D. W. HUDSON.

INTERFOLDING MACHINE.

APPLICATION FILED JULY 17, 1909.

1,053,914. Patented Feb. 18, 1913.

4 SHEETS—SHEET 1.

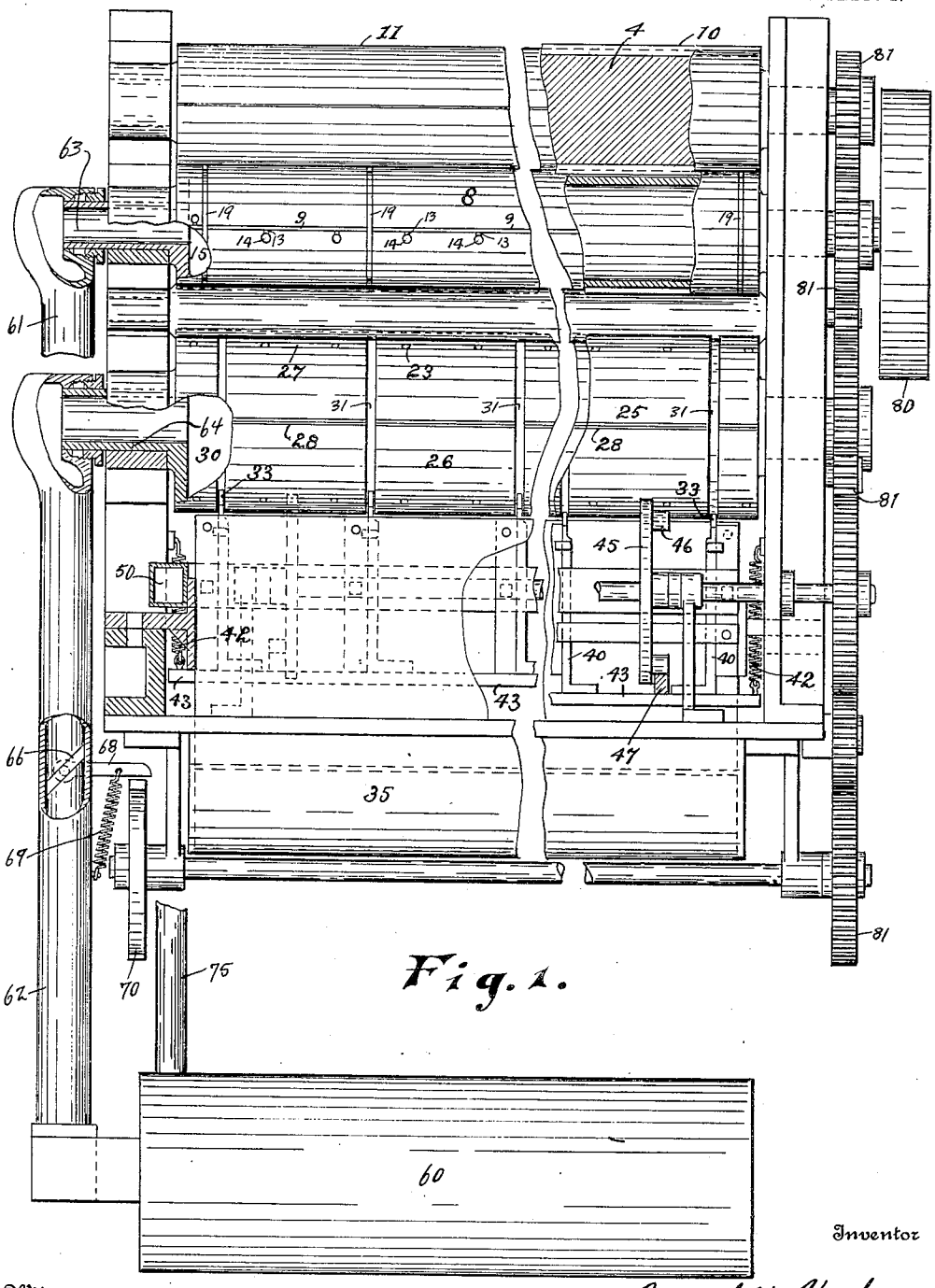

Fig. 1.

