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(54) **Web folding apparatus.**

(57) A web former apparatus (4) comprising three elongated elements (A, B, C,) which are located in a fixed axial relationship and which apparatus is bodily movable transversely of a traveling web (6) to vary the axis of the web along which the web is folded.

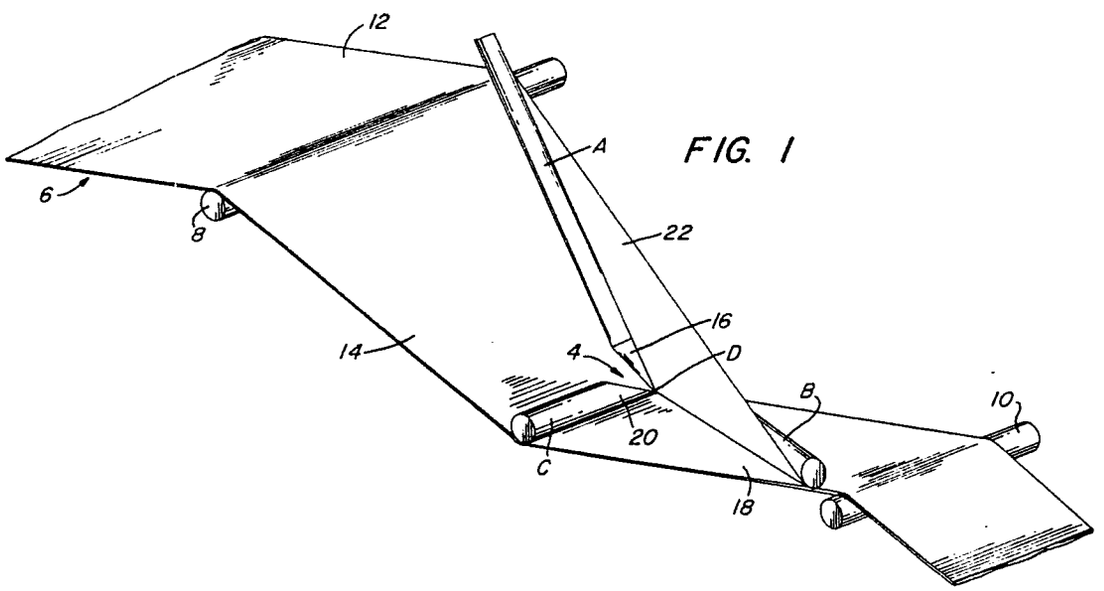

FIG. 1

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WEB FOLDING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to an improved method and apparatus for producing longitudinal folds in a traveling web of paper or like material. In the printing industry it is a common practice to produce one or more successive folds in a traveling elongated web in the axial direction of travel between a printing unit and a cutter such that multipage folded products can be made. Presently, plow folders are used to make axial folds in a traveling web. Such plow folders are generally mounted in a structure in between an inlet and exit roller and adjustment means are provided to vary the position of the folder mechanisms in various directions to vary the location of the fold line across the web width. These mechanisms suffer from many disadvantages such as marking, wrinkling and gussetting along the fold line. These problems are relieved by use of various mechanical assists such as brushes, wheels and guide rods, and the like. Also, since there is no definite geometry of paper fold inherent in the folding apparatus, the position of the fold in the web is varied by moving the plow forming shoe and various mechanical assists to obtain a satisfactory fold line. This requires time consuming effort and a higher skill level of the operators. Further, when the linear extent of the fold is changed, the various components have to be repositioned, thus requiring equipment downtime and lost production. These problems are common to the current plow folding apparatus, whether these be a stationary plow shoe, a rotary plow shoe or a mechanism such as shown in U.S. Patent No. 4,421,501. The present invention overcomes these problems by providing a new and improved apparatus that creates a definite geometry of fold thus eliminating the need for multiple adjustments and mechanical assists. Besides, the new apparatus provides for less friction and marking and, therefore, more accurate folds by a definite relationship of its members, which can be moved as an assembly to change the width of the fold, thus saving time in operation and set up. The new apparatus also enables higher speeds than hitherto possible by reducing friction and eliminating speed restrictive elements such as brushes, guide wheels and guides.

Another kind of apparatus currently in use for making folds in the axial direction of a traveling web is former boards. Such boards are generally triangular elements in a single plane with beveled or rounded edges and produce efficient folds in the web with less adjustments than plow shoes. The orientation of a board formed folded web is normally at right angles to the plane of the incoming web. Such orientation is a serious disadvantage as the apparatus cannot be arranged in series for multiple folds in line with the printing press. The present invention provides an apparatus for high speed folding along the web axis such that the orientation of folded web is the same as that of the incoming web, enabling several such folding stations to be configured in series for multiple folds.

SUMMARY OF THE INVENTION

The present invention is to an apparatus and method for folding a traveling web continuously along a longitudinal line or axis of the web. Further, the apparatus is adjustable to control the lateral position of the fold line of the traveling web by actuating a single adjustment handle mounted on the exterior of the frame of the folder without requiring any adjustment of the relative position of the elements which fold the web or control the movement of the web through the folder.

