

No. 616,290.

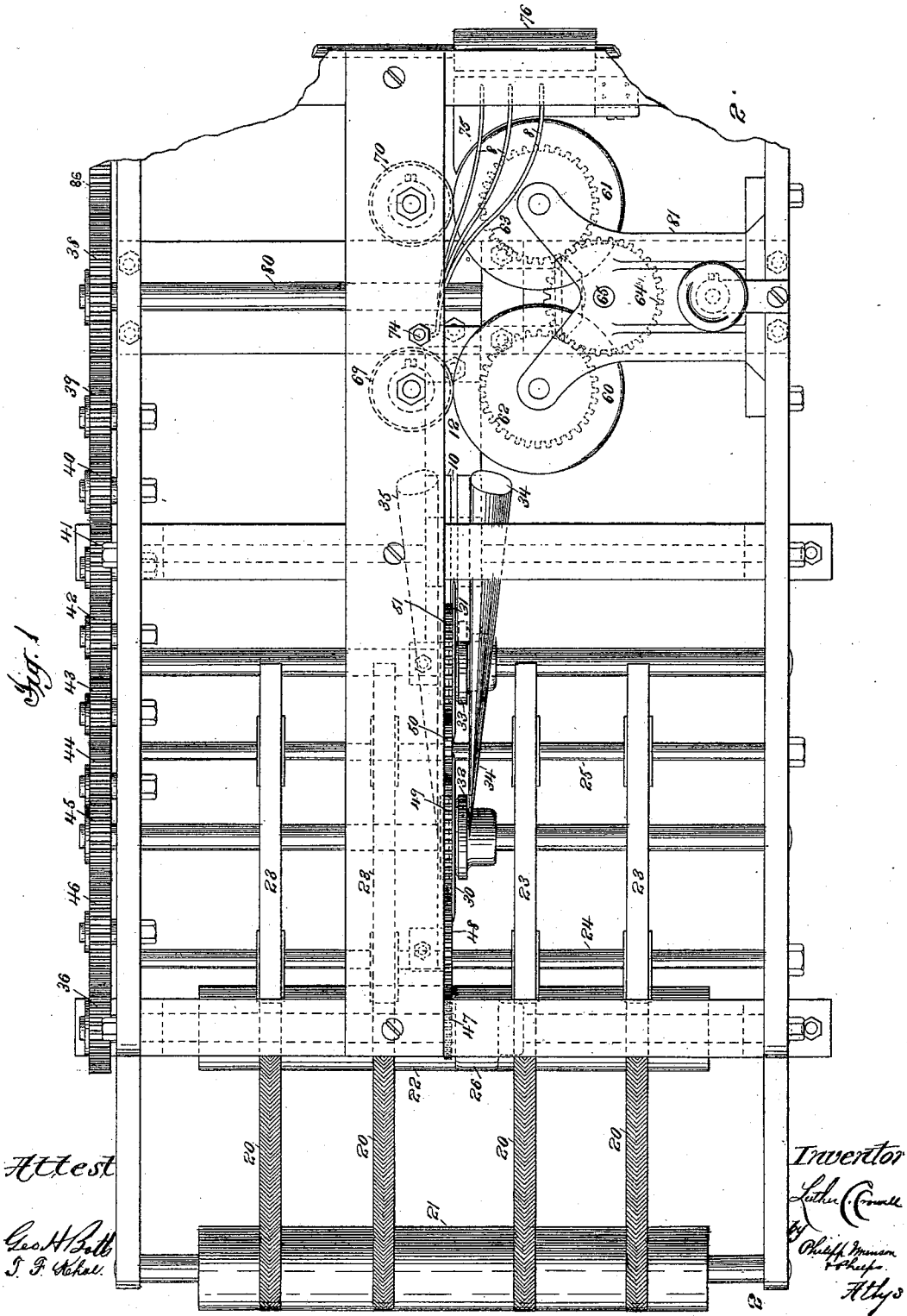
Patented Dec. 20, 1898.

L. C. CROWELL.
FOLDING MACHINE.

(Application filed Feb. 19, 1892.)

(No Model.)

4 Sheets—Sheet 1.



No. 616,290.

