Nov. 1, 1932. F. L. STANTON 1,886,312

PAPER FOLDING MACHINE

Filed Nov. 30, 1929 7 Sheets-Sheet 1

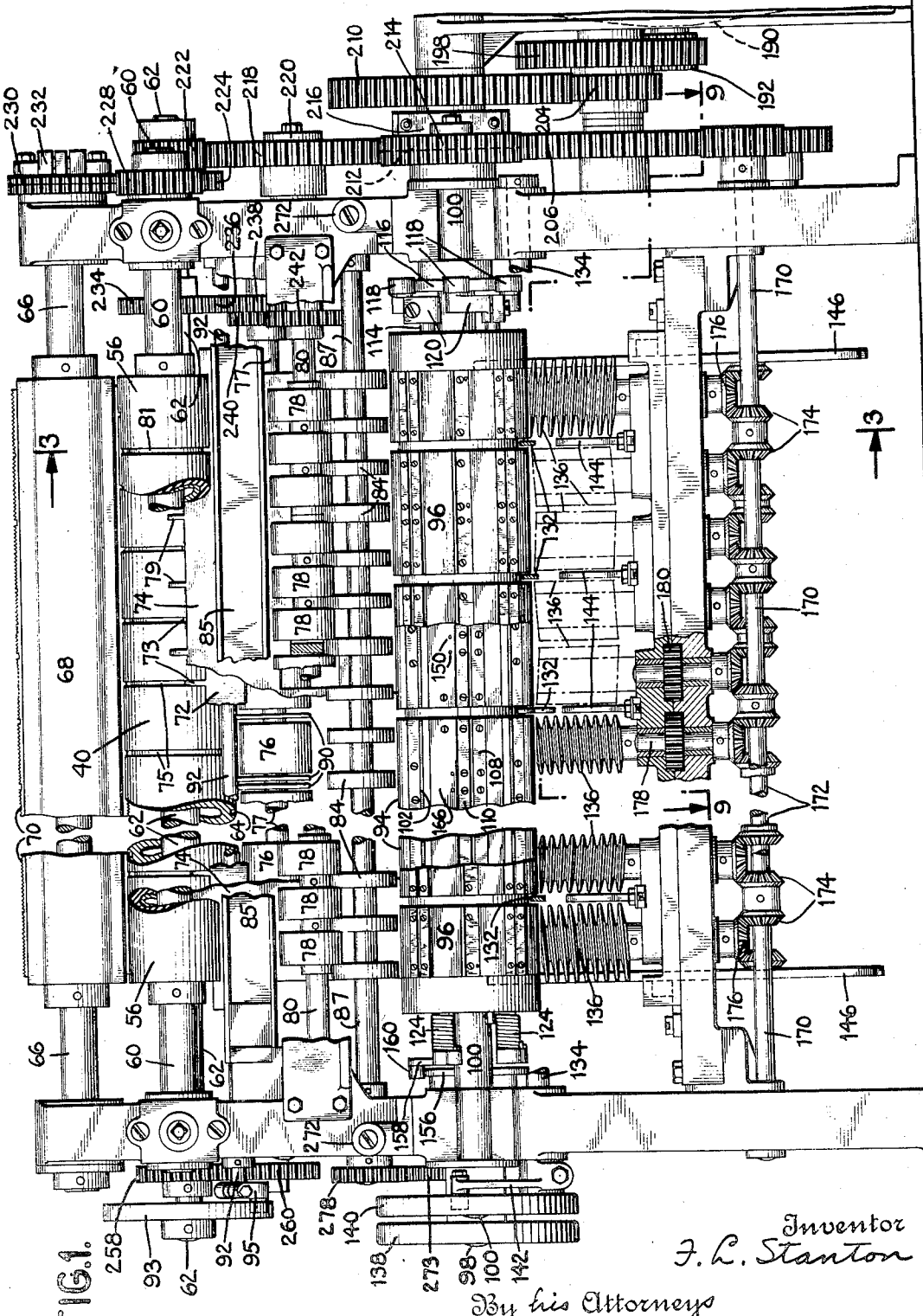


FIG. 1.

