United States Patent [19]

Tokuno

[11] **3,920,502**

[45] **Nov. 18, 1975**

[54] **APPARATUS FOR SPLICING PAPER ROLLS**

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[73] Assignee: **Rengo Co., Ltd.,** Osaka, Japan

[22] Filed: **Aug. 7, 1973**

[21] Appl. No.: **386,293**

[30] **Foreign Application Priority Data**

Mar. 7, 1973 Japan 48-26748
Apr. 24, 1973 Japan 48-47068

[52] **U.S. Cl.** **156/504;** 156/159; 156/505; 242/58.2; 242/58.3

[51] **Int. Cl.²** **B65H 19/08**

[58] **Field of Search** 156/502, 504, 505, 506, 156/507, 159; 242/58.1, 58.2, 58.3, 58.4, 58.5

[56] **References Cited**

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Primary Examiner—William A. Powell
Assistant Examiner—Brian J. Leitten
Attorney, Agent, or Firm—Stewart and Kolasch, Ltd.

[57] **ABSTRACT**

The present invention relates to a method and apparatus for splicing webs of paper, and more particularly, to a method and apparatus for splicing a leading end of a fresh paper roll, which is not yet unwound, with a running web of an expiring paper roll which is being successively unwound. The two paper rolls are supported by means of a mill stand which is capable of rotatably supporting a pair of paper rolls rotating in opposite directions.

8 Claims, 33 Drawing Figures

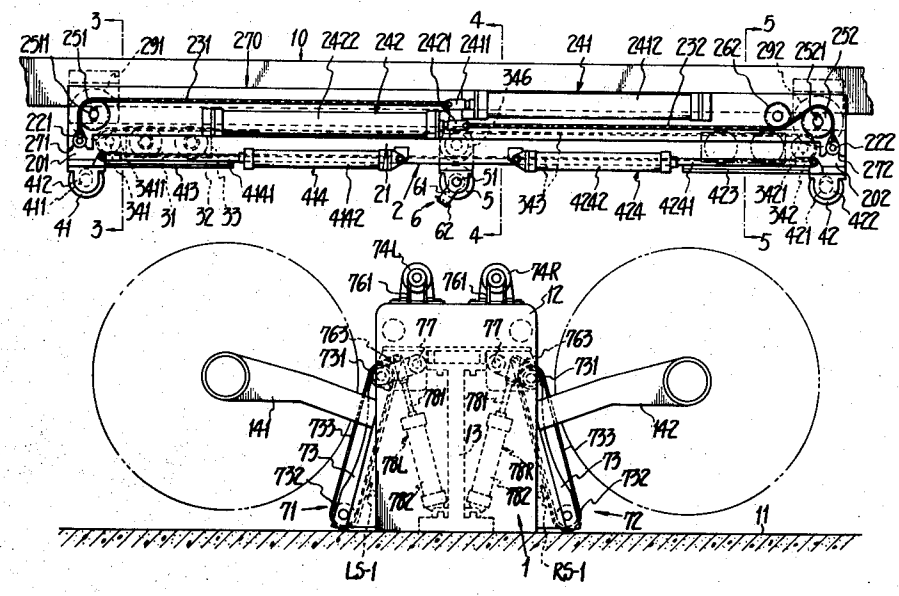
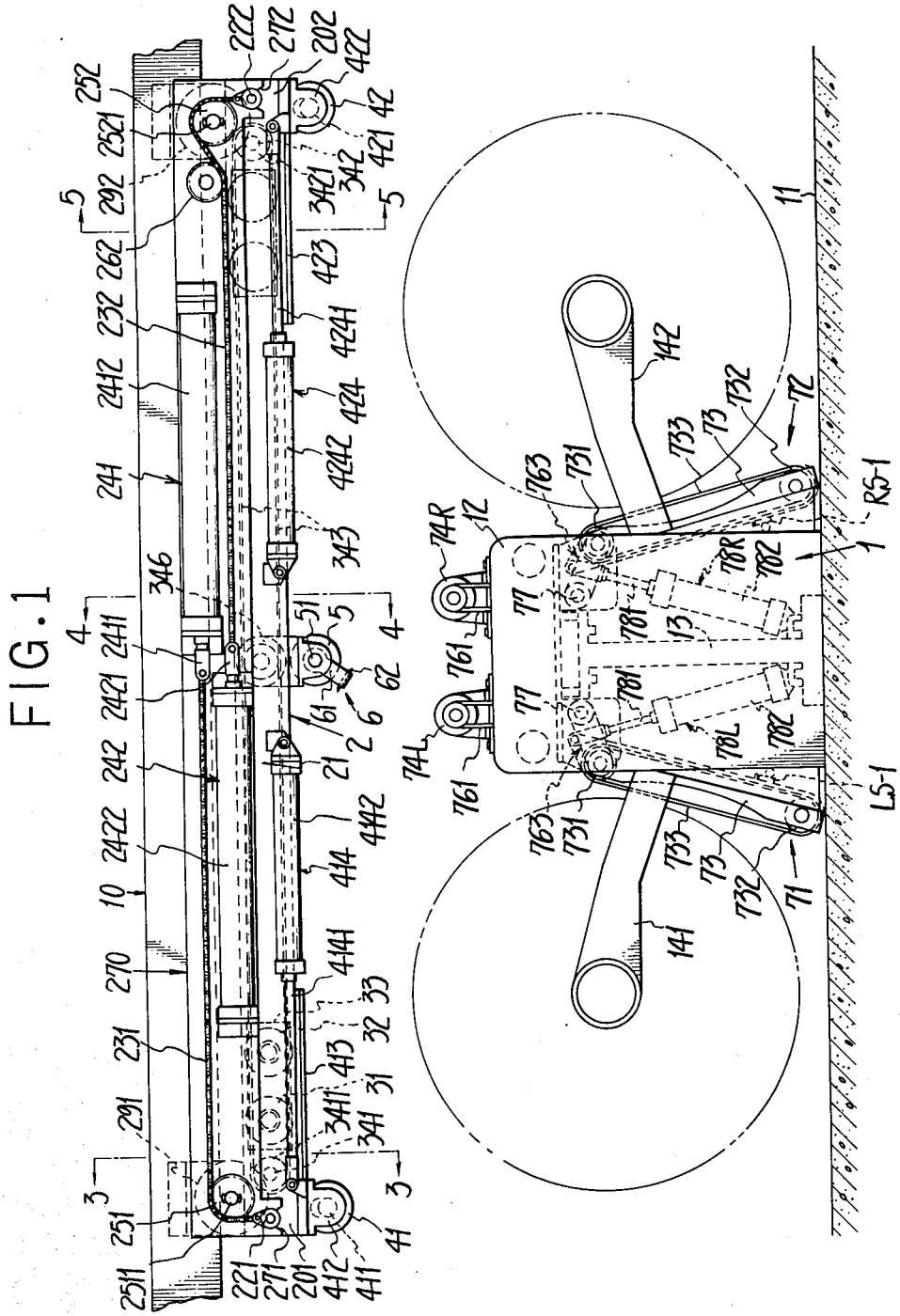


FIG. 1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4442
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414
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3411
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2511
221
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201
412
411
41
11
142
732
72
733
73
763
731
74R
12
R5-1
1
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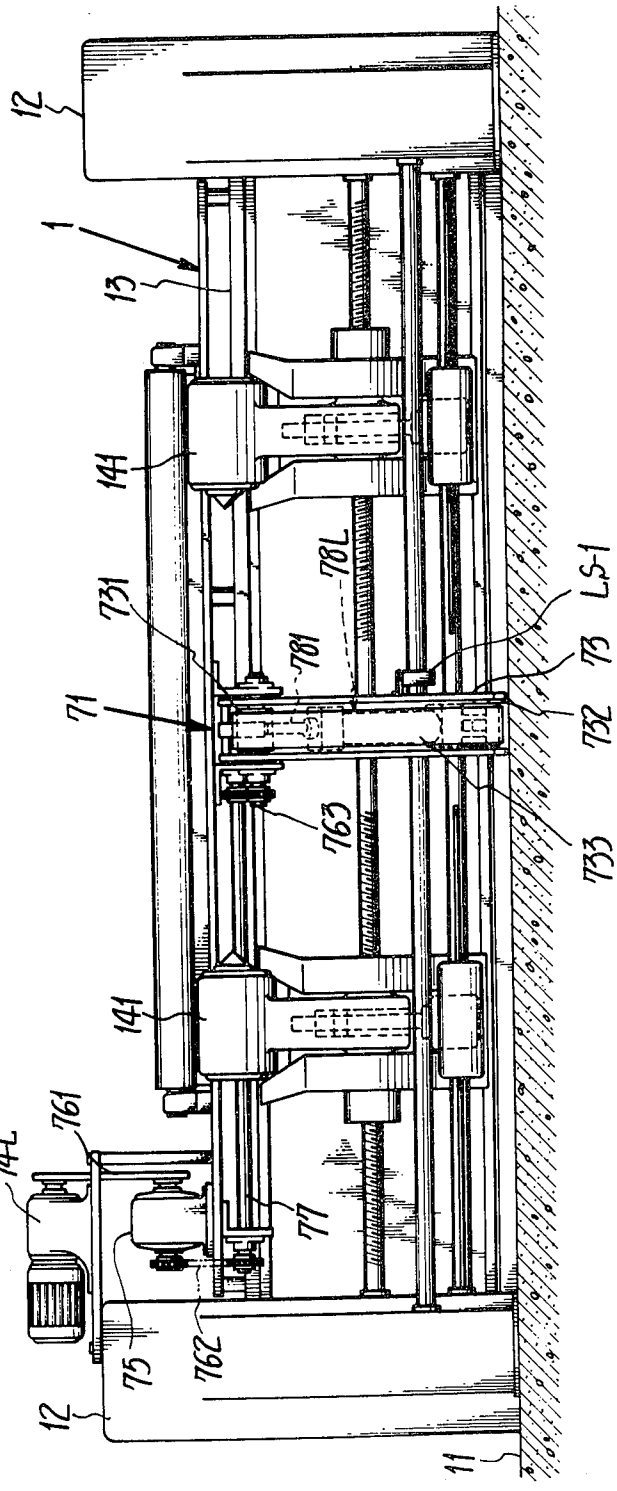
782
781
13
77
761
744
78L
L5-1
71
141

FIG. 2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141
731
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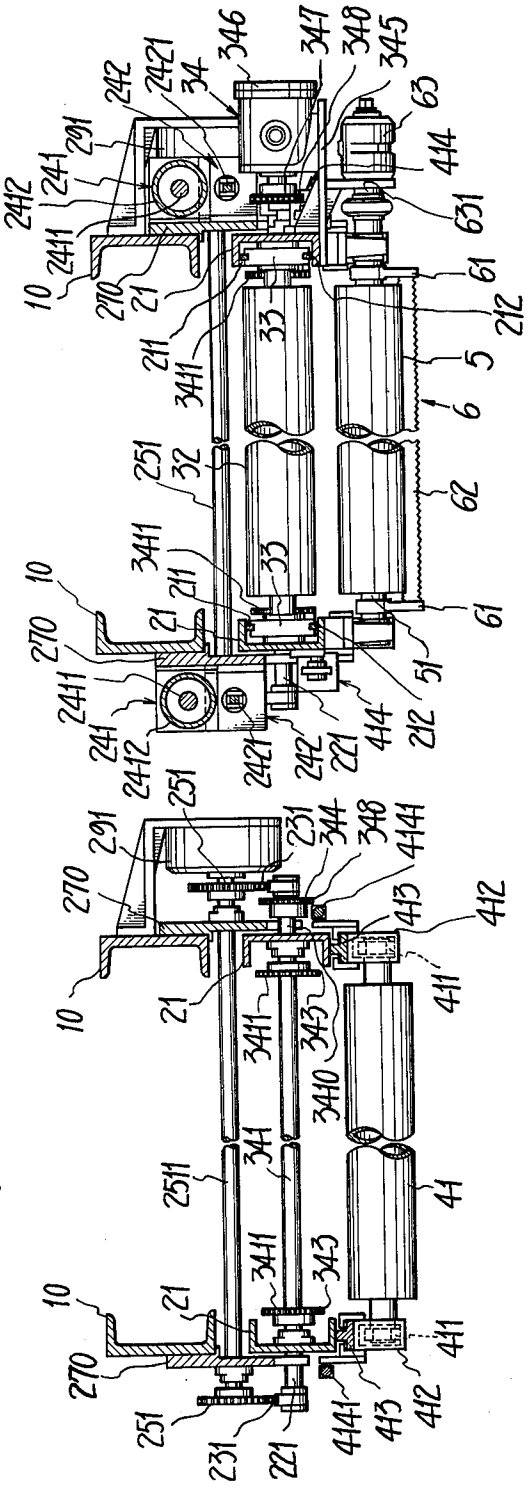
762
12
11