More specifically, the apparatus of this invention comprises three formed elements which are positioned in fixed relationship to each other, but which elements are bodily movable as a unit to laterally adjust the location of the fold line. Such three elements have central axes in a fixed geometric relationship and are of a form to produce a fold in a traveling web regardless of the bodily position of the elements transversely of the web.

The web folding apparatus of this invention consists of a three element former assembly with the axis of a middle element being at right angles to the web axis and with the other two elements being angularly placed on respective sides of the middle element. Such three element former assembly is positioned between inlet and exit rollers such that the inlet roller, the outlet roller and the middle element of the former assembly have axes at right angles to the web axis and positioned so that the web portion defined between the inlet roller and the middle element undergoes a change of direction by a certain angle as the web travels between the middle element and the exit roller. Preferably the angular change in direction is 45 degrees; however, an angular change from 25 to 55 degrees is satisfactory. With such angular change the angle between the exiting web portion and the web portion immediately prior thereto is preferably 135 degrees or a range from 125 to 155 degrees. Another element of the former assembly lies tangentially above or below the web portion between the inlet

roller and the middle element and at an angle to the axis of the paper. Such angle is preferably 32 degrees although a range of 15 to 45 degrees is satisfactory. The third element of the former lies tangentially above or below the web between the middle element and the exit roller and at an angle to the axis of the web. Such angle is preferably 25 degrees although a range of 14 to 30 degrees is satisfactory.

Further, the present invention permits the three fold producing elements thereof to be selectively positioned transversely of a traveling web to vary the lateral position of a longitudinal fold line without requiring any adjustment of the elements relative to each other.

Accordingly, one object of this invention is to provide a new and improved apparatus for folding a traveling web along a longitudinal fold line.

Another object of this invention is to provide a new and improved method for varying the width of fold of a traveling web.

Still another object of this invention is to provide a new and improved apparatus for folding a traveling web along a longitudinal fold line which has three stationary members located in a fixed relationship to produce a folded web.

A specific object of this invention is to provide a new and improved apparatus for folding a traveling web along a longitudinal fold line which consists of three elongated elements having central axes which remain in fixed relationship as the width of fold is varied.

A further object of this invention is to provide a new and improved method for varying the width of fold of a traveling web while the web is traveling.

These and other objects of this invention will become more apparent upon consideration of the following description and illustrations of presently preferred embodiments thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective representation of the fold-former assembly and the entrance and exit rollers associated therewith arranged in accordance with the principles of this invention.

Fig. 2 is a perspective view of an alternate form of a structure as shown in Fig. 1.

Fig. 3 is a perspective view of another alternate form of the structure as shown in Fig. 2.

Fig. 4 is a perspective representation of the structure for supporting the fold producing elements as shown in Fig. 1.

Fig. 5 is a side elevational view of a folder constructed in accordance with the principles of this invention.

Fig. 6 is a top plan view of the folder as shown in Fig. 5, and

Fig. 7 is a diagrammatic representation of a folder similar to that shown in Fig. 5.

DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

The web folding apparatus or former of this invention comprises a fabricated framework or frame 2 for suitably supporting a folder mechanism 4 which continuously folds a traveling web 6 of paper passing through the folder 4. In order for the web 6 to travel through folder 4, the web is initially threaded or fed through folder 4 in the path to be traveled by the web 6. Further, in order to better understand this invention, folder 4, in part, and adjacent entrance and exit rollers 8, 10 are shown in Fig. 1 in perspective without the necessary supporting structure therefor.

In Fig. 1 the incoming traveling portion 12 of web 6 travels over the entrance roller 8 and is discharged from roller 8 to form an intermediate traveling portion 14 of web 6 which extends forwardly and downwardly from roller 8. The terms forwardly, downwardly and the like as used herein are with reference to the direction in which the web 6 travels. Folder 4 comprises three formed elongated elements, A, B and C with element A extending longitudinally forwardly and downwardly from roller 8. The undersurface of element A is spaced forwardly of roller 8 to guide the web 6 as it forms portion 14. Element A is a stationary member having throughout its length a suitably formed undersurface for guiding the web 6 through portion 14. The lowermost end of element A is provided with an axially downwardly extending pointed portion 16 which is of a form that the guiding undersurface of element A is continuous with and throughout the axial extent of the portion 16.

Element C forms the lowermost extent of portion 14 with web 6 continuously traveling therearound to form a forwardly extending traveling portion 18 of web 6. Element C is an elongated stationary member having a continuous under and lower surface for guiding the web 6 to continuously form portion 18 and a pointed inner end portion 20 which is of a form that the guiding undersurface of element C is continuous with and throughout the axial extent of portion 20. The undersurfaces of elements A and C are of any suitable form to provide the guiding of web 6 as described; however, since cylindrical members are preferred for elements A and C, elements A and C will be described hereinafter with reference to the preferred cylindrical structure. With a cylindrical element C the central axis of element C is parallel to

the central axis of rollers 8 and 10. With such structure portion 14 of web 6 extends tangentially downwardly from roller 8 and is also tangential to a rearwardly facing portion of the cylindrical surface of element C. Thus, the outer cylindrical surfaces of roller 8 and element C form the plane through which portion 14 travels between roller 8 and element C. Elements A and C have their pointed ends 16, 20 located to form a theoretical stationary point D. Theoretical point D lies at the intersection of the lowermost outer line of the lowermost continuous surface of element C and the outermost outer line of the outer surface of element A furthermost from element C. Thus, theoretical point D is the fold point of web 6.