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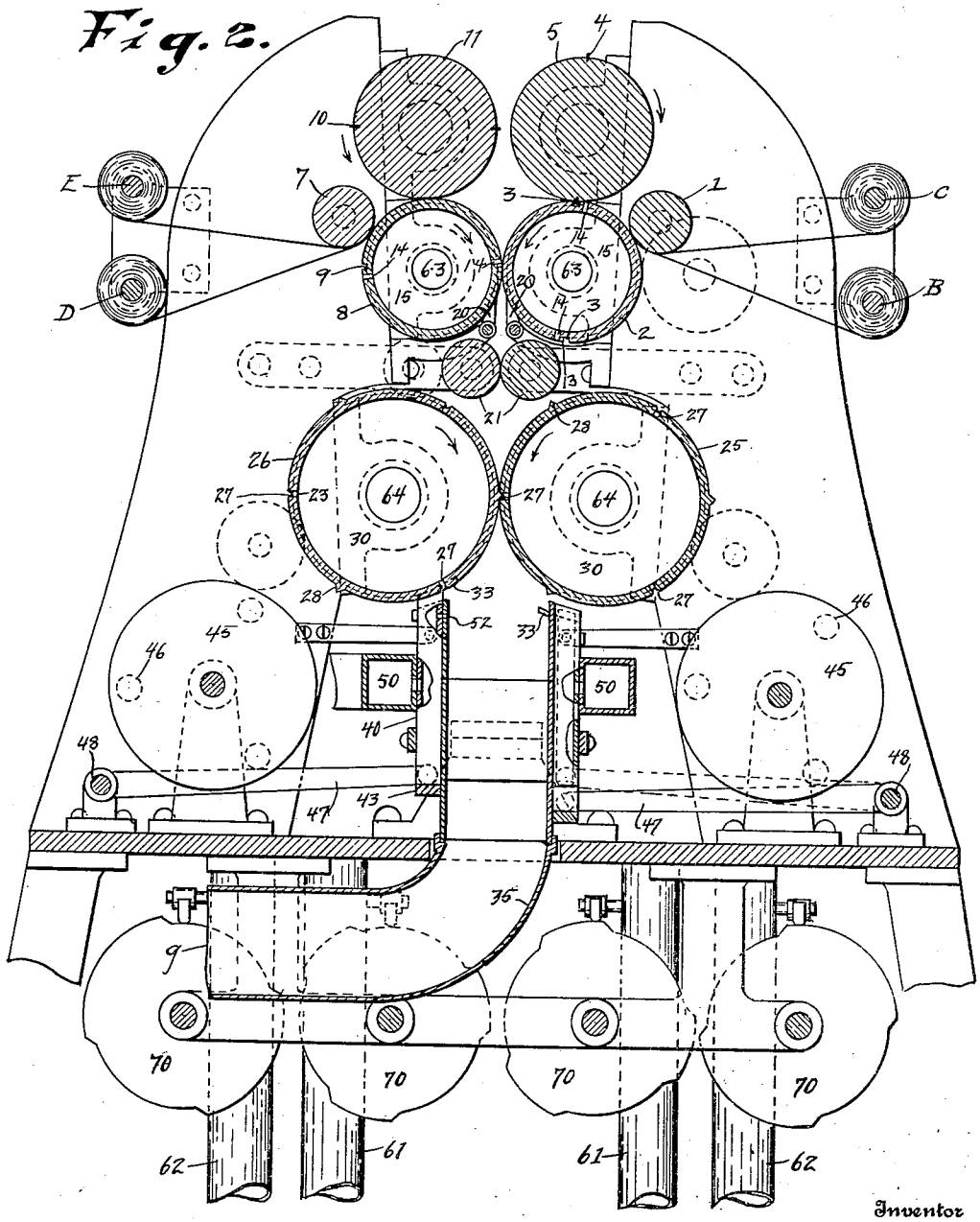
4 SHEETS—SHEET 2.

Fig. 2.



