April 16, 1929. E. D. RADER 1,709,282

FOLDING MACHINE

Filed March 25, 1926 6 Sheets-Sheet 1

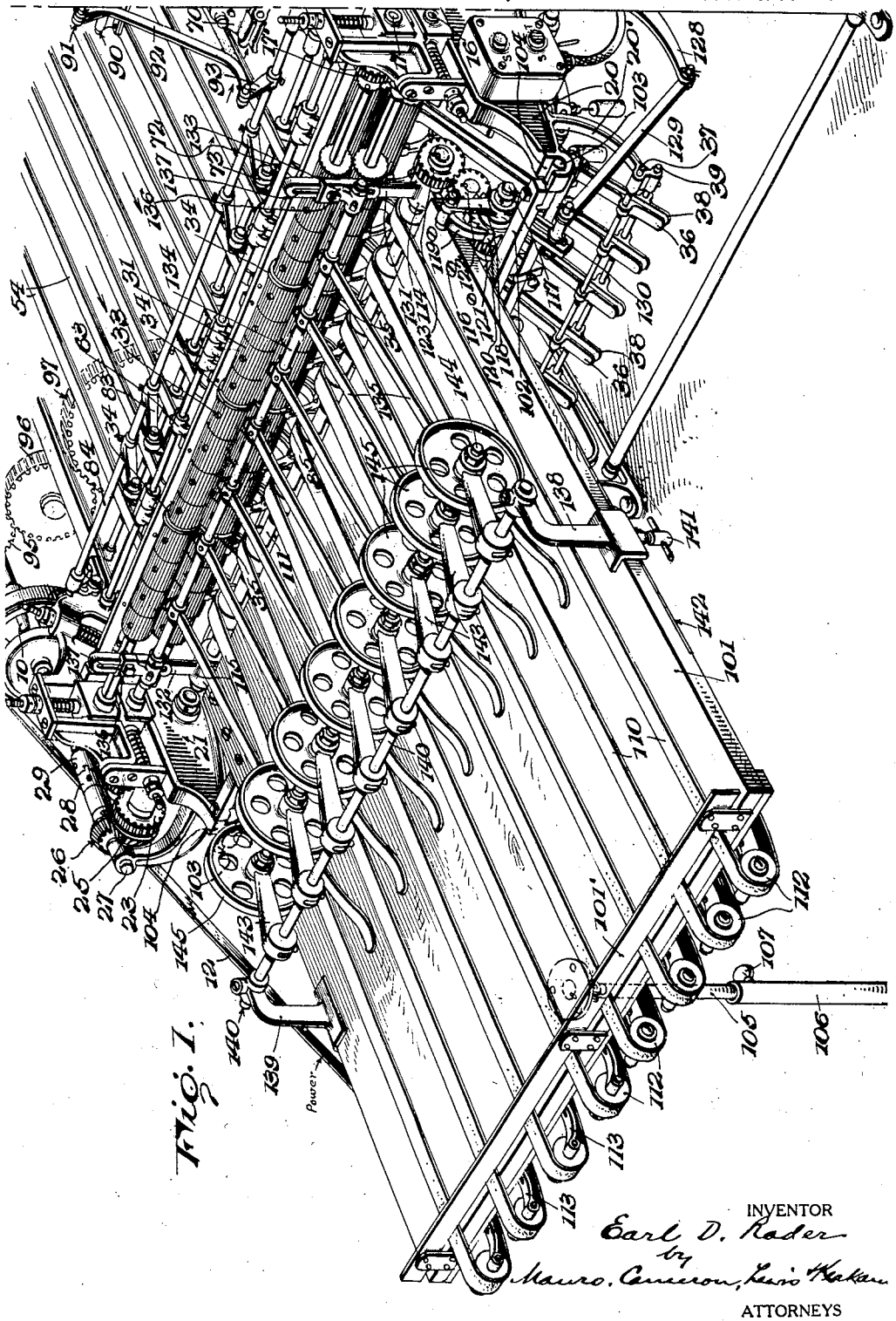


Fig. 1.

