June 11, 1929. R. J. WATERWORTH 1,716,936

FOLDING MACHINE

Filed Nov. 10, 1924 3 Sheets-Sheet 1

Fig. 1.

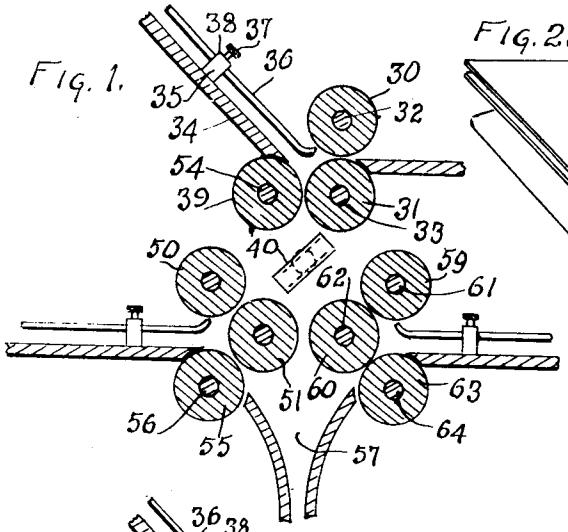


Fig. 2.

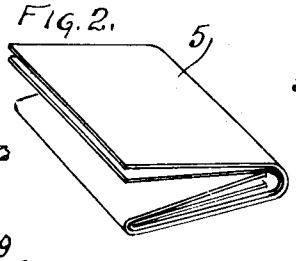


Fig. 8.

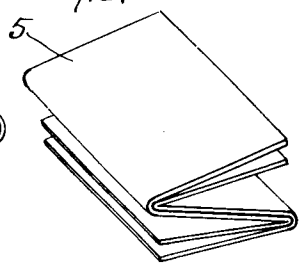


Fig. 3.

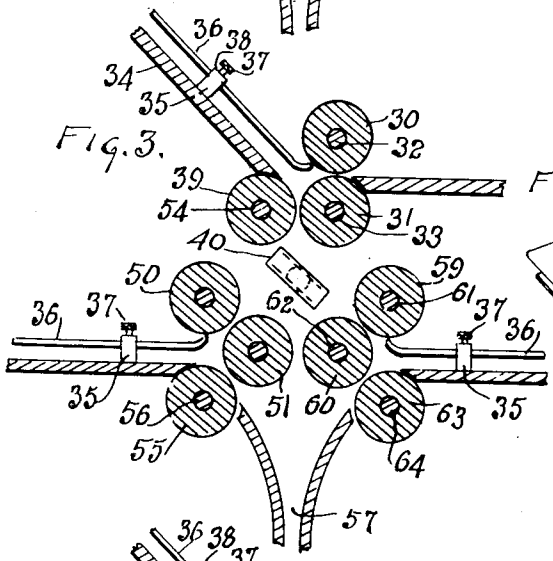


Fig. 4.

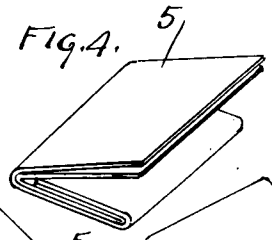


Fig. 9.

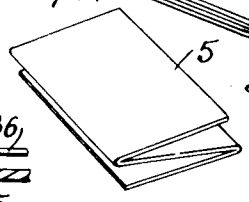


Fig. 10.



Fig. 5.

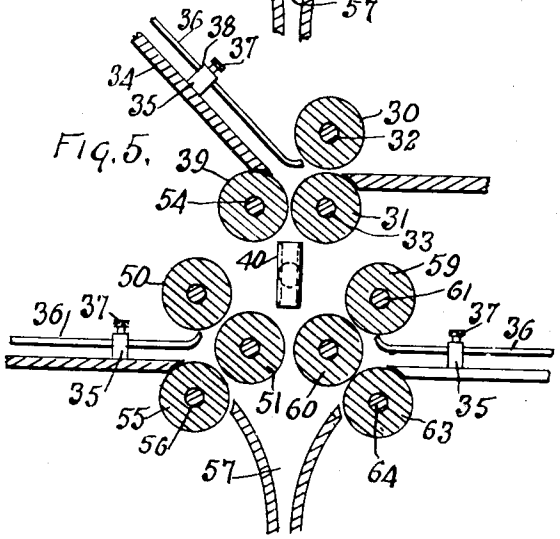


Fig. 6.