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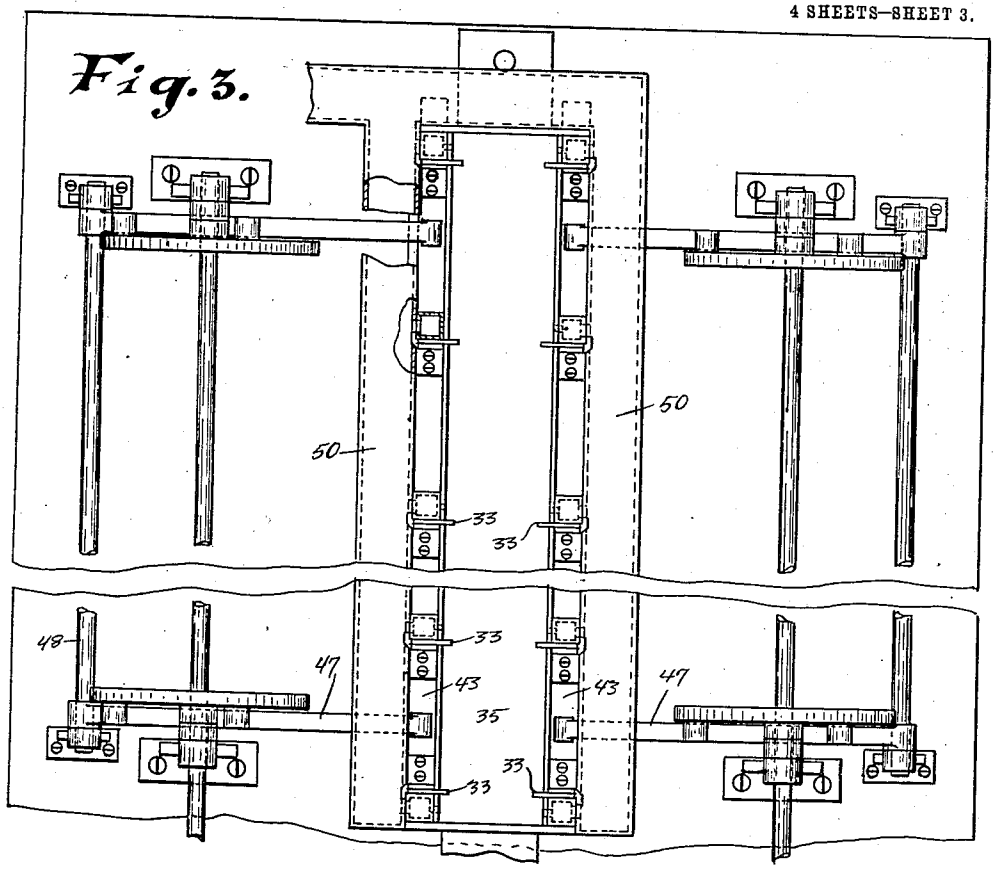
4 SHEETS—SHEET 3.

Fig. 3.



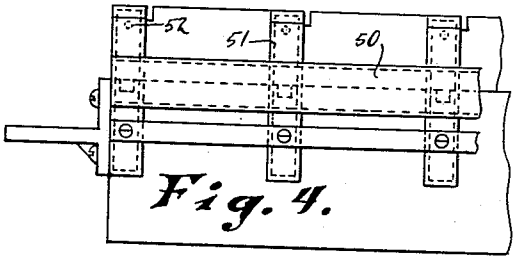


Fig. 4.

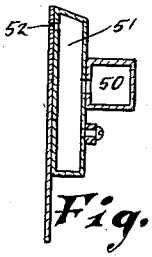


Fig. 5.

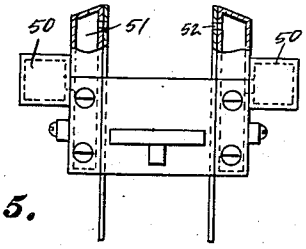


Fig. 6.

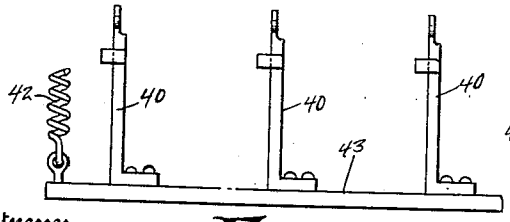


Fig. 7.