INVENTOR
Earl D. Rader
by
Mauro, Cameron, Lewis & Hakan
ATTORNEYS

April 16, 1929. E. D. RADER 1,709,282

FOLDING MACHINE

Filed March 25, 1926 6 Sheets-Sheet 2

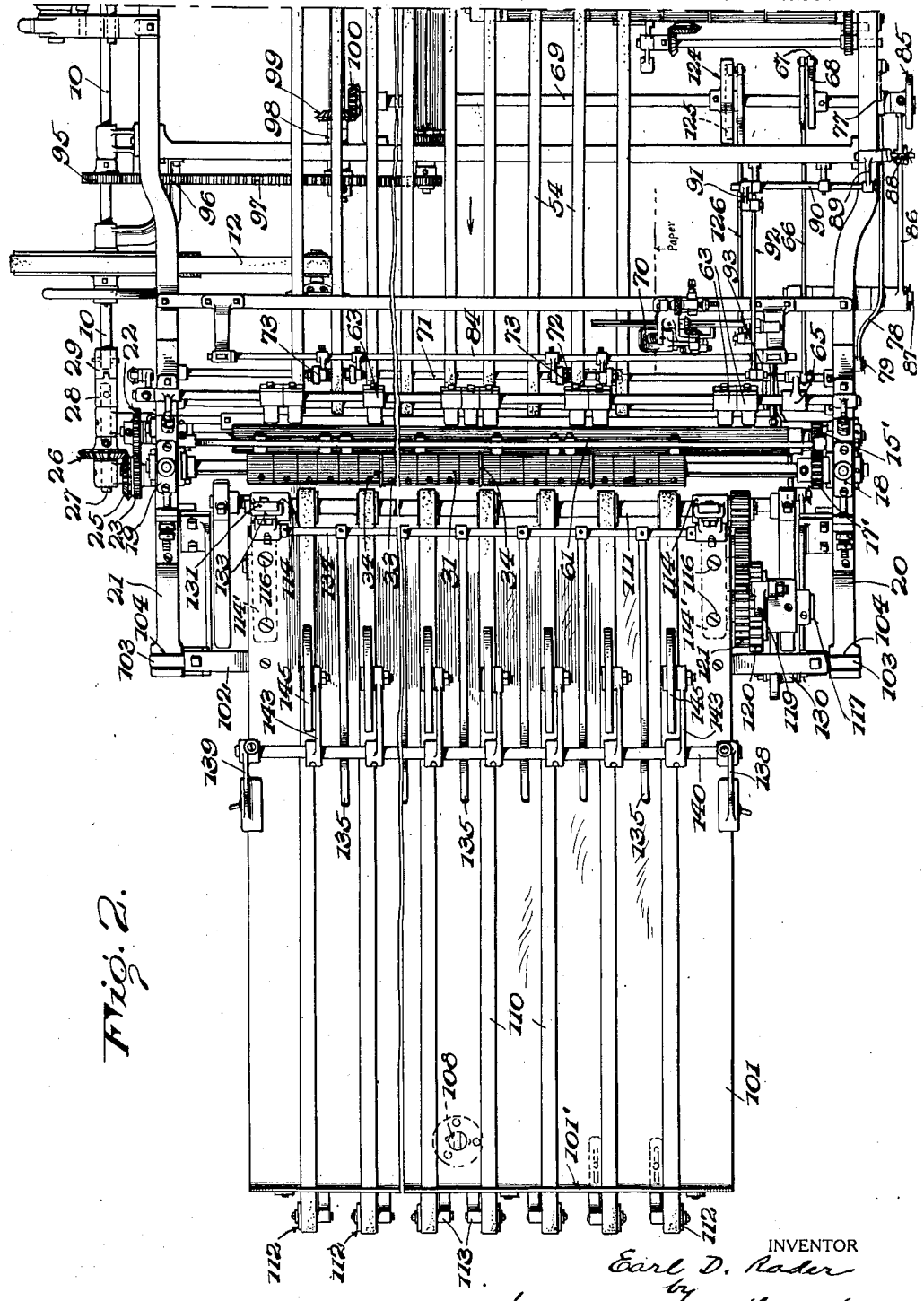


Fig. 2.

INVENTOR
Earl D. Rader
by
Mauro, Cameron, Lewis & Kerkam
ATTORNEYS

April 16, 1929. E. D. RADER 1,709,282

FOLDING MACHINE

Filed March 25, 1926 6 Sheets-Sheet 3

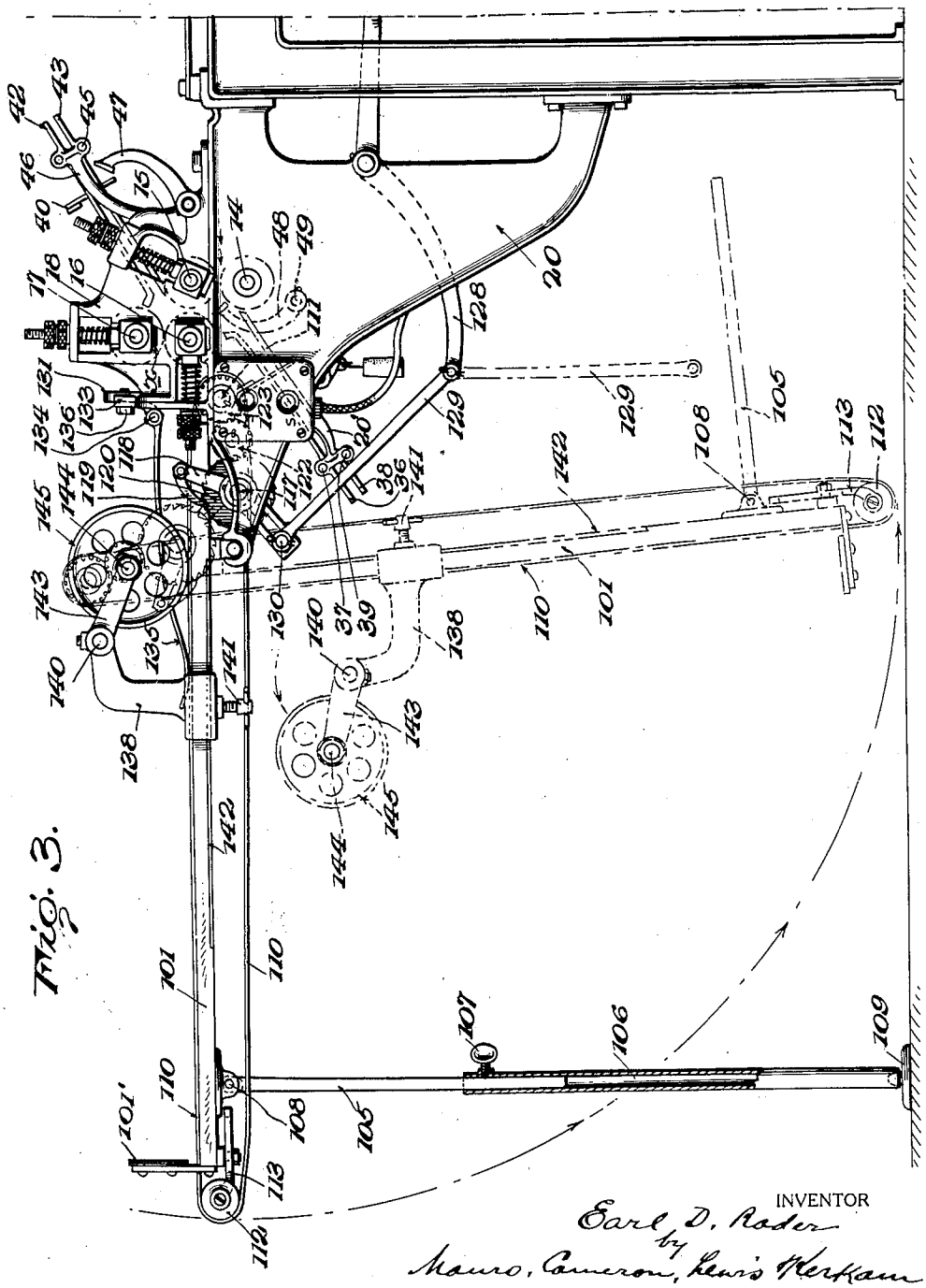


Fig. 3.

