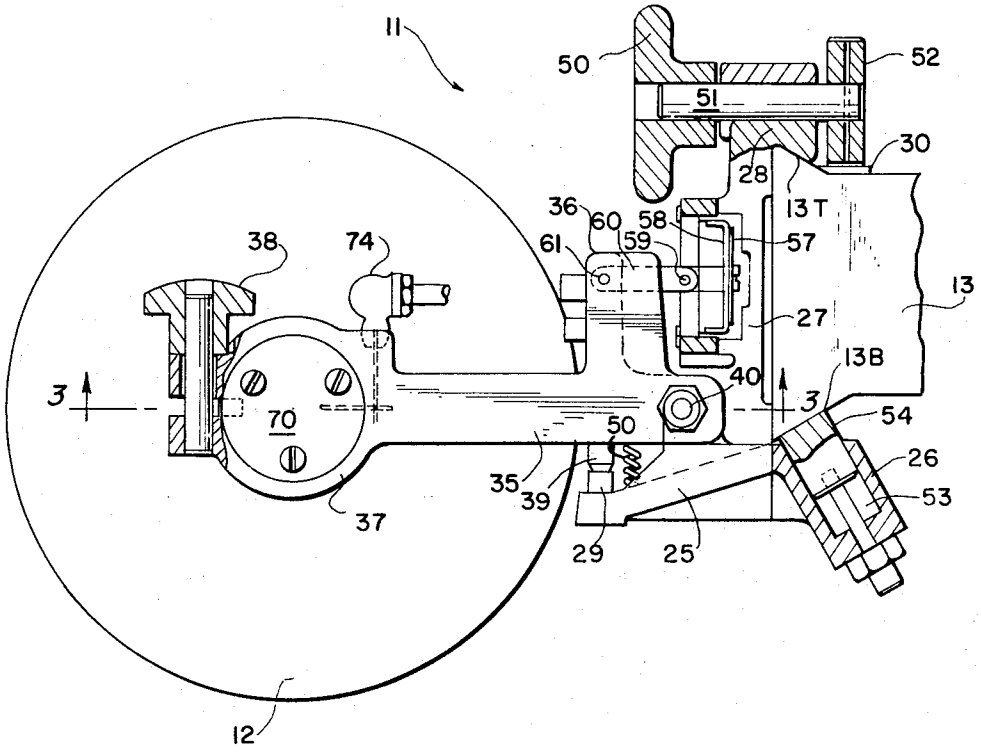

FIG. 2

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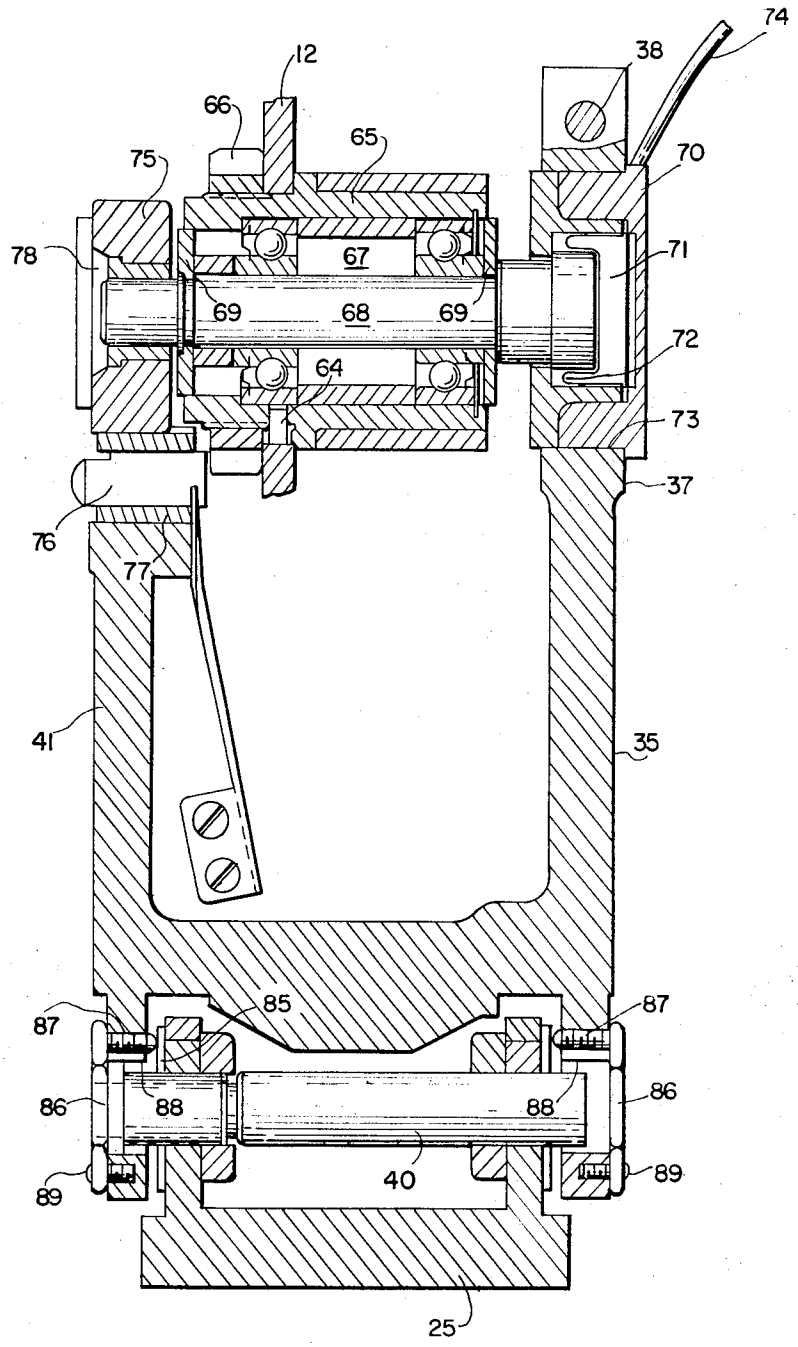

