

May 5, 1936.

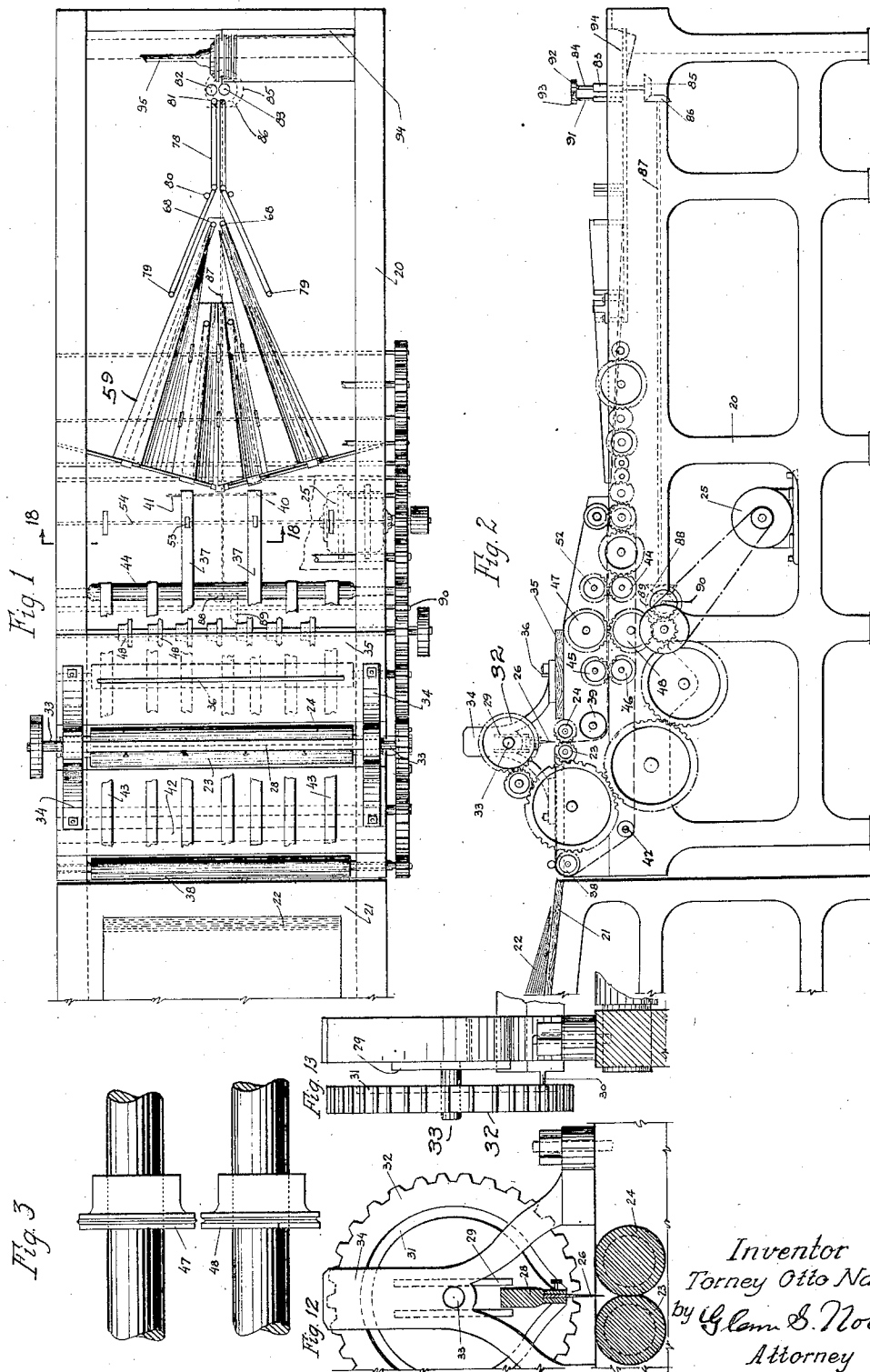
T. O. NALL

2,039,335

METHOD AND APPARATUS FOR FOLDING SHEETS

Filed April 20, 1931

3 Sheets-Sheet 1



