

June 12, 1928.

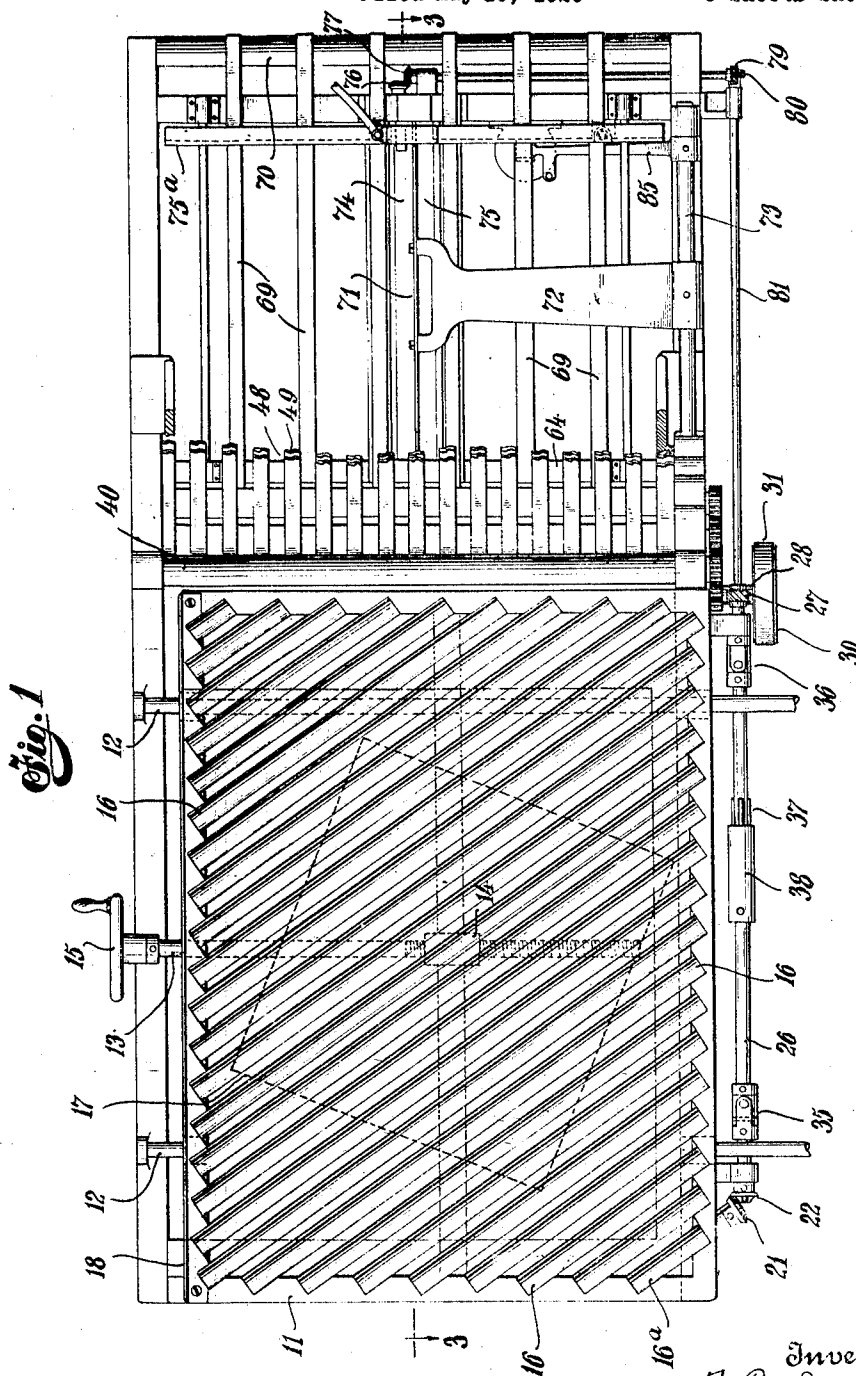
1,673,064

T. C. DEXTER

PAPER FOLDING MACHINE

Filed May 15, 1925

5 Sheets-Sheet 1



Inventor
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By his Attorneys
Cooper, Kerr & Dunham