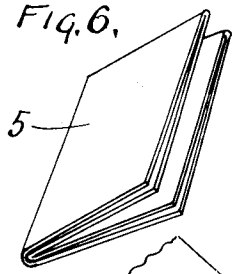
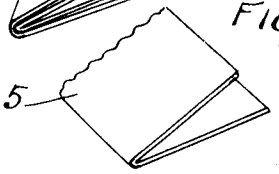


Fig. 7.

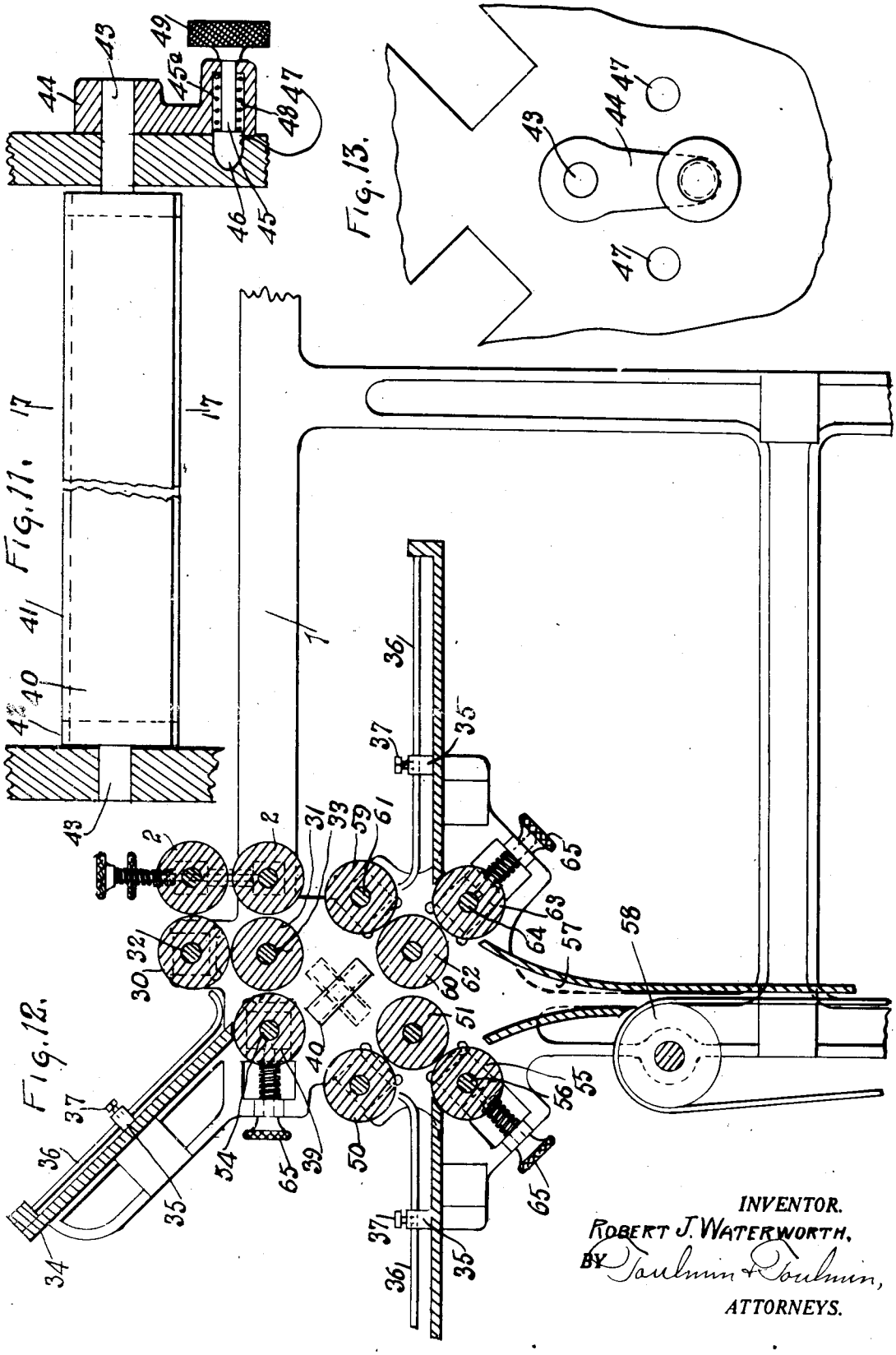


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Fig. 14.

