

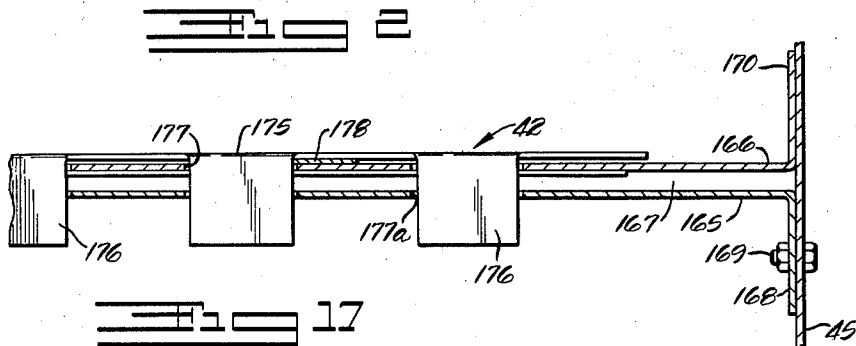
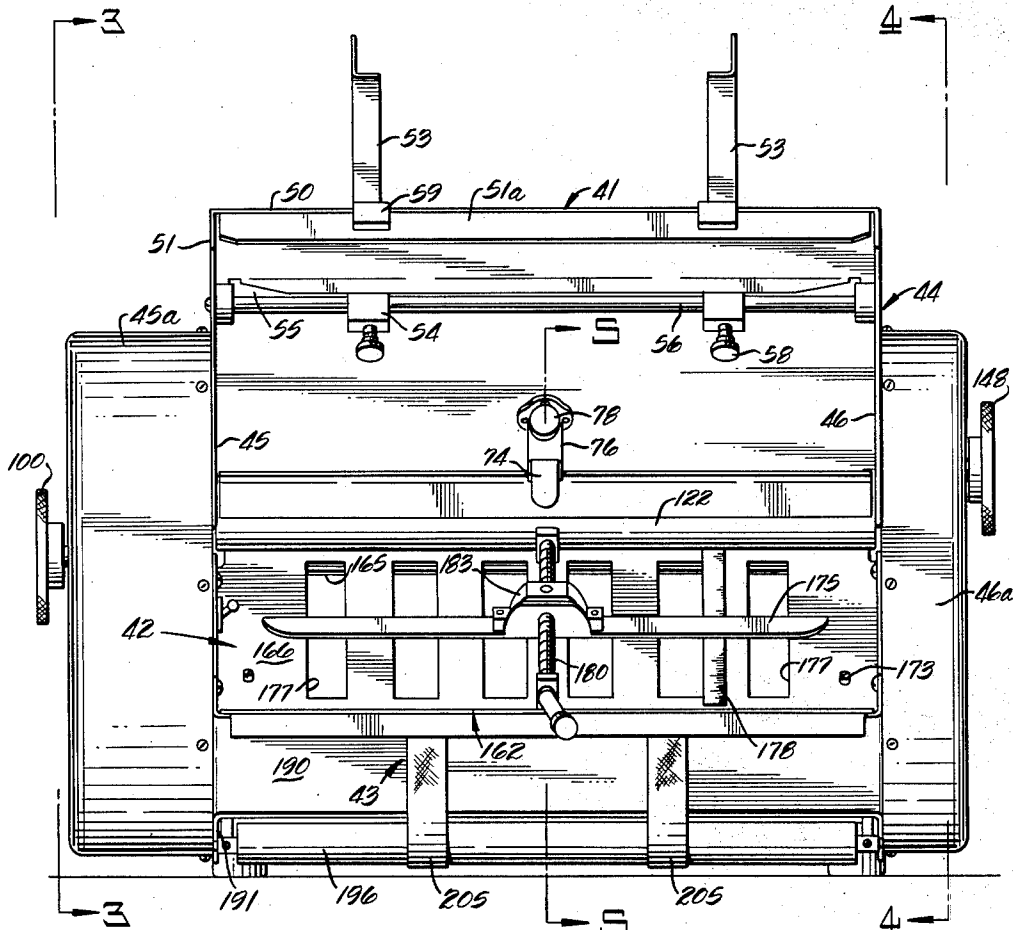
Sept. 29, 1964

H. BOBLIT, JR., ETAL
 ROLLER SUPPORTING AND ADJUSTING MEANS FOR
 BUCKLE-TYPE SHEET FOLDING MACHINE

3,150,871

Filed July 11, 1961

18 Sheets-Sheet 2



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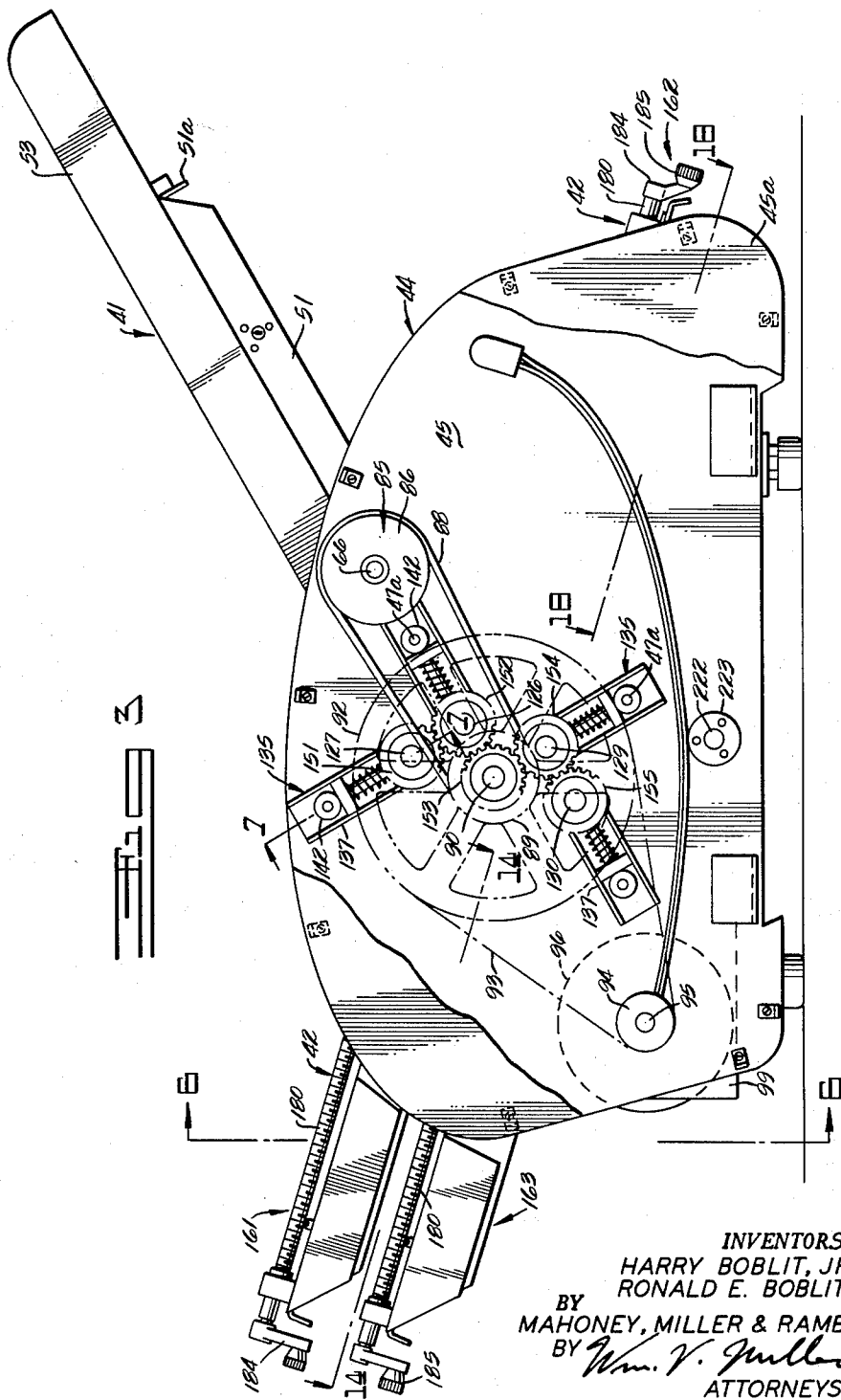
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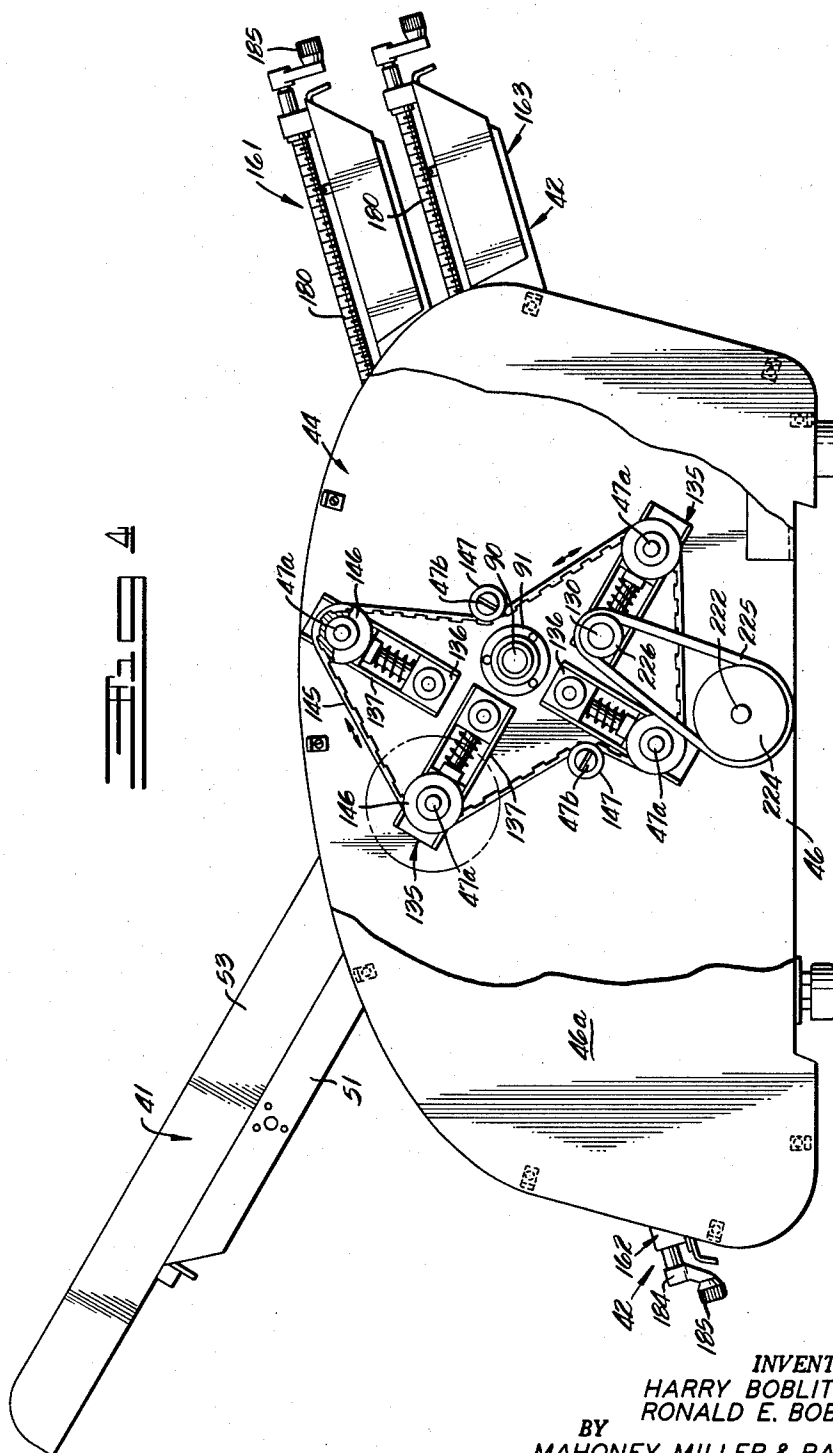
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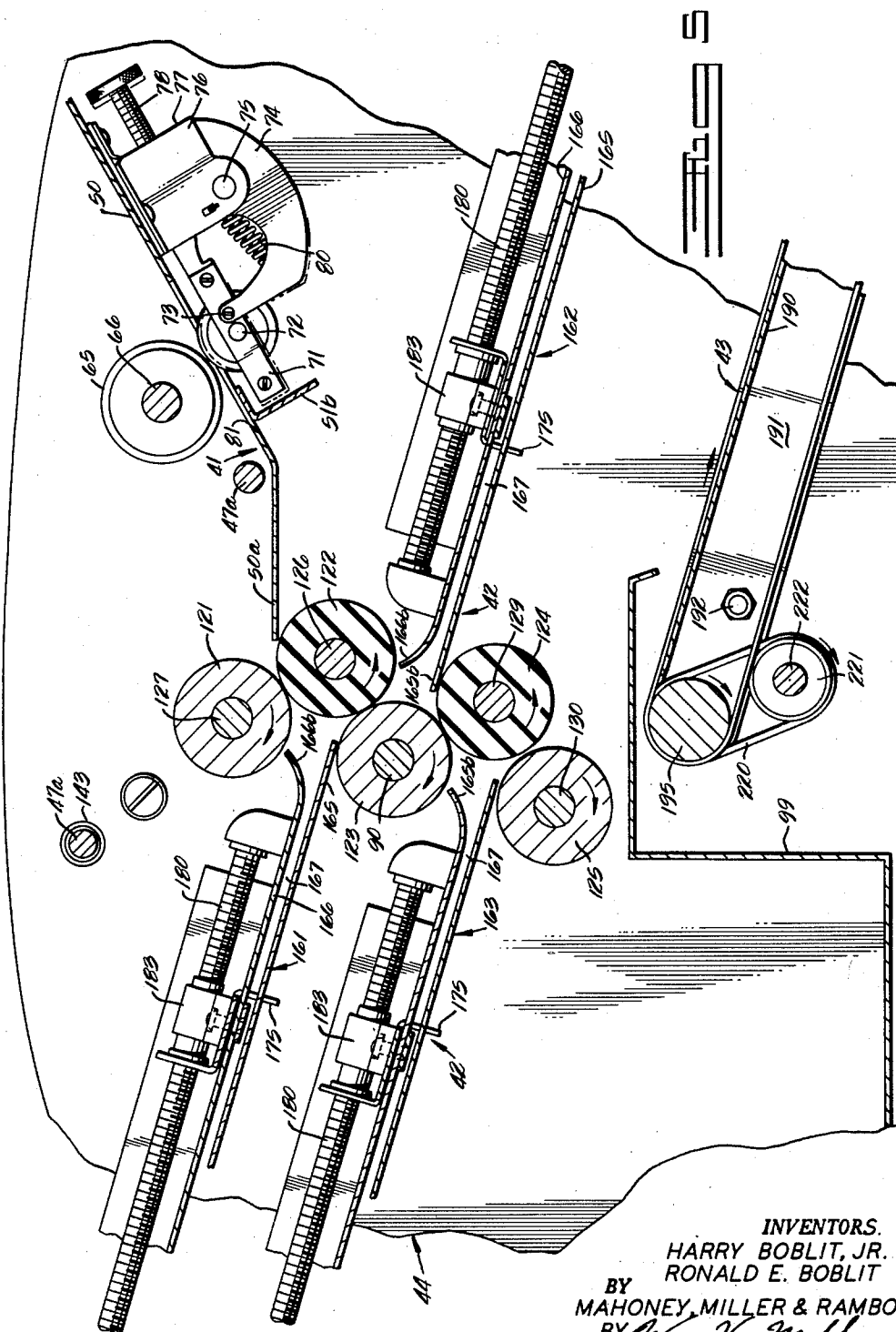
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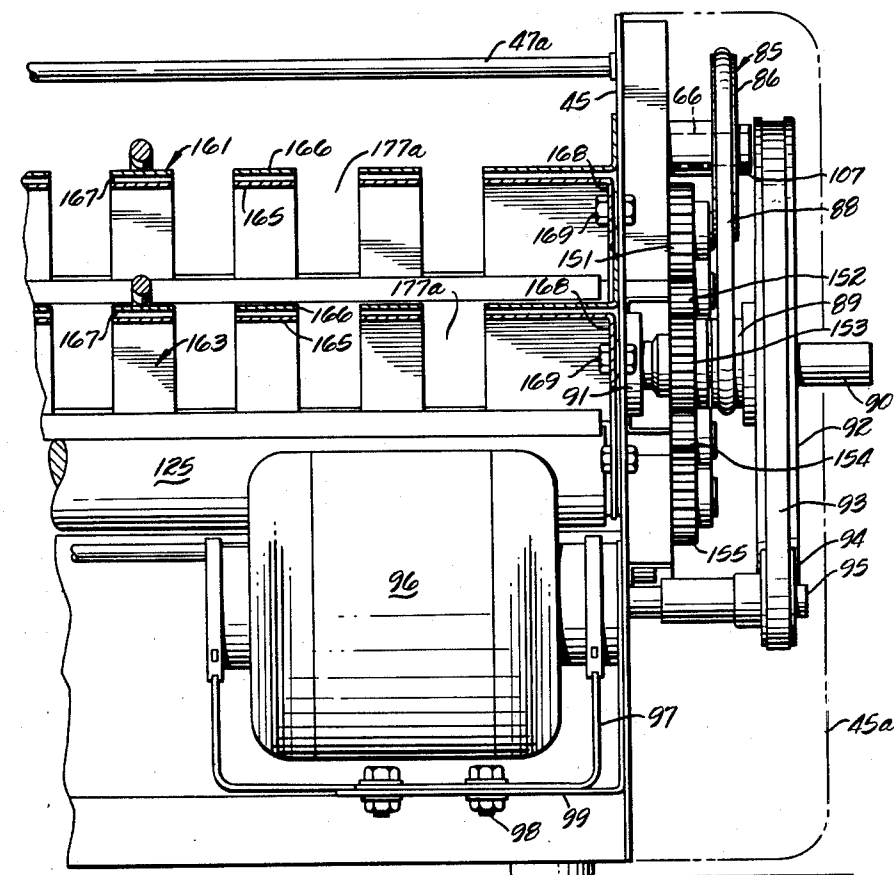


