(No Model.) 2 Sheets—Sheet 1.

J. C. KNEELAND.

PAPER FOLDING MACHINE.

No. 411,151. Patented Sept. 17, 1889.

Fig. 1.

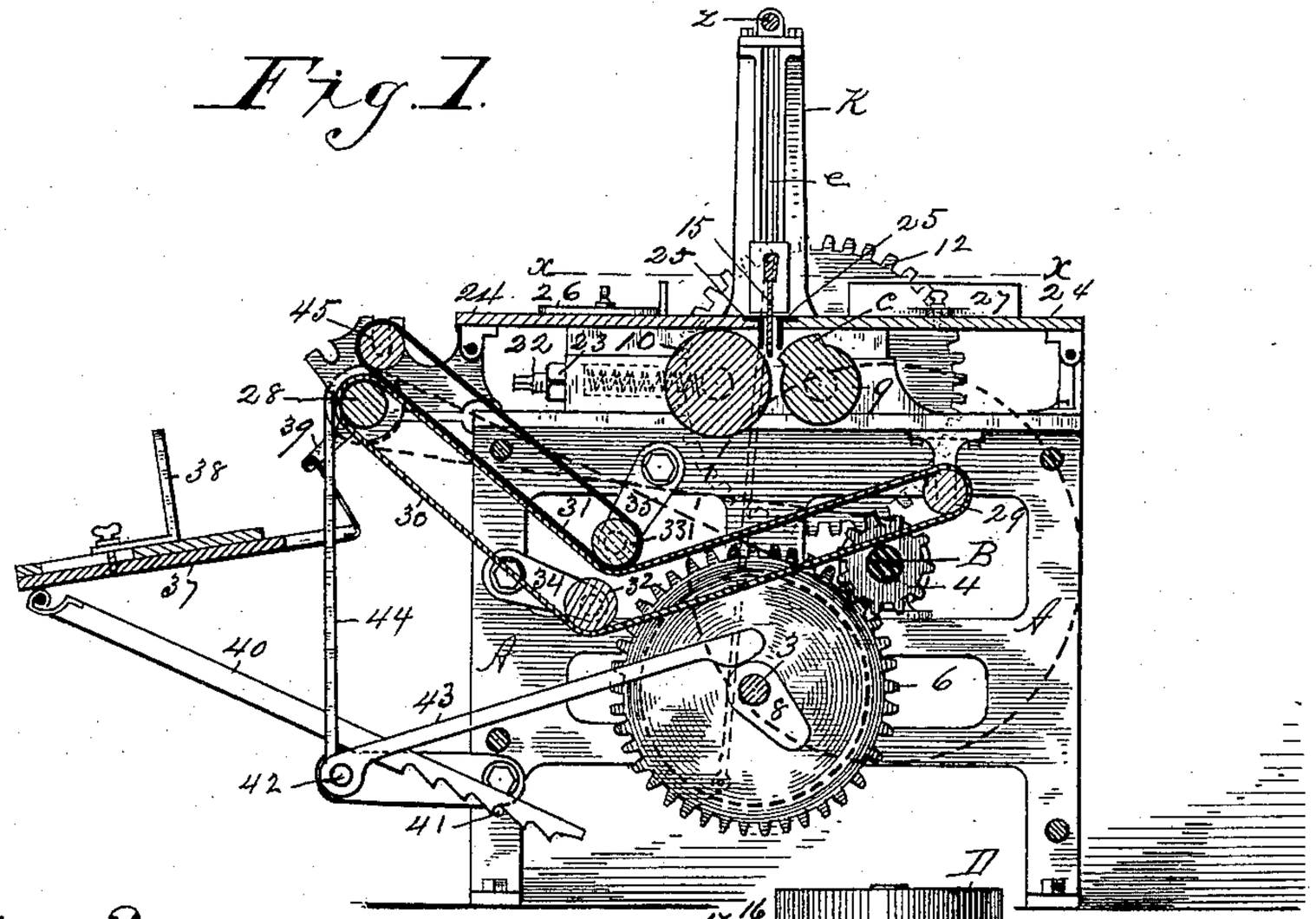
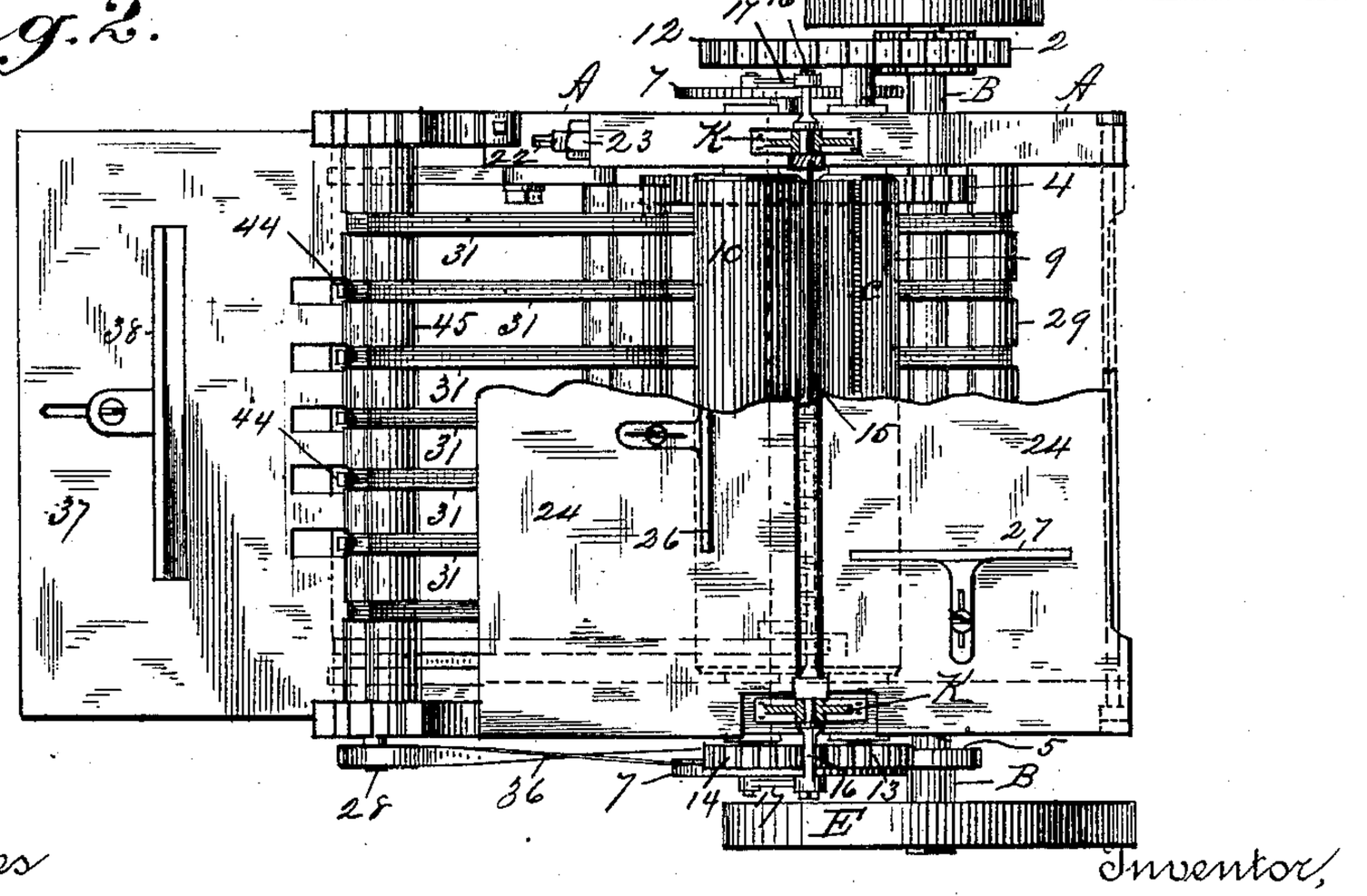