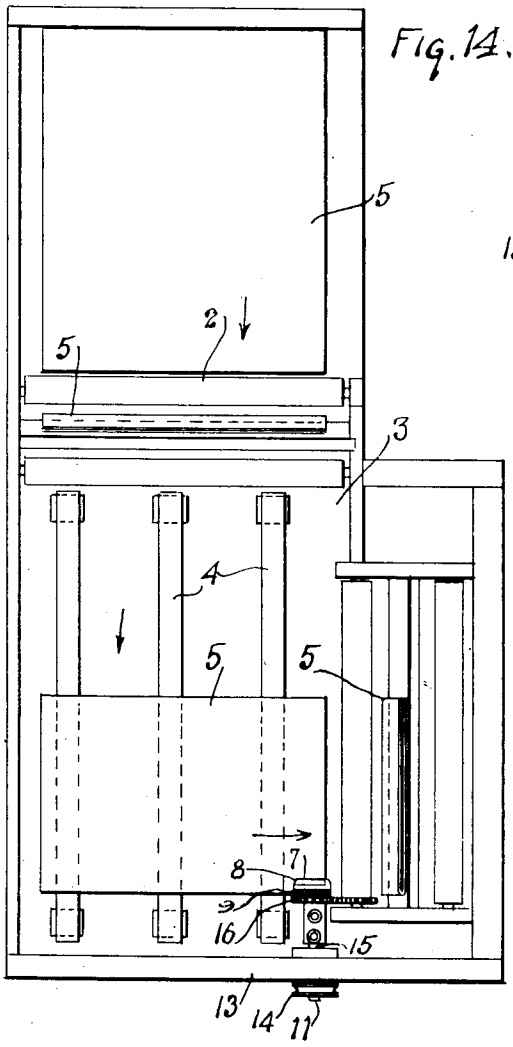
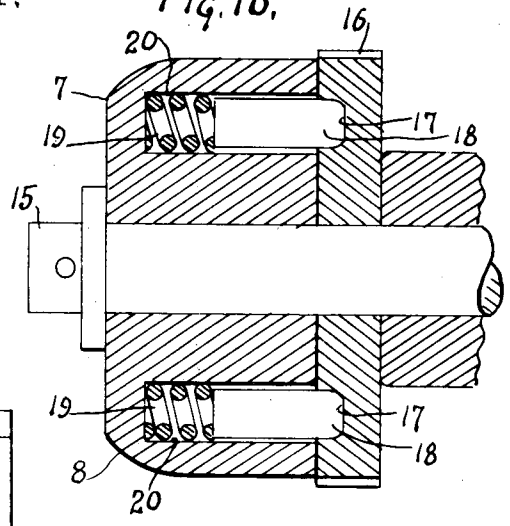


Fig. 16.



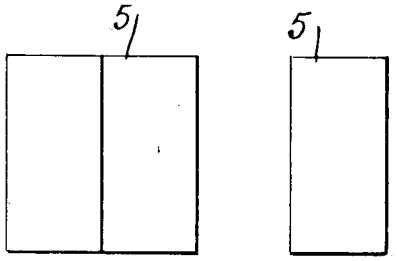


Fig. 15.

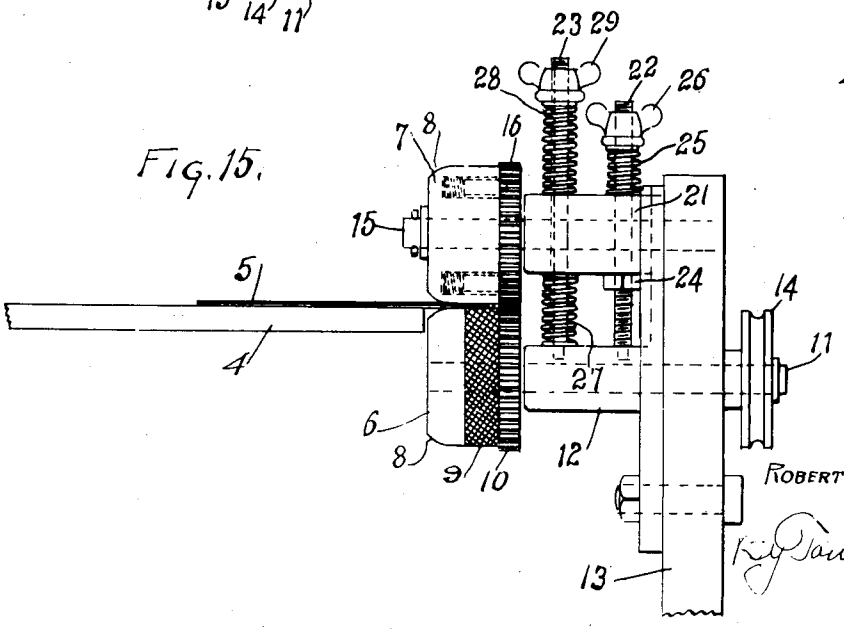
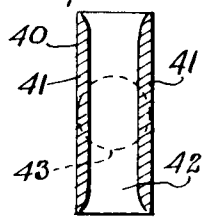


Fig. 17.



