June 21, 1960 P. DENSEN ET AL 2,941,572

EDGE ALIGNING MEANS FOR TRAVELLING COMBINING WEBS

Filed May 6, 1957 4 Sheets-Sheet 1

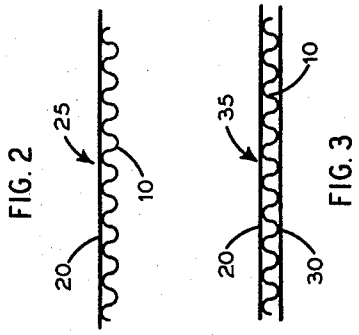


FIG. 2

FIG. 3

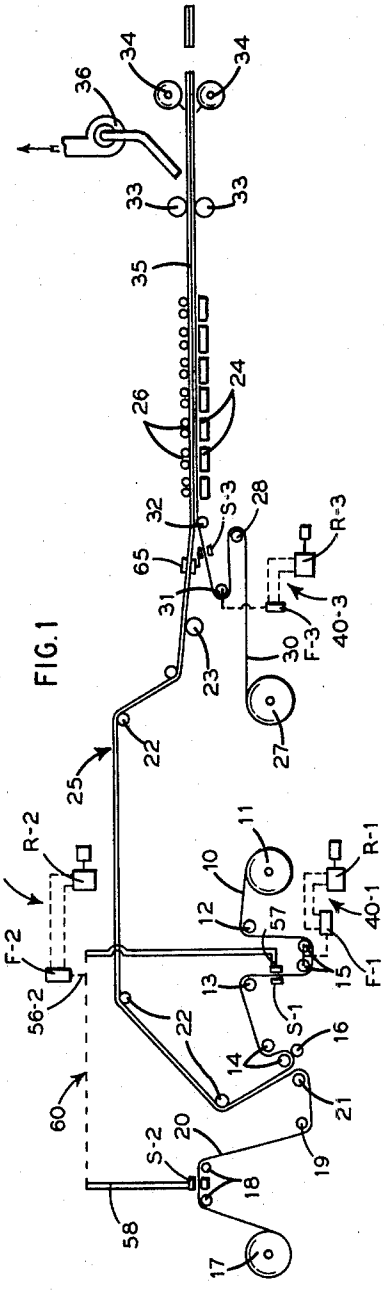


FIG. 1

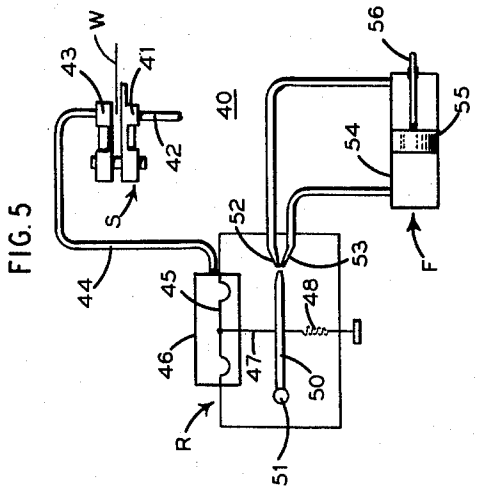


FIG. 5

INVENTORS
Paul Densen
Lawrence H. Roberts