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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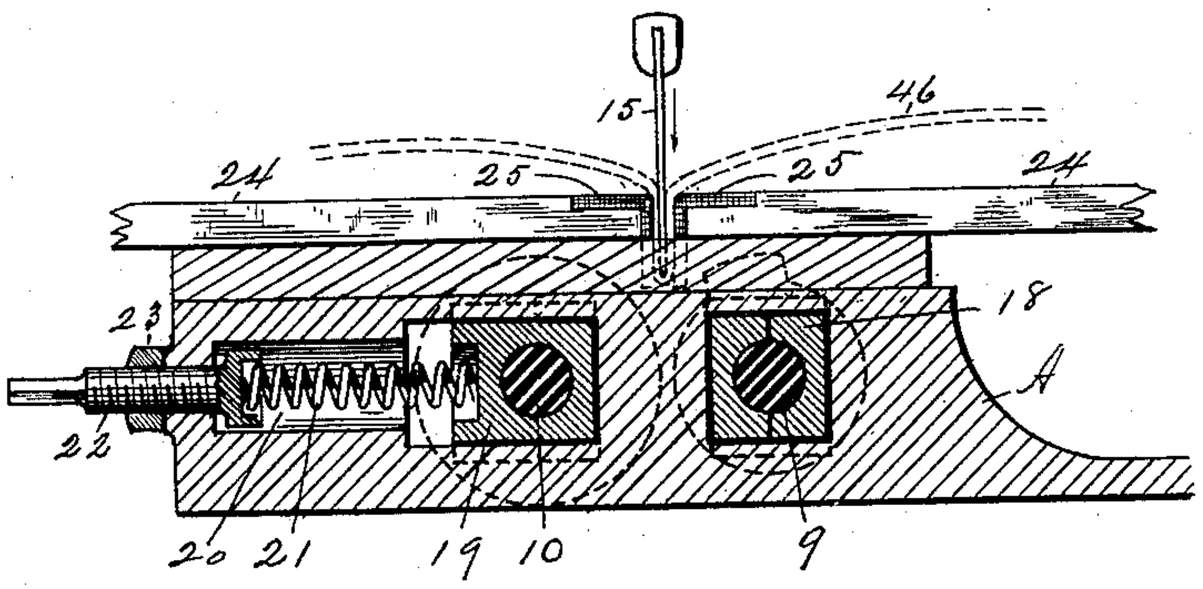
Fig. 3.