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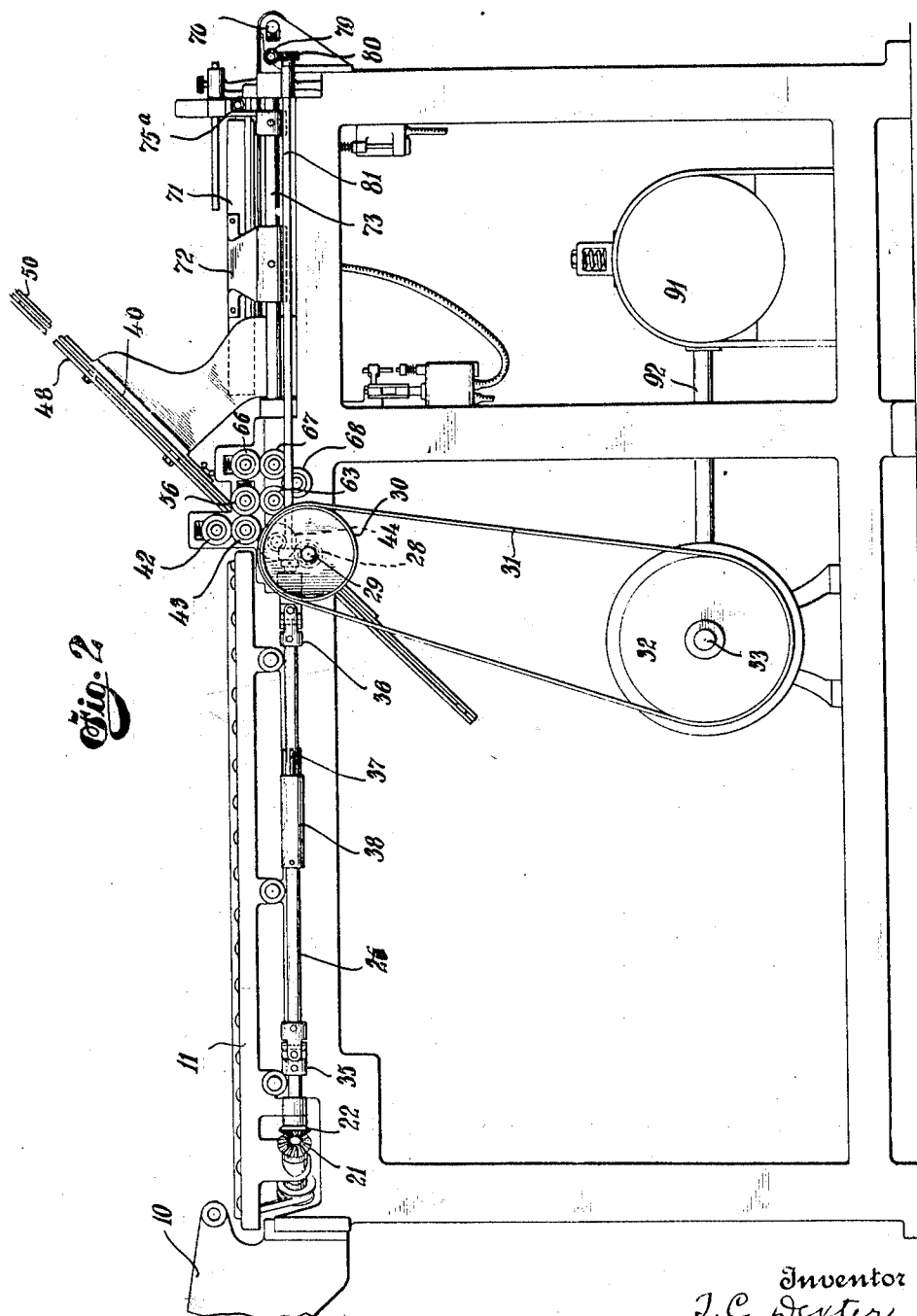
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