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Patented June 11, 1929. 1,716,936

UNITED STATES PATENT OFFICE.

ROBERT J. WATERWORTH, OF SIDNEY, OHIO, ASSIGNOR TO L. M. STUDEVANT, OF SIDNEY, OHIO.

FOLDING MACHINE.

Application filed November 10, 1924. Serial No. 748,807.

My invention relates to machines for folding paper and similar materials.

It is the object of my invention to provide a machine for folding sheets of paper and the like in a variety of folds such as a left angle two parallel fold and twelve page accordion fold, a right angle two parallel fold and six page accordion fold, or a six page standard fold, an eight page two fold or a four page one fold without rearranging the machine or substituting one part for another but by simply shifting the control from one position to another.

Heretofore it has been necessary to either have an especially designed machine for performing these separate operations to secure the above mentioned folds or it has been necessary to reconstruct the machine by substituting certain parts which takes a considerable period of time and greatly increases the expense of the machine.

It is my object to provide a machine which will produce all of these results by the simple shifting of a lever on the exterior of the machine or some similar mechanism so that reconstruction of the machine or substitution of the parts is unnecessary.

It is my object to provide a single deflector bar for determining the particular type of fold desired.

It is a further object of my invention to provide means of feeding to the folding apparatus sheets of varying thickness and weight so that they will be uniformly fed at right angles to the machine no matter what the thickness or size of the sheets may be.

Referring to the drawings:

Figure 1 is a diagrammatic view of the arrangement of the several parts for producing sheets known as a left angle two parallel fold consisting of three folds;

Figure 2 is a perspective of a sheet of paper so folded;

Figure 3 is a diagrammatic view of the several parts arranged to produce a right angle two parallel fold having three folds;

Figure 4 is a perspective of the sheets so folded;

Figure 5 is a diagrammatic view of the parts arranged for a one or two fold sheet consisting of two or four pages;

Figure 6 is a perspective view showing an eight page two fold sheet;

Figure 7 is a perspective of the end of a four page one fold sheet;

Figure 8 is a perspective of a twelve page accordion fold;

Figure 9 is a perspective of a six page accordion fold;

Figure 10 is a perspective of a six page standard fold;

Figure 11 is a section through the supports and positioning mechanism for the deflector bar;

Figure 12 is a side elevation of the complete machine;

Figure 13 is an enlarged detail view of the mechanism for adjusting the position of the deflector bar;

Figure 14 is a plan view of the complete machine;

Figure 15 is a section on the line 15—15 of Figure 14 showing the mechanism for feeding the sheets of paper for the second folding operation after the sheets have been folded once;

Figure 16 is a section through the gear 16 and the roller 7 showing the method of positioning the clutch members; and

Figure 17 is a section on the line 17—17 of Figure 11 showing the construction of the deflector bar.

Referring to the drawings in detail, I prefer to provide, although it is not essential to the present invention, folding mechanism for doubling the sheet as soon as it comes upon the table to be fed to the mechanism embodying the present invention. It is not esssential but it is preferable.

The sheet is placed upon the feeding part 1 and delivered in the direction of the arrows passing between a group of rollers designated generally 2 and more fully described in my copending application Ser. No. 707,566 which has matured into Patent No. 1,525,969. These rollers are adjusted to deliver a folded sheet upon the table 3 which is provided with driving plates 4 for moving the sheet to the position shown, the sheet being designated 5. At this point it comes in contact with rollers which move it at right angles to its former line of movement, so that it may be fed into the rolls for the subsequent operations to be hereinafter described. The rollers which so feed it consist of a lower metallic roller 6 and an upper fiber roller 7, both of which have tapered surfaces 8. The lower steel roller is provided with a knurled surface adjacent its hub as at 9 and with a driving gear 10 mounted upon the shaft 11 therewith which is the

driving shaft journalled in the bearing 12 of the frame 13. This shaft is driven by a belt on a pulley 14.