June 21, 1960 P. DENSEN ET AL 2,941,572

EDGE ALIGNING MEANS FOR TRAVELLING COMBINING WEBS

Filed May 6, 1957 4 Sheets-Sheet 2

FIG. 8

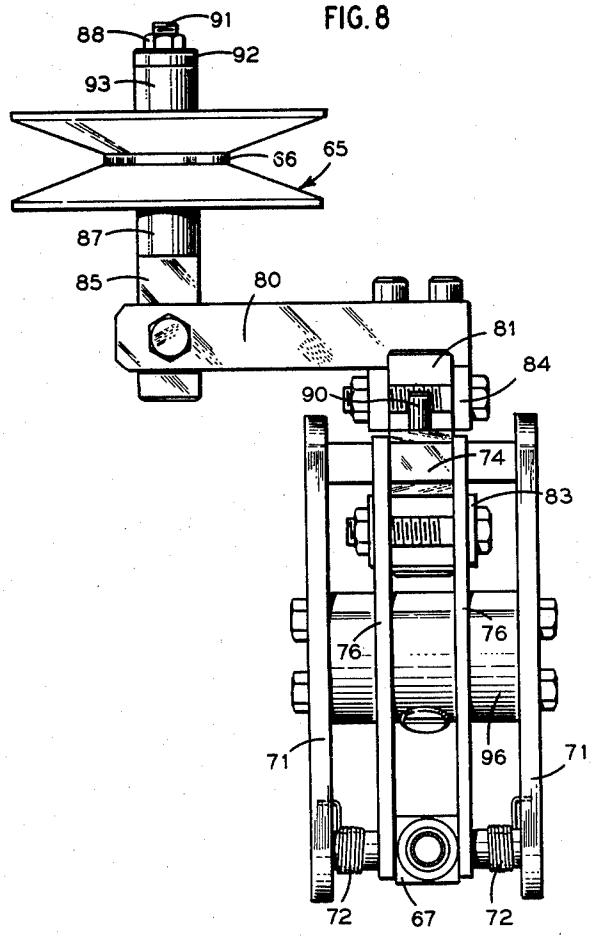
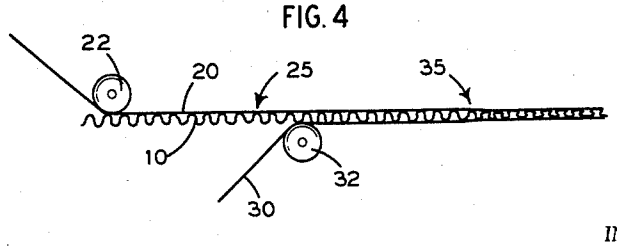


FIG. 4



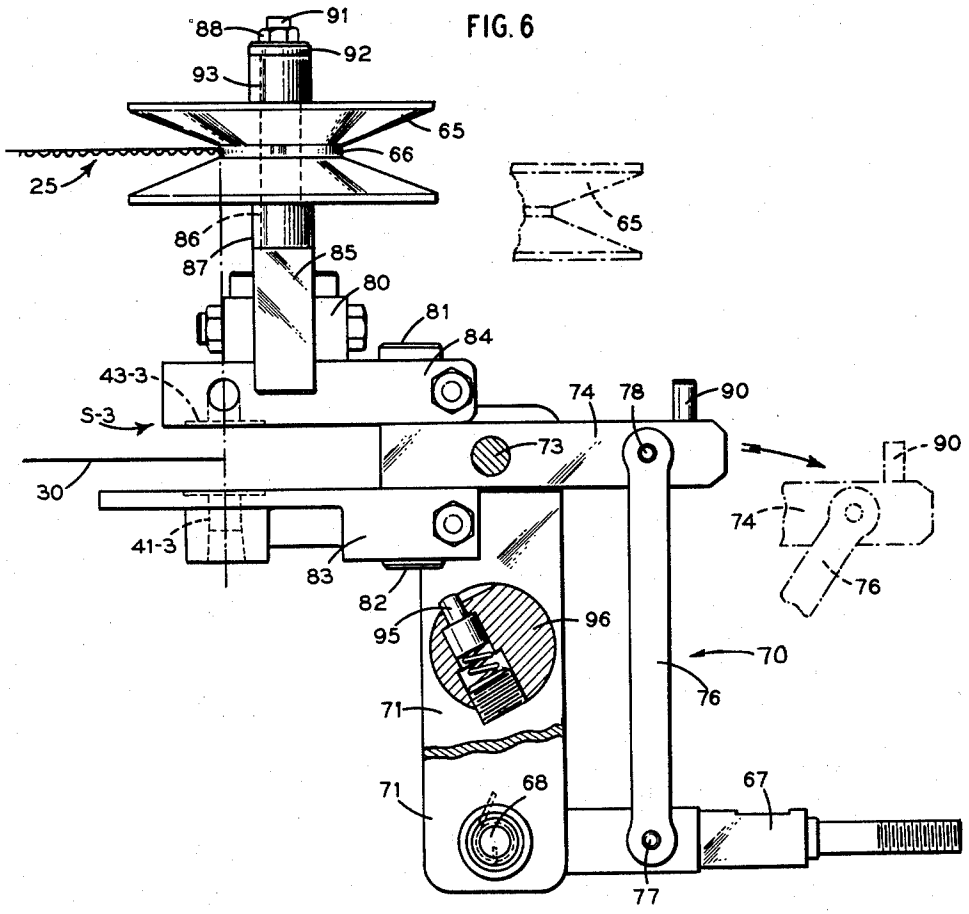
INVENTORS
Paul Densen
Lawrence H. Roberts