Fig 20

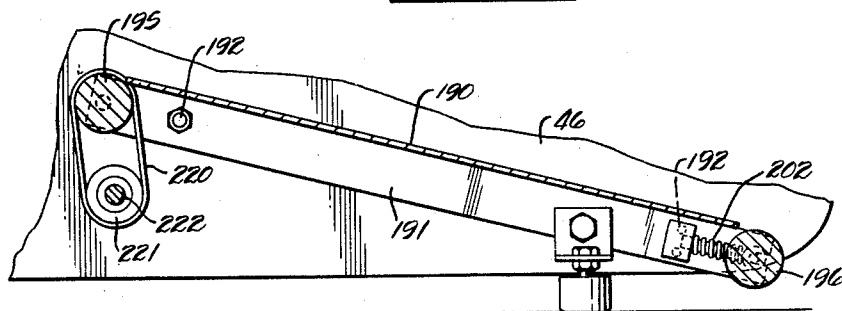


Fig 21

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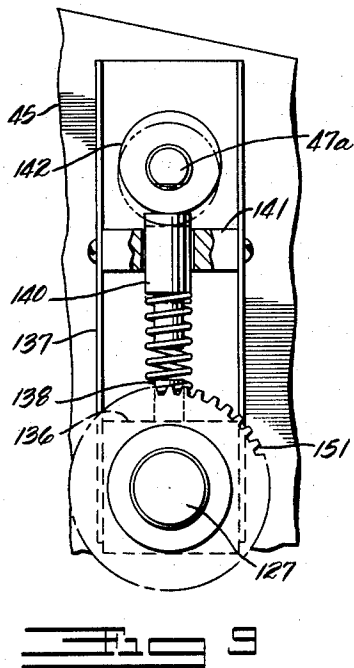
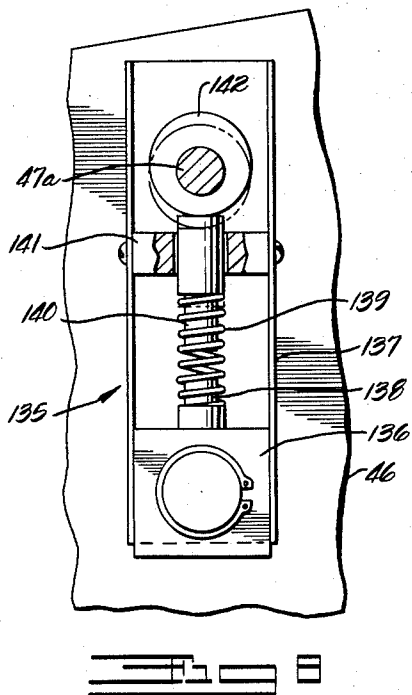
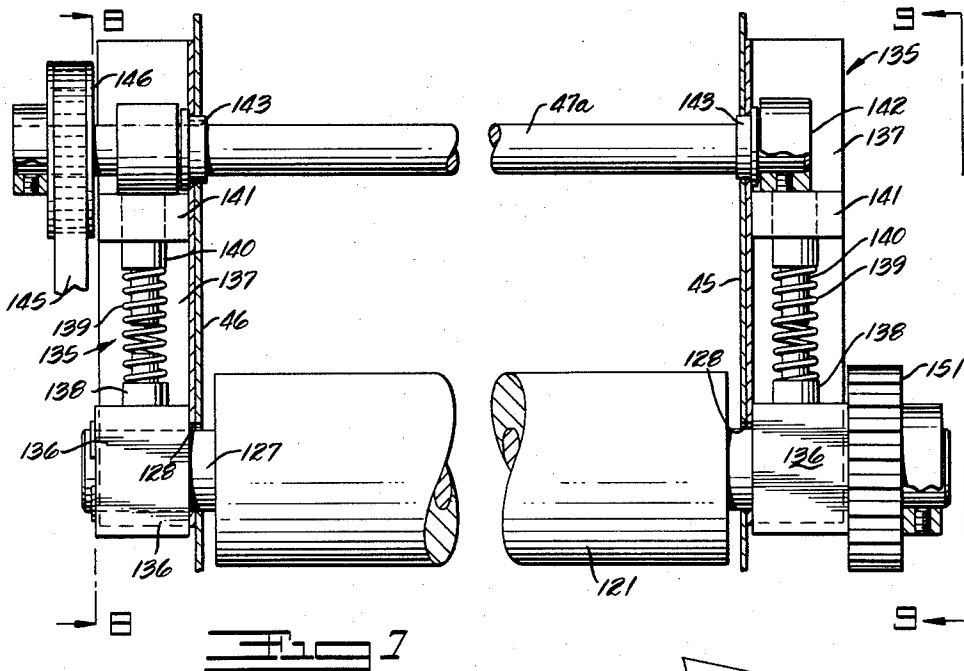
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18 Sheets-Sheet 7