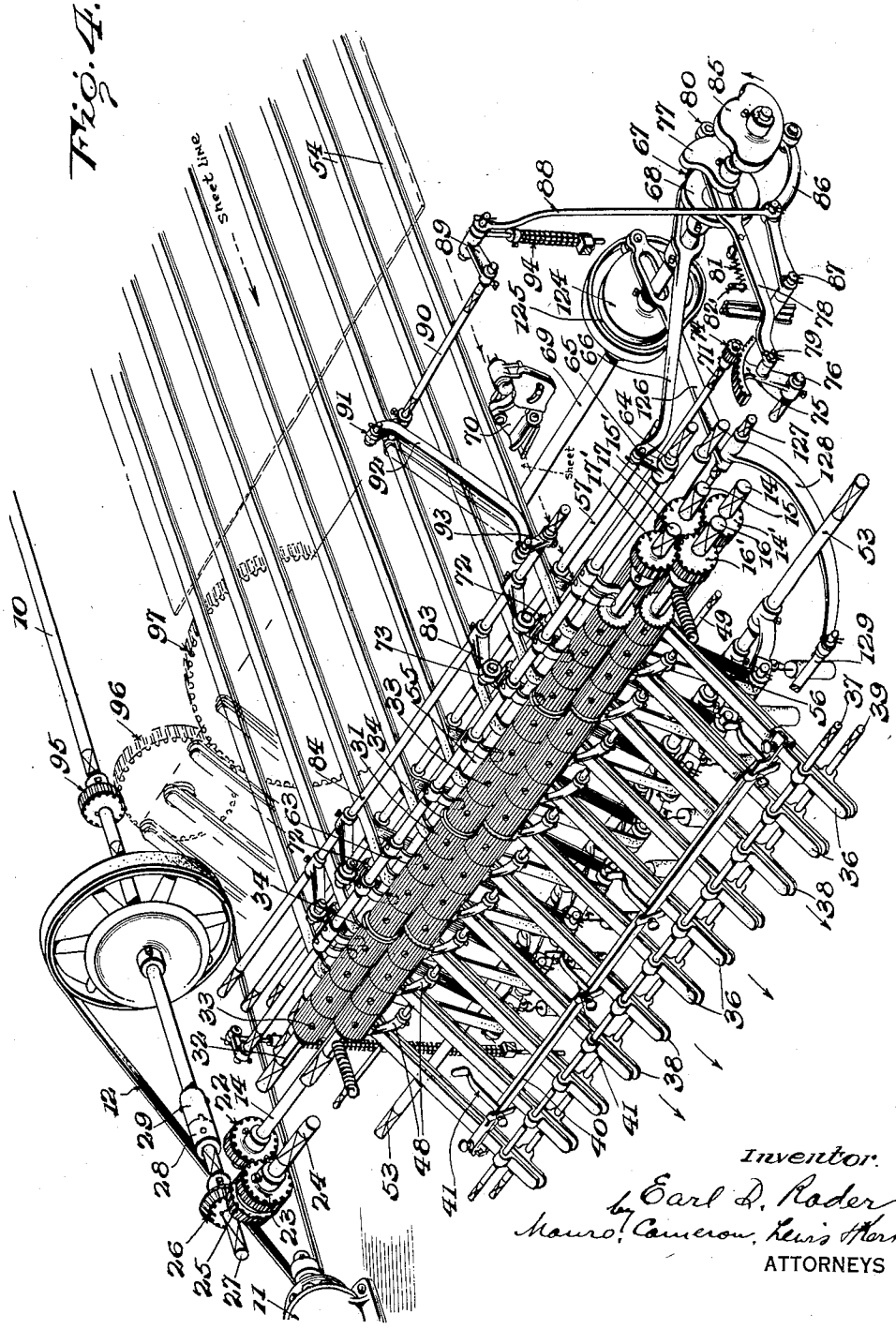
INVENTOR
Earl D. Rader
by
Mauro, Cameron, Lewis & Kerkam
ATTORNEYS

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FOLDING MACHINE

Filed March 25, 1926 6 Sheets-Sheet 4

Fig. 4.