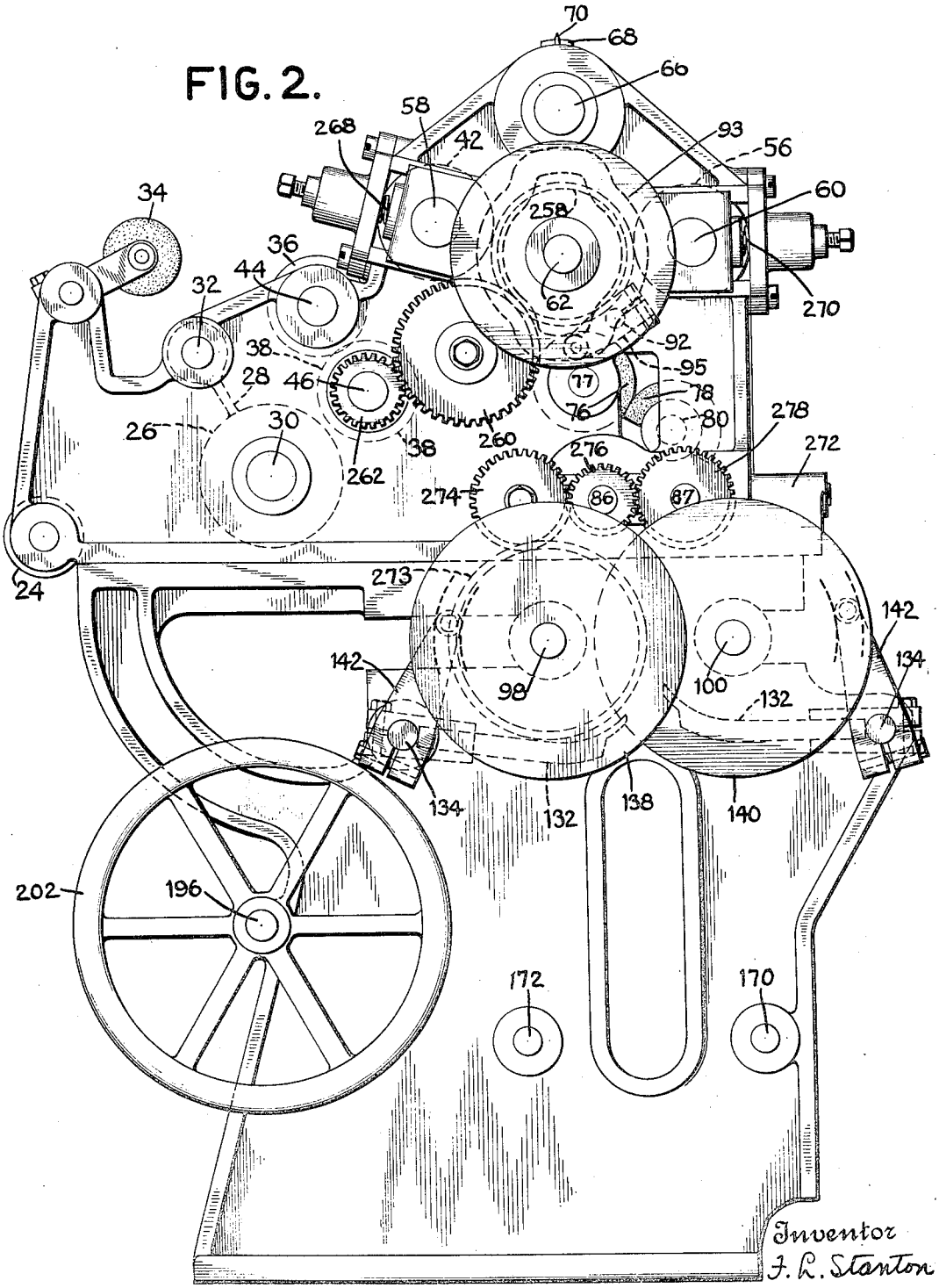
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PAPER FOLDING MACHINE

Filed Nov. 30, 1929 7 Sheets-Sheet 2

FIG. 2.



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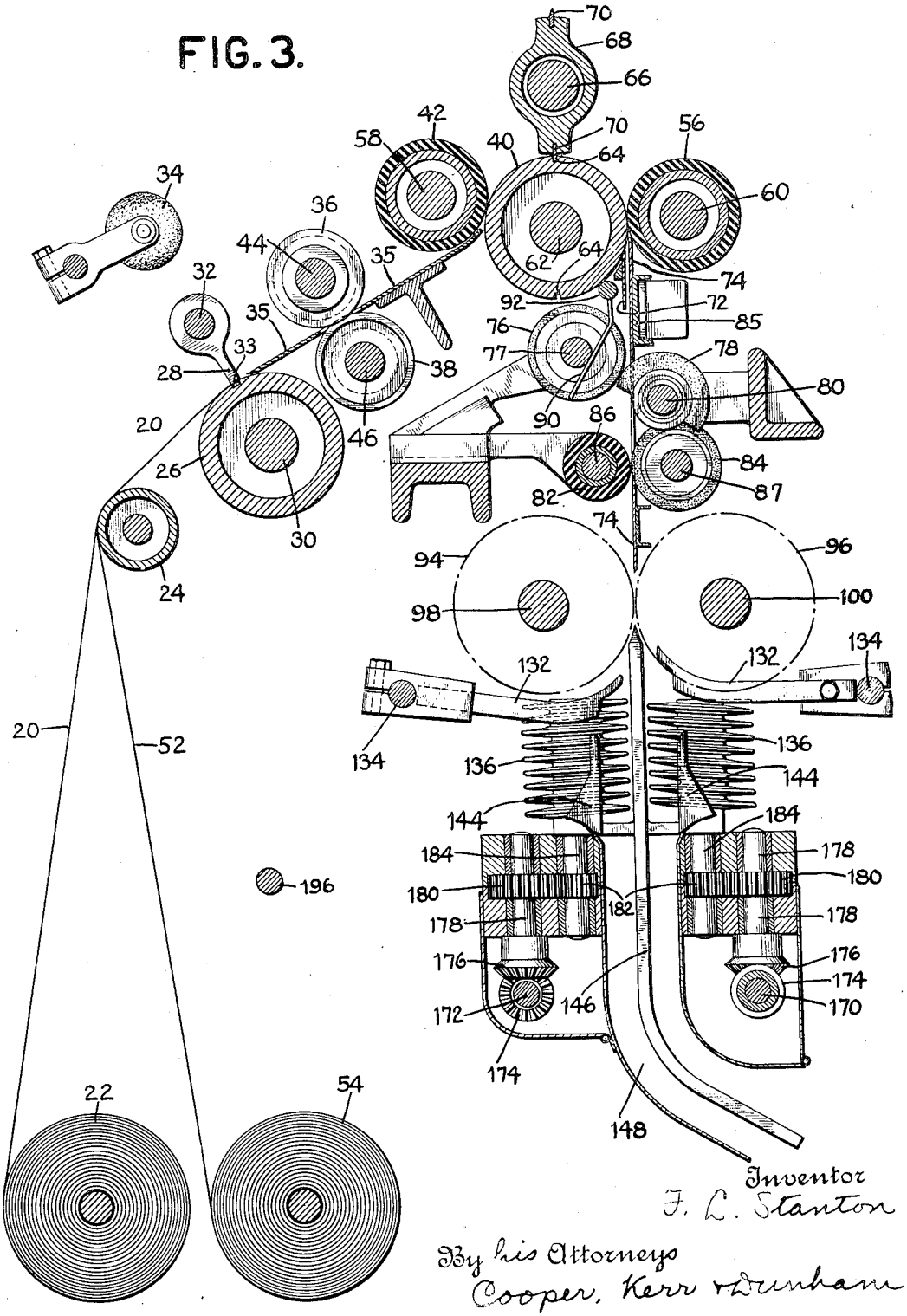
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PAPER FOLDING MACHINE

