July 3, 1962 W. GALLAGHER, JR 3,041,907

SLITTER MECHANISM

Filed Feb. 21, 1961 3 Sheets-Sheet 1

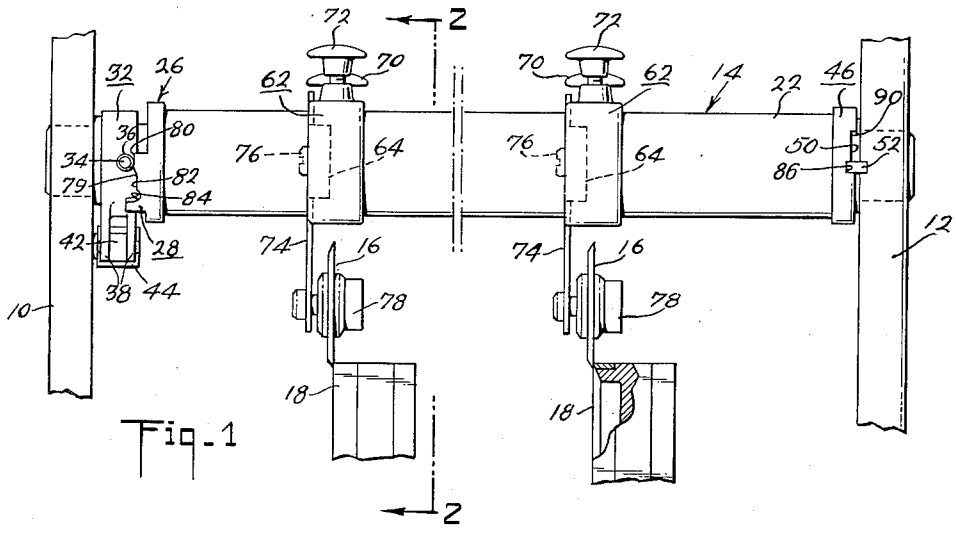


Fig. 1

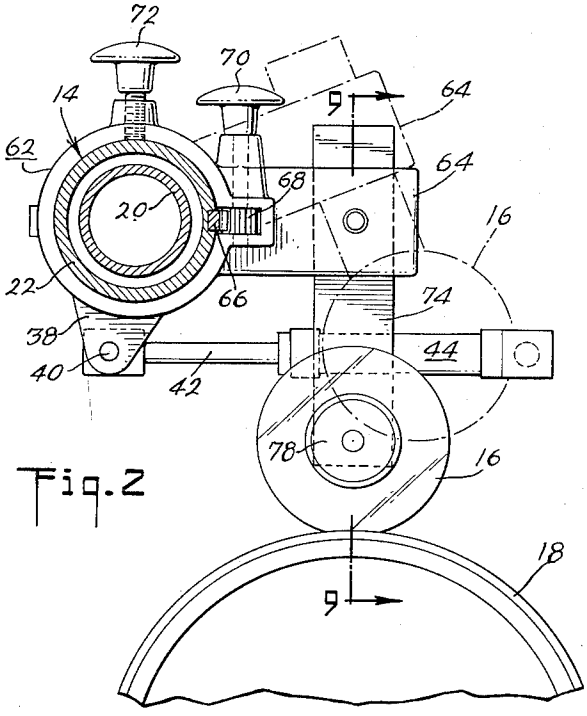


Fig. 2