FIG. 4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211
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33
3411
5
1
6
251
32
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3411
211
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270
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61
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221
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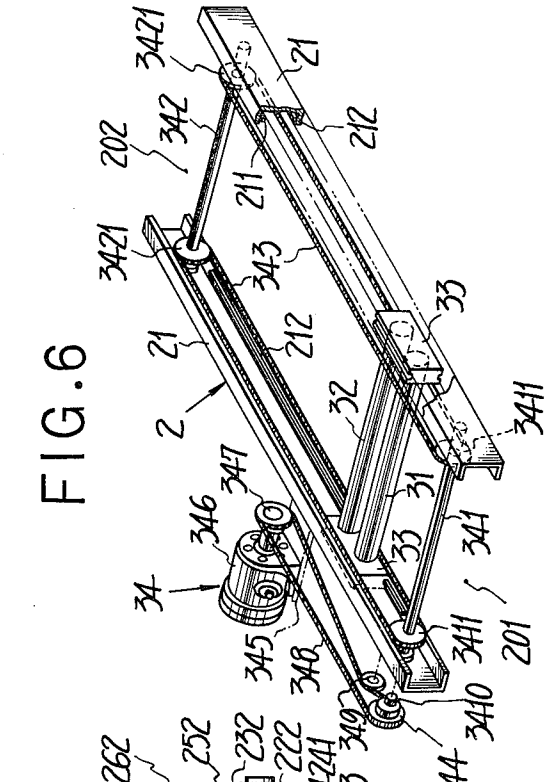
FIG. 3

FIG. 6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348
3411
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3410
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4241
423
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252

FIG. 5

FIG. 9

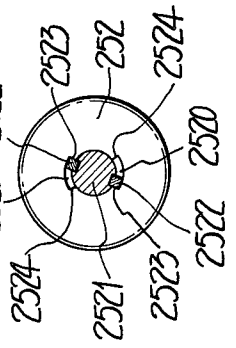


FIG. 8

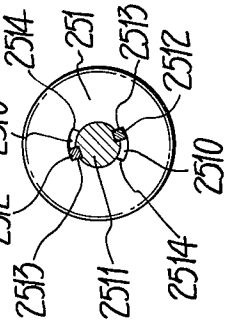


FIG. 7

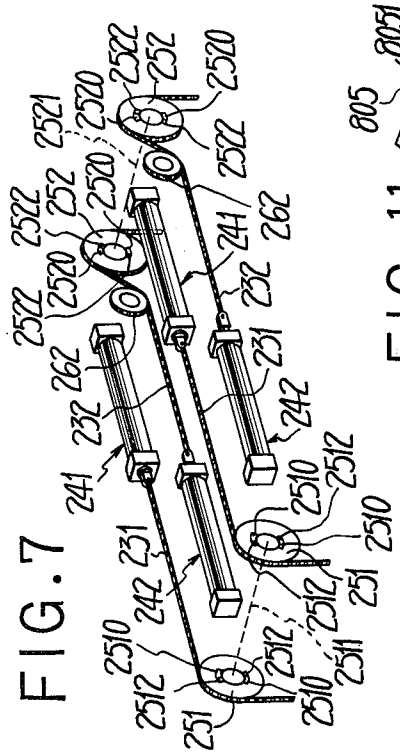


FIG. 11

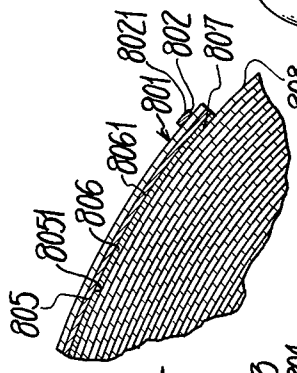


FIG. 12

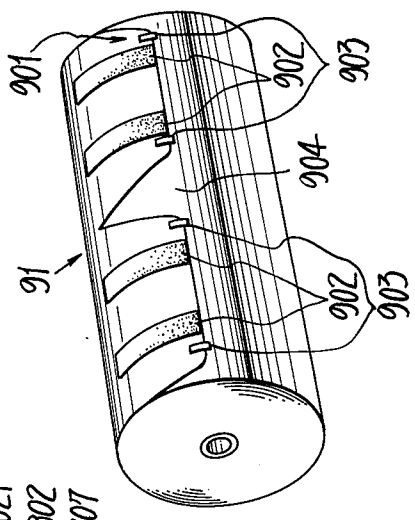


FIG. 10

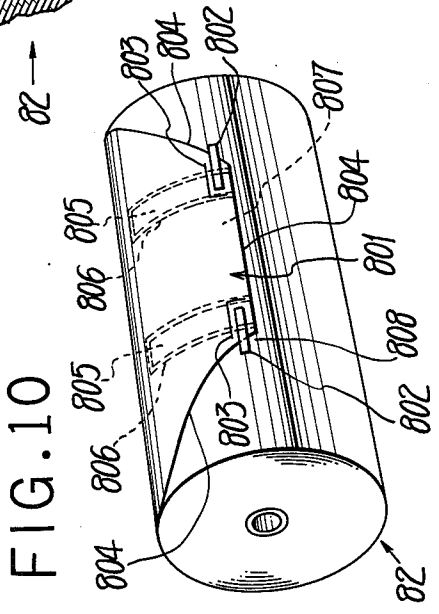
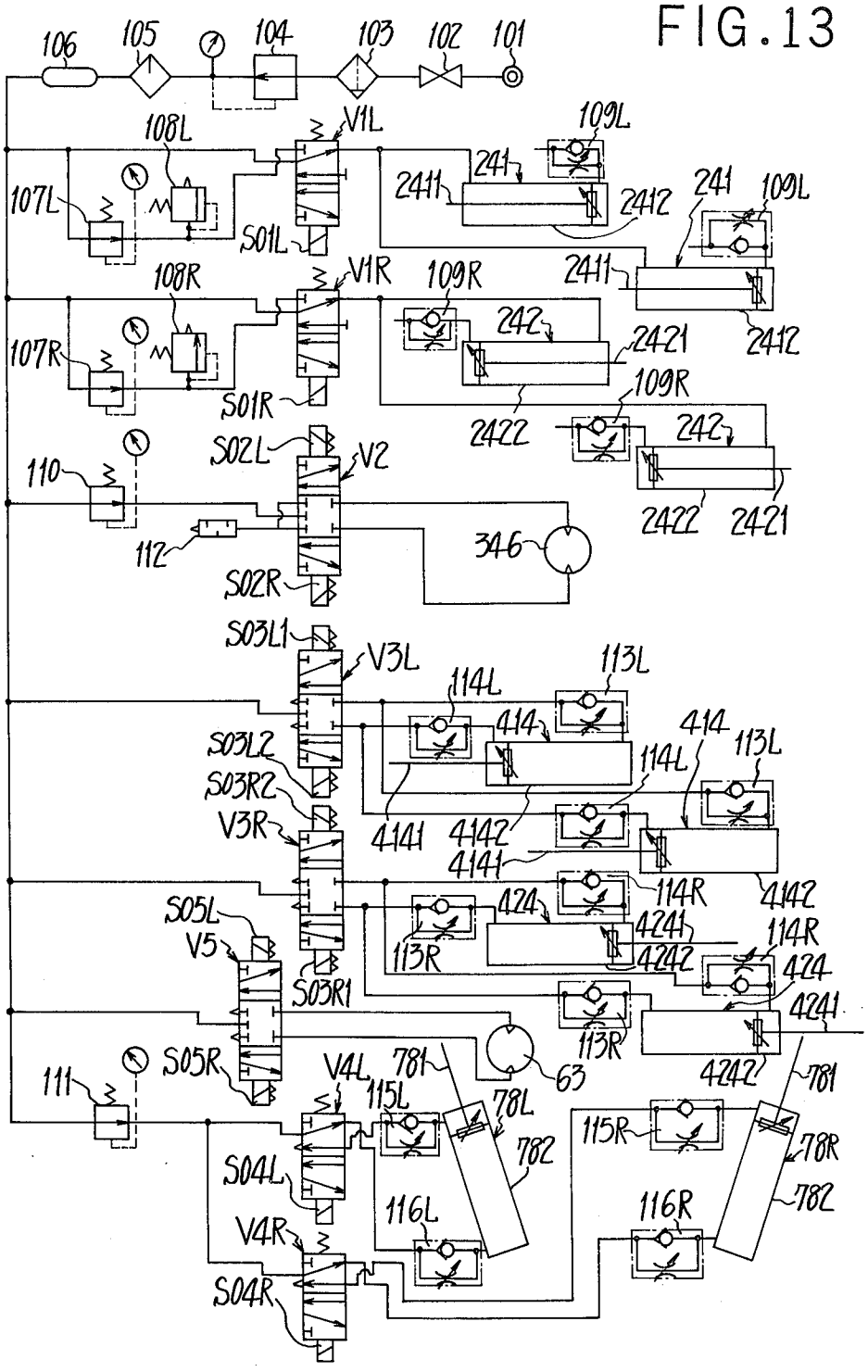


FIG. 13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103
102
101
108L
V1L
109L
107L
S01L
241
2411
2412
108R
V1R
109R
107R
S01R
242
2421
2422
110
S02L
V2
112
S02R
346
S03L1
V3L
114L
113L
414
S03L2
S03R2
V3R
4141
4142
S05L
V5
S03R1
424
4241
4242
113R
114R
111
S05R
V4L
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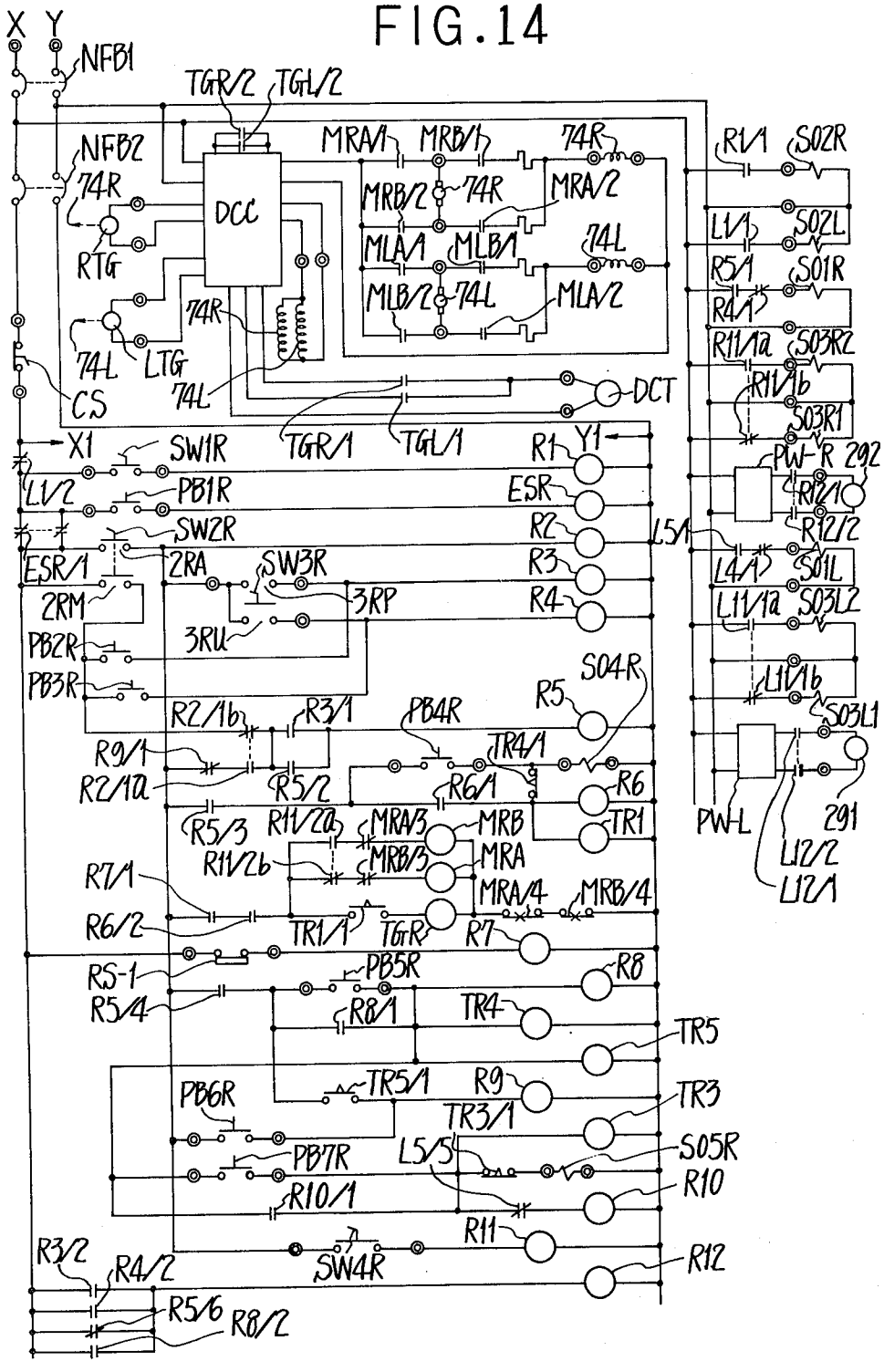
78L
782
63
115R
78R
S04L
116L
V4R
116R
S04R