The upper roller is mounted on a shaft 15 which carries the tapered fiber roller 7 and a gear 16 which meshes with the gear 10 for driving the rollers together. This gear 16 is provided with a number of depressions 17 in which the heads of the plungers 18 which are forced by the springs 19 carried in cut away portions 20 in the upper roller 7. This permits the upper roller to slip with respect to its driving gear 16 and with respect to the lower roller 6. This is essential in adjusting the speed of feeding the paper sheet 5 according to the thickness and according to the position it therefore occupies with respect to the two rollers. The gear 16 and the upper roller are both mounted on the shaft 15. This shaft is formed on the end of a block 21 which is drilled to receive the two bolts 22 and 23 which support the block. The apertures through the bolts are of such a size as to permit the block to rock on the bolts. A nut 24 threaded on the bolt 22 below the block serves to support the block which is yieldingly held against the nut by the helical spring 25 which is mounted on the bolt 22 between the block and the adjusting thumb nuts 26.

The other bolt carries similar helical springs both below and above the block and yieldingly resisting this rocking movement up and down, such springs being designated 27 and 28. A thumb nut 29 adjusts the tension of these springs.

It will be seen that due to this rocking movement permitted by the supporting shaft 15 the rollers can be spread apart to accommodate varying thicknesses of paper and due to the tapered surfaces of the rollers the driving action will be the same no matter what the thickness of the paper and the speed of the drive can be synchronized with the speed of the rollers which are taking the paper in for further fold due to the clutch which permits the upper roller to slip with respect to the driving mechanism.

The paper so folded and so fed first passes between the knurled rollers 30 and 31 mounted upon the shafts 32 and 33 in the side frame 34. The paper thus introduced is moved until it comes in contact with the lower member of the abutment holder 34 which causes it to travel upwardly and at an angle to its original plane of movement. At this point it comes in contact with the stop 35 carried on the upper tapered guides 36 which are parallel to the guides 34ª. These guides are held in position by a screw 37 in the supporting blocks 38 carried on the supports 34. When the paper comes in contact with the abutment 35 it buckles and is forced downwardly along the line of the buckle by the continued feeding of the rollers 31 and 30 until it is introduced between the rollers 31 and 39 which fold downwardly and in doing so crease it along the line of its fold. As it passes between the rollers 31 and 39 it engages with a deflector bar designated generally 40, which may be deflected either to the right or to the left or downwardly according to the setting of the bar.

With reference to this bar it will be observed that the bar 40 consists of a pair of spaced walls 41. These walls are joined together at the end as at 42 by an interconnecting member which also serves as a support for the stub shaft 43. These stub shafts are journalled in the side frame of the machine, designated 34.

On the outer end of one of them is a lever 44 having a spring pressed plunger 45 with a tapered head 46 which is normally thrust into one of the setting apertures 47 in the side wall 34 of the machine. A spring 45ª tends to normally force the plunger inwardly, the spring being located within a cup shaped portion 48 of the lower end of the lever 44 between one end of this cup shaped portion of the lever and the head 46 of the plunger. A knurled head 49 is provided so that the plunger can be withdrawn and moved to a new location for a new setting of the deflector bar.

This deflector bar if it is set as in Figure 1, deflects the sheet which has now been folded in two directions at right angles to each other between the rolls 50 and 51 which are supported on the shafts 52 and 53. The roller 39 is supported on the shaft 54.

The sheet thus introduced in its folded condition between the rolls 50 and 51 is forced along similar guides until it comes in contact with a similar abutment to 35 and is again folded by being caused to buckle due to the continued feeding of the sheet by the rollers 51 and 50 until it passes between the rollers 51 and 55, the last mentioned roll being carried on the shaft 56. Whence the folded sheet is conveyed in the form shown in Figure 2 to a stacker at the bottom of the machine. This conveyor consists of a pair of wide mouthed guides 57 converging closely adjacent to one another to a point where conveyors 58 are located for moving the sheets downwardly in engagement with one of the guides to a point where the sheets can be stacked in folded condition.

If the deflector bar is turned to the position shown in Figure 3, the sheets are fed between the rollers 59 and 60 carried on the shafts 61 and 62 until they come into engagement with the stop between the guides. The sheet then buckles and is then fed between the rollers 60 and 63 which latter roller is carried on the shaft 64. It is then fed out in folded condition as in Figure 4 between the guides 57 to the position to be stacked.

If the deflector bar is in vertical position as in Figure 5 the sheet which is in the position shown in Figure 6 for instance, will pass

directly downwardly between the rollers 51 and 60 to the position to be stacked.