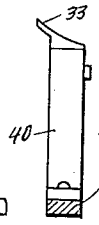


Fig. 8.

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4 SHEETS—SHEET 4.

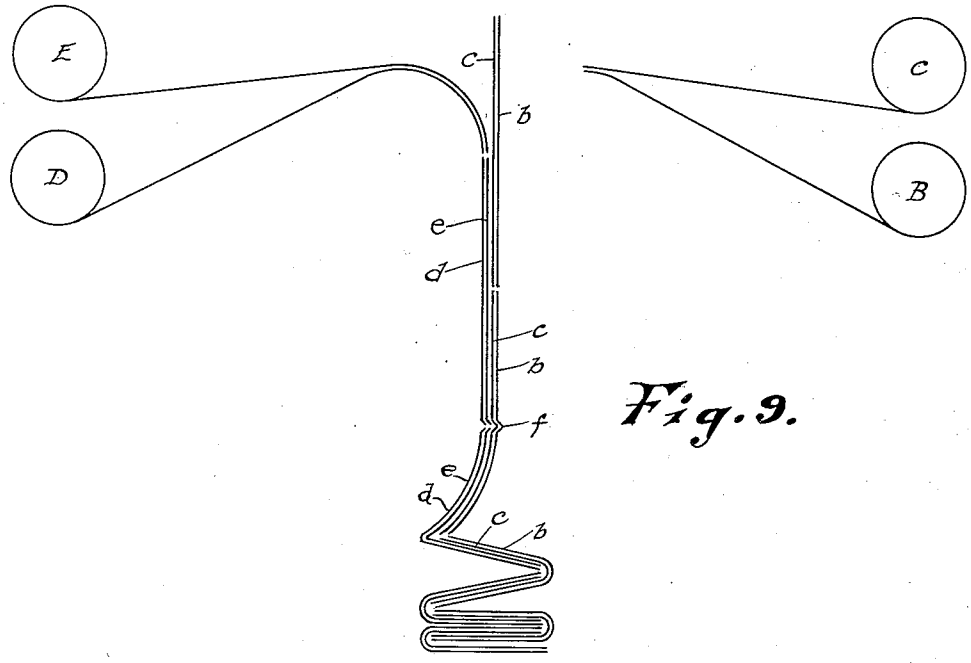

Fig. 9.

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UNITED STATES PATENT OFFICE.

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INTERFOLDING-MACHINE.

1,053,914. Specification of Letters Patent. Patented Feb. 18, 1913.

Application filed July 17, 1909. Serial No. 508,159.

To all whom it may concern:

Be it known that I, DAVID W. HUDSON, a citizen of the United States, residing at Green Bay, county of Brown, and State of Wisconsin, have invented new and useful Improvements in Interfolding-Machines, of which the following is a specification.

My invention relates to improvements in interleafing machines.

The objects of my invention are to provide improved means for manipulating the sheets during the cutting, creasing, folding and packing operations and to further provide means whereby a plurality of sheets can be interfolded, with the margins of each substantially at the central fold of the next and held in such positions by pneumatic means pending the packing operations.

In the following description, reference is had to the accompanying drawings, in which—

Figure 1 is a front elevation, part in section, of my improved apparatus. Fig. 2 is a vertical sectional view, drawn to a plane cutting the feeding and folding rollers transversely. Fig. 3 is a plan view of the lower portion of the machine, the cutting and creasing rollers being removed. Fig. 4 is a detail view of a portion of the outer face of one wall of the packer chamber. Fig. 5 is a transverse sectional view of the same drawn through one of the suction chambers. Fig. 6 is an end view of the packer chamber with parts of two suction chambers shown in vertical section. Fig. 7 is a detail front elevation of a set of packer fingers. Fig. 8 is a detail side view of one of the packer fingers showing the operating bar in cross section. Fig. 9 is a diagrammatic view showing the paths of the several sheets from their supporting rollers to folded position.

Like parts are identified by the same reference characters throughout the several views.