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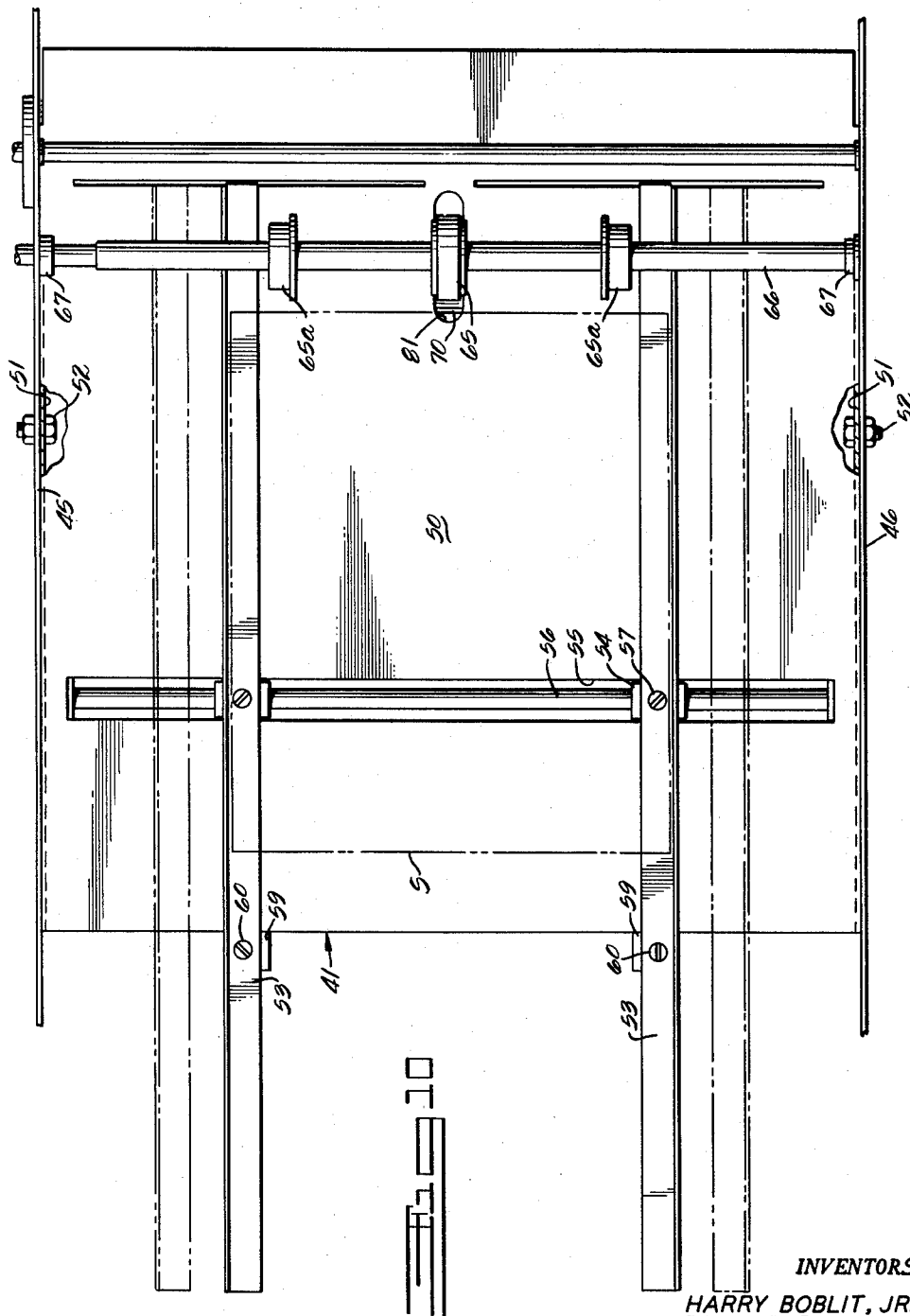
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18 Sheets-Sheet 8



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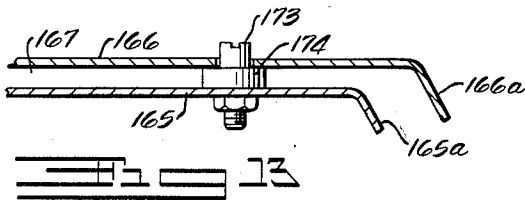
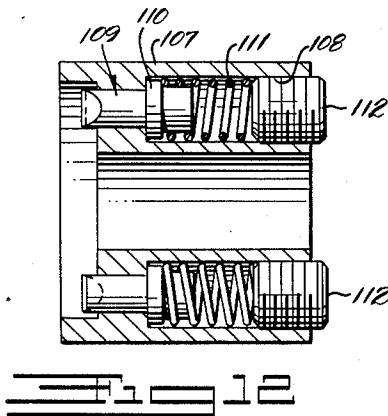
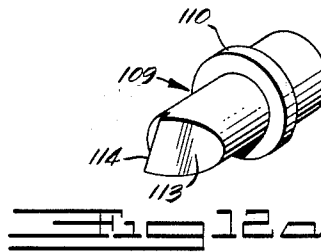
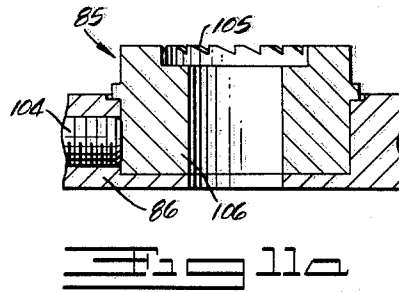
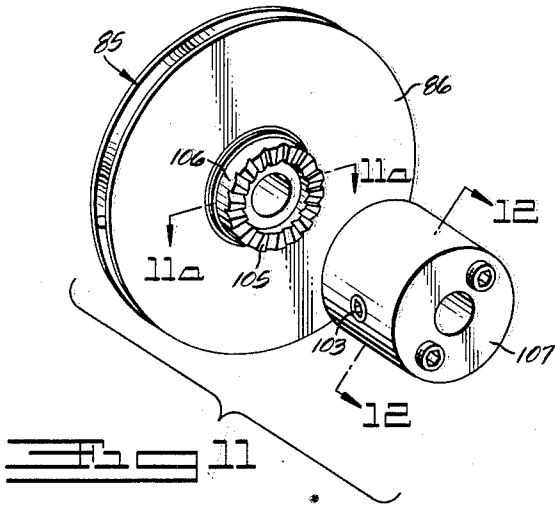
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18 Sheets-Sheet 9



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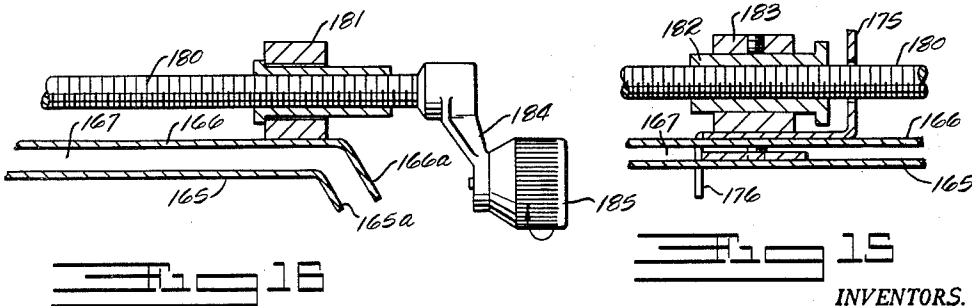
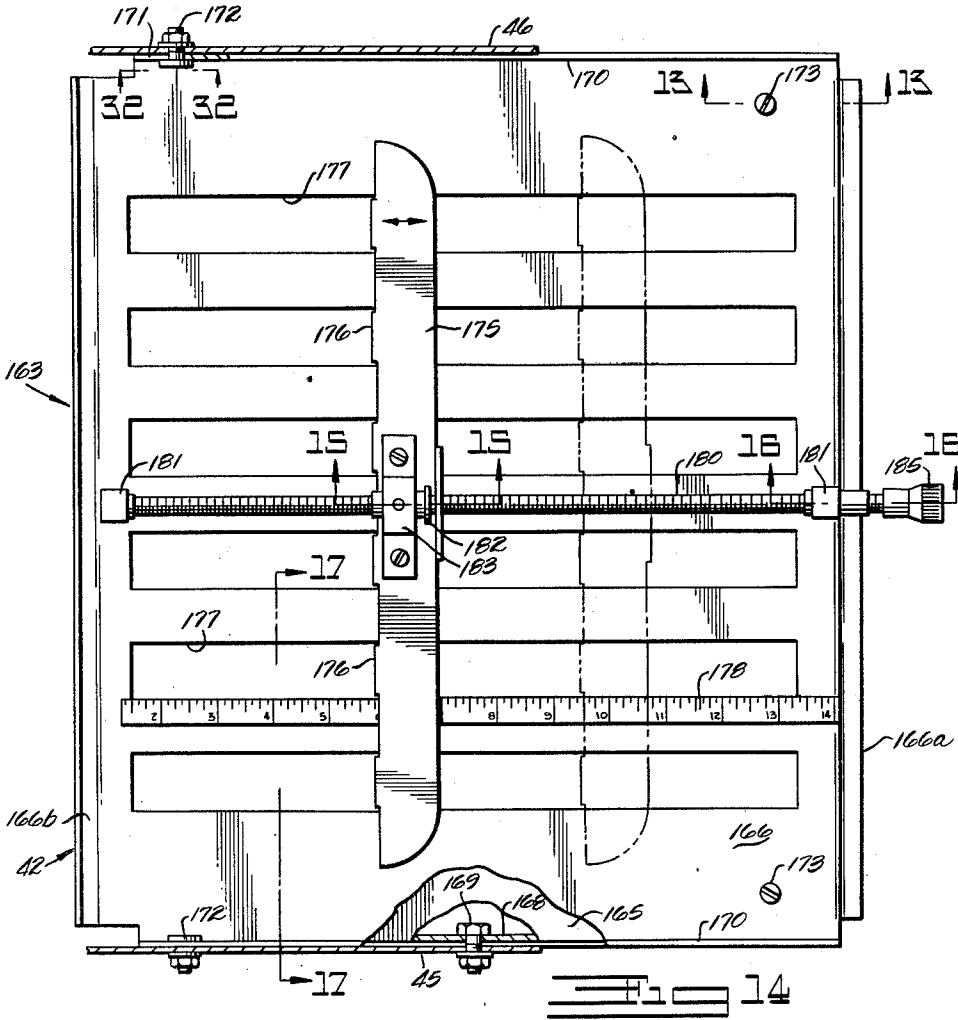
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18 Sheets-Sheet 10



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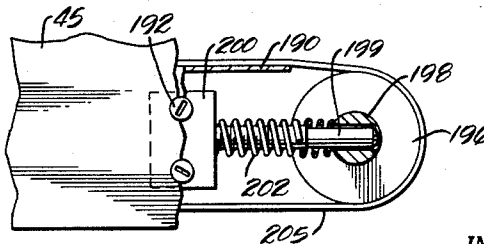
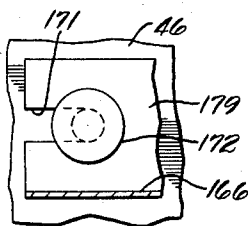
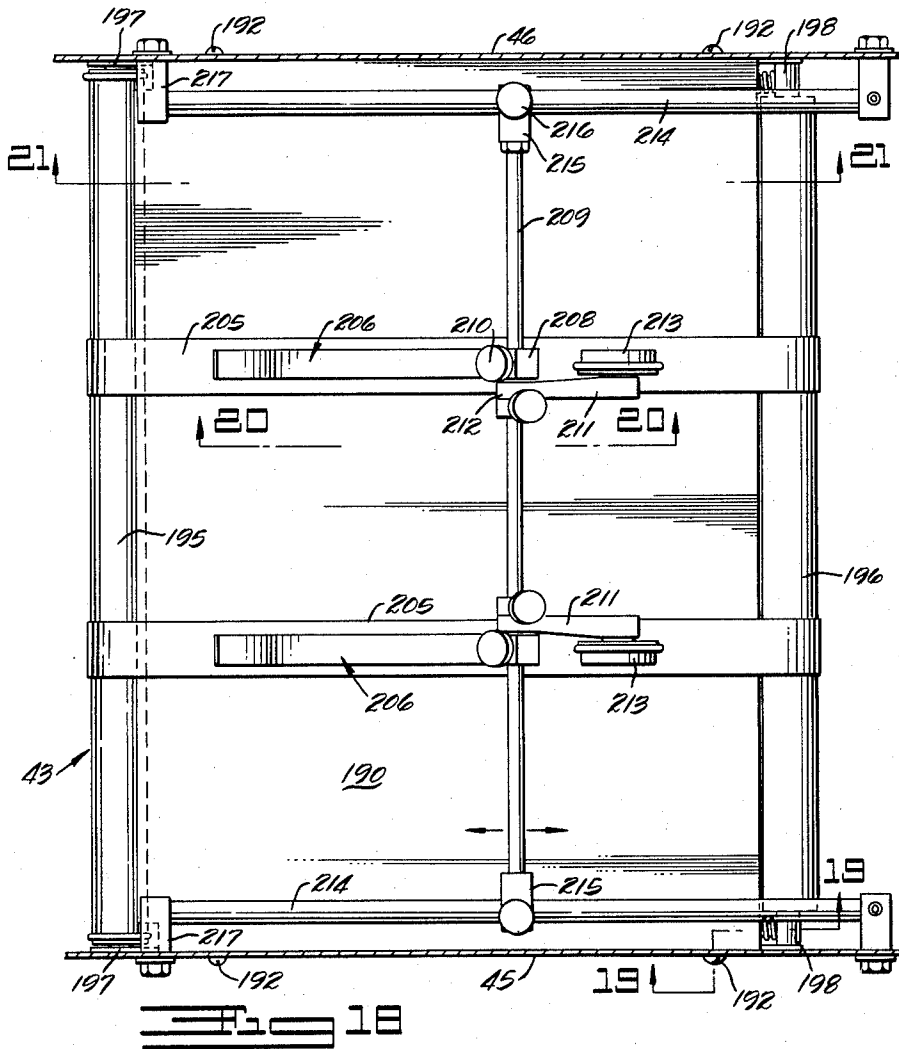
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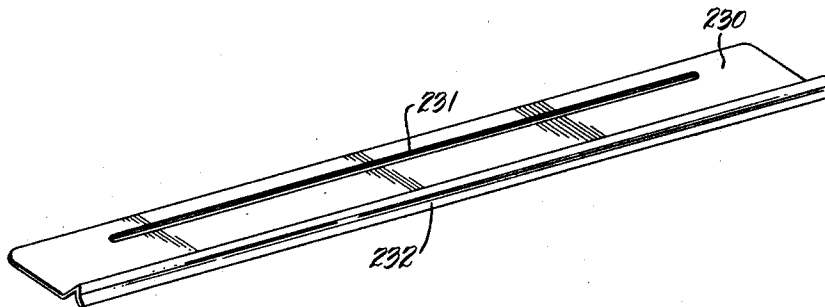
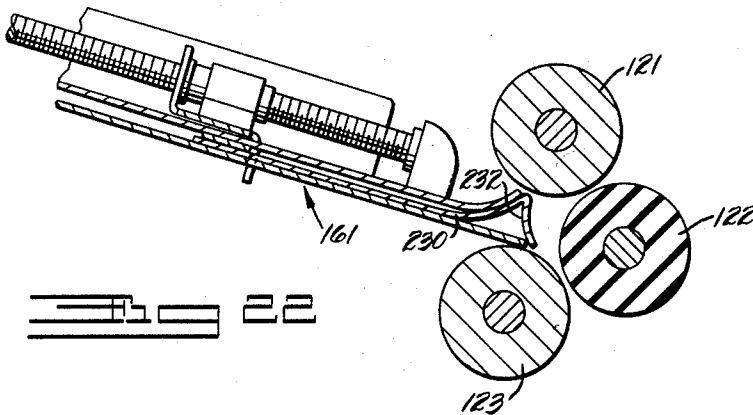
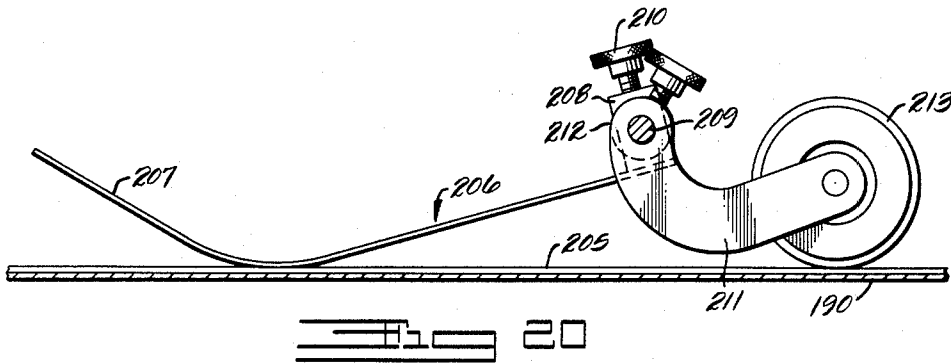
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Filed July 11, 1961