In fact, the points of portions 16 and 20 are spaced from each other a slight distance to provide a fold point which is located in space free of the pointed ends of portions 16 and 20. A spacing of 3/32 of an inch between the pointed ends of portions 16 and 20 has proven to be satisfactory. By providing theoretical point D in space, the web 6 can be folded without wrinkling, crimping or tearing of the web. Also, by providing theoretical point D in space, the offset of the intersection of the planes of portions 14 and 18 from the outer cylindrical surface portions of element C can readily be compensated for. Also, the pointed ends of portions 16 and 20 are rounded to facilitate folding of paper without tearing or wrinkling. If desired, the pointed ends of portions 16 and 20 can be arcuate in form.

With theoretical point D being the fold point, the traveling web 6 continuously forms a side portion 22 which extends forwardly and downwardly from roller 8. Assuming for the purpose of description that the web 6 is to be folded on its longitudinal center line, theoretical point D is located on the longitudinal centerline of web 6 and element A also extends angularly from adjacent an end of roller 8 to the center of web 6. With such angularity of element A, a part of incoming portion 12 travels along the outer surface of element A to form side portion 22 which subsequently becomes the folded portion of the web 6. As the linear extent of the angularity of the element A increases, the transverse linear extent of portion 22 increases until, at theoretical point D, one-half the transverse extent of web 6 is formed by the lowermost end of intermediate portion 14. In addition to establishing the fold point D, it is necessary to fold one-half of web 6 in overlapping relationship with the other half of web 6 which is accomplished by means of an element B. Element B has a rearward end forwardly adjacent theoretical point D and extends forwardly at a forward angle across forward portion 18. Element B has a linear extent at least equal to one-half the width of web 6 to fold the side portion 22 forwardly of theoretical point D over portion 18, It will be realized that portion 22 is progressively continuously folded from adjacent point D to the opposite side of portion 18 at an angle to prevent wrinkling, tearing or the like of portion 22. After passing under element B, the folded web 6 passes over the exit roller 10 for further processing as desired. Alternatively stated, portion 22 continuously increases in lateral extent as it travels along element A and continuously decreases in lateral extent as it travels forwardly from theoretical point D.

Althouth element C has been described as a stationary element C, if desired, it can be a rotating roller. Further, elements A and B and element or roller C are provided with suitable holes to provide for air film lubrication between the web and the elements A, B and C as is known in the art. In order to prevent any undesirable marking, wrinkling or the like to web 6 such air lubrication is required.

An important feature of this invention is that the elements A, B and C can readily be constructed to provide a theoretical fold point D at various positions transversely of the web 6. As described, elements A, B and C provide the structure for folding the web 6. By supporting elements A, B and C from a common frame, separate from and supported by frame 2, and supporting such common frame for movement transversely of web 6, the transverse location of theoretical point D can be varied as desired. Fig. 4 represents such an adjustable frame structure in a simplified perspective view. In such structure element A is suitably rigidly attached to a bracket 30 which extends transversely outwardly adjacent the upper end thereof and in turn is suitably rigidly secured to a downwardly and forwardly extending rigid structural member 32. Member 32 is suitably rigidly secured to a slide member 34 having an elongated open ended formed slideway 36 therein. Slideway 36 suitably captively receives an elongated cross bar 38 therein having the ends thereof suitably rigidly secured to the frame 2. The lower end of member 32 is suitably rigidly secured to element B by an intermediate rigid bracket 40. Similarly, element C is suitably rigidly secured to slide member 34 by an intermediate rigid bracket 42. Thus, members 30, 32, 34, 40 and 42 form a rigid frame structure which can be moved as a unit or bodily longitudinally along cross bar 38 to any selected longitudinally relative position to vary the location of theoretical point D relative to the width of web 6. Thus, solely by sliding the slide member 34, the fold line can be varied without requiring any other adjustment. Obviously such structure has the members thereof located so as to not interfere with the travel

of web 6. As hereinafter described, the slideable structure can be moved longitudinally along cross bar 38 by a suitable hand wheel and screw structure.

If desired, Fig. 2, element C can be formed by providing bracket 42 with a laterally outwardly extending stationary pointed portion 45 to form one-half of theoretical point D. Bracket 42 also supports a roller 47 which extends outwardly therefrom to permit web portion 14 to travel therearound. Alternatively, a modified bracket 42', Fig. 3, can be provided to support an inclined rotatable disk 49 to form one-half of theoretical point D. Bracket 42' also supports a roller 47 to permit web portion 14 to travel thereunder.