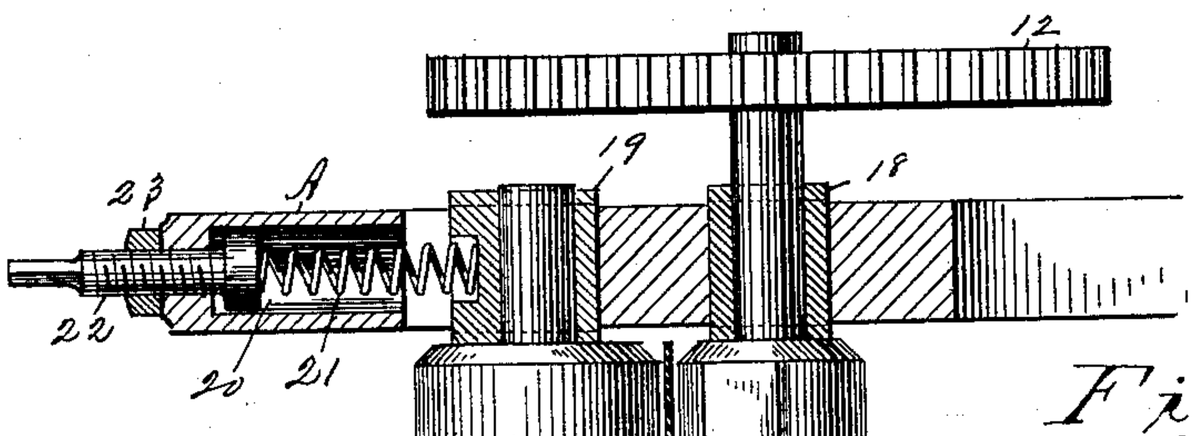
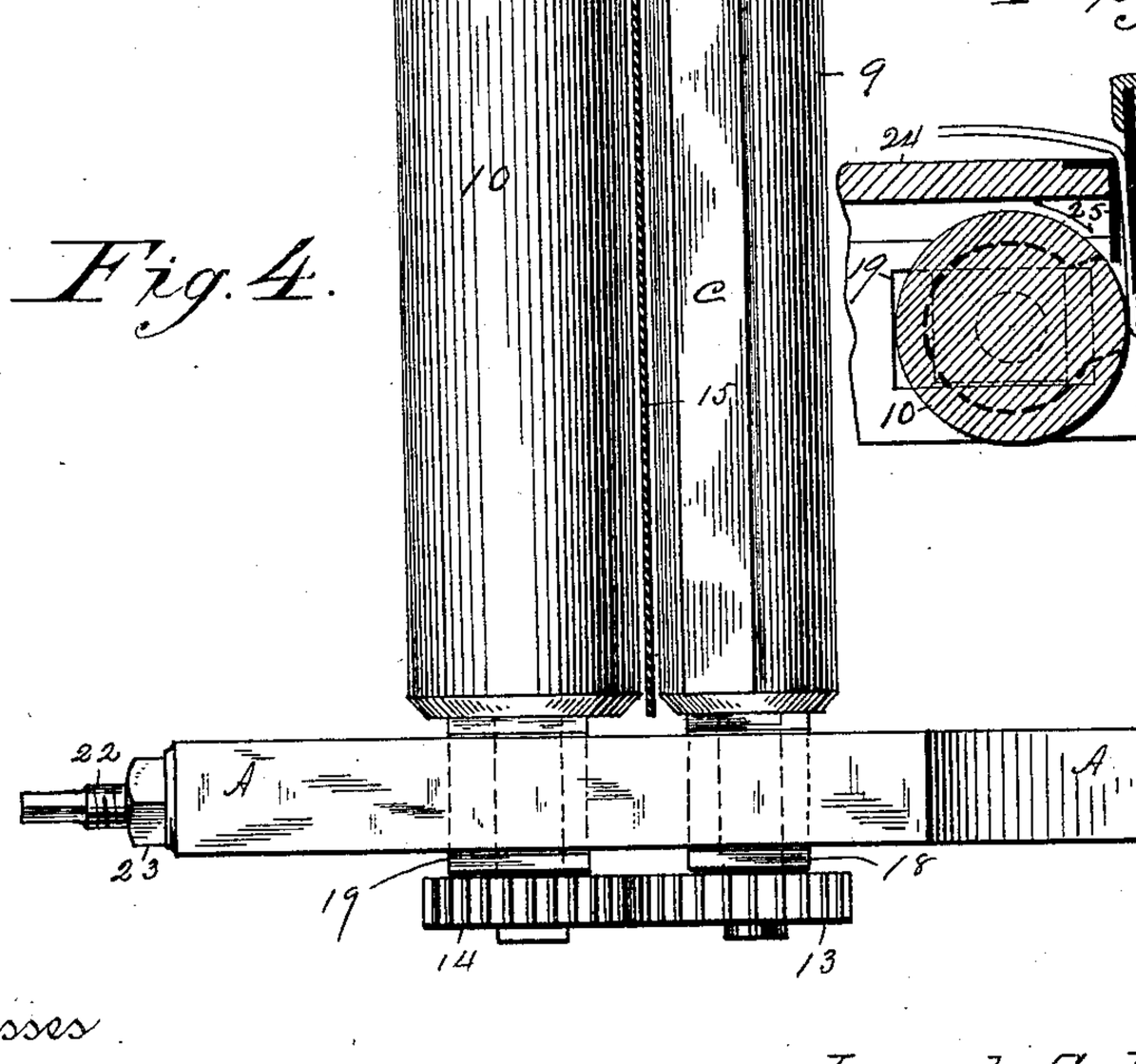
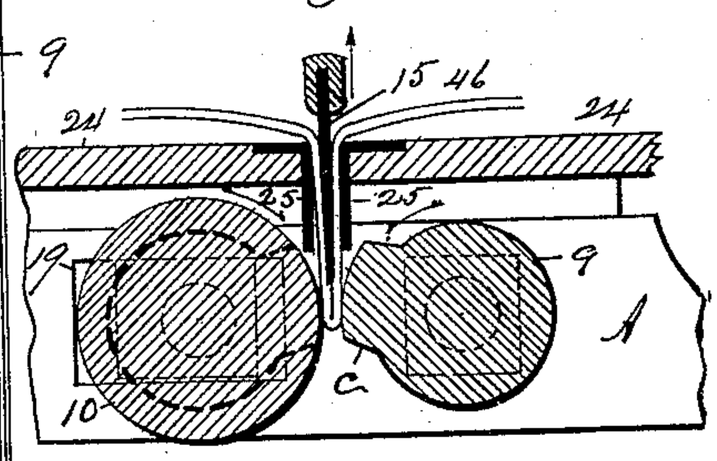