Filed Nov. 30, 1929 7 Sheets-Sheet 3

FIG. 3.



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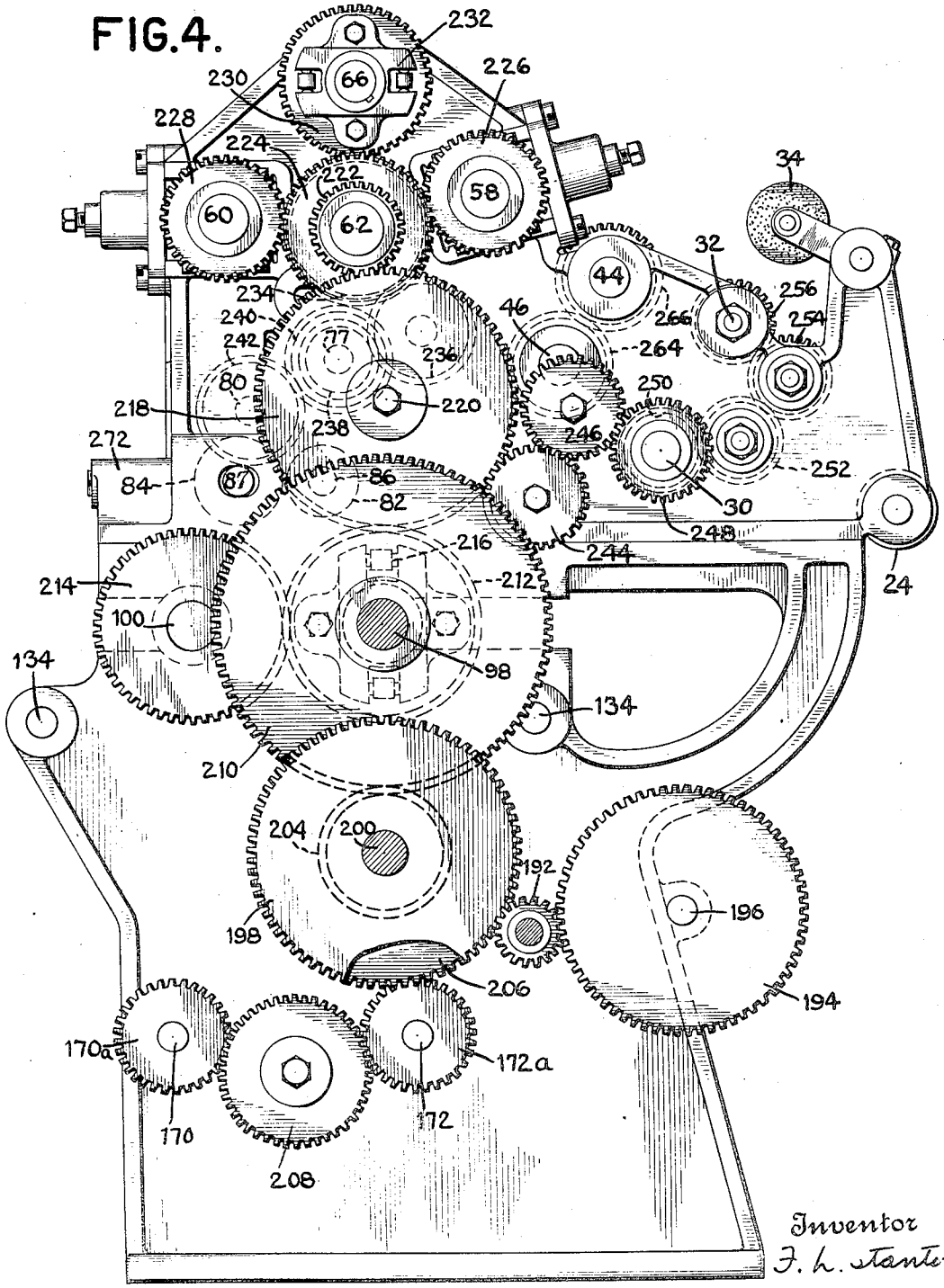
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PAPER FOLDING MACHINE

Filed Nov. 30, 1929 7 Sheets-Sheet 4

FIG.4.