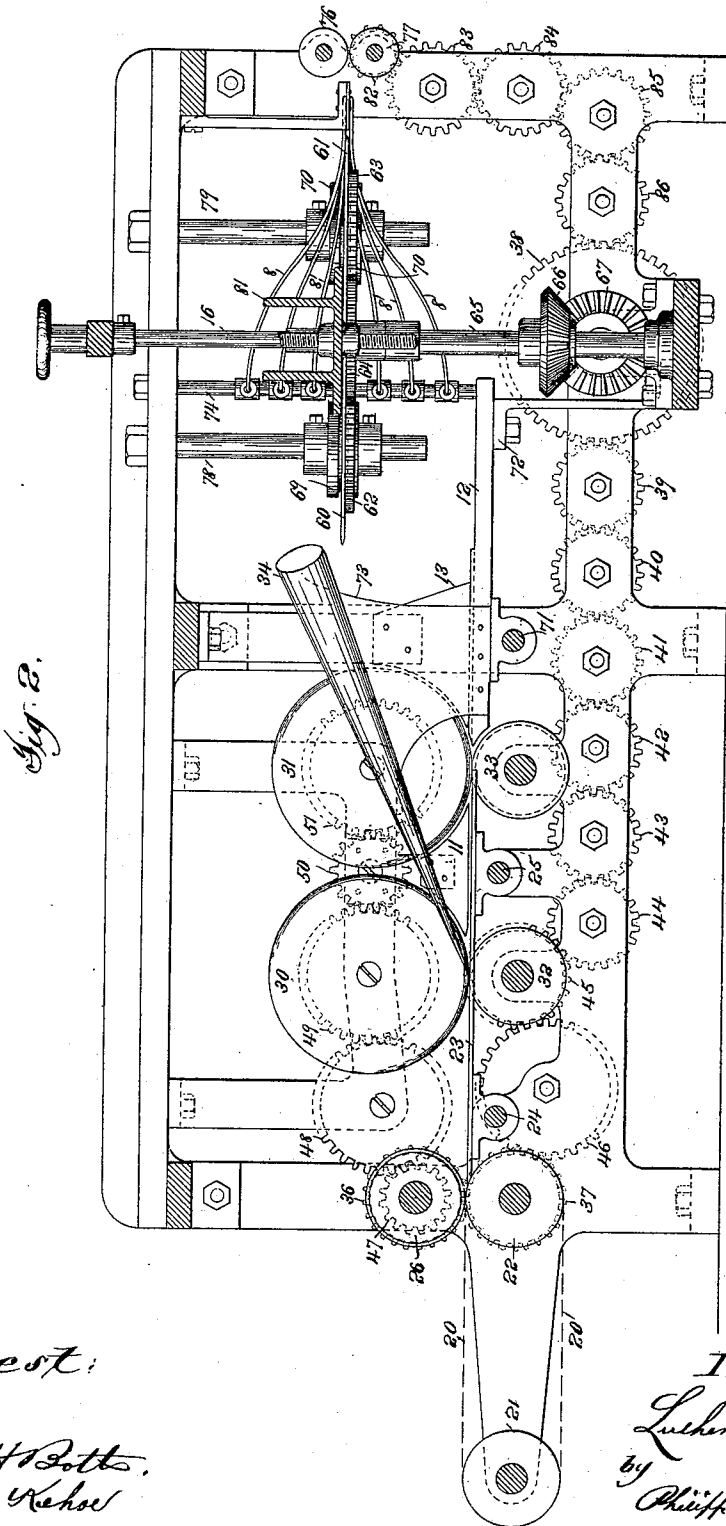
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L. C. CROWELL.
FOLDING MACHINE.

(Application filed Feb. 19, 1892.)

(No Model.)

4 Sheets—Sheet 2.



Attest:

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No. 616,290.

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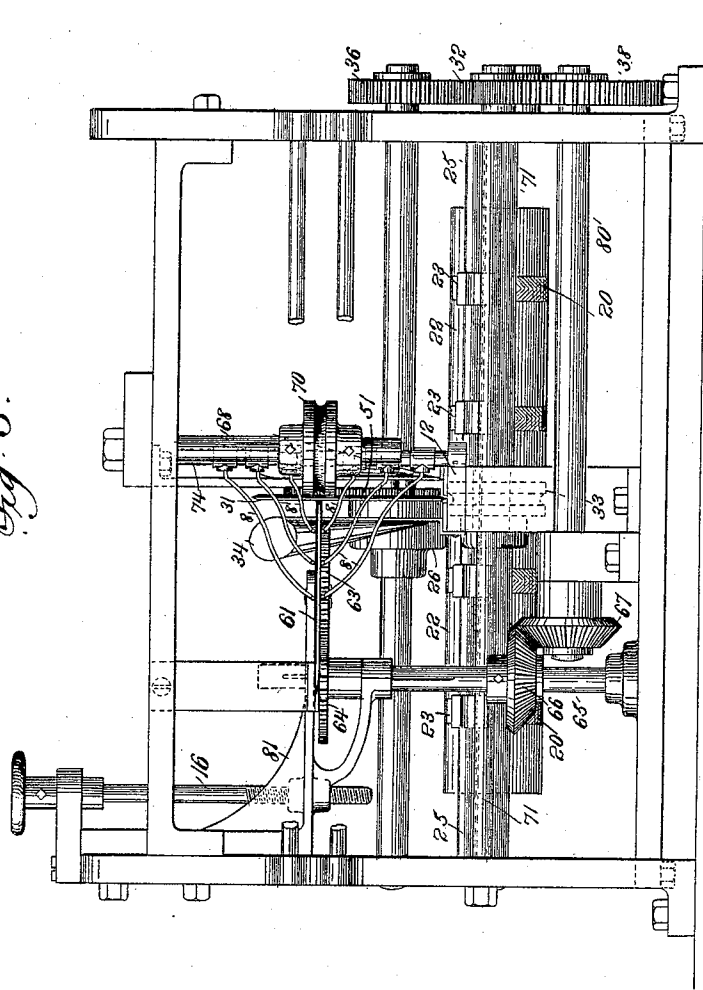
L. C. CROWELL.
FOLDING MACHINE.