18 Sheets-Sheet 12



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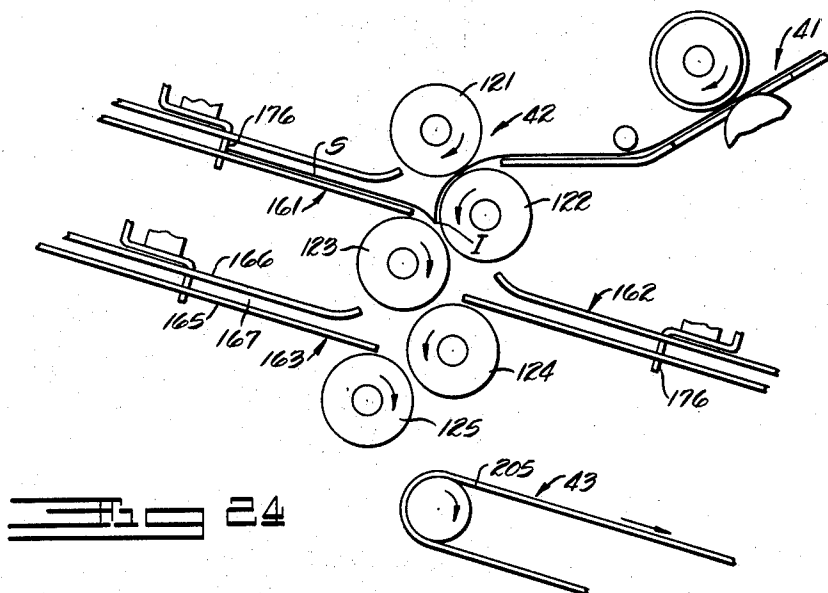
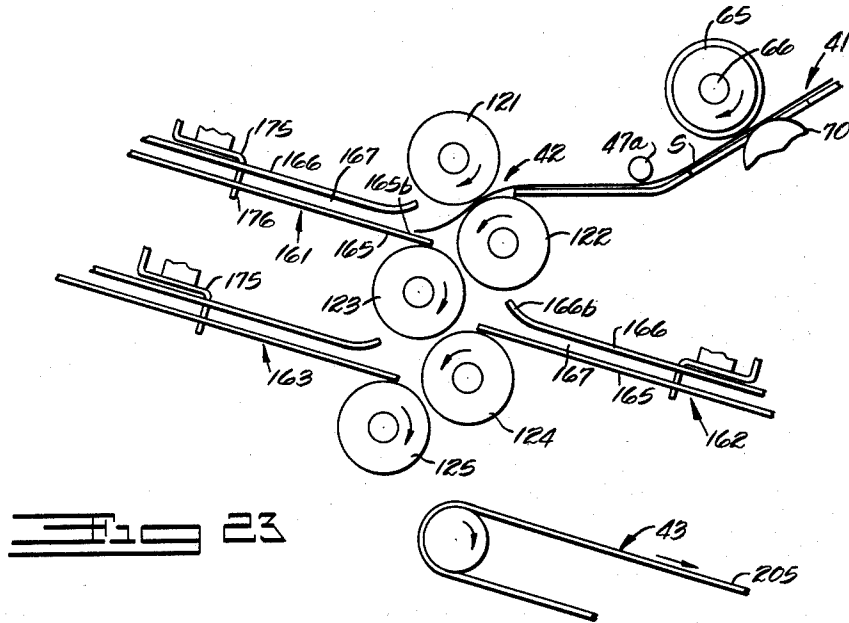
Sept. 29, 1964

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18 Sheets-Sheet 13



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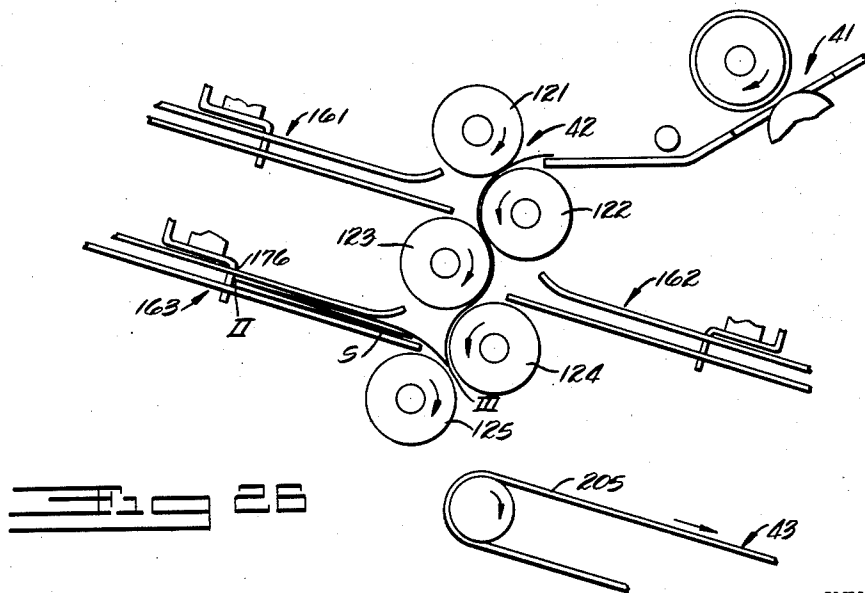
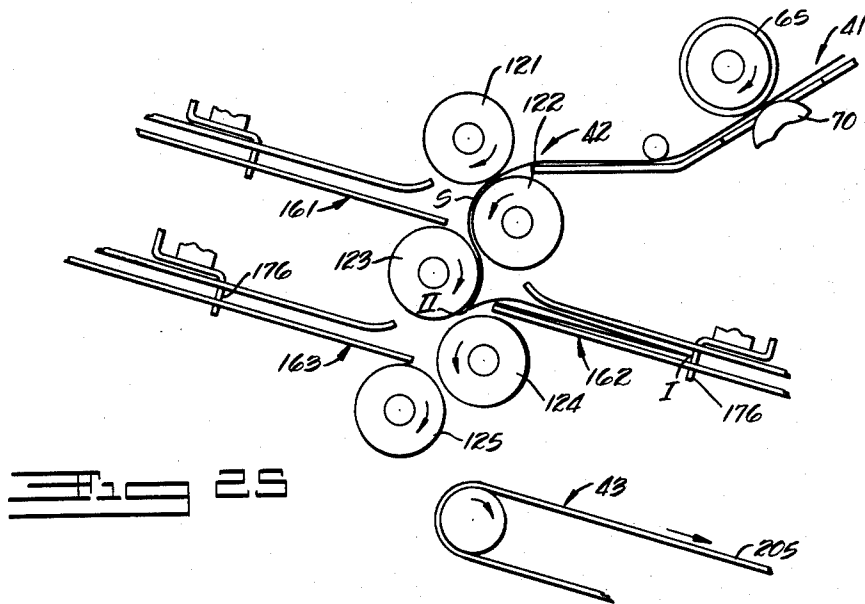
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18 Sheets-Sheet 14



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 Filed July 11, 1961 18 Sheets-Sheet 1

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18 Sheets-Sheet 15



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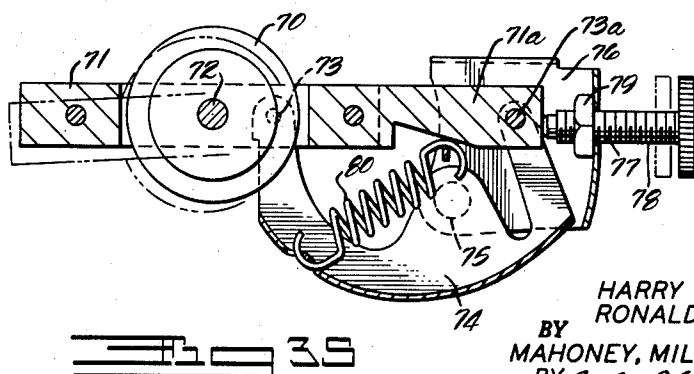
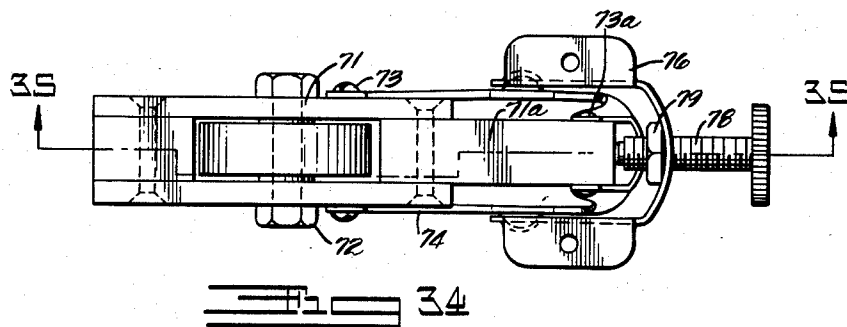
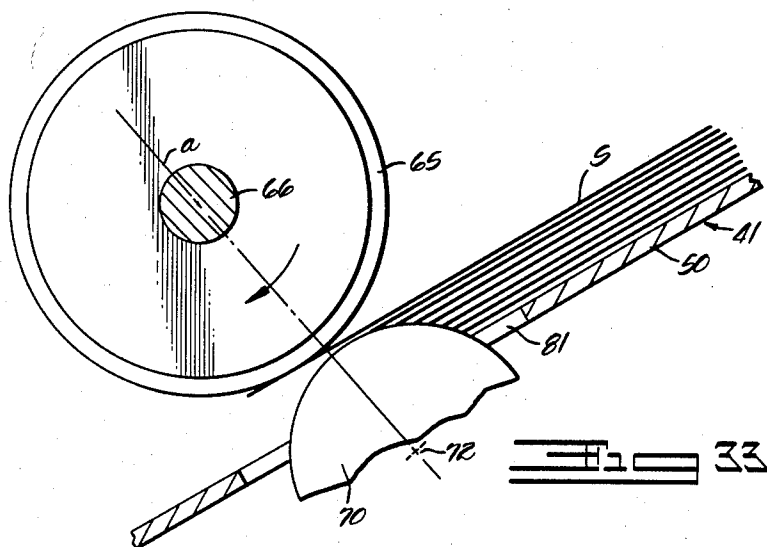
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18 Sheets-Sheet 16