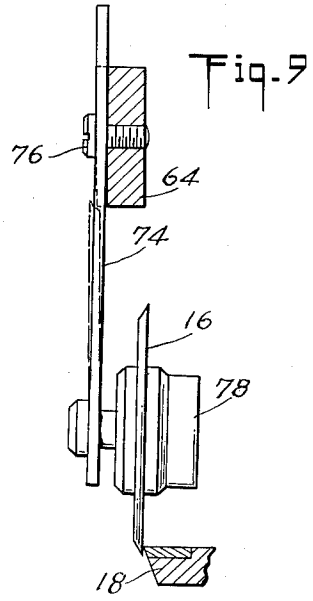


Fig. 3

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SLITTER MECHANISM

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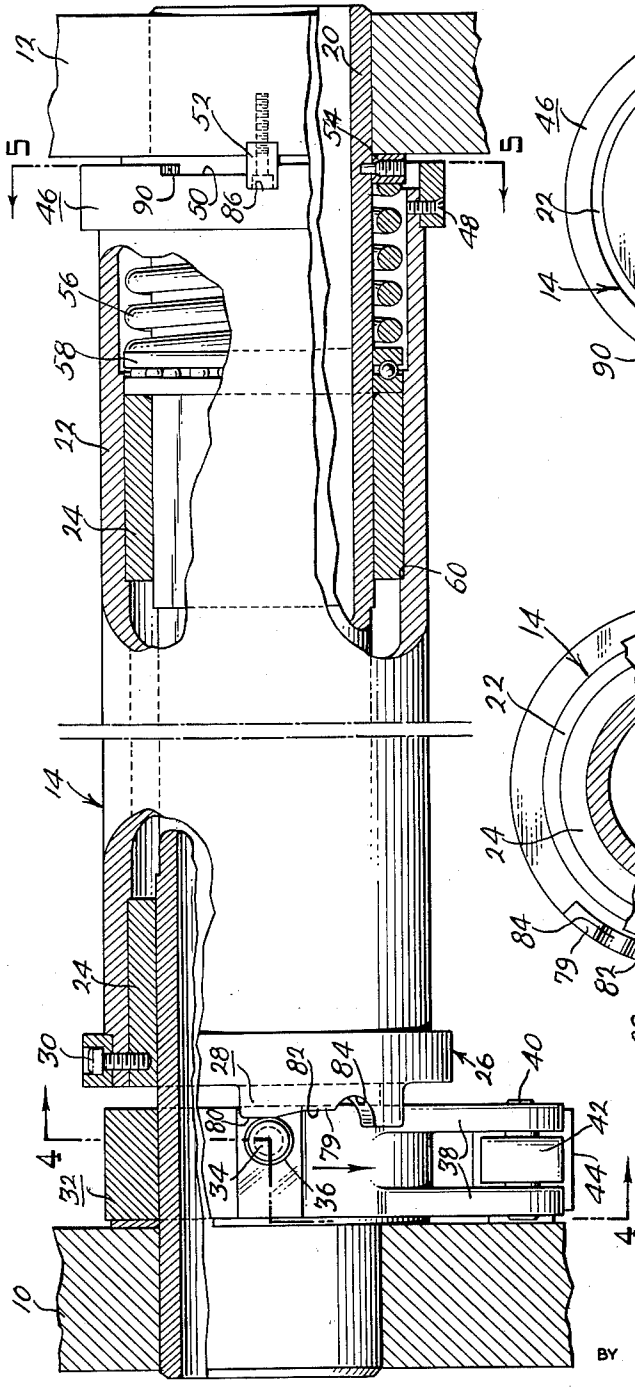