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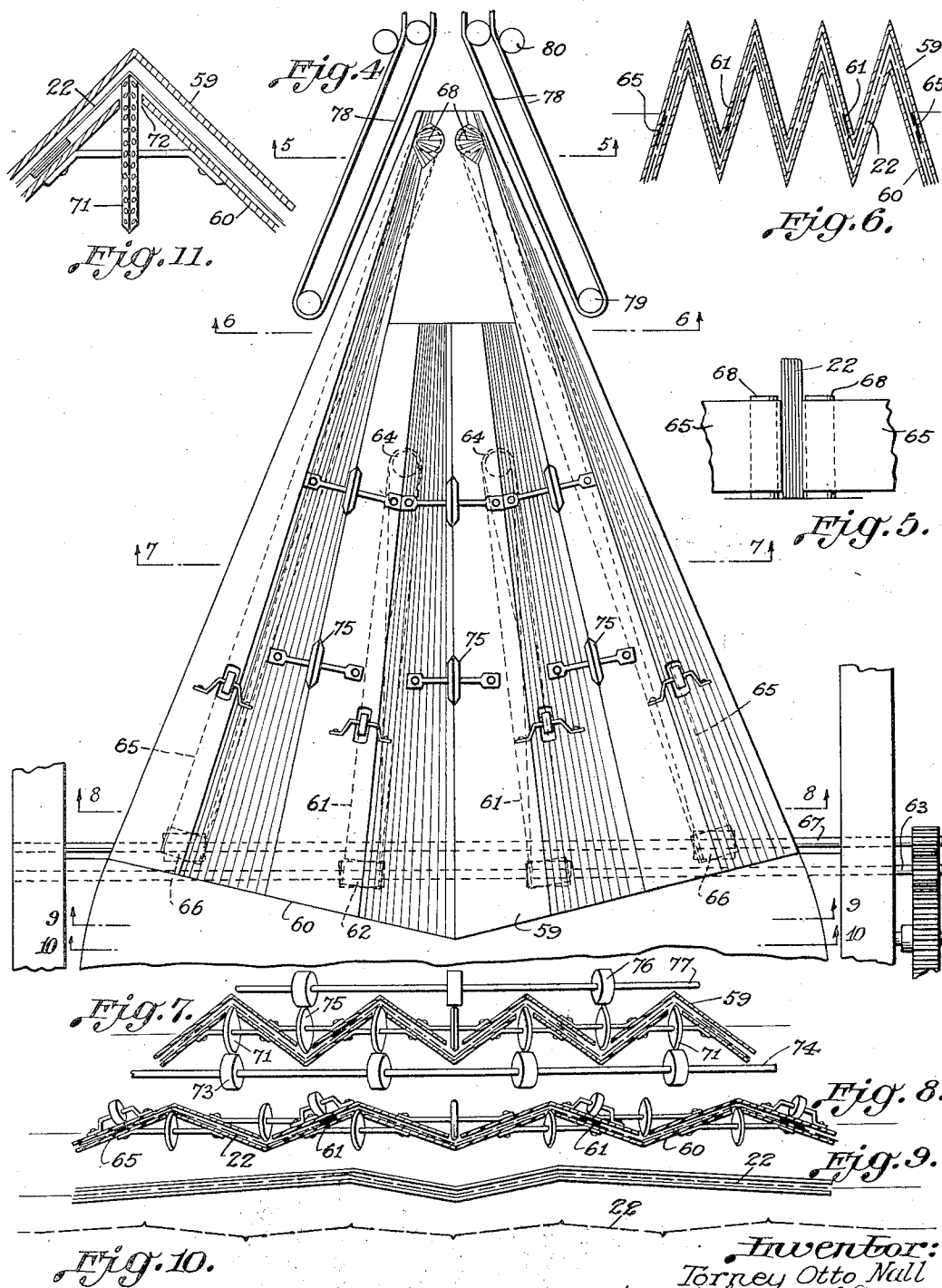
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METHOD AND APPARATUS FOR FOLDING SHEETS