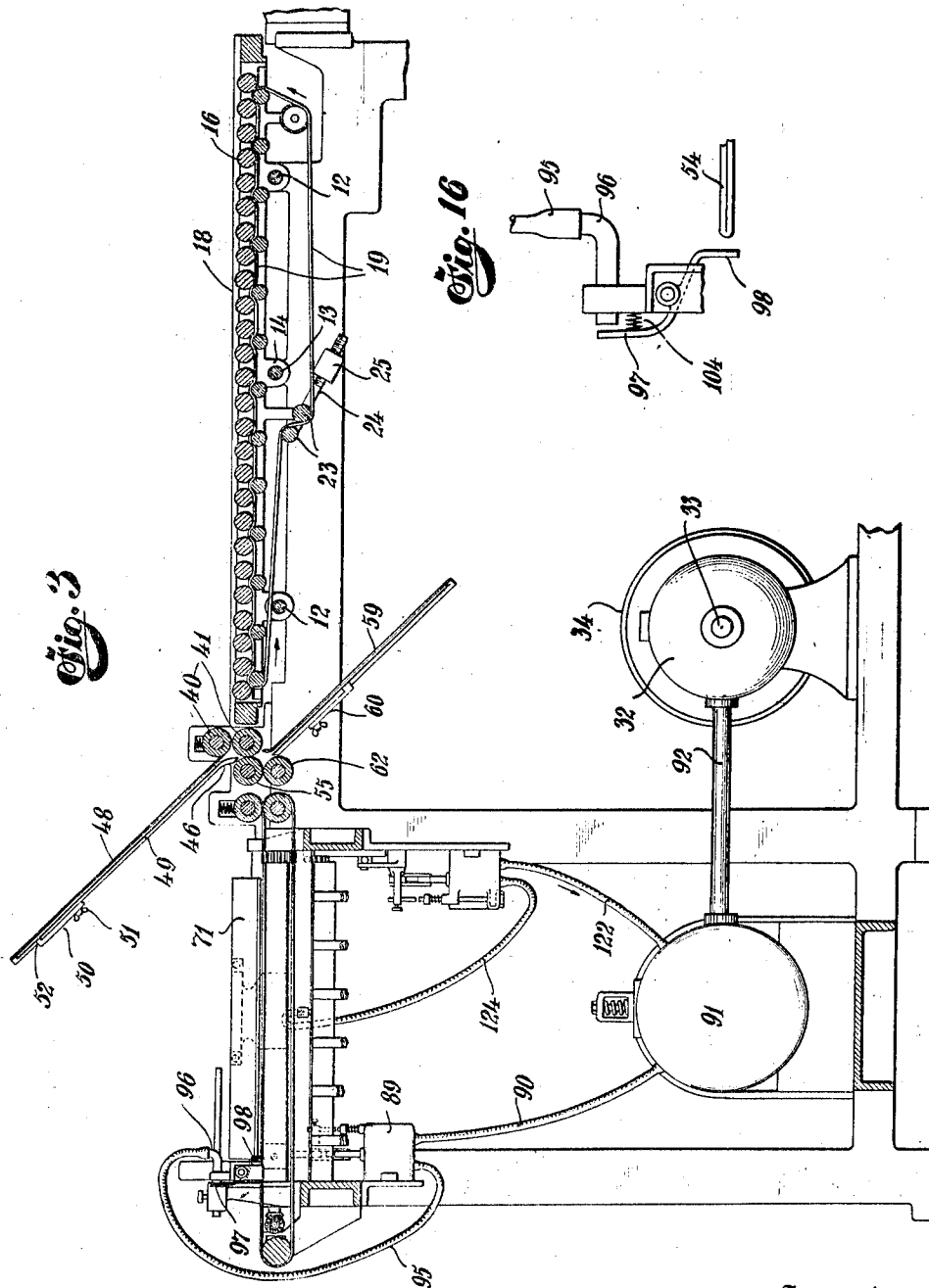
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Fig. 4