Fig. 7 is a schematic illustration of the web folding apparatus of this invention. A suitable frame means 2' are provided with a suitable cross bar 38 to support the former 4. The support structure for the former is such that the former can be positioned in a lower position wherein the web 6 is folded upwardly. Alternately, the former can be repositioned in an upper position such that the web 6 is folded downwardly. If desired, pull roller 44 with wheels 46 can be provided to pull the web into the folder. Pull roller 44 and idler roller 10 provide the inlet and exit rollers for the former 4 in the lower position. Similarly, rollers 54 and 56 are positioned in the frame 2' to provide inlet and exit rollers, respectively, for the upward position of former 4. If desired, other drive rollers 50 or guide rollers 8 and 48 may be provided to facilitate web handling. The elements A and C of the former are provided with dual mounting positions such that when the former 4 is repositioned from lower to upper position, the bars A and C have lubrication holes in the proper orientation.

Figs. 5 and 6 illustrate a double folder in which a pair of formers is positioned in opposite manner to permit a fold to be made simultaneously inwardly of each side of web 6 in the manner described; i.e., the lower former 4 will make an upward fold and the upper former 4 will make an upward fold simultaneously. Frame 2 has a pair of elongated laterally spaced sides 55 with inlet roller 8' and exit roller 10' suitably rotatably supported between sides 55 inwardly adjacent the ends of frame 2. Rollers 8' and 10' are identical to rollers 8 and 10 in function; however, they are longer in length. Frame work 2 is provided with a cross bar 38 intermediate rollers 8' and 10' which bar 38 slideably supports an upper slide member 34 and a lower slide member 34. Members 34 slide separately and longitudinally along cross bar 38 and are separately slideably actuated by rotatable upper and lower threaded shafts 58, 56 respectively. Crossbar 38 has a central bore 60 for receiving shafts 56, 58 from the opposite ends thereof with the shaft 56 being suitably threadedly engageable with threaded means in the lower slide member 34 whereby the lower slide member 34 can be positioned as desired longitudinally of the lower half of crossbar 38. In a similar manner, the upper slide member 34 can be positioned longitudinally of the upper half of crossbar 38 by rotating the upper shaft 58. In order to facilitate rotation of shafts 56, 58, suitable hand wheels 62 are provided at the outer ends thereof respectively.

As shown in Fig. 6, the member 32 with the brackets 30 and 40 rigidly secured thereto, is suitably anchored to slide member 34 and slide member 34 is releasably secured to crossbar 38. As shown, suitable means 66 are provided in slide member 34 to receive suitable fasteners (not shown) to releasably secure member 34 to bar 38. Means 66 are located so that regardless of which set of means 66 is utilized, the former 4 is properly located with respect to a traveling web 6. It will be noted, however, that it may be necessary to remount the elements A and B to obtain proper air flow through the air discharge ports therein. Thus, each of the formers 4 can be located in various lateral positions with respect to the frame 2.

From the foregoing description, it will be noted that roller 8 and element C form the incoming plane of paper (portion 14) and that the lower outer cylindrical surfaces of element B and C form the outgoing plane of paper (portion 18). The angle between the incoming and outgoing paper planes can be varied as desired within practical limitations. Obviously, the larger the angle between the incoming and outgoing planes, the longer the frame 2 or the like will have to be. Also, the angle between the incoming and outgoing planes is greater than 90 degrees. It is to be particularly noted that the former of this invention is readily capable of operating in any position and the description of a horizontal web portion 12 is only for convenience in understanding the invention. Once the angle between portions 14 and 18 is established, the angle that elements A and B extend with respect to the side of the web is also established. Element A preferably extends at an angle of 32 degrees with respect to the edge of the web; however, an angle in the range of 15 to 45 degrees is satisfactory. Element B extends at an angle of 25 degrees with respect to the edge of the web, although an angle between 14 to 30 degrees is also satisfactory.

It is to be noted that the structure of this invention consists of a former with three fold producing elements (elements A, B and C) which are supported in fixed geometrical relationship between a pair of rollers (rollers 8, 10). Since the fold forming elements are fixed, they can be located to produce a fold in any traveling web regardless of its direction of travel; i.e., horizontal, vertical or

inbetween regardless of the plane in which the web is traveling. Further, the fold forming elements are secured to a sub-frame (members 30, 32, 34, 40 and 42) which is slideable with respect to the main frame 2 (i.e., member 34 slides over crossbar 38). Thus, by moving the sub-frame laterally of the traveling web portion I4, the position of the longitudinal fold axis can be varied. Such movement of the sub-frame can be made while the web is traveling to obtain precise positioning of the fold axis. Further, the movement of the sub-frame can be done by easily operated means, such as a hand wheel 62 for rotating screw shafts 56, 58, to permit changing the location of the fold axis without requiring any machine assembly skills. From Fig. 7, the folder of this invention can be positioned as desired in a supporting frame to produce either an upward or downward fold. Such positioning is readily achieved by releasing the sub-frame carrying the folding elements from the main frame and then resecuring the sub-frame to the main frame in its alternate position. Again, no special skills are required to reposition such sub-frame; however, it is sometimes necessary to adjust the location of the elements A and B to insure that proper air film lubrication is maintained. Also, a plurality of folders of this invention (Fig. 5 and 6) can be supported from a single main frame to simultaneously produce two laterally spaced folds with the position of each fold being easily adjustable.