The paper is fed in strips of any desired width from the rollers B, C, D and E, and is cut transversely into sheets *b*, *c*, *d* and *e*, and these sheets are so manipulated in the machine that the sheets *b*, *c* will form pairs, with their central portions overlapping the lines of severance of the sheets *d*, *e*, and vice versa. (See Fig. 9). These pairs of sheets are so folded that each pair *b c* will engage the abutting or contiguous edges of the sheets *d* and *e*, thus forming a zig-zag folded series of interfolded sheets as shown at the lower end of Fig. 9.

The strips of paper leaving the rollers B, C, respectively, are passed under the guide roller 1 and over the cylinder 2, which serves as a rotary die, being provided with longitudinal channels 3 with which the blades 4, carried by roller 5, are adapted to register. The strips of paper leaving the rollers D and E are similarly passed under roller 7 and over cylinder 8, the latter having channels 9 similar to the channels 3 and adapted to receive the blades 10 carried by roller 11. The blades 4 and 10 sever the paper transversely of the strip, forming the sheets *b*, *c* and *d*, *e*, respectively.

The ends of the strips of paper remaining after a severing operation, are held to the cylinders 2 and 8 respectively, by suction applied through perforations 14 in the cylinders, each of the cylinders having a cavity 15 from which the air may be exhausted and the rows of perforations 14 lead from these cavities through the outer walls of the cylinders to the exterior, immediately in the rear of the channels 3 (or 9). A shallow and narrow groove 13 (Fig. 1) connects the channels 9, (or 3 in roller 2) respectively with the perforations 14 in the cylinders 2 and 8. The suction through these grooves acts on the edges of both sheets and holds them firmly to the roll.

The cylinders 2 and 8 revolve in contact and the ends of the strips are held to the cylinder surfaces by suction until they are carried between the cylinders, when the suction is relieved, and the ends of the strips are then separated from the cylinders 2 and 8 by take off fingers 20, which have extremities fitted to annular channels 19 in the cylinders and guide the strips (or sheets cut from the strips), between the guide rollers 21. It will be observed that the blades 4 on roller 5 are in a plane at right angles to the plane of the blades 10 on roller 11, whereby the latter blades will cut the strips coming from rollers D, E, at intervals between the cutting operations of blades 4 upon the strips coming from rollers B, C.

The cylinders 2 and 8 and guide rollers 21 hold the sheets in a vertical position until

engaged between the folding cylinders 25 and 26. These cylinders are provided with apertures 23 communicating with longitudinal V-shaped grooves 27 in their outer surface, and also with ribs 28, which are so arranged that each rib 28 will register with and enter a groove 27 in the other cylinder on passing the line of contact, and the cylinders are so located that the ribs 28 on cylinder 26 will engage two pairs of sheets *d* and *e* at their severed edges and one pair of sheets *b* and *c* centrally, and push them into the corresponding groove 27 on cylinder 25. If desired, the holes 23 may extend in the form of a continuous slot at the base of each groove 27. This creases the sheets, (as shown at *f* in Fig. 9), transversely, and engages the edges of the two pairs of sheets *d* and *e* in the crease. A similar result is secured in the opposite direction, when a rib 28 on cylinder 25 registers with a groove 27 in the cylinder 26. The column of overlapping sheets is thus partially folded successively in opposite directions.

Each of the cylinders 25 and 26 is provided with an interior cavity 30, from which the air is exhausted at intervals to produce a suction at the grooves 27, whereby the sheets are held in position in each groove, after a rib 28 has withdrawn therefrom. These cylinders are also provided with annular channels 31, in which packing fingers 33 are adapted to enter, and the continued rotation of the cylinders carries the paper engaged in any given groove 27 around and underneath the set of packing fingers 33, pertaining to the cylinder in which such groove is located, whereupon the suction is relieved and the packing fingers moved downwardly to complete the folding operation and pack the folded sheets in a receiver 35, preferably in the form of a curved open ended chamber, rectangular in cross section.

The packing fingers 33 are mounted upon the upper ends of the vertical bars 40, normally held in a raised position, (with the fingers 33 in the roller channels 31), by springs 42 connected to support the horizontal bars 43 upon which bars 40 are mounted. These bars and the fingers 33 are periodically depressed by the rotary members 45, having arms 46 adapted to engage and operate at the proper intervals the bar actuating levers 47 pivoted at 48 to suitable supports and arranged to bear upon the upper surfaces of the bars 43.