FIG. 14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Y
NFB1
TGR/2
TGL/2
NFB2
74R
RTG
DCC
MRA/1
MRB/1
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MRA/2
MLA/1
MLB/1
74L
MLB/2
74L
MLA/2
74R
74L
LTG
CS
74L
DCT
X1
SW1R
TGR/1
TGL/1
R1
Y1
L1/2
PB1R
ESR
SW2R
R2
ESR/1
2RA
SW3R
R3
2RM
3RP
R4
3RU
PB2R
PB3R
R2/1b
R3/1
PB4R
R5
S04R
R9/1
R2/1a
R5/2
TR4/1
R6/1
R6
R5/3
R11/2a
MRA/3
MRB
TR1
R11/2b
MRB/3
MRA
R7/1
MRA/4
MRB/4
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TR1/1
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R7
R5-1
PB5R
R8
R5/4
R8/1
TR4
TR5
PB6R
TR5/1
R9
TR3
TR3/1
PB7R
L5/5
S05R
R10/1
R10
R11
R3/2
R4/2
SW4R
R12
R5/6
R8/2
R1/1
S02R
L1/1
S02L
R5/1
S01R
R4/1
R11/1a
S03R2
R11/1b
S03R1
PW-R
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R12/1
R12/2
L5/1
L4/1
S01L
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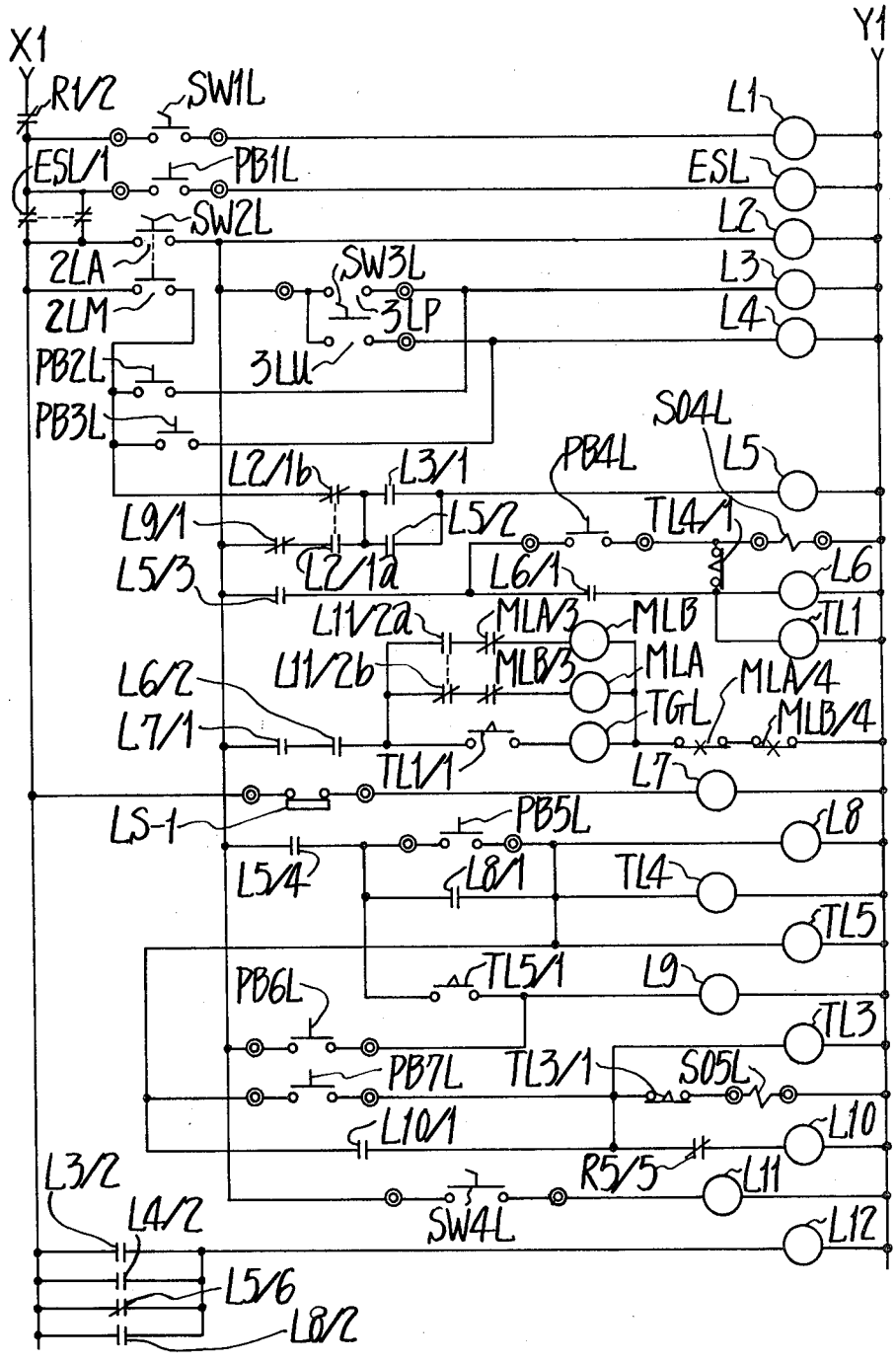
S03L2
L11/1b
S03L1
PW-L
291
L12/2
L12/1

FIG. 15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Y1
R1/2
SW1L
L1
ESL/1
PB1L
ESL
SW2L
L2
2LA
SW3L
L3
2LM
3LP
L4
3LU
PB2L
PB3L
S04L
L2/1b
L3/1
PB4L
L5
L9/1
L5/2
TL4/1
L5/3
L2/1a
L6/1
L6
L11/2a
MLA/3
MLB
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MLA
MLA/4
L7/1
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TL1/1
L7
LS-1
PB5L
L8
L5/4
L8/1
TL4
TL5
PB6L
TL5/1
L9
TL3
PB7L
TL3/1
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L4/2
SW4L
L12
L5/6
L8/2

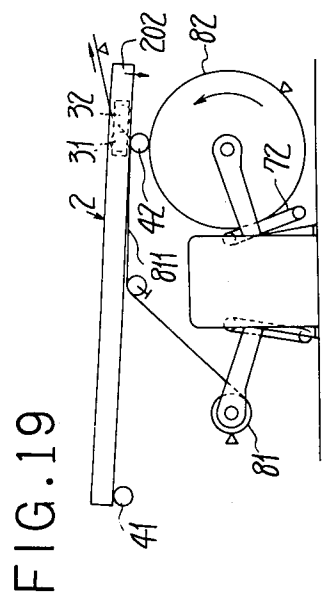

FIG. 19

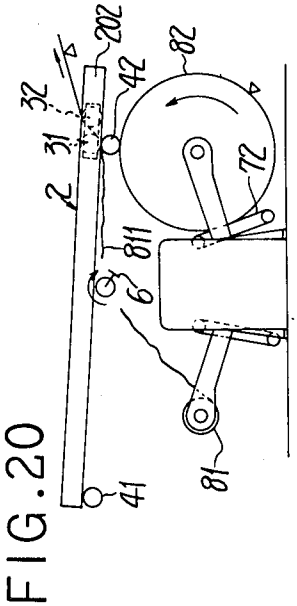

FIG. 20

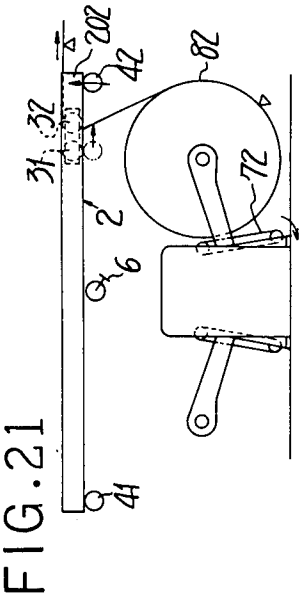

FIG. 21

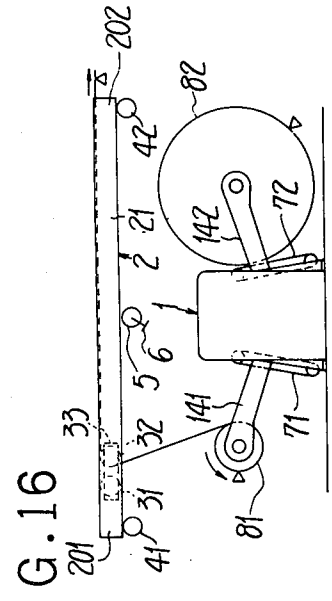

FIG. 16

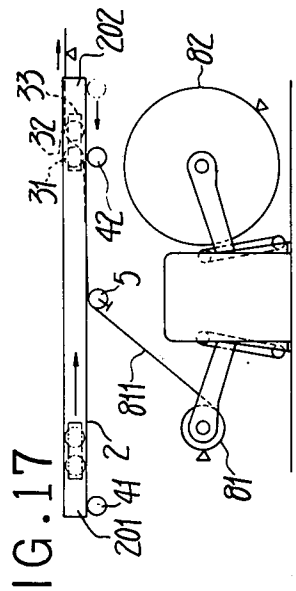

FIG. 17

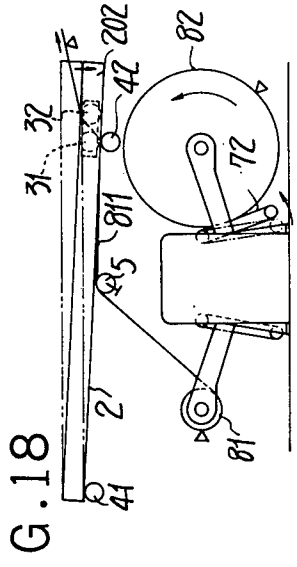

FIG. 18

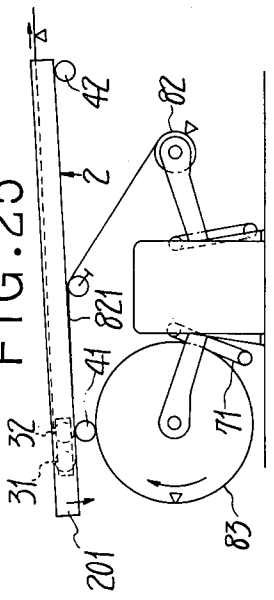
FIG.25
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32
42
2
82
821
41
71
201
83