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PAPER FOLDING MACHINE

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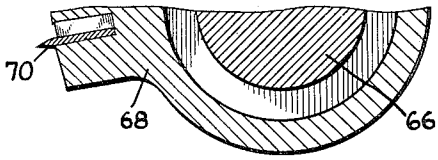
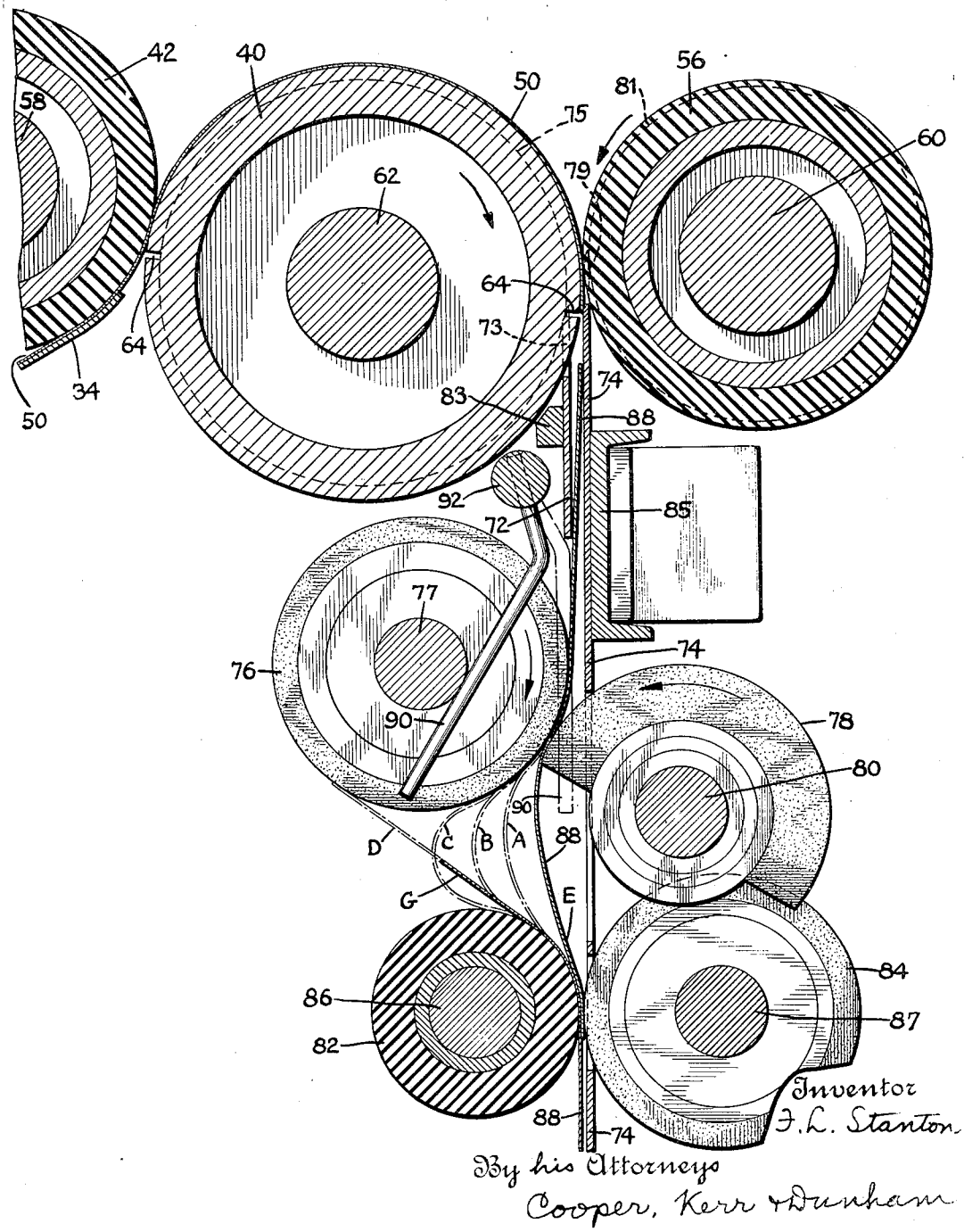


FIG.5.