Main suction boxes 50 are disposed along the outer surfaces of the receiver 35 and suction ducts 51 extend upwardly therefrom along the walls of the receiver to apertures 52, which are so located that when the folded sheets are depressed in the receiver by the packing fingers 33, the edges of the top sheets will be caught and held to the walls of the receiver by suction, and thus prevented from springing upwardly to a position where they would interfere with the reception of the succeeding fold.

The suction is applied as follows: A main vacuum chamber 60, from which air is exhausted by any suitable means (not shown), is connected by pipes 61, 62, with the die cylinders 2 and 8 and folding cylinders 25 and 26 respectively, through their tubular trunnions 63, 64. These suction pipes are provided with valves 66 having levers 68 normally operated by springs 69 to close the valves. Cams 70, one for each valve, are employed to actuate the levers 68 to open the valves at the proper intervals for applying the suction. The suction is preferably applied continuously to the suction boxes 50 through a pipe 75. The vacuum chamber 60 is sufficiently large and air is withdrawn therefrom at sufficient speed so as to maintain the requisite suction at all of the points where such suction is employed.

The various rollers and cylinders are positively driven from a main driving pulley 80 through a train 81 of transmitting gear wheels and pinions located at one side of the machine, as shown in Fig. 1. The specific arrangement of the driving and power transmitting connections is, however, not essential to this invention and is therefore not illustrated or described in detail.

In starting the machine, the receiver 35 is wadded with ordinary paper inserted at *g* through its open lower end, thus enabling the sheets from the rollers to be packed in the receiver and also making the suction effective which is exerted through the aperture 52, to hold the pile of sheets in their folded and packed position. The machine being then set in operation, the paper will be withdrawn from the rollers B, C and D, E, the strips being severed by the knives 4 and 10 and the sheets carried downwardly in their proper positions as above described between the cylinders 2 and 8 and between the guide rollers 21 to the creasing or initial folding point between the cylinders 25 and 26, at which point the edges of sheets *d* and *e* will be interfolded between the sheets *b* and *c* and carried by suction through one of the apertures 27 of cylinder 25 toward the right in the position shown in Fig. 2, and downwardly until the creased or initially folded portion is carried underneath the right hand packing fingers 33, at which point the suction will be released by the cams 70 pertaining to this cylinder, and a rib 28 on this cylinder will then enter one of the slots 27 on the cylinder 26, thus centrally creasing a pair of sheets *d*, *e*, and interfolding the edges of two pairs of sheets *b* and *c* in the crease. This creased portion will then be carried downwardly and to the left in Fig. 2, under the left hand packing fingers 33, the latter being then depressed to

a position corresponding with that of the right hand packing fingers, as shown in Fig. 2. The next folding will be formed in the next succeeding groove 27 of cylinder 25, the folding operations thus alternating in the groove of one folding cylinder and then in the groove of the other, and the operation being continuous until the paper on the rollers B, C, D and E is exhausted. It will be understood that the cams 70 are so formed that the suction will be applied to the folded cylinder at the time when the grooves 27 therein reach the line of contact with the other cylinder and this suction will be released when such groove has carried the creased or initially folded paper under the corresponding set of packing fingers 33. It will be also understood that the cams 70 pertaining to the upper die cylinders 2 and 8 will be arranged to apply the suction when a row of holes in the cylinder is about to pass underneath one of the rollers 4 or 11, and that this suction will be released immediately after such row of holes passes the line of contact with the opposing die roller. The projecting arms 46 of the rotary members 45 are so arranged as to depress each set of packing fingers 33 simultaneously with the release of the suction in the corresponding folding cylinder 25 (or 26), the sheets being then in proper position for the packing operation.

While I am aware that cylinders or rollers provided with suction apertures have heretofore been employed for the purpose of handling paper sheets or strips, I believe I am the first to arrange the suction apertures in longitudinal rows and particularly in connection with a groove through which the suction may be applied to the edges of a plurality of superposed sheets. I am thereby enabled to handle the superposed sheets as readily and efficiently as I am able to handle the single sheets. I also believe that I am the first to provide a form of suction groove in a folding cylinder, which is capable of receiving and holding partially folded sheets in a manner to engage and retain the end or edge margins of interfolded sheets for an interval during the folding operation, the partially folded receiving sheet being preferably held in the groove by suction applied through apertures or slots at the base of the groove.