Fig. 5.

Fig. 4.





14 13

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UNITED STATES PATENT OFFICE.

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PAPER-FOLDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 411,151, dated September 17, 1889.

Application filed June 6, 1888. Serial No. 276,251. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH C. KNEELAND, a citizen of the United States, residing at Northampton, in the county of Hampshire and State of Massachusetts, have invented new and useful Improvements in Paper-Folding Machines, of which the following is a specification.

This invention relates to paper-folding machines, the object being to provide in machines of this class improved mechanism for manipulating one or many sheets of paper, to fold the same, to compress the fold thereof, and to deliver the folded sheets of paper on a receiving-table in proper order; and the invention consists in the peculiar construction and arrangement of the operative elements of the machine, all as hereinafter fully described, and pointed out in the claims.

In the drawings forming part of this specification, Figure 1 is a vertical section, and Fig. 2 is a plan view, partly in section, showing the table, partly broken away, of a paper-folding machine constructed according to my invention. Fig. 3 is a sectional view of a part of the frame and of detail parts, below described, and an end view of a part of the table and of the folding-blade, the ends of the fold-compressing rolls being indicated in dotted lines. Fig. 4 is a plan view of portions of the frame and roll bearings, partly in section, and of the fold-compressing rolls and their gear-connections, and showing the folding-blade in section between said rolls. Fig. 5 is a transverse section of the fold-compressing rolls, showing a fold of paper therebetween and the folding-blade within the paper, this figure showing parts of the frame and of the table of the machine in connection with said rolls.

Heretofore machines for folding paper have been constructed with two cylindrically-formed rolls for compressing the fold of the paper; but such rolls have an engagement with the sheets of paper passing therebetween equal to the width of the paper folded, and thereby said folded paper is not permitted to drop away from the rolls after the fold thereof has been compressed; but the rolls have such an extended engagement with the paper under such conditions that the capacity of a machine so constructed is too limited to merit the favorable consideration of those having a use for such a machine; also, it has been the practice heretofore to construct said cylindrically-formed cold-compressing rolls with bearings therefor in the frame of the machine, which permitted of adjusting one roll relative to the other to produce such distance of separation of the rolls as may be required for folding a certain number of sheets of paper, said adjustment requiring the attention and labor of a skilled mechanic for a certain time.

The essential purpose of this invention is to provide a paper-folding machine possessing peculiar features of construction which obviate the above-described inconveniences, and which possess other novelties of construction which conduce to produce a machine of this class at a comparatively low cost, and which is capable of operating effectively to fold paper without injuring the same and to do so rapidly.

In the drawings, A indicates the frame of the machine, which is constructed, preferably, of metal.