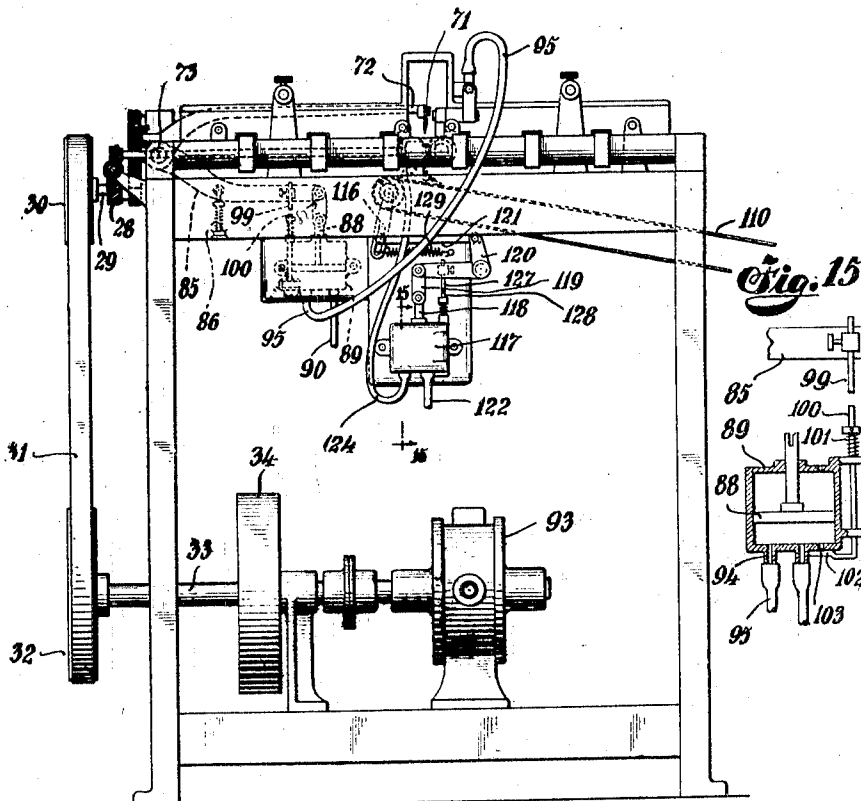


Fig. 5

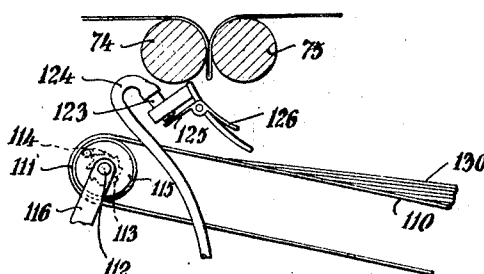
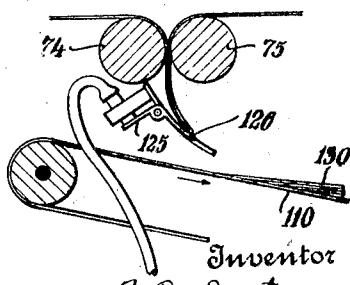


Fig. 6



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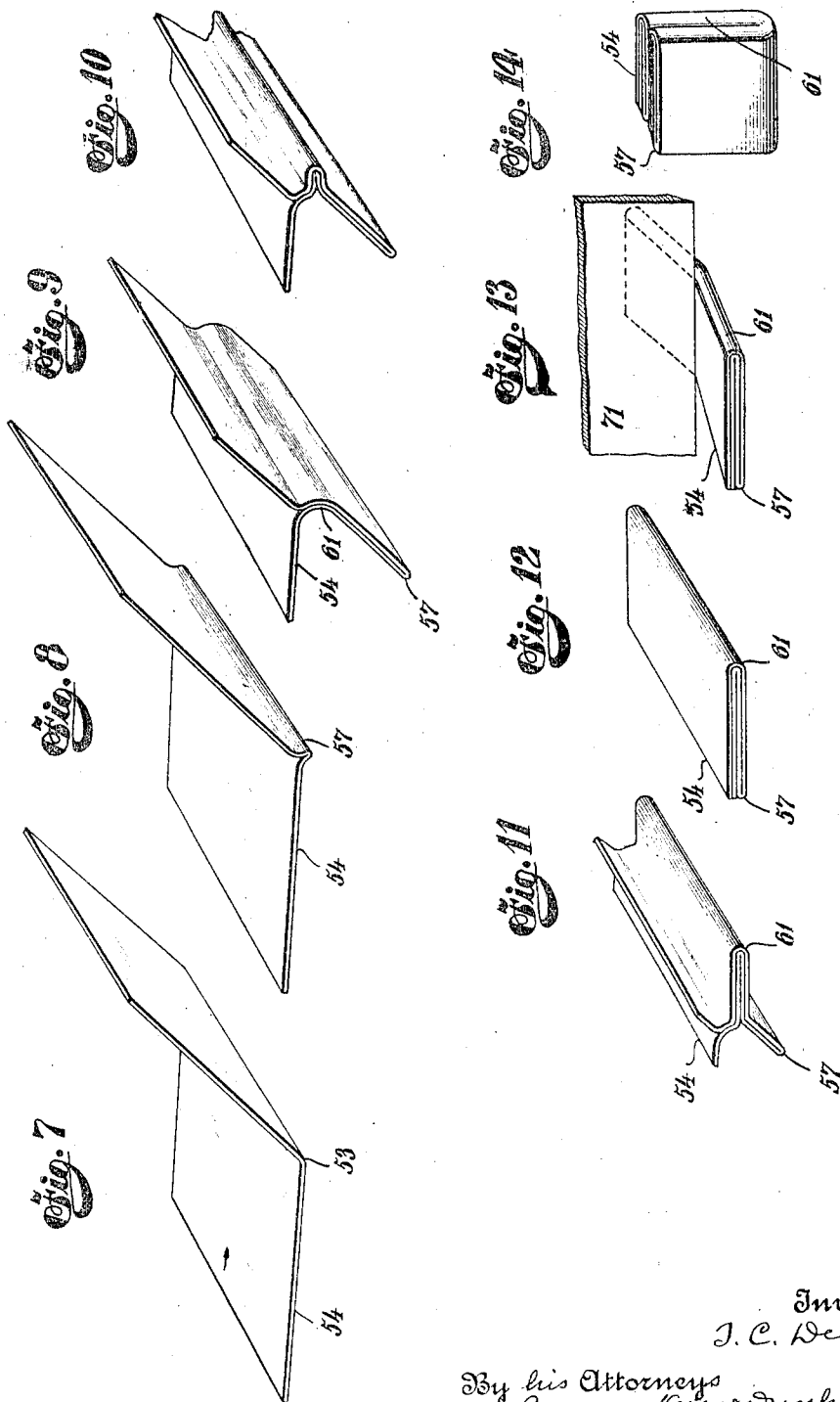
1,673,064

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Filed May 15, 1925

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE.