FIG. 3

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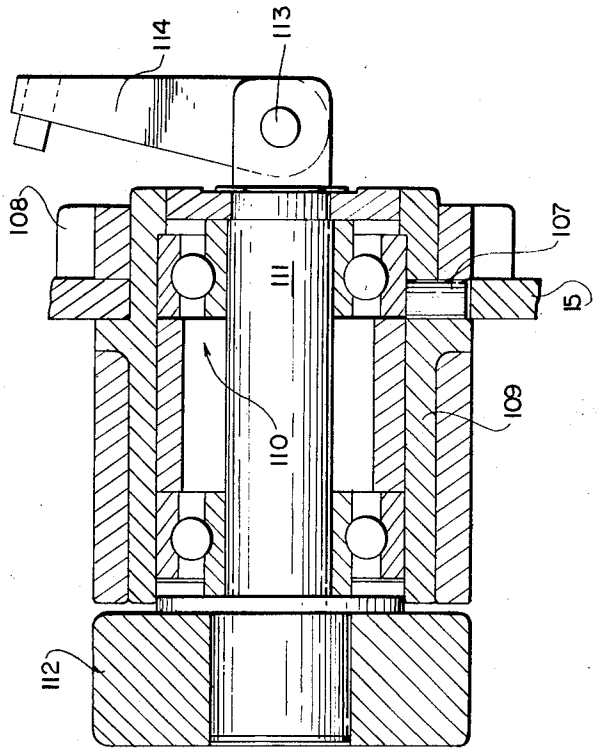