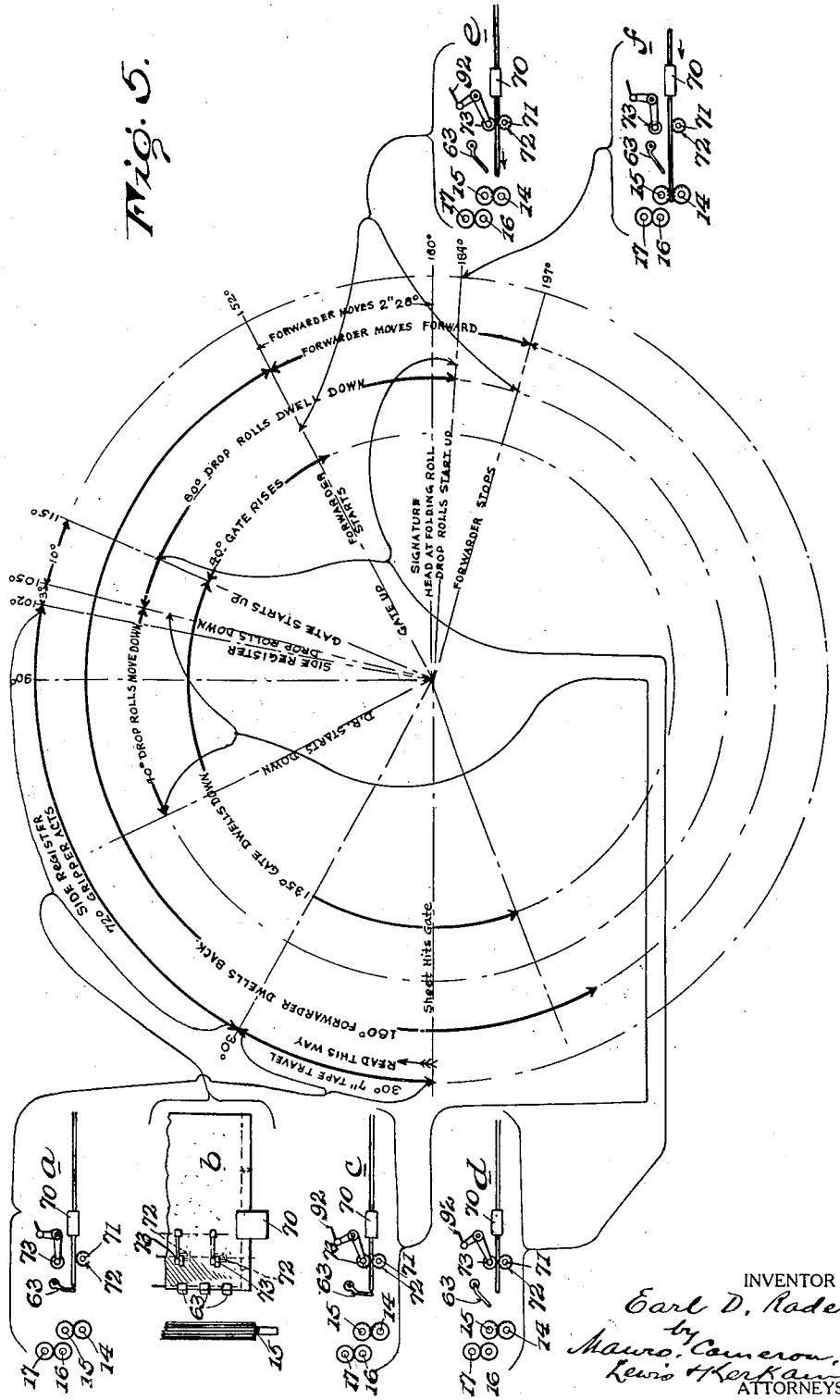
Inventor:
Earl D. Rader
by Mauro, Cameron, Lewis & Herkamp
ATTORNEYS

April 16, 1929. E. D. RADER 1,709,282

FOLDING MACHINE

Filed March 25, 1926 6 Sheets-Sheet 5

Fig. 5.