June 21, 1960 P. DENSEN ET AL 2,941,572

EDGE ALIGNING MEANS FOR TRAVELLING COMBINING WEBS

Filed May 6, 1957 4 Sheets-Sheet 3

FIG. 6



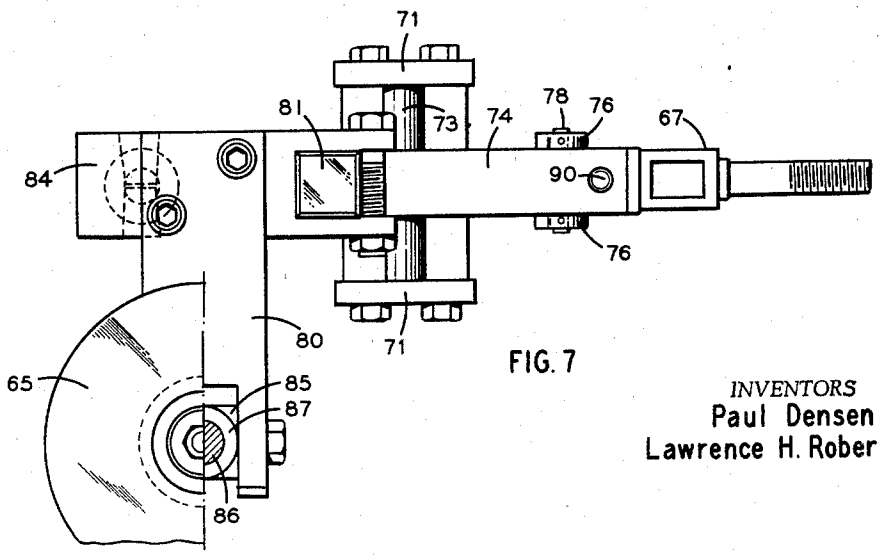


FIG. 7

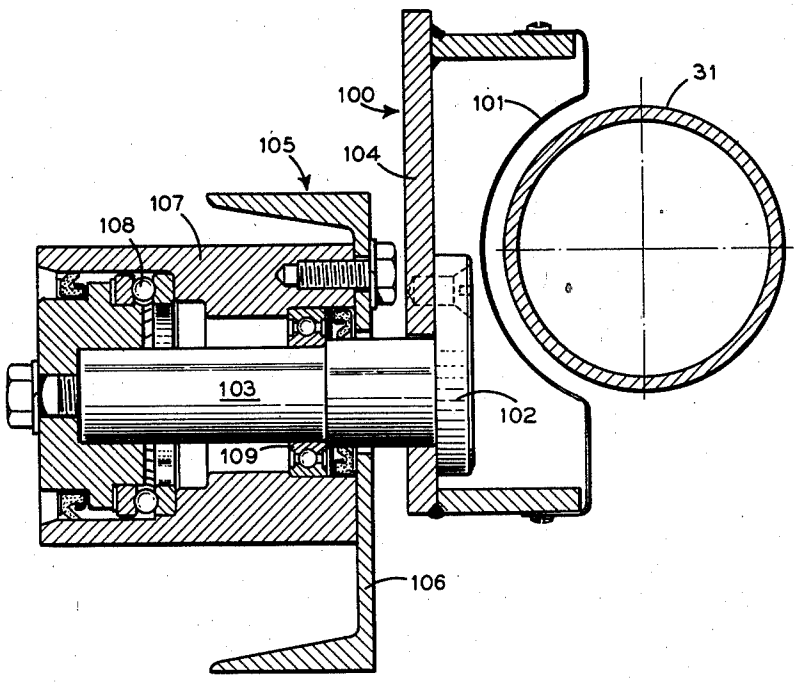
INVENTORS
Paul Densen
Lawrence H. Roberts