In the method of this invention, a traveling web is continuously folded along one or more longitudinal axes, the location of which can be selectively varied by bodily or unitary movement of the components which produce the fold.

Having described presently preferred embodiments of the invention in accordance with the Patent Statutes, I am aware that modifications other than those previously indicated can be made to the described structures without departing from the spirit and scope of the invention. Accordingly, the invention is to be construed in accordance with the broadest interpretation of the following claims as supported by the foregoing description.

Claims

I. A former for a traveling web of paper which continuously travels forwardly, characterized by an elongated frame having laterally spaced sides, a crossbar extending laterally between said sides in a fixed relationship, a slide block longitudinally slideable along said crossbar, a paper web folding mechanism carried by said slide block, said folding mechanism including a plurality of elements arranged in a relationship to continuously fold a paper web traveling continuously therethrough in one direction, and means for selectively moving said slide block longitudinally of said crossbar with said folding mechanism being continuously maintained in such folding relationship with said web.

2. A former according to claim I, characterized in that said folding mechanism is located within said frame.

3. A former according to claim I, characterized in that an additional folding mechanism is carried by said frame intermediate the longitudinal ends thereof to provide an additional folding of said web.

4. A former according to claim 3, characterized in that said additional folding mechanism is operable to fold said web simultaneously with said first mentioned folding mechanism.

5. A former according to claim I, characterized in that said slide block is repositionable with respect to said frame to produce a fold opposite that produce prior to such repositioning.

6. A former according to claim I, characterized in that said folding mechanism includes means for producing an air film in conjunction with a traveling web.

7. Apparatus for folding a traveling paper web characterized by an elongated frame having an axial extent to permit a paper web to travel continuously therethrough in forwardly extending path, an elongated entrance roller carried by said frame and extending transversely of said path to define an entrance portion of said path, an elongated exit roller carried by said frame an extending transversely of said path to define an exit portion of said path forwardly of said entrance roller, a web folding mechanism carried by said frame, said mechanism having a plurality of elements located to define a fold point intermediate said entrance and exit rollers for initiating a fold in such a traveling web, said fold point being offset forwardly from said entrance roller whereby an entering traveling web portion leaves the entrance roller as an intermediate web portion which travels forwardly to said fold point and then travels forwardly from said fold point as an exit web portion to said exit roller and said folding mechanism including means for completing the fold in said exit web portion prior to said exit web portion traveling forwardly to said exit roller.

8. Apparatus according to claim 7, characterized in that said mechanism consists of three elongated elements, one of which has an external surface for guiding a portion of the traveling web from said entrance roller to said exit roller and which forms a part of the fold point.

9. Apparatus according to claim 7, characterized in that said folding mechanism consists of three elongated elements, two of which form said fold point, said two elements having rounded ends

forming said fold point, and in that said two elements have passageways to provide an air film in conjunction with a traveling web.

10. Apparatus according to claim 7, characterized in that said mechanism is carried by said frame in a manner that said mechanism can be moved laterally of said frame whereby the position of said fold point laterally of said frame can be varied, in that said frame has a rigid crossbar extending laterally thereof and said mechanism is attached to said crossbar and slideable with relation thereto, and in that said frame carries a hand wheel, a threaded shaft connecting said mechanism to said hand wheel whereby the position of said mechanism can be readily adjusted.

