United States Patent [19]

Tokuno

[11] **3,895,763**

[45] **July 22, 1975**

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

[75] Inventor: **Masateru Tokuno,** Nishinomiya, Japan

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

[22] Filed: **Mar. 29, 1973**

[21] Appl. No.: **345,849**

[30] **Foreign Application Priority Data**

Aug. 29, 1972 Japan 47-86942
Nov. 14, 1972 Japan 47-114578

[52] **U.S. Cl.** **242/58.3;** 156/504
[51] **Int. Cl.** **B65h 19/16**
[58] **Field of Search** ..... 242/58.3, 58.1, 58.4, 58.2, 242/58.5, 56, 67.3; 156/502, 504; 24/67 AF

[56] **References Cited**

UNITED STATES PATENTS

1,843,470	2/1932	Wood	242/58.3
2,775,409	12/1956	Pomper	242/58.2
3,106,360	10/1963	Kohler	242/58.3

Primary Examiner—John W. Huckert
Assistant Examiner—John M. Jillions
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 direction.

11 Claims, 28 Drawing Figures

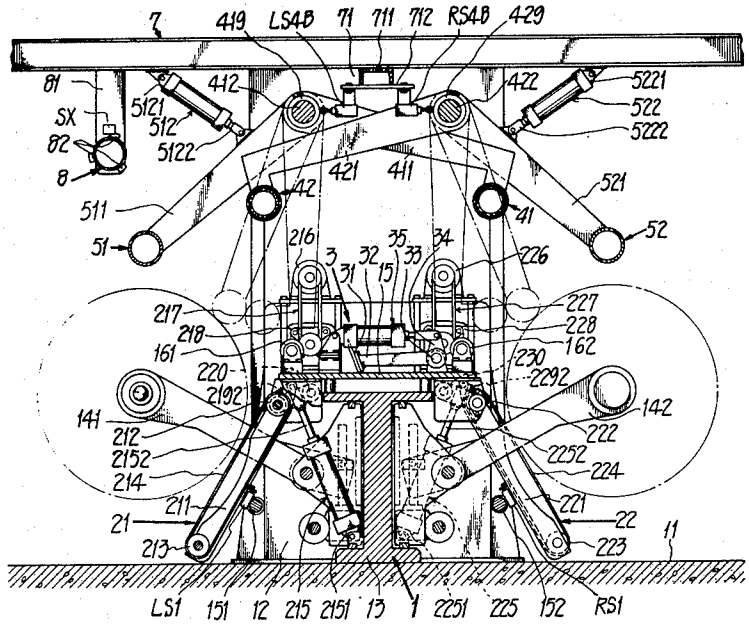
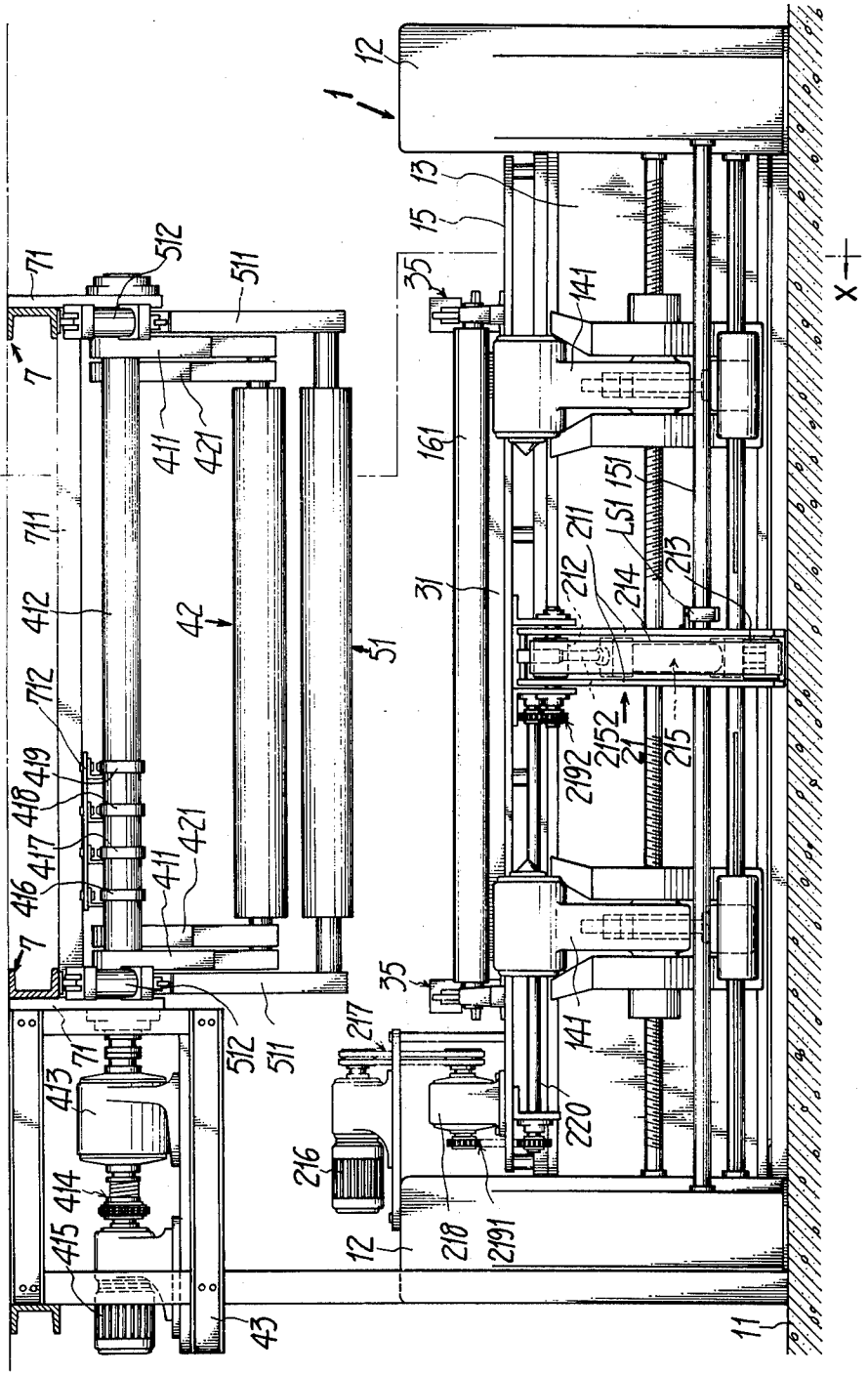


FIG. 1


1
12
13
15
35
141
161
151
LS1
211
212
213
214
215
2192
2152
21
31
51
42
X
X
7
71
711
712
512
511
411
421
412
419
418
417
416
413
414
415
43
11
217
216
218
2191
220

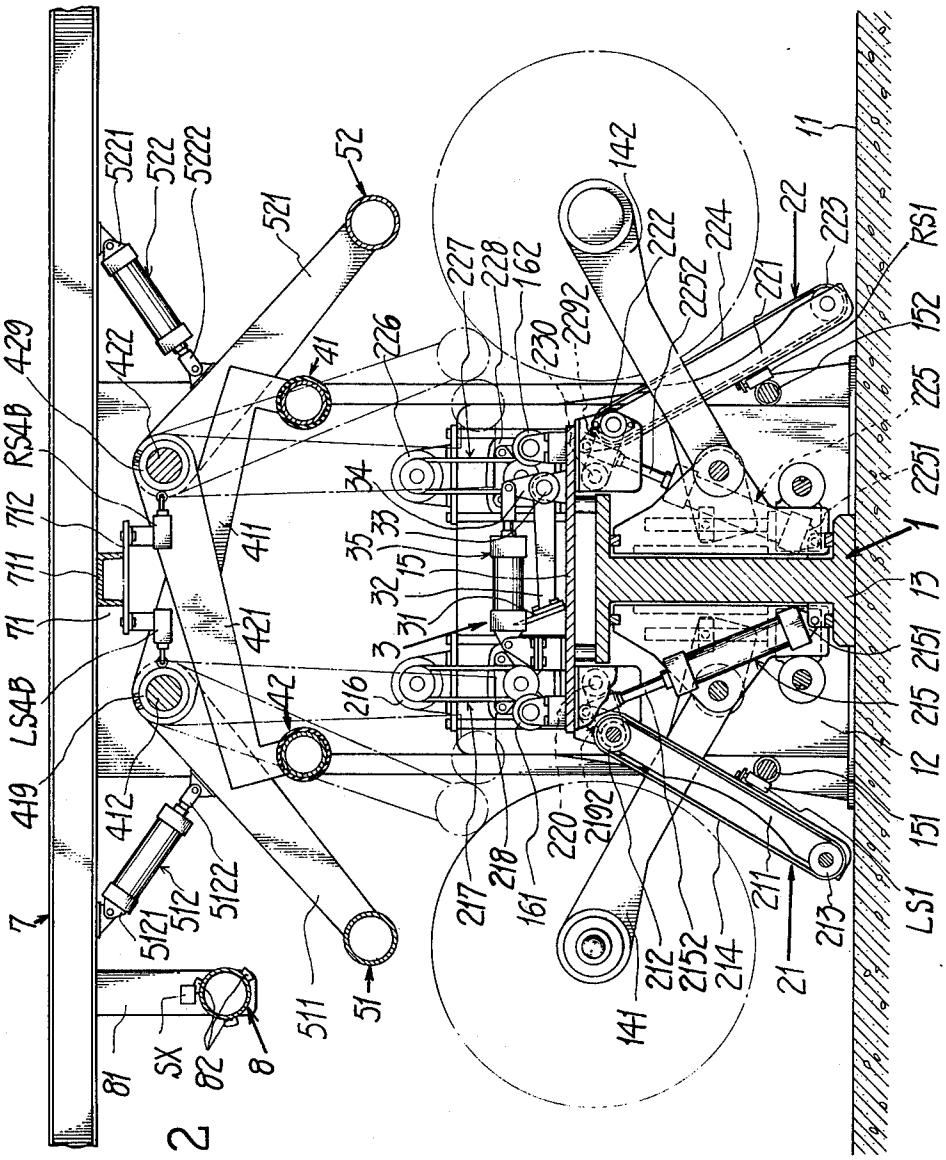

7
419
LS4B
71
711
712
RS4B
429
5221
522
5222
52
521
422
41
226
227
228
162
142
222
224
22
223
11
RS1
152
225
2251
1
13
2151
215
12
151
LS1
213
211
21
212
2152
214
141
2192
220
218
217
161
216
42
421
411
34
35
33
15
32
31
3
412
5121
512
5122
511
51
81
SX
82
8