Fig. 3

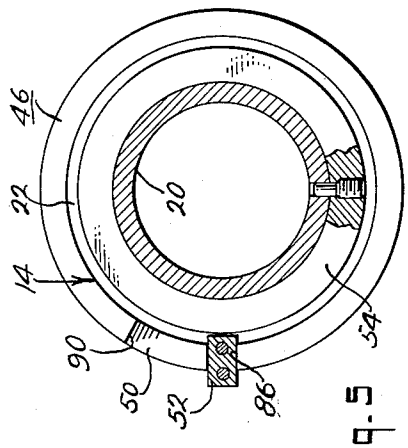


Fig. 5

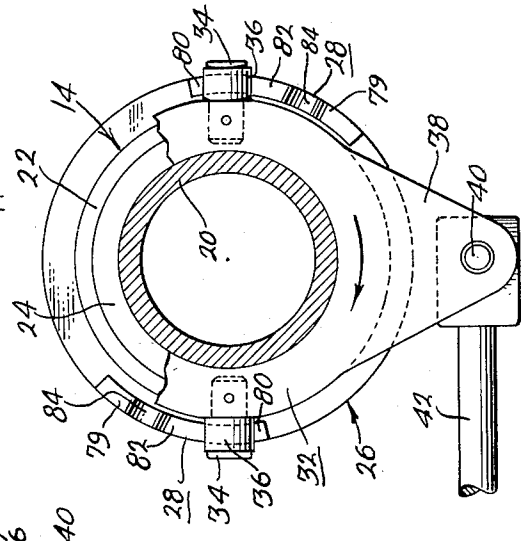


Fig. 4

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SLITTER MECHANISM

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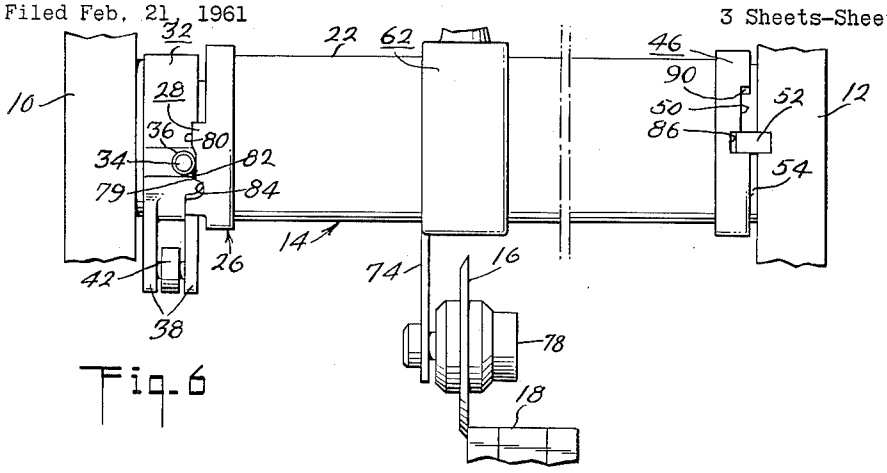