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PAPER-FOLDING MACHINE.

Application filed May 15, 1925. Serial No. 30,468.

This invention relates to paper-folding machines, and its chief object is to provide a machine of simple construction capable of rapid and accurate operation. Another object is to provide a machine in which the folding mechanism and the mechanism for feeding the sheets thereto are capable of relative adjustment so that the position of one or another of the folds can be accurately predetermined, such fold being located at the center of the sheet or at any other selected point, at will. A further object is to provide a machine in which the folding operations are under the control of the paper itself, the folds being made only when the paper is properly positioned, with respect to the folding instrumentalities, regardless of how early or how late the sheet may be in arriving at any particular folding device. In other words, in the preferred form of the invention the folding devices are timed by the paper and not by each other or by the feeding means. To these and other ends the invention comprises the novel features and combinations hereinafter described.

In carrying out the invention in the preferred manner I provide a feed-table having feed rollers which not only advance the sheet into the folding mechanism but also automatically align the sheet in a predetermined manner so that successive sheets are presented in exactly the same way to the folding mechanism. The latter mechanism is designed to cause one or more of the folds to be made, or at least initiated, by the forward movement of the paper itself, rather than by the action of a folding blade or like instrumentality, though folding blades or equivalent devices may be employed if desired. Preferably, also, the operation of the folding blades or like devices, when used, is controlled by pneumatic agencies which are themselves actuated or controlled by the paper in its travel through the machine. Of the various constructions in which the invention may be embodied I have selected for illustration and specific description herein the one which at the present time is considered to exhibit the invention in its most convenient and effective form. This embodiment is shown in the accompanying drawings, in which

Fig. 1 is a plan view and Fig. 2 a side view.

Fig. 3 is a longitudinal section about on line 3 of Fig. 1, looking in the direction of the arrow.

Fig. 4 is an end elevation, from the right of Fig. 2, omitting the flat-chute or receiver into which the paper is fed from the feed-table.

Figs. 5 and 6 are detail sectional views of part of one of the pneumatic controls, illustrating the actuation thereof by the moving paper.

Figs. 7 to 14, inclusive, are perspective views showing the sheet of paper at successive stages of the folding operations. In these views the thickness of the paper is much exaggerated in proportion to its length and breadth, for the sake of clearness.

Fig. 15, on the same sheet as Fig. 4, is a detail sectional view about on line 15 of Fig. 4.

Fig. 16, on the same sheet as Fig. 3, is a detail side view of one of the pneumatic control devices shown in Fig. 3.

The sheets of paper are delivered to the feed table by hand, or by any suitable machine for the purpose, indicated generally at 10, Fig. 2. The feed table, which receives the sheets and passes them on to the folding devices, comprises a rectangular frame 11 mounted on transverse rails or guide rods 12 (Figs. 1 and 3) and shiftable thereon by means of a transverse screw 13 working in a nut 14 on the underside of the frame 11. The screw is rotated by means of a hand-wheel 15. The feed rollers 16, upon which the sheets rest and by which they are carried to the folders, are journaled diagonally in the frame 11, as shown. Referring to Fig. 1 it will be understood that a sheet (indicated by the dotted lines at 17) resting on the rollers will be carried longitudinally of the machine, and also transversely toward the aligning strip or bar 18, by the diagonal or inclined rollers. If either corner of sheet strikes the guide bar 18 before the other corner reaches it, the transverse movement of the first corner is arrested but the other continues to move in that direction until it also strikes the bar. The sheet is thus accurately squared up or aligned with the bar 18, and its further forward movement is therefore parallel to the bar.

The feed rollers 16 are rotated at suitable speed by a belt 19, Fig. 3, held in driving

contact with the undersides of the rollers by means of idler cramp-rollers 20 and itself driven by the roller 16^a, Fig. 1. The latter is rotated by bevel gears 21, 22, as described below. The driving belt 19 passes between tension pulleys 23 on a pivoted carrier 24 having an adjustable weight 25. By adjusting the latter the tension of the belt can be accurately regulated, as will be readily understood.

The bevel gear 22, which drives the bevel gear 21, is itself rotated by its shaft 26, provided at its other end with a diagonal gear 27 meshing with a similar gear 28 (see Fig. 4) on the counter shaft 29 driven by the pulley 30, belt 31 and pulley 32. The latter is on the main driving shaft 33 having a driving pulley 34 which may be belted to a motor or other source of power, not shown. To permit the transverse adjustment of the feed table as described above, the roller-driving shaft 26 is provided with universal joints 35, 36 (Figs. 1 and 2), and is made in two telescoping parts, one having splines 37 and the other having a sleeve 38 provided with internal grooves for the splines. When the feed-table frame is shifted transversely the shaft lengthens or shortens, as the case may be, and flexes at the universal joints 35, 36, as will be readily understood.