FIG. 5

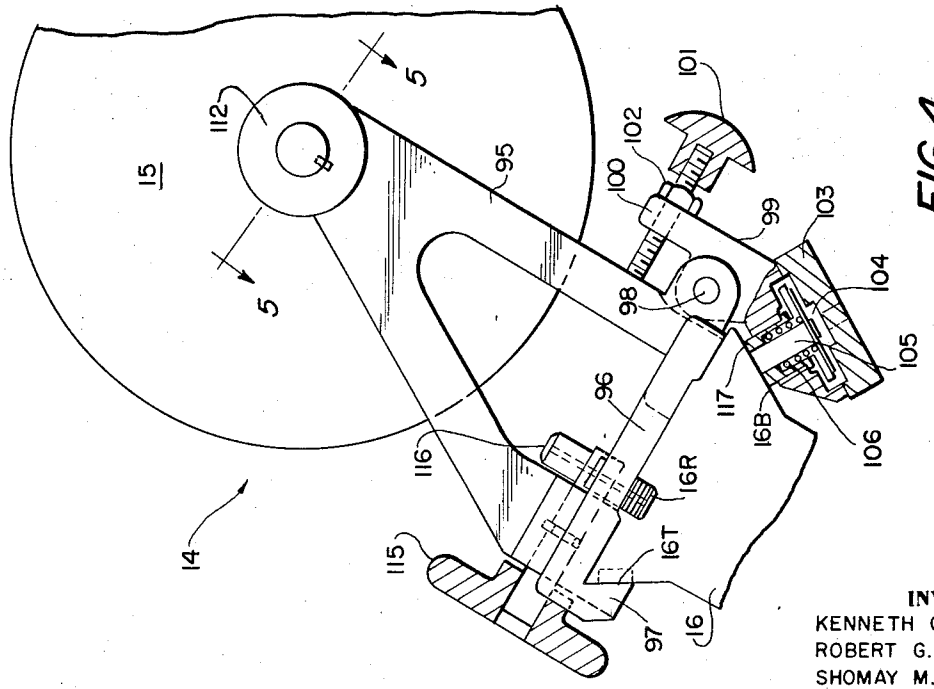

FIG. 4

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SLITTER BLADE MOUNTING ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to the lengthwise slitting of web material such as paper; and in particular, it relates to a new and improved web slitter assembly.

It is known to use a pair of rotating engaging disc-shaped blades to slit a web of material such as paper. The two discs touch and their circumferences overlap slightly, whereby the paper passing between the two discs in a plane generally perpendicular to a plane passing through the axes of rotation of the two discs is slit into a plurality of webs of smaller widths.

However, in some applications such as in the paper industry, these discs run at very high speed for 24 hours a day; and thus wear requirements are very demanding. Moreover, the task of forming a clean slit edge on the paper while running at high speed makes paper slitting a very delicate and precise operation.

Present slitters use external drive sources such as motors to rotate the disc-shaped blades to obtain the necessary rotational speeds. However, such motor driven slitters have suffered from certain disadvantages including, inter alia, excessive wear. For example, during certain periods the cutting load might be very light or it may be eliminated altogether such as when paper is not passing through the slitter assembly. However, the motors would continue to run during these periods, thus continuing to rotate the discs which then rub against each other with an excessive force causing excessive wear. On the other hand, precise and instantaneous control of the motor speeds might render the assembly uneconomical. It would not be feasible to eliminate the above disadvantages by simply removing the motor altogether because under previous conditions the slitters may not rotate at all and in any event there would be no means for controlling the loading force and the relative positions of the blades.

Thus, there exists a need for a new and improved slitter assembly which overcomes disadvantages of slitter assemblies known heretofore.

SUMMARY OF THE INVENTION

Thus, it is a purpose of the present invention to provide a new and improved slitter assembly of the type for lengthwise slitting of a web of material.

This purpose of the present invention is achieved by providing a slitter assembly having new and improved slitter blade mounting and loading means which permit the slitter blades to be driven solely by the web being cut, without any need for external driving sources. Consequently, with this arrangement the speed of rotation of the blade is directly responsive through actual contact to the speed of movement of the web being cut.