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PAPER FOLDING MACHINE

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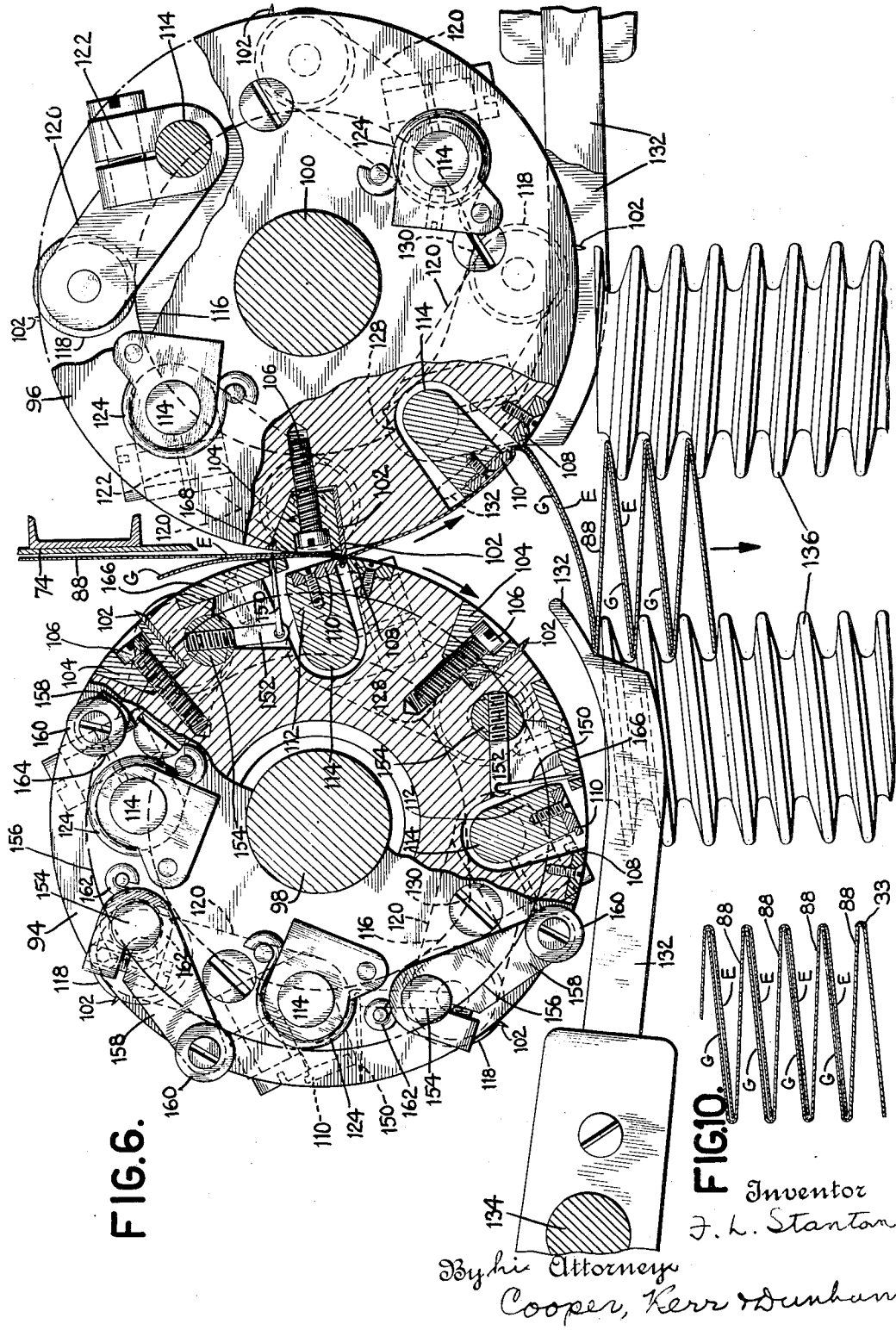


FIG. 6.

FIG. 10.

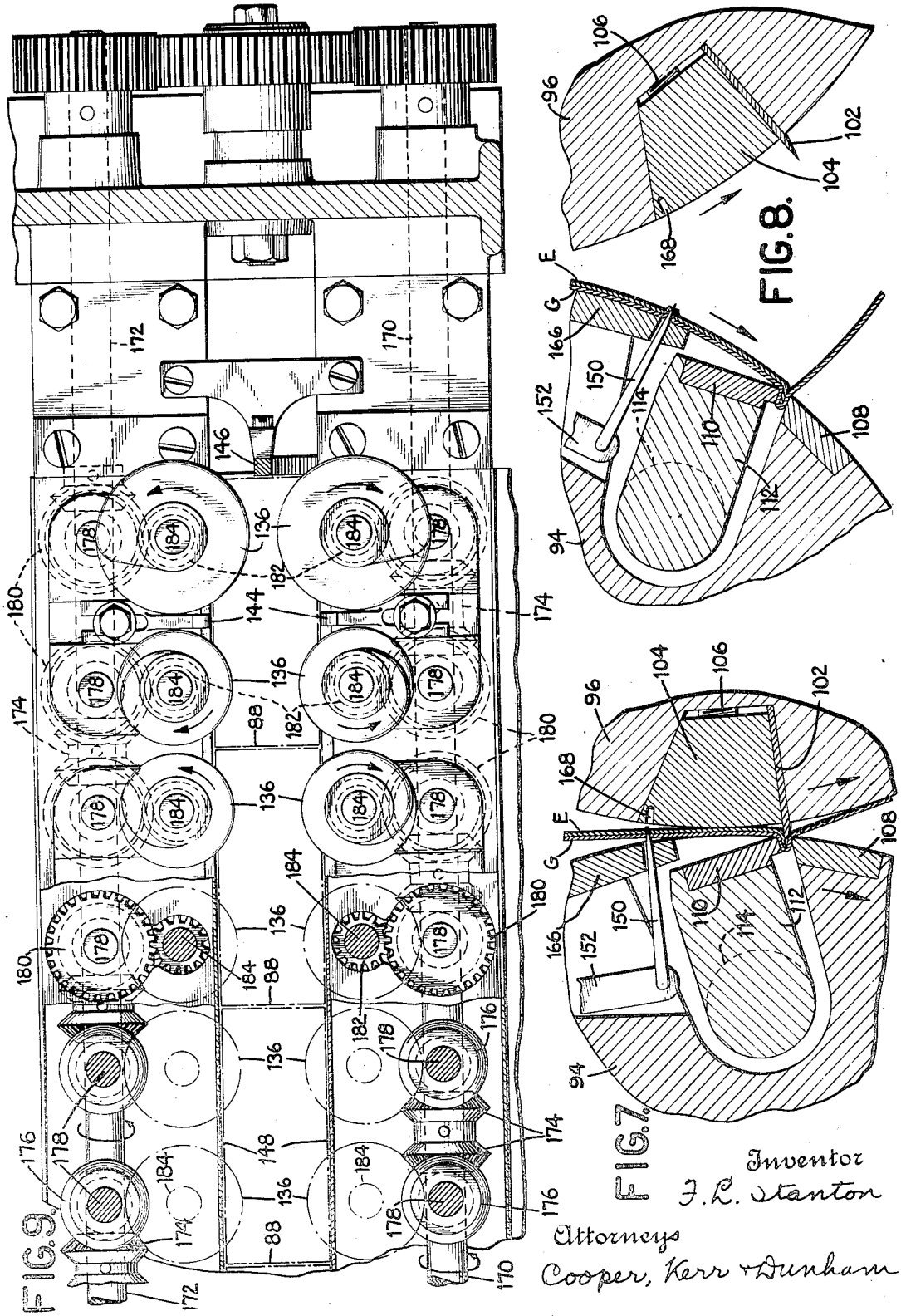
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PAPER FOLDING MACHINE