FIG. 2

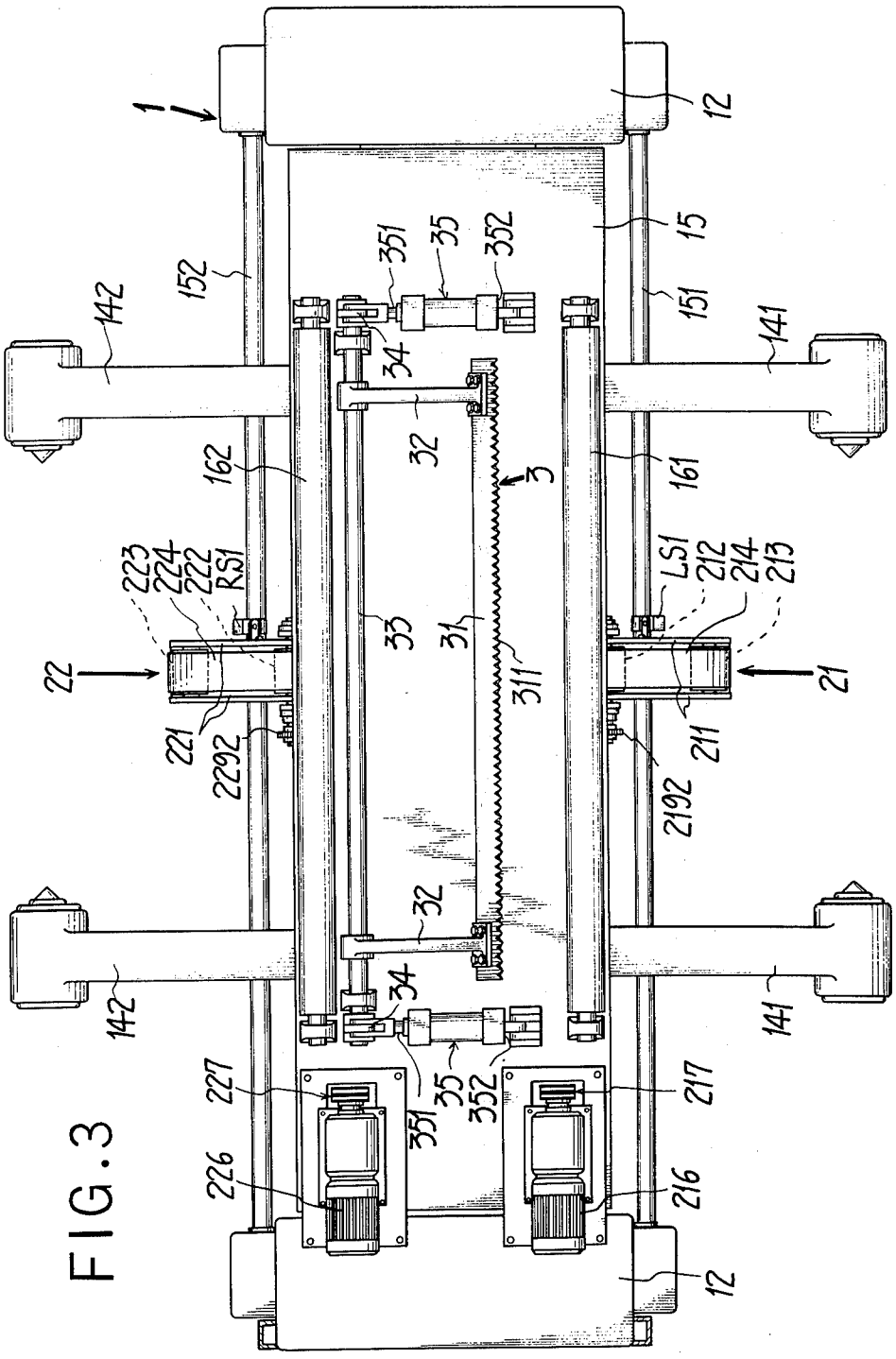
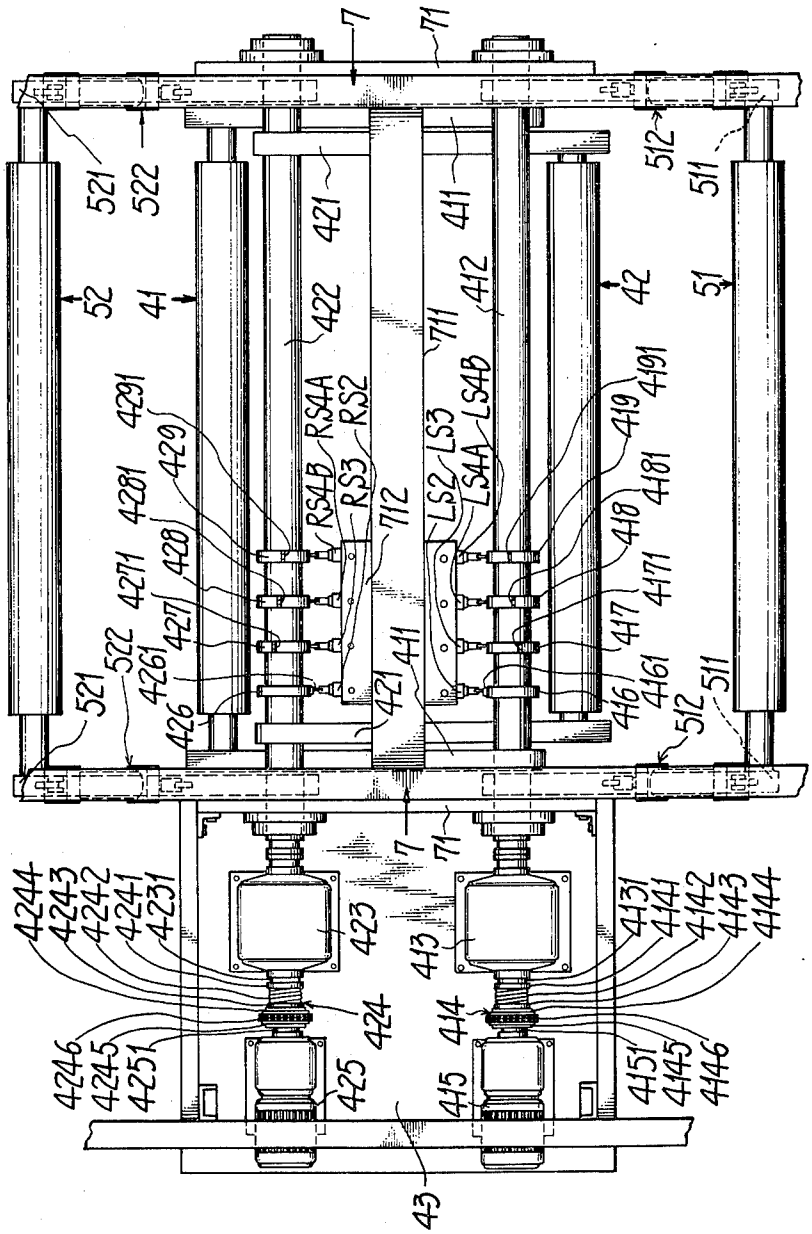

1
12
15
151
152
141
142
351
35
352
34
32
3
161
162
LS1
212
214
213
223
224
222
RS1
33
31
311
22
21
221
2292
211
2192
227
217
226
216

FIG. 3

FIG. 4


7
71
521
522
421
411
512
511
52
41
422
412
42
51
711
4291
RS4A
RS2
LS3
LS4B
4191
429
RS4B
RS3
LS2
LS4A
419
4281
4181
712
428
418
4271
4171
427
417
522
4261
411
4161
521
421
416
511
426
512
7
71
4244
4243
4242
4241
4231
4131
4441
4142
4443
4144
423
413
424
414
4246
4245
4251
425
415
4151
4445
4446
43

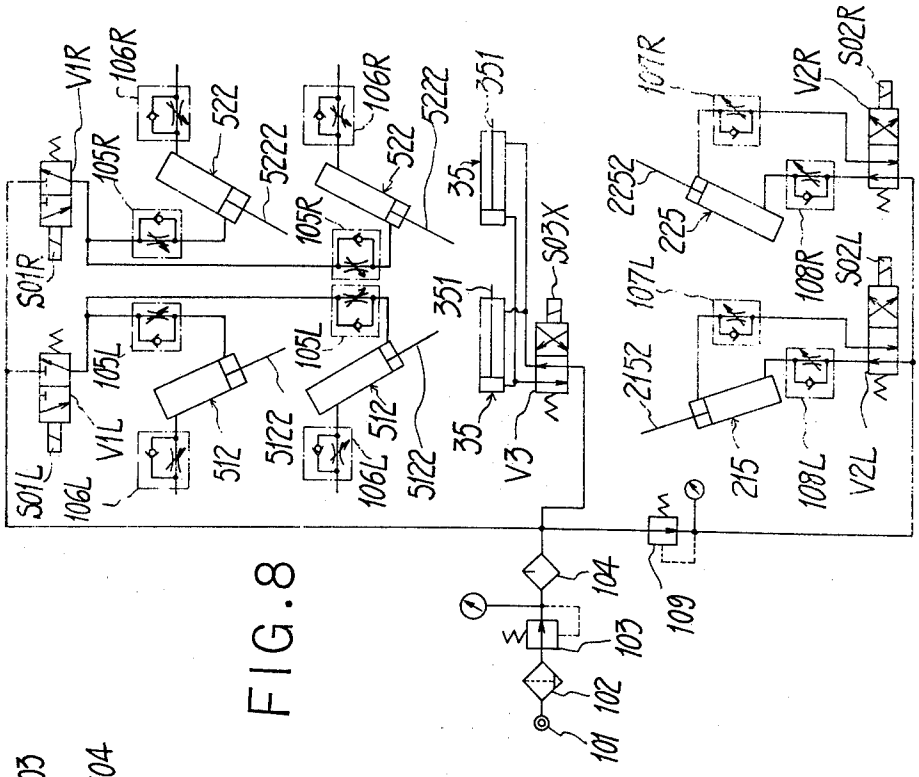


FIG. 8

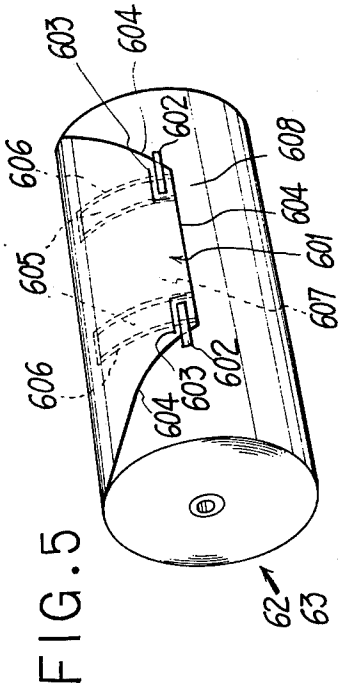


FIG. 5

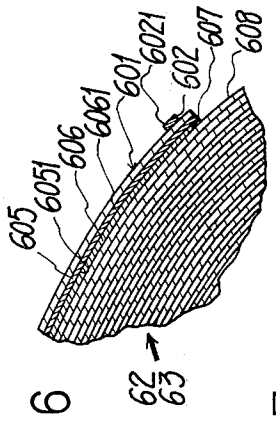


FIG. 6

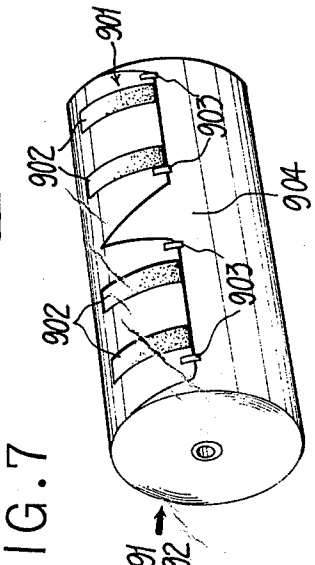


FIG. 7

FIG. 9

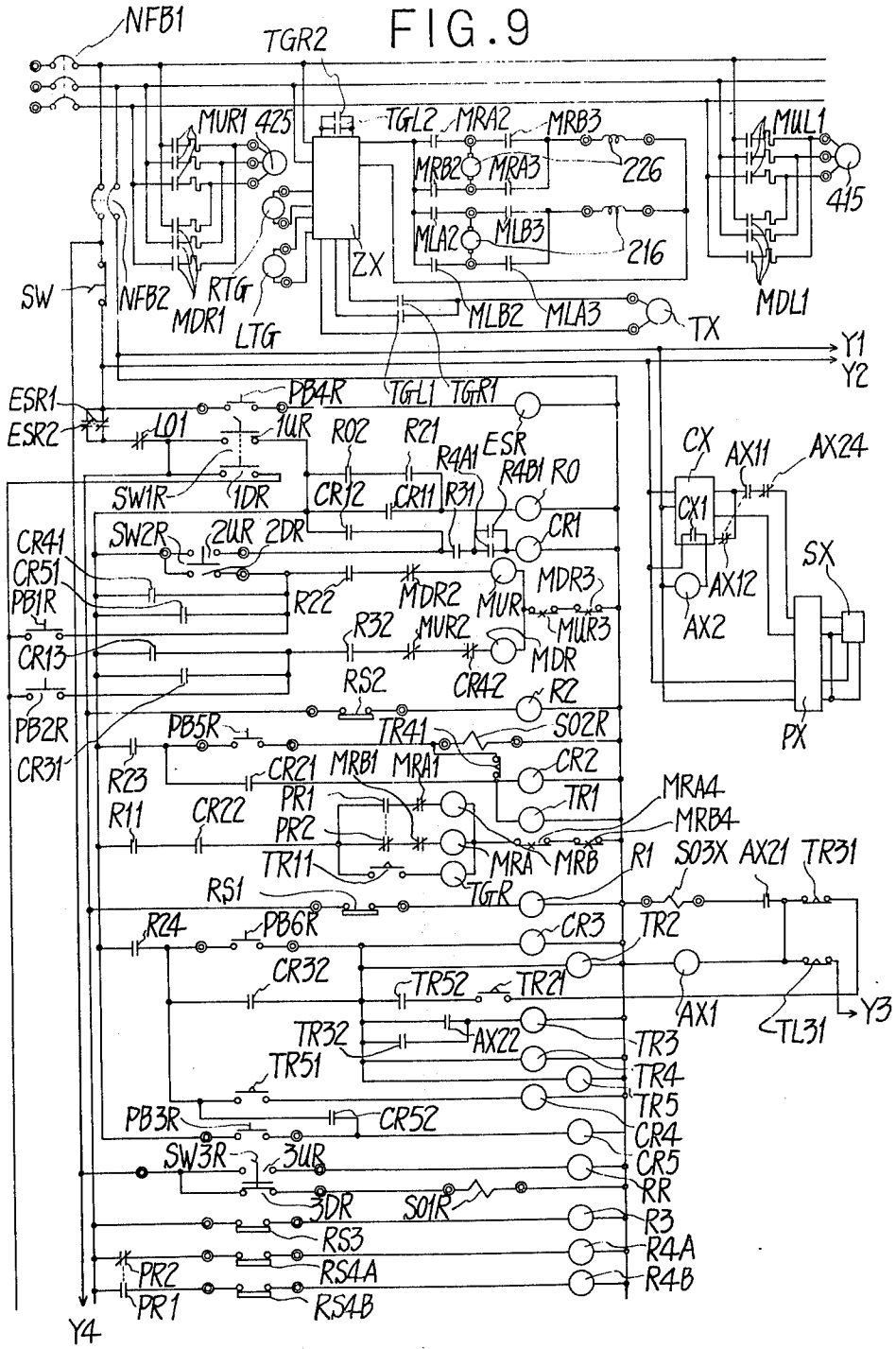

NFB1
TGR2
MUR1
425
TGL2
MRA2
MRB3
MRB2
MRA3
226
MUL1
415
MLA2
MLB3
216
ZX
SW
NFB2
RTG
MDR1
LTG
MLB2
MLA3
TX
MDL1
Y1
Y2
ESR1
ESR2
PB4R
TGL1
TGR1
LO1
1UR
RO2
R21
R4A1
ESR
R4B1
RO
CX
AX11
AX24
SW1R
1DR
CR12
CR11
R31
CR1
CX1
SW2R
2UR
2DR
SX
CR41
CR51
PB1R
R22
MDR2
MUR
MDR3
AX12
AX2
R32
MUR2
MUR3
CR13
MDR
RS2
CR42
R2
PB2R
PB5R
TR41
SO2R
CR31
R23
CR21
MRB1
MRA1
CR2
PX
R11
CR22
PR1
TR1
MRA4
PR2
MRB4
TR11
MRA
MRB
R1
SO3X
AX21
TR31
RS1
TGR
R24
PB6R
CR3
TR2
CR32
TR52
TR21
AX1
TL31
Y3
TR32
AX22
TR3
TR51
TR4
TR5
PB3R
CR52
CR4
SW3R
3UR
CR5
RR
3DR
SO1R
R3
RS3
R4A
PR2
RS4A
R4B
PR1
RS4B
Y4

FIG. 10

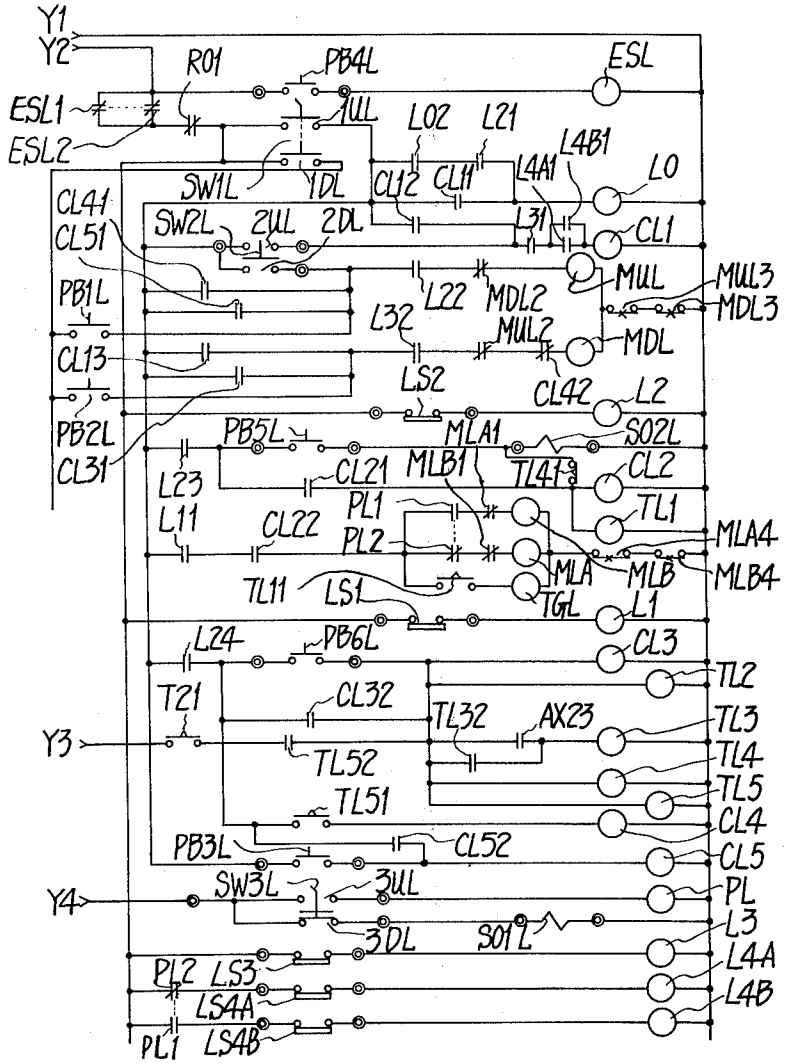

Y1
Y2
R01
PB4L
ESL
ESL1
ESL2
1UL
L02
L21
L4B1
L4A1
L0
SW1L
1DL
CL12
CL11
CL41
CL51
SW2L
2UL
2DL
L31
CL1
MUL
MUL3
MDL3
PB1L
L22
MDL2
L32
MUL2
MDL
CL13
LS2
CL42
L2
PB2L
CL31
PB5L
MLA1
SO2L
L23
CL21
MLB1
TL41
CL2
PL1
TL1
L11
CL22
PL2
MLA4
MLA
MLB
MLB4
TL11
LS1
TGL
L1
L24
PB6L
CL3
TL2
T21
CL32
TL32
AX23
TL3
Y3
TL52
TL4
TL5
TL51
CL4
PB3L
CL52
CL5
SW3L
3UL
Y4
PL
3DL
SO1L
L3
PL2
LS3
L4A
LS4A
L4B
PL1
LS4B

FIG. 11

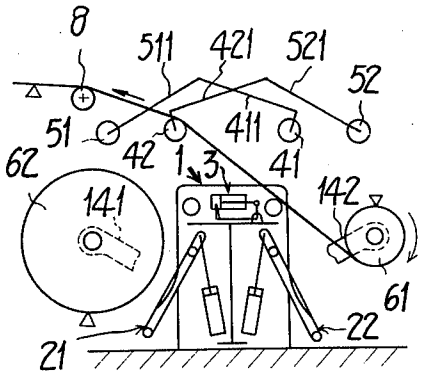


FIG. 12

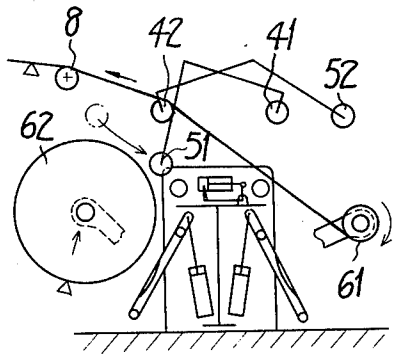


FIG. 13

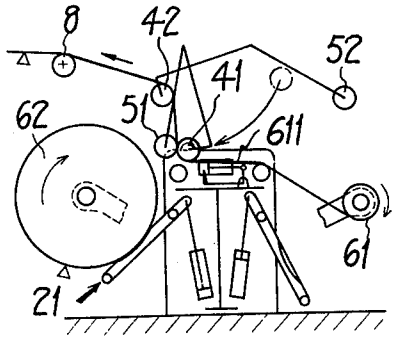


FIG. 14

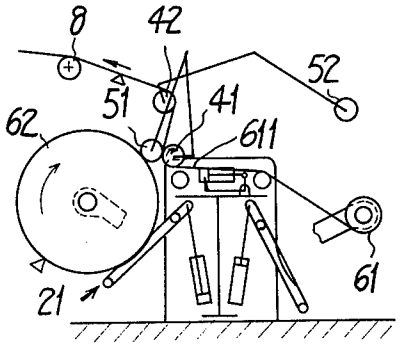


FIG. 15

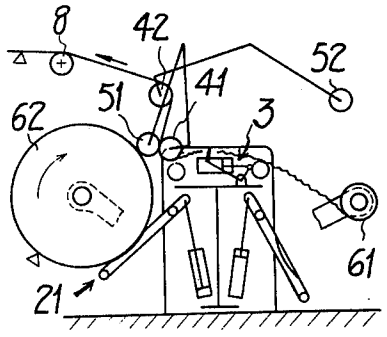


FIG. 16

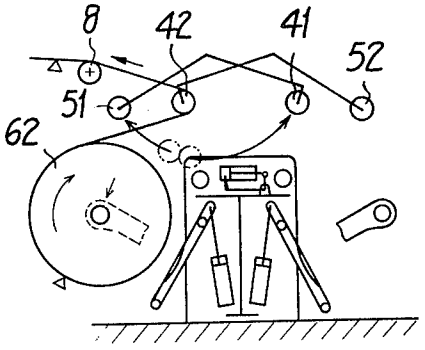


FIG.17

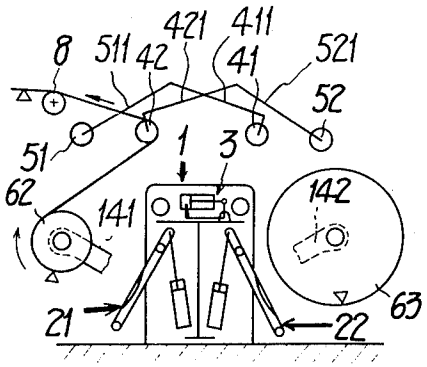


FIG.18

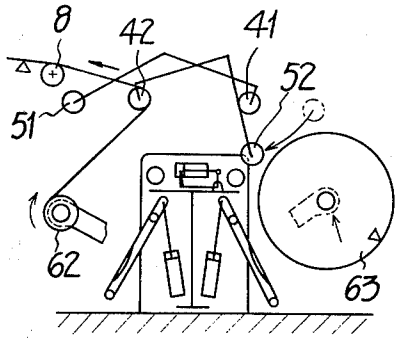


FIG.19

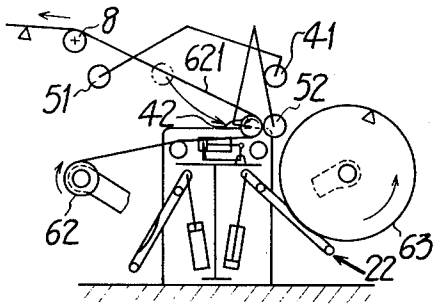


FIG.20

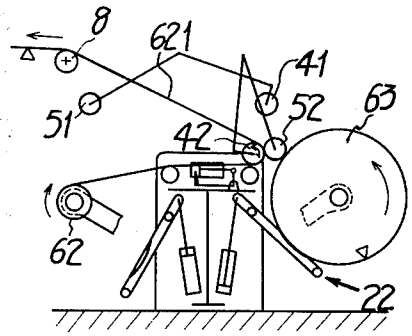


FIG.21

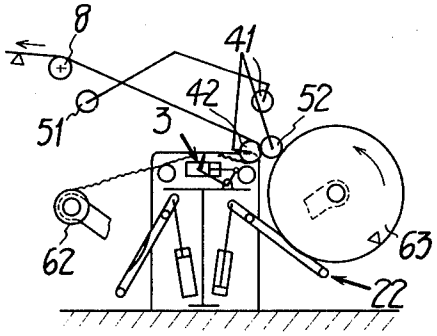


FIG.22

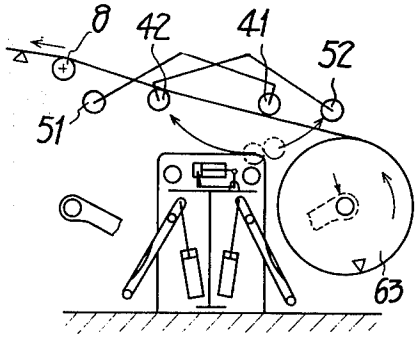


FIG.23

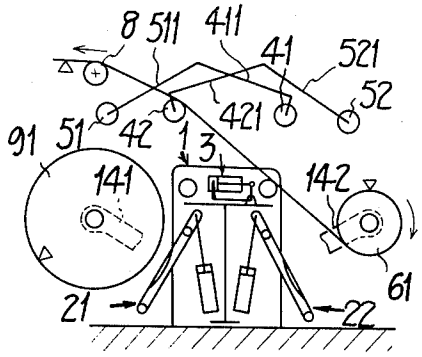


FIG.24

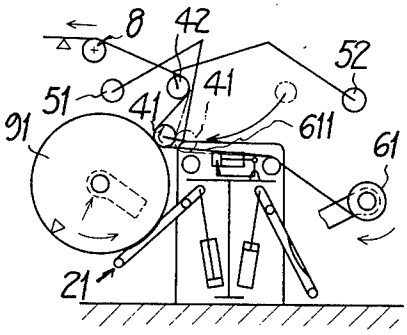


FIG.25

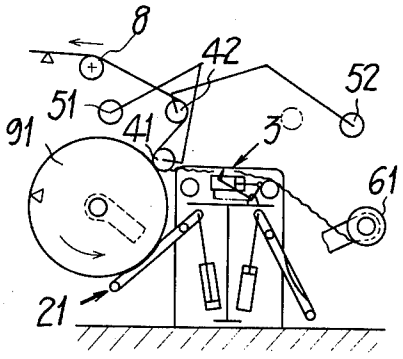


FIG.26

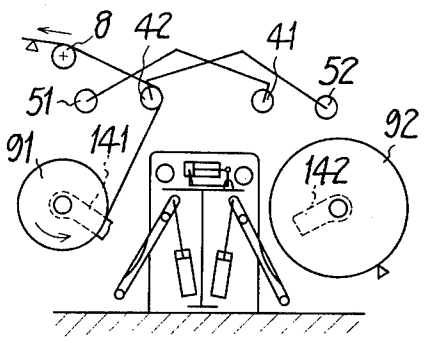


FIG.27

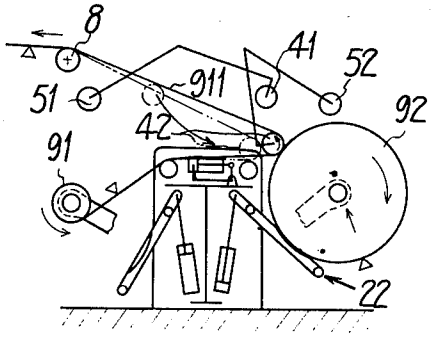
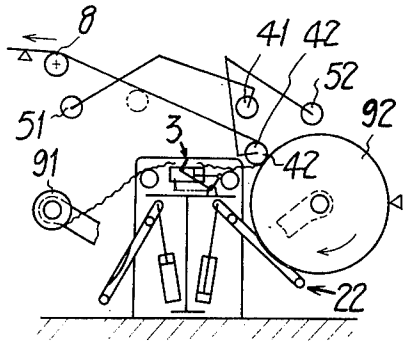


FIG.28



METHOD AND 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 operations. An expiring paper roll and a fresh paper roll are suspended from a stand (as seen in a Langston 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, one 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 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. The running web from the expiring roll is then cut away. In order to perform this kind of web-splicing operation, a number of the related processes must be reduced in speed to compensate for the slowdown in the roll rotation for effecting the transition from the expiring roll to the fresh roll.

Accordingly, an object of the present invention is to provide a method and apparatus for splicing webs of paper wherein the leading end of a fresh paper roll is spliced with the web running from an expiring paper roll so that the smoother face of the leading end follows the smoother face of the running web and the rougher face of the leading end follows the rougher face of the running web, without reducing the speed of the web running from the expiring paper roll. The web is supported by a mill stand, and when the splicing is completed, the web running from the expiring paper roll is immediately cut away.

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 various 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** is a front view of an apparatus for splicing webs in accordance with the present invention;

FIG. **2** is a sectional view of an apparatus for splicing webs, taken along a line X—X of FIG. **1** together with a mill stand and a predriver which is partially broken away;

FIG. **3** is a plan view of a mill stand, two predrivers and a cutter;

FIG. **4** is a plan view of first and second web-pushing rolls, first and second intermediate rolls and means for causing these rolls to effect a pendulum swinging motion;

FIGS. **5** and **6** show, respectively, a perspective and a partially enlarged sectional view of the paper roll which is employed in splicing the webs by use of the intermediate rolls;

FIG. **7** is a perspective view of the paper roll which is employed in splicing the webs without using the intermediate rolls;

FIG. **8** is a diagram of a pneumatic circuit for splicing the webs in accordance with the present invention;

FIGS. **9** and **10** are, respectively, a diagram of the electrical circuit for the apparatus for splicing the webs in accordance with the present invention;

FIGS. **11–22** show a sequence illustrating the web splicing operation conducted by the use of the intermediate rolls; and

FIGS. **23–28** show a sequence illustrating the web splicing operation conducted without the use of the intermediate rolls.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method and apparatus of the present invention will be described with respect to the situation where webs of a liner for corrugated boards are spliced with each other so that a smoother face of the fresh web follows a smoother face of a running web and a rougher face of a fresh web follows a rougher face of a running web. As shown in FIG. **11**, a paper roll **61** for corrugated board liner is suppported on the rear side of a mill stand **1** which is capable of supporting a pair of paper rolls rotating in opposite directions with respect to each other. The roll **61** which has the rougher surface facing outwardly (the rough surface of the web being indicated by the mark Δ in the drawing) is rotated clockwise in FIG. **11** and the web from the roll **61** is extended above the front side of the mill stand **1**, between the first and second web pushing rolls **41, 42** and above the mill stand **1**. The web from the roll **61** is guided and drawn out continuously by means of a guiding roll **8** suspended above the mill stand. The mill stand **1** is shown in FIGS. **1–3**. As is apparent from these drawings, the mill stand **1** is erected on a base **11** with both ends of its I-shaped long core frame **13** being secured to opposite side frames **12** and **12**. A pair of arms **141** and **141** are provided on the front side of the core frame **13** to enable said arms **141** and **141** to approach and separate from each other and to move in the vertical direction. Similarly, a pair of arms **142** and

142 are provided on the rear side of the core frame 13, said arms 142 and 142 being adapted to approach and separate from each other and to move vertically. A plate 15 is secured on the top face of the core frame 13. A paper guiding roll 161 is rotatably installed at the end edge, on the side of the arms 141 and 141, at the top face of the plate, and a paper guiding roll 162 is rotatably installed at the end edge, at the side of the arms 142 and 142, at the top face thereof. A pair of arms 141 and 141, and a pair of arms 142 and 142 rotatably support the respective paper rolls at the tip end portions thereof.

As shown in FIG. 11, a fresh paper roll 62 for corrugated board liner, which is to be spliced with the web from the paper roll 61, is rotatably supported on the front side of the mill stand so that the roll 62 may be unwound in a clockwise rotation as shown in the drawing. The paper roll 62 also has its rough surface facing in the outward direction. As shown in FIGS. 5 and 6, tapes 602 and 602 with an adhesive disposed on both sides thereof are provided for temporary fastening to small areas, that is, to both of the angled portions of the outer face of the leading end 601 of the paper roll 62. The respective angled portions are in the form of a trapezoid produced by cutting both ears of the end 601, respectively, into a triangular shape. The end of each tape 602 is extended somewhat from the leading end 601. The leading end 601 is cut so that tear-off line 603 and 603 are provided at the periphery of the adhesive tape 602. Both ends of each tear-off line 603 approach very close to the edge 604 of the leading end 601. For splicing purposes, double faced adhesive tape 605 and 605 are applied to the inner face of the leading end 601. Single-face adhesive tape 606 whose top faces 6061 are treated into non-binding faces, are applied to the surface 607 of the paper roll 62 which faces the unadhered faces 6051 and 6051 of the double-faced adhesive tape 605 whereby the separating faces are formed. The unadhered face 6051 of each double-faced adhesive tape 605 applied on the inner surface of the leading end 601 is superimposed on the top face 6061 of the single-face adhesive tape 606. The respective ends of the double-faced adhesive tapes 602 and 602, which extend from the leading end 601, are applied to the surface 608 of the paper roll 62. Each single-face adhesive tape 606 is the same in area as the double-faced adhesive 605, or slightly greater than said tape 605. Also, the respective edges of the double-faced adhesive tape 605 and the single-face adhesive tape 606 are approximately in alignment with the edge 604 of the leading end 601.

Under such a condition, when the paper roll 61 almost runs out, a first intermediate roll 51 (hereinafter referred to intermediate roll 51) located above the paper roll 62 is lowered to a position immediately near the paper roll 62, as shown in FIG. 12. As shown in FIGS. 1, 2 and 4, the intermediate roll 51 has a metallic surface and is rotatably installed at the lower end of a pair of swing arms 511 and 511. The upper ends of the pair of arms 511 and 511 are rotatably fixed to a shaft 412, which is located above the paper guiding roll 161 of the mill stand and is rotatably installed on plates 71 and 71 which are suspended from the frames 7 and 7 above the mill stand 1. A cylinder head 5121 of an air cylinder 512 is rotatably provided in a portion, above the paper roll 62, of the each frame 7. A piston rod 5122 is rotatably coupled to the swing arm 511. As described hereinbefore, in order to lower the intermediate roll 51, compressed air pressure is removed from the air cylinders 512 and 512 thereby causing the piston rod 5122 to be lowered, by its stroke length, because of the weight of the arms 511 and 511, and the roll 51. Also, in order to prevent the intermediate roll from hitting the paper roll 62 when traveling in its downward direction, the arms 141 and 141 of the mill stand 1 are lowered to lower the paper roll 62. The paper roll 62 is raised, after the intermediate roll 51 has completed its descent, so that the roll 51 may be placed right near the paper roll 62 as shown in FIG. 12.

As described hereinbefore, the intermediate roll 51 is lowered and then a first web-pushing roll 41 (hereinafter referred to as web-pushing roll 41) placed above a paper guiding roll 162 of the mill stand 1 is lowered to press against the web 611 running from the web roll 61 and pull it, whereby the paper 611 is brought into contact with the intermediate roll 51. As shown in FIGS. 1, 2 and 4, the web-pushing roll 41 is provided with an elastic rubber and is rotatably mounted at the lower end of a pair of swing arms 411 and 411. The upper ends of the pair of swing arms 411 and 411 are internally engaged with the swing arms 511 and 511 and are secured to the shaft 412. The swing arms 411 and 411 are oscillated by the rotation of the shaft 412 thereby elevating the web-pushing roll 41. The length from the center of the shaft 412 to the center of the web-pushing roll 41 is almost equal to the length from the center of the shaft 412 to the center of the intermediate roll 51. The end of the shaft 412 projects from the outer face of the plate 71 and is connected with a motor 415 for elevating the web-pushing roll through a speed change gear 413 and a torque limiter 414. The shaft 412 is rotated by means of the motor 415. The speed change gear 413, the torque limiter 414 and the motor 415 are installed on a frame 43 above the side frame 12 of the mill stand 1. The torque limiter 414 is composed of a disc 4141, a coil spring 4142, a friction plate 4143 and a chain gear 4144 which forms a friction face on a face opposing the friction plate 4143. The plate 4143 is sequentially engaged with a input shaft 4131 of the speed change gear 413; the disc 4141 is secured to the shaft 4131; the coil spring 4142 is secured at one end, to the disc 4141 and at its other end, to the friction plate 4143; the chain gear 4144 is rotatably engaged with the shaft 4131 so that the gear 4144 will not move along the axial direction of the shaft 4131 and so the friction plate 4143 will contact, under pressure, the friction plate of the chain gear 4144 by the resilient restoring force of the coil spring 4142; and a chain gear 4145, which is axially aligned with the chain gear 4144, is secured to the shaft 4151 of the motor 415 so that the two chain gears may be mutually connected by entraining a mutually-connected two-row chain 4146 on the two chain gears. When the shaft 412 is rotated by the driving of the motor 415, and a load of a given value is applied upon the shaft 412, the chain gear 4144 and the friction plate 4143 slip thereby suspending the shaft 412, the arms 411 and 411, and the web-pushing roll 41 if the operation of the motor 415 is continual.

As described hereinabove when the web 611 running from the roll 61 contacts the intermediate roll 51, the web-pushing roll 41 is suspended. Thereafter, the paper roll 62 is rotated, in advance, in a clockwise direction as shown in FIG. 13, namely, in the same direction as

the web-pushing roll **41**, by means of the predriver **21** provided in the mill stand **1**, and synchronized to the unwinding speed of the paper roll **61**. As shown in FIGS. **1** through **3**, the predriver **21** is composed of a pulley supporting member **211** which is rotatably installed in and suspended from, the underface of the plate **15** placed above the mill stand in the approximate central portion on the front side of the mill stand **1**. Pulleys **212** and **213** are rotatably provided in the respective upper portion and lower portion of the pulley supporting member **211**. An endless belt **214** is mounted on these pulleys. An air cylinder **215** having a cylinder head **2151** rotatably mounted in the lower end of the central portion of the core frame **13** of the mill stand also has a piston rod **2152** rotatably connected with the upper end of the pulley supporting member **211**. A motor **216** is provided on the side frame of the mill stand. A belt transmission gear **217** transmitting energy from the motor **216** to the input shaft of the speed change gear **218** provided on the end portion of the plate **15**. A chain transmission gear **2191** transmits energy from the output shaft of the speed change gear **218** to an intermediate shaft **220** rotatably provided on the underface of the plate **15**. Also a chain transmission gear **2192** transmits energy from the intermediate shaft **220** to the pulley **212** on the top side thereof. The projection of the piston rod **2152** from the air cylinder **215** pivots the pulley supporting member **211** causing the endless belt **214** to be held away from the paper roll **62** which is supported by the arms **141** and **141** of the mill stand, while the retraction of the piston rod **2152** pivots the pulley supporting member **211** in the reverse direction causing the endless belt **214** to contact the paper roll **62**. When the motor **216** is rotated, the power is transmitted thereby rotating the endless belt **214**. Therefore, the paper roll **62** may be rotated by the rotation of the endless belt **214**.

As described hereinabove, the paper roll **62** is rotated by means of the predriver **21**. The motor **415** for elevating the web-pushing roll is rotated immediately after the leading end **601** of the paper roll **62** has passed before the intermediate roll **51**. Thus, the web-pushing roll **41** is further lowered to push the intermediate roll **51** into contact with the paper roll **62**, as shown in FIG. **14**.

When the intermediate roll **51** is brought into contact with the rotating roll **62**, the unadhered faces **6021** and **6021** of the double-faced adhesive tape **602** and **602** which are applied upon the outer face of the leading end **601** of the fresh roll **62**, are applied upon the surface of the intermediate roll **51** and the leading end **601** is wound on the roll **51** in reverse. The unadhered faces **6051** and **6051** of the double-faced adhesive tape **605** and **605** on the inner face of the leading end **601** are applied upon the web **611** running from the expiring paper roll **61**. The leading end **601** of the paper roll **62** is spliced with the web **611** from the paper roll **61** so that a smoother face of the leading end **601** may follow a smoother face of the running web **611** and a rougher face of the leading end **601** may follow a rougher face of the running web **611**. Thus, the leading end **601** is drawn out together with the web **611**. When the leading end **601** is drawn out with the web **611**, the doublefaced adhesive tape **602** and **602** on the intermediate roll **51** are separated from said roll **51**, that is, when the double-faced adhesive tape **602** and **602** are tightly bound on the roll **51**, the uncut portions between the ends of the tear-off line **604** and the edge **604** of the leading end **601** is broken and the broken pieces of the leading **601** are left behind on the surface of the roll **51**.

Thus, after the leading end **601** of the paper roll **62** is spliced with the web running from the expiring paper roll **61**, the web **611** from the roll **61** is cut away by means of a cutter **3** as shown in FIG. **15**. As shown in FIGS. **1** through **3**, the cutter which is provided on the top face of the plate **15** of the mill stand **1** is composed of a knife **31** whose edge **311** is extended along the longitudinal direction of the plate **15** and is formed into a triangle-connected shape. The knife is provided with transverse arms **32** and **32**, which are disposed in approximately vertical directions with respect to the axial line of the knife. The erected knife **31** is secured at its tip end to said arms **32**. A shaft **33** is rotatably mounted on the top face of the plate **15** of the mill stand **1**, almost parallel with the knife, with the rear end of the transverse arms **32** and **32** being secured thereto. Longitudinal arms **34** and **34** are secured to both ends of the shaft **33**, and air cylinders **35** and **35** which contain piston rods **351** and **351** are rotatably connected to the upper end of the longitudinal arms **34** and **34** and are rotatably provided with the cylinder heads **352** and **352** on the top face of the plate **15**. The projection of the piston rods **351** and **351** from the air cylinders **35** and **35** rotates the longitudinal arms and the transverse arms around the shaft **33** thereby raising the knife **31**. Accordingly, the web which is being continuously drawn out from the paper roll and conveyed above the plate **15** is cut away. When the piston rods **351** and **351** are retracted, the knife is lowered.

The web splicing operation is completed by cutting the web **611** running from the paper roll **61** by use of the cutter **3**. As shown in FIG. **16**, the motor **415** for vertically lifting the web-pushing roll is rotated in the reverse direction to raise the web-pushing roll **41** to the original position. After lowering the paper roll **62** somewhat by properly lowering the arms **141** and **141** of the mill stand **1**, after the paper roll **62** is reduced in size, the piston rods **5122** and **5122** of the air cylinders **512** and **512** for vertically moving the intermediate roll are retracted thereby raising the intermediate roll **51**, whereby preparation is made for the next operation. The roll paper **62** is extended from between the web-pushing roll **41** and a second web-pushing roll **42** and above the intermediate roll **51**. Then, the web from the roll **62** is guided by means of the guiding roll **8** suspended from the frames **7** and **7** located above the mill stand **1** and is successively drawn out and conveyed to the next process.

Subsequently, the paper roll **62** which is successively unwound is reduced into a small roll. The operation for splicing a smooth faced outside paper roll **63** is reversed to that discussed above. The smooth face of the web is faced outwardly on the roll and is indicated by the mark Δ in the drawing. The rough base of the web is, of course, faced inwardly. The corrugated board liner is supported on the back side of the mill stand **1** so that the web of the fresh paper roll **63** may be drawn out through a rotation in the counterclockwise direction, as shown in FIG. **17**.

The structure of the leading end of the fresh paper roll **63** is formed, in advance and has the same structure as the leading end of the paper roll **62** as shown in FIGS. **5** and **6**.

Now, a second intermediate roll 52 (hereinafter referred to as intermediate roll 52) disposed above the paper roll 63 is lowered into a position near the paper roll 63 as shown in FIG. 18. The intermediate roll 52 has a metallic surface roll which is rotatably installed at the lower end of a pair of swing arms 521 and 521 as shown in FIGS. 2 and 4. The upper ends of said pair of swing arms 521 and 521 are rotatably mounted on the shaft 422. The shaft 422 which is located above the paper guiding roll 162 of the mill stand is almost parallel with the shaft 412, and is rotatably installed on plates 71 and 71 suspended from the frames 7 and 7 above the mill stand. The cylinder head 5221 of an air cylinder 522 is rotatably provided in a portion of the frame 7 above the paper roll 63 and the piston rod 5222 of the air cylinder is rotatably connected with the swing arm 521. In order to lower the intermediate roll 52, the compressed air is removed from the air cylinders 522 and 522. Due to the weight of the arms 521 and 521, and the roll 51, the roll 52 is lowered by the length of the stroke of the piston rod 5222. The arms 142 and 142 of the mill stand 1 are lowered so that the intermediate roll 52 does not hit the paper roll 63 in its downward direction, and the paper roll 63 is raised after the intermediate roll 52 has completed its descent, whereby the intermediate roll 52 is located near the paper roll 63.

After the intermediate roll 52 has been lowered, a second web-pushing roll 42 (hereinafter referred to as web-pushing roll 42) located above the paper guiding roll 161 of the mill stand 1, as shown in FIG. 19, is lowered. Accordingly, the roll 42, is pressed against the web 621 running from the paper roll 62 and the web 621 is pulled and brought into contact with the intermediate roll 52. The web-pushing roll 42 has an elastic rubber surface and is rotatably installed at the lower end of a pair of swing arms 421 and 421 as shown in FIGS. 1, 2 and 4. The upper ends of the pair of swing arms 421 and 421 are internally engaged with the swing arms 521 and 521 and are secured to the shaft 422. The swing arms 421 and 421 are oscillated by the rotation of the shaft 422 and the web-pushing roll 42 is elevated. The length from the center of the shaft 422 to the center of the web-pushing roll 42 is almost equal to the length from the center of the shaft 422 to the center of the intermediate roll 52. Also, the swing arms 421 and 421 are internally engaged with the swing arms 411 and 411 on which the web-pushing roll 41 is mounted. The end of the shaft 422 projects from the outer face of the plate 71 and is connected with a motor 425 for vertically moving the paper pushing roll through a speed change gear 423 and a torque limiter 424. The shaft 422 is rotated by means of the motor 425. The torque limiter 424 is the same, in construction, as the torque limiter 414. The torque limiter is composed of a disc 4241, a coil spring 4242, a friction plate 4243 and a chain gear 4244 which are engaged, with the input shaft 4231 of the speed change gear 423, a chain gear 4245 engaged with the shaft 4251 of the motor 425, and a chain 4246 connecting the chain gear 4244 with the chain gear 4245. The speed change gear 423, the torque limiter 424 and the motor 425 are also disposed on the frame 43.

As described hereinbefore, when the web 621 drawing out from the paper roll 62 is brought into contact with the intermediate roll 52, the web-pushing roll 42 is suspended. Thereafter, the paper roll 63 is, in advance, rotated in a counter-clockwise in FIG. 19, namely, in the same direction as the web-pushing roll 42 by means of a predriver 22 provided in the mill stand 1 and is synchronize to the unwinding speed of the paper roll 62. The predriver 22 is the same, in construction, as the predriver 21. The predriver is composed of a pulley supporting member 221 rotatably provided and suspended from the underface of the plate 15 on the mill stand in an approximate central portion on the rear side of the mill stand 1, pulleys 222 and 223 rotatably provided on a pulley supporting member 221, an endless belt 224 entrained on these pulleys, an air cylinder 225 having a cylinder head 2251 rotatably provided in the lower end of the central portion of core frame 13 of the mill stand, while having a piston rod 2252 rotatably connected with the upper end of the pulley supporting member 221, a motor 226 for driving the pulleys, a speed change gear 228, a belt transmission gear 227 transmitting from the motor 226 to the speed change gear 228, a chain transmission gear (not shown) transmitting from the speed change gear 228 to the intermediate shaft 230 on the underface of the plate 15, and a chain transmission gear transmitting from the intermediate shaft 230 to the pulley 222 on the upper side.

The paper roll 63 is rotated by means of the predriver 22, and the motor 425 for elevating the paper pushing roll is rotated right after the leading end of the paper roll 63 has passed before the intermediate roll 52. As shown in FIG. 20, the web-pushing roll 42 is further lowered thereby pushing the intermediate roll 52 into contact with the paper roll 63. By the contact made between the intermediate roll 52 and the rotating paper roll 63, the unadhered faces 6021 and 6021 of the double face adhesive tapes 602 and 602 applied upon the outer face of the end 601 of the paper roll 63 are applied to the surface of the intermediate roll 52. Accordingly, the leading end 601 is wound on the intermediate roll 52 and reversed. The unadhered faces 6051 and 6051 of the double-face adhesive tapes 605 and 605 on the inner face of the leading end 601 of the roll 63 are applied to the web 621 running from the paper roll 62. The leading end 601 of the paper roll 63 is spliced with the web 621 running from the expiring paper roll 62 so that a smoother face of the leading end 601 may follow a smoother face of the running web 621 and rougher face of the leading end 601 may follow a rougher face of the running web 621. Thus, the leading end 601 of the fresh paper roll 63 is spliced with the running web 621. As shown in FIG. 21, the running web 621 from the paper roll 62 is cut away by means of the cutter 3, thus completing the web splicing operation. Then, as shown in FIG. 22, the motor 425 for vertically moving the web-pushing roll is reversed thereby elevating the web-pushing roll 42 to its original position, while the arms 142 and 142 of the mill stand 1 are properly lowered thereby to somewhat lower the paper roll 63. Alternately after the paper roll has been reduced in volume, the piston rods 5222 and 5222 of the air cylinders 522 and 522 for raising the intermediate rolls are retracted thereby raising the intermediate roll 52, and preparing for the next operation.

In order to splice a leading end 901 of a smooth face-outside paper roll 91 for the corrugated board liner with the web 611 from paper roll 61 which is supported by the arms 142 and 142 on the rear side of the mill

stand 1, the intermediate roll 51 is held suspended for the following operation:

As shown in FIG. 7 double-face adhesive tapes 902 are applied upon the outer face of the leading end 901 of the paper roll 91, while double-face adhesive tapes 903 much smaller than the double-face adhesive tapes 902 are applied across the leading end 901 and the outer face 904 of the paper roll 91. Thus the leading end 901 is temporarily fixed to the outer face 904 of the paper roll 91. The paper roll 91 is supported by the arms 141 and 141 on the front side of the mill stand 1 as shown in FIG. 23 and is arranged to be unwound by rotating the paper roll 91 counter-clockwise in the drawing. As shown in FIG. 24, the arms 141 and 141 of the mill stand are, in advance, elevated and the paper roll 91 is disposed within a track of the web-pushing roll 41. The web-pushing roll 41 is pressed against the web 611 running from the paper roll 61. The web-pushing roll 41 is lowered right near the fresh paper roll 91, pulling the web 611 and is suspended. Then, the paper roll 91 is rotated counter-clockwise by means of the predriver 21, synchronized to the unwinding speed of the paper roll 61. The web-pushing roll 41 is lowered again right after the leading end 901 of the paper roll 91 has passed before the web-pushing roll 41, and the web 611 running from the paper roll 61 is brought into contact with the paper roll 91 as shown in the solid line of FIG. 24. And the unadhered face of the respective double-face adhesive tapes 903 (which are used to temporarily fix) applied to the outer face of the leading end 901 of the paper roll 91, and the unadhered face, of the respective double-face adhesive tapes 902 (for splicing) are applied to the paper 611 running from the paper roll 61.

Thus, the leading end 901 of the paper roll 91 is spliced with the web 611 from the paper roll 61 so that a smoother face of the leading end 901 may follow a smoother face of the running web 611 and a rougher face of the leading end 901 may follow a rougher face of the running web 611. After the leading end 901 of the paper roll 91 is spliced with the web 611 from the expiring paper roll 61, the web 611 running from the paper roll 61 is cut away by means of a cutter 3 as shown in FIG. 25, whereby the web splicing operation is completed. Thereafter, the web-pushing roll 41 is elevated to its original position to prepare for the next operation.

Also, the splicing operation of a leading end of a rougher face-outside paper roll 92 with the web 911 from the paper roll 91 which is supported by the arms 141 and 141 of the mill stand 1 and which is being successively unwound is performed as follows with the intermediate roll 52 being maintained in a suspended state.

The paper roll 92 is also the same in the structure of its leading end as that of the paper roll 91, as shown as FIG. 7. As shown in FIG. 26, the paper roll 92 is supported by the arms 142 and 142 of the mill stand 1 and is arranged to be unwound by a rotation, as shown in the drawings. Then, as shown in FIG. 27, the paper pushing roll 42 is pressed against the web 911 running from the paper roll 91, and is lowered near the fresh paper roll 92, pulling the web 911 with it. Then the roll 42 is stopped. The paper roll 92 is synchronized to the unwinding speed of the paper roll 91 and rotated clockwise (in the drawing) by means of the predriver 22. Right after the leading end 901 of the paper roll 92 has past before the web-pushing roll 42, the web-pushing roll 42 is lowered again. The web 911 which is unwound from the paper roll 91 is brought into contact with the paper roll 92 as shown in FIG. 27.

The leading end of the roll 92 is then spliced with the web 911 from the roll 91 so that a smoother face of the leading end may follow a smoother face of the web 911 and a rougher face of the leading end may follow a rougher face of the web 911. Thereafter, the running web 911 from the roll 91 is cut away by means of the cutter 3 as shown in FIG. 28, thus completing the splicing operation. Then, the web-pushing roll 42 is elevated to the original position to prepare for the next operation.

The pneumatic circuit for air cylinders 512, 512 and 522, 522 for vertically moving the intermediate rolls 51 and 52 in the web splicing apparatus, for air cylinders 215 and 225 for moving the predrivers 21 and 22, and for air cylinders 35 and 35 for moving the cutter 3 are shown in FIG. 8.

Referring now to FIG. 8, VIL and VIR are respectively a 3-port, 2-position solenoid operated valve, V2L, V2R and V3 being respectively, 4-port 2-position solenoid operated valves. The feed air port of valves VIL, VIR and V3 are connected, by means of piping, with a proper compressed air source 101 through a filter 104, with a flow rate regulating valve 103 with a pressure gauge, and with a lubricator 102. Also, solenoid operated valves V2L and V2R are connected, by means of piping, with the filter 104 through a flow rate regulating valve 109. A cylinder side port of the valves VIL and VIR is connected, by means of piping, with a port on the rod cover side of the air cylinders 512, 512 and 522, 522, which vertically move the intermediate roll through speed controllers 105L, 105L and 105R, 105R. A port on the head cover side of the air cylinders 512, 512 and 522, 522 communicates with the atmosphere through speed controllers 106L, 106L and 106R, 106R. Under the condition as shown in FIG. 8, a solenoid SOIL of the valve VIL and a solenoid of the valve VIR are both demagnetized, and the piston rods 5122, 5122 and 522, 522 of the air cylinders 512, 512 and 522, 522 are lowered by selfweight. Accordingly, the intermediate rolls 51 and 52 are also lowered. Excitation of the respective solenoids SOIL and SOIR raises piston rods 5122, 5122 and 5222, 5222 thereby retracting them into the respective cylinder tube. Two cylinder side ports of the valve V2L are connected, by means of piping, with the air cylinder 215 of the predriver 21 through speed controller 107L and 108L, while two cylinder side ports of the valve V2R are connected, by means of piping, with the air cylinder 225 of the predriver 22 through speed controllers 107R and 108R. Under the condition as shown in FIG. 8, the solenoid SO2L of the valve V2L and the solenoid SO2R of the valve V2R are both demagnetized. The piston rods 2152 and 2252 of the air cylinders 215 and 225 project from the cylinder tube and accordingly the pulley supporting members 211 and 221 of the predriver are lowered. Accordingly, the pulley supporting members 211 and 211 of the predriver are lowered. Excitation of the solenoids SO2L and SO2R changes the air flow and thus the piston rods 2152 and 2252 are retracted into the cylinder tube thereby causing the pulley supporting members 211 and 221 of the predriver to be retracted. Two cylinder side ports of a valve V3 are connected, by means of piping, with the ports of the air cylinders

35 and 35 of the cutter 3. Under the condition as shown in FIG. 8, the solenoid SO3X of the valve V3 is demagnetized and the piston rod 351 of each air cylinder 35 is retracted into the cylinder tube. Thus, the knife 31 of the cutter 3 is lowered. Excitation of the solenoid SO3X of the valve V3 projects each piston rod 351 thereby raising the knife 31. The electric circuits for the web splicing apparatus are shown in FIGS. 9 and 10. Referring now to FIGS. 9 and 10, parts shown with a mark containing a letter L are used in controlling motors 415 and 216, and solenoid operated valves VIL, V2L and V3, the motors 415 and 216 being operated in splicing a web running from an expiring paper roll, which is supported by means of arms 142 and 142 of the mill stand, with a leading end of a fresh paper roll, which is supported by means of the arms 141 and 141 of the mill stand. Also, parts designated by a mark containing a letter R are used in controlling the motors 425 and 226, and solenoid operated valves VIR, V2R and V3, the motors 425 and 226 being operated in splicing a web running from an expiring paper roll, which is supported by means of arms 141 and 141 of the mill stand, with a leading end of a fresh paper roll, which is supported by means of arms 142 and 142 of the mill stand. Parts designated by a mark containing a letter X are operated in any splicing operation described hereinabove.

Referring now to FIGS. 9 and 10, PBIL and PBIR are respectively a manually-operated switch for rotating the motors 415 and 425 in a direction for elevating the web-pushing rolls 41 and 42. PB2L and PB2R are respectively a manually-operated switch for rotating the motors 415 and 425 in a direction for lowering the web pushing rolls 41 and 42. PB3L and PB3R are respectively, a switch for resetting, PB4L and PB4R being, respectively, a switch for providing an emergency stop. PB5L and PB5R are, respectively, a switch for predriver operation, PB6L and PB6R being, respectively, a switch for splice start. The switches PBIL, PB2L, PB3L, PB4L, PB5L, PB6L and PBIR, PB2R, PB3R, PB4R, PB5R, PB6R are, respectively, a push button switch of the momentary type, and are normally opened. They are closed only when the knob of the respective switches is in a depressed state.

SW is a switch for apparatus locking. SWIL and SWIR are, respectively, a switch for an automatic operation to a manual operation transfer, SW3L and SW3R being switches for intermediate roll operation. The switches SW, SWIL, SWIR, SW3L and SW3R are, respectively, switches of the rotary type, and the contacts can be kept open or closed by properly rotating the switch handle to a suspend position. SW2L and SW2R are, respectively, switches for changing over a splice preparation of a web-pushing roll to a gradual raising operation and are normally open. They are, respectively, switches of the momentary type which are closed only while the switch handle is rotated.

LSI, LS2, LS3, LS4A, LS4B, RS4B, and RSI, RS2, RS3, RS4A, RS4B are limit switches. The limit switches LSI and RSI are secured to support rods 151 and 152 which are bridged in and secured to the side frames 12 and 12 of the mill stand 1 as shown in FIGS. 1, 2, and 3. The limit switch LSI is pushed and opened by means of a pulley support member 211 of the predriver 21 which is located at its descent limit, and is closed when the pulley support member 211 is raised from the descent limit. The limit switch RSI is pushed and opened by means of a pulley support member 221 of the predriver 22 which is located at its descent limit, and is closed when the pulley support member 221 is raised from the descent limit. The limit switches LS2, LS3, LS4A, LS4B and RS2, RS3, RS4A, RS4B are suspended from the underface of the plate 712 which is secured to a support rod 711 bridged in plates 71 and 71 above the mill stand 1 as shown in FIGS. 1, 2 and 4. The limit switches LS2, LS3, LS4A and LS4B look toward the shaft 412, while the limit switches RS2, RS3, RS4A and RS4B look toward the shaft 422. Rings 416, 417, 418 and 419 with projections are fixedly engaged with the shaft 412, while springs 426, 427, 428 and 429 with projections are fixedly engaged with the shaft 422. The limit switches LS2 and RS2 are pushed and opened by the projections 4161 and 4261 of the rings 416 and 426 when the web-pushing rolls 41 and 42 are located at its limit and closed when the web-pushing rolls 41 and 42 are lowered from the top limit. The limit switches LS3 and RS3 are pushed and opened by the projections 4171 and 4271 of the rings 417 and 427 when the web-pushing rolls 41 and 42 are located at their bottom limit, and are closed when the web-pushing rolls 41 and 42 are raised from their bottom limit. In the splicing operation without the intermediate rolls 51 and 52, the limit switches LS4A and RS4A are pushed and opened by the projections 4181 anad 4281 of the rings 418 and 428 when the web-pushing rolls 41 and 42 are located in a position for the splice preparation, namely, when the web-pushing rolls 41 and 42 are located in a position close to a fresh paper roll as shown in FIGS. 24 and 27. But the limit switches LS4A and RS4A are closed when the web-pushing rolls 41 and 42 are removed from the splice preparing position. In the splicing operation, using the intermediate rolls 51 and 52, the limit switches LS4B and RS4B are pushed and opened by the projections 4191 and 4291 of the rings 419 and 429 when the web-pushing rolls 41 and 42 are placed in another splice-preparing position, that is when the paper pushing rolls 41 and 42 are located in a position which permits a drawing-out web roll to contact an intermediate roll which is located immediately close to a fresh paper roll as shown in FIGS. 13 and 19. However, the limit switches LS4B and RS4B are closed when the web-pushing rolls 41 and 42 are removed from the other splice preparing position.

Referring now to FIGS. 9 and 10, NFBI and NFB2 are no-fuse breakers. The breakers NFBI and NFB2 are respectively used for protection of a main circuit and a control circuit. ESL, L0, LI, L2, L3, L4A, L4B, PL, CL1, CL2, CL3, CL4, CL5, MLA, MLB, TGL (see FIG. 10) and ESR, R0, RI, R2, R3, R4A, R4B, PR, CR1, CR2, CR3, CR4, CR5, MRA, MRB, TGR (see FIG. 9) are relay coils. ESL1 and ESL2 (see FIG. 10) are, respectively normally closed contact points for the relay ESL, while the ESR1 and ESR2 (see FIG. 9) are respectively, closed contact points for the relay ESR. L01 (FIG. 9) and L02 (FIG. 10) are, respectively, a normally closed contact point and a normally opened contact point for a locking relay L0. R01 (FIG. 10) and R02 (FIG. 9) are respectively a normally closed contact point and a normally opened contact point for a locking relay R0. Hereinafter, the normally opened contact point is referred to as an A contact point, while the normally closed contact point is referred to as B contact point. L11 is an A contact point for the relay L1, while L21, L22, L23, and L24 are respectively an A contact point for the relay L2. L31 and L32 are re-

spectively an A contact point for the relay L3. L3A1 and L4B1 are respectively an A contact point for the relay L4A and the relay L4B (see FIG. 10). R11 is an A contact point for the relay R1; R21, R22, R23 and R24 are respectively an A contact point for the relay R2; R31 and R32 are respectively, an A contact point for the relay R3; R4A1 is an A contact point for the relay R4A; and R4B1 is an A contact point for the relay R4B (see FIG. 9). PL1 and PL1 are respectively an A contact point for the relay PL; PL2 and PL2 are respectively, a B contact point for the relay PL (see FIG. 10). PR1 and PR1 are respectively an A contact point for the relay PR, while PR2 and PR2 are respectively a B contact point for the relay PR.

CL11, CL12 and CL13 are respectively an A contact point for the relay CL1, CL21 and CL22 are an A contact point for the relay CL2, CL31 and CL32 are an A contact point for the relay CL3, CL41 is an A contact point for the relay CL4, CL51 and CL52 are respectively, an A contact point for the relay CL5; CL42 is a B contact point for the relay CL4 (see FIG. 10). CR11, CR12 and CR13 are, respectively, an A contact point for the relay CR1, CR21 and CR22 are an A contact point for the relay CR2, CR31 and CR32 are respectively, an A contact point for the relay CR3, C41 is an A contact point for the relay CR4, CR51 and CR52 are respectively, an A contact point for the relay CR5; and CR42 is a B contact point for the relay CR4 (FIG. 9). TGL1 and TGL2 are, respectively, an A contact point for the relay TGL (see FIGS. 9 and 10), and TGR1 and TGR2 are respectively, an A contact point for the relay TGR (FIG. 9). MLA1 is a B contact point for the relay MLA, MLA2 and MLA3 being respectively an A contact point for the relay MLA (FIGS. 9 and 10). MRA1 is a B contact point for the relay MRA, and MRA2 and MRA3 are respectively, an A contact point for the relay MRA (see FIG. 9). Also, MLB1 is a B contact point for the relay MLB, MLB2 and MLB3 are respectively, an A contact point for the relay MLB (see FIGS. 9 and 10). MRB1 is a B contact point for the relay MRB, and MRB2 and MRB3 are respectively, an A contact point for the relay MRB (FIG. 9). MLA4, MLB4 and MRA4, MRB4 are, respectively, a B contact of the respective thermal relay for the relays MLA, MLB and MRA, MRB, forming a protection apparatus for overload. Referring now to FIGS. 9 and 10, MUL, MDL and MUR, MDR are, respectively, an operating coil of a magnetic connector. MUL1 and MDL1 (see FIG. 9) are respectively an A contact point for the magnetic connectors MUL and MDL, and MUR1 and MDR1 (FIG. 9) are respectively an A contact point for the magnetic connectors MUR and MDR, any of said connectors being a contact point for main circuit operation. MUL2 and MDL2 (see FIG. 10) are respectively auxiliary B contact points for the connectors MUL and MDL, while MUR2 and MDR2 (see FIG. 9) are, respectively, an auxiliary B contact points for the connectors MUR and MDR. MUL3, MDL3 and MUR3, MDR3 are B contact points of the respective thermal relays for the connectors MUL, MDL and MUR, MDR. TL1, TL2, TL3, TL4, TL5 (see FIG. 10) and TR1, TR2, TR3, TR4, TR5 (see FIG. 9) are respectively a coil of a timer relay. TL11 is a time limit A contact point (a contact point which is closed, after the elapse of a set time, after the current has flowed to a relay coil) for the relay TL1, TL21 is a time limit A contact point for the relay TL2, and TL51 is a time limit A contact point for the relay TR5 (see FIG. 10). TR11 is a time limit A contact point for the relay TR1, TR21 is a time limit A contact point for the relay TR2, and TR51 is a time limit A contact point for the relay TR5 (see FIG. 9). TL31 is a time limit B contact point (a contact point which is opened, after the elapse of a set time, after current has flowed to the relay coil) for the relay TL3, TL41 is a time limit B contact point for the relay TL4, TR31 is a time limit B contact point for the relay TR3, and TR41 is a time limit B contact point for the relay TR4 (see FIG. 9). TL32 is an instantaneous A contact point (a contact point which is opened immediately after current has flowed to the relay coil) for the relay TL3, TL52 is an instantaneous A contact point for the relay TL5 (see FIG. 10), TR32 is an instantaneous A contact point for the relay TR3, TR52 is an instantaneous A contact point for the relay TR3, and TR52 is an instantaneous A contact point for the relay TR5. The usage of the respective timer relay will be described hereinafter. Relays TL1 and TR1 are used for a predriver rotation start timing, relays TL2 and TR2 for a cutter knife lift timing, relays TL3 and TR3 for a cutter knife drop timing, relays TL4 and TR4 and TR4 for a drop start timing of the pulley-supporting member of the predriver, and relays TL5 and TR5 for a lift start timing of the web pushing roll. SOIL, SO2L (FIG. 10) and SO1R, SO2R (FIG. 9) and SO3X (FIG. 9) are, respectively, solenoid coils of a solenoid operated valve as shown in FIG. 8. Referring now to FIG. 9, AX1 is a relay for resetting a counter (described later), and AX2 is a relay for starting the paper roll cut. AX11 and AX12 are respectively, an A contact point for the relay AX1 and a B contact point therefore. AX21, AX22 and AX23 are, respectively, an A contact for the relay AX2, and AX24 is a B contact point for the relay AX2. TX is a motor which is provided in a suitable location of a machine for manufacturing corrugated boards for detecting the running speed of the web from the paper roll. LTG is a motor for detecting the rotating speed of the motor 216 of the predriver 21, and RTG is a motor for detecting the rotating speed of the motor 226 of the predriver 22. ZX is a ratio control board which receives the signals from the motors TX, LTG and RTG thereby controlling the rotational speed of the motors 216 and 226 of the predriver, whereby the leading end of a fresh paper roll which is to be spliced with the web running from the expiring paper roll is synchronized to the running speed of the web from the expiring paper roll. CX is a digital counter which counts the drawing out amount of the paper roll after having spliced the web thereby determining the cutter operating time. CX1 is an A contact point for the relay built-in in the counter CX, SX is a proximity switch, and PX is a power source portion of the proximity switch SX and an amplifier portion thereof. The proximity switch SX is secured to a supporting rod 81 of the guiding roll 8 suspended from the frames 7 and 7 above the mill stand 1 as shown in FIG. 2. A count signal is transmitted to the digital counter CX every time vanes 82, 82, and 82 which are secured in radial form to the end of the roll 8 and rotate with a roll 8 approach the proximity switch.

Subsequently, the function of the electric circuits will be briefly described wherein the leading end of the paper roll 62 which is supported by means of the arms 141 and 141 of the mill stand 1 is spliced, by use of an intermediate roll 51, with the web from the paper roll

61 which is supported by means of the arms 142 and 142 of the mill stand as shown in FIGS. 11 to 16.

A switch SW for apparatus locking is kept closed, and a contact point IUL for the automatic operation of the switch SW1L for changing an automatic operation to a manual operation is kept closed.

Under a steady state shown in FIG. 11, by means of the switch SW3L for operating the intermediate roll, the contact point 3UL is opened and the contact point 3DL is closed. Thus, the solenoid SO1L is excited. Accordingly, the piston rod 5122 of the air cylinder 512 for vertically moving each intermediate roll is retracted into the cylinder tube, and the intermediate roll 51 is located at its top limit. Also, the web pushing roll 41 is also suspended at its top limit, and accordingly, the limit switch LS2 is kept open, while the limit switches LS3, LS4A and LS4B are kept closed. Furthermore, the predriver 21 is in its suspended position, and the pulley supporting member 211 is located at its bottom limit. Accordingly, the limit switch LS1 is kept open and also, the cutter 3 is suspended with its knife 31 being in its descended position.

From such a steady condition, the handle of the switch SW3L is then rotated thereby to closing the contact point 3UL, and the contact point 3DL is opened. The solenoid is then demagnetized and the intermediate roll 51 is lowered by its self-weight. Accordingly, the roll 51 may be positioned close to the paper roll 62 as shown in FIG. 12. Then, closure of the contact point 2UL for "splice preparation" of the switch SW2L excites the magnetic contactor MDL thereby closing the contact point MDL1 in the main circuit. Thus, the motor 415 is rotated and the paper pushing roll 41 is lowered. The limit switch LS2 is closed by lowering of the web-pushing roll 41. The contact of the running web 611 with the intermediate roll 51, as shown in FIG. 13, by lowering the web pushing roll 41 to a position of the splice preparation, opens the limit switch LS4B thereby to demagnetizing the relay L4B and the magnetic contractor MDL. Thus, the motor 415 is stopped thereby suspending the descent of the web-pushing roll 41. Subsequently, the solenoid SO2L is excited by pushing the switch PB5L for the predriver operation, and the piston rod 2152 of the air cylinder 215 of the predriver 21 is retracted into the cylinder tube thereby raising the pulley supporting member 211. The limit switch LS1, which has been kept open, is closed by the ascent of the pulley supporting member 211. Also, the relays MLB and TGL are excited by pushing the switch PB5L, and the contact points MLB2, MLB3 and TGL1, TGL2 are closed. Accordingly, the motor 216 is rotated and thus the endless belt 214 of the predriver 21 is rotated so that the paper roll 62 may be rotated clockwise, as shown in FIG. 13, while synchronizing to the unwinding speed of the paper roll 61. Subsequently, the magnetic contactor MDL is excited again, by pushing a switch PB6L for splice starting, thereby to rotating the motor 415. Thus, the web-pushing roll 41 is lowered, while pushing the running web 611 and the intermediate roll 51 thereby causing the intermediate roll 51 to contact the paper roll 62 as shown in FIG. 14. Also, the pushing of the switch PB6L excites timer relays TL2 and TL5 thereby closing a time limit A contact point TL21 of the timer relay TL2. Thus, as the relay AX1 is excited, the contact point AX11 of the relay AX1 is closed thereby causing the proximity switch SX to connect with the digital counter CX. Every time the vanes 82 of the end of the guiding web is running, which is being rotated as the roll approaches the proximity switch SX, the proximity switch SX transmits a count signal to the counter CX. The signals are counted in the counter CX. When they have reached a set count, the A contact point CX1 for the built in relay is closed. The time required for the signals to reach the set count is sufficient to complete the web 611 from the splicing operation of the paper roll 61 with the leading end of the paper roll 62. The closure of the relay contact point CX1 after the webs have been spliced with each other excites the relay AX2. Thus, the solenoid SO3X is excited thereby raising the knife 31 of the cutter 3 as shown in FIG. 15, whereby the web 611 running from the roll 61 is cut. After the web 611 has been cut, the time limit B contact point TL31 of the timer relay TL3 is opened and a solenoid SO3X is demagnetized thereby lowering the cutter knife 31. The time limit A contact point TL51 of the timer relay TL5 is closed thereby exciting the relay CL4. Accordingly, the magnetic contact or MDL is demagnetized and simultaneously the magnetic contactor MUL is excited. The motor 415 is rotated reversely thereby raising the web-pushing roll 41. When the roll 41 has reached its top limit, the limit switch LS2 is opened thereby to demagnetizing the relay L2 and the contactor MUL, whereby the motor 415 is stopped. Also, after the webs have been spliced with each other, the time limit B contact point TL41 of the timer relay TL4 is opened thereby to demagnetizing the solenoid S02L and lowering the pulley supporting member 211 of the predriver 21 lowered. When the pulley supporting member 211 has reached its descent limit, the limit switch LS1 is opened, thereby demagnetizing the relays L1, MLB and TGL, whereby the motor 216 is suspended. Thus, by properly closing the contact point 3DL of the switch SW3L for operating the intermediate roll, the intermediate roll 51 is raised, whereby the steady condition returns.

As shown in FIGS. 17 to 22, the function of the electric circuits in splicing the leading end of the paper roll 63, which is supported by means of the arms 142 and 142 of the mill stand 1, with the web running from the paper roll 62, which is supported by means of the arms 141 and 141 of the mill stand 1, by the use of the intermediate roll 52, is almost the same as the function of the electric circuit in splicing the paper roll 62 with the paper roll 61 as described hereinabove. The contact point IUR for the automatic operation of the switch SW for apparatus locking, and of the switch SWIR for changing over from the automatic operation to the manual operation is kept closed in advance. Thereafter, the closure of the contact point 3UR of the switch SW3R for the intermediate roll operation and the opening of the contact point 3DR thereof, the closure of the contact point 2UR of the switch SW2R for the splice operation, the closure of the switch PB5R for the predriver operation and the closure of the switch PB6R for splice start are conducted in a consecutive order. In this case, the motor 226 of the predriver 22 is rotated with contact points MRB2, MRB3 being closed, while the paper roll 63 is rotated counter-clockwise as shown in FIG. 19.

As shown in FIGS. 23 to 28, in splicing the leading end of paper roll 91, which is supported by means of the arms 141 and 141 of the mill stand 1, with the web running of paper roll 61, which is supported by means

of the arms 142 and 142 of the mill stand 1, without using the intermediate roll 51, or in splicing the leading end of the paper roll 92, which is supported by means of the arms 142 and 142 of the mill stand 1, with the web running from the the paper roll 91, without using the intermediate roll 52, the contact points IUL and IUR for the switch SW, and switches SWIL and SWIR are kept closed in advance. Furthermore, the contact points 3DL, 3DR of the switches SW3L, SW3R for the intermediate roll operation are closed thereby exciting the solenoids SOIL and SOIR. The intermediate rolls 51 and 52 are kept suspended at this ascent limit. Thereafter, a switch SW2L (SW2R), a switch PB5L (PB5R) and a switch PB6L (PB6R) may be operated in a consecutive order. In this case, the motor 216 (226) of the predriver 21 (22) is rotated by closure of contact points MLA2 and MLA3 (MRA2, MRA3), the paper roll 91 (92) being rotated counter-clockwise (clockwise).

In any splicing operation as shown in FIGS. 11 to 28, the intermediate rolls 51 and 52, the web-pushing rolls 41 and 42, the predrivers 21 and 22, and the cutter 3 are restored to a steady state by pushing the switches PB3L and PB3R for resetting. The motors 415 and 425, and the motors 216 and 226 are suspended by pushing the switches PB4L and PB4R for initiating an emergency stop. Thus, the solenoids SO2L and SO2R are demagnetized and thus the predrivers 21 and 22 are returned to a steady condition. Also, when the web-pushing rolls 41 and 42 have been descended in the apparatus inspecting operation, etc., the web-pushing roll passes the splice preparing position. When the web-pushing roll has reached its bottom limit, the limit switches LS3 and RS3 are opened thereby suspending the motors 415 and 425. Accordingly, the web-pushing roll is suspended. Furthermore, in the situation where the web-pushing rolls 41 and 42 are located below their top limit, the limit switches LS2 and RS2 are closed, and the web-pushing rolls 41 and 42 are not being lowered, the web-pushing rolls 41 and 42 may be raised little by little by closing the contact points 2DL and 2DR of the switches SW2L and SW2R.

By properly closing switches PB1L, PB1R, PB2L, PB2R with contact points IDL and IDR for manual operation of the switches SWIL and SWIR for changing over the automatic operation to the manual operation being kept close, the web-pushing rolls 41 and 42 may 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. A continuous method of splicing the 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 drawn from an expiring roll, without interrupting the continuous operation thereof, so that the smooth face of the leading end of the fresh web roll corresponds to the smooth face of the expiring roll and the rough face of the leading end of the fresh web roll corresponds to the rough face of the expiring roll which comprises pushing a rotatable web-pushing roll against the web running from the expiring roll thereby moving said running web towards the fresh web roll which is not yet unwound and causing said running web to contact a rotatable intermediate roll which is disposed near said fresh roll, rotating the fresh web roll in synchronization with the unwinding speed of the expiring roll, causing the web-pushing roll to push the intermediate roll into contact with the rotating fresh web roll, the running web of the expiring roll being grasped between the intermediate roll and the web-pushing roll, temporarily fastening the leading end of the fresh web roll to the surface of the intermediate roll, thereby drawing out the leading end from the fresh web roll, and splicing the leading end of the fresh web roll to the running web of the expiring roll by causing said leading end to attach to said running web.

2. The method of claim 1, further comprising the step of providing the exposed surface of the leading end of the fresh web roll with a double-face adhesive tape for temporarily fastening the leading end of said fresh web roll to said roll and for temporarily fastening said leading end to the surface of the intermediate roll.

3. The method of claim 2, further comprising the steps of applying at least one single-face adhesive tape to the surface of the paper roll beneath said leading end thereof, the top face of said single-face adhesive tape being the non-adhesive face, and further providing the unexposed surface of said leading end of the fresh web roll with at least one double-face adhesive, said double-face adhesive tape being disposed on said leading end in opposition to said non-adhesive face of the single-face adhesive tape.

4. The method of claim 3, wherein the single-face adhesive tape is dimensionally larger than the double-face adhesive tape.

5. The method of claim 4, wherein the non-adhesive face of the single-face adhesive tape is readily separable from the exposed surface of the double-face adhesive tape.

6. The method of claim 3, further comprising the step of attaching the double-face adhesive tape for temporarily fastening the leading end of said fresh web roll to said roll, to serrated tear-away portions of said leading end so that when the double-face adhesive tape provided on the unexposed surface of the fresh roll adheres to the running web of the expiring roll, said leading end of the fresh web roll is torn away at its serrated portions from attachment to the intermediate roll.

7. The method of claim 1, wherein after the leading end of the fresh web roll is spliced to the running web, the running web is cut.

8. The method of claim 1, wherein said method is used for splicing corrugated board liner paper rolls.

9. An apparatus for splicing a leading end of a fresh web roll having a smooth and rough face, and which is releasably attached to said roll and is not yet unwound, with a running web which is being continuously withdrawn from an expiring roll having a smooth and rough face, without interrupting the continuous operation thereof, so that the smooth face of the leading end of the fresh web roll corresponds to the smooth face of the expiring roll and the rough face of the leading end of the fresh web roll corresponds to the rough face of the expiring roll which comprises a mill stand adapted to rotatably support the fresh web roll and the expiring roll in mutually opposed positions, means for rotating said fresh web roll and expiring roll, respectively, intermediate roller means suspended above said mill stand, and above said rolls, means for swinging said intermedi-

ate roller means towards and away from the fresh web roll, web pushing roller means suspended above said mill stand and above said rolls, means for swinging said pushing roller means towards and away from the running web being drawn from the expiring roll, said pushing roller means being thereby adapted to engage the running web and push said web into engagement with the intermediate roller which is in close proximity with the fresh web roll and also to push said intermediate roll into contact with the fresh web roll, means for initiating the rotation of the fresh web roll prior to its contact with the intermediate roll, and 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 between said intermediate roller means and pushing roller means.

10. The apparatus of claim **9,** wherein the means for rotating the fresh web roll and the expiring roll comprises conveyor belts containing driving means, said conveyor belts being associated with means for bringing them into engaging and disengaging relationship with the surface of the fresh web roll and the surface of the expiring roll.

11. The apparatus of claim **10, wherein cutting means are supported in the mill stand for cutting the web running from the expiring roll after the splicing operation has been achieved.**

* * * * *