I am aware of the fact that it has been attempted heretofore to hold sheets of paper to the surface of a hollow cylinder by suction, while the sheet is being cut or creased preparatory to being folded and that in some instances, the apertures through which such suction is exerted, have been formed in close proximity to a creasing groove in the surface of the cylinder, and in other instances, such apertures have been arranged to extend through one wall of the groove, and such apertures have been found more or less affective in producing sufficient suction to hold a single sheet to the cylinder during the interval, while such suction is exerted. I have discovered, however, that by applying suction at the bases of V-shaped grooves, it is not only possible to hold a single sheet of paper to the cylinder, but also to hold the opposing edges of another set of sheets which are to be interfolded with the sheet which is in direct contact with the surface of the cylinder, if the edges of the interfolded sheets are pressed into the crease formed by forcing the other sheet into the groove. This is due to the fact that the suction exerted through apertures at the apex of the angle formed by the side walls of a V-shaped groove extends outwardly along the sides of the grooves and to some extent through the sheet, so that the opposing edges of the interfolded sheets may be held partly by friction and partly by suction.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is—

1. In a machine of the described class, the combination with sheet feeding devices, for delivering paper in a plurality of sets, with the sheets of one set lapping upon those of another set, of a set of rotary hollow folding cylinders, each provided with longitudinal surface grooves and ribs and having apertures leading from the hollow interior to the base of the grooves, said cylinders being arranged with the ribs of one in position for registry with and entry into the grooves of the other at the line of contact, and means for applying intermittent suction through said grooves.

2. In a machine of the described class, the combination with means for feeding paper in separate sheets and in a plurality of sets with the sheets of one set overlapping the opposing edges of the sheets of the other set, of a set of rotary hollow folding cylinders adapted to receive said sheets between them, each of said cylinders being provided with longitudinal apertured grooves and ribs and arranged with the ribs of one in position for registry with and entry into the grooves of the other at the line of contact, means for applying intermittent suction at the bases of said grooves, and means for receiving and packing the folded sheets one upon another when said suction is released.

3. In a machine of the described class, the combination of a set of rotary hollow folding cylinders, each provided with longitudinal apertured grooves and ribs and arranged with the ribs of one in position for registry with and entry into the grooves of the other at the line of contact, means for applying intermittent suction through said grooves and means for receiving and packing the folded sheets when said suction is

released, together with means for feeding sheets of paper to said folding cylinders in columns of sheets, arranged in pairs with the sheets of each pair overlapping the abutting edges of two other pairs; said suction applying means being arranged to withdraw air from the space between the folding cylinders and the sheets, along the opposing edges of the sheets.

4. In a machine of the described class, the combination of a set of rotary hollow folding cylinders, each provided with longitudinal apertured grooves and ribs and arranged with the ribs of one in position for registry with and entry into the grooves of the other at the line of contact, means for applying intermittent suction through said grooves, and means for receiving and packing the folded sheets when said suction is released, together with means for feeding sheets of paper to said folding cylinders in columns of sheets, arranged in pairs with the sheets of each pair overlapping the abutting edges of two other pairs, said feeding means being arranged to deliver said sheets in lengths corresponding substantially to the distance between the suction grooves on said cylinders, and with the central portions of each pair of sheets in registry with a rib on one cylinder and a groove on the other at the line of cylinder contact.

5. In a machine of the described class, the combination with sheet folding mechanism, of a receiver for the folded sheets, a set of sheet packing devices, suction boxes at the sides of the receiver provided with suction apertures extending through the walls of the receiver, and means for exhausting air from said suction boxes.