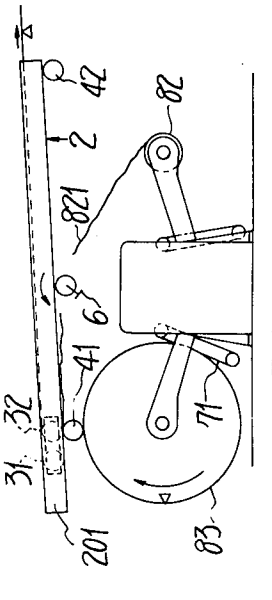
FIG.26
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821
6
41
71
201
83

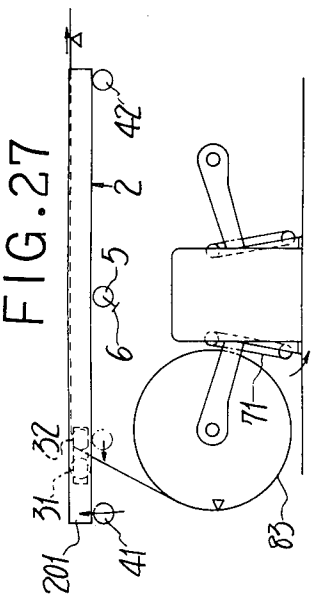
FIG.27
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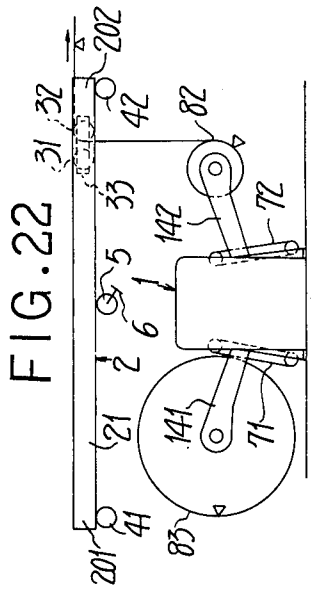
FIG.22
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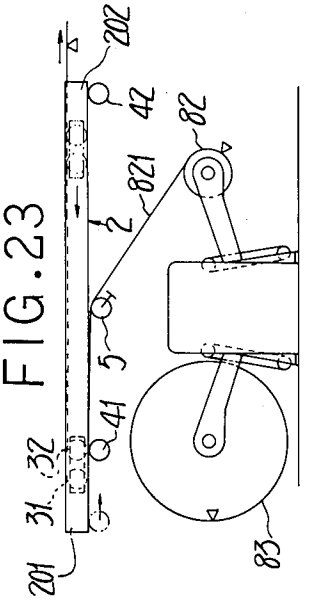
83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821
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5
41
71
201
83

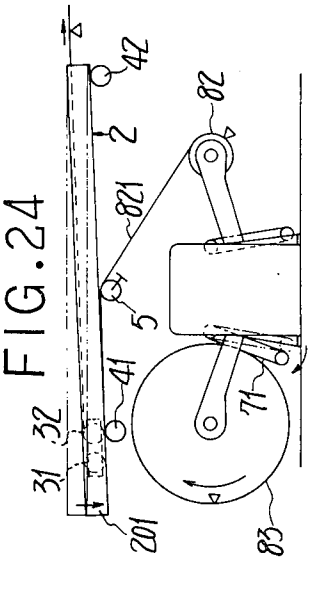
FIG.24
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201
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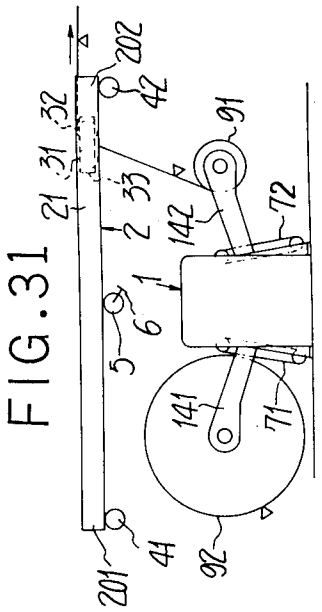

FIG. 31

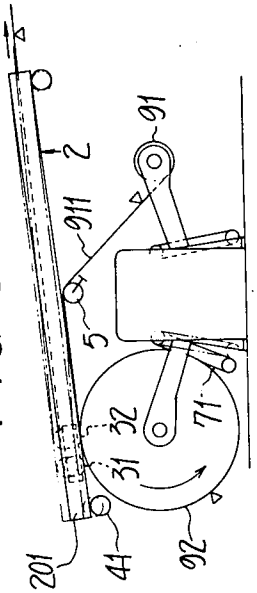

FIG. 32

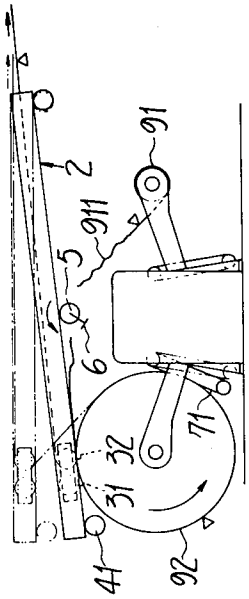

FIG. 33

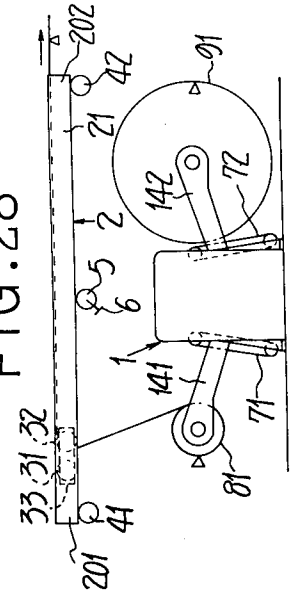

FIG. 28

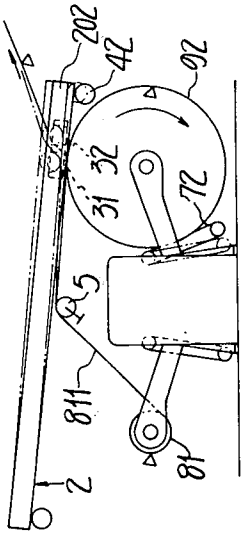

FIG. 29

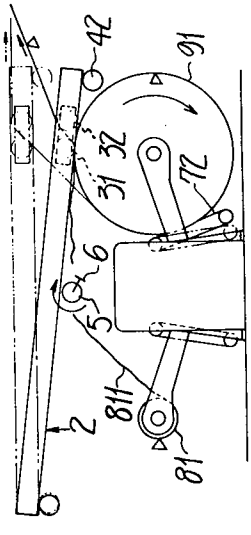

FIG. 30

APPARATUS FOR SPLICING PAPER ROLLS

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to a method and apparatus for splicing a leading end of a fresh paper roll, which is not yet unwound, with a web running from an expiring paper roll which is being continuously unwound, so that the smooth face of the leading end may follow the smooth face of the running web and the rough face of the leading end may follow the rough face of the running web. More particularly, the present invention is directed to a method and apparatus for splicing webs of liner for corrugated boards.

Conventionally, the splicing operation of webs of paper has been performed by the following operation: An expiring paper roll and a fresh paper roll are suspended from a stand (as seen in a Lang Stone type of mill stand of a machine for manufacturing corrugated boards), which is capable of rotatably supporting a pair of paper rolls rotating in opposite directions. A short time before the expiring paper roll becomes depleted, the unwinding speed of the expiring paper roll is considerably reduced. Then, an operator rotates the fresh paper roll manually and another operator draws out the leading end of the fresh paper roll. The leading end is then spliced with the slowly running web from the expiring paper roll using a binding agent or an adhesive tape, so that the smooth face of the leading end may follow the smooth face of the running web and the rough face of the leading end may follow the rough face of the running web. The running web from the expiring roll is then cut away. In order to perform this kind of web-splicing operation, a number of related processes must be reduced in speed to compensate for the slow down in the roll rotation for effecting the transition from the expiring roll to the fresh roll.

An object of the present invention is to provide a method and apparatus for splicing a fresh paper roll with a running web which is being continuously withdrawn from an expiring paper roll, wherein the operational speed of the apparatus is not required to be reduced. In the splicing operation the respective inside and outside of the paper rolls are aligned, and the exhausted or expired paper roll is cut away.

Another object of the present invention is to provide a method and apparatus for splicing paper rolls evenly and securely across their respective widths when splicing the web from the expiring paper roll with the leading end of the fresh paper roll.

A further object of the present invention is to provide a compact apparatus for splicing the paper rolls, wherein the operation is limited to a small space so that the paper rolls and supporting stand can be readily incorporated into existing machinery.

Other objects and further scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since variuos changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention and wherein,

FIG. **1** shows a side view showing an apparatus for splicing paper rolls in accordance with the present invention,

FIG. **2** is a front view showing a mill stand equipped with a predriver,

FIG. **3** is a sectional view, taken along a line **3** — **3** of FIG. **1**,

FIG. **4** is a sectional view taken, along a line **4** — **4** of FIG. **1**,

FIG. **5** is a sectional view, taken along a line of **5** — **5** of FIG. **1**,

FIG. **6** is a schematic perspective view showing a roll shaft holding plate driving portion, several portions thereof being somewhat displaced in position,

FIGS. **7** to **9** illustrate how guiding sprockets for guiding the chains which suspend the roll supporting frames are mounted to sprocket shafts,

FIGS. **10** and **11** are, respectively, a perspective view and an essential sectional vew showing the paper roll employed in the paper roll splicing operation when using an intermediate roll,

FIG. **12** is a perspective view showing the paper roll employed in the paper roll splicing operation when not using the intermediate roll,

FIG. **13** is a diagram of a pneumatic circuit for splicing webs of paper in accordance with the present invention.

FIGS. **14** and **15** are, respectively, a diagram of an electrical circuit for the apparatus for splicing paper rolls in accordance with the present invention,

FIGS. **16** to **27** show, sequence, the paper roll splicing operation performed by the use of an intermediate roll, and

FIGS. **28** to **33** show, in sequence, the paper roll splicing operation performed without the use of an intermediate roll.

Before we proceed with the description of the present invention, it is to be noted that identical elements are designated by the same reference numerals throughout the various views the accompanying drawings.

The method and apparatus of the present invention will be described in connection with paper rolls for corrugated board liner which are spliced with each other in a corrugate machine, that is, a corrugated board manufacturing machine.

As shown in FIG. **16,** a paper roll **81** for corrugated board liner is supported on the front side of a mill stand **1** which rotatably supports two paper rolls in an opposing face-to-face relationship. The paper roll **81** (the rough face of the web of the roll **81** faces outwardly, and the rough face is indicated by a Δ mark in the drawing) is rotated counter-clockwise in FIG. **16,** so that the paper drawn from the roll may extend between a pair of paper pushing rolls **31** and **32** located above the mill stand **1.** The paper web, as it is drawn out, is in contact with the rotating paper roll **32.**

As apparent from FIGS. **1** and **2,** in the mill stand **1** of a Lang Stone type, and I-shaped (in section) long center frame **13** is secured, at both ends, to opposing

side frames 12 and 12, and is erected on a foundation 11. A pair of arms 141 and 141 are provided on the front face side of the center frame 13 so that they can contact each other or be separated from each other for loading and unloading the paper rolls. The arms can also be moved vertically. Similarly a pair of arms 142 and 142 (only one arm is shown in the drawings) are provided on the rear face side of the center frame 13 and are adapted to operate in the same manner as arms 141. The pair of arms 141 and 141, and the pair of arms 142 and 142 rotatably support the paper rolls at the respective front ends.

As shown in FIGS. 1, 4 and 6, the pair of paper pushing rolls 31 and 32 are arranged in parallel with each other and with the width direction of the paper roll. The rolls are also rotatably mounted between a pair of roll shaft holding plates 33 and 33. Parallel side rods 21 and 21, of the roll supporting frame 2 are groove-shaped and extend from one paper roll to the other paper roll above the mill stand. The roll shaft holding plate 33 is movably engaged with the rails 211 and 212 so that it can be shifted from near one end 201 of the roll supporting frame 2 to near the other end 202 thereof with the paper pushing rolls 31 and 32 supporting thereon.