B indicates a main or driving shaft extending horizontally from side to side of the frame of the machine, and having suitable bearings in the latter. On one end of said shaft B is fixed a driving-pulley D, and on the opposite end thereof is fixed a balance-wheel E. A gear 2 is fixed on said shaft B between the frame A and said driving-pulley, and on said shaft, inside of said frame, is fixed a pinion 4. A pulley 5 is fixed on said shaft B between said balance-wheel and the adjoining side of the frame of the machine. A second horizontal shaft 3 is supported in suitable bearings in the frame A, parallel with said shaft B, and on said shaft 3 is fixed a gear 6, which engages with said pinion 4 on shaft B. A cam 8 is fixed on shaft 3 within the frame of the machine, and on the opposite ends of said shaft 3, which extend beyond the sides of the machine, are secured two crank-disks 7. Two fold-compressing rolls 9 and 10 are hung to rotate in bearings in said frame A near to and parallel with each other, and on the end of one of the journals of said roll 9 is fixed a gear 12, which engages with said gear 2 on shaft B, and on the opposite ends of said two rolls 9 and 10 are fixed two gears 13 and 14, which engage with each other, the teeth of

the last-named gears being of such length as permits of a certain degree of movement of one of said rolls from the other one without disengaging the teeth of said gears. One of said fold-compressing rolls 10 is made, preferably, of cylindrical form, and the other one 9 is constructed with a longitudinal segmental rib *c*, in order that only a limited portion of one of said fold-compressing rolls shall engage with the opposite roll at each revolution; or, in other words, in order that said limited portion only of the periphery of one roll shall be permitted to engage with the folded portion of a sheet or sheets of paper interposed between said two rolls. If preferred, both of said fold-compressing rolls may be constructed with said longitudinal rib thereon, as indicated in full and in dotted lines in Fig. 5; but since the construction of a cylindrical roll is less costly than a ribbed one and the required effect is produced when only one roll is ribbed, the preferable construction is that shown in Figs. 1, 3, and 4. The journal bearings or boxes 18, in which the journals of said ribbed roll 9 rotate, are fixed in the frame A; but the journal-boxes 19, in which the journals of the cylindrical roll 10 rotate, are capable of a sliding motion in said frame in a direction toward and from the journal-boxes of said ribbed roll, thereby providing for the above referred-to movement of one of said rolls from and toward the other one, for a purpose hereinafter fully described.

To provide means for forcing the said roll 10, which is hung in movable boxes, as aforesaid, toward the adjoining roll 9, with a force sufficient to properly compress the folded portion or edge of the paper which is carried between said rolls by the folding-blade 15, as below described, two springs 21 are arranged in suitable chambers 20, in the frame of the machine, which springs have one end bearing directly against the journal-boxes 19, of said roll 10, and the opposite ends of said springs bear against the socketed ends of two screw-abutments 22, and by means of the latter the said springs are compressed to such degree as is required to impart to the roll 10 such resistance to movement from the roll 9 as may be desired to properly compress the aforesaid folded portion of the paper which is carried between said rolls, said springs acting as a constant force against the roll 10 for the purpose aforesaid, but permitting the roll to move from said roll 9 to such degree as the thickness of the paper carried between said rolls may require. Said springs 21 are in practice adjusted to drive the roll 10 toward roll 9 with the force ordinarily required to properly compress the fold in the paper, and having been so adjusted it is seldom necessary to readjust them, and by this means the machine is always ready for operation, and does not require readjustment, as is ordinarily the case with other similar machines, for slight variations in the thickness of the sheets of paper to be folded. The said screw-abutments 22 have a shank screwing into and engaging with that part of the frame A at the base of said spring-chamber 20, the said shank projecting beyond the end of the frame and having a square shape to adapt it to be turned by an ordinary wrench. A lock-nut 23 is screwed onto said shank to secure the screw-abutment against movement when once adjusted. The measure of the distance from the axis of the roll 9 to the surface of its rib *c* is in practice one-half of the diameter of the roll 10, and therefore the curve of the face of said rib from edge to edge thereof coincides with that of the face of the roll 10.