Fig. 6

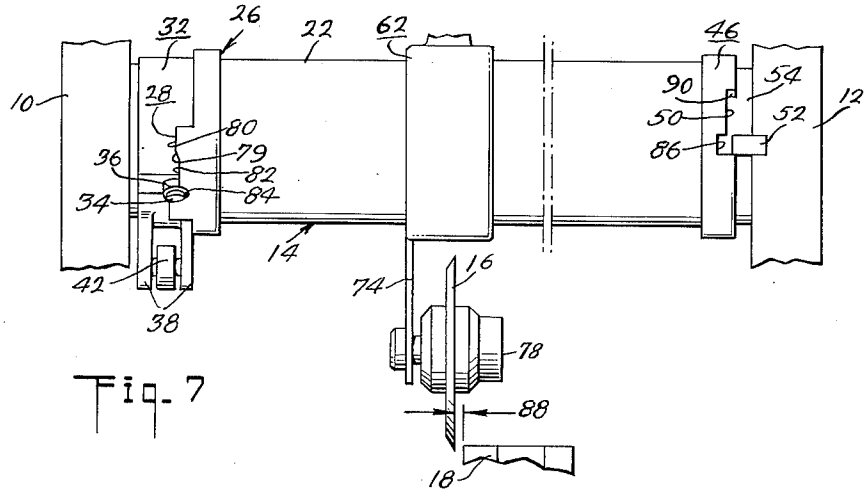


Fig. 7

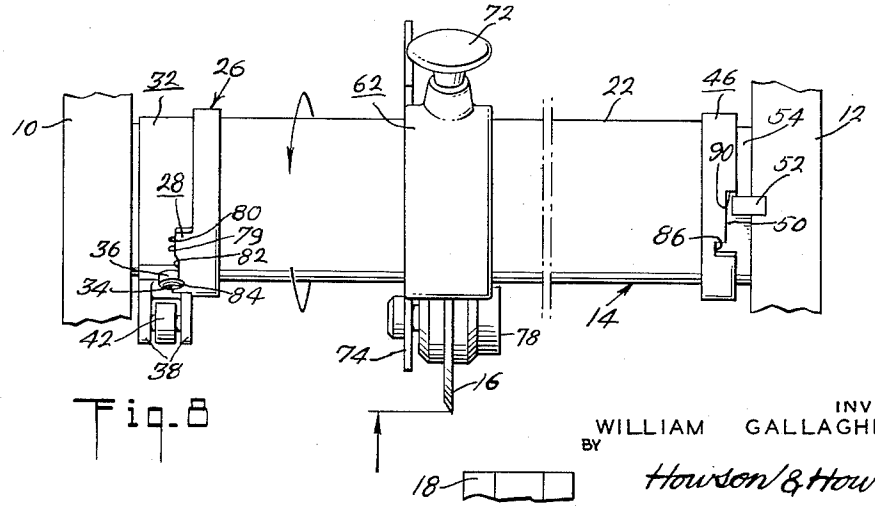


Fig. 8

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3,041,907 SLITTER MECHANISM

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7 Claims. (Cl. 83—482)

The present invention relates generally to paper working machinery and more particularly to improvements for engaging and disengaging slitter knives in slitter mechanisms.

In processing paper is is a usual operation to tranform wide-width rolls of paper as manufactured into rolls of narrower widths. This is accomplished by a machine known in the industry as a slitter which in the usual installation longitudinally advances a paper web between opposed sets of rotary knives.

Since slitting is performed at high speeds, the setting up of unslit rolls in such a machine is a frequent and relatively time consuming step in the slitting operation. This step includes leading the paper web between disengaged opposed sets of rotary knives, corresponding pairs of which in the engaged slitting position are in overlapping spring-pressed contact.

To disengage the spring-pressed knives without damaging the knife edges, it is first necessary to provide an axial separation of the knives followed by a radial separation thereof to provide clearance for the paper webs. For reengagements, the process is reversed: first radial, and then axial movement is required.

A mechanism for accomplishing axial and radial motion of the knives by a manual two stage operation is the subject of Langston Patent No. 2,305,536. The present invention provides a much simpler device for attaining such a knife motion which in addition is adaptable to automatic control.

It is accordingly one object of the present invention to provide a mechanism for engaging and disengaging opposed web slitting knives which produces both an axial and radial relative movement thereof.

An additional object is to provide a mechanism as described which is adaptable to automatic actuation such as by a hydraulic cylinder.

A further object of the invention is to provide a mechanism as described which provides an intermediate setting position of the opposed slitting knives, this position permitting an initial setting of the knives in their respective axial positions to produce the desired slitting widths.

Another object is to provide a mechanism as described of a compact simple design which may be actuated to engage and disengage the opposed sets of knives in an expeditious manner.

Additional objects and advantages of the invention will be more readily apparent from the following detailed discussion of an embodiment thereof when taken together with the accompanying drawings in which:

FIG. 1 is a fragmentary front elevational view of a slitting machine incorporating an embodiment of the present invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is an enlarged fragmentary view partly in section of the embodiment of FIG. 1;

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 3;

FIG. 5 is a sectional view taken along line 5—5 of FIG. 3;

FIG. 6 is a fragmentary front elevational view of the embodiment in the setting position;

FIG. 7 is a view as in FIG. 6 showing the knives in an initial disengaging step;

FIG. 8 is a view also in FIG. 6 showing the mechanism in the final disengaged position; and

FIG. 9 is a sectional view taken along line 9—9 of FIG. 2.

Referring to the drawings, FIG. 1 shows a preferred embodiment of the invention mounted on and between the usual vertical frame members 10 and 12 of a slitter. Since the invention is only concerned with means for engaging and disengaging the web slitting knives, the paper handling apparatus such as idler rolls, rewind rolls and guide bars such as shown in the Langston patent is not shown in the drawings although such apparatus would of course be employed in conjunction with the present mechanism to effect a practical slitting operation.

An upper slitter shaft asssembly generally designated 14 is mounted between the frame members 10 and 12. Slideably and adjustably mounted on the shaft 14 and extending downwardly therefrom are the upper slitter rotary knives 16. FIG. 1 shows the mechanism in the slitting position with the upper slitter knives 16 engaged in overlapping spring-pressured contact with the lower slitter rotary knives 18 which are driven in rotation by a lower slitter shaft (not shown) mounted on the frame members. The present invention provides a mechanism which disengages the upper slitter knives 16 from the lower slitter knives 18 first axially by providing axial movement of the upper knives 16 to the left, and radially by swinging the upper slitter knives into the position shown in broken lines in FIG. 2.