Reaching the forward end of the feed-table the paper passes between and is seized by two transverse feed-rollers 40, 41 (Fig. 3), driven by gears 42, 43, 44, 45 (Figs. 1, 2 and 4) from the countershaft 29. As the sheet travels on, its forward edge strikes the depending guide plate 46, Fig. 3, and is guided up into the upper forwardly inclined chute or receiver composed of upper and lower slatted frames 48, 49 (see also Fig. 1). The lower frame carries a longitudinally adjustable stop 50, Fig. 3, secured in adjusted position by a wing-nut 51 and having a stop-finger 52 extending into the path of the paper. Striking this finger the paper is arrested in its upward movement, and from what follows it will be seen that the position of the first fold is determined by the position of this adjustable stop. The sheet now has a transverse bend, as shown at 53, Fig. 7, in which the sheet is designated 54. This and the succeeding Figures, 8, 9, 10, 11, 12, 13, 14, correspond to Fig. 2 as respects the position of the sheet and the bends and folds therein. Although the forward portion of the sheet can no longer move, the rear portion, engaged by the feed rollers 40, 41, must continue its forward movement, and since the sheet already has a downwardly directed bend, and cannot flex elsewhere or in any other direction by reason of its confinement in the chute or receiver 48—49, the sheet continues to bend downwardly, thereby bringing its transverse bend between the transverse folding and feeding rollers 41,

55, Fig. 3, the latter driven by gear 56 (Fig. 2) meshing with gear 43, which, it will be remembered, drives roller 41. These rollers crease the sheet, as indicated at 57, Fig. 8, and as the sheet advances (drawing the forward portion downwardly out of the chute 48—49) the crease strikes the transverse guide plate 58, Fig. 3, and the entire sheet, guided thereby, passes into the lower rearwardly inclined chute 59, of the same construction as the upper chute and having a stop 60 similar to the stop 50 and similarly adjustable. From what follows it will be seen that the position of the lower stop 60 determines the position of the second fold. As the folded sheet travels down into the lower chute the crease 57 strikes the stop 60, whereupon the lower portion is arrested, but the upper portion, already bent (as indicated at 61, Fig. 9), continues its movement and causes the sheet to buckle further at 61, carrying this bend into the bight of the transverse folding and feeding rollers 55, Fig. 3. Roller 62 is driven by gear 63, Fig. 2, meshing with gear 56 which drives roller 55. Rollers 55, 62 crease the fold 61, as indicated in Fig. 10, and advance the sheet, drawing its rear portion horizontally of the feed table, its upper portion downwardly out of the upper chute, and its lower portion upwardly out of the lower chute. The shape of the sheet just before these three movements are completed is shown in Fig. 11, and its shape just after is shown in Fig. 12. Preferably the two chutes or receivers 48—49 and 59 are at least as wide as the effective width of the feed table, so as to accommodate a sheet at least as wide as the feed table can handle.

As the sheet is advanced by the rollers 55, 62, it is seized by the transverse feed-rollers 64, 65, Fig. 3, driven by gears 66, 67, the latter gear being driven by gear 63 through an idler 68. Issuing from rollers 64, 65, the sheet is received by the feed belts or tapes 69, Fig. 1, running over rollers 65 and 70, and passes under a folding blade or knife 71 mounted on an arm 72 (see also Fig. 2) carried by a rock shaft 3 journaled at the side of the machine. At the proper time the arm 72 is rocked downwardly (as described below), causing the knife to engage the sheet as in Fig. 13 and force it downwardly into the bight of the folding and feeding rollers 74, 75, Fig. 1, driven by bevel gears 76, 77, shaft 78, diagonal gears 79, 80, and shaft 81 from gear 27, at a speed which will insure carrying the sheet (which is being folded) out of the way of the next succeeding sheet. These rollers complete the fold initiated by the knife, and pass the sheet on in the condition illustrated in Fig. 14. A transverse bar 75^a, Figs. 1 and 2, is provided to square up the sheet before operation of the blade 71. Thus if the sheet is

askew as it is carried forward by the tapes or belts 69 the corner which strikes the bar first will be arrested but the lagging corner will continue its advance thus giving it an opportunity to catch up with the other.