June 21, 1960 P. DENSEN ET AL 2,941,572

EDGE ALIGNING MEANS FOR TRAVELLING COMBINING WEBS

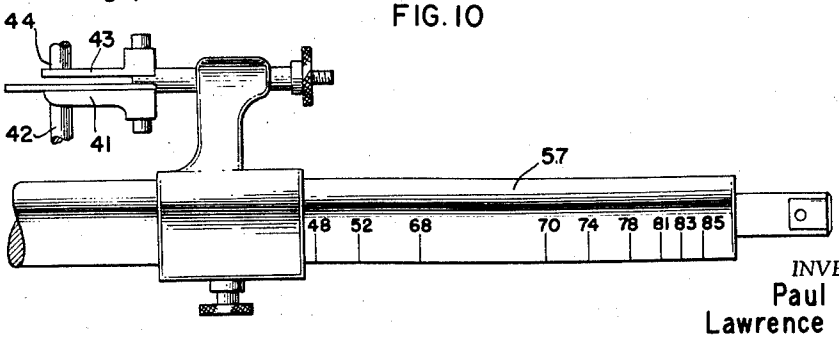
Filed May 6, 1957 4 Sheets-Sheet 4

FIG. 9



S-1

FIG. 10



INVENTORS
Paul Densen
Lawrence H. Roberts

United States Patent Office 2,941,572
Patented June 21, 1960

2,941,572

EDGE ALIGNING MEANS FOR TRAVELLING COMBINING WEBS

Paul Densen, West Orange, and Lawrence H. Roberts, Clifton, N.J., assignors to Eastern Corrugated Container Corporation, Clifton, N.J.

Filed May 6, 1957, Ser. No. 657,222

1 Claim. (Cl. 154—31)

This invention relates to the manufacture of corrugated board and, more particularly, to novel mechanism for maintaining accurate edge alignment of the several sheets of paper, used in forming the board, as they are combined to make the board.

In the manufacture of corrugated paperboard, a first sheet, known as the "medium," is fed from a supply roll between two heated metal rolls having fluted surfaces which corrugate the medium. While the medium is maintained in contact with one of the corrugating rolls, it is glued to a second flat sheet called the "first liner." The gluing is performed under high heat and great pressure by means of a smooth surface roll pressing the first liner against the corrugated medium engaged with the one corrugating roll. The product at this stage is known as a sheet of "single face" corrugated paperboard.

In the next step of the operation, a sheet of paper called the "second liner" is glued to the opposite face of the medium. This is effected by applying glue to a surface of the single face and then passing the combined single face and second liner over one or more highly heated metal plates against which the two liners and the medium are pressed by a series of metal rolls. The duration of the pressure heat applications is varied in accordance with the weight (thickness) of the paper sheets and is regulated by varying the rate of movement of the sheets over the hot plates.

The corrugated board is purposely made oversize in width to allow subsequent edge trimming to provide smooth even edges, as the board emerging from the machine, and before trimming, does not have such smooth even edges. The trimmed board may then be slit to narrower widths, if desired, and cut into desired lengths.

If at least one edge of each sheet could be kept in perfect alignment with the corresponding edges of the other sheets during the gluing operations, the resulting corrugated paperboard emerging from the final gluing and heating operation would have at least one smooth even edge. Thus, only one edge, at the most, would have to be trimmed. This would not only cut down the percentage of scrap but would also substantially reduce the slight crushing of the board attendant upon the trimming steps. This tendency of the cutting or trimming operations to break down the corrugations gives the board a weakened appearance.

In accordance with the present invention, accurate alignment of the corresponding edges of the several sheets is automatically maintained by using known edge controlling and positioning mechanism in operative association with novel means interconnecting such mechanisms in such manner that any variation in the position of an edge of one sheet automatically effects an accurate corresponding variation in the position of the corresponding edge of another sheet or sheet assembly being joined to such one sheet.