In the assembly of the present invention, both the upper and lower slitter blades are mounted for movement along a rail (commonly referred to as a dovetail) to any transverse position across the winding apparatus on which the slitter assembly is mounted. A pinion gear on each of the upper and lower slitter blade assemblies engages a rack fixed to its respective dovetail to provide transverse movement. Further, each of the slitter assemblies includes a fluid operated clamping device for clamping the respective slitter assembly to the respective dovetail rail at the selected crosswise, or transverse position. Moreover, in both the upper and lower slitter assemblies, the respective blades are mounted on low friction roller bearings which permit free rotation of the blades relative to the assemblies on which each is mounted.

In addition to the above, the upper slitter claim 1 assembly includes means for moving piston-and-cylinder upper slitter blade vertically from a raised inoperative position to a lowered operative position. Further means are provided for moving the upper slitter blade along its own axis for loading the upper slitter blade against the lower slitter blade. This side loading means is constructed such that it does not interfere with the low friction properties of the bearings on which the upper slitter blade is mounted. In addition, this side loading means is variable so that the loading force of the upper blade against the lower blade can be varied in accordance with operating conditions. The upper slitter blade assembly also includes means for toeing-in the upper slitter blade relative to the lower slitter blade.

The various features outlined above combine with each other to precisely and accurately control loading and positioning of the blades relative to each other such that the blades will be driven at the proper speed by the web itself without external motor means thereby positively correlating and hence controlling the speed of movement of the blades relative to the speed of movement of the web being cut. Thus, in a surprisingly simplified manner, the present invention overcomes numerous disadvantages of the prior art including speed control of the blades and the elimination of excess blade wear.

Thus, it is a purpose of the invention to provide a new and improved slitter blade assembly for lengthwise slitting of web material such as paper or the like.

It is another object of the invention to provide a new and improved slitter blade assembly which may be driven solely by the web of material being cut.

It is another object of this invention to provide a new and improved slitter blade assembly including improved means for moving one of the slitter blades between an inoperative position and an operative position, properly loaded against the other blade.

It is another object of this invention to provide a new and improved means for more accurately positioning the slitter blade assembly on the dovetail rail.

It is another object of this invention to provide a slitter blade assembly having improved slitter blade positioning means coupled with low friction mounting means such that the blades can be driven at speeds related directly to the speed of movement of the web being cut.

Other objects and the attendant advantages of the present invention will become apparent from the detailed description to follow, together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

There follows a detailed description of the invention to be read together with the accompanying drawings, the description and the drawings being provided only to illustrate a preferred embodiment of the invention.

FIG. 1 is a side elevational view of the slitting station of a winding apparatus and showing the general location of the slitter blade assembly therein.

FIG. 2 is an enlarged side elevational view of an upper slitter blade assembly as shown in FIG. 1.

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 2.

FIG. 4 is an enlarged side elevational view of a lower slitter blade assembly as shown in FIG. 1.

FIG. 5 is partial cross-sectional view taken along line 5—5 of FIG. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, like elements represent like numerals throughout the several views.

FIG. 1 illustrates the slitting station **10** of a web re-winding apparatus. Such a re-winding apparatus is used, for example, to wind rolls of newly formed paper into rolls of smaller diameter and also, and more importantly, for the purposes of the present invention, to slit a web of paper into a plurality of rolls having a smaller width. In FIG. 1 the web **17** is supported for movement through the slitting station **10** by means of rollers **18**. These rollers form the subject matter of a separate patent application of common ownership with the present invention and filed concurrently herewith.

The slitter assembly of the present invention includes an upper slitter assembly **11** and a lower slitter assembly **14**. The upper assembly **11** is movable across the machine (perpendicular to the plane of the paper) along a dovetail-shaped rail **13**. A slitter blade **12** which may have an 8-inch diameter is mounted on the assembly **11**. The lower slitter assembly **14** is also movable across the machine on the dovetail-shaped rail **16** and includes a slitter blade **15** mounted thereon. In cooperation with an 8-inch upper slitter blade it is preferable to use an 8.5 inch diameter lower blade.