Filed Nov. 30, 1929 7 Sheets-Sheet 7



Patented Nov. 1, 1932

1,886,312

UNITED STATES PATENT OFFICE

FREDERICK L. STANTON, OF CARTHAGE, NEW YORK, ASSIGNOR TO NATIONAL PAPER PRODUCTS COMPANY, OF CARTHAGE, NEW YORK, A CORPORATION OF CALIFORNIA

PAPER FOLDING MACHINE

Application filed November 30, 1929. Serial No. 410,677.

This invention pertains to apparatus for folding paper, particularly toilet paper, towels, napkins, etc.

The machine is particularly adapted for folding and interleaving such paper in the familiar Z fold manner with the sheets so overlapped and interleaved that when a sheet is removed from the package or stack it always leaves an end of the next sheet in an easily accessible position.

Previous machines for this purpose have been uncertain in their action because they relied on air pressure, suction or the force of gravity to carry the paper through its various operations, none of which is sufficiently positive in its action. An object of the present invention is to avoid those shortcomings by so designing the apparatus that the paper is positively controlled by mechanical devices in every stage of its progress through the machine.

Previous machines have done their folding and interleaving by oscillating and reciprocating devices. An object of the present invention is to perform all operations by rotating members which can of course operate at higher speed than the former devices.

As a result of the positive paper control and the use of the rotating in place of reciprocating principle, the present machine is much faster and has a much greater output than any apparatus heretofore used for the purpose.

Further and other objects and advantages will be apparent from the specification and claims, and from the drawings which illustrate what is now considered the preferred embodiment of the invention.

Fig. 1 is a front view of the machine, partly broken away.

Fig. 2 is a view of an end of the machine, taken from the left of Fig. 1.

Fig. 3 is a cross-section of the machine, on the line 3—3 of Fig. 1.

Fig. 4 is a view of an end of the machine, taken from the right of Fig. 1.

Fig. 5 is an enlarged view of an upper portion of Fig. 3.

Fig. 6 is an enlarged view of the lower portion of Fig. 3, showing details of the folding cylinders.

Figs. 7 and 8 show enlarged details of the folding devices.

Fig. 9 is an enlarged cross-section, on the line 9—9 of Fig. 1.

Fig. 10 is a detail view showing the final arrangement of interfolded and interleaved sheets.

In the operation of the machine, a wide web of paper 20 (Fig. 3) is fed from roll 22 over idler roll 24, and into the machine between marker roll 26 and marker finger 28. Roll 26 is supported for rotation on shaft 30, and finger 28 is carried on shaft 32. During each revolution of shaft 32 the end of finger 28 contacts with ink roll 34 and then later in the revolution, when it reaches the position shown in Fig. 3, it contacts with the paper and makes an ink mark 33 thereon. Rotation of shaft 32 is so timed that the ink marks are made at regular predetermined intervals, the marks serving later to guide the operator in the assembly of the finished product in packages of uniform content. A series of fingers 28 is provided, spaced along shaft 32 to mark web 20 at intervals, so that when the web is later cut into narrow strips there will be a mark on each strip. Fingers 28 are so located circumferentially on shaft 32 that the marks are placed on the paper at points where folds later occur, in order that the marks will be visible after the product is interleaved and folded, as indicated in Fig. 10 at 33.

After passing the marking device the paper is guided by plate 35, first between upper and lower slitting rolls 36 and 38, and then into the bite between cutting drum 40 and back feed roll 42. Slitters 36 and 38 are mounted for rotation on shafts 44 and 46 respectively, and are so spaced along those shafts as to slit web 20 into comparatively narrow strips 50 (Fig. 5) of suitable width for the product being made.

For some purposes it is desired to form a product having two or more thicknesses of paper. When that is the case it is only necessary to draw additional webs such as 52 from additional rolls such as 54 and pass the webs over roll 24 and through the machine as

though they were a single web. For clarity of illustration and description, this application considers the paper as being of a single thickness only.

After passing the slitters, the strips of paper pass between back feed roll 42 and cutting drum 40, over the top of drum 40 and then downwardly between the drum and front feed roll. Roll 42 is fast on shaft 58, roll 56 on shaft 60, and drum 40 on shaft 62. Drum 40 is provided on its circumference with equally spaced longitudinal grooves 64, the circumferential distance between grooves being equal to the desired length of the towel or napkin being made by the machine.

Mounted on a shaft 66, parallel with shaft 62 and above it, is a drum 68 provided with longitudinal serrated knives 70 (Figs. 1 and 3) projecting from the circumference thereof. Shafts 62 and 66 are geared together so that a knife 70 enters each longitudinal groove 64 of drum 40, through the paper, thereby cutting the paper into sheets of proper lengths. Knives 70 are so shaped as to not completely sever the paper, but to leave the cut in such condition that partially severed sheets may readily be later pulled apart by the machine.