As apparent from FIGS. 1 and 3, a shaft 221 is secured to one end 201 of the roll supporting frame 2, and projects, at both of its ends, from the outer face of the side rods 21 and 21. Similarly, shaft 222 is secured to the other end 202 of the roll supporting frame 2 and projects, at both of its ends, from the outer face of the side rods 21 and 21. One end of a pair of chains 231 and 231 is connected to both ends of the shaft 221, while the other end of the chains 231 and 231 is connected to piston rods 2411 and 2411 of a pair of air cylinders 241 and 241. One end 201 of the roll supporting frame 2 is suspended by securing these pair of air cylinders to plates 270 and 270 which are secured to both side faces of a substantially horizontal frame 10 placed above the mill stand 1. Also, one end of a pair of chains 232 and 232 is connected to both ends of the shaft 222, while the other end of chains 232 and 232 is connected to the piston rods 2421 and 2421 of a pair of air cylinders 242 and 242. The air cylinders are secured to the plates 270 and 270 thereby suspending the other end 202 of the roll supporting frame 2. The pair of chains 231 and 231 are guided by a pair of guiding sprockets 251 and 251, which are rotatably mounted on the frame 10 as shown in FIGS. 1, 3, 7 and 8, and are keyed to the both ends of a sprocket shaft 2511 which project from the plates 270 and 270. The width of a key groove 2510 on each guiding sprocket 251 is slightly bigger than that of a key 2512 secured to the shaft 2511 so that the sprocket 251 may loosely rotate with respect to the shaft 2511. Key grooves 2510 and 2510 of a pair of sprockets 251 and 251, and keys 2512 and 2512 engaged therewith are provided to align the shaft in the axial direction.

The pair of chains 232 and 232 are guided by a pair of guiding sprockets 252, 252 and 262, 262. As apparent from FIGS. 1, 5, 7 and 9, the guiding sprockets 252 and 252 are keyed to both ends of a sprocket shaft 2521 which is rotatably mounted on the plates 270. The width of a key groove 2520 on each guiding sprocket 252 is slightly bigger than that of a key 2522 secured to the shaft 2521 so that the sprocket 252 may slightly rotate without rotating the shaft 2521. Also, the guiding sprockets 262 and 262 are rotatably mounted on the plates 270 and 270. Retraction of the piston rod 2411 of each air cylinder 241 into the cylinder tube 2412, and retraction of the piston rod 2421 of each air cylinder 242 into the cylinder tube 2422, respectively, causes both ends of the shaft 221 of the roll supporting frame end to be engaged into a notch 271 provided in one end of the each plate 270, and both ends of the shaft 222 of the roll supporting frame end to be engaged into a notch 272 provided at the other end of the plate 270. Accordingly, as shown in FIG. 1, the roll supporting frame 2 is stabilized almost horizontally. Also, under the condition where the roll supporting frame 2 is stabilized almost horizontally, each key 2512 of the sprocket shaft 2511 is engaged with the side face 2513 of the key groove 2510 of the guiding sprocket 251, and each key 2522 of the sprocket shaft 2521 is engaged with one side face 2523 of the key groove 2520 of the guiding sprocket 252. When the piston rod 2411 of air cylinder 241 and the piston rod 2421 of the air cylinder 242 are extended or retracted, one end 201 or the other end 202 of the roll supporting frame 2 can be raised or lowered with the shaft 222 or the shaft 221 as a pivotal point. A solenoid-operated brake 291 secured to the frame 10 is connected to an end of the shaft 2511 of the sprockets 251 and 251 guiding the chains 231 and 231, and a solenoid-operated brake 292 secured to the frame 10 is connected to an end of the shaft 2521 of the sprockets 252 and 252 guiding the chains 232 and 232.

A roll shaft holding plate driving means 34 is additionally provided on the roll supporting frame 2 to drive the roll shaft holding plates 33 and 33. As apparent from FIG. 6, the roll shaft holding plate driving means 34 comprises a shaft 341 rotatably mounted on side rods 21 and 21 in one end 201 of the roll supporting frame 2, and a shaft 342 mounted on the side rods 21 and 21 in the other end 202 of the roll supporting frame 2. A pair of sprockets 3411 and 3411 are secured to both ends of the shaft 341 between the side rods 21 and 21, and a pair of sprockets 3421 and 3421 are rotatably engaged with both ends of the shaft 342. A pair of endless chains 343 and 343 are placed along the side rods 21 and 21 of the roll supporting frame and are entrain on the sprockets 3411 and 3421. The chains are also connected to the roll shaft holding plates 33 and 33. A sprocket 344 secured to the end 3410 of the shaft 341 projects from the outer face of the side 21, and a rotating air motor 346 disposed on a motor supporting plate 345 projects from an approximate middle portion of the side rod 21. A sprocket 347 is secured to the shaft of the motor 346, and an endless chain 348 is entrained on sprocket 347, and sprocket 349, the latter sprocket being mounted on the side rod 21. Chains 343 and 343 are reciprocably rotated by the air motor 346 thereby shifting the roll shaft holding plates 33 and 33 from near one end 201 of the roll supporting frame 2 to near the other end 202 thereof.

A fresh paper roll 82 for corrugated board liner which is to be spliced with the web 811 from the paper roll 81 is rotatably supported on the rear side of the mill stand 1 as described in FIG. 16 so that it may be unwound by rotating it counter-clockwise in the drawing. The rougher force of the web of the paper roll 82 is also forced outwardly. In the paper roll 82, as shown in FIGS. 10 and 11, two small double-sided adhesive tapes 802 and 802 are applied on both corners of the outer

face of a leading end **801**, the corners of which are cut respectively into a triangle, thereby forming a trapezoid. The respective end of each tape **802** is extended somewhat beyond the leading end **801**. The leading end **801** is cut so that the cut lines **803** and **803** substantially surround the double-sided adhesive tape **802**. Furthermore, both ends of each cut line **803** approaches very close to the respective edge **804** of the leading end **801**. Double-sided adhesive tapes **805** and **805** are applied upon the inner face of the leading end **801**, and single faced adhesive tapes **806**, and **806** whose top faces **8061** and **8061** are treated into a non-binding face are applied upon the surface **807** of the paper roll **82**. The unadhered face **8051** of each double-sided adhesive tape **805** applied on the inner face of the leading end **801** is superposed upon the single faced adhesive tape top face **8061** which is treated into a non-binding face, and the respective ends of the double-sided adhesive tapes **802** which are extended beyond the leading end **801** is applied upon the paper roll outer face **808**. Each single face adhesive tape **806** is provided with an area of almost same size as the double-sided adhesive tape **805** or an area somewhat bigger than the tape **805**. Also, the respective end edge of the double-sided adhesive tape **805** and the single faced adhesive tape **806** are approximately aligned with the leading end edge **804**.

When the paper roll **81** becomes smaller under such a condition as shown in FIG. **16**, the air motor **346** of the roll supporting frame **2** is rotated thereby rotating the chains **343** and **343**. Accordingly, the roll shaft holding plates **33** and **33** are shifted thereby moving the paper pushing rolls **31** and **32** toward the end **202** of the roll supporting frame **2** as shown in FIG. **17**. Furthermore, an intermediate roll **42** is placed under the paper pushing roll **31**. As described hereinbefore, as the paper pushing rolls **31** and **32** move closer to the end **202** of the roll supporting frame **2**, the running web **811** of the paper roll **81** is guided by a paper guiding roll **5** rotatably suspended from the under face of the middle portion of the roll suporting frame **2** as shown in FIG. **11**. As apparent from FIGS. **1** and **5**, the intermediate roll **42** is rotatably supported by a pair of bearings **421** and **421**. The bearings **421** and **421** may move slightly in a vertical direction in a pair of bearing cases **422** and **422**. The bearing cases **422** and **422** are slidably suspended along rails **423** and **423** which are provided on the under face of the side rods **21** and **21**, from the end **202** of the roll supporting frame **2** toward end **201** thereof. Furthermore, tip ends of the piston rods **4241** and **4241** of the air cylinders **424** and **424**, which are mounted on the outer face of the side rods **21** and **21** are mounted on the bearing cases **422** and **422**. The bearing case **422** are slid along the roll-supporting frame **2** by the reciprocating motion of piston rods **4241**, and accordingly the intermediate roll **42** can be moved under the roll supporting frame end **202** and under the paper pushing roll **31** placed near the end **202**. The vertical play of the bearing **421** in the bearing case **422** is provided to such an extent that a little clearance may be provided between the two rolls when the intermediate roll **42** has been placed under the paper pushing roll **31**, and the roll **42** may contact the paper pushing roll **31** when the intermediate roll **42** has been lifted.

As described hereinbefore, when the paper pushing rolls **31** and **32** have been moved close to the roll supporting frame end **202** and thus the intermediate roll **42** has been placed under the paper pushing roll **31**, the air pressures inside the cylinder tubes **2422** and **2422** of the air cylinders **242** and **242** are reduced thereby causing the end **202** of the roll supporting frame **2** to be gradually lowered by its own weight, while preventing chains **232** from becoming slack. As shown in FIG. **18**, when the intermideate roll **42** has become closer to the paper roll **82**, each chain **232** and the roll supporting frame **2** are stopped by a solenoid-operated brake **292**. In a condition where the roll supporting frame **2** is made stationary by the brake **292**, each key **2522** of the sprocket shaft **2521** is engaged with the side face **2524** of the key groove **2520** of the guiding sprocket **252**.

As described hereinbefore, when the intermediate roll **42** has been placed near the paper roll **82**, the paper roll **82** is rotated counter-clockwise in the drawing, by a predriver **72** as shown in FIG. **18**, and set to the unwinding speed of the expiring paper roll **81**.

As shown in FIG. **1**, in the predriver **72**, pulleys **731** and **732** are rotatably provided at upper and lower ends of a longitudinally long pulley supporting member **73** which is pivotally suspended, at the middle portion, on the rear side of the mill stand, and the endless belt **733** is entrained on these pulleys. The upper pulley **731** may be driven by a motor **74R**. The piston rod **781** of an air cylinder **78R**, which is pivotally mounted on the mill stand **1**, is connected to the pulley supporting member **73** thereby causing the air cylinder **78** to oscillate the pulley supporting member **73**. The endless belt **733** which is rotated by a motor **74R** is brought into contact with the paper roll supported by the arms **142** and **142** thereby rotating the paper roll. The predriver **72** is the same in construction as the predriver **71** provided on the front side of the mill stand **1**, and accordingly, it will be described in detail in connection with the description of the predriver **71** provided hereinbelow.

When the paper roll **82** has been rotated by the predriver **72** as described hereinbefore, the current flowing to the solenoid operated brake **292** is stopped, before the leading end **801** of the paper roll **82** reaches under the intermediate roll **42**, thereby lowering the roll supporting frame **2** by its own weight again. Thus, the web **811** from the paper roll **81** is grasped by the intermediate roll **42** and the paper pushing roll **31** as shown in FIG. **19**, while the intermediate roll **42** is pushed against the paper roll **82**. Accordingly, the unadhered faces **8021** and **8021** (see FIG. **11**) of the double-faced adhesive tapes **802** and **802** applied on the leading end outer face is applied upon the peripheral surface of the intermediate roll **42**. The leading end **801** is bound on the intermediate roll **42** and is reversed, and accordingly the unadhered surfaces **8051** and **8051** of the double-sided adhesive tapes **805** and **805** applied on the inner face of the leading end **801** are exposed and are applied upon the running web **811** of the expiring paper roll **81**. Thus, the leading end **801** of the web **811** from the paper roll **82** is spliced with the paper roll **81** so that the smoother face of the leading end corresponds with the smoother face of the running web and the rougher face of the leading end corresponds with the rougher face of the running web.

When the paper roll **82** has been spliced with the paper roll **81**, the double-sided adhesive tapes **802** and **802** on the leading end outer face applied on the intermediate roll **42** are separated from the intermediate roll **42**. Or when the tapes **802** and **802** have been ap-

plied tightly on the roll **42**, the uncut portion between the respective end of the serrated lines **803** of the leading end **801** and the leading end edge **804** is broken so that the broken pieces of the leading end **801** may remain on the peripheral surface of the roll **42**.