6. In a machine of the described class, the combination of a set of cylinders provided with V-shaped longitudinal grooves in the periphery, and ribs on each cylinder adapted to enter the grooves of the other, each of said cylinders having apertures extending to the bases of said grooves, means for intermittingly exhausting air from said grooves through said apertures, and means for feeding sheets of paper between said cylinders in a plurality of sets with the opposing edges of the sheets of one set, and the central portions of the sheets of the other set in position to be held by suction in said grooves after being forced therein by a rib of the other cylinder.

7. In a machine of the described class, the combination with sheet feeding devices, of a set of rotary folding cylinders located and adapted to receive a strip of paper between them from said feeding devices, each provided with longitudinal surface channels and ribs, and arranged with the ribs of one in position for registry with the channels of the other, and means for applying intermittent suction at the bases and along both side walls of each of said channels and alternately in the respective cylinders, whereby said paper strip may be folded alternately in opposite directions.

8. In a machine of the described class, the combination of a pair of hollow die cylinders for cutting strips of paper into sheets, each having a peripheral channel and a set of apertures in proximity to said channel and communicating therewith, and means for intermittingly and alternately exhausting air from the interior of the cylinders, together with a set of folding cylinders provided with alternate longitudinally extending peripheral channels and ribs, arranged with the ribs on one cylinder adapted to register with the channels of the other, means for intermittingly exhausting air from the bases and the respective sides of said channels, and sheet packing devices adapted to engage the sheets in the intervals between periods of air exhaustion.

9. In a machine of the described class, the combination with sheet folding devices, of a pair of hollow die cylinders, each having a peripheral longitudinal die channel and a row of apertures adjacent thereto, sheet severing devices in operative relation to the die cylinders, the apertures being connected by shallow grooves at the periphery of the cylinder, and paper strip feeding means, adapted to feed a plurality of strips of paper over each of said cylinders, said strip severing devices being arranged to sever the strips passing over one cylinder, substantially at the middle of the interval between the severing operations of the other strip severing devices, and means for feeding the sheets severed by such devices to the sheet folding devices in substantially the same relation to each other as at the time of severance; said sheet folding devices comprising separate cylinders provided with mutually interacting grooves and ribs, and means for applying suction to the sheets through the grooves.

10. In a machine of the described class, the combination with sheet folding devices, of a pair of hollow die cylinders, each having a peripheral longitudinal die channel and a row of apertures adjacent thereto and connected therewith by shallow peripheral grooves, sheet severing devices in operative relation to the die cylinders, and paper strip feeding means, adapted to feed a plurality of strips of paper over each of said cylinders, said strip severing devices being arranged to sever the strips passing over one cylinder, substantially at the middle of the interval between the severing operations of the other strip severing devices, and means for feeding the sheets severed by such devices to the sheet folding devices in substantially the same relation to each other as at the time of severance, said sheet folding

devices comprising separate cylinders arranged to fold the sheets alternately in opposite directions, and along the lines of severance of each set, and a set of packing devices adapted to receive the folded sheets.

11. In a machine of the described class, the combination with sheet folding devices, of a receiver for the folded sheets, provided with apertures near its upper margin and means for applying suction to the upper folded sheets through said apertures.

12. In a machine of the described class, the combination with sheet folding devices, of a receiver for the folded sheets, provided with apertures near its upper margin, and means for applying suction to the upper folded sheets through said apertures, said receiver extending downwardly and laterally from said apertures in the form of a curved elbow open at its lower end.

13. In a machine of the described class, of a receiver for the folded sheets, sets of vertically reciprocating bars on opposite sides of the receiver and provided with packing fingers, means for normally holding said bars in a raised position, and rotary members adapted to intermittingly depress the bars and fingers of each set in alternation with those of the other set, together with means for applying suction to the sheets when the packing fingers are in a raised position.

14. In a machine of the described class, the combination with sheet folding devices, of a receiver for the folded sheets, sets of vertically reciprocating bars on opposite sides of the receiver and provided with packing fingers, means for normally holding said bars in a raised position, and rotary members adapted to intermittingly depress the bars and fingers of each set in alternation with those of the other set, together with means operating through suction on the sheets to convey them in partially folded positions underneath the packing fingers when the latter are in a raised position.

In testimony whereof I affix my signature in the presence of two witnesses.

DAVID W. HUDSON.

Witnesses:
Jos. Hoslett,
A. L. Cannard.