Two vertical posts K are fixed on the opposite sides of frame A of the machine, each of said posts having a vertical slot *e* therein, and stay-rod *z* unites the upper ends of said posts. A metallic folding-blade 15, having end blocks thereon fitting the inner sides of said posts K, extends between the latter and occupies a position vertical to a line between said fold-compressing rolls, said folding-blade being capable, by means below described, of a reciprocating vertical movement between said posts K. A stud 16 has one end engaging with each end of said folding-blade, and extends through the said slot *e* in the posts K, and to the ends of the two studs so attached to the opposite ends of the folding-blade are pivotally connected one end of two pitmen 17, and the opposite ends of said pitmen are pivotally connected to said crank-disks 7 on the shaft 3, and by means of said connection the folding-blade is given, by the rotation of said shaft 3, its said reciprocating vertical movement.

The table 24 of the machine is made in two sections, the separating-line therebetween being the slot through which the folding-blade moves when carrying the paper between the rolls 9 and 10, as aforesaid, and the outer edge of each of said table-sections is pivotally attached to the frame of the machine, in order that they may be opened, thereby uncovering those parts of the machine beneath the table, so that they may be conveniently accessible for adjustment, cleaning, or repairs. To the opposite edges of the table, between which said folding-blade moves, are attached two metallic angle-strips 25, as clearly shown in Figs. 1 and 5, the pending edges of said angle-strips extending nearly to the surfaces of the roll 10 and of the segmental rib *c* on the roll 9, the inner opposite sides of said pending portions of the angle-strips 25 constituting frictional bearing-surfaces, against which the paper is drawn when carried downward by the folding-blade, and whereby the paper is held up against the edges of said blade until it is engaged between said roll 10 and segmental rib *c* on roll 9, as shown in Fig. 5. The said table has thereon adjustable guides 26 and 27, against which the paper to be folded is moved to ena-

ble the operator to bring the paper invariably to a proper position under the descending blade.

To provide convenient means for transporting the folded packages of paper or sheets from under said fold-compressing rolls from which they drop after being folded, two series of conveying tapes or bands 30 and 31 are provided—one above the other, as below described. The lower series of conveying-tapes 30 are supported on two rolls 28 and 29, which have suitable bearings in the frame of the machine and over which said tapes run, the roller 28 having a pulley on one end thereof and a belt 36 running on the pulley 5 on shaft B, and said pulley on roll 28 imparts the requisite rotary motion to the latter. Idler-rolls 32 and 33, hung in bearings on arms 34 and 35, cause the said carrying-tapes 30 to run in the directions shown in Fig. 1, whereby they lie in convenient positions to catch the paper when it drops from said fold-compressing rolls, as above described. The said upper series of tapes 31 are arranged on said idler-roll 33, and on a roll 45, nearly over said roll 28, and said upper series of tapes is arranged so that the several tapes thereof are brought directly over those of the lower series 30, and have such engagement therewith as causes the upper tapes to move with and by the lower series in such manner that paper dropping upon the latter is carried between the two series of tapes, and by them is transported to the upper portion of the end of the frame of the machine, and from thence is dropped onto a receiving-table 37, which is hung by one end to arms 39, on the end of the machine, and its opposite end is supported by a brace or braces 40, pivoted by one end to the under side of said table and having a series of notches in its under edge, near its opposite end, which engage with a pin 41, projecting from the leg of the machine, whereby said table is given the desired inclined position for receiving the paper when delivered from the machine.

A paper-guide 38, against which the paper is placed, is adjustably attached to the table 37.