INVENTOR
Earl D. Rader
by Mauro, Cameron, Lewis & Kerkam.
ATTORNEYS

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FOLDING MACHINE

Filed March 25, 1926 6 Sheets-Sheet 6

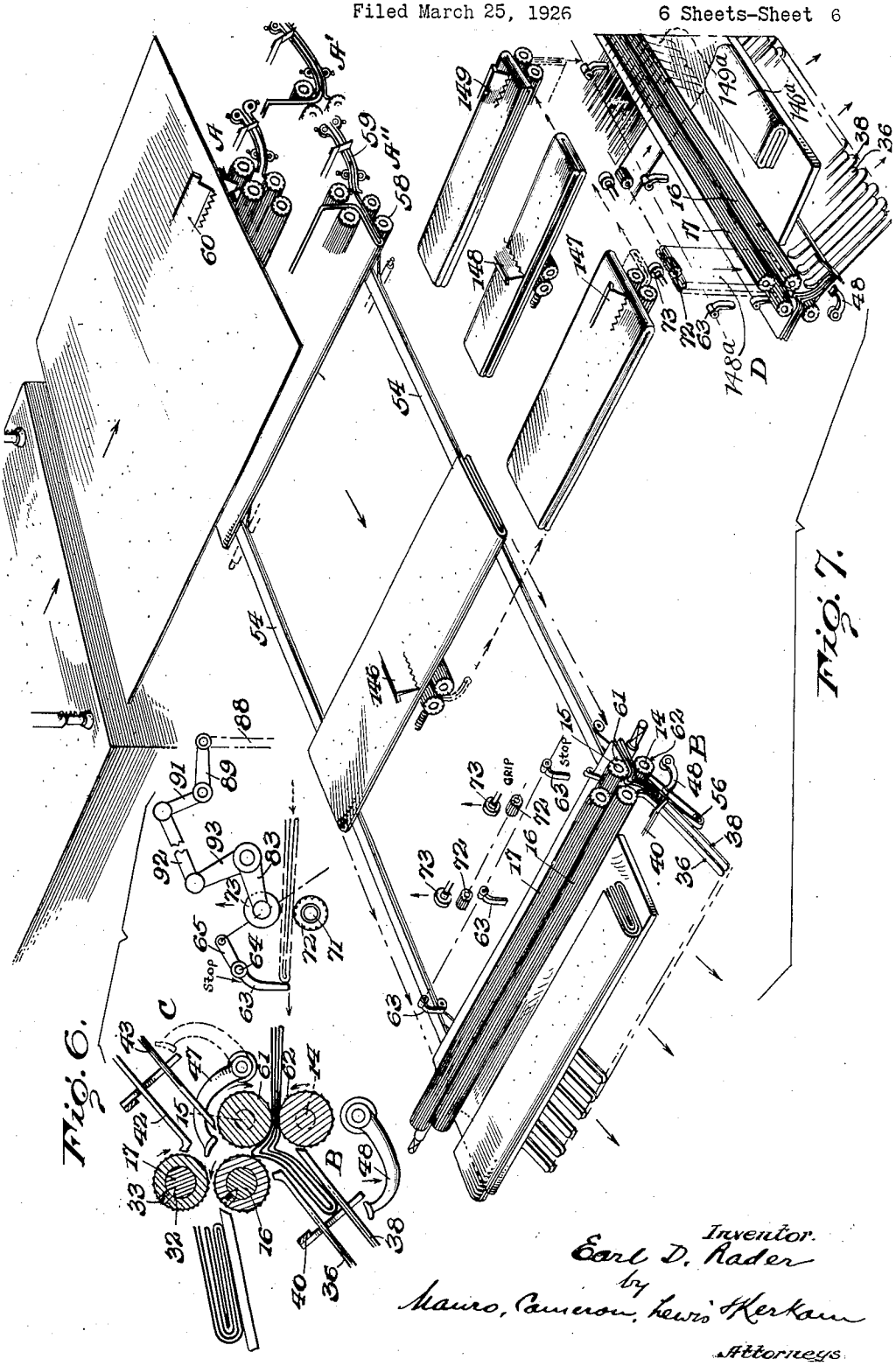


Fig. 7.

Fig. 6.

Inventor.
Earl D. Rader
by
Mauro, Cameron, Lewis & Kerkam
Attorneys.

Patented Apr. 16, 1929. 1,709,282

UNITED STATES PATENT OFFICE.

EARL D. RADER, OF MOUNT KISCO, NEW YORK, ASSIGNOR TO DEXTER FOLDER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

FOLDING MACHINE.

Application filed March 25, 1926. Serial No. 97,378.

The present invention is an improvement in folding machines.

The objects of the invention, generally, are to provide a mechanism by which a larger number of folds can be made with greater economy, accuracy and speed than has been possible with standard machines heretofore on the market.

In one aspect the invention resides in providing a consecutive series of loop-folding mechanisms and breaking up or separating the same so that the partially folded sheet can be re-registered before the folding operation thereon of a succeeding looper mechanism, whereby there is secured uniformity in the final folding of the sheet and the perfection of the folding of the title page and the fold dimension regardless of any error of registering in the preceding folding operation. In such a separated series of loop folders, the operating is greatly simplified so far as diagnosing trouble and rectifying the same is concerned.

In another aspect, the invention resides in providing improved mechanism for delivering a partially folded and re-registered sheet to a loop-folding mechanism at the surface speed of the rollers of the latter, thus insuring great accuracy and facility in the making of the succeeding loop folds. This is a feature of great importance in the successful operation of the folder.

In another aspect the invention resides in an improved means for registering and folding sheets in association with conveying means, to which means the sheets, whether previously folded or not, may be fed manually or by any suitable feeding mechanism.

In still another aspect, the invention resides in slitting or separating the folded sheet while it is still in the control of the folding rollers, which has important advantages, particularly as regards accuracy.

In another and important aspect, the invention resides in the provision of a loop-folding attachment that can be readily attached to the standard jobbing or other folder in various positions, with marked advantages over present types of knife-fold attachments in economy of space, accessibility to the basic machine, accuracy and speed of folding, and control of the desired imposition.

Further, the invention resides in an improved construction of folding roller constituted by a plurality of separable and adjustable sleeves; and also in an improved construction of stacker board that is adjustable with relation to the final folding rollers, and that is preferably adapted to be easily moved to inoperative position or to be readily removed from the folding machine.

Various other features of invention and improvements will be pointed out in connection with the detailed description of the accompanying drawings, illustrating one embodiment of the inventive idea, and wherein—

Figs. 1, 2 and 3 are respectively a perspective, plan and side elevation of the last looper mechanism and the associated stacker-board;

Fig. 4 is a perspective view of the loop-fold mechanism and associated parts, with the stacker-board removed;

Fig. 5 is a diagrammatic layout, showing the relative positions of the sheet, the gate or stop, and the sheet-forwarding or feeding mechanism at various stages of the operation, in association with a diagram showing the sequence and duration of the several operations;

Fig. 6 is a side elevation, partially in section, of the loop-folding mechanism and associated parts; and

Fig. 7 is a view showing the improved attachment in two positions.

Referring to the drawings, wherein like reference numerals indicate like parts, 10 is a power shaft which is driven from any suitable source of power, as a motor 11, through belt 12. From this shaft 10 is driven all of the mechanisms of the folder proper, as well as the folding rollers and associated mechanism shown in Figs. 1–4, inclusive.

These folding rollers are mounted, respectively, on shafts 14, 15, 16 and 17, which latter have suitable bearings in standards 18 and 19 carried, respectively, by brackets 20 and 21 which are bolted or otherwise secured to the frame of the jobber or other folder, as shown in Fig. 3.

Shaft 14 is driven from shaft 10 through gear 22 mounted on shaft 14, meshing with a gear 23 carried by a shaft 24 which is also provided with a bevel gear 25 that meshes with a bevel gear 26 carried by a short shaft 27, which latter is secured in any suitable manner to shaft 10, as by coupling sleeves 28 and 29. Uncoupling the sleeves 28 and 29 renders the attachment inoperative.

Shafts 15, 16 and 17 are driven from shaft

14 and are rotated therefrom in the direction indicated by the arrows in Fig. 6. A gear 14′ meshes with a gear 15′ on shaft 15, gear 15′ meshes with a gear 16′ on shaft 16, and gear 16′ meshes with gear 17′ on shaft 17.