The upper slitter blade assembly **11** is shown in greater detail in FIGS. **2** and **3**. A slitter frame **25** has formed integrally therewith a clamp portion **26**, a vertically extending portion **27**, an upper portion **28** and a down-stop **29**. The dovetail-shaped rail **13** includes an upper portion **13T** and a lower portion **13B** which cooperate with the portions **28** and **26**, respectively, of the slitter frame **25**. Movement of the slitter frame along the rail **13** is provided by engagement between a pinion **52** of the slitter frame **25** and a rack **30** fixed on and extending longitudinally with the rail **13**.

A first slitter arm **35** is movable vertically with respect to frame **25** about the axis of pivot pin **40** (see in particular FIG. **3**). The arm **35** includes an upwardly extending abutment **36** and a split hub portion **37**. A clamp **38** threadedly engages the two portions of the split hub **37** for urging the two portions of the hub together. A second slitter arm **41**, similar to the arm **35** except that it does not have a split hub, is located on the opposite side of the slitter blade **12** (see FIG. **3**).

For moving the entire upper slitter assembly **11** along the rail **13**, the slitter frame **25** includes a hand-wheel **50** integral with a pin **51** which extends through portion **28** and drivingly engages the pinion **52**. Thus, by turning handwheel **50**, the pinion **52** is turned and moved along rack **30** whereby the entire upper slitter assembly **11** is moved along the rail **13**.

The sub-assembly including the slitter blade **12** and the two arms **35** and **41** are moved vertically about pivot pin **40** by means of a vertical movement cylinder **57**. By introducing fluid to the chamber to the right of piston diaphragm **58** (see FIG. **2**) the piston **58** is moved to the left and this in turn acts through pivot pin **59**, link **60**, pivot pin **61** and abutment **36** to move the said sub-assembly downwardly, that is clockwise about pivot pin **40** as shown in FIG. **2**. Downward movement of this sub-assembly is limited by engagement of the stop member **39** on the arm **35** with a stop member **29** on the frame **25**. A spring **50** may be provided adjacent these two stop members and tending to urge the arm **25**, and thus the said sub-assembly upwardly, that is clockwise relative to pivot pin **40**. Thus, pressurizing cylinder **57** will cause downward movement of the slitter blade **12** and the release of pressure from this cylinder will permit the said spring to move the sub-assembly and hence the slitter blade **12** upwardly until the piston **58** engages the end wall of cylinder **57**.

In operation, the lower slitter blade will be positioned first. The upper slitter blade will then be moved transversely of the machine to the proper position. The blade will first be lowered in the manner as described above. Next, the blade will be moved parallel to its axis to properly load the upper blade against the lower blade. The low friction support for the slitter blade and the means for exerting this sideward force against the slitter blade are shown in FIG. **3**. Slitter blade **12** in non-rotationally connected to a sleeve **65** through a radially extending pin **64**. The blade **12** is fixed axially on the sleeve **65** by means of a holding nut **66**, the inside of which threadedly engages the exterior surface of sleeve **65**. Within sleeve **65** is a low friction roller bearing **67**, the interior of which supports a non-rotating shaft **68**. The bearing space may be provided with suitable seals of a suitable material such as teflon.

A feature of the invention is that the side loading thrust on the blade **12** is parallel to the axis of the blade **12** and parallel to the axis of bearing **67** and shaft **68**. Consequently, this side loading force does not interfere with the function of the bearing. Thus, the bearing continues to act as a low friction bearing permitting free rotation of the loaded blade **12** relative to the shaft **68**.

The sideward thrust of blade **12** is provided by introducing fluid under pressure through a line **74** to a chamber **71** where the pressurized fluid acts against a rolling diaphragm **72** and the righthand end of shaft **68** thereby moving the entire bearing assembly and the blade **12** to the left (as shown in FIG. **3**) to load the blade **12** against the lower blade **15**. The shaft **68** is returned to the right by introducing pressurized fluid through a line (not shown) to the space **78** whereat the fluid acts on the lefthand end of shaft **68**. In a preferred embodiment, this stroke may be 0.22 inches.