The known edge positioning control mechanism preferred for use in the present invention comprises a sensing nozzle assembly, a regulator unit, and a work edge positioning unit. The sensing nozzle assembly includes a pair of rectangular or slotted orifice nozzles having their discharge ends facing each other in alignment and spaced a short distance apart. Air under pressure is discharged from one nozzle, known as the "pressure orifice," into the other nozzle, known as the "recovery orifice," and the pressure air received by the latter is applied against one side of a delicate diaphragm, the air pressure being counterbalanced by a light and adjustable spring pressure.

With the edge of a web or sheet positioned between the nozzles and obstructing exactly one-half of the lateral width of the orifices, the diaphragm is maintained in a central or balanced position by adjustment of its biasing spring. Any lateral movement of the sheet or web will correspondingly vary the air entering the "recovery" nozzle and thus correspondingly shift the position of the diaphragm.

The shifting of the diaphragm controls the position of a pivoted discharge nozzle in the regulator unit which, in the neutral or balanced position of the diaphragm, delivers equal amounts of fluid under pressure to tubes or conduits leading to opposite ends of a cylinder in the work positioning unit. As the pivoted nozzle is shifted away from its neutral position, the fluid delivered to one end of the cylinder is decreased and that delivered to the other end is increased. As a result, a piston in the cylinder is shifted to move web steering and alignment means in a corrective direction to restore the controlled edge of the web to its pre-set lateral position.

In accordance with the invention, one of these edge control mechanisms is operatively associated with a selected edge of the "medium" so as to automatically maintain this edge in pre-set position. The sensing nozzle assembly of this mechanism is adjustably mounted on a calibrated shaft connected by mechanical linkage to a second calibrated shaft in such manner that both shafts are movable only as a unit and in the same direction. This second calibrated shaft has adjustably mounted thereon the sensing nozzle assembly of a second edge control mechanism whose work positioning cylinder-piston assembly, or fluid actuator, is connected to the aforementioned mechanical linkage.

Before starting the board forming operation, both sensing nozzle assemblies are adjusted to the same position on their respective calibrated shafts. The selected edge of the "medium" web is then accurately positioned centrally of the nozzles of the first edge control medium, and the corresponding edge of the "first liner" is accurately centered relative to the nozzles of the second edge control mechanism. During operation, the first edge control mechanism accurately maintains the edge of the "medium" web in its pre-set lateral location. Should the corresponding edge of the "first liner" web vary from its pre-set location, the resultant operation of the fluid actuator of the second edge control mechanism will, through the mechanical linkage, shift both sensing nozzle assemblies as a unit in the same direction until the pre-set relation between the edge of the "first liner" web and its associated sensing nozzle assembly is re-attained. The corresponding shifting of the "medium" web nozzle assembly will result in its associated fluid actuator moving the "medium" web to maintain its edge accurately aligned with the corresponding edge of the "first liner" web. Thus, the "medium" web and "first liner" web have their corresponding edges accurately aligned as the medium and first liner are glued together to form a sheet of "single face" corrugated paperboard.

As stated, a "second liner" web is glued to the corrugated face of the "single face" web, and it is highly desirable to maintain corresponding edges of the "second liner" and "single face" webs aligned. For this purpose, a third edge control mechanism is provided having its sens-

ing nozzle assembly operatively associated with the controlled edge of the "second liner," and its fluid actuator controlling guiding or aligning means, such as steering roller means, for the latter. This third sensing nozzle unit is mounted on a parallel linkage support which carries a grooved pulley having a cylindrical surface engaged with the edge of the "single face" web and having its projected line of contact laterally bisecting the third sensing nozzle assembly. The parallel linkage support is spring biased to maintain the pulley engaged with the controlled edge of the "single face" web. Thus, any lateral shifting of the latter will correspondingly shift the third sensing nozzle assembly, and this results in the fluid actuator of the latter operating the "second liner" guiding means to maintain the two corresponding edges in alignment as the "second liner" is glued to the "single face."