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3 Sheets-Sheet 2



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METHOD AND APPARATUS FOR FOLDING SHEETS

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3 Sheets-Sheet 3

Fig. 14

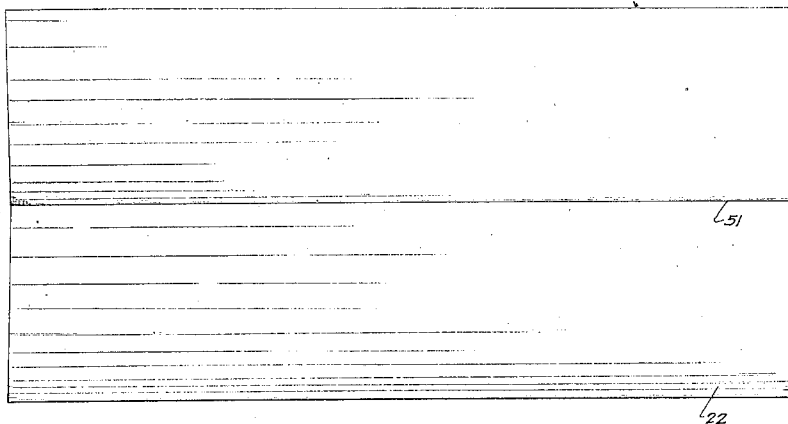


Fig. 15

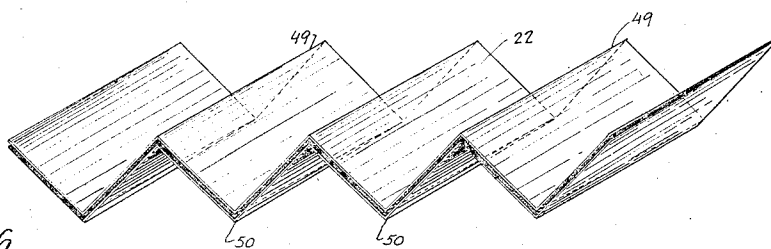


Fig. 16

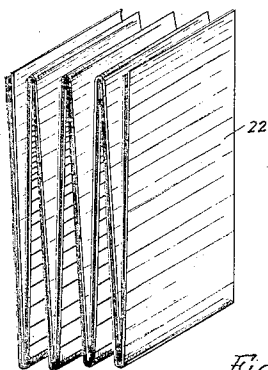


Fig. 17

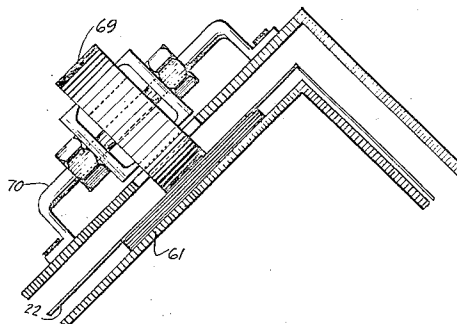


Fig. 18

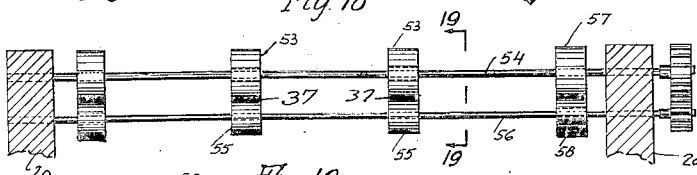
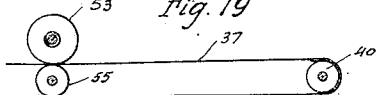