FIG. **3** also illustrates the means for mounting and dismounting a blade to and from the sub-assembly. First the clamp **38** is loosened permitting rightward movement of first shaft mounting **70** along cylindrical surface **73**. The entire sub-assembly may be moved to the right until the lefthand end of shaft **68** is spaced from the second shaft mounting **75**. The holding nut **66** is then removed and the slitter blade **12** removed from the sleeve **65** to the left (as shown in FIG. **3**). A new blade may then be mounted, the holding nut **66** returned to the sleeve **65** and the lefthand end of shaft **68** re-introduced into the second shaft mounting **75**. To further facilitate this operation, the generally cylindrical mounting **75** is pivotally connected at pivot pin **76** through a bushing **77** to the second arm **41**. Thus, after the shaft **68** has been removed from portion **75**, the

portion **75** can be turned about the axis of pivot pin **76** into or out of the paper to permit free access to the nut **66**.

FIG. **3** illustrates the means for turning the entire sub-assembly including arms **35** and **41** angularly about a vertical axis to provide toe-in of the upper blade **12** relative to the lower blade **15**. A pair of inclined cam surfaces **85** fixed to the frame **25** about the pivot pin **40** are engaged by pins **87** which are movable along a curved slot **88**. The pins **87** are in turn connected to flat plates **86** which are in turn connected to the sub-assembly including arms **35** and **41** at pivot pins **89**. For clarity, it should be noted that these plate **86** are not connected to the pivot pin **40**. Thus, by turning the plates **86** about the axis of pins **89**, the location of pins **87** will vary along the surface of cam plates **85**. The height of these cam plates will vary along the said path so that the arms **35** and **41** will be moved about a vertical axis depending upon the position of pins **87** relative to cam plates **85**. In a preferred embodiment, the plates **86** may be permitted to move through approximately 90° about axis pins **89** and this will provide a turning movement of the sub-assembly including arms **35** and **41** through a range of between 0° and 1.5°. For balanced control, the two cams **85** should be mounted symmetrically so that the said turning movement is accomplished by turning the two plates **86** by an equal amount in opposite directions.

Referring again to FIG. **2**, the sub-assembly is fixed at a selected position along rail **13** by first reaching the selected position along rack **30** and then introducing pressure to the chamber **53** thereby moving the piston **54** upwardly against portion **13B** so that the portions **13T** and **13B** will be firmly engaged by portions **28** and piston **54**, respectively.

FIGS. **4** and **5** illustrate the lower slitter blade assembly **14**. This assembly includes a lower slitter arm **95** having formed integrally therewith a back portion **96**, a top portion **97**, all of which portions are pivotally connected to a lower clamp portion **99** through a pivot pin **98**. This lower clamp portion includes a flange **100** having an adjusting bolt **101** and a tightening nut **102** engaged therewith. This portion **99** includes a fluid operated clamp **103** for clamping this lower slitter assembly to the dovetail **16**. A piston **105** in a cylinder **104** is urged upwardly against the lower portion **16B** of the dovetail **16**, also urging the portion **97** against dovetail portion **16T**. A return spring **106** urges the piston **105** downwardly so that the clamp is disengaged when fluid is released from the cylinder **104**. This lower slitter assembly may also be clamped to the dovetail **16** mechanically by turning the bolt **101** with its lower end engaging the arm **95** thereby turning the portion **99** about pivot pin **98** such that an extension **117** of the cylinder **104** will mechanically engage the dovetail portion **16B**. Movement of the lower slitter assembly along the dovetail **16** is provided by turning a hand wheel **115**, and thereby turning a pinion **116** to move the assembly along rack **16R**.