The arm 72, carrying the folding knife or blade 71, is actuated by the arm 85, Figs. 1 and 4, pinned on the rockshaft 73 and urged upwardly by a returning spring 86. The inner end of the arm is flexibly connected by link 87 to a piston 88 movable vertically in a cylinder or chamber 89. See also Fig. 15, alongside of Fig. 4. Below the piston the cylinder is connected by a tube 90 to a vacuum tank 91. Fig. 3, in which a partial vacuum is maintained through the pipe 92 by an exhaustor 93 driven by the shaft 33. The suction thus applied below the piston tends to draw the latter down against the tension of spring 86, but this tendency is normally nullified by the inflow of air into the cylinder through port 94, tube 95 and intake tube 96 located at the forward end of the folding knife 71. The intake orifice of this tube 96 may be closed by a pivoted valve 97 (see Fig. 16, on the same sheet as Fig. 3) having an actuating finger 98 in the path of the sheet of paper 54, so that as the paper advances it will rock the valve and close the said intake orifice. The suction under the piston 88 is now effective on the piston and draws the latter down, thereby rocking the arm 85, as already described.

As the arm 85 swings down the vertically adjustable rod 99 carried thereby (see Figs. 4 and 15) strikes a valve rod 100, movable vertically in ears on the side of the cylinder and urged upwardly by a spring 101 so as to normally hold the valve 102, on the lower end of rod 100, in hermetic contact with the bottom of the cylinder and over the air-port 103 therein. Continuing its downward movement the rod 99 depresses rod 100, and opens the port 103, thereby admitting air to the cylinder below the piston, which relieves the vacuum therein and permits spring 86 to raise the arm 85 and blade 71 as the sheet of paper, descending rapidly between rollers 74, 75, clears the valve-finger 98 and thereby permits spring 104, Fig. 16, to rock valve 97 back to open position. As arm 85 raises rod 99 the valve-rod 100 is raised by its spring 101 and closes the port 103.

Passing downwardly through rollers 74, 75, the folded sheet is deposited on a downwardly inclined belt conveyor 110, Figs. 4, 5 and 6, the upper end of which passes over a driving roller 111. The latter is loose on the spindle 112, but carries a ratchet 113 cooperating with a pawl 114 carried by a disk 115 which is fixed on the spindle, so that as the spindle is rocked back and forth by the arm 116 the roller will be rotated step by step, thereby imparting a similar movement

to the conveyor in the direction of the arrow in Fig. 6. The arm 116 is rocked by pneumatic means comprising a cylinder 117, Fig. 4, having a piston 118 connected to said arm by link 119, bell crank lever 120, and link 121. The cylinder 117 is similar to that shown in Fig. 15 and is connected to the vacuum tank 91 by tube 122 and to relief tube 123 (Figs. 5 and 6) by a tube 124. The normally open orifice of tube 123 may be closed by a pivoted flap valve 125 having an actuating finger 126 overlying the curved plate 127 which receives the folded sheet from rollers 74, 75, and directs it laterally upon the conveyor 110. As the paper engages finger 126 it rocks the valves and thereby closes the relief tube 123, as in Fig. 6, whereupon the piston 118 is drawn down exactly as piston 88 is actuated in Fig. 15 when inflow of air through port 94 is prevented. This downward movement of the piston 118 rocks the arm 116 clockwise and gives roller 111 a like movement of corresponding extent through the agency of pawl 114 and ratchet 113, as already described. The rocking of the bell crank lever 119 by descent of the piston brings rod 127, adjustably mounted on the bell crank, down on valve-rod 128, Fig. 4, depressing the latter and opening a relief port (not shown) in the bottom of the cylinder, exactly as the depression of valve-rod 100 in Fig. 15 opens the port 103. The suction on the piston being thus relieved, spring 129, Fig. 4, retracts the arm 116 and raises the piston until valve-rod 128 closes the relief port (not shown) in the cylinder; whereupon, relief tube 123 being still closed by valve 125 held therein by the paper, the action described is repeated until the paper passes off the actuating finger 126. In this way the conveyor 110 is advanced, step by step, as the folded sheet is laid upon it, thereby spreading the sheets out as indicated, roughly, at 130, Figs. 5 and 6. The conveyor carries the sheets or signatures to any desired point, where they are removed by hand or otherwise.

It is to be understood that the invention is not limited to the specific construction herein illustrated and described but can be embodied in other forms without departure from its spirit as defined by the appended claims.

I claim:

1. In a paper folding machine, in combination, a feed table having sheet-feeding means and means cooperating with one lateral edge of a sheet of paper to determine a path for the sheet, folding mechanism receiving the sheet from the feed table and having means for producing a fold in the sheet longitudinally of said path, means for shifting the feed table transversely to shift the said path transversely and thereby vary

the position of said fold in the sheet, and flexible driving means for said feeding means.