(Application filed Feb. 19, 1892.)

(No Model.)

4 Sheets—Sheet 3.

Fig. 3.



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FOLDING MACHINE.

(Application filed Feb. 19, 1892.)

(No Model.)

4 Sheets—Sheet 4.

Fig. 4.

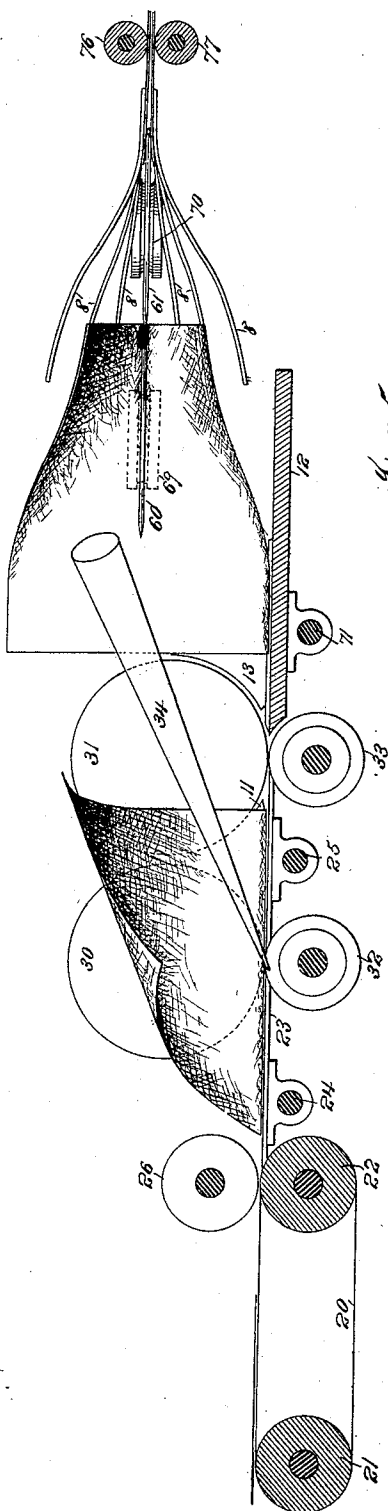


Fig. 5.

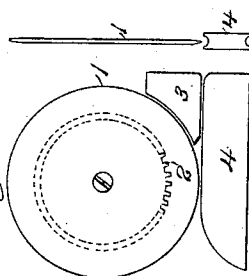
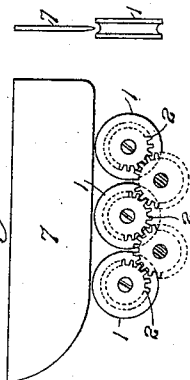


Fig. 6.



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UNITED STATES PATENT OFFICE.

LUTHER C. CROWELL, OF NEW YORK, N. Y.

FOLDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 616,290, dated December 20, 1898.

Application filed February 19, 1892. Serial No. 422,088. (No model.)

To all whom it may concern:

Be it known that I, LUTHER C. CROWELL, a citizen of the United States, residing at New York, (Brooklyn,) county of Kings, and State of New York, have invented certain new and useful Improvements in Folding-Machines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

10 This invention relates to that class of machines particularly designed to fold sheets of paper or other material. In this instance the machine is more especially adapted for use as a part of a wrapping-machine, the object being to impart folds to a sheet, either flat or preliminarily folded, fed to the machine automatically or by hand, and after folding such sheet to deliver the same directly to the wrapping mechanism; but the machine may
15 20 obviously be used as a folding-machine irrespective of such connection.