Fig. 19



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UNITED STATES PATENT OFFICE

2,039,335

METHOD AND APPARATUS FOR
FOLDING SHEETS

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Application April 20, 1931, Serial No. 531,407

12 Claims. (Cl. 270—40)

This invention relates to the folding of sheets, preferably of paper such as used for maps, folders and books or the like. In accordance with this invention such sheets may be folded transversely and then longitudinally to provide zig-zag folds or a sheet of single thickness may be zig-zag folded without transverse folding. Folding of similar character has been heretofore performed by various well known types of folding machines but such machines are usually of intermittent action and of consequently limited capacity. In accordance with the present invention I provide means for making a plurality of folds whereby the sheets will pass through the machine with a substantially continuous movement.

The objects of this invention are to provide an improved machine for making various folds in sheets of paper or the like; to provide improved folding which may be rapidly performed and whereby a plurality of folds may be made with a continuous movement of the sheet; to provide a folding machine adapted to fold a sheet transversely and to fold the same longitudinally with a plurality of folds; to provide novel means for folding a sheet in a zig-zag manner or with oppositely disposed folds; to provide forms for shaping a sheet of paper or the like and means for passing the sheet through such forms; and to provide such other improvements and novel features as will appear more fully hereinafter.

In the accompanying drawings illustrating this invention;

Figure 1 is a plan view with parts broken away or shown diagrammatically;

Figure 2 is a side elevation;

Figure 3 is a detail showing a pair of creasing rollers;

Figure 4 is an enlarged plan view of the form and conveyor for performing the principal zig-zag folding;

Figures 5, 6, 7, 8, 9, and 10 are sectional views taken on corresponding lines of Figure 4;

Figure 11 is an enlarged sectional detail showing one of the conveying or feeding means for feeding the sheets through the forms;

Figure 12 is a detail of the first or transverse folding mechanism;

Figure 13 is a side view of the parts shown in Figure 12;

Figure 14 illustrates the sheet to be folded indicating the first or transverse folding;

Figure 15 shows the sheet with the longitudinal folds partially completed;

Figure 16 is a view similar to Figure 15 showing the longitudinal folds practically completed ready for the leaves to be pressed together;

Figure 17 is a detail showing the mounting of one of the pressure rolls or wheels which co-act with the tapes;

Figure 18 is a sectional detail taken on the line 18—18 of Figure 1; and

Figure 19 is a detail illustrating the arrangement of the feed tapes and rollers.

As shown in these drawings, 20 represents a frame for supporting the various operating mechanisms and 21 is a feed table for supporting the sheets 22 which may be fed manually into the machine or any suitable feeding mechanism (not shown) may be utilized for this purpose. A pair of rollers 23 and 24 are mounted at the head of the machine adjacent to the feed table 21. These rollers are driven in any suitable manner, for instance, as shown in the drawings, by means of gears or drive mechanism from a motor 25 which also supplies power for operating the other portions of the machine. The rollers 23 and 24 co-act with the vertically movable blade 26 for making the first or transverse crease in the sheet as designated at 51 in Figure 14. The blade 26 is mounted in a vertically reciprocable bar 28 which moves in guideways 29 at either side of the machine. The bar 28 is provided with pins or projections 30 which engage with cam slots 31 in cam wheels 32 which are carried on a shaft 33 mounted in bearings 34 on the frame 20. One of the cam wheels is provided with teeth to form a gear which is driven from the motor 25 through the gearing or driving mechanism as shown.

The frame 20 is provided with a table 35 for receiving the sheets 22 as they are fed to the machine. A guide or stop 36 is arranged on this table for stopping the sheets when they are in proper position to be acted upon by the blade 26. When the sheets are in such position, the blade 26 moves downwardly to fold the sheet transversely and cause it to be engaged by the rollers 23 and 24 which complete the fold and the folded sheet is passed downwardly between such rollers.