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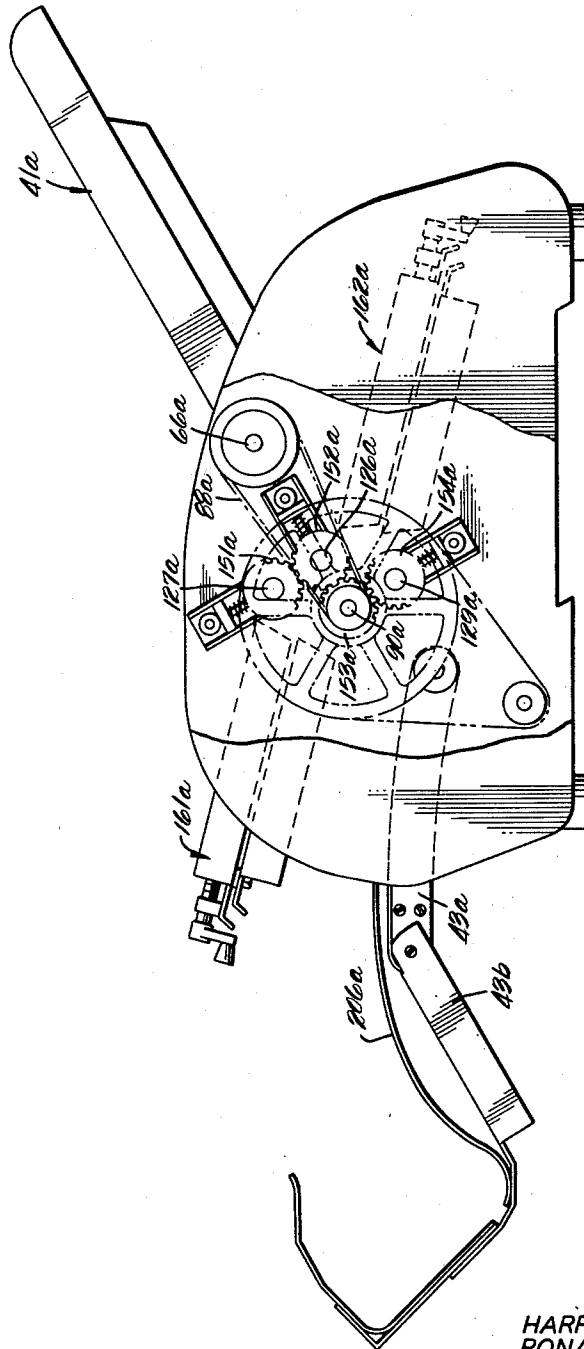
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18 Sheets-Sheet 17



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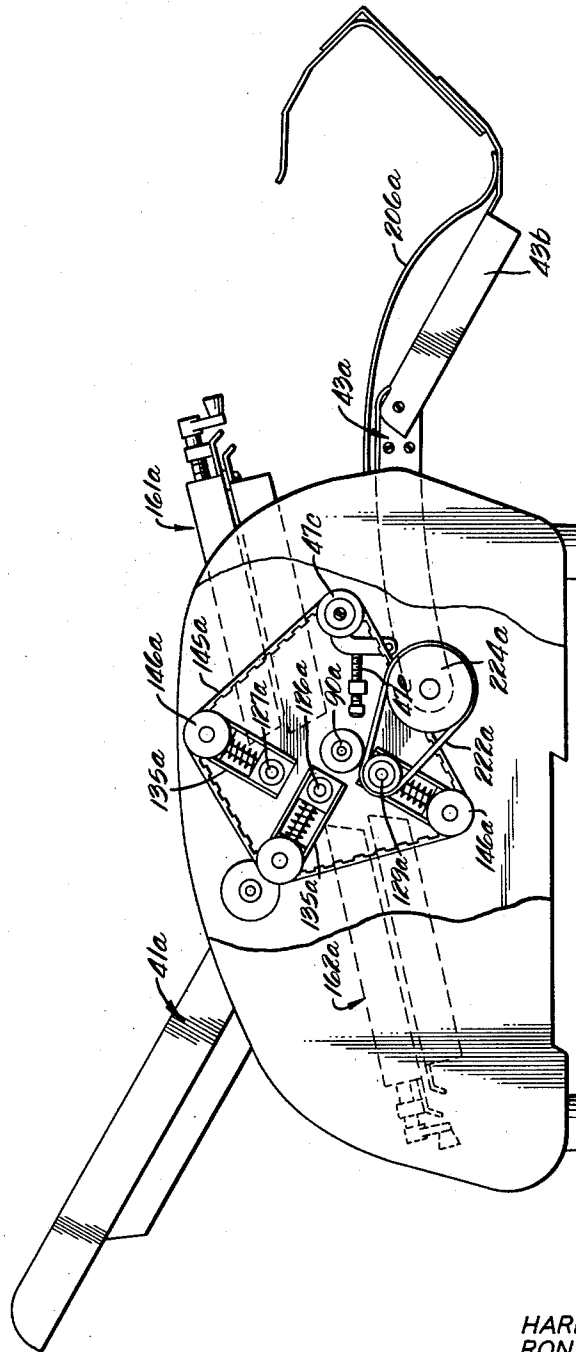
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18 Sheets-Sheet 18



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3,150,871

ROLLER SUPPORTING AND ADJUSTING MEANS FOR BUCKLE-TYPE SHEET FOLDING MACHINE

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Filed July 11, 1961, Ser. No. 123,157

11 Claims. (Cl. 270-68)

Our invention relates to a buckle-type sheet folding machine. In general, this type of machine embodies means for producing a buckling action on sheets of paper or other similar material to form parallel folds therein.

More specifically, this type of paper folding machine includes a feeding unit, a folding unit, and a delivery unit. The feeding unit serves to feed sheets of paper successively into the folding unit. The folding unit receives such sheets successively and produces in each successive sheet the selected number of folds in parallel relationship. The folding unit consists of a plurality of feeding and folding rollers arranged in successive pairs, the rollers of each pair cooperating with each other to feed the sheets therebetween. Associated with each pair of rollers for receiving the sheet therefrom is a fold plate or pan having an adjustable stop bar thereon. As the sheet is fed between the rollers of a pair, it enters into the associated fold plate or pan and its free end engages the stop bar thereon. Continued feeding of the sheet causes it to buckle and the next pair of rollers is so arranged that it receives the buckled portion and as it passes between such rollers forms a permanent crease or fold therein. From the second pair of rollers the folded end of the sheet is fed into another fold plate or pan into arrangement with the stop bar thereof and another buckle is produced, the buckled portion being fed between the next two folding rollers. This operation is repeated over and over depending upon the number of sets of rollers and associated fold plates which are provided in the folding unit which is determined by the number of folds it is desired to produce in each sheet of paper. The folded sheets are received from the folding unit by the delivery unit from which they may be removed.

The main object of this invention is to provide a buckle-type paper folding machine which is improved in many respects with regard to prior art machines of this general type so that it will operate more effectively to receive a pile of sheets of paper to be folded, fan the sheets and align them to properly position each successive sheet for the feeding operation, positively feed each sheet through the various folding rollers and associated buckle plates while keeping the sheet properly aligned to produce accurate folds in parallel relationship, and delivering and stacking the folded sheets for removal from the machine. Our machine is so designed that all necessary adjustments can be made with ease and without tools. These adjustments include adjustments necessary for the machine to operate on sheets of paper of various thicknesses and to vary the gripping action thereon, adjustments necessary for the machine to operate on various widths of paper sheets to be folded, adjustments necessary for the machine to operate on various lengths of sheets to be folded, adjustments necessary for the machine to produce different numbers of folds in the sheets, etc. The machine of our invention is also so designed that it is very rugged and is extremely compact both as to length and width as well as to overall height. Many other objects and advantages of our machine will appear as this description progresses.

The accompanying drawings illustrate a folding machine of the buckle-type embodying the various improvements according to our invention.

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In these drawings:

FIG. 1 is a perspective view of the buckle folding machine;

FIG. 2 is an end view of the folding machine taken along line 2-2 of FIG. 1 at the feeding and delivery end of the machine;

FIG. 3 is a partially schematic side elevational view of the folding machine with portions of a guard cut away showing the driving mechanism for the feeding and folding rollers and taken along line 3-3 of FIG. 2;

FIG. 4 is a side elevational view of the folding machine taken at the opposite side with portions of the guard cut away showing the adjusting mechanism for the feeding and folding rollers and taken along line 4-4 of FIG. 2;

FIG. 5 is an enlarged vertical sectional view taken along line 5-5 of FIG. 2 at the longitudinal center line of the machine;

FIG. 6 is an enlarged fragmentary transverse vertical sectional view taken along line 6-6 of FIG. 3 and showing the roller driving mechanism;

FIG. 7 is an enlarged transverse vertical sectional view taken along line 7-7 of FIG. 3 and showing details of the roller adjusting mechanism;

FIG. 8 is a sectional view taken along line 8-8 of FIG. 7;

FIG. 9 is a detail in elevation taken along line 9-9 of FIG. 7;

FIG. 10 is an enlarged diagrammatic top plan view, partly broken away, of the feed table showing the adjustable guide rails thereof taken along line 10-10 of FIG. 1;

FIG. 11 is a perspective view of parts of the roller drive clutch of the feed unit;

FIG. 11a is a sectional detail of the ratchet teeth assembly of the clutch taken on line 11a-11a of FIG. 11;

FIG. 12 is a sectional detail of the ratchet pawl assembly of the clutch taken along line 12-12 of FIG. 11;

FIG. 12a is a detail in perspective of the ratchet pawl of the clutch;

FIG. 13 is an enlarged sectional detail of one of the fold pans and the locking pins taken along line 13-13 of FIG. 14;

FIG. 14 is an enlarged sectional view taken along line 14-14 of FIG. 3, showing one of the fold pans;

FIG. 15 is an enlarged sectional view taken along line 15-15 of FIG. 14 showing a stop bar mounting bracket;

FIG. 16 is an enlarged sectional view taken along line 16-16 of FIG. 14 showing a feed screw mounting bracket;

FIG. 17 is an enlarged sectional view taken along line 17-17 of FIG. 14 and showing details of one of the fold pans and stop bars;

FIG. 18 is an enlarged sectional view taken along line 18-18 of FIG. 3 and showing the stacking conveyor of the delivery unit;

FIG. 19 is an enlarged sectional view taken along line 19-19 of FIG. 18 and showing the roller tensioning mechanism of the stacking conveyor;

FIG. 20 is an enlarged sectional view taken along line 20-20 of FIG. 18 and showing the stacking conveyor friction roller and sheet-engaging fingers;

FIG. 21 is a vertical sectional view taken along line 21-21 of FIG. 18 and showing the driving roller and tensioning roller of the stacking conveyor;

FIG. 22 is a vertical sectional view of a fold pan and the associated feeding and folding rollers with a deflector plate positioned in the fold pan;

FIG. 23 is a diagrammatic vertical sectional view of the feeding and folding rollers and the fold pans showing a sheet of paper being fed into the first fold pan by the first pair of the feeding and folding rollers;

FIG. 24 is a view similar to FIGURE 23 but showing

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the first fold being made in the sheet of paper as it is drawn between the second pair of the feeding and folding rollers;

FIG. 25 is a view similar to FIGURE 24 but showing the second fold being made in the sheet of paper as it is drawn between the third pair of feeding and folding rollers;

FIG. 26 is a view similar to FIG. 25 showing the third fold being made in the sheet of paper as it is drawn between the fourth pair of feeding and folding rollers;

FIG. 27 is a view similar to FIG. 26 showing the completely folded sheet of paper being removed by the stacking conveyor and a second sheet of paper being fed into the first fold pan by the first pair of the feeding and folding rollers;

FIG. 28 is a diagrammatic sectional view similar to FIG. 25 but showing a deflector plate positioned within the first fold pan and a first fold being made in a sheet of paper as it is drawn between the third pair of rollers;

FIG. 29 is a perspective view of the deflector plate;

FIG. 30 is a perspective view of a sheet of paper having three parallel transverse folds as folded by our complete machine;

FIG. 31 is a perspective view of a sheet of paper having two parallel transverse folds as folded by our machine with a deflector plate positioned within one of the fold pans;

FIG. 32 is a detail in enlarged section of a pin and notch connection on the fold pan taken along line 32—32 of FIG. 14;

FIG. 33 is a diagrammatic sectional detail of the friction feed roller and the retarder of the feed unit showing a stack of sheet paper being fanned by the retarder block;

FIG. 34 is a plan view of the mechanism for supporting and adjusting the retarder of the feed unit;

FIG. 35 is a vertical sectional view taken substantially along line 35—35 of FIG. 34;

FIG. 36 is a side elevational view of a modification of our buckle folding machine with portions of a guard cut away showing the driving mechanism for the feeding and folding rollers; and

FIG. 37 is a side elevational view of the modification of the buckle folding machine of FIG. 36 taken at the opposite side of the machine with portions of a guard cut away showing the roller adjusting mechanism for the feeding and folding rollers.