In a machine constructed in accordance with the invention in the preferred form I provide a thin interior plate about which the sheets are folded by suitable lapping-guides and which has a narrow edge which determines the final line of fold of the sheet, and an exterior bearer for coöperating with the fold-forming edge of the interior plate to advance the sheet longitudinally of said edge, and which exterior bearer is preferably grooved to bend the sheet on the fold-line about the fold-forming edge of the interior plate. The interior plate is preferably formed
25 30 by a rotary disk or a plurality of such disks in line, and the exterior bearer is preferably formed by a corresponding number (one or more) of rotary disks or wheels, preferably grooved.

40 A feature of the invention is found in a guiding plate or plates between the interior disks and forming with said disks an interior support for the sheet. Another feature is the extensor-plate that prolongs the said interior support, so that the same shall be effective during the whole folding operation.

Other features of the invention are found in combinations of parts too fully hereinafter described and specifically claimed to need
50 preliminary description.

In the drawings the principal illustrations

are of one form of machine embodying the present improvements.

Figure 1 is a plan view thereof. Fig. 2 is a side elevation on the line 2 2 of Fig. 1. Fig. 3 is an end elevation with the delivery-rolls omitted. Fig. 4 is a diagrammatic illustration of the folding operation and includes only such of the devices as are useful in aiding and understanding of the same. Figs. 5 and 6
55 60 show modifications of the folding devices.

In order to obtain a ready understanding of this invention, the particular embodiment of it in the primary folder shown in Figs. 1 to 4 will first be described and thereafter
65 the modifications thereof will be explained, as well as the mechanism of the secondary folder. Premising that the object is to impart longitudinal folds to a sheet of material passed through this machine, the devices
70 thereof and their action thereon will be explained in connection with a description of the passage of a sheet through them.

The sheet to be operated upon, either unfolded or previously folded into a pack as a signature, is while spread flat to its widthwise extent fed into this machine by means of endless tapes 20 20 20 20, that extend from carrying rollers or pulleys 21 22, the support of which they form a part being extended
80 sufficiently beneath the primary folder by means of conductors 23 23 23 23, supported by cross-rods 24 25 to operate as a bridge sustaining the ingoing sheet. A narrow feed-roller 26 coöperates with and is driven con-
85 certedly with its companion feed-roller 22 through pinions 36 37, and its position is such that the sheet is fed by contact near its central line, which limited feeding contact thus permits the sides of such sheet or folded pack
90 to be upraised from a point more or less rearward of the feeding-nip of these rollers, and thus have imparted to it a preliminary shaping or incipient folding that enables the final lapping of its sides to be performed without
95 wrinkling, buckling, or crimping the material.

The roller 22 might be narrow like the roller 26, so far as its feeding function is concerned, in which case its tape-carrying parts would be in the form of simple pulleys.

The primary folder comprises two alined disks 30 31, that rotate within the folded ma-
100

terial and which have narrow edges for determining the line of fold of the sheet in substantially a single line, and coacting with the fold-forming edges of said disks to advance the sheet tangentially of said disks—that is, longitudinally of the portions of the edges of the disks engaging the sheet—are wheels 32 33, preferably grooved, that bear upon the outside of the sheet on the line of doubling or folding, each disk and wheel reciprocally constituting a sheet-propelling mechanism that acts solely upon the line of doubling or folding. Coacting with the propelling mechanism are side lapping or turning guides 34 35, that cause the opposite sides of the sheet to be upturned and lapped or laid together. These guides are respectively arranged on opposite sides of said disks 30 31 and practically, when vertically considered, have their inner or facing sides parallel therewith, and they occupy such angles, horizontally considered, that they will have one end extended within the plane of travel of the sheet near its middle part to intercept the same and their opposite ends raised high enough to cause the sides of the sheet to be guided and sustained between them and said disks. The sheets as they are advanced between the disks 30 and 31 and the wheels 32 and 33 will thus be folded about the disks 30 and 31, and the disks being thin and their edges being made very narrow, as before stated, as the sheets are folded about such edges they will be folded at once on the line of the final fold of the sheet as it is advanced from the folder. The edges of the disks are thus final-fold-forming edges. These side-lapping guides are preferably in the form of cones, whereby curved surfaces suited to the work are presented for all portions of the sheet during any position it assumes as the sheet travels onward and has its sides gradually lifted from a central point outward to its edges, so that these sides are progressively turned upward and inward and until they finally stand in parallel vertical planes and substantially in contact in a position for delivery, it may be, to a secondary folding apparatus, in which case the folded sheet stands substantially at right angles to the folding mechanisms of the same. During this folding operation the doubled edge of the sheet remains in the same horizontal plane in which the sheet has been fed, it being maintained interiorly by the edge of the disks 30 31 by a narrow guide-plate 11, extending between them, and by a narrow extensor-plate 13, projecting a distance beyond the disk 31, and exteriorly by the conductors, in part by the table 12, the latter constituting a bridge upon which said doubled edge bears.