The strip 50, after being perforated or partly severed as above described, passes downwardly between drum 40 and front feed roll 56 (Fig. 5), between guide plates 72, 74, between breaker roll 76 on shaft 77 and its cooperating segment roll 78 on shaft 80, and into the bite between feed rolls 82, 84 on shafts 86 and 88 respectively. Guide plate 72 has upwardly projecting fingers 73 which enter circumferential grooves 75 in drum 40 (Figs. 1 and 5). Plate 74 has similar fingers 79 entering grooves 81 of roll 56. Plate 72 is supported by bar 83 and plate 74 by channel 85.

The peripheral speeds of drum 40, and its roll 56, are the same as the peripheral speeds of rolls 82 and 84, whereas the peripheral speeds of rolls 76 and 78 are considerably higher. As the strip passes downwardly, as above described, the full-diameter portion of segment roll 78 is out of contact with roll 76; consequently the paper strip passes between and out of contact with those rolls until the lower end of the strip enters the bite between rolls 82 and 84. At that instant segment 78 rotates into engagement with roll 76, pinching the paper strip between them. And since rolls 76 and 78 are traveling at higher speed than drum 40 and roll 56, the result is that the paper is pulled apart along the partially perforated line adjacent the groove 64 which is at the bite between drum 40 and roll 56, thus forming a separate sheet of paper 88, of a length substantially equal to the distance from the center of shaft 62 to the center of shaft 86.

Finger 90, on rock shaft 92, serves while in its dotted position as a temporary extension of plate 72 to guide the paper strip past the breaker and segment rolls and then moves to its full line position when rolls 76 and 78 grip the paper. Shaft 92 is rocked by a cam 93 on the left end of shaft 62 (Figs. 1 and 2), by means of rocker arm 95. Finger 90 also serves the important purpose of removing all static electricity from the paper before the latter enters control of the folding cylinders. Segment roll 78 is preferably made of semi-hard rubber, but any suitable material may be used. Although rolls 78 and 84 are referred to as "rolls" they are in fact simply series of short rolls or disks on shafts 80 and 87 respectively, thus providing for the overlap of those rolls as shown in Figs. 1, 3 and 5.

After the sheet 88 has been broken from the strip by the breaker rolls 76, 78, those rolls continue to rotate and feed the sheet downwardly at a much higher speed than rolls 82, 84 can take it away. The result is that the sheet, aided by rotation of roll 76, assumes successively the positions A, B, C and D, and then while that particular sheet is being taken away between rolls 82, 84, the lower end of the next succeeding sheet is pushed down rapidly by rolls 76, 78, as at E, to overlap the upper end G of the first sheet substantially as shown. In practice the apparatus is arranged to cause the lower one-third "E" of the upper sheet to overlap the upper one-third "G" of the lower sheet, and the sheets go through the remaining operations in the machine in that relationship, i. e., each sheet overlaps one-third of the body of the sheet ahead of it. Thus arranged they next pass between the folding cylinders 94, 96, mounted on shafts 98 and 100, respectively. Details of the devices carried by the folding cylinders are shown in Figs. 6, 7 and 8.

As the sheets enter the bite between cylinders 94 and 96, a tucker blade 102 engages the sheet one third the distance from the top of the lower sheet and tucks that part of the lower sheet and the lower edge of the upper sheet between the gripper jaws of cylinder 94, as is best shown in Fig. 7. Tucker blades 102 are held fixed in cylinders 94 and 96 by wedge blocks 104 and screws 106. There are a number of blades 102 spaced around each cylinder, and corresponding grippers on the other cylinder so spaced that the blades and grippers cooperate to tuck and grip the advancing sheets at the lower edge of the upper overlapping sheet, as above described, where a tucker 102 on cylinder 96 enters a gripper on cylinder 94. In like manner each tucker 102 on cylinder 94 enters a gripper on cylinder 96, carrying with it a fold formed two thirds the distance from the top of the lower sheet, together with the upper edge of the sheet in advance of the lower one. Each

gripper comprises a jaw 108, fixed in the periphery of the cylinder, and a movable jaw 110 on the outer end of an arm 112 fast on a rock shaft 114. These shafts pass lengthwise through the cylinders and are rocked by a stationary cam 116 shown in Fig. 1 and in dotted outline in Fig. 6. Engagement with cam 116 is effected by cam followers or rollers 118 on the free ends of arms 120 fixed by clamps 122 to the projecting ends of shafts 114. Torsion springs 124 surrounding the shafts and fast to the cylinders operate to hold rollers 118 in contact with cams 116.

Immediately after tucker 102 enters between gripper jaws 108 and 110, the roller 118 controlling that particular jaw passes over the edge 128 of cam 116, thereby permitting spring 124 to rock shaft 114 and move jaw 110 toward jaw 108, gripping and folding the paper which tucker 102 had placed between the jaws. As this occurs, rotation of the cylinders withdraws tucker 102 from between the jaws, leaving the jaws in possession of the fold, as in Fig. 8. This fold is carried downwardly and to the left by cylinder 94 until the cam roller is restored to normal position at 130 on cam 116, thus opening the jaws. In like manner the folds formed by cylinder 96 are carried by that cylinder downwardly and to the right until released by the grippers as indicated in Fig. 6.

As each fold is released by the grippers, it is engaged by the free end of a stripper finger 132 (Figs. 1 and 6) mounted on a rock shaft 134 and so shaped and actuated as to positively remove the interfolded sheets from the open gripper and place them under control of one of the delivery spirals 136. Shafts 134 are rocked by cams 138, 140 at the left end of the machine (Fig. 1) through the instrumentality of arms 142.