FIG. **5** illustrates the mounting assembly for the lower slitter blade **15**, which mounting assembly is also characterized by low friction free rolling like the upper slitter blade mounting assembly. This assembly includes a pin **107**, a holding nut **108**, a sleeve **109** and bearing **110**, which elements correspond, respectively, with the elements **64**, **66**, **65** and **67**, as shown for the upper slitter blade assembly in FIG. **3**. This lower slitter blade assembly also includes a hub **112** which receives the end of a non-rotating shaft **111**. The righthand end of this shaft includes a pivot connection **113** to a locking handle **114**. This handle may be moved upwardly, that is counterclockwise as shown in FIG. **5**, against the holding nut **108**. Alternatively, it can be moved downwardly such that it extends along the axis of shaft **111** so that the holding nut **108** and the blade **15** can be removed from the assembly to the right as shown in FIG. **5**.

There has thus been described a combination of elements which cooperate and interrelate with each other to provide a substantially improved slitter mounting assembly. The combination of at least some of the following factors permit controlled operation with the motive force for the blades provided entirely by the moving web; low friction roller bearings, controlled toeing-in, controlled blade loading, proper penetration of the blades across the plane of the paper (penetration is also defined as the vertical overlap of the two blades). Further, accurate control is provided by permitting variation of the side loading force. For example, under high speed conditions high pressure and hence a high loading force is required. Alternatively, during low speeds a low pressure, and hence a low loading force is required. If these conditions are not met, for example if high loading is provided during low speed operation, the result could be considerable excess wear of the blades. Moreover, proper penetration is extremely important for determining the characteristics of the cutting operation. The fluid operated device now permits good control of the lowering of the upper blade, and hence of penetration. All elements of both assemblies, including the clamping devices, are arranged such that they do not bind the bearings or otherwise produce torque drag on the sleeves of the blade mounting assemblies since these sleeves rotate with the blade. Fluid operated clamping of the assembly to the dovetail-shaped rail permits such clamping without twisting of the assembly which would be inherent with a mechanical screw. Lowering of the sub-assembly including arms **35** and **41** may be carefully controlled by employing an orifice in the fluid line to the chamber **57**.

Another feature of the invention is that both the upper and lower slitter blade mountings are somewhat flexible at their sleeves so that each slitter assembly can "give" in the axial direction when momentarily acted on by the other slitter blade. This is in contrast to some previous arrangement wherein at least one of the blades had very little if any flexibility.

Although the invention has been described in considerable detail with respect to a preferred embodiment thereof, it will be apparent that the invention is capable of numerous modifications and variations apparent to those skilled in the art without departing from the spirit and scope of the invention.

We claim:

1. A web slitting apparatus comprising, upper and lower disc-shaped cutter blades mounted, respectively, on upper and lower slitter blade assemblies such that the blades are rotatable about generally parallel axes for slitting lengthwise a web passing between the blades, an elongated rail, at least one of said assemblies including;

a frame mounted on and moveable along the rail to vary the position of the assembly along the rail, a pair of arms pivotally connected to the frame for movement about a pivot axis generally parallel to the blade axes, said arms extending outwardly from said pivot axis and being generally horizontal when the blades engage, a bearing assembly connecting these arms together at their outer ends, the said one blade being mounted on said bearing assembly between said arms,

means interconnecting the frame and the arms to move the axis of the said one blade towards and away from the axis of the other blade

and including means for turning said arms about an axis generally perpendicular to the said pivot axis to toe-in the said one slitter blade relative to the other slitter blade.

2. A web slitting apparatus according to claim **1** including a stop means for limiting movement of the arm and the said one blade towards the other blade under the action of said fluid operated piston-and-cylinder unit, and a spring mounted between the frame and the arm to urge the arm and the said one blade away from the other blade.

3. A web slitting apparatus according to claim including a further fluid operated piston-cylinder unit located in one of the said arms for moving the blade parallel to its axis towards and away from the other blade.

4. A web slitting apparatus according to claim **3**, in which the said further piston-and-cylinder unit acts directly on the bearing assembly of the said one blade.