Furthermore, if the intermediate roll **42** and the paper roll **82**, or the intermediate roll **42** and the web **811** of the paper roll **81**, are respectively unable to simultaneously contact each other across the width of the paper roll because of irregular diameter dimensions of both ends on the paper roll **82**, or because of manufacturing errors or installing errors, etc. of the apparatus when the roll supporting frame **2** has been lowered by the release of the solenoid-operated brake **292**, the roll supporting frame side rod **21** is further lowered, thus finally establishing on even contact across the width of the paper rolls. When the roll supporting frame side rod **21** on the uncontacted side is further lowered, the key **2522** of the sprocket shaft is adapted to slide through the key groove **2520**, with the guiding sprocket **252** of the chain **232** located on the contacted side, being kept stationary.

Thus, after the leading end of the paper roll **82** has been spliced with the web **811** from the paper roll **81**, the unnecessary position of the web **811** (per a) is cut away by a cutter **6** as shown in FIG. **20**.

As shown in FIGS. **1** and **4**, the cutter **6** comprises a shaft **51** with which the paper guiding roll **5** is freely rotatably engaged, the shaft **51** being rotatably mounted on the under face of the middle portion of the roll supporting frame; a pair of parallel arm rods **61** and **61** which are fixed to both ends of the shaft **51**; a knife **62** which is secured to the lower end of the arm rods and an air motor **63** secured to the side rod **21** of the frame **2**, the driving shaft **631** of the air motor **63** being connected to the shaft **51**. The shaft **51** which is connected to the driving shaft **631** is reciprocably rotated through approximately **270** degrees by the air motor **63**. The arm rods **61** and **61** are oscillated clockwise or counterclockwise in FIG. **1** by the motor **63**. Accordingly, the knife **62** is raised thereby cutting away the running web.

After the running web **811** has been cut away by the clockwise rotation of the cutter knife **62**, as shown in FIG. **20**, the web splicing operation is completed. Thereafter, as shown in FIG. **21**, the roll supporting frame **2**, the intermediate roll **42**, and the predriver **72** are restored to their original position thereby preparing for the subsequent operation. In this case, the paper pushing rolls **31** and **32** are set, as they are, close to the end **202** of the roll supporting frame **2**, while the cutter knife **62** is also maintained as it is. Then, the splicing operation will be described wherein a leading end of a paper roll **83** (the smoother face of the web of the roll **83** faces outwardly, and the rougher face of the web is indicated by a Δ mark in the drawing) is pulled out through the clockwise rotation thereof, and is spliced with the web **821** from the paper roll **82** which is continuously unwound. At first, the structure of the leading end of the paper roll **83** is the same as that of the leading end of the paper roll **82** shown in FIGS. **10** and **11**.

Then, as shown in FIG. **23**, the air motor **346** of the roll supporting frame **2** is rotated thereby moving the roll shaft holding plates **33** and **33** close to the end **201** of the roll supporting frame **2**, while the intermediate roll **41** is positioned under the paper pushing roll **32** which is closer to the roll supporting frame and **201**.

As apparent from FIGS. **1** and **3**, the intermediate roll **41** is rotatably supported by a pair of bearings **411** and **411** which are engaged with a pair of bearing cases **412** and **412**. The bearings **411** may move slightly in a vertical direction in cases **412**. The bearing cases **412** and **412** are slidably suspended, along rails, **413** and **413** which are provided on the under face of the side rods **21** and **21** from the end **201** of the roll supporting frame **2** towards the other ends **202** thereof. The tip end of piston rods **4141** and **4141** of the air cylinders **414** and **414**, which are mounted on the outer face of the side rods **21** and **21**, are fixed to the bearing cases **412** and **412**. The reciprocating motion of the piston rods **4141** and **4141** slides the bearing cases **412** along the frame **2** thus allowing the intermediate roll **41** to reciprocate from a position under the roll supporting frame end **201** and under the paper pushing roll **32** which is disposed near the end **201**. The vertical play of the each bearing **411** in the bearing case **412** is provided to such an extent that a little clearance is produced between the two rolls when the intermediate roll **41** has been disposed under the paper pushing roll **32**, and the intermediate roll **41** contact the paper pushing roll **32** when the intermediate roll **41** is raised.

As described hereinbefore, when the paper pushing roll **31** and **32** have moved close to the roll supporting frame end **201**, and the intermediate roll **41** has been placed under the paper pushing roll **32**, the air pressures inside the cylinder tube **2412** of the air cylinders **241** are reduced thereby causing the end **201** of the roll supporting frame **2** to be gradually lowered by its own weight. The portion of each chain **231** extending from the air cylinder **241** to the guiding sprocket **251** is also prevented from becoming slack, and the arms **141** and **141** of the mill stand **1** are raised, as required. As shown in FIG. **24**, when the intermediate roll **41** comes close to the paper roll **83**, the solenoid operated brake **291** is operated thereby stopping each chain **231** and the roll supporting frame **2**. In the situation where the roll supporting frame **2** is made stationary by the brake **291**, the key **2512** of the sprocket shaft **2511** is engaged with the side face **2514** of the key groove **2510** of the sprocket **251**.

When the intermediate roll **41** has been placed close to the paper roll **83**, the paper roll **83** is rotated clockwise, as shown in FIG. **24**, by a predriver **71**, while setting to the unwinding speed of the paper roll **82**.

As apparent from FIGS. **1** and **2**, in the predriver **71**, a longitudinally long pulley supporting member **73** is pivotally suspended from an approximate middle portion on the front side of the mill stand **1** and the pulleys **731** and **732** are rotatably provided at the upper and lower ends of the pulley supporting member **73**, with an endless belt **733** being entrained on these pulleys. A motor **74L** provided on the mill stand **1** is connected to the an shaft of a speed change gear **75** through a belt transmission gear **761**. An output shaft of the speed change gear **75** is connected to one end of a transmission shaft **77**, which is rotatably mounted on the mill stand **1**, by a chain transmission gear **762**. The other end of the transmission shaft **77** is connected to a shaft of the pulley **731** by a chain transmission gear **763**. Accordingly, the pulley **731** can be driven by the motor **74L**. Furthermore, a tip end of a piston rod **781** of an air cylinder **78L** is rotatably connected to the pulley supporting member **73**, while the cylinder tube **782** is pivotally mounted in the lower portion of the mill stand

1. Retraction of the piston rod 781 of the air cylinder 78L into the cylinder tube 782 raises the pulley supporting member 73 thereby causing the endless belt 733 to contact and roll the paper rotate supported by the mill stand arms 141 and 141.

As described hereinbefore, when the paper roll 83 has been rotated by the predriver 71 (see FIG. 24), the current flowing to the solenoid operated brake 291 is stopped before the leading end of the paper roll 83 is reaches a position under the intermediate roll 41, thereby lowering the roll supporting frame 2 again by its own weight. As shown in FIG. 25, the running web 821 of the paper roll 82 is grasped between the paper pushing roll 32 and the intermediate roll 41, while the intermediate roll 41 is pushed against the paper roll 83. In the same manner as in splicing the paper roll 81 with the paper roll 82, the leading end of the paper roll 83 is spliced with the web 821 from the paper roll 82, so that the smoother face of the leading end corresponds to the smoother face of the running web and the rougher face of the leading end corresponds to the rougher face of the running web. Thereafter as shown in FIG. 26, the small unnecessary portion of the web 821 is cut away by rotating the knife 62 of the cutter 6 counterclockwise in the drawing. Then, as shown in FIG. 27, the roll supporting frame 2, the intermediate roll 41 and the predriver 71 are restored to their original position and thus are prepared for the following operation. The paper pushing rolls 31 and 32 are set, as they are, close to the end 201 of the roll supporting frame 2.

In order to splice a leading end of a winding paper roll 91 (the smoother face of the web of the roll 91 facing outwardly) with the web from the paper roll 81, the following operation is performed without use of the intermediate roll 42.

As shown in FIG. 12, the double-sided adhesive tapes 902 are applied on the outer face of the leading end 901 of the paper roll 91. Much smaller double-sided adhesive tapes 903, ... than the double-sided adhesive tapes 902 are applied upon the leading end 901 and the outer face 904 of the paper roll. As shown in FIG. 28, the paper roll 91 is supported by the arms 142 and 142 on the rear face side of the mill stand 1 as shown in FIG. 22 so that it may be unwound through clockwise rotation thereof in the drawing.

Then, the paper pushing rolls 31 and 32 are moved close to the end 202 of the roll supporting frame 2 and the end 202 of the roll supporting frame 2 is lowered thereby stopping the paper pushing roll 31 close to the paper roll 91, as shown with the imaginary line in FIG. 29. Then, the paper roll 91 is rotated clockwise, in FIG. 29, by the predriver 72. Thereafter, the roll supporting frame 2 is again lowered thereby contacting the running web 811 of the paper roll 81 with the paper roll 91 by the paper pushing roll 31. The unadhered face of the double-faced adhesive tapes 903 which are applied on the outer face of the leading end 901 of the paper roll 91, and the unapplied face of the both face adhesive tapes 902 are applied upon the web 811 of the leading end of the paper roll 81. The paper roll 91 is spliced with the web 811 running from the the paper roll 81, so that the smoother face of the leading end may follow the smoother face of the running web and the rougher face of the leading end may follow the rougher face of the running web. Thus, the leading end of the paper roll 91 is spliced with the web 811 from the paper roll 81 and then the unnecessary portion of the web 811 is cut away by a cutter 6 as shown in FIG. 30. The roll supporting frame 2, and the predriver 72 are restored to the original condition.

Also, in order to splice the paper roll 92 with the paper roll 91 (with the rougher face of the web of the roll 92 facing outwardly), the following operation is performed without the use of the intermediate roll 41.

The structure of the leading end of the paper roll 92 is the same as that of the leading end of the paper roll 91 as shown in FIG. 12. The paper roll 92 is supported by the mill stand arms 141 and 141 as shown in FIG. 31 so that it may be unwound through the counterclockwise rotation thereof in the drawing. Then, the paper pushing rolls 31 and 32 are moved close to the roll supporting frame end 201 and the roll supporting frame end 201 is lowered. As shown with an imaginary line in FIG. 32, the paper pushing roll 32 is suspended close to the paper roll 92. Subsequently, the paper roll 92 is rotated counter clockwise in FIG. 32, by the predriver 71. Thereafter, the roll supporting frame 2 is lowered again thereby causing the paper pushing roll 32 to contact the web 911 of the paper roll 91 with the paper roll 92. The leading end of the paper roll 92 is spliced with the web 911 running from the paper roll 91, so that the smoother face of the leading end may correspond to the smoother face of the running web and the rougher face of the leading end may correspond to the rougher face of the running web. Thereafter, the unnecessary portion of the web 911 is cut away by a cutter 6 as shown in FIG. 33 and the roll supporting frame 2, and predriver 71 are restored to the former condition.