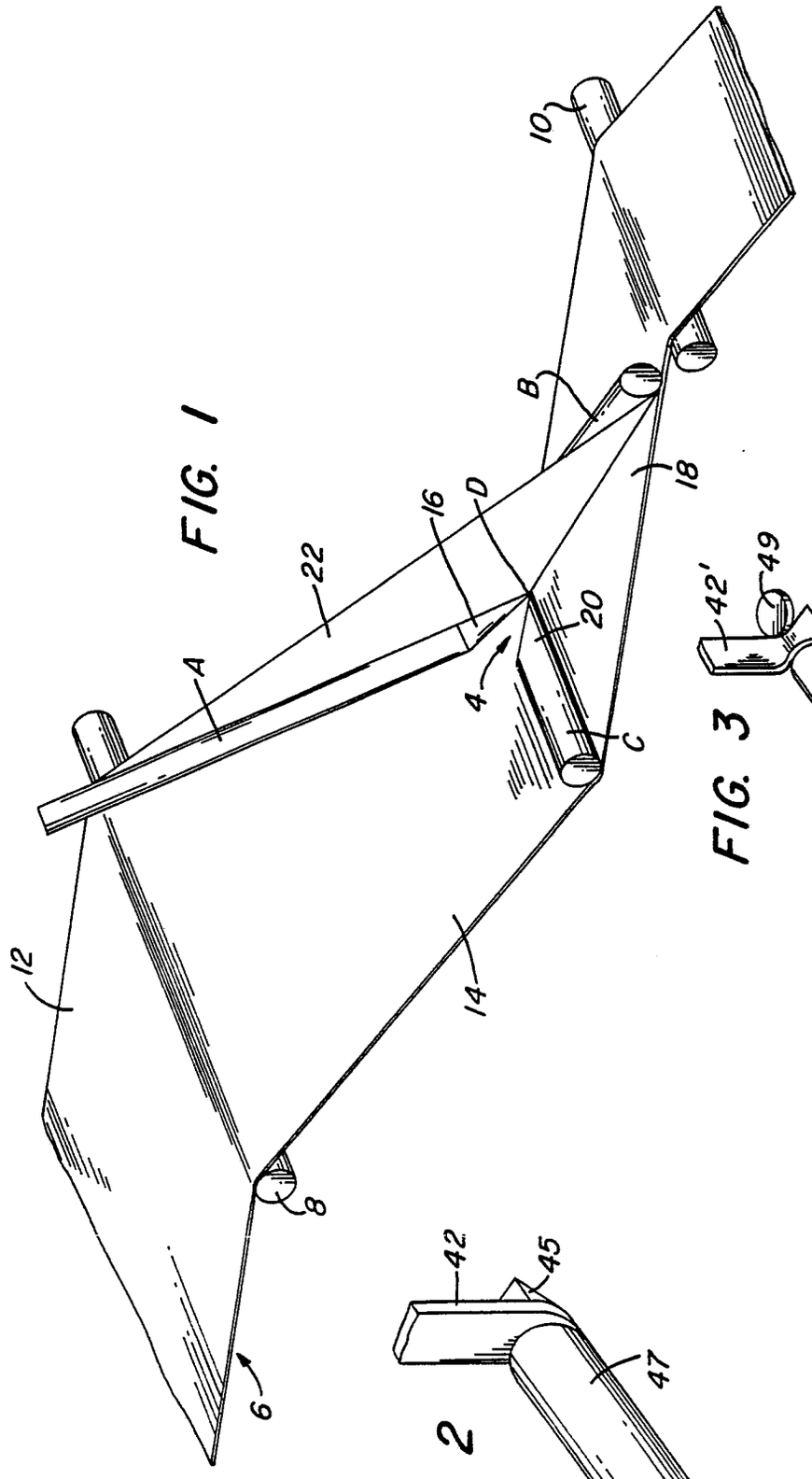


FIG. 1

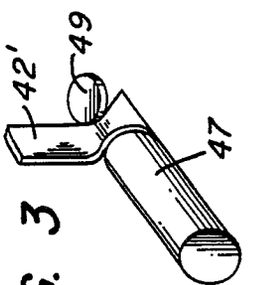


FIG. 3

FIG. 2

FIG. 7

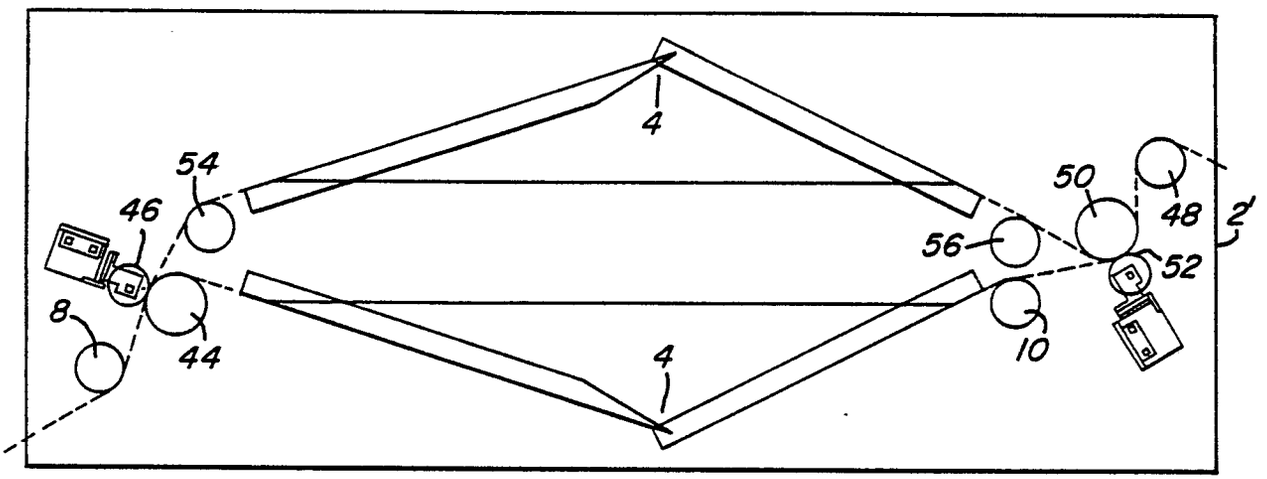


FIG. 4

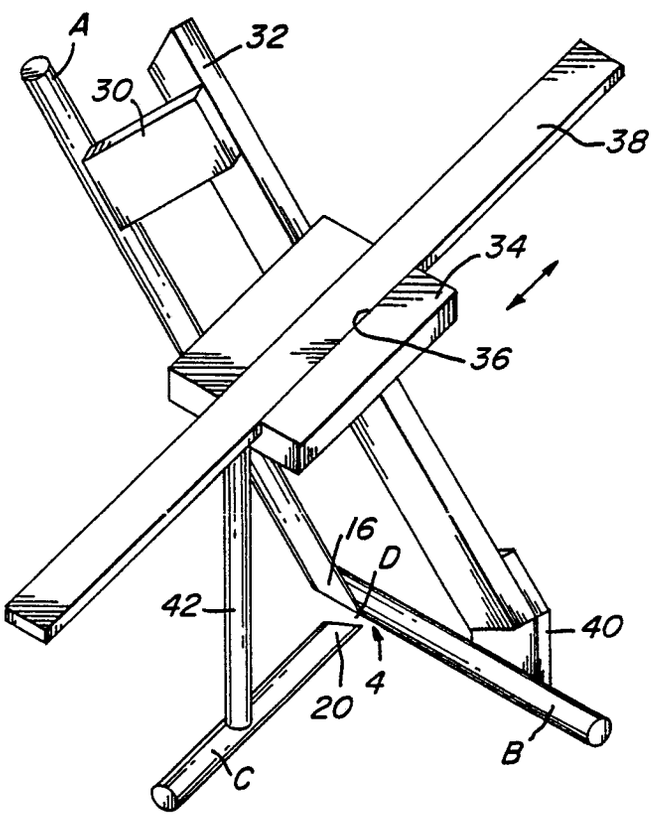


FIG. 5

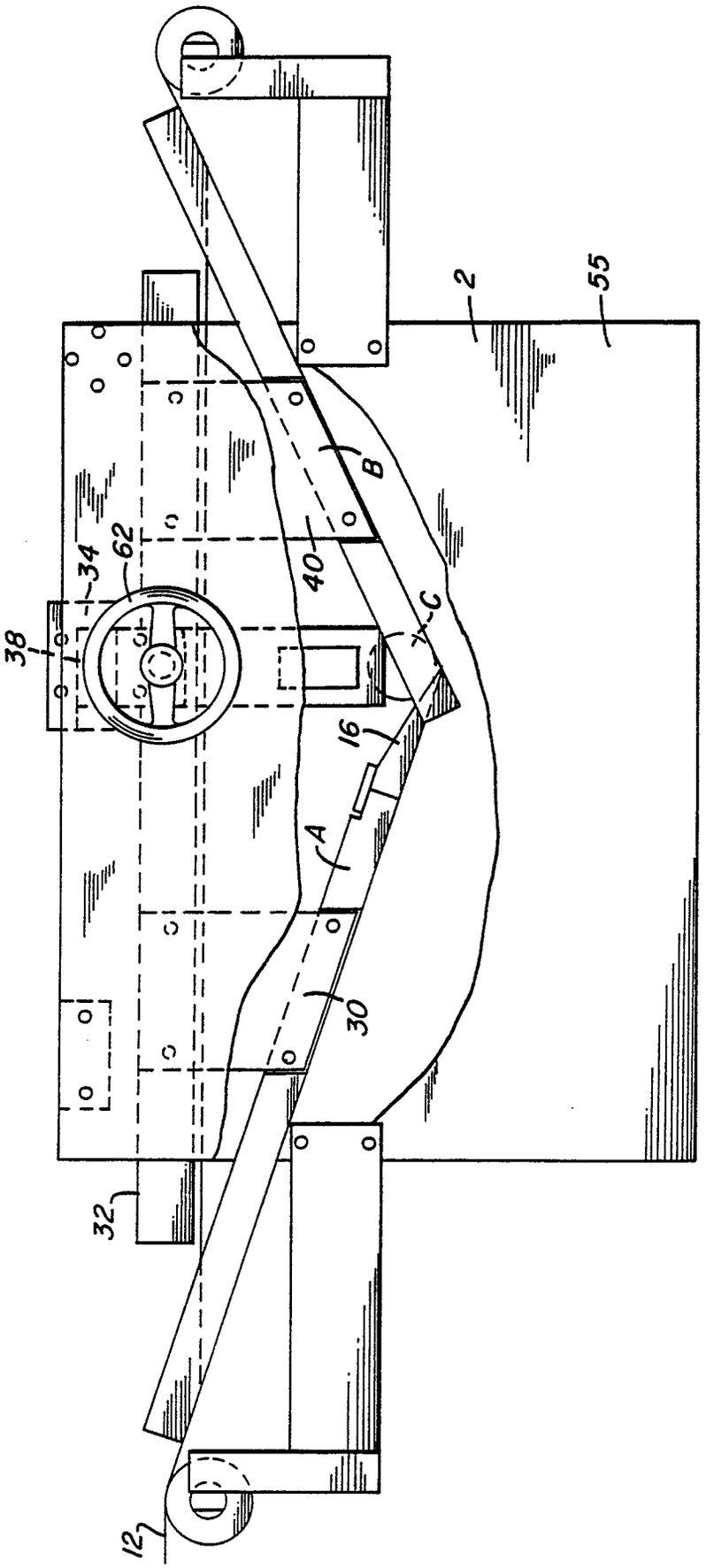
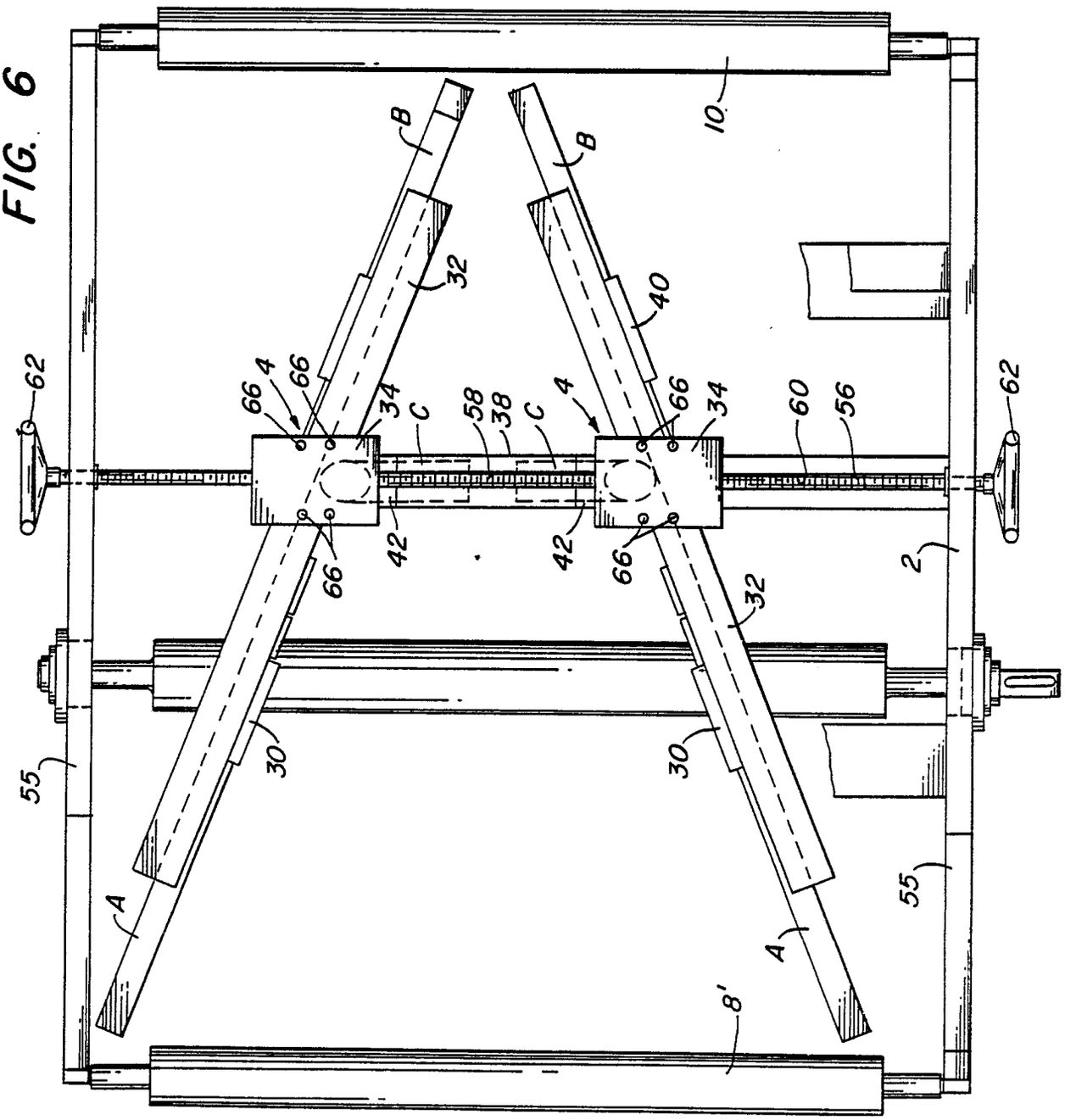


FIG. 6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European Patent Office

EUROPEAN SEARCH REPORT

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 87104592.8

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
	GB - A - 2 159 909 (POLYGRAPH LEIPZIG)		B 65 H 45/22
	* Fig. 1-4; specification page 2, lines 1-80 *		
X		1,2,5, 7	
Y		6	
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	US - A - 4 304 561 (H.SHINGO)		
	* Fig. 1,10; specification row 1, lines 12-36 *		
X		7,8,10	
Y		9	
	--		
Y	US - A - 4 321 051 (J.HAJEK et al.)	6,9	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
	* Fig. 1-6; abstract *		
	----		B 31 B
			B 65 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	11-06-1987	SÜNDERMANN

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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