The plate 11 is curved to conform with the edges of the disks 30 31 and is hung in place by a bracket, and the plate 13, which is supported in like manner, also has its rear edge similarly shaped to conform with the disk 31, and the two plates 11 and 13, with the disks, thus practically form a continuous narrow-

fold-forming edge on the inside for the line of doubling or folding, which extends far enough forward to perfectly coact with the side-lapping guides 34 35. Beneath the plate 13 a narrow table 12 is provided to form a support upon which the doubled edge of the sheet rests in a portion of its forward travel, said table being preferably provided for a suitable distance with a guiding-groove 10, in which the doubled edge of the sheet runs. This table is secured by a rod 71 and a bracket 72, and from it supporting-standards, as 73, rise to sustain the guides 34 35. The grooved wheel 32 is driven by the toothed wheel 45, while the grooved wheel 33 runs freely and the disks 30 31 are driven from the wheel 38 on the main shaft 80 through a train of wheels 39, 40, 41, 42, 43, 44, 45, and 46, that gears with the wheel 37, which meshes with the wheel 36. The shaft of the latter carries a wheel 47, that drives the wheel 49 on the shaft of the disk 30 by means of an intermediate 48, and the wheel 49 in turn drives the wheel 51 on the shaft of the disk 31 through an intermediate 50. It will now be understood that the flat sheet or pack delivered to this machine by the tapes 20 will pass between the feed-rollers 26 22 and the disk 30 and grooved wheel 32, and that its body portion, widthwise considered, or, in other words, the sides of the sheet considered as the major portion thereof on each side of its central point or line of fold, will be prevented from drooping or be guided by the conductors 23, so that its thin or limp leading edge will be intercepted by the ends of the lapping guides 34 35 at points close to the said disk, and thereby cause its sides to ride up the inclined planes said guides form, and that as its central line of folding or doubling is confined to a horizontal plane of travel by the edge of the disks 30 31 and guide-plates 11 13 its sides will be bent upward, and that the bends in the sides of the sheet will be made to such an extent that such sides will be upturned to a degree rearward of said disk, for the reason that the feeding-rolls offer no obstruction thereto, and hence that the preliminary conformation of or approximation to the final folding will be formed without rupturing the paper or causing it to crease, buckle, or break. As the sheet moves onward its central line or doubled edge will be confined to said horizontal plane by the edges of the disks and the plates 11 13, while its sides will be gradually and progressively turned upward by the guides 34 35 until when it leaves the said guides and the plate 13 it will be longitudinally folded in its center, with its sides practically laid together. In the folding operation thus performed and whereby the ultimate disposition of the material constituting the fold-line is directly attained and undergoes no preliminary partial formation it will be observed that that member which is inside of the fold must not only be as thin a disk or other shaped plate as is possible, but its bearing upon the line of

fold must be as near a knife-edge as can be maintained without severing the paper. These are the conditions which produce a perfect fold-line, and consequently a doubled edge of minimum thickness or bulk. In this folding operation the bend of or doubled edge of the sheet will conform more or less, according to its thickness, to the groove in the wheels 32 33, which, as shown, is quite wide as compared with the edge of the interior disk, its smooth onward movement being thus aided in a manner that removes any cause for smutting or injury from dragging when that part of the paper is being bent laterally as well as moved onwardly, and this double edge will be suitably embraced, supported, and guided in the groove as the sheet passes out of this primary folder.

It will now be obvious that if both the disks 30 31 and the grooved wheels 32 33 are driven they will coöperatively form a rotating propeller acting to drive or carry the sheet onward by contact with that portion of it constituting its line of doubling or folding, the disks acting on the inside and the grooved wheels on the outside thereof.

Although it is desirable to employ the interior disks and exterior grooved wheels, as shown in Figs. 1 to 4, and to have one or all of both the disks and grooved wheels driven, it is, however, only essential that the rotary or other moving member on one side of the sheet shall be driven, and to coact with such driven sheet propelling or driving member I may provide a stationary bearer or support for the other side of the sheet on the fold-line, and this driving member may be either the one acting on the outside or the inside; but the surface of whichever member is to act as a driver should be roughened, as by being finely milled or draw-filed, and the surface that is to act merely as a support or bearer should be made as smooth as possible.