The mechanism which actuates the upper slitter knives 16 in the manner described is most clearly shown in FIG. 3. A fixed center tube or shaft 20 is mounted between the frame members 10 and 12. An outer tube 22 is rotatably supported on the fixed center tube 20 by bearings 24.

A cam ring 26 having identically shaped diametrically opposed cam projections 28 extending axially therefrom is secured to one end of the outer tube 22 by bolts 30 or other suitable means. A yoke 32 is journaled on the center tube 20 between the cam ring end of the outer tube 22 and the frame member 10. Diametrically opposed yoke studs 34 extend radially from the yoke. Rollers 36 on the studs 34 coact with the corresponding cam projections 28 extending from the cam ring 26 of the outer tube 22 as shown in FIGS. 3 and 4.

Parallel yoke arms 38 extending radially from the yoke 32 provide a pin connection 40 for an actuating rod 42 positioned therebetween. Although a variety of devices may be used to actuate the rod 42, the preferred embodiment incorporates a hydraulic cylinder 44 as shown in FIG. 2 to actuate the mechanism.

On the end of the outer tube 22 opposite the cam ring end, a locking collar 46 is secured by machine screws 48 or other convenient means. The locking collar 46 is positioned so as to extend beyond the end of the tube as shown in FIG. 3. A slot 50 in the outer radial face of the locking collar 46 coacts with a locking key 52 projecting axially inwardly from the frame member 12 as shown in FIG. 5.

A securing collar 54 mounted on the center tube 20 serves as a stop for the compression coil spring 56 which is mounted over the center tube 20 and bears against a thrust bearing 58 which abuts a bearing 24. The bearing is axially seated against an interior shoulder 60 of the outer tube 22, thus allowing the lateral compression spring force to be transmitted through the thrust bearing 58, bearing 24, and apply an axial force to the left against the outer tube 22.

Referring to FIGS. 1 and 2, brackets 62 having radially extending bracket arms 64 are adjustably mounted on

the slitter shaft 14. A rack 66 extending axially along the outer surface of the outer tube 22 is engaged by a pinion 68 rotatably mounted on the bracket arm 64 and actuated by the pinion control knob 70 as shown in FIG. 2. A bracket locking screw 72 is radially mounted for threaded advancement through the bracket into engagement with the outer tube 22.

As shown in FIGS. 2 and 9, a slitter spring arm 74 is perpendicularly mounted on the bracket arm 64 by fastening means 76. A slitter knife bearing assembly 78 is mounted on the lower end of the slitter spring arm 74 and supports the upper slitter rotary knives 16 mounted thereon.

The pattern of operation of the mechanism is more readily understood upon consideration of the function which the mechanism serves in the slitting operation. FIG. 9 shows an opposed set of rotary knives 16 and 18 which are in spring pressed overlapping contact due to the elastic spring force provided by the spring arm 74. A vertical separation of the contacting rotary knives while in this spring-biased relation would result in a destructive "snapping" of the corresponding blade peripheries. To avoid this harmful effect, the mechanism first accomplishes an axial separation of the blades followed by a vertical separation thereof as shown in the broken lines of FIG. 2. In addition, to permit an initial setting of the corresponding rotary knives, the mechanism provides an overlapping, contacting knife relation without spring pressure, the spring arm 74 being in the straight, vertical position shown by the broken lines of FIG. 9.

In operation, to accomplish the desired manner of separation of the knives, the slitter shaft 14, to which the upper slitter knives 16 are attached as described above, is laterally and rotationally actuated. As shown in FIG. 3 the compression coil spring 56 produces an axial force to the left on the outer tube 22, thus firmly engaging the cam projections 28 with the yoke stud rollers 36. The movement of the yoke stud rollers along the edge surface of the cam projections 28 combined with the spring force laterally positions the outer tube 22.

Movement of the actuating rod 42 acting through the yoke arms 38 rotates the yoke 32, yoke studs 34 and rollers 36. Hydraulic cylinder controls providing automatic stop settings at predetermined positions of the yoke can be used although not essential in controlling the mechanism for reasons appearing hereinafter.