With reference to the drawings, FIGURES 1 to 5 illustrate the general arrangement of a machine in which our invention is embodied. It includes mainly a feed unit 41, a folding unit 42, and a delivery unit 43. All of these units are supported in proper association with each other by the frame 44.

The folding machine of our invention is designed to produce a series of successive folds in a sheet of paper that is fed thereinto. These folds will be formed transversely of the sheet of paper in exact parallel relationship. The machine illustrated in the drawings and described hereinafter, as an example of our invention, is designed to produce in the sheet S the three folds I, II, and III, as shown in FIGURE 30. However, by a simple insertion of a deflector in one of the fold plates or pans, the machine may be modified to produce in the sheet S only the two folds Ia and IIa, as shown in FIGURE 31. If a deflector is inserted in each of two of the fold plates, the machine may be modified to make a single fold.

The frame 44 is preferably of lightweight metal, such as aluminum and is suitably rigidly fabricated. However, for illustration, we have shown it as comprising mainly the vertical or upright side plates 45 and 46 which extend the length of the machine forwardly and rearwardly thereof and are disposed in laterally spaced parallel relationship. The forward end of the machine will be considered that end where the feed unit 41 is disposed since that is the feeding or inlet end for the paper, although the delivery or outlet unit 43 is located at the same end. By

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having the unit 43 at the same end as the unit 41, it is unnecessary to reach over the machine to remove the folded sheets since they are delivered directly below the unit 41. The plates 45 and 46 are held in spaced parallel relationship by various rods 47a or other transversely extending braces and by various functional members of the machine such as fold plates, feeding and folding rollers and associated axles, shafts, etc. as will appear later.

The feed unit 41 is illustrated best in FIGURES 1, 2, 5, 10, and 33. It comprises an inwardly and downwardly inclined feed table 50 which is in the form of a plate which is mainly flat and which has the downturned flanges 51 along its opposed parallel side edges and a downturned flange 51a at its outer edge. The feed table has its lower or inner portion positioned between the side plates 45 and 46 and its upper portion extending upwardly and outwardly from the side plates. The lower portion is fastened rigidly to the side plates by means of the bolts 52 (FIGURE 10). A supporting brace 51b (FIGURE 5) is provided adjacent the inner portion of the feed table 50 and its ends are fastened to the side plates 45 and 46. The table 50 is provided with the laterally adjustable paper guide rails 53 which extend the full length thereof and project outwardly and upwardly beyond the corresponding edge thereof. These rails 53 are in the form of angles and the lower flange of the angle rests on the table and extends laterally inwardly whereas the other flange is upright. The rails 53 are mounted on the table 50 for lateral adjustment by means of guide blocks 54 which are positioned for movement in a guide slot 55 formed in the table transversely thereof intermediate its inner and outer edges. These guide blocks 54 are slidably mounted on a supporting rod 56 which is positioned below the slot 55. The rails 53 may be fastened to the blocks 54 by means of screws 57 and the blocks may be secured in adjusted position along the rod 56 by means of setscrews 58 (FIGURE 2) which are tapped upwardly therethrough and may be adjusted to engage the rod 56. The upper portions of the rails 53 have additional guide blocks 59 (FIGURE 10) attached thereto by means of the screws 60 for engaging the associated outer edge of the table 50. Thus, the rails 53 are mounted on the table 50 for lateral adjustment relative to each other and can be clamped in any desired spaced relationship to receive sheets of various widths.

At the lower or inner end of the table 50 there is provided positive feeding means for feeding successive sheets from any stack or pile positioned on the table 50. This positive feeding means is in the form of a feed roller 65 carried midway of the ends of a driven shaft 66 positioned adjacent the inner or lower end of the table 50 and carried rotatably in bearings 67 (FIGURE 10) provided on the plates 45 and 46. At each side of the roller 65, the shaft 66 carries idler roller discs 65a which also engage the sheets to hold them flat as they are being successively fed by the roller 65. The roller discs 65a preferably are metal and the roller 65 preferably includes a friction surface such as rubber. The roller 65 and discs 65a are concentric and are of substantially the same diameter so that all will engage each successive sheet simultaneously.

Associated with the feed roller 65 is a retarder cam 70 which cooperates with the roller 65 to fan out the sheets of a pile supported on the inclined feed table as indicated in FIGURE 33. To function in this manner, the retarder 70 is in the form of a disc or wheel although it could be a segmental member. The details of this retarder and its mounting are shown in FIGURES 34 and 35. The wheel is preferably provided with a friction surface, such as rubber, and is disposed within a clamping support 71 on a clamping bolt 72 which also serves as its axle. By loosening the bolt 72, the retarder wheel can be rotated to different positions to compensate for wear on its surface and can again be clamped in position

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by tightening the bolt. The support 71 is clamped by a bolt 73 between the bifurcated upper and inner end of an arm 74 which is pivoted intermediate its ends at 75 between a depending bracket 76 that is rigidly attached to the lower surface of the table 50. The outer wall of the bracket 76 is provided with an opening 77 through which an inwardly extending screw 78 is passed. This screw is threaded through a nut 79 which bears against the inner surface of the rear wall of the bracket and its inner end bears against the outer end of an extension 71a on the support 71. The outer upper end of the arm 74 is also bifurcated to receive the extension 71a and is clamped thereto by a bolt 73a. A tension spring 80 is connected between the arm 74 and the bracket 76 and tends to swing the arm 74 and, therefore, the support 71 upwardly about the pivot 75 to cause the retarder 70 to move upwardly through a slot 81, provided in the table 50, toward the feed roller 65. Adjusting the screw 78 inwardly will cause the arm 74 to pivot about the pivot 75 and will move the retarder 70 downwardly, as shown by the broken lines in FIGURE 35, away from the roller 65. In this way the space between the roller and retarder can be adjusted so that sheets of different thicknesses can be fed.

It will be apparent from FIGURE 33 that the axis of the retarder 70 is offset outwardly relative to the axis of the roller 65 in such a manner that a plane, indicated by the dotted line *a*, passing through such axes is at an angle relative to the table 50 which is greater than 90° at the feed side of the roller. Thus, the retarder 70 cooperates with the roller 65 to provide an inlet or feed throat therebetween and since the curved portion of the periphery of the retarder above the table is offset rearwardly relative to the surface of the roller, the retarder surface serves to fan out the sheets *S* so that each successive sheet will feed into association with the feed roller 65. The spacing of the roller and retarder can be changed by adjustment of the screw 78.

The shaft 66 is driven by a drive including a slip clutch which slips, as will later appear, whenever the sheet being fed thereby into the unit 42 is pulled into such unit at a speed greater than the linear speed of the surface of the driven feed roller 65. The drive includes the slip clutch 85 indicated generally in FIGURES 3 and 6 and shown in detail in FIGURES 11, 11a, 12, and 12a. The clutch includes a pulley disc 86 rotatably mounted on the shaft 66 outside the associated side plate 45. This pulley disc is driven continuously by a belt 88 from a pulley 89 keyed on a continuously driven central transverse shaft 90 which is rotatably mounted on bearings 91 carried by the respective side plates 45 and 46. At the side of the machine where the plate 45 is located (FIGURE 6) the shaft 90 is extended and carries the driven large pulley 92 which is driven by means of a belt 93 and a smaller pulley 94 carried by the drive shaft 95 of an electric drive motor 96. The motor 96 is rigidly mounted by means of a bracket 97 bolted by the bolts 98 to a transverse support, brace or shelf 99 rigidly connected to the opposed plates 45 and 46. The belt and pulley drives are so arranged that the shaft 90 is driven at a higher rate of speed than the shaft 66. The shaft 90 extends through the associated removable guard cover 45a and carries a knob 100 (FIGURE 2) keyed on its outer end by means of which the shaft 90 may be manually rotated.

The pulley has at one face thereof (FIGURE 11) a series of ratchet teeth 105 formed on a hub member 106 and arranged in a circular pattern. The hub 106 is fixed in position concentrically within a socket in the pulley 86 (FIGURE 11a) by means of a setscrew 104. Fixed on the shaft 66 adjacent the pulley 86 is a pawl-carrying hub 107, the hub being fixed in position by means of a setscrew 103 extending radially therethrough (FIGURE 11). At diametrically opposed positions in the hub 107, bores or sockets 108 are provided which extend

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longitudinally and which have their axes parallel with each other and with the axis of the hub. Each socket has slidably mounted therein a pawl 109 which has an annular shoulder 110 (FIGURE 12) that limits outward movement thereof by contacting with the outer reduced end of the socket which slidably receives the correspondingly outer reduced end of the pawl. Each pawl is urged outwardly by a compression spring 111 which presses against the shoulder 110 at one end and which bears against an adjusting screw 112 at its opposite end, the screw being threaded into the adjacent end of the socket 108. The pawl 109 is shaped at its outer end with an angled cam surface 113 and with a buttress surface 114. The pawls 109 engage the ratchet teeth 105 to permit rotation of the pulley 86 relative to the hub 107 in one direction but to prevent relative rotation in the opposite direction. Thus, a slip clutch 85 is provided by this ratchet and pawl arrangement.

The feed unit 41, including the feed table 50 is adapted to feed and guide the sheets of paper successively into the folding unit 42 which is made up of a plurality of sets of cooperating feeding and folding rollers and cooperating folding plates or pans. The unit 42 is shown best in FIGURES 1 to 9, 13, 14, 15, 16, and 17. These rollers are arranged in cooperating pairs, one pair being associated with each folding pan and although in the machine illustrated we have shown three pans, it is to be understood that any desired number may be used depending upon the number of folds to be produced in each sheet of paper.

The feeding and folding rollers include a central roller 123 extending transversely of the machine being disposed on the driven shaft 90 between the plates 45 and 46 which is mounted in the bearings 91 carried by the respective plates. The surface of the roller 123 is preferably of smooth metal. Cooperating with the roller 123 is a transversely disposed roller 122 which is disposed upwardly and slightly forwardly or toward the feeding side of the machine relative to the roller 123 as shown best in FIGURE 5. This roller 122 is preferably of rubber and is carried by a transverse shaft 126 extending through enlarged openings in the respective plates 45 and 46. The roller 122 cooperates with a roller 121 similar to the roller 122 but being of metal which is carried by a transverse shaft 127 that also extends through enlarged openings in the respective plates 45 and 46 which are indicated at 128 in FIGURE 7. It will be noted from FIGURE 5 that this roller is upwardly and rearwardly of the roller 122. The central roller 123 also cooperates with a roller 124 like the roller 122 which is of rubber and which is carried by a transverse shaft 129 extending through enlarged openings in the plates 45 and 46. The roller 124 is forwardly and downwardly of the roller 123 and cooperates with a roller 125 which is downwardly and rearwardly of the roller 124. This roller 125 is of metal and is carried by a transverse shaft 130 which also extends through enlarged openings in the side plates 45 and 46. All of the roller shafts, with the exception of the central roller shaft 90 which is fixed, are carried by adjustable bearing units which are actuated simultaneously to adjust the contact pressure between the roller 121 and the roller 122, the roller 122 and the roller 123, the roller 124 and the roller 123, and the roller 125 and the roller 124. This adjustment of the bearing units is for the purpose of adjusting the contact of the adjacent rollers to receive sheets of paper of various thicknesses. It will be noted from FIGURE 5 that the axes of the rollers 121, 123 and 125 are in a common plane inclined forwardly and that the axes of the rollers 122 and 124 are in a common plane also inclined forwardly and parallel to the first plane. The inclination is preferably at an angle of about 30° from the vertical. This inclined arrangement permits a reduction in the overall height of the machine and aids in the feeding of the sheets of paper between cooperating rollers, as will be apparent later. It will

also be noted from FIGURE 5 that the axis of each pair of cooperating rollers is in a common inclined plane. Thus, the axes of the cooperating relatively movable rollers 121 and 122 are in a common inclined plane, the axes of the cooperating relatively movable rollers 122 and 123 are in a common inclined plane, the axes of the cooperating relatively movable rollers 123 and 124 are in a common inclined plane, and the axes of the cooperating relatively movable rollers 124 and 125 are in a common inclined plane.