It will be appreciated from the above that each sheet is overlapped for a third of its length at each end by the sheets preceding and following it, and that each sheet is folded at the ends of the overlap, the folds being delivered alternately to the right and to the left into control of the right and left delivery spirals, which deliver the folded sheets between guides 144 and 146 into chute 148.

Cylinder 94, in addition to the devices described above, carries mechanism for locking together the overlapping sheets in order to insure their remaining in proper relationship with each other. This apparatus comprises pointed transfer needles 150 arranged in pairs to puncture the sheets near their edges. A pair of needles 150 is located near each pair of grippers. Each needle 150 is pivotally connected at its inner end to an arm 152 mounted on a rock shaft 154 extending through cylinder 94 and beyond the left end thereof (Fig. 1), where it is rocked by a fixed cam 156 by means of arms 158 and cam followers 160. Coil springs 162 surrounding shafts 154 serve to hold rollers 160 against the cam. Whenever a roller 160 encounters the dip 164 on the cam (Fig. 6), needle 150 is projected through a hole in block 166 to puncture a pair of overlapped sheets, the end of the needle entering into a hole 168 bored in wedge block 104 of cylinder 96. Needle 150 is later restored to normal position by the cam, but the slightly burred edges of the punctures remain, to lock the sheets together sufficiently for the desired purpose.

Spirals 136 (Figs. 1, 3, 6 and 9) rotate as indicated by the arrows in Fig. 9, there being four spirals engaging each sheet 88 to direct it into chute 148. The front row of spirals is driven from shaft 170, and the rear row from a parallel shaft 172, through trains of gears. The front train comprises bevel gears 174 fast on shaft 170, bevel pinions 176 fast on vertical shafts 178, spur gears 180 fast on shafts 178, and spur pinions 182 fast on studs 184 upon the upper ends of which are mounted the front row of spirals 136. The rear row is driven by a similar train of gears from rear shaft 172. It will be noted that the end spirals of each row are of larger diameter than the others. This is done simply as a matter of structural convenience and has no other significance.

The machine parts above described are all interconnected in proper operative relationship by trains of gearing mostly located at the ends of the machine, outside the frames. It is not believed necessary to trace the gearing through in detail, but enough of it will be described to enable any one familiar with machine details to follow the drawings with full understanding.

Referring to Figs. 1, 2 and 4, the machine is driven by a motor 190 equipped with a pinion 192, engaging on one side a gear 194 on shaft 196 and on the other side a gear 198 on stud 200. Shaft 196 extends the length of the machine and bears on its left end a hand wheel 202 by which the machine may be manually operated if the motor is idle.

On stud 200 with gear 198 are pinion 204 and gear 206. Gear 206 drives gear 172^a directly, and through idler 208 drives gear 170^a. Pinion 204 engages gear 210 on cylinder shaft 98, and gear 212 on the same shaft engages a gear 214 of the same size on the other cylinder shaft 100, thus driving the gripper cylinders in unison. Gear 212 is split circumferentially and equipped with a back-lash take-up device represented conventionally at 216.

Gear 212 also engages idler gear 218 on stud 220 which in turn drives pinion 222 on shaft 62. Gear 224 on that same shaft drives shafts 58 and 60 by means of gears 226 and 228 respectively, and also drives shaft 66 through gear 230 provided with a back-lash take-up 232. A gear 234 on shaft 62, inside the end frame of the machine, through an

idler 236 drives shaft 77 by means of pinion 238 fast thereon, and another gear 240 on shaft 77 drives shaft 80 through its gear 242. Shaft 30 is driven from idler gear 218 through idlers 244 and 246 to gear 248. Shaft 30, in turn, drives shaft 32 from pinion 250 through idlers 252, 254 to gear 256.

At the left end of the machine gear 258 on shaft 62, through idler 260, drives pinion 262, fast on lower slitter shaft 46 (Figs. 1 and 2). At the other end of the machine, gear 264 on shaft 46 drives upper slitter shaft 44 by gear 266, fast thereon.

Feed roll shafts 58 and 60 are mounted in guides and are pressed toward cutting drum 40 by springs 268 and 270 respectively. In like manner, shaft 88 is pressed toward roll 86 by springs (not shown) in housings 272. These shafts and rolls are driven by gear 273 on shaft 98 through idler 274 to pinion 276 on shaft 86 and gear 278 on shaft 88.

It is to be understood that the invention is not limited to the specific construction herein described and illustrated, but may be used in other ways without departure from its spirit as defined by the claims which follow.

I claim—

1. In a machine of the class described, in combination, means for drawing a wide web of paper into the machine, means for slitting the web into a plurality of narrow strips, means for marking said strips at predetermined intervals, means for cutting the strips into short sheets, and means for folding the sheets with the marks at the folds thereof, for the purpose set forth.

2. In a machine of the class described, in combination, a pair of separated breaker rolls, means for feeding sheets of paper in succession at normal speed between said rolls, means for bringing said rolls into momentary engagement with each sheet whereby the speed of the sheet is increased above normal, and means for thereafter reducing said speed to normal, whereby each sheet is overlapped by the sheet following it through the machine.

3. In a machine of the class described, in combination, means for feeding sheets of paper in succession through the machine at normal speed, means for momentarily increasing the speed of each sheet whereby the forward end thereof is caused to overlap the rear end of the sheet ahