

[54] WEB SPLICING APPARATUS

[75] Inventors: Masateru Tokuno, Nishinomiya; Tetsuya Sawada, Kyoto, both of Japan

[73] Assignee: Rengo Kabushiki Kaisha (Rengo Co., Ltd.), Osaka, Japan

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Primary Examiner—George F. Mautz
Assistant Examiner—Edward J. McCarthy
Attorney—E. F. Wenderoth et al.

[57] ABSTRACT

A web splicing apparatus has a pair of bilaterally disposed suction boxes with a plurality of conveyor belts passing over the suction boxes and conveying liner paper toward the opposite terminal sections of the boxes while the liner paper is being sucked by the action of said suction boxes. Outlet rolls and press rolls disposed above the opposite terminal sections of the suction boxes guide the liner paper which has been transported by the conveyor belts over the suction boxes upwardly by holding the paper therebetween. Guide plates guide the liner paper transported by said rolls to a next apparatus for treating the paper. Means is provided for controlling the press rolls so that they separate from the outlet rolls or move into pressure contact with the outlet rolls during paper feeding for splicing the tip of a liner paper transported by one of the conveyor belts with another liner paper. A cutter is also provided for severing the butt of the liner paper after splicing, and a pair of holder means for holding webs is also provided.

3 Claims, 9 Drawing Figures

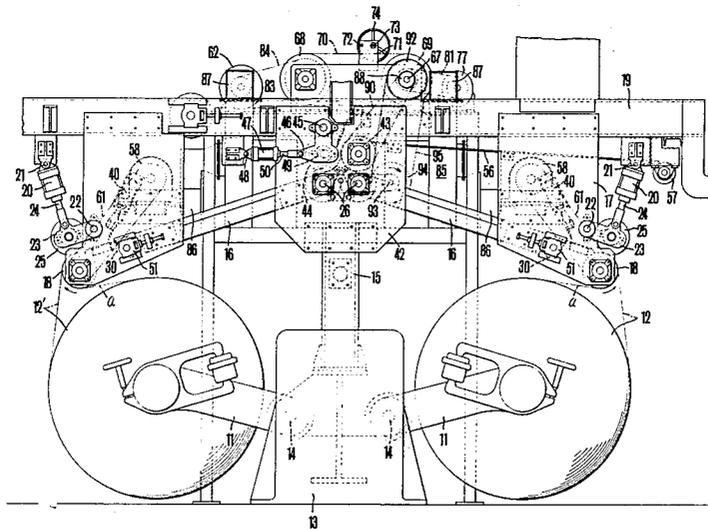
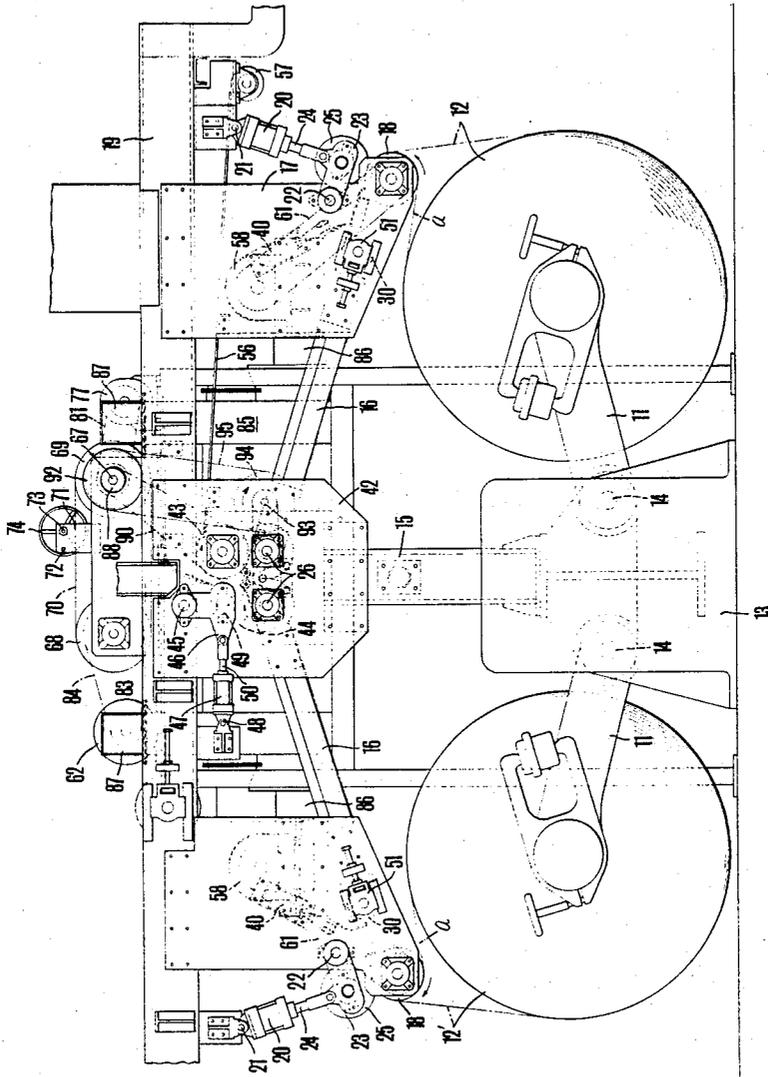
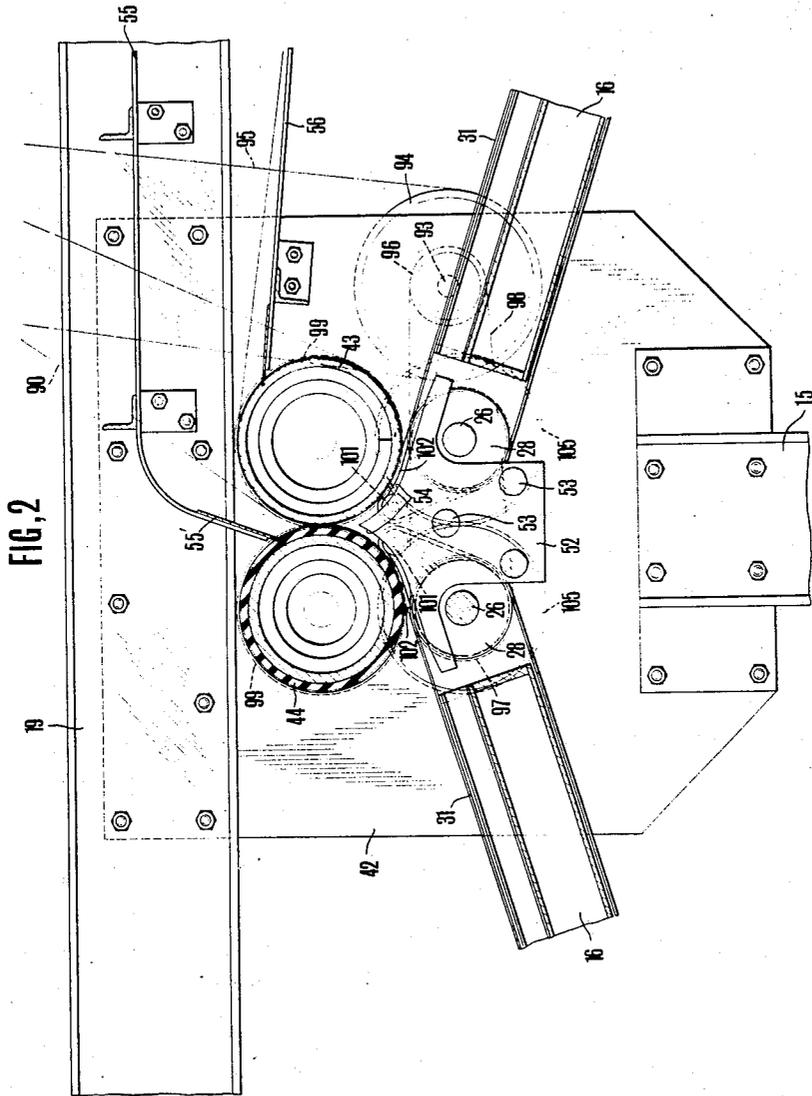
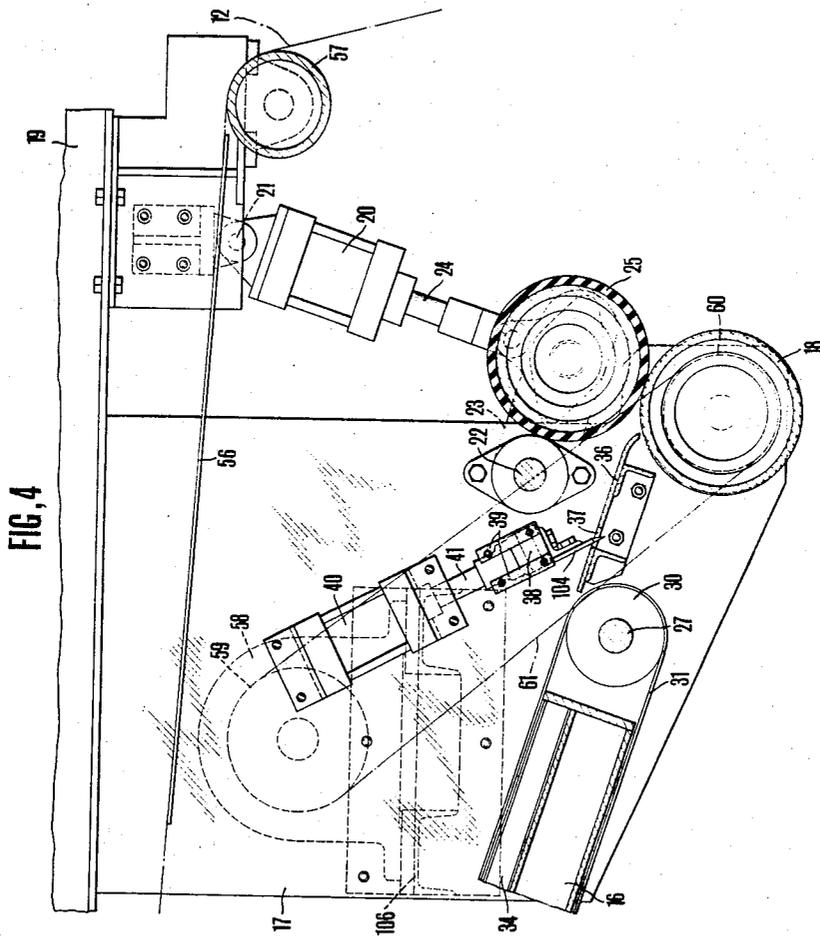
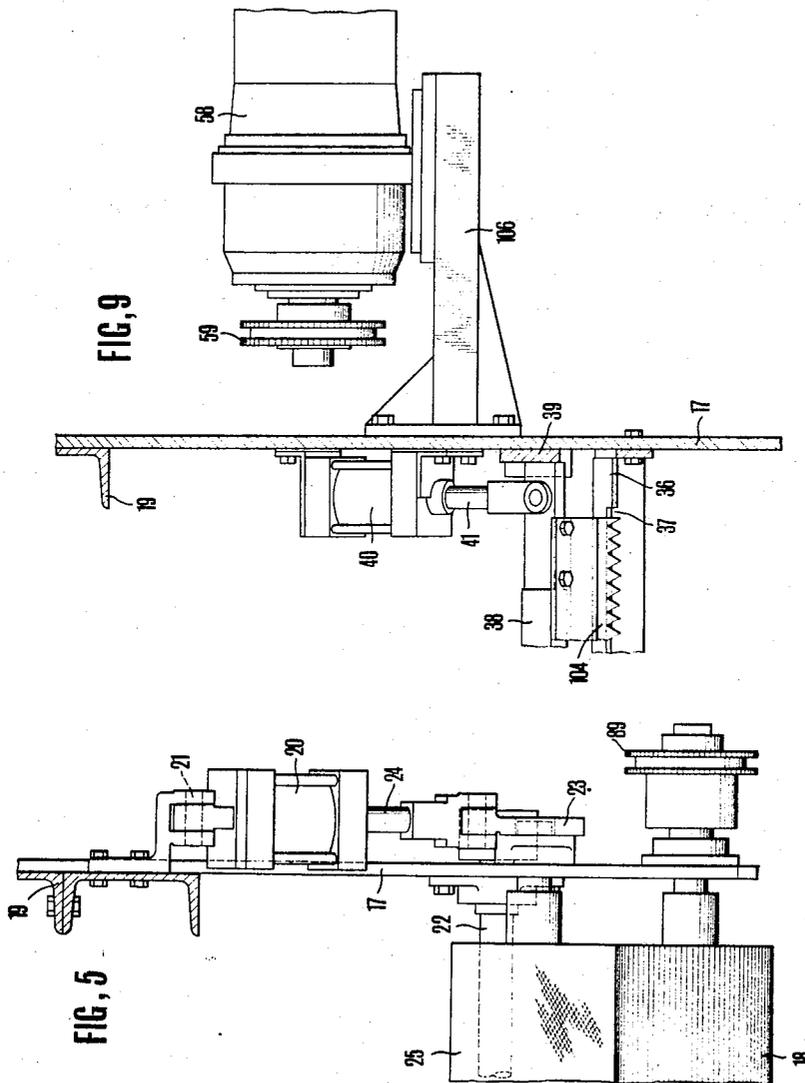


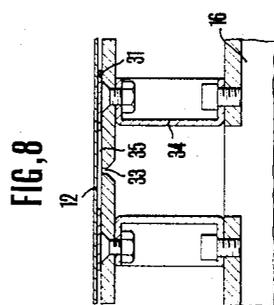
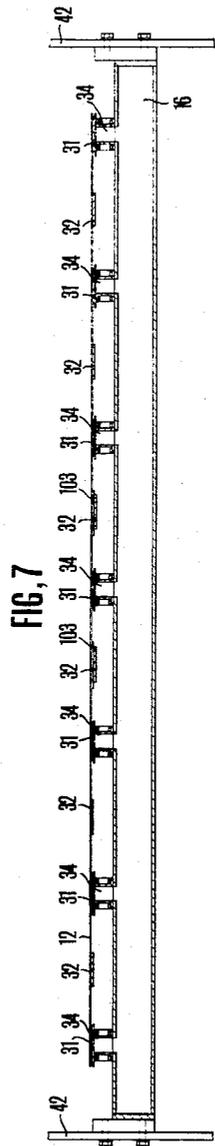
FIG. 1











WEB SPlicing APPARATUS

This invention relates to a web splicing apparatus for splicing a standing web before it expires with a new web without stopping the supply of paper to a doublefacer, in an apparatus for feeding paper for lining the under-
side of corrugated board in which doublefaced cor-
rugated board is produced by lining with flat paper singlefaced corrugated board produced by a singlefacer wherein singlefaced corrugated board is produced by
pasting paper liner on the surface of corrugated board.

Apparatuses for splicing liner paper which is to be supplied to corrugated board manufacturing machines have hitherto been introduced in great variety. However, all such apparatus were provided with a storage reservoir for the expiring web filled by previously slackening it adjacent the splicer since it was necessary to splice the two webs without stopping the operation of the doublefacer and the like, with the result that such conventional splicers had defects in that the apparatuses were not only large in size and complicated in construction but also required intricate mechanisms for controlling the liner paper storage and the like.

This invention has for its object to obviate the aforementioned defects incidental to the known apparatuses, and more particularly to provide a splicing apparatus capable of dispensing with the liner paper storage reservoir thereby making it possible to reduce the size and simplify the mechanism of the apparatus as well as that of the control means.

The object of this invention is accomplished by the parts, improvements, combinations and arrangements comprising this invention, a preferred embodiment of which is shown by way of example in the accompanying drawings and herein described in detail. Various modifications and changes in details of construction are comprehended within the scope of the appended claims.

FIG. 1 is an elevation showing the whole of the apparatus of the invention.

FIG. 2 is a longitudinal sectional elevation on a magnified scale of the splicer in the center of the apparatus.

FIG. 3 is a plan of the apparatus.

FIG. 4 is a longitudinal sectional elevation on a magnified scale of the liner paper feeding section.

FIG. 5 is a lateral view showing one side of the feeding section, of which a part is broken away.

FIG. 6 is a plan of a suction box, of which a part is broken away.

FIG. 7 is a cross section of said suction box on a magnified scale.

FIG. 8 is a cross section on a magnified scale of a suction slit of said suction box.

FIG. 9 is a cross section on a magnified scale of a paper cutter member, of which a part is broken away.

Referring to FIG. 1, the numeral 11 designates a pair of web holders so fitted to a support frame 13 on shaft 14 so as to be capable of rising and falling, a web 12, 12' being detachably fitted into each said holder 11. The numeral 15 designates a frame, a pair of suction boxes 16 being obliquely secured to said frame 15. The external end of each suction box 16 is fixed to a mounting plate 17 which is secured to each side of the frame 15, a horizontal liner roll 18 consisting of a grooved metal roll as shown in FIG. 4 being rotatably fitted between the external lower ends of said mounting plates 17.

Furthermore, the upper end of each air cylinder 20 is pivoted on a pin 21 on one side of each end portion of an upper member 19 of the frame 15, the lower end of a piston rod 24 protruding from an air cylinder 20 being pivoted on the upper part of an oscillation plate 23 pivoted on a pin or shaft 22 on the lower part of the external end of each said mounting plate 17. A horizontal press roll 25 is rotatably fitted between said oscillation plates 23 so as to oppose the liner feed roll 18, the external periphery of each press roll 25 being provided with a rubber layer having small indentations formed on the surface thereof.

A horizontal shaft 26 is rotatably fitted to the opposing end portion of each suction box 16, a horizontal shaft 27 being likewise fitted rotatably to the external end of each suction box 16 by an adjustable bearing 51. To each of said shafts 26 are alternately secured a plurality of pulleys 28 and 29 which are suitably spaced from each other, a plurality of endless conveyor belts 31 being wound around the respective pulleys 28 and a long roll 30 secured to said shaft 27 so that said belts 31 may enclose the upper and lower sides of each suction box 16. Likewise, a plurality of endless conveyor belts 32 consisting of material which is generally adhesion-repellent, such as Teflon (ethylene quadrifluoride resin), are wound around each pulley 29 and the roll 30 so that said belts 32 may enclose the upper and lower sides of the suction box 16, said roll 30 having thereon pulley-like portions around which the belts 31 and 32 are wound. Moreover, a slit 33 is formed on the surface of said box 16 so that the inside surface of the upper run of each belt 31 runs along said slit. As shown in FIGS. 7 and 8, this slit 33 is formed at the top of parallel hollow projections 34 formed on the upper side of the box 16, each slit 33 communicating with the inside of said box 16, spaced holes 35 being provided in the belt 31 above the slit 33.

A guide plate 36 positioned between the end portions of the belts 31 and 32 wound around the upper part of the liner roll 18 and roll 30 is secured between the mounting plates 17, a transverse slit 37 being provided in said guide plate 36 as shown in FIG. 4.

Referring to FIGS. 1, 4 and 9, the numeral 38 designates a horizontal slide frame so provided as to be obliquely slidable along a guide 39 provided on the mounting plate 17, a liner cutter 104 being secured to said frame 38, the lower part of said cutter 104 being formed into the shape of saw teeth. Moreover, an air cylinder 40 is secured so as to be positioned in the upper part of each said guide 39, the lower end of each piston rod 41 extending from the lower part of each said cylinder 40 being connected to both ends of the slide frame 38.

Above each of said pulleys 28 and 29 provided on the opposed ends of suction boxes 16 are disposed a horizontal outlet roll 43 and a press roll 44 constituting a splicing member. The roll 43 is a grooved metal roll as shown in FIG. 3, said roll 43 being rotatably journaled by suitable bearings in two mounting plates 42 secured to the frame 15. The roll 44 is provided with a rubber layer on the external periphery thereof, small indentations being formed on the outside of said rubber layer. This roll 44 is rotatably fitted between the lower ends of an oscillation plate 46, the upper end of which is pivoted by an axis 45 to each mounting plate 42 as shown in FIGS. 1 and 3. Furthermore, the rear end of a cylinder 47 is pivoted on a shaft 48 on a suitable position in

the lower part of the upper member 19, and a piston rod 50 protruding from the front end of the cylinder 47 is connected to the oscillation plate 46 for causing said oscillation plate to oscillate 46 by the reciprocation of the piston rod 50.

Since the oscillation plate and the associated parts are located on the outside of the mounting plate 42, while the roll 44 is located on the inside of said plate 42, a port 49 is formed in said plate 42 into which is loosely fitted the shaft on each end of the roll 44. In addition thereto, on one side of each pulley 28 is secured a guide plate 52 in the shape as indicated in FIG. 2 by a plurality of transverse rods 53 secured inside the mounting plate 42, an arcuate guide member 54 being formed below each of the rolls 43 and 44 suitably spaced therefrom as shown in FIG. 2.

A horizontal guide plate 55 is secured between upper members 19 as shown in FIG. 2, the internal end of said guide plate 55 having a curved portion 55' bent toward the upper side of the roll 44 as indicated in FIG. 2, another guide plate 56 being disposed below said guide plate 55. This guide plate 56 is positioned between the roll 43 and horizontal guide rolls 57 rotatably pivoted on the underside of the terminal portion of the upper member 19, both sides thereof being secured to the mounting plates 17 and 42 respectively. Furthermore, a plurality of peripheral grooves 107 and 108 are suitably spaced along the external periphery of each of said rolls 43 and 44, projections on an element at the end of the curved section 55' and projections on an element at the end of the guide plate 56 being loosely fitted into the peripheral grooves 107 and 108, respectively.

The numeral 58 in FIGS. 1 and 4 designates proportional cup motors each provided on a bracket 106 secured to the mounting plate 17, each motor 58 being adapted to synchronize with a power selsyn motor which is described hereinafter, an endless transmission chain 61 being engaged around a sprocket 59 secured to the shaft of each motor 58 and a sprocket 60 secured to the shaft of each liner feed roll 18.

The numeral 62 in FIGS. 1 and 3 designates a power selsyn motor on a mounting stand 64 secured to the upper part of one side of the frame 15, said motor 62 synchronizing with the doublefacer motor, a sprocket 63 being secured to the output shaft thereof. Also on the mounting stand 64 are secured a pair of support plates 65 as indicated in FIG. 3, horizontal shafts 66 and 67 being rotatably fitted between both ends of the support plates 65 respectively, tapering pulleys 68 and 69 being secured to respective shafts 66 and 67. As is clear from FIG. 3, the pulleys 68 and 69 taper in the opposite direction to each other, an endless transmission belt 70 being wound around said pulleys 68 and 69. A horizontal guide rod 72 is secured between two plates 71 secured to the central upper part of the support plates 65, a threaded shaft 73 being rotatably fitted between the plates 71 so as to be parallel with the rod 72, a handle 74 being secured to the end of said shaft 73.

The numeral 75 designates a slide member loosely fitted on the guide rod 72, a threaded hole therein having the shaft 73 engaged therein, the slide member 75 being thereby adapted to slide on the guide rod 72 when the shaft 73 is rotated by the handle 74. A plurality of rolls 76 is located on both sides of the belt 70 being rotatably mounted on the slide member 75. The belt 70 is displaced in accordance with the displacement of the slide member 75, thereby varying the speed

ratio between the shafts 66 and 67. The numeral 77 designates a geared motor secured to one end of the mounting stand 64, an endless transmission chain 81 being engaged around a sprocket 78 secured to the shaft of said motor 77 and a sprocket 80 secured to one end of the shaft 67 with a one-way clutch 79 interposed therebetween. A sprocket 83 is also mounted one end of the shaft 66 with a one-way clutch 82 interposed therebetween, an endless transmission chain being engaged around the sprocket 83 and the sprocket 63. On both sides of each suction box 16 suction pipes 86 are provided which communicate with the suction intake of suction blowers 85, outlets 87 of said blowers 85 opening outwardly in the upper part of the upper member 19.

A sprocket 88 is secured to the internal end of the shaft 67, an endless transmission chain 90 being wound around said sprocket 88 and a sprocket 89 at the end of the shaft of the roll 43, gears 99 having the same number of teeth being secured to the shafts of the rolls 43 and 44 respectively and meshing with each other. An endless transmission chain 95 is engaged around a sprocket 92 secured to the shaft 67 with an electromagnetic clutch 91 interposed therebetween and a sprocket 94 secured to an intermediate shaft 93, an endless transmission chain 98 being engaged around a sprocket 96 secured to the shaft 93 and a sprocket 97 secured to the shaft 26 on the left side in FIGS. 1 and 2, the right and left shafts 26 being geared together by meshing gears 105 having the same number of teeth and secured to the end of each shaft 26. The intermediate shaft 93 is rotatably journaled in a bearing secured to the mounting plate 42 and a bearing secured to the mounting stand 64. The number of teeth in each sprocket is such that the rotary speed of the roll 43 coincides with that of the belts 31 and 32. Furthermore, as shown in FIG. 6, a pair of grooved pulleys 100 are rotatably mounted on each shaft 26, an endless belt 102 being wound around each pulley 100 and a roll 101 rotatably pivoted on each guide plate 52 disposed beside each said grooved pulley 100, the upper side of each said belt 102 being brought into pressure contact with the underside of each roll 43 and 44 as indicated in FIG. 2.

Now, as shown in FIG. 1, webs 12 and 12' are fitted into the web holders 11 respectively, the web 12 on the right side in FIG. 1 being pulled out as indicated by broken lines, the tip of said web being led onto the roll 43 after passing between the right-hand rolls 18 and 25 and on each belt 31, 32 on the suction box 16 between the underside of the right-hand roll 43 and the belt 102 and then between the rolls 43 and 44. Then said tip of the web 12 is fed into a doublefacer, which is not shown in the drawings, after travelling on the guide plate 56 and guide roll 57 as indicated by broken lines in FIGS. 2 and 4. Thus the web 12 is pasted liner paper on the underside of corrugated board which already has a liner on the upper side thereof.

On the other hand, as to the web 12' fitted into the holder 11 on the left side in FIG. 1, the front or leading end thereof has both corners cut off, and a plurality of pieces 103 of doublefaced adhesive tape having an adhesive layer on both faces thereof are applied to the underside of the leading end adjacent the cut off corners, said pieces of tape being adapted to be positioned on the belt 32 as shown in FIG. 7, and the leading end is pulled out through the left-hand rolls 25 and 18 until

it reaches a point substantially one-third the distance from the left-hand suction box 16, the left-hand suction blower 85 being activated by turning on a left-hand stand-by switch, so that the web 12' being sucked onto the left-hand suction box 16.

Next, if the suction belt activation switch on the operation board is turned on, an electromagnetic clutch 91 is actuated, thereby starting the rotation of the belts 31 and 32, and simultaneously the left-hand cylinder 20 is activated, thereby pressing the left-hand roll 25 against the web 12' on a roll 18. In this instance, since the roll 25 is stationary the braking action is being applied to the web 12' by the engagement of the rolls 25 and 18. Furthermore, if the press roll activation switch on the operation board is turned on, the cylinder 47 is brought into action, thereby pressing the roll 44 against the roll 43.

The preparatory action is completed by the process as described hereinbefore. In this state, the motor 62 on the mounting stand 44 alone rotates synchronously with the paper feeding speed of the doublefacer which is not shown in the drawings. Moreover, since the one-way clutch 82 is engaged while another one-way clutch 79 is disengaged, the shafts 66 and 67 rotate, the rotation of the shaft 67 being transmitted to the roll 43 through the sprockets 88, 89 and the chain 90, the rolls 43 and 44 being rotated through the gear 99. Prior to this, the threaded shaft 73 is rotated by means of the handle 74, the belt 70 being thus transversely displaced by the slide member 75 thereby controlling the speed ratio between the shafts 66 and 67 so as to synchronize the rotary speed of the roll 43 with that of the feeder of the doublefacer. In this instance, the right-hand roll 18 is in a state of free rotation in the direction indicated by the arrow, while the right and left belts 31 and 32 are halted.

Now, as the amount of the right-hand web 12 which is fed to the doublefacer dwindles, the diameter of the roll formed by said web 12 is reduced. As soon as the diameter is reduced to a predetermined size a suitable electric detector, such as a limit switch, produces a signal, or it may be so arranged that said reduction of the diameter is visually detected by an operator. Then, the left-hand motor 58 is activated by turning on a switch or the like, thereby rotating the left-hand roll 18 in the direction indicated by the arrow in FIG. 1. As a result, the left-hand web 12' which has been compressed between the rolls 18 and 25 is sucked onto and brought into pressure contact with the belts 31 and 32, said web 12' being fed between the rolls 43 and 44 by the action of the left-hand roll 18 and the belts 31 and 32. The proportional cup motor 58 rotates synchronously with the power selsyn motor 62, the predetermined rotary speed being reached immediately after the activation. Moreover, since the rotary speed of the roll 18 rotated by the motor 58 is adapted to synchronize with that of the roll 43 and the belts 31 and 32, no slip is allowed between the web and the rolls 18 and 25, the belts 31 and 32, and the rolls 43 and 44.

As described hereinbefore, when the left-hand web 12' is fed between the left-hand belt 102 and the roll 44 and then between the rolls 43 and 44, the end portion of the left-hand web 12' adheres to the right-hand web 12 through the adhesive tapes 103, thus both webs 12, 12' are solidly spliced together by the action of the rolls 43 and 44, thereafter the spliced portion being dis-

placed in the right direction travelling on the right-hand roll 43.

During the splicing process, the left-hand suction blower 85 is automatically brought to a halt. When the webs 12 and 12' have been spliced together, the right-hand cylinder 40 is activated by a timer switch or the like thereby causing a right-hand cutter 104 to descend and sever the web 12 on the right-hand guide plate 36.

After the cutter 104 has descended as described hereinbefore, said cutter 104 is restored to its original position by the cylinder 40 activated by the action of a limit switch or the like. Simultaneously, the left-hand piston rod 24 is withdrawn by the action of the left-hand cylinder 20, thereby separating the left-hand roll 25 from the left-hand roll 18, at the same time the left-hand roll 18 being brought to a halt by switching off the left-hand motor 58. The right-hand roll 25 is raised and the right-hand motor too is off. Moreover, the clutch 91 is disengaged, thereby bringing each of the belts 31 and 32 to a halt. After confirming that the splice has entered into a next processing stage, such as preheating, the cylinder 47 is activated by operating a switch, thereby withdrawing the piston rod 50 and separating the roll 44 from the roll 43, and thus the splicing is completed.

Through the aforementioned process the left-hand web 12' is fed into the doublefacer. The control of said cylinders 20, 40, 47, clutch 91 and motor 58 can be effected by hand making use of manual switches.

While the left-hand web 12' is being fed into the doublefacer, the remainder web 12 is removed from the right-hand web holder 11, a fresh roll of web 12 being fitted into the right-hand web holder 11, double-faced adhesive tapes being applied to the leading edge of the web 12 just as in the case of the web 12', the web 12 being thus allowed to be sucked by the suction box 16 after the tip is passed between the rolls 18 and 23, so that the web 12 is ready in a stand-by state just as in the case described hereinbefore. As soon as the roll of the left-hand web 12' becomes small, the right-hand web 12 is spliced with the left-hand web 12' through the aforementioned process, the left-hand web 12' being severed, the butt thereof being cut off.

To feed the liner paper, the leading end thereof is cut into a tapering shape just as in the case of splicing, said end being passed between the rolls 18 and 25 and then on the belts 31 and 32, said end being allowed to be sucked by activating the suction blower 85, then the roll 44 being brought into contact with the roll 43 by activating the cylinder 47.

Then, when the electromagnetic clutch 91 is brought into engagement by the operation of a switch, the belts 31 and 32 start rotation when the motor 62 is in operation, the liner paper being fed between the rolls 43 and 44, while being kept in contact with the belts 31 and 32.

Furthermore, when the doublefacer is halted and the motor 62 is out of operation, the one-way clutch 70 is brought into engagement, another one-way clutch 82 being disengaged by activating the motor 77, and the belts 31 and 32 and the rolls 43 and 44 are rotated by said motor 77. After the liner paper has been duly passed through in this way, the entire rotation is brought to a halt by the operation of a switch.

Since the liner paper has an obverse and a reverse side, one roll of the web has its obverse on the outside thereof, while the other roll of web has its reverse side

on the outside thereof. In the case of a web which has its obverse on the outside thereof, if the webs 12 and 12' are led between the rolls 18 and 25 as indicated in FIG. 1, the liner paper is fed into the doublefacer with its obverse facing downwardly, so that the reverse side of said liner paper adheres to the underside of the single-faced corrugated board.

On the other hand, in the case of a roll of web which has its reverse side on the outside thereof, the liner paper will be fed into the doublefacer with the obverse facing downwardly if said liner paper is inserted between the rolls 18 and 25 by leading it outwardly from the underside of the roll 18 as indicated by the broken lines in FIG. 1. Consequently, whether a web has its obverse on the outside or inside thereof, the web can be used without inconvenience simply by changing the direction of pulling out the web.

Moreover, since this invention employs a suction belt system wherein the liner paper is fed while a suction box brings said paper into pressure contact with the belt, this invention is capable of preventing slippage between the paper and the belt, thereby enabling splicing to be effected perfectly synchronously with the speed of the travelling paper, with the result that the risk of breakage of the liner paper can be obviated even when splicing is effected while the paper is fed at high speed.

In addition thereto, this invention needs no device for a paper storage reservoir which is usually provided adjacent the splicer, since this invention enables splicing to be effected while the liner paper is allowed to travel at full speed, as a result of which this invention is advantageous in that the apparatus is conveniently installable between singlefacers and doublefacers because of its small size and is employable in mill stands of any type because of its simple construction and control mechanism.

What is claimed is:

1. A web splicing apparatus comprising a pair of bilaterally disposed suction boxes, a plurality of conveyor belts on said suction boxes capable of conveying liner

paper toward the opposed terminal sections of said boxes as said liner paper is held on said belts by the action of said suction boxes, a holder means for holding a supply of liner paper at each remote end of said suction boxes, outlet rolls and press rolls disposed above the opposed terminal sections of the suction boxes for sending the liner paper which has been transported by the conveyor belts on the suction boxes upwardly by holding said paper therebetween, guide plates above said rolls for guiding the liner paper transported by said rolls to a next required apparatus, a means coupled to the press rolls for moving the press rolls for separating said rolls from said outlet rolls in the paper feeding state and for bringing said press rolls into pressure contact with said outlet rolls in the splicing state for splicing the tip of liner paper transported by the conveyor belts on one of the suction boxes with the liner paper transported by the belts on the other suction boxes, and at least one cutter along the path of the liner paper for severing the liner paper after splicing.

2. A web splicing apparatus as claimed in claim 1 in which a part of said plurality of conveyor belts on the suction box over which said porous conveyor belts run have suction slits therein over which the porous belts run, and the remaining conveyor belts consist of material to which double-faced adhesive tapes applied to the liner paper are at most only slightly adherable, said two types of belts being disposed alternately across the suction box.

3. A web splicing apparatus as claimed in claim 1 further comprising a paper feed roll at the remote end of each suction box for taking up liner paper travelling onto the conveyor, and a press roll disposed above said feed roll, elevation means connected to said press roll for moving said press roll away from said feed roll and toward and into pressure contact with said feed roll, whereby liner paper pulled out of the holder means can be inserted between said feed roll and press roll.

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