FIG. 13 shows a pneumatic circuit of the air cylinders 241, 241 and 242, 242 for moving the roll supporting frame numeral 2, the rotary air motor 346 for moving the roll shaft holding plates the air cylinders 414, 414 and 424, 424 for moving the intermediate rolls, 41 and 42 the air cylinders 78L and 78R for the predrivers 71 and 72, and the air motor 63 for the cutter 6. Referring now to FIG. 13, V1L, V1R, V4L and V4R are respectively a spring off-set type of 5-port 2-position solenoid operated valve, and V2, V3R, V3L and V5 are respectively a closed-center type of 5-port 3-position solenoid operated valve. The solenoid operated valves V1L and V1R have respectively one feed air port pipe-connected with a proper compressed air source 101 through a manifold 106, a lubricator 105, a pressure regulating valve 104 with a pressure gauge, a filter 103 and a stop valve 102, while the valves V1L and V1R have the other feed air port pipe-connected with the manifold 106 through relief valves 108L and 108R, and pressure regulating valves 107L and 107R, respectively, with a pressure gauge. Each port, on the side of the cylinder, of the valves V1L and V1R is pipe-connected with the respective corresponding ports, on the rod-cover side, of the air cylinders 241, 241 and 242, 242. Each port, on the head-cover side, of the air cylinders 241, 241 and 242, 242 communicates with atmosphere through speed controllers 109L, 109L and 109R, 109R. The pressure regulating valves 107L and 107R are reduced in pressure from the pressure regulating valve 104 and thus are adjusted so that the end of the roll supporting frame 2 may be lowered by its own weight, overcoming air pressure when the feed air port of the valve V1L or V1R have been connected to the pressure regulating valve. The feed air ports of the

solenoid operated valves V2, V3L, V3R, V4L, V4R and V5 are respectively pipe-connected with the manifold **106.** However, a pressure regulating valves **110** and **111,** respectively with a pressure gauge are pipe-connected between the feed air port of the valve V2 and the manifold **106,** and between the feed air ports of the valves V4L, V4R and the manifold **106.** An exhaust port of the valve **2** communicates with atmosphere through a silencer **112,** and a port, on the side of the air motor, of the valve V2 is pipe-connected with the rotary air motor **346.** One port, on the side of the cylinder, of the respective valves V3L and V3R is pipe-connected with the respective corresponding ports, on the headcover side, of the air cylinders **414, 414** and **424, 424** through speed controllers **113L, 113L** and **113R, 113R,** while the other port, on the side of the cylinder, of the respective valves is connected with the respective corresponding ports, on the rod-cover side, of the air cylinders **414, 414** and **424, 424** through speed controllers **114L, 114L** and **114R, 114R.** Also, one port, on the side of the cylinder, of the respective valves V4L and V4R is pipe-connected with the respective corresponding ports, on the rod-cover side of the air cylinders **78L** and **78R,** through speed controllers **115L** and **115R,** while the other port, on the side of the cylinder, of the respective valves is pipe-connected with the respective corresponding ports, on the head-cover side of the air cylinders **78L** and **78R** through speed controllers **116L** and **116R.** The port, on the side of the cylinder, of the valve V5 is pipe-connected with the air motor **63.**

Under a condition shown in FIG. **13,** the solenoids SO1L and SO1R of the valves V1L and V1R are respectively demagnetized and thus the piston rods **2411,** 2411 and **2421, 2421** of the air cylinders **241, 241** and **242, 242** are retracted into cylinder tubes **2412, 2412** and **2422, 2422.** Also, the solenoids SO2L and SO2R of the valve V2 are also demagnetized and thus the air motor **346** is topped. Furthermore, the solenoids SO3L1 and SO3R1 of the valves V3L and V3R are demagnetized, and the solenoids SO3L2 and SO3R2 of the valves V3L and V3R are demagnetized. The piston rod **4141** of each air cylinder **414,** and the piston rod **4241** of each air cylinder **424** are respectively projected and stopped. Furthermore, the solenoids SO4L and SO4R of the valves V4L and V4R are both demagnetized, and the piston rods **781** and **781** of the air cylinders **78L** and **78R** are projected from the cylinder tubes **782** and **782,** while the solenoid SO5L and SO5R of the valve V5 is also demagnetized, and thus the air motor **63** is stopped.

Electrical circuits for the web splicing apparatus are shown in FIGS. **14** and **15.** Referring now to FIGS. **14** and **15,** electric parts designated by a mark containing a letter "R" are used in controlling the motor **74R,** the solenoid operated brake **292** and the solenoids SO1R, SO2R, SO3R1, SO3R2, SO4R and SO5R of solenoid operated valves V1R, V2, V3R, V4R and V5. The motor **74R** and the solenoid operated brake **292** are operated in splicing the leading of the paper roll, which is supported by the arms **142** and **142** of the mill stand, with the web from the paper roll which is supported by the arms **141** and **141** of the mill stand. Also, electric parts designated by a mark containing a letter "L" are used in controlling the motor **74L,** a solenoid operated brake **291** and solenoids SO1L, SO2L, SO3L1, SO3L2, SO4I and SO5L of solenoid operated valves V1L, V2, V3L, V4L and V5. The motor **74L** and the solenoid operated brake **291** are operated in splicing the leading of the paper roll, which is supported by the arms **141** and **141** of the mill stand, with the web of the paper roll which is supported by the arms **142** and **142** of the mill stand. Electric parts designated by a mark containing a letter "C" are operated even in any splicing operation as described above.

Referring now to FIGS. **14** and **15,** NFB1 and NFB2 are respectively a no-fuse breaker. NFB1 is designed to make and break an electric route from power-leading terminals X and Y to a main circuit, and (or) to protect a secondary side load circuit, while NFB2 is designed to protect a control operating circuit of the present apparatus which functions as the secondary side load circuit. DC motor **74L** and **74R** are motor for the predrivers **71** and **72.** DCC is a ratio controlling device for the motors **74L** and **74R** which operates, through proportional controlling operation, the motor by inputs from a motor DCT which detects the running speed of the web from the paper roll supported by the arms **141** and **141** or **142** and **142** of the mill stand and by inputs from a tachometer generator LTG and RTG which directly detects the rotation speed of the motors **74L** and **74R** for feedback controlling. Thus the fresh fully wound paper roll to be spliced with, the exhausting roll is rotated, while setting to the unwinding speed of the exhausting paper roll. The solenoid operated brakes **291** and **292** are operative when current is not flowing, and become inoperative through the separation of brake discs when current is flowing. PW-R and PW-L are respectively a power source box for feeding power to the solenoid operated brake. CR, SW1R, SW2R, SW3R, SW4R and SW1L, SW2L, SW3L and SW4L are respectively a switch of a rotary type, and the opening and closing condition of contact can be maintained by proper rotation and suspensation of a switch handle. The switch CS is designed for the operation and suspension lock switching of the apparatus. The switches SW1R and SW1L are respectively a switch for moving the paper pushing roll, while the switches SW2R and SW2L are respectively designed for an auto-manual operation switching of the apparatus. The switches SW3R and SW3L are respectively a switch for switching the splice preparing operation and the roll supporting frame ascending operation. The switches SW4R and SW4L are respectively a switch for moving the intermediate roll. PB1R, PB2R, PB3R, PB4R, PB5R, PB6R, PB7R and PB1L, PB2L, PB3L, PB4L, PB5L, PB6L, PB7L are respectively a so-called momentary push button switch which is closed only when the switch knob is in a depressed position. PB1R and PB1L are respectively a switch for emergency stop. The switches PB2R and PB2L are respectively a switch for descending operation of the roll supporting frame, while PB3R and PB3L are respectively a switch for ascending operation of the roll supporting frame. PB4R and PB4L are respectively a switch for operating the predriver. PB5R and PB5L are respectively a switch for splice starting, PB6R and PB6L being respectively a switch for operating the cutter, while PB7R and PB7L are respectively a switch for cutter operation. RS-1 (FIG. **14**) and LS-1 (FIG. **15**) are respectively a limit switch. RS-1 and LS-1 are respectively secured to the mill stand **1** as shown in FIG. **1.** The respective contacts of the limit switches are opened through the pushing force of the pulley supporting member when the pulley

supporting members 73 and 73 of the predriver are located at their lower limits, while the contacts of the limit switches are respectively closed when the pulley supporting members 73 and 73 are raised from their lower limits. MRA, MRB and MLA, MLB are respectively an operating coil of magnetic contactor with a thermal relay for normally and reversely rotating the DC motors 74R and 74L of the predrivers 72 and 71. ESR R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12 and TGR (FIG. 14) and ESL, L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L11, L12 and TGL (FIG. 15) are respectively a relay coil. Relays ESR and ESL are designed for emergency stop. Also, relays R1, L1 are respectively an auxiliary relay to be excited only when the switches SW1R and SW1L are respectively closed, while the relays R2 and L2 are respectively an auxiliary relay to be excited only when the contacts for the switches SW2R and SW2L are respectively closed. The relays R3 and L3 are respectively an auxiliary relay to be excited only when the contacts 3RP and 3LP for switches SW3R and SW3L, or switches PB2R and PB2L are closed. Relays R4 and L4 are respectively an auxiliary relay to be excited only when the contacts 3RU and 3LU for switchs 3W3R and 3W3L or switches PB3R and PB3L are closed, while relays R11 and L11 are respectively an auxiliary relay to be excited only when switches SW4R and SW4L are respectively closed. Relays R5, R6, R7, R8, R9, R10, R12, TGR and L5, L6, L7, L8, L9, L10, L12, TGL are respectively a relay for sequence-controlling the web splicing processes. TR1, TR3, TR4, TR5 (FIG. 14) and TL1, TL3, TL4, TL5 (FIG. 15) are respectively an operating coil for timer relay. The timer relays TR1, and TL1 are designed for setting the rotation start timing of the DC motor 74R and 74L for the predriver, the timer relays TR3 and TL3 being for setting the return timing of the cutter 6, the timer relays TR4 and TL4 being for setting the return timing of the predrivers 72 and 71 the timer relays TR5 and TL5 being for setting the ascent start timing of the roll supporting frame 2. Contacts MRA/1, MRA/2 and MLA/1, MLA/2 are respectively a normally-opened contact (hereinafter the normally-opened contact is referred to as A contact) for magnetic contactors MRA and MLA. Contacts MRA/3 and MLA/3 are respectively a normally-closed contact (hereinafter the normally-closed contact is referred to as B contact) for magnetic contactors MRA and MLA. MRA/4 and MLA/4 are respectively a B contact of a thermal relay attached to the magnetic contactor and are opened upon operation of the thermal relay. Also, contacts MRB/1, MRB/2 and MLB/1, MLB/2 are respectively an A contact for magnetic contactors MRB and MLB. Contacts MRB/3 and MLB/3 are respectively a B contact for magnetic contactors MRB and MLB. MRB/4 and MLB/4 are respectively a B contact of a thermal relay attached to the magnetic contactor and are opened upon operation of the thermal relay. Contacts R1/1, R2/1a, R3/1, R3/2, R4/2 and L1/1, L2/1*a*, L3/1, L3/2, L4/2 are respectively an A contact for relay R1, R2, R3, R4 and L1, L2, L3, L4. Contacts R5/1, R5/2, R5/3, R5/4, R6/1, R6/2, R7/1 and L5/1, L5/2, L5/3, L5/4, L6/1, L6/2, L7/1 are respectively an A contact for relays R5, R6, R7 a and L5, L6, L7. Also, contacts R8/1, R8/2, R10/1, R11/1*a*, R11/2*a*, R12/1, R12/2, TGR/1, TGR/2 and L8/1, L8/2, L10/1, L11/1*a*, L11/2*a*, L12/1, L12/2, TGL/1, TGL/2 are respectively an A contact for relays R8, R10, R11, R12, TGR and L8, L10, L11, L12, TGL. Contacts ESR/1, R1/2, R2/1*b*, R4/1, R5/5, (FIG. 15), R5/6, R9/1, R11/1b, R11/2b and ESL/1, L1/2, L2/1*b*, L4/1, L5/5, L5/6, L9/1, L11/1*b*, L11/2*b* are respectively a B contact for relays ESR, R1, R2, R4, R5, R9, R11 and ESL, L1, L2, L4, L5, L9, L11. Contacts TR1/1, TR5/1 and TL1/1, TL5/1 are respectively a time limit A contact (which is closed after elapse of a set time after the current has been flowed into the relay coil) for timer relays TR1, TR5 and TL1, TL5. Contacts TR3/1 TR4/1 and TL3/1, TL4/1 are respectively a time limit B contact (which is opened after elapse of a set time after the current has been flowed into the relay coil) for timer relays TR3, TR4 and TL3, TL4.

Subsequently, the functions of the electric circuits will be schematically described in a case where the leading end of the paper roll 82 which is supported by arms 142 and 142 of the mill stand 1 is spliced with the web from the paper roll 81 which is supported by the arms 141 and 141 of the mill stand 1 by use of the intermediate roll 42.

Assume that switch CS for stop locking of the apparatus is closed and a contct 2RA for automatic operation of a switch SW2R is closed, and the contact 2RM for manual operation is opened. Under a first steady condition as shown in FIG. 16, a switch SW1R for moving the paper pushing roll 42 is opened and the roll supporting frame 2 is suspended at its ascent limit. Also, the pulley supporting member 73 of the predriver 72 is suspended at its descent limit and the limit switch RS-1 is opened. The cutter 6 is stopped with the knife 62 being under the paper guiding roll 5.