For an understanding of the invention principles, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawing. In the drawing:

Fig. 1 is a schematic side elevation view of a corrugated paperboard machine embodying the invention;

Figs. 2 and 3 are side elevation views of a "single face" sheet and a completed board, respectively;

Fig. 4 is a side elevation view of a board, illustrating the crushing effect which may occur during trimming of the edges;

Fig. 5 is a schematic side elevation view of a known edge control mechanism used in the invention apparatus;

Fig. 6 is an end elevation view of the means maintaining accurate alignment of corresponding edges of the "single face" and "second liner";

Fig. 7 is a partial plan view of this means;

Fig. 8 is a side elevation view of said means;

Fig. 9 is a transverse sectional view of a steering roller used in the invention apparatus; and

Fig. 10 is an enlarged elevation view illustrating one of the calibrated shafts.

Referring to Fig. 1, a first paper web **10**, hereinafter referred to as the "medium," is fed from a roll **11** over a guide roll **12**, through steering rolls **15** controlled by an edge control mechanism hereinafter described, over guide roll **13**, and between highly heated steel rollers **14** having longitudinally fluted surfaces which corrugate web **10** due to the heat and pressure exerted by rolls **14**. A roll **16** applies glue to the corrugated medium. At the same time, a second paper web **20**, hereinafter referred to as the "first liner," is fed from a roll **17** over guide rolls **18**, between which is disposed a sensing nozzle assembly described hereinafter, over a guide roll **19**, and between medium **10**, on one fluted roll **14**, and a pressure roll **21**. Rolls **21** and **14** press medium **10** and first liner **20** together to joint them into a "single face" web **25** as shown in Fig. 2.

The "single face" web **25** is then fed over guide rolls **22** and a glue applying roll **23** toward a series of heated metal plates **24** associated with pressure rolls **26**. Roll **23** applies glue to the exposed surfaces of medium **10**. Plates **24** and pressure rolls **26** applying heat and pressure to join "single face" **25** to a "second liner" **30**. The paper web forming second liner **30** is fed from a roll **27** over a guide roll **28** and a steering roll **31**. Just beyond roll **31** is a sensing nozzle assembly described more fully hereinafter. Second liner **30** then passes over guide roll **32**, and between plates **24** and pressure rolls **26** in contact with medium **10**. The completed corrugated paperboard **35**, shown in Fig. 3, then passes through rotary edge trimmers **33** and through cut off knives **34** which cut the board to length. A vacuum device **36** removes scrap material.

If the edges of the three webs **10**, **20** and **30**, are not accurately aligned, material must be trimmed from both edges of board **35** to form smooth even edges on the board. This not only wastes material, but may also result in slight crushing of medium **10**, as illustrated in Fig. 4, giving board **35** a weakened appearance which detracts from its sales appeal.

To maintain accurate alignment of corresponding edges of the three webs, the present invention uses known edge control mechanisms, of the type shown in Fig. 5, in combination with certain auxiliary devices. Referring to Fig. 5, the edge control mechanism **40** therein schematically illustrated is designed to automatically maintain the edge of a web in a predetermined lateral location. Mechanism **40** comprises sensing nozzle assembly S, a regulator unit R, and a fluid actuator F. The actuators, and particularly actuators F–1 and F–3, are shown schematically in Fig. 1, and not in practical operating position. Sensing nozzle assembly S comprises a pressure nozzle **41** receiving air under pressure from line **42** and discharging the air into a second nozzle **43**. Nozzles **43** have elongated orifices, which may be slotted and which extend parallel to the edge of a web W. These orifices are vertically aligned and web W is disposed with its controlled edge bisecting the lateral extent of the orifices.

Nozzle **43** is connected by a line **44** to a housing **46** enclosing a diaphragm **45** connected by link **47** to a pivoted nozzle **50**. An adjustable light spring **48** biases diaphragm **45** toward line **44**. Spring **48** is so set that, with web W positioned as stated, the spring balances the air pressure against the diaphragm **45** so that the latter remains in a neutral position.