A plurality of tapes are provided for feeding the sheets through the machine. Two central tapes 37 pass over a roller 38 adjacent to the feed table, then over the roller 23, then down and under a guide roller 39, and then forwardly to approximately the center of the machine where they pass around driving rollers or pulleys 40 on a shaft 41 which is mounted in suitable bearings on the frame and which is driven by means of the gearing as shown. The lower reaches of the belts or tapes 37 pass back and under the guide pulley 42 and then to the roller 38, as shown in Figure 2.

Other similar feed belts or tapes 43 also pass around the roller 38 and around the same guide rollers as the tapes 37 but engage at the rear with a driving roller 44 which is somewhat in advance of the rollers 40 and which roller is also driven by suitable gearing from the motor 25.

A pair of feed rollers 45 and 46 are arranged respectively above and below the upper reaches 60

of the tapes 37 and 43, as shown in Figure 2, and at a suitable distance from the guide roller 39 to engage with the folded sheets as they pass from this roller along on the tapes. The sheets are next carried between pairs of grooving rollers 47 and 48 which make longitudinal grooves therein as indicated at 49 and 50 in Figure 15, the transverse groove being indicated at 51, the terms longitudinal and transverse being used to indicate the position of the grooves with relation to the passage of the sheets through the machine although of course, such grooves or folds may be arranged in any desired manner with reference to the sheet. The sheets next pass between a feed roller 52 which coacts with the feed roller 44 which pass them along to the next devices which start the preliminary longitudinal folding or prepare the sheets for passage through the forming guides or corrugated plates. As the sheet is carried along on the tapes 37 beyond the rollers 52 and 44 it is engaged at points opposite the tapes by friction wheels or feed wheels 53 on a shaft 54 mounted in suitable bearings on the frame, this arrangement being particularly illustrated in Figures 18 and 19. Another pair of rollers or wheels 55 are carried by a shaft 56 mounted in suitable bearings on the frame and positively driven by means of the gearing shown. The rollers or wheels 55 engage with the upper reaches of the tapes to support the same so that when the sheets are pressed against the tapes by the rollers 53, the center portions of the sheets will be positively moved at the same speed as the tapes. Another pair of feed or friction rollers 57 are mounted on the shaft 54 and coact with rollers 58 on the shaft 56, the rollers 58 being somewhat larger than the rollers 55 so that the speed of the sheets passing between the rollers 57 and 58 will be slightly greater than the speed at the center part of the sheets so that the side portions tend to be flexed or bent forwardly thereby giving a slight transverse bending at the various grooves, as indicated in Figure 10. This causes the sides of the front edge of the sheet to converge so that they conform approximately to the rear edges of the forming guides or plates 59 and 60, as shown particularly in Figures 4 to 9. The sheets with the oppositely disposed grooves formed by the grooving rollers 47 and 48 pass between the front or feed end of these forming guides or plates which are only slightly bent or corrugated at such end as indicated in Figure 9. The corrugation or bending gradually increases and the sides or grooves converge toward the discharge end as indicated in Figures 6, 7, and 8, the arrangement being such that when the sheets pass through such guides they emerge with the longitudinal folding substantially completed as indicated in Figure 16. It will be seen that the converging V-shaped spaces between the forming guides or plates gradually draw the sections or leaves together until they change from a substantially flat surface to a folded condition, as shown.

Any suitable means may be utilized for conveying the sheets through such forming guides. For instance, I have shown a pair of tapes 61 with their upper reaches passing over the surfaces of two of the central panels of the lower guide members 60 for engagement with the sheet passing over the same. These tapes are driven by means of pulleys 62 on a shaft 63 mounted in the frame and driven by suitable gearing as shown. The rear ends of these tapes pass over guide rollers

or wheels 64 which are arranged at suitable angles so that the tapes may follow the surface of the adjacent panel or section of the guide.