The edge configuration 79 of the cam projections 28 is of particular importance inasmuch as it is determinative of the lateral positioning of the outer tube 22 in response to the relative movement of the yoke stud rollers 36 thereagainst. Each cam projection edge includes a slitting step portion 80, a setting step portion 82, and a disengagement notch 84 as shown in FIG. 3. In order to restrain the cam projections 28 and the outer tube 22 from rotating with the yoke 32 as the yoke rollers 36 move along the configured edges 79 of the cam projections, the locking key 52 is mounted on the frame member 12 so as to coact with the slot 50 of the locking collar 46. The slot 50 includes a locking notch 86 within which the key 52 is engaged by the lateral positioning effect of the rollers 36 on the outer tube 22 when the rollers 36 coact with the slitting steps 80 or the setting steps 82 of the configured edges 79. The locking key 52 when engaged with the locking notch 86 prevents rotation of the outer tube 22. When the rollers 36 engage the disengagement notches 84, the force of the spring 56 acting laterally to the left on the outer tube 22 frees the locking key 52 from the locking notch 86 as shown in FIG. 7.

Passing from the operational relationship of the components of the mechanism to the function thereof with respect to the resulting disengagement of the slitter knives, reference is made to FIG. 1 to show the assembly as it appears with the opposed sets of rotary knives 16 and 18 in the spring-pressed slitting position. To produce this slitting position of the knives the rollers 36 are moved into coacting relation with the slitting steps 80. Because of the shape of the configured edges 79 of the cam projections 28, coaction of the rollers with the slitting step results in a positioning of the outer tube 22 in its extreme lateral position to the right, thereby setting up the desired spring pressure of the spring arms 74. Rotation of the outer tube 22 is prevented in this position by the interaction of the locking key 52 with the locking notch 86. This is the position in which the machine is operated during the slitting process.

Actuation of the hydraulic cylinder to move the rollers 36 along the configured edge 79 into coaction with the setting step 82 results in a leftward movement of the outer tube 22 and the rotary knives positioned thereon while still maintaining engagement of the locking key 52 and locking notch 86. This leftward movement is of a degree sufficient only to release the spring pressure provided by the spring arm 74 while maintaining contact of the opposed rotary knives. It is in this setting position that the initial lateral positioning of the brackets 62 and their attached knives 16 is accomplished by manipulation of the pinion control knob 70 and the bracket locking screw 72. The lower slitter rotary knives 18 are first positioned in accordance with the desired slit paper widths, accomplished in a manner known in the art. With the bracket locking screw 72 loosened, each bracket 62 is laterally moved along the outer tube 22 by rotation of the pinion knob 70 which actuates the pinion 68 with the rack 66 until the knives 16 are in contact with the knives 18.

The bracket locking screw 72 is then tightened into engagement with the outer tube 22, thus locking the brackets 62 on the outer tube. This completes the initial setup of the knives and further actuation of the knife engagement and disengagement mechanism is accomplished entirely by the hydraulic cylinder.

Advancement of the rollers 36 into the disengagement notch 84 permits additional lateral movement to the left of the outer tube 22, producing an axial clearance 88 between the opposed knives and also disengaging the locking key 52 from the locking notch 86, as shown in FIG. 7. The axial separation of the knives having been effected, radial separation thereof may now take place without danger of damage to the knife edges. Since the locking key 52 has been disengaged, the outer tube 22 is free to rotate with the rollers 36 within the limits of the slot 50. Rotation of the tube 22 by the rollers 36 as shown in FIG. 8 so as to move the shoulder 90 of the slot 50 towards the locking key 52, swings the upper slitter rotary knives 16 into the raised position shown in FIGS. 8 and 2 (broken lines), thus providing sufficient clearance between the opposed knives 16 and 18 to permit threading of a paper web therebetween. Clearance is normally provided so that the shoulder 90 does not contact the key 52 when the tube is rotated to this position.