The adjustable bearing units for the various roller shafts are indicated in detail in FIGURES 7 to 9 and generally in various other figures, such as FIGURES 3 and 4, by the numeral 135. In FIGURES 7 to 9, the bearing units for supporting the shaft 127 of the roller 121 is shown as an example but all the units are identical. Each end of the shaft 127 is carried rotatably in a bearing block 136 which is slidably mounted in a guide channel 137 which is fixed to the outer surface of the adjacent plate 45 or 46. The center line of the channel corresponds with the plane of the axes of the rollers being relatively adjusted. Each block 136 is provided with an outwardly extending spring-locating pin 138 which receives and locates a compression spring 139. The outer end of this spring extends over an inwardly extending pin 140 which is slidably mounted in a guide block 141 fixed in position adjacent the outer end of the guide channel 137. The outer end of the pin 140 is engaged by an eccentric or cam 142 which is mounted on a rotatable rod 47a that may be similar to the rods 47 previously mentioned. Each of these rods 47a extends transversely and has its outer ends mounted in bearings 143 in the respective side plates 45 and 46. Thus, a cam 142 is provided at each end of the rod 47a and rotation of the rod will rotate the cams and will vary the pressure exerted by the springs 139 which cause the bearing blocks 136 to slide inwardly in the channels 137. The blocks 136 will thus be urged inwardly by a resilient pressure since the springs 139 provide yieldable connections between the pins 138 and 140. This pressure can be varied by adjusting the pair of cams 142 which will, in turn, adjust the pressure of contact between adjacent rollers to compensate for sheets of varying thicknesses to be received by such cooperating rollers. The rollers supporting shafts are permitted to move in the openings 128 in the plates 45 and 46 for this adjustment. Thus, from the above, it is apparent that roller adjustments results from rotation of the cams 142.

We provide means whereby all of the roller adjustments can be made simultaneously and to the same extent. This means comprises a timing belt arrangement for rotating all of the cams 142 simultaneously and to the same extent. This timing arrangement may include a timing belt, as shown, or a roller chain and sprocket arrangement, direct gearing, or other interfitting drive means. The timing belt arrangement is illustrated best in FIGURES 4 and 7 to 9, inclusive, wherein a timing belt 145 is shown for rotating all the cam-carrying rods 47a simultaneously. The timing belt is a flexible belt provided with a smooth outer surface and teeth on its inner surface for cooperating with the teeth of a timing pulley 146 around which it passes, one of the pulleys being keyed to a corresponding end of each of the rods 47a. The belt 145 is tensioned by means of idler pulleys 147 which engage the smooth outer side thereof and hold the belt inwardly to create sufficient tension. These members 147 are carried on the side plate 46 by means of studs 47b which also cooperate with certain fold pans. One of the cam-carrying rods 47a is extended outwardly beyond the timing pulley 146 which it carries and outwardly through the associated guard 46a and has a knob 148 (FIGURES 1 and 2) keyed thereon by means of which that rod 47a can be rotated to rotate the associated timing pulley 146 to move the timing belt 145 and, consequently, to move all the other pulleys 146 simultaneously and to the same degree.

Thus, all of the roller-adjusting cams 142 are rotated simultaneously to apply the same pressure to the various adjustable rollers 121, 122, 124 and 125.

The various rollers are driven in the manner illustrated best in FIGURES 3 and 6. As previously indicated, the central roller 123 is driven by the large pulley 92 keyed thereon which is located at the side of the machine opposite to the side where the timing belt 145 is located. Inwardly of the pulley 92 the shaft 90 carries a pinion 153. This pinion 153 meshes with a pinion 152 keyed on the shaft 126 of the roller 122 which meshes with a pinion 151 keyed on the roller shaft 127 of the roller 121. The pinion 153 also meshes with a pinion 154 keyed on the roller shaft 129 of the roller 124. This pinion 154 meshes with a pinion 155 keyed on the roller shaft 130 of the roller 125. Thus, all of the rollers 121, 122, 123, 124 and 125 are driven simultaneously and continuously from the motor 96. It will be noted from FIGURE 5 that the roller 123 will be driven clockwise or toward the feeding or loading end of the machine. The rollers 122 and 124 will be driven counterclockwise or in a direction opposite to that of the associated roller 123. The upper roller 121 and the lower roller 125 will also be driven clockwise.

The adjustment of the pressure between the various rollers 121, 122, 124 and 125 by the cams 142 will not interfere with the roller drive. The driven pinion on each roller shaft and the associated driving pinion, are provided with meshing teeth of such depth that the necessary relative movement of the rollers as the sheet passes therebetween is possible. The enlarged plate openings 128 will permit the relative movement of the roller shafts and rollers carried thereby laterally of each other. It will be apparent that during this movement the parallel relationship of the axes of the roller shafts is maintained because both ends thereof are simultaneously moved.

It will be noted from FIGURE 5 that the rollers 121 and 122 receive the sheet to be folded from the feed table or pan 50. Therefore, the lower end of the table 50 is angled at 50a into a horizontal position to direct the sheet into the converging throat between the rollers 121 and 122 which are rotated toward each other. Because the axes of the rollers 121 and 122 are in a plane at an angle, approximately 120°, to the feed pan portion 50a, the sheet strikes the roller 121 with a glancing blow and is then directed between the two rollers. As the sheet leaves the rollers 121 and 122, it is fed into the first of a series of three fold plates or pans, the first being indicated generally by the numeral 161 and the others by the numerals 162 and 163, respectively. However, as previously indicated, different numbers of fold plates or pans may be provided depending upon the number of folds to be produced in the successive sheets. All of the fold pans or chutes are identical and, therefore, only the chute 163 will be described in detail. This chute is shown best in FIGURES 1, 3, 4, 5, 6, 12 to 17, and 32.

Each fold pan or chute is disposed in an inclined position between the side plates 45 and 46 and is carried thereby. However, it will be noted that the fold pans 161 and 163 are at right angles to a plane passing through the axes of the rollers 121, 123 and 125 and that the fold pan 162 is at right angles to a plane passing through the axes of the rollers 122 and 124. Each pan includes FIGURES 14 to 17) the lower plate 165 and the upper plate 166 which are spaced to provide a sheet-receiving channel or space 167 therebetween. The plate 165 along its sides is provided with integral depending flanges 163 which are bolted by the bolts 169 to the associated side plates 45 and 46. The upper plate 166 is removably mounted and includes the integral upstanding flanges 170 along its side edges which frictionally engage the respective side plates 45 and 46. Each upstanding flange 170 is provided with an outwardly opening notch 171 at its inner end (FIGURES 14 and 32) which slides over a cap

screw or bolt 172 extending inwardly from the associated side plate 45 or 46. The plate 166 is normally prevented from slipping outwardly by means of pins 173 upstanding from the lower plate 165 which carries them and which extend upwardly through cooperating openings formed in the plate 165 adjacent its outer edge. Each pin 173 (FIGURE 13) includes a spacer shoulder 174 which cooperates with the bolts 172 to space the plate 166 upwardly from the plate 165. The outer edges of both the plates 165 and 166 (FIGURES 13 and 16) are preferably downturned, as indicated at 165a and 166a, to substantially close the outer end of the channel 167 between the plates. It will be apparent that the upper plate 166 is normally positioned over the lower plate 165 but can be removed merely by lifting its outer end above the pins 173 and pulling it outwardly to slip the notched ends of the flanges 170 off the bolts 171 and eventually slip the plate 166 bodily outwardly of the side plates 45 and 46. The inner end of the lower plate 165 is flat but the corresponding end of the upper plate 166 is turned upwardly at 166b and is spaced slightly behind the inner edge 165b of the lower plate, as shown in FIGURE 5.

Each upper fold plate 166 carries a buckling stop bar 175 which extends transversely thereof and is adjustable inwardly or outwardly thereof. The stop bar 175 carries a series of stop lugs 176 spaced longitudinally thereof (FIGURE 17) and extending downwardly through a corresponding number of slots 177 formed in the upper plate 166 (FIGURE 14) which extend inwardly and outwardly or longitudinally thereof. When the plate 166 is properly positioned in operative position with respect to the plate 165, the stop lugs 176 also depend through slots 177a (FIGURE 17) formed in the plate 165 in alignment with the slots 177. A scale 178 may be provided on the upper surface of the plate 166 (FIGURE 14) to indicate the adjusted position of the stop bar 175. This adjustment is made by means of a single micrometer lead screw 180 which extends longitudinally or inwardly and outwardly of the plate 166. This screw is mounted in a fixed axial position but rotatably by bearings 181 fixed to the plate 166 (FIGURES 14 and 16). The screw 180 is threaded through a sleeve 182 which is nonrotatably fixed in a block 183 (FIGURE 15) rigidly carried by the stop bar 175. This rotation of the screw 180 will slide the stop bar 175 inwardly and outwardly. Even though the adjusting force is applied midway of the ends of the stop bar 175 by the screw 180, it will not bind since the lugs 176 will cooperate with the slots 177 in guiding it. The screw is rotated by a crank handle 184 fixed on its outer end and carrying a rotatable knob 185. The screw and its supports are carried by the plate 166 and stop bar 175 and it will be removable therewith.

Referring again to FIGURE 5, it will be noted that the fold pan 161 is positioned to receive the sheet from the cooperating rollers 121 and 122 and direct it to the cooperating rollers 122 and 123. The fold pan 162 is positioned to receive the sheet from the cooperating rollers 122 and 123 and direct it to the cooperating rollers 123 and 124. Finally, the fold pan 163 is positioned to receive the sheet from the cooperating rollers 123 and 124 and direct it to the cooperating rollers 124 and 125.

The cooperating rollers 124 and 125 discharge the finally folded sheets onto the delivery unit 43. This unit is illustrated best in FIGURES 2, 5 and 18 to 21.

The unit 43 comprises an inclined plate or discharge table 190 (FIGURES 5 and 21) which is directed downwardly and forwardly of the machine in substantially parallel relationship to the fold pan 162. This plate or table extends transversely of the machine and is provided with downturned flanges 191 along its side edges which are bolted by bolts 192 to the associated side plates 45 and 46. It will be noted from FIGURE 5 that the shelf or support 99 previously mentioned is shaped to fit around the inner end of the unit 43 and will aid in

directing the folded sheets of paper from the cooperating rollers 124 and 125 to the unit 43.

At the upper end of the plate 190 the unit 43 is provided with a tape-carrying shaft 195 extending transversely between the plates 45 and 46. At the lower end of the plate 190 a similar shaft 196 is provided. The shaft 195 is rotatably mounted in fixed bearings 197 which are carried by the respective side plates 45 and 46. The shaft 196 is rotatably mounted on studs 198 which are slidably mounted on rods 199 rigidly carried by blocks 200 which are secured to the side plates 45 and 46 by means of the screw 192. A compression spring 202 is provided on each rod 199 between the members 198 and 200 and pushes the stud 198 outwardly. Thus, the shaft 196 is normally urged outwardly by resilient pressure.

The transversely extending shafts 195 and 196 carry a plurality of laterally spaced, longitudinally running endless tapes 205, two of these tapes being shown (FIGURE 18) but any suitable number being provided. Since the shaft 196 is urged outwardly and downwardly by the springs 202 away from the shaft 195, the endless tapes 205 will be kept taut and the upper runs thereof will be kept in contact with the upper surface of the plate 190, as shown in FIGURE 20. Associated with each of the tapes 205 is a hub spring member 206 which is directly thereabove and will serve to hold a sheet of paper down in contact with the associated tape. The inner end of the leaf spring 206 is upturned as indicated at 207 and its outer end is carried by the block 208. The block 208 is slidably and rotatably mounted on a transverse supporting rod 209 and the block 208 carries a setscrew 210 for engaging the rod 209. Thus, the block 208 can be adjusted along the rod 209 or around its axis and then be fixed in position. Adjacent each spring 206 and extending in the opposite direction, is an arm 211. This arm is similarly adjustably clamped to the rod 209 by means of a clamping block 212. This arm, at its outer end, carries a roller 213 which will be disposed directly above the tape 205 on the opposite side of the rod 209 relative to the spring 206. The transversely extending rod 209 is slidably mounted on parallel support rods 214 by means by blocks 215 which carry setscrews 216 for engaging the rods. The support rods 214 are carried by the respective side plates 45 and 46 inwardly thereof in parallel relationship thereto by means of the clamping supports 217.