Each of said folding rollers has preferably a knurled surface, and each of the rollers carried by shafts 16 and 17 is preferably constituted by a plurality of separate, knurled sleeves 30 (on shaft 16) and 31 (on shaft 17). These sleeves are adjustable along their respective shafts, and each is provided with means for fixedly securing the same in position on its shaft. As here shown (Figs 6), each of said shafts is provided with a V-shaped slot 32 that extends longitudinally thereof, each sleeve being provided with a V-shaped set-screw 33 that is adapted to be screwed into said slot to securely hold the sleeve in any desired position of adjustment. This arrangement is not only effective in avoiding the difficulties heretofore encountered with respect to adjustment of the sleeves and the absence of burring of the groove and play of the sleeves, but enables slitters 34 to be placed and secured in any desired position on shaft 17, for example, with corresponding clearances 35 between the sleeves 30 on shaft 16, so that the slitters 34 can cut against the ends of the associated sleeves 30.

Associated with said folding rollers is a looper-mechanism of any suitable construction, preferably composed of a series of upper grid members 36 mounted on a rod 37, and lower grid members 38 mounted on a rod 39, these rods having bearings in brackets 20′ (Fig. 3). The upper grids preferably carry means to determine the point at which the loop or fold in the sheet is to be effected. As here shown, this may consist of a rod or bar 40 that is adjustable along said grids, said rod carrying a plurality of gages 41 which are engaged by the sheet between the upper and lower grids. Preferably, a second similar looper mechanism is associated with the folding rollers 14, 15, 16 and 17, the same being mounted in the position indicated in Fig. 6, in which 42 are the upper grid members and 43 the lower grid members, mounted, respectively, on rods 44 and 45 (Fig. 3) carried by brackets 46. It will be understood that either one of these looper mechanisms may be used, dependent upon the desired imposition of the folded product, or that both may be used to secure two parallel folds at this point, or that neither may be used, in which event the rollers simply act to deliver the product of the preceding folding mechanism, either slitted or unslitted. If it is desired to deliver the signatures unslitted, the cutting roller will be elevated out of engagement with the signature, as by the use of a wedge at *x*, Fig. 3.

As clearly shown in Fig. 6, when the sheet is being looped between grids 36 and 38, deflector fingers 47 prevent the entry of the sheet between grids 42 and 43, whereas when the deflector fingers 47 are in the dotted line position, deflector fingers 48 associated with grids 36 and 38 will be moved to position to prevent the entry of the sheet between said latter grids. When both looper mechanisms are employed at the same time, both deflectors will be moved to their inoperative position. These deflector fingers 48 (Fig. 4) are preferably mounted on a rod 49 carried in the side frames of the attachment. The deflector fingers 47 are similarly mounted. Said fingers are moved by the operator to their operative or inoperative position by rotating the rod 49 through a hand-wheel (not shown) and by it held in operative or inoperative position.

The partially folded sheets are progressed into position to be delivered to the folding rollers (Figs. 4, 6 and 7) by suitable conveying means, such as a series of endless tapes 54 that pass downwardly over idler roller 55, around idlers 56, upwardly over idler rollers on shaft 57, and thence around roller 58 (Fig. 7, from which said tapes are preferably driven. The roller 58 is one of the group associated with a looper mechanism 59 which, in the embodiment of the invention herein illustrated, is associated with the first-fold knife 60. The indications at A, A′ and A″ (Fig. 7) show the manner in which, by a knife and loop construction, two parallel folds are imparted to the product (as fully described and claimed in my copending application Sr. No. 71,167) that is deposited on the tapes 54 to be progressed to the looper mechanism heretofore described, by which there is imparted to the sheet a third and fourth parallel fold.

The accuracy of this third parallel folding operation depends upon the manner in which the partially folded sheet is delivered to the rapidly rotating rollers 61 and 62 (Fig. 6); and to this end there are provided means for registering the sheet before it is so delivered and likewise means for effecting this delivery at substantially the surface speed of said rollers while maintaining register, thus insuring the greatest accuracy of presentation and the maximum output of a highly uniform product.

As best shown in Figs. 4–7, inclusive, the progress of the partially folded sheet on the tapes 54 is stopped and the sheet brought to rest by a gate or stop mechanism, preferably comprising a series of fingers 63 adjustably mounted on a shaft 64 having bearings in standards 18 and 19. These fingers are lowered into the path of the partially folded sheet and raised out of the path of the same by means of an arm 65 secured to shaft 64, to the free end of which arm is connected one end of a link 66, the other end of which carries a roller 67 that engages the face of a

cam 68 mounted on a cam shaft 69. The sheet so arrested is then side registered, if desired or necessary, by any suitable means 70.

The previously folded sheet in this position against the gate or stop 63 is engaged on one, preferably its under, surface by a forwarding or feeding mechanism that is adapted to be intermittently operated and which, during the time the gate is in the path of the sheet, is stationary. This forwarding or feeding mechanism, as herein illustrated, comprises a shaft 71, preferably provided with knurled members 72 adjustable therealong and engaging the under side of the sheet, a drop roller 73 being preferably associated with each member 72 and being adapted to engage the other surface of the sheet above said member 72.

The shaft 71 is driven or rotated intermittently by any suitable means. As here shown, a gear 74 carried by said shaft 71 meshes with a toothed segment 75 pivoted at 76 and operated by a cam 77, mounted on shaft 69, through a link 78, one end of which is connected to said segment at 79 and the other end of which carries a roller 80 that engages the surface of said cam 77. The forwarding or feeding movement of said shaft 71 is in a counterclockwise direction, as seen in Fig. 6, and this movement is effected by said cam which is designed to rotate said shaft at accelerated speed which, at the moment the sheet is delivered into the bight of rollers 61 and 62, is the surface speed of said rollers. The segment 75 is moved to its initial position by means of a spring 81 secured at one end to the link 78 and anchored at its other end to the frame of the machine at 82.