2. In a paper folding machine, in combination, a transversely shiftable feed table comprising a longitudinal guide bar at the side thereof to cooperate with a side edge of a sheet of paper and means for moving the sheet laterally toward and longitudinally along the guide bar to determine the path of the sheet and advance the same therein, relatively stationary folding mechanism to receive the sheet from the feed table and having means for folding the sheet longitudinally of its path, driving mechanism for the folding mechanism, and driving means for the feed table flexibly connected with said driving mechanism to permit the transverse shift of the feed table.

3. In a paper folding machine, in combination, means for advancing a sheet of paper and determining the transverse position of its path, means to receive the advancing sheet and produce a transverse bend therein, means adapted to engage the sheet at said bend and fold the same transversely, means to fold the sheet longitudinally after it has been folded transversely, and means, controlled by movement of the paper into operative position with respect to the longitudinal folding means, for actuating the latter.

4. In a paper folding machine, in combination, means for advancing a sheet of paper in a transversely predetermined path, a chute positioned at an angle to the path of the sheet to receive the latter and produce a transverse bend therein, means for continuing the advance of the portion of the sheet in rear of said bend after the portion in advance of the bend has reached a predetermined position in the chute, whereby the said bend is sharpened, means for folding the sheet at the sharpened bend and advancing the folded sheet in its path, and means under the control of the advancing transversely folded sheet to fold the same longitudinally of its path.

5. In a paper folding machine, in combination, a chute arranged to receive a predetermined portion of an advancing sheet of paper and give the same a bend transverse to its path of advance, means for receiving the bent sheet to fold the same at said bend and continue its advance, and means controlled by the sheet for folding the sheet longitudinally of its path.

6. In a paper folding machine, in combination, a chute arranged to receive a predetermined portion of an advancing sheet of paper and give the same a bend transverse to its path of advance, means for folding the sheet at said bend, and means controlled by the sheet for folding the sheet longitudinally of its path.

7. In a paper folding machine, in combination, means for folding an advancing sheet of paper on a transverse line determined by the position of the paper in its path of advance, and means to fold the sheet on a line longitudinal of its path, and means actuated by the advancing sheet at a predetermined point in its path to cause operation of the second-mentioned folding means.

8. In a paper folding machine, in combination, means for advancing a sheet of paper in its own plane, cooperating folding and feeding rollers on one side of said plane, a folding knife on the other side of the plane, means for actuating the knife to engage the sheet and bend the same through said plane into the bight of said rollers, and controlling means actuated by the advancing sheet to cause operation of the knife-actuating means when the sheet reaches a predetermined point in its path.

9. In a paper folding machine, in combination, means for advancing a sheet of paper in its own plane, means, including an intermittently operable folding knife, for folding the sheet of paper, and pneumatic means controlled by the advancing sheet to actuate said knife when the sheet reaches a predetermined point in its path of advance.

10. In a paper folding machine, in combination, means for advancing a sheet of paper in its own plane, means for folding the sheet, including an intermittently operable folding knife, pneumatic means controlled by the advancing sheet to actuate the knife when the sheet reaches a predetermined point in its path, and a conveyer to receive the folded sheet from said folding means.

11. In a paper folding machine, in combination, means for advancing a sheet of paper in its own plane, intermittently operating means for folding the sheet, an intermittently operable conveyer to receive the sheet from the folding means and carry the sheet away, and means controlled by the moving folded sheet to actuate the conveyer.

12. In a paper folding machine, in combination, means for folding a sheet of paper, a conveyer to receive and carry away the folded sheet, pneumatic means for actuating the conveyer, and means actuated by the sheet to control the conveyer actuating means.

13. In a paper folding machine, in combination, means for advancing a sheet of paper, intermittently operable means for folding the sheet, pneumatic suction means for actuating said folding means, means actuated by the sheet upon reaching a predetermined point in its path of advance to cause operation of said suction means, a conveyer to receive the folded sheet and carry it away, pneumatic suction means for actuating the conveyer, means actuated by the advancing folded sheet to cause operation of the second-mentioned suction means, and

vacuum-producing means common to both said suction means.

14. In a paper folding machine, in combination, means for advancing a sheet of paper; means for folding the paper, including a folding knife; means for actuating the knife, including a suction cylinder and a suction-actuated piston movable therein and connected with the knife; a source of vacuum connected with the suction cylinder to produce the suction therein; valve means actuated by the advancing sheet as it reaches a predetermined point in its path to render said suction effective on the piston; a conveyer to receive and carry away the folded sheet; suction-actuated means connected with the said source of vacuum to actuate the conveyer; and means actuated by the advancing folded sheet to control the operation of the said suction-actuated means for actuating the conveyer intermittently.

In testimony whereof I hereto affix my signature.

TALBOT C. DEXTER.