Nozzle **50** is supplied with fluid under pressure from a line **51** and normally discharges equal amounts of fluid into orifices or nozzles **52**, **53** connected to opposite ends of cylinder **54** of fluid actuator F. This cylinder contains a piston **55** having a rod **56** connected to web steering rolls or other web guiding or aligning means. If web W shifts its position, the change in air pressure results in movement of diaphragm **45** and nozzle **50**. This inversely varies the fluid delivered to opposite ends of cylinder **54** to shift piston **55** and its connected web steering means in a web-position-correcting direction.

In accordance with the invention, and as best seen in Fig. 1, a first edge control mechanism **40—1** has its sensing nozzle assembly S–1 operatively associated with a selected edge of medium **10**, and its fluid actuator F–1 controlling steering rolls **15**. Sensing nozzle assembly S–1 is adjustably mounted on a calibrated shaft **57** for lateral adjustment relative to the edge of medium **10**. Shaft **57** is connected by linkage **60** to a second calibrated shaft **58** on which is adjustably mounted the sensing nozzle assembly S–2 of a second edge control mechanism **40—2**.

Assembly S–2 is adjustable along shaft **58** laterally relative to the corresponding edge of first liner **20**. The fluid actuator F–2 of mechanism **40—2** is connected to linkage **60**, and the linkage is so designed that shafts **57** and **58** are moved in unison and in the same direction relative to the corresponding edges of medium **10** and first liner **20**, respectively.

With the described arrangement, mechanism **40—1** automatically maintains the controlled edge of medium **10** centered in assembly S–1. In advance of starting the board forming operation, assemblies S–1 and S–2 are accurately set at the same point on their respective shafts **57** and **58**. Thereby, the corresponding edges of medium **10** and first liner **20** are accurately aligned. During operation, should first liner **20** shift laterally, the resultant operation of actuator F–2 will move both nozzle assemblies S–1 and S–2 until the edge of first liner **20** is again centered laterally of assembly S–2. The corresponding operation of actuator F–1 will shift medium **10** until it is accurately centered laterally of assembly S–1, thus maintaining the edge of medium **10** aligned with the corresponding edge of first liner **20**.

Referring to Figs. 1, 6, 7 and 8, a third edge control mechanism **40—3** is utilized to maintain the corresponding edge of second liner **30** aligned with the edge of single face **25**. In this case, nozzle assembly S–3 is

centered laterally of the edge of second liner 30 and fluid actuator F–3 controls steering roll 31 for the second liner. Nozzle assembly S–3 is mounted for lateral movement in unison with a grooved pulley 65 having a cylindrical surface 66 engaging the corresponding edge of single face 25.

Assembly S–3 and pulley 65 are mounted on a parallel linkage 70 in such manner that surface 66 extended laterally bisects assembly S–3.

Parallel linkage 70 includes a bottom support bar 67 arranged to be secured to the framework of the machine to extend horizontally. The end of this bar carries a cross-shaft 68 on which are pivotally mounted a pair of main links 71 biased to swing toward single face 25 and second liner 30 by means of coil springs 72. The upper ends of main links 71 carry a cross shaft 73 extending through an upper support bar 74. A pair of auxiliary links 76 are pivotally connected between a cross shaft 77 in lower bar 67 and a cross shaft 78 in upper bar 74. With the described arrangement, upper bar 74 will always move parallel to lower bar 67 during swinging of links 71 and 76.

Square or polygonal abutments or posts 81, 82 project upwardly and downwardly from the inner end of bar 74, and serve as mounting anchors for the supports of nozzle assembly S–3. Pressure nozzle 41—3 of the assembly S–3 is mounted in a support 83 clamped to post 82, and recovery nozzle 43—3 is mounted in a support 84 clamped to post 81, the nozzles being in facing coaxial alignment.

A support arm 80 is bolted to support 84 to extend upstream at right angles thereto, and has a forked outer end in which is secured a vertical post 85 having a square or polygonal cross-section. The upper end of post 85 is reduced and cylindrical, as at 86, to form a shaft for pulley 65. Pulley 65 rests on a sleeve 87 on shaft 86 and is held in position by a nut 88 threaded on the reduced upper end 91 of shaft 86 and holding a washer 92 against a sleeve 93 engaging the upper side of pulley 65. The relation of pulley 65 and assembly S–3 is such that the common axis of nozzles 41—3 and 43—3 is aligned with cylindrical surface 66.