The drop rollers 73 are each carried in an arm 83 adjustably mounted on a shaft 84. This shaft is rocked to raise and lower the drop rollers at the proper time by a cam 85 mounted on cam shaft 69 and operating through an arm 86 pivoted at 87, a rod 88, arm 89, shaft 90, arm 91, link 92 and arm 93 carried by said shaft 84. The drop rollers are elevated by said cam and are pressed yieldingly against the sheet by means of a spring 94.

The sequence and duration of the operation of the gate or stop 63, the side registering mechanism 70, the drop rollers 73 and the forwarding or feeding shaft 71 are graphically indicated in Fig. 5, the positions of the several parts at each stage of the operation of stopping, side registering and feeding the sheet forward into the bight of rollers 61 and 62 being shown at *a*, *b*, *c*, *d*, *e*, *f*.

The shaft 69 on which the cams 68, 77 and 85 are mounted is driven from shaft 10 through a train of gearing comprising a pinion 95 on shaft 10 that meshes with an idler 96 that in turn meshes with a gear 97 on a shaft 98 that carries a bevel gear 99 meshing with a bevel gear 100 on shaft 69.

The folded sheet, slitted or separated, if desired, into component parts, is delivered from the folding rollers onto a suitable stacker-board. Preferably, the stacker-board employed is that illustrated herein. as shown, the board 101 is provided on its under surface with a cross-bar 102 in the ends of which are carried pivot pins 103 that engage in recesses 104 in the brackets 20 and 21. at the end of the board remote from the rollers is provided a telescopic support comprising members 105 and 106, a set-screw 107 acting to hold the parts in any desired position of adjustment. The supporting member 105 is preferably pivoted to the under side of the board at 108, and the supporting member 106 preferably engages over a projection on a base plate 109. Through the structure described, the end of the stacker-board adjacent the rollers can be readily raised or lowered with respect to the same, the proper position of the stacker-board for successful stacking of any signatures being determined by the character of the stock, the weight of the sheet or signature, and the number of sections into which the signature may have been cut. Further, the stacker can be readily swung to the dotted line position shown in Fig. 3 by simply withdrawing the member 105 from member 106; member 106 then may be lifted from base plate 109, thus clearing the floor when the stacker-board is not in use.

This stacker-board is preferably provided with a plurality of endless tapes 110 which pass around rollers on a shaft 111 and around rollers 112 carried in arms 113. Step-by-step movement is preferably imparted to the tapes from this shaft 111 which is mounted in castings 114, 115 secured to the under surface of the board in any suitable manner, as by screws 116. The outline of this casting beneath the board is shown in dotted lines at 114′ in Fig. 2.

The shaft 111 is rotated step-by-step in any suitable manner as by a pawl and ratchet connection. Mounted on a stub shaft 117 carried by the stacker-board 101 is a pawl carrier 118 on which a pawl 119 is secured. This pawl meshes with a ratchet 120 loosely mounted on stub shaft 117, to which ratchet there is secured a gear 121 that meshes with an idler gear 122 which in turn meshes with a gear 123 on said shaft 111. The pawl carrier is operated from a cam 124 on shaft 69. This cam is preferably provided with a cam slot in which engages a roller 125 carried in one end of a lever 126 pivoted on shaft 127, the other arm 128 of said lever being connected to one end of a link 129, the other end of which link is connected to the pawl carrier through a pin and slot connection at 130 for controlling the extent of movement of the pawl 119.

There are preferably formed integrally

with the castings 114 and 115 a pair of uprights 131 and 132 which carry blocks 133 forming bearings for a cross-rod 134 rigidly mounted in said blocks 133. Carried by said rod 134 are a plurality of top rods 135. The blocks 133 are adjustable vertically along the uprights 131 and are adapted to be secured in any desired position of adjustment by means of a screw 136 engaging in a slot 137.

There is also preferably mounted on said stacker-board 101 a pair of standards 138 and 139 which carry a cross-rod or bar 140. These standards are adjustable longitudinally of the board and are adapted to be secured in adjusted position by means of set-screws 141. The screws 141 are adapted to engage a metal plate 142 secured to the under surface of the board. The cross-rod 140 has mounted thereon a plurality of arms 143, in the free end of each of which there is mounted on a pin 144 a roller 145. Preferably, there is a roller associated with each of the endless tapes 110, said rollers bearing on the top of the delivered signatures and pressing the same by gravity or otherwise against the endless tapes 110. These arms 143 are so mounted on rod 140 that they may be swung through an arc of 180° to accommodate various sizes of signatures. A stop 101′ is secured to the outer end of the stacker-board in any suitable manner. The signatures are stopped by the same, a pile being formed at said stop, and succeeding signatures are fed onto the pile.

The stacker-board 101 and the various parts carried thereby can be readily removed from the folder, when desired, by simply disconnecting the pin and slot connection at 130 between the link 129 and the pawl carrier 118, as indicated in Fig. 3, disconnecting the parts 105 and 106 of the telescopic support, and then lifting the stacker-board from its pivotal position at 104.

From the foregoing description of the construction and operation of the device, the manifest advantages of the same will be readily understood by those skilled in the art. The attachment described can be secured in any desired position on the jobber or other folder, two of which are indicated in Figs. 6 and 7. In these views, the attachment is shown in position at BC and D. When the attachment is in use at BC, it is not used at D, and it will be understood, as heretofore described, that when so used at BC the folded sheet will pass directly from A to BC without any intermediate folding and that at this time knife 146 is inoperative. The attachment as shown at D is operating on a signature that has received two parallel folds (by the knife 60 and the associated looper mechanism) followed by a right angle fold at the knife 146, to impart thereto one or two folds parallel to that made by the knife 146, it being understood that a pair of looper mechanisms similar to B and C are, or may be used at D for this purpose. It will be understood that, when the attachment at D is operating, the knife fold mechanisms 147, 148 and 149 are inoperative. When the attachment is used at D, the attachment at BC is readily disconnected by uncoupling sleeves 28 and 29.

The signature 146ª (Fig. 7) is the result of the operation of the folding mechanism at 146 followed by the operation of the loop folding mechanism at D. The signature 148ª, indicated in dotted lines in a position to be delivered from the machine, is the result of the operation of the folding mechanism at 148; and the signature 149ª, indicated in the delivery, is the result of the operation of the folding mechanism 149. In this view the signature 146ª is the only signature that has been operated on by the looping mechanism at D.

It is to be noted that that part of the mechanism illustrated in Fig. 4 may, if desired, have sheets either folded or unfolded fed thereto manually or by any suitable feeding mechanism.

The terms "sheet" and "signature" have been interchangeably used in the description and claims.

While, for the purpose of illustration, one expression of the inventive idea has been shown and described in detail, it will be understood that the invention is not limited thereto and that the inventive idea is susceptible of various mechanical expressions within the limits of the appended claims.

What is claimed is:—

1. In a folding machine, the combination of means for folding a sheet, a second folding instrumentality provided with a plurality of folding rollers driven at a predetermined speed, a conveyor for progressing the folded sheets from said means to said instrumentality, means for stopping the folded sheet before it is presented to said instrumentality, and means having an accelerated movement and engaging the folded sheet on said conveyor for presenting the folded sheet to said instrumentality at substantially the speed of the latter.

2. In a folding machine, the combinaiton of means for folding a sheet, a loop folding mechanism provided with a plurality of folding rollers driven at a predetermined speed, a conveyor for progressing the folded sheet from said means to said mechanism, means for stopping the folded sheet before it is presented to said mechanism, and means having an accelerated movement and engaging the folded sheet on said conveyor for presenting the folded sheet to said mechanism at substantially the surface speed of the latter.

3. In a folding machine, the combination of means for folding a sheet, a loop folding mechanism provided with folding rollers, driven at a predetermined speed, a conveyor

for progressing the folded sheet from said means to said rollers, means for registering the folded sheet before it is presented to said rollers, and means having an accelerated movement and engaging the folded sheet on said conveyor for presenting the folded sheet to said rollers at substantially the surface speed of the latter.

4. In a folding machine, the combination of means for folding a sheet, a loop folding mechanism provided with folding rollers, a conveyor for progressing the folded sheet from said means to said rollers, means for stopping the folded sheet before it is presented to said rollers, and means engaging the folded sheet on said conveyor for advancing the sheet at accelerated speed and presenting it to said rollers at substantially the surface speed of the latter.

5. In combination, sheet advancing means, folding means provided with rollers, means for registering said sheet, and means positioned below and engaging the under surface of said sheet for delivering said sheet to said rollers at substantially the surface speed of the latter.

6. In combination, sheet advancing means, folding means provided with rollers, means for registering said sheet, and intermittently operating means for delivering said sheet to said rollers at substantially the surface speed of the latter.

7. In combination, sheet advancing means, folding means provided with rollers, means for registering said sheet, normally stationary feeding mechanism engaging the sheet, and means for driving said mechanism at accelerated speed and delivering said sheet to said rollers at substantially the surface speed of the latter.

8. In combination, sheet advancing means, folding means provided with rollers, means for registering said sheet, a normally stationary member engaging one side of said sheet, cooperating means engaging the other side, and means for delivering said sheet to said rollers at substantially the surface speed of the latter through the movement of said member.

9. In combination, sheet advancing means, folding means provided with driven rollers, means for stopping and registering said sheet, a normally stationary shaft mounted adjacent the sheet path, and means for driving said shaft at an accelerated speed and delivering said sheet to said rollers at substantially the surface speed of the latter.

10. In combination, sheet advancing means, folding means provided with driven rollers, means for stopping and registering said sheet, a normally stationary shaft mounted adjacent the sheet path, and cam-operated means for driving said shaft intermittently and delivering said sheet to said rollers at substantially the surface speed of the latter.

11. In combination, a plurality of loop folding mechanisms, conveying means for progressing the partially folded sheet from one mechanism to another, means for registering the sheet on said conveying means, and means intermittently operated and having an accelerated movement for delivering said partially folded sheet to the succeeding loop folding mechanism at substantially the surface speed of the latter.

12. In a loop folding mechanism, a plurality of folding rollers, and rotary means for slitting the sheet as it passes through said folding rollers.

13. In a loop folding mechanism, a plurality of folding rollers, and means carried by one of said rollers for slitting or separating the sheet as it passes through said rollers.

14. A folding roller comprising a shaft provided with a longitudinal groove, a plurality of separable sleeves slidable along said shaft, and means carried by each sleeve and engaging in said groove to position said sleeve on said shaft.

15. A folding roller comprising a shaft provided with a longitudinal groove V-shaped in cross-section, a plurality of separable sleeves slidable along said shaft, and a V-shaped screw carried by each sleeve and engaging in said groove to position said sleeve on said shaft.

16. A folding roller comprising a shaft provided with a longitudinal groove V-shaped in cross-section, a plurality of separable sleeves slidable along said shaft, a V-shaped screw carried by each sleeve and engaging in said groove to position said sleeve on said shaft, and a plurality of removable slitters slidable along said shaft and held in position between said sleeves.

17. An attachment for a folding machine comprising a loop fold mechanism, a conveyor for delivering the signature to said mechanism, means for registering the signature, on said conveyor and means for presenting the signature to said mechanism at substantially the surface speed of the latter.

In testimony whereof I have signed this specification.

EARL D. RADER.