Another pair of tapes 65 are arranged with their upper reaches above the outer sections of the lower forming guide and are driven by pulleys 66 on a driving shaft 67 driven by suitable gearing as shown. The rear ends of the tapes 65 pass around substantially parallel guide rollers 68 mounted adjacent to the apex of the forming guides and are shown particularly in Figures 4 and 5, the arrangement being such that when the sheet 22 passes out between these rollers the folds are substantially completed.

In order to cause the paper to be held closely against the tapes at various points I provide pressure rollers 69, for instance, as shown in Figure 17, these rollers being rotatably mounted on brackets 70 and having holes therethrough of sufficiently greater diameter than the shaft to permit the rollers to press against the tops of the sheets 22 and thereby press the sheets against the tapes, such devices being more or less commonly used in this art.

In addition to the tapes, or in lieu thereof, I may provide driving or friction wheels 71 which project through slots or openings 72 in the guide plates 60 and engage with the sheets 22 preferably at the apexes of the guide members as shown particularly in Figure 11. These friction wheels may be driven by frictional engagement with driving wheels 73 on a driving shaft 74 as indicated in Figure 7. Similar friction wheels 75 may also be arranged above the forming guides and project down through openings in the upper guide member 59, these wheels being driven by coacting wheels 76 on a driving shaft 77. By means of such tapes and friction wheels the sheets will be positively forced through the forming guides but in some instances, as for different kinds of paper, either the tapes or the wheels may be used separately.

During the movement through the forming guides the sheet will have passed from a substantially flat horizontal position to a folded vertical position as it emerges from the apex of the guides. When it passes therefrom it is engaged by tapes or conveyor belts 78 which are arranged on either side of the discharge end of the guides as shown in Figures 1 and 4. These belts pass around forward guide pulleys or rollers 79, intermediate rollers 80, and driving rollers 81, the arrangement being such that the folded sheets engage with substantially parallel reaches of the belts or tapes and are carried toward the discharge end of the machine where they are engaged by a pair of pressure rollers 82 and 83 which make the final compression for completing the folding operation. The roller 83 is mounted on a shaft 84 which is driven by a gear 85 that meshes with a gear 86 on a shaft 87, which shaft is driven by bevel gears 88 and 89 from a counter shaft 90, which is driven by suitable gearing, as shown. The roller 82 is mounted on a shaft 91 which may be driven from the shaft 84 through gears 92 and 93, Figure 2. When the folded sheets pass from the rollers 82 and 83 they drop into a chute or receptacle 94 and are moved laterally by means of any suitable plunger 95 which may be operated by mechanism (not shown) such as commonly used for this purpose.

The complete operation of the machine will be apparent from the above description but may be briefly described as follows. The sheets 22 are fed onto the table 35 to proper position to be

engaged by the blade 26 which forms a transverse crease and presses the center of the sheet down to be engaged by the rollers 23 and 24. These rollers complete the transverse folding and the sheet then passes over the tapes and under the roller 39 and is engaged by the rollers 45 and 46 which pass it to the grooving or creasing rollers 47 and 48. From these rollers it is caught by the feed rollers 52 and 44 and moved along until it is engaged by the sets of rollers for bending the sheet and directing it into the forming guides 59 and 60. When the sheet has passed between these guides it comes out with all of the longitudinal folds practically completed and then moves into engagement with the pressure rollers 82 and 83 which make the final pressing which is desirable to complete the folds. From these pressure rollers the sheets may be carried away or disposed of in any desired manner.

From this description it will be seen that I provide means for rapidly folding sheets of paper or the like with a continuous movement of the sheet instead of several intermittent movements as commonly used in ordinary folding machines. It will also be observed that my improved folding apparatus may be modified for different sheets or for different folds and therefore I do not wish to be limited to the exact arrangement herein shown and described except as specified in the following claims in which I claim.

1. The method of folding a sheet of paper or the like to form a plurality of fan folds which comprises making a transverse fold through the sheet, then creasing the sheet with longitudinal creases, then folding the parts between the creases together, and finally pressing the folded parts together.