By closing the switch SW1R for the paper pushing roll moving operation from such a steady condition, the relay R1 is excited and the contact R1/1 is closed. Thus, the solenoid SO2R is excited thereby rotating the air motor 346 of the means 34 for moving the roll shaft holding plates. The roll shaft holding plates 33, 33 and the paper pushing rolls 31 and 32 are moved towards the roll supporting frame end 202. When the paper pushing rolls 31 and 32 have reached a position close to the roll supporting frame end 202, the switch SW1R is opened thereby suspending the roll shaft holding plates 33 and 33 (see FIG. 17). Subsequently, closure of the switch SW4R for moving the intermediate roll to 42 excites the solenoid coil SO3R2 of the solenoid operated value V3R thereby retracting the piston rod 4241 of each air cylinder 424 into the cylinder tube 4242. Accordingly, the intermediate roll 42 is moved downwardly of the paper pushing roll 31 and is stopped (see FIG. 17). Then, by closing a contact 3RP of the switch SW3R for the splicing preparation, and opening a contact 3RU for manual operation, the solenoid coil SO1R of the solenoid operated valve V1R is excited thereby connecting a pressure regulating valve 107R to each air cylinder 242. The relay R12 is excited thereby disengaging a solenoid operated brake 292. Accordingly, the end 202 of the roll supporting frame 2 starts to descend by its own weight as shown in FIG. 18. When the intermediate roll 42 has descended close to the paper roll 82 to be spliced, the relay R12 is demagnetized upon opening the contact 3RP of the switch SW3R. Thus, the solenoid operated brake 292 acts to cause the roll supporting frame 2 to suspend its descent. By depressing the switch PB4R for predriver operation, the solenoid coil SO4R of the solenoid operated valve V4R is excited thereby retracting the piston

rod 781 of the air cylinder 78R into the cylinder tube 782 and then initiating the accent of the pulley supporting member 73 of the predriver 72. Closure of the limit switch RS-1 by the ascending operation of the pulley supporting member 73 excites the magnetic contactor MRB thereby to cause the motor 74R to rotate the paper roll 82 counter-clockwise in the drawing. Also, as described hereinbefore, closure of the switch PB4R excites the timer relay TR1 simultaneously thereby to close the A contact TR1/1 of the timer relay TR1 after elapse of the set time. The relay TGR is excited thereby to close contacts TGR/1 and TGR/2. The ratio controlling device DCC starts to operate and the motor 74R is rotated under speed controlling by the ratio controlling device DCC so that the paper roll 82 may start to rotate while being setting to the unwinding speed of the paper roll 81 (see FIG. 18). By pressing the switch PB5R for splicing start, the relay R8, timer relays TR4 and TR5 are excited, since the contact R5/4 is closed. Accordingly, a self-holding circuit is formed by means of the contact R8/1, while the timer relays TR4 and TR5 start to count time. Simultaneously, the contact R8/2 is closed and thus the solenoid operated brake 292 is disengaged again. The roll supporting frame 2 is descended again thereby bringing the web 811 from the paper roll 81 into contact with the intermediate roll 42, and pressing the intermediate roll 42 against the paper roll 82 (see FIG. 19). The B contact TR4/1 of the timer relay TR4 is opened after elapse of a proper time sufficient enough to complete the web splicing operation after the roll supporting frame 2 has again started to descend. The solenoid coil SO4R is demagnetized and thus the pulley supporting member 73 of the predriver 72 is lowered thereby separating from the paper roll 82 until the limit switch RS-1 is opened. Furthermore, the A contact TR5/1 of the timer relay TR5 is closed thereby exciting the relay R9 and demagnetizing the relay R5. Accordingly, the contact R5/1 is opened and the solenoid coil SO1R is demagnetized. The end 202 of the roll supporting frame 2 is ascendingly restored and stopped. Also, by the demagnetization of the relay R5, the contact R5/3 is also opened and the relay R6 is demagnetized. The magnetic contactor MRB and the relay TGR are demagnetized thereby stopping the operation of the motor 74R and the ratio controlling device DCC. Since the solenoid coil SO5R of the solenoid operated valve V5 is excited upon closing of the switch PB7R the cutting operation after the web splicing operation has been completed, the air motor 63 is rotated to cut the web 811 from the paper roll 81 by a knife 62 as shown in FIG. 20. After the switch PB7R has been closed, and the cutting operation thereof has been completed, the B contact TR3/1 of the timer relay TR3 is opened. The solenoid coil SO5R is demagnetized and the motor 63 is stopped thereby stopping the knife 62 in its position. Thus, the switch SW4R for the intermediate roll operation is opened and the intermediate roll is restored to the roll supporting frame end 202, whereby a second steady condition as shown in FIG. 21 is obtained.

As shown in FIGS. 22 and to 27, the function of the electric circuits in splicing the leading end of the paper roll 83 (which is supported by the arms 141 and 141 of the mill stand 1, with the web from the paper roll 82 which is supported by the arms 142 and 142 of the mill stand 1, through the use of the intermediate roll 41, as shown in FIGS. 16 to 21) is almost the same as that of the electric circuits in splicing the leading of the paper roll 82 with the web from the paper roll 81 as described hereinbefore.

The contact 2LA for automatic operation, respectively, of the switch CS for stop locking of the apparatus, and the switch SW2L for automatic-manual operation switch are kept closed in advance. The switch SW1L for moving the paper pushing roll, the switch SW4L for moving the intermediate roll, the switch SW3L for the splicing preparation, the switch PB4L for predriver operation, the switch PB5L for the splicing start and the switch PG7L for the cutter operation are operated in consecutive order. In this case, the motor 74L of the predriver 71 is rotated with the contacts MLB/1 and MLB/2 for the magnetic contactor MLB being closed, while the paper roll 83 is rotated clockwise in FIG. 24.

As shown in FIGS. 28 to 30, in splicing the paper roll 91 which is supported by the arms 142 and 142 of the mill stand, with the web from the paper roll 81 which is supported by the arms 141 and 141 of the mill stand 1, without using the intermediate roll 42, and as shown in FIGS. 31 to 33, in splicing the leading end of the paper roll 92 which is supported by the arms 141 and 141 of the mill stand 1 with the web from the paper roll 91, which is supported by the arms 142 and 142 of the mill stand 1, without using the intermediate roll 41, the contact 2RA (2LA) of the switch CS for stop locking of the apparatus and the switch SW2R (SW2L) are kept closed in advance. Thereafter, the switch SW1R (SW1L), the switch SW3R (SW3L), the switch PB4R (PB4L), the switch PB5R (PB5L) and the switch PB7R (PB7L) are operated in consecutive order. In this case, the motor 74R (74L) of the predriver 72 (71) is rotated by closure of the contacts MRA/1 (MLA/1) and MRA/2 (MLA/2) of the magnetic contactor MRA (MLA) and the paper roll 91 (92) is rotated clockwise (counter-clockwise).

Even in the splicing operation as shown in FIGS. 16 and 33, by depressing the switches PB6R and PB6L for the resetting operation, the roll supporting frame 2, and the predrivers 72 and 71 are returned, respectively, to a steady position, and the cutter 6, the motors 74R, 74L and the ratio controlling device DCC are stopped. By depressing the switches PB1R and PB1L for emergency stop, the roll supporting frame 2, and the predrivers 72 and 71 are returned respectively to a steady position, and the cutter 6 and the intermediate rolls 41 and 42 are stopped, respectively, at in the position where they are. The motors 74R, 74L and the ratio controlling device DCC are stopped in operation. By closing the contact 3RU (3LU) of the switch SW3R (SW3L) when the roll supporting frame 2 is located at a position of the top limit or lower, the roll supporting frame 2 can be raised up to the ascent limit.

Furthermore, by closing the switch PB2R (PB2L) and the switch PB3R (PB3L), with the contact 2RM (2LM) for manual operation of the switch SW2R (SW2L) for automatic to manual operation switching being kept close, the end 202 (end 201) of the roll supporting frame 2 can be raised or lowered properly.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications are intended to be included within the scope of the following claims.

What I claim is:

1. An apparatus for splicing a leading end of a fresh web roll which is releasably attached to said roll and which is not yet unwound, with a running web which is being continuously withdrawn from an expiring roll, without interrupting the continuous operation thereof which comprises a mill stand adapted to rotatably support the fresh web roll and the expiring roll in mutually opposed position, means for rotating said fresh web roll and expiring roll, respectively, a roll supporting frame having side rails and disposed above the mill stand and extending from a position above the fresh roll to a position above the expiring roll, means for suspending the roll supporting frame so that each end thereof may move up and down with the other end thereof acting as a pivot point, a pair of roll shaft holding plates mounted in said side rails and a pair of substantially parallel web pushing rolls rotatably mounted between said pair of roll shaft holding plates and bridging said side rails, driving means for shifting the position of the roll shaft holding plates containing the web pushing rolls from one end portion of the roll supporting frame to the other end portion thereof, an intermediate roll suspended below each end portion of the roll supporting frame, said intermediate roll being suspended with a slight play in the vertical direction and a free sliding movement along the roll supporting frame, means for moving each of the intermediate rolls along the roll supporting frame, a web guiding roll disposed above the mill stand and below the roll supporting frame for guiding the web running from the expiring roll, means for initiating the rotation of the fresh web roll prior to its contact with the intermediate roll, and means for splicing the leading end of the fresh web roll with the running web of the expiring roll by bringing said leading end and running web together either between said intermediate roll and one of said web pushing rolls or between the fresh web roll and one of said web pushing rolls.

2. The apparatus of claim 1 wherein cutting means are disposed above the mill stand for cutting the web running from the expiring roll.

3. The apparatus of claim 2, wherein frame means are provided for suspending the roll supporting frame above the mill stand, said frame means comprising means connected to each end of the roll supporting frame, air cylinders secured to the frame means, said air cylinders connecting each end of the roll supporting frame with chains, said chains being connected to piston rods, and sprocket means rotatably mounted in the frame means and adapted to guide said chains.

4. The apparatus according to claim 2, wherein the sprockets which guide the chains for suspending each end of the roll supporting frame are keyed to the sprocket shaft which is rotatably mounted in the frame means, the key groove width of the sprocket being slightly greater than the key width so that the sprockets may slightly rotate without rotating the sprocket shaft.

5. The apparatus of claim 2, wherein driving means for moving the pair of roll shaft holding plates comprises sprockets rotatably mounted on both ends of the roll supporting frame and in both sides of the roll supporting frame, a pair of endless chains disposed on both sides of the roll supporting frame and being mounted around the sprockets, said chains being also connected to the roll shaft holding plates so that they may be moved by the rotation of the endless chains, and a motor means fixedly secured to the roll supporting frame for driving, through a chain transmission system, a shaft to which the sprockets with the chains entrained therearound are secured.

6. The apparatus of claim 2, wherein the means for suspending each intermediate roll comprises a pair of bearings for rotatably supporting the intermediate roll, and a pair of bearing cases with which the bearings are engaged with a slight play in the vertical direction, said bearing cases being suspended from the roll supporting frame end portion so that they may move from said end portion fo the roll supporting frame to a position under the paper pushing roll disposed near said end portion, the means for moving the intermediate rolls comprising air cylinders which are secured to the roll supporting frame to correspond to each bearing case, while connecting the piston rods to the bearing cases.

7. The apparatus of claim 2, wherein means for rotating the fresh web roll which is supported by the mill stand and is not yet unwound comprises a pulley supporting member which is pivotally suspended from the mill stand so that it may contact with and separate from the web roll, pulleys which are rotatably mounted in the upper and lower end of the pulley supporting member, one of the pulleys being driven by a motor means, and an endless belt, for the web roll driving operation, entrained around the pulleys.

8. The apparatus of claim 2, wherein the means for cutting the web running from the expiring roll comprises a pair of parallel arm rods fixed to both ends of a shaft on which the web guiding roll is freely rotatably engaged, so that said arms may oscillate by the rotation of the shaft, an air motor for rotating the shaft from which the arm rods are suspended and a knife secured to the lower end of the arm rods.

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