The form illustrated by Fig. 5 consists of a disk 1, adapted to be rotated as by a toothed wheel 2. This disk will run on the inside of the line of doubling or folding, and like the disks 30 31 will have an extensor guide-plate 3, which is similar to the plate 13. The disk in this instance is the driver or propeller and has by preference a finely-milled or draw-filed edge, which is thus made very slightly rounding. It will of course have exterior co-operating side-lapping guides, which may be like those 34 35 already described, and related to the disk 1 as they are to the disk 30. The bearer or support for the outside of the line of doubling or folding consists in this example of a long narrow plate 4, whose bearing edge is slightly curved to form a smooth channel which will conform to the rounded form of a doubled or folded edge of paper, and its rear portion is slightly curved downward in order not to impede the smooth introduction of the paper.

In Fig. 6 the grooved wheels, as 1 1 1, act-

ing upon the outside of the line of doubling or folding, constitutes the propellers, while the support on the inside of such line of doubling or folding is constituted by a narrow plate, as 7, the lower edge of which is rounded and made as smooth as possible. Although one of these wheels 1 will successfully operate, especially when it is provided with a smooth grooved supporting plate or table similar to table 12 of the main views or the plate 4 of Fig. 5, it is preferable to provide a number of wheels of small diameter, as 1 1 1, the grooves of which are preferably slightly milled. The plate, as 7, will have a curved end to cause the sheet to smoothly pass beneath it, and the wheels 1 1 1 will be driven by toothed wheels, as 2 2 2, or in any other suitable manner. In this construction there will be provided side-lapping guides, as those 34 35 or of any other suitable form.

A single set of such devices as the foregoing will perfectly perform the operation of folding sheets of suitable size; but when the sheets are larger, and consequently longer, two or more propelling-disks, as 30 31, with intervening smooth guide-plates, as 11, will be needed.

The secondary folder, which imparts a longitudinal fold parallel to that given by the primary folder, may be of the same construction as the primary folder. As illustrated in Figs. 1 to 4, it consists of two horizontally-arranged disks 60 61, hung in the branching arms of a bracket 81 and rotated by means of wheels 62 63, and an intermediate 64 on a vertical shaft 65, that is actuated by means of bevel-gears 66 67 from the main shaft 80, carrying the wheel 38. Coöperating with these disks there are horizontally-arranged grooved wheels 69 70, constructed and operating in all respects like the wheels 32 33, which are supported on vertical shafts 78 79, journaled in the framework. These disks and grooved wheels are so positioned that their contact with the sheet shall agree horizontally with the plane in which the sheet folded by the primary folder travels, and their vertical position is the center or other predetermined point of the fold which shall be imparted to such sheet. To a rod 74, which is alined in a plane slightly at one side of the vertical plane occupied by the folded sheet emerging from the primary folder, a number of side-lapping guides 88 88 88 are secured and bent forward, inward, and laterally (see Fig. 1) to suit the curvature which a sheet will assume in being gradually folded by having its sides bent toward each other and finally lapped while its central portion or line of doubling is confined by the disks 60 61. It will now be understood that the sheet, folded longitudinally by the primary folder and emerging therefrom in a vertical plane, will, fed by the driven folding mechanism of the primary folder, be entered directly between the disk 60 and grooved wheel 69, with its central portion embraced thereby, and that as it is moved onward by

the disk 60 and beyond the disk 61 its sides will be intercepted by the guides 8 8, and thereby gradually be turned toward each other, and that this turning will be progressively advanced toward horizontal planes until a lapping or folding is accomplished, while the doubled edge of the sheet passes outward in a straight line onto the disk 61, between it and the wheel 70, and onto the extensor-plate 75, (which is like the plate 13,) and, finally, that the sheet will be doubled longitudinally, with its sides practically lapped together, embracing the plate 75. In this folded condition the sheet will be entered between the pressing-rollers 76 77 and be delivered. These rollers are arranged to be positively rotated by means of a train of wheels 82 83 84 85 86, the former being on the shaft of roller 77 and the latter meshing with the wheel 38. As the sheet undergoing the final folding operation in the secondary folder has previously received one or more folds, its double edge is sufficiently rigid to make it unnecessary to interpose a throat-plate like 11 between the disks 60 61; but the extensor-plate 75 is desirable, so that the folded product shall reach the pressing and delivery rollers in a true position for delivering, and no distortion shall result from the pressing action of such rollers.