2. A folding machine of the character indicated, comprising means for forming a transverse fold in a sheet, means for forming longitudinal creases in the sheet, forming guides through which the sheet is passed which causes the portions between the creases to be folded together to form fan folds and means coacting with the guides to drive the sheet therethrough.

3. In a folding machine, the combination of means for forming a transverse fold in a sheet, means for conveying the sheet, creasing rolls adapted to form longitudinal creases in the sheet, means for moving the sheet forwardly whereby the side portions thereof will advance beyond the central portion, coacting forming guides for next receiving the sheet, said guides being corrugated transversely and converging toward the discharge end, means for feeding the sheet through said guides, a conveyor for receiving the sheet as it passes from the guides and pressure rollers through which the folded sheet is finally passed.

4. In a machine of the character set forth, the combination of a frame, a pair of coacting rolls adjacent to one end of the frame, means for feeding sheets over said rolls, a blade for inserting a doubled portion of the sheet between said rolls whereby the rolls will engage with the same and complete a fold, creasing rolls mounted in said frame, means for passing the sheet from the first named rolls to the creasing rolls, a pair of coacting forming guides for folding the sheet longitudinally as it passes through the same, means for transferring the sheet from the creasing rolls to said forming guides, a pair of pressure rollers for completing the folding of the sheet and means for conveying the sheet from the forming guides to said pressure rollers.

5. In a machine of the character set forth, the combination of a pair of coacting rolls, means for feeding a sheet over said rolls, a stop for said sheet, a blade for inserting the sheet between the rolls, means for actuating said blade, creasing rolls for forming longitudinal creases in the sheet, means for conveying the sheet from the first named rolls to the creasing rolls, feeding means for transferring the creased sheet whereby the sides will be moved in advance of the center to partially bend the sheet, a pair of forming guides comprising coacting upper and lower corrugated members with converging corrugations between which the sheet is next passed, means for forcing the sheet through said guides, conveying means for receiving the sheet as it passes from the guides and pressure rollers for pressing the folded sheet as it passes from the conveying means.

6. In a folding machine, the combination with a pair of forming members between which the sheets to be folded are passed, of tapes for moving the sheets through said forming members and means for actuating said tapes.

7. In a folding machine, the combination with upper and lower guide plates which are similarly corrugated, of tapes mounted to pass along the sides of some of said corrugations, means for actuating the tapes, and means for pressing the sheet passing through the guides against said tapes.

8. In a folding machine for folding sheets for forming fan folds, the combination with a pair of coacting, longitudinally, corrugated, forming guide plates between which the sheets are to be passed, of friction wheels projecting through openings in said plates for engagement with the sheets and means for actuating the wheels.

9. In a folding machine, the combination with a pair of coacting guide plates having V-shaped corrugations therein, of feed wheels mounted to project through openings in oppositely disposed apexes of the corrugations and adapted to engage with the sheet to force the same through the guide plates, and means for actuating said wheels.

10. In a folding machine, the combination with creasing means for forming a plurality of longitudinal creases in a flat sheet preparatory to forming fan folds, of a pair of corrugated forming guides adapted to receive the creased sheets and to draw the sections between the creases together as the sheets are driven therethrough whereby the sheet will be folded longitudinally to form accordion folds, and means coacting with said guides to drive the sheet through the same.

11. In a machine for folding sheets of paper or the like, the combination of creasing rolls adapted to form longitudinal creases in the sheet, means for transferring the sheet from the creasing rolls whereby the side portions thereof will be moved somewhat in advance of the central portion thereof, and means adapted to receive the sheet in such condition and gather the sections together to form folds along the creases, substantially as described.

12. The method of folding a relatively wide sheet to form a plurality of fan folds, or folds which permit the sections to be turned in a manner similar to the leaves of a book without being opened outwardly, which consists in forming longitudinal creases therein and then driving the sheet through forming guides adapted to gather portions of the sheet together and complete the folding thereof.