5. A web slitting apparatus according to claim **1**, wherein the last said means includes a pair of inclined cams mounted on opposite sides of the slitter assembly, and follower means mounted one on each arm and engaging said cams and movable thereover to cause said turning movement.

6. A web slitting apparatus according to claim **1**, wherein the outer end of one of said arms is turnable about an axis through that arm relative to the remainder of that arm whereby said end is movable out of the axis of the said one blade.

7. A web slitting apparatus according to claim **6**, including a nut holding the blade on the bearing assembly, said nut being positioned on the side of the blade towards the said one arm having the movable outer end, the said nut being removable from the bearing assembly in an axial direction, whereby when the said outer end of the said one arm is turned about the said axis and the said nut is moved axially, the said one blade can be removed axially from the bearing assembly.

8. A web slitting apparatus according to claim **1**, including a connecting means for interconnecting said arms, and wherein the means interconnecting the frame and the arms comprises a piston connected to the connecting means and a cylinder cooperating with the piston and connected to the frame.

9. A web slitter assembly comprising a pair of disc-shaped slitter blades rotatable about generally parallel axes and arranged to move into engagement with each other to slit lengthwise a web passing between the blades in a plane generally parallel to the axes of the blades, said assembly including an upper slitter blade assembly and a lower slitter blade assembly, each of said assemblies being mounted on a rail for movement therealong, whereby the position of the slitter blades on the respective rails can be varied, and wherein at least one of said slitter blade assemblies includes a fluid operated means for clamping that slitter blade assembly against its respective rail.

10. A web slitter assembly comprising a pair of disc-shaped slitter blades rotatable about generally parallel axes and arranged to move into engagement with each other to slit lengthwise a web passing between the blades in a plane generally parallel to the axes of the blades, said assembly including an an upper slitter blade assembly and a lower slitter blade assembly, at least one of said assemblies including a means for turning that assembly and hence also turning the blade about an axis generally perpendicular to the plane of the web being cut to toe-in that slitter blade relative to the slitter blade of the other assembly, the last said means including a pair of inclined cams mounted on opposite sides of the said one assembly, and follower means engaging said cams and movable thereover to cause said turning movement.

11. A web slitting apparatus comprising, upper and lower disc-shaped cutter blades mounted, respectively, on upper and lower slitter blade assemblies such that the blades are rotatable about generally parallel axes for slitting lengthwise a web passing between the blades, an elongated rail, at least one of said assemblies including;

a frame mounted on and movable along the rail to vary the position of the assembly along the rail, a pair of arms pivotally connected to the frame for movement about a pivot axis generally parallel to the blades axes, said arms extending outwardly from said pivot axis and being generally horizontal when the blades engage, a bearing assembly connecting these arms together at their outer ends, the said one blade being mounted on said bearing assembly between said arms,

means interconnecting the frame and the arms to move the axis of the said one blade towards and away from the axis of the other blade,

and including a further fluid operated piston and cylinder unit located in one of the said arms for moving the blade parallel to its axis towards and away from the other blade.

12. A web slitting apparatus comprising, upper and lower disc-shaped cutter blades mounted, respectively, on upper and lower slitter blade assemblies such that the blades are rotatable about generally parallel axes for slitting lengthwise a web passing between the blades, an elongated rail, at least one of said assemblies including:

a frame mounted on and movable along the rail to vary the position of the assembly along the rail, a pair of arms pivotally connected to the frame for movement about a pivot axis generally parallel to the blades axes, said arms extending outwardly from said pivot axis and being generally horizontal when the blades engage, a bearing assembly connecting these arms together at their outer ends, the said one blade being mounted on said bearing assembly between said arms,

means interconnecting the frame and the arms to move the axis of the said one blade towards and away from the axis of the other blade,

and wherein the outer end of one of said arms is turnable about an axis through that arm relative to the remainder of that arm whereby said end is movable out of the axis of the said one blade.

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