This machine is adapted to fold various widths of sheets or folded packs, and in order that the secondary folder may be adapted to impart its fold in any predetermined relation to the preceding fold all of its fold-producing mechanisms are arranged to be adjusted to the appropriate vertical position. Thus the bracket 81, which supports the disks 60 61, their wheels 62 63, and their driver 64, which is splined on the shaft 65, is arranged to slide in guides fixed to the frame and provided with an adjusting screw-shaft 16, whose threaded portion turns in a nut fixed to the bracket.

The grooved wheels 69 70 are adjustable on their shafts 78 79 by set-screws through their hubs, and the guides 8 are all adjustable on the rod 74 by collars and set-screws, while the extensor-plate 75 has its supporting end in like manner adjustable by a set-screw.

One disk, one grooved wheel, and one or both of the plates 11 13 may with lapping-guides be conjointly used where the nature of the work as to exactness will permit it, as when a subsequent wrapping operation makes it less necessary that accurate doubling shall be effected, and in this same case the grooved wheel may be omitted. Thus the disk 31, wheel 33, and the forward ends of conductors 23 may be removed and the table 12 and parts beyond be moved rearward, so that the disk 30 and wheel 32 take the place of disk 31 and wheel 33, or vice versa.

What therefore is claimed is—

1. The combination of a thin interior plate having a final-fold-forming edge about which the sheet is folded, an exterior bearer for co-operating with said fold-forming edge to ad-

vance the sheet longitudinally of said fold-forming edge, and exterior side-lapping guides arranged to fold the sides of the sheet about said plate as the sheet is advanced, substantially as described.

2. The combination of a thin interior plate having a final-fold-forming edge about which the sheet is folded, an exterior bearer for co-operating with said fold-forming edge to advance the sheet longitudinally of said fold-forming edge, one or both of which members is driven rotatively, and exterior side-lapping guides arranged to fold the sides of the sheet about said plate as the sheet is advanced, substantially as described.

3. The combination of a thin interior plate having a final-fold-forming edge about which the sheet is folded, an exterior bearer for co-operating with said fold-forming edge to advance the sheet longitudinally of said fold-forming edge, one or both of which members is driven rotatively, and exterior side-lapping guides arranged to fold about said plate the portions of the sides of the sheet adjacent to the fold-line and then to complete the folding of said sides progressively as the sheet is advanced, substantially as described.

4. The combination of a thin interior plate having a final-fold-forming edge about which the sheet is folded, an exterior bearer having a grooved edge for co-operating with said fold-forming edge to advance the sheet longitudinally of said fold-forming edge, one or both of which members is driven rotatively, and exterior side-lapping guides arranged to fold the sides of the sheet about said plate as the sheet is advanced, substantially as described.

5. The combination of an interior disk having a final-fold-forming edge, an exterior bearer for co-operating with said fold-forming edge to advance the sheet, one or both of which members is rotatively driven, and exterior side-lapping guides arranged to fold the sides of the sheet about said disk as the sheet is advanced, substantially as described.

6. The combination of an interior disk having a final-fold-forming edge, an exterior bearer for co-operating with said fold-forming edge to advance the sheet, one or both of which members is rotatively driven, a narrow plate extending beyond said disk, and exterior side-lapping guides arranged in vertical planes substantially parallel with the sides of said disk and said plate to fold the sides of the sheet about said disk and said plate as the sheet is advanced, substantially as described.

7. A folding mechanism consisting of an interior disk, a co-operating exterior grooved wheel, side-lapping guides arranged in vertical planes substantially parallel with the sides of said disk and angularly arranged with respect to the disk with their receiving ends projecting below the periphery of the disk so as to intercept the sides of the sheet near the fold-forming point, substantially as described.

8. The combination with a thin interior

plate over which the fold-line is formed, an exterior bearer cooperating therewith in forming the fold-line, one or both of which members is driven rotatively, and side-lapping guides on opposite sides of said interior plate, of feeding-rollers for forwarding the sheet to be folded, the upper one of which feeding-rollers bears only centrally upon the sheet, whereby provision is made for the upward bending of the sides of the sheet in taking the direction of folding, and a sheet support or bridge extending from the lower feeding-roller to said plate and bearer, substantially as described.

9. The combination with a thin interior plate over which the fold-line is formed, an exterior bearer cooperating therewith in forming the fold-line, one or both of which members is driven rotatively, and side-lapping guides on opposite sides of said interior plate, of feeding-rollers for forwarding the sheet to be folded, the upper one of which feeding-rollers bears only centrally upon the sheet, whereby provision is made for the upward bending of the sides of the sheet in taking the direction of folding, a sheet support or bridge extending from the lower feeding-roller to said plate and bearer and a plate extending beyond the disk and bearer to guide the folded sheet, substantially as described.