In operatoin, if single face 25 shifts laterally, the pulley 65 will correspondingly shift due to springs 72 biasing the pulley toward the edge of singly face 25. Shifting of pulley 65 will shift assembly S–3 resulting in corrective action by actuator F–3 on steering roll 31 to shift second liner 30 to maintain its edge laterally centered in nozzle assembly S–3. Thus, the single face and second liner have their corresponding edges maintained in accurate alignment during the gluing operation.

Should there be a rough edge on the single face or liner, or should it be desirable to disengage the control for any reason, the parallel linkage may be swung to the retracted position, shown in dotted lines in Fig. 6, by the operator grasping a pin 90 on the outer end of bar 74. A spring pressed locking pin 95, in a cylindrical cross member 96 secured between main links 71, latches the linkage in retracted position. The latch may be released by a sharp inward blow on the outer end of bar 74 or on pin 90.

Fig. 9 shows a typical mounting of a steering roll such as 31. Roll 31 is rotatably mounted in spaced arms projecting from the ends of a generally channel shape bracket 100, and a paper guard 101 is secured to extend in substantially parallel spaced relation to the surface of roll 31. Bracket 100 is bolted to a plate 102 eccentrically disposed on the outer end of a shaft 103 and preferably integral therewith. Shaft 103 projects through a hole in the base 104 of bracket 100 and through a hole in the base 106 of a fixed channel bracket 105. A bearing housing 107 is secured to the inner surface base 106 and contains anti-friction bearings 108, 109 supporting shaft 103. Piston rod 56 of fluid actuator F–3 is secured by a link (not shown) to bracket 100.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

In a corrugated paperboard machine of the type including means for corrugating a first paper web to form a corrugated medium, means to adhere a first liner web to one side of said medium to form a single face board, and means to adhere a second liner web to the other side of said medium to complete the board; apparatus for maintaining corresponding edges of the webs accurately aligned during the joining operation, said apparatus comprising, in combination, a first edge control mechanism including edge sensing means arranged in predetermined lateral relation to a selected edge of said medium, first steering roller means operable to laterally adjust said medium and engaging the latter just in advance of said sensing means, and a first actuator operatively associated with said sensing means and said first steering roller means and operable, upon lateral shifting of said medium, to operate said first steering roller means to restore the edge of said medium to said predetermined lateral relation; first edge scanning means operatively associated in predetermined lateral relation with the corresponding edge of said first liner web; first positioning means operatively associating said first edge sensing means and said first edge scanning means and operable, upon lateral shifting of said first liner web, to correspondingly shift said first sensing means and said first edge scanning means to maintain said corresponding edges in accurate predetermined relation; a second edge control mechanism including second edge sensing means arranged in predetermined lateral relation to a selected edge of said second liner web, second steering roller means operable to laterally adjust said second liner web and engaging the latter just in advance of said second sensing means, and a second actuator operatively associated with said second sensing means and said second steering roller means and operable, upon lateral shifting of said second liner web, to operate said second steering roller means to restore the edge of said second liner web to said predetermined lateral relation; second edge scanning means operatively associated in predetermined lateral relation with the corresponding edge of said single face board; second positioning means operatively associating said second edge sensing means and said second edge scanning means and operable, upon lateral shifting of said single face board, to correspondingly shift said second sensing means to maintain said corresponding edges of said single face board and second liner in accurate predetermined relation; a parallel linkage; said second scanning means comprising a pulley rotatably mounted on a laterally shiftable element of said parallel linkage and having a cylindrical surface engaging an edge of the single face board; and means biasing said linkage to maintain such engagement; said second sensing means being mounted on said element in fixed relation to said pulley.

References Cited in the file of this patent

UNITED STATES PATENTS

2,641,416	McCleary et al.	June 9, 1953
2,735,630	Ziebolz	Feb. 21, 1956