It will be observed that the shafts 54, 56 and 64 are carried in the usual slide blocks in the frame 34 which blocks are controlled by the set screws 65 so that the position of the rollers can be adjusted with respect to the other rollers in each group.

It will be observed that the rollers are spaced an appreciable distance apart. This is preferable because it permits of a low friction loss in a high speed machine, the handling of the machine at high speed and the delivering of the sheets between the rollers at high speed without the likelihood of jamming or buckling.

It will be understood that I desire to comprehend within my invention such modifications as may be necessary to adapt it to varying conditions of use.

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

1. In a folding machine, a plurality of groups of folding mechanisms, and a separate deflector member consisting of a pivotally arranged unit of a permanently spaced pair of plates moving together interposed between said mechanisms to guide the paper to the respective mechanisms or to permit the paper to pass between said plates after having been passed through one of said mechanisms.

2. In a folding machine, a plurality of groups of folding mechanisms and a separate deflector member consisting of a pivotally arranged spaced pair of plates moving together interposed between said mechanisms to guide the paper to the respective mechanisms or to permit the paper to pass between said plates after having been passed through one of said mechanisms, means to adjustably hold said deflector member in position.

3. In a folding machine, a feed table, a pair of superimposed spaced rollers, a diagonally disposed guide, a stop member, a third roller spaced from but on a level with one of the other rollers and beneath the guide, and a deflector member located beneath the space between the last mentioned rollers, said deflector member consisting of a pair of parallel spaced plates rotatably mounted in the frame of the machine.

4. In a folding machine, a feed table, a pair of superimposed spaced rollers, a diagonally disposed guide, a stop member, a third roller spaced from but on a level with one of the other rollers and beneath the guide, a deflector member located beneath the space between the last mentioned rollers, a second pair of rollers widely spaced from one another, a guide and stop mechanism disposed therebetween to one side thereof, and a third roller disposed oppositely from the guide and stop mechanism, said deflector member constituting a guide unit consisting of a pair of permanently spaced guide members adapted to rotate about a central axis to guide paper therethrough in any desired direction according to the position of the spaced guide members.

5. In a folding machine, a feed table, a pair of superimposed spaced rollers, a diagonally disposed guide, a stop member, a third roller spaced from but on a level with one of the other rollers and beneath the guide, a deflector member located beneath the space between the last mentioned rollers, a second pair of rollers widely spaced from one another, a guide and stop mechanism disposed therebetween to one side thereof, a third roller disposed oppositely from the guide and stop mechanism, said second group of rollers being located to one side of the deflector member and mainly below it, so that the sheets can be directed by the member between the rollers of the second group, and a third group of rollers like the second group so arranged that the three rollers are adjacent to one another and the guide members are opposite one another, whereby as the deflector member may be positioned, the sheets may pass from the first group to the second or third or between the third rollers of the second and third groups.

6. In a folding machine, a horizontally disposed feed table projected between first and second rollers superimposed one over the other, a third roller disposed on a level with the second and lower roller, a diagonally disposed guide and adjustable stop mechanism located between the first and third rollers, an adjustable deflector member between and below the second and third rollers, a second group of rollers substantially below and to one side of the deflector member consisting of widely spaced upper and lower rollers one above the other, and a third roller to one side of and partially between the first and second rollers, a guide, an adjustable stop member to one side of and between the first and second rollers, and a third group of rollers, and guide and stop mechanisms arranged in the reverse position substantially below and to one side of the deflector member and spaced from the second group to permit sheets to pass between the third rollers thereof, and means to adjust the third roller of the first group and the second rollers of the second and third groups.

7. In a folding machine, means to fold a sheet, a receiving table, means to convey the sheet on the receiving table to one edge thereof, means to engage said sheet to change its direction of movement and feed it to a second folding means, a second folding means, and a deflector member associated with said second folding means to determine the character of the folds finally imparted to the sheet.

8. In a folding machine, means to fold a sheet, a receiving table, means to convey the sheet on the receiving table to one edge thereof, means to engage said sheet to change its direction of movement and feed it to a second folding means, a second folding means, and a deflector member associated with said second folding means to determine the character of the folds finally imparted to the sheet, said deflector member being adjustable, and a plurality of guide and adjustable stop members associated with the folding mechanisms for determining the size and number and order of the folds imparted to the sheet.

In testimony whereof I affix my signature.

ROBERT J. WATERWORTH.