10. The combination with interior disks 30, 31, and exterior bearers alined therewith and constituting cooperating fold-line-forming members one or both being driven, of side-lapping guides arranged on opposite sides of said disks and intercepting the sides of the sheet near the fold-forming point, a narrow plate extending beyond the disk 30 and a sheet-support extending beneath said disks and plate, substantially as described.

11. The combination with interior disks 30, 31, and exterior bearers alined therewith and constituting cooperating fold-line-forming members one or both being driven, of side-lapping guides arranged on opposite sides of said disks and intercepting the sides of the sheet near the fold-forming point, a narrow plate extending beyond the disk 30, a sheet-support extending beneath said disks and plate, feeding-rollers for advancing the sheet to be folded, and conductors extending from said rollers to the disk 30, substantially as described.

12. The combination with interior disks 30, 31, and exterior bearers alined therewith and constituting cooperating fold-line-forming members one or both being driven, side-lapping guides arranged on opposite sides of said disks, a narrow plate 11 extended between the disks 30, 31, a plate 13 extending beyond the disk 31 and a sheet-support beneath said plates 11 and 13, substantially as described.

13. The combination with interior disks 30, 31, and exterior bearers alined therewith and constituting cooperating fold-line-forming members one or both being driven, side-lapping guides arranged on opposite sides of said

disks, a narrow plate 11 extended between the disks 30, 31, a plate 13 extending beyond the disk 31, a sheet-support beneath said plates 11 and 13, feeding-rollers for advancing the sheet to be folded, and conductors extending from said rollers to the disk 30, substantially as described.

14. The combination with interior disks 30, 31, and exterior bearers alined therewith and constituting cooperating fold-line-forming members one or both being driven, side-lapping guides arranged in vertical planes substantially parallel with said disks and operating to intercept the sides of the sheet near the fold-forming point, a narrow plate 11 extended between the disks 30, 31, and a sheet-support beneath said plate, substantially as described.

15. The combination with interior disks 30, 31, and exterior bearers alined therewith and constituting cooperating fold-line-forming members one or both being driven, side-lapping guides arranged in vertical planes substantially parallel with said disks and operating to intercept the sides of the sheet near the fold-forming point, a narrow plate 11 extended between the disks 30, 31, a sheet-support beneath said plate, feeding-rollers for advancing the sheet to be folded, and conductors extending from said rollers to the disk 30, substantially as described.

16. The combination with interior disks 30, 31, and exterior bearers alined therewith and constituting cooperating fold-line-forming members one or both being driven, side-lapping guides arranged in vertical planes substantially parallel with said disks and operating to intercept the sides of the sheet near the fold-forming point, a narrow plate 11 extended between the disks 30, 31, a plate 13 extended beyond the disk 31, a sheet-support beneath said plate, a cooperating table 12 and feeding-rollers and conductors, substantially as described.

17. The combination of an exterior disk as 31, guiding extensor-plate as 13, and a table provided with a guiding-groove as 10, an exterior grooved wheel as 33 and side-lapping guides, substantially as described.

18. The combination of an interior disk, guiding-plate 11, extensor-plate 13, a table provided with a guiding-groove 10, an exterior grooved wheel and side-lapping guides, substantially as described.

19. The combination of a plurality of interior rotative disks having final-fold-forming edges, corresponding exterior grooved wheels for cooperating with said disks to advance the sheet, and exterior side-lapping guides arranged in vertical planes substantially parallel with the sides of said disks to fold the sides of the sheet about said disks, substantially as described.

20. The combination of a plurality of interior rotative disks having final-fold-forming edges, corresponding exterior grooved wheels for cooperating with said disks to advance

the sheet, guide-plates interposed between said disks, and exterior side-lapping guides arranged in vertical planes substantially parallel with the sides of said disks to fold the
5 sides of the sheet about said disks, substantially as described.

21. The combination of a plurality of interior rotative disks having final-fold-forming edges, corresponding exterior grooved wheels
10 for coöperating with said disks to advance the sheet, one or more guide-plates 11 interposed between said disks, extensor-plate 13, and exterior side-lapping guides arranged in vertical planes substantially parallel with the
15 sides of said disks to fold the sides of the sheet about said disks, substantially as described.

22. The combination with a primary folder constructed to fold the sheet by lapping its sides vertically, of a secondary folder constructed to double said folded sheet by lapping its sides horizontally and comprising a disk operating inside the sheet and a grooved wheel coöperating therewith supported in a vertically-adjustable bracket, substantially
25 as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

LUTHER C. CROWELL.

Witnesses:

H. T. MUNSON,
T. F. KEHOE.