A series of paper-pushing arms 44 is attached by one end to a rock-shaft 42, supported on arms on the machine, and said arms 44 extend upwardly through slots or openings in the receiving-table 37 to a point about opposite the side of said tape-roll 28. A rocking motion is imparted to said shaft 42 by means of an arm 43, one end of which is fixed on said shaft, and the opposite end thereof has an engagement with said cam 8 on the shaft 3, and said rocking motion of the shaft 42 imparts a vibratory motion to said arms 44, whereby folded sheets of paper which drop onto the table 37 are pushed back to a proper uniform position against the guide 38 on the table. The end of the arm 43, which engages with said cam 8, is made sufficiently heavy to cause it to rest constantly against the edge of said cam, thereby returning the free ends of said pushing-arms 44 to the position shown in Fig. 1, after they have been swung toward the guide 38 on the receiving-table, for the purpose aforesaid.

The operation of the above-described improvements in folding paper is as follows: The operator stands at the end of the machine opposite to that to which the receiving-table 37 is attached, and taking the number of sheets to be folded places them against the faces of the guides 26 and 27, thereby bringing them to a proper position on the table of the machine over the slot in the table through which the folding-blade descends, and said blade then moving downward engages with the sheets of paper, and carrying them through said slot causes their outer edges to assume the positions, substantially, indicated by 46 in Figs. 3 and 5. The movement of the folding-blade and the rotary motion of the rolls 9 and 10 are so timed that when the paper so engaged by the blade is carried downward so that it can be caught between the roll 10 and the segmental rib *c* the blade is immediately withdrawn from the paper, leaving the latter to receive upon its doubled or folded line the full force of the compressing action of said rolls, and by the action of the latter the folded paper is quickly drawn downward, and the said rib *c*, having but a momentary engagement with the paper, is quickly carried away from contact with the latter, leaving it free to drop quickly down onto the carrying-tapes 30, which convey the folded paper to the receiving-table 37, as already described. The said fold-compressing rolls operate as effectively to properly fold the paper be there one or many sheets, and, owing to the fact that immediately after the fold of the paper is compressed, the rolls have no further contact with the paper, the latter is subject to no derangement or action of the rolls whereby the sheets can be wrinkled or damaged in any way, and the movement of the folded sheets or packages of paper away from the rolls after being compressed is much more rapid than it would be if the said folded sheets were controlled by the rotary movement of the rolls from the time the latter engaged them until they should have passed through or completely between the rolls, and consequently the capacity of the machine for folding paper is considerably greater than it would be were it constructed with a pair of cylindrical rolls instead of the said rolls 9 and 10.

Fig. 3 illustrates the relative positions of the paper, the folding-blade, and the fold-compressing rolls just before said blade in its downward movement has reached a point where said rolls engage the folded edge of the paper, and Fig. 5 illustrates the folded edge of the paper engaged by said rolls and the folding-blade at a point in its upward movement, its edge being withdrawn from the fold of the paper, thereby offering no obstacle to

the compressing action of said rolls solely upon the fold of the paper, whereby said fold is completed.

What I claim as my invention is—

1. In a paper-folding machine, a reciprocating folding-blade to engage the paper to be folded, two parallel fold-compressing rolls, one of which has a longitudinal rib thereon the surface of which rotates coincidingly with the surface of the adjoining roll, said rib being peripherally arranged with relation to the folding-blade to nip the fold of the paper between said rib and the surface of the adjoining roll immediately on the lowermost presentation of said paper by said folding-blade, substantially as described.

2. In a paper-folding machine, a reciprocating folding-blade to engage the paper to be folded, two parallel fold-compressing rolls, one of which has a narrow longitudinal rib thereon, said rib being arranged to nip the paper presented by said folding-blade between said rib and the surface of the other roll only at the folded portion thereof, substantially as described.

3. In a paper-folding machine, a reciprocating folding-blade to engage the paper to be folded, a fold-compressing roll and sliding journal-boxes therefor, a second fold-compressing roll having a longitudinal rib thereon, said rib being peripherally arranged with relation to the folding-blade to nip the fold of the paper between said rib and the surface of the adjoining roll immediately on the lowermost presentation of said paper by said folding-blade, and springs acting against said journal-boxes to force the one roll toward the other, substantially as described.

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