To re-engage the knives after the web has been positioned therebetween, the hydraulic cylinder is actuated in the reverse direction causing a reverse rotation of the outer tube 22 back to the position shown in FIG. 7, at which point the locking key 52, engaging the locking notch 86, halts further rotation of the tube 22. The rollers, continuing along the edge 79 of the cam projection 28, advance to the setting steps 82 and axially position the tube 22 so as to engage the locking key 52 in the locking notch 86 as shown in FIG. 6. The knives 16, having been lowered by the rotation of the tube 22, are brought in contact with the knives 18 by the advancement of the rollers 36 into the setting position. With the tube 22 locked by the locking key 52, the rollers 36 are advanced into the slitting position shown in FIG. 1, thus laterally positioning the tube 22 so as to set up the desired spring pressure of the spring arm 74 as indicated in FIG. 9. The re-engagement phase and also the disengagement phase are accomplished by one continuous stroke of the hydraulic cylinder, permitting the phases to be rapidly effected.

To summarize the basic steps in the operation of the mechanism, with the upper knives **16** in the raised position shown in FIG. 8, the lower knives **18** are laterally positioned to correspond with the required slit widths of the paper web. By means of the adjusting knobs and screws **70** and **72** the brackets **62** are positioned on the tube **22** in an approximate manner so that the knives **16** will clear the knives **18** when they are dropped into the lower position. The mechanism is then actuated into the setting position shown in FIG. 6 following which each bracket **62** is moved along the tube **22** by means of the rack and pinion until the knives **16** are in contact with the knives **18**. The bracket locking screws **72** are then secured and the mechanism is moved back into the raised position of FIG. 8.

The knives having been laterally positioned, a paper web is led between the opposed sets of knives and the mechanism is actuated into the slitting position shown in FIG. 1. The web is then moved through the slitting knives and is slit into the width determined by the lateral positioning of the knives. Upon completion of a slitting operation, the knives are returned to the position shown in FIG. 8 either to permit threading of additional paper webs, or to permit changing of the lateral knife positions to attain different slitting widths.

Manifestly minor changes in details of construction can be effected by those skilled in the art without departing from the spirit and the scope of the invention as defined in and limited solely by the appended claims.

I claim:

1. In a slitter for slitting paper webs by advancing a web between upper and lower opposed overlapping spring-pressed knives, a mechanism for engaging and disengaging the knives to allow introduction of a web therebetween comprising a center tube mounted in said slitter, an outer tube rotatably and slidably mounted over said center tube, means securing the upper knives to said outer tube, and means providing selective and sequential lateral and rotational actuation of said outer tube including a cam ring secured on one end of said outer tube defining a plurality of circumferentially arrayed steps extending axially therefrom, camming means operable for coacting with said steps for laterally moving said outer tube to provide an axial positioning of the upper knives and to provide a limited rotation of said outer tube for radial movement of the upper knives, means resiliently biasing said steps against said camming means, and means limiting rotation of said outer tube.

2. A mechanism as claimed in claim 1, said steps providing an intermediate setting position of the knives characterized by a pressure-free overlapping contact of the upper and lower knives.

3. A mechanism as claimed in claim 2, said camming means coacting with said steps including a yoke journaled on said center tube adjacent the cam ring end of said center tube, a yoke stud extending radially from said yoke, a roller mounted on said yoke stud coacting with said steps, and means for actuating said yoke in rotation, whereby rotation of said yoke results in a camming action of said roller with said steps.

4. A mechanism as claimed in claim 3, said means limiting rotation of said outer tube including a locking collar mounted on said outer tube, a slot in said locking collar, a locking notch within said slot, and a locking key adapted for coacting with said slot and notch.

5. A mechanism as claimed in claim 4, said means resiliently biasing said steps against said roller comprising a coil spring mounted over said center tube and in operative engagement with said outer tube for effecting a lateral spring force on said outer tube.

6. A mechanism as claimed in claim 5, said means actuating said yoke in rotation including radially extending arms on said yoke, an actuating rod pivotally connected with said arms, and a hydraulic cylinder coactively connected to said actuating rod.

7. A mechanism as claimed in claim 6, said means securing the upper knives to said outer tube including a rack laterally disposed on said outer tube, brackets slidably positioned on said outer tube, pinions on said brackets engaging said rack to provide lateral bracket positioning means, spring arms extending from said brackets having the upper knives mounted thereon, and means operable for locking said brackets on the outer tube in the desired lateral position.

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