The shaft 195 is driven continuously and will continuously drive the tapes 205. The folded sheets will be discharged onto the tapes 205 and will be carried beneath the springs 206 which will maintain them in contact with the tapes and retard them to fan them out longitudinally of the table or plate 190. They will eventually pass beneath the rollers 213 which will aid the fanning out and when they pass beyond the rollers, they will be discharged from the tapes and will be stacked in a suitable container. The shaft 195 is driven continuously by means of an endless belt 220 which passes around the shaft 195 and downwardly around a pulley 221 (FIGURES 5 and 21) carried by a transverse shaft 222 rotatably mounted by bearings 223 (FIGURE 3) in the side plates 45 and 46. This shaft 222 carries a pulley 224 on its one end which is extended beyond the plate 46 (FIGURE 4). The shaft 222 is driven by a belt 225 which is driven by a pulley 226 which is on the outer end of the roller shaft 130 that carries the roller 125. Thus, the stacking or discharge conveyor is driven by the roller shaft.

The operation of our machine in folding sheets of paper S will be apparent from an examination of FIGURES 23 to 27. As previously indicated, the machine is adjusted for sheets of paper of a particular thickness to be folded by proper adjustment of the retarder 70 by means of the screw 78 and by proper simultaneous adjustment of the feeding and folding rollers 121, 122, 124 and 125 by

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means of the knob 148. Furthermore, the guides 53 on the feed table 50 are laterally adjusted in accordance with the width of the sheet to be folded. Also, the springs 206 and rollers 213 of the discharge and stacking unit 43 are properly adjusted as indicated above. The stop bars 175 are all properly adjusted relative to their associated fold pans 161, 162 and 163 by operation of the screws 180, this adjustment depending upon the length of the sheets S being folded and the desired locations of the folds. With all these adjustments made, a stack of sheets of paper is placed on the unit 41 and the retarder 70 and the cooperating roller 65 will serve to fan out the sheets in the manner indicated in FIGURE 33. The leading sheet will be fed from the unit 41 to the unit 42; after it enters the unit 42, it will pass between the first pair of cooperating rollers 121 and 122, as shown in FIGURE 23. The rollers 121 and 122, as previously indicated, are driven faster than the feed roller 65. Therefore, the rollers 121 and 122 will tend to exert a pull on the sheet S and the slip clutch 85 associated with the roller shaft 66 will permit this. As previously indicated, because the plane of the axes of the rollers 121 and 122 are angled, the leading edge of the sheet will strike the roller 121 with a glancing blow and will be deflected downwardly into the converging throat between these rollers. The leading edge striking the roller 121 in this manner provides a cam action which tends to insure that the sheet is straight before it enters between the rollers 121 and 122. As the sheet passes through the rollers 121 and 122, it enters the cooperating first fold pan 161. The leading edge of the sheet will contact the forward extended edge 165b of the lower plate 165 and will be directed upwardly into the passage 167 of the fold pan 161. As shown in FIGURE 24, the sheet S will move upwardly until it strikes the buckling stops 176 of the fold pan 161. This will cause the sheet S to buckle downwardly into the converging throat between the second pair of cooperating rollers 122 and 123, as shown in FIGURE 24, thereby producing the first folded edge I. This folded sheet will now be pushed and drawn between the rollers 122 and 123, the folded edge I now being the leading edge, and will pass into the second fold pan 162 until it strikes the stop lugs 176 thereof, as shown in FIGURE 25. When the folded edge I does strike the associated stops 176, it will be pushed further and will again be buckled to produce a second fold II which will be formed at the converging throat of the third set of rollers 123 and 124. This folded edge II will now be the leading edge of the sheet as the rollers 123 and 124 engage it and pull it therebetween. The sheet will then pass upwardly into the third fold pan 163 until it strikes the stops 176 thereof, as shown in FIGURE 26. When the folded edge II does strike such stops 176, it is again buckled into the converging throat between the fourth pair of cooperating rollers 124 and 125, as shown in FIGURE 26, thereby producing the third fold III. As indicated in FIGURE 27, the leading edge III of the sheet of paper will be drawn through the rollers 124 and 125 to produce the finally folded sheet which will be discharged onto the unit 43. Thus, the sheet is folded into the condition illustrated in FIGURE 30 with the three parallel transverse folds I, II and III.

If it is desired to produce only two folds in a sheet, as indicated at Ia and IIa in FIGURE 31, a deflector plate 230, shown in FIGURE 29, may be inserted in the first fold pan 161, as shown in FIGURES 22 and 28, to block the entrance to the passage 167 therein. This plate 230 is of elongated form and is adapted to be disposed transversely completely across the inlet end of the fold pan 161. It is provided with a longitudinally extending slot 231 for receiving the stop lugs 176 on the stop bar 175 of the fold pan. It is further provided with a resilient stop flange 232 along its forward edge. The member 230 is mounted in the pan 161 by removing the upper plate

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166, mounting it on the stops 176 thereof and then replacing the upper plate so that the deflector plate 230 will be located as shown in FIGURE 28. The stop flange 232 will extend downwardly over the inner edge 165b of the lower plate 165. By proper adjustment of the position of the stop bar 175 on the plate 165, the angle of the flange 232 may be adjusted accurately since it is flexible and will engage the plate edge 165b. The angle may be properly selected so that when the sheet passes through the first pair of cooperating rollers 121 and 122, it will hit the flange 232 and will be directed or carried into the next pair of cooperating rollers 122 and 123, as shown in FIGURE 28. Thus, the use of the fold pan 161 is eliminated and only the pans 162 and 163 are utilized, thereby producing the two folds Ia and IIa only.

In FIGURES 36 and 37, we have illustrated a modification of our machine which is in the form of a smaller machine that is designed to produce two folds only in a sheet of the nature shown in FIGURE 31. In this machine, the feed unit 41a is exactly as previously described. The discharge and stacking unit 43a is substantially as previously described with the exception that it is at the side of the machine opposite to the unit 41a and is provided with a downward and outward extension 43b which receives the stacked folded sheets and is provided with an associated leaf spring 206a retaining the stack in position thereon. In this machine, only two fold pans designated 161a and 162a are employed. The pan 161a is associated with rollers carried by the shafts 127a and 126a and the pan 162a is associated with rollers carried by the shafts 90a and 129a. Thus, four rollers are provided instead of five and two associated fold pan units are provided instead of three.

The rollers are adjusted relatively to each other in substantially the manner previously described by means of a timing belt 145a (FIGURE 37) and associated pulleys 146a which cooperate with the cam-adjusted bearing units 135a. The belt 145a, however, is provided with an adjustable take-up in the form of a roller 47c carried by a pivoted arm 47d adjustable by means of screw 47e. The pulley 224a which drives the tapes of the discharge unit 43a is driven by a belt drive 222a from the roller shaft 129a.

This unit is driven substantially in the same manner as illustrated in FIGURE 3 in connection with the first machine. Thus, as shown in FIGURE 36, there is a pinion 153a on the roller shaft 90 which engages the pinion 152a on the roller shaft 126a that drives the pinion 151a on the roller shaft 127a. The pinion 153a also drives the pinion 154a on the roller shaft. The shaft 90a also drives a belt drive 88a which drives the feed roller shaft 66a.

It will be apparent that this unit will function substantially as the machine previously described except that it will produce only two folds and not the final fold previously referred to because the fifth roller and the third feed pan are not provided.

It will be apparent from the above description that we have provided a buckle type paper folding machine which is improved in many respects which have been discussed in detail above. Other advantages will also be apparent.

According to the provisions of the patent statutes, the principles of this invention have been explained and have been illustrated and described in what is now considered to represent the best embodiment. However, it is to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

Having thus described this invention, what is claimed is:

1. In a folding machine of the type described, folding mechanism including a frame, a plurality of pairs of contacting folding rollers, a shaft carrying each of said rollers, bearings supporting each roller shaft at both ends for rotational movement, supporting means for support-

ing the bearings of one roller shaft of each pair for relative movement, said supporting means comprising radially extending guideways on said frame and bearing guides operating therein to support one roller shaft for movement radially relative to the other shaft, rotatable cams for acting on said guides in said guideways, said cams having continuous cam surfaces for gradual adjustment of said guides, and means for rotating all of said cams simultaneously to simultaneously adjust all of said guides radially in said guideways.

2. The combination of claim 1 including resilient means acting to urge the bearing guides of one shaft in their cooperating guideways radially toward the other shaft.

3. The combination of claim 1 in which each cam is carried by a rotatable rod mounted on said frame in parallel relationship with the shaft which it adjusts, said means for rotating said cams comprising a gear mounted on each rod for rotation therewith, and means for rotating all of said gears simultaneously.

4. The combination of claim 3 in which said last-named means comprises an interfitting drive in engagement with all of said gears.

5. The combination of claim 3 in which said rotating means comprises an endless timing belt having teeth for engaging the teeth of said gears, and means for driving the belt.

6. The combination of claim 5, including adjustable take-up means engaging the belt.

7. The combination of claim 3 in which said resilient means comprises a spring-type plunger slidably carried by the guideway between the cam and each cooperating guide to maintain the rollers of a pair in resilient contact.

8. The combination of claim 7 including driving means for the rollers of each pair, said driving means comprising intermeshing gears carried by the roller shafts of each pair which have meshing teeth of sufficient depth to permit the relative movement of the roller shafts which carry them.

9. In a folding machine of the type described, folding mechanism including a frame, a plurality of folding rollers, each carried by a shaft supported on said frame, said rollers comprising a central roller, a plurality of pairs of rollers disposed around said central roller, each of said pairs of rollers comprising a first roller adjacent to and cooperating with the central roller and a second roller adjacent to and cooperating with the first roller, means for mounting the shaft of the first roller of each pair for radial movement relative to the shaft of the central roller, means for mounting the shaft of the second roller of each pair for radial movement relative to the shaft of the first roller of that pair, said mounting means comprising guides carrying the shafts and slidable in radial

guideways, yieldable means for biasing the shafts of each pair of rollers toward each other and for urging the shaft of the first roller of each pair toward the shaft of the second roller of each pair, means for adjusting said biasing means, means for positively driving all of said rollers including gears carried by all of said roller shafts with the adjacent gears intermeshing, said gears comprising a drive gear carried by the central roller shaft, a driven gear carried by the first roller shaft of each pair meshing with the drive gear, and a driven gear carried by the second roller shaft of each pair meshing with the driven gear carried by the first roller shaft, said yieldable biasing means comprising a spring-pressed plunger for engaging each of the guides of the associated shafts which is movably mounted, cams rotatably cooperating with said plungers and having continuous cam surfaces for gradually varying the biasing effect exerted by the springs, means for rotating all of said cams simultaneously and comprising gears fixed relative to the cams and rotatable therewith, and an intermeshing movable adjusting means engaging all of said gears.

10. The combination of claim 9 in which the first roller of each pair is intermediate the central roller and the second roller of each pair with the axis of the first roller of each pair in a common vertical plane and with the axes of the second rollers and central roller in a common vertical plane parallel to the first plane, said planes being inclined relative to the horizontal.

11. The combination of claim 10 including a feed chute for directing sheets into the two adjacent uppermost rollers comprising a first and second roller of a pair, and a fold chute having an end located respectively between adjacent rollers in each of said planes.

References Cited in the file of this patent

UNITED STATES PATENTS

1,285,705	Hitchcock	Nov. 26, 1918
1,426,904	Olson	Aug. 22, 1922
2,058,876	Hitchcock	Oct. 27, 1936
2,230,168	Speiss	Jan. 28, 1941
2,359,856	Morse	Oct. 10, 1944
2,414,386	Olson	Jan. 14, 1947
2,461,214	Holmes	Feb. 8, 1949
2,642,798	Ras	June 23, 1953
2,757,927	Bach et al.	Aug. 7, 1956
2,831,676	Runzi	Apr. 22, 1958
2,847,209	Olson	Aug. 12, 1958
3,089,695	Brooks	May 14, 1963

FOREIGN PATENTS

263,860	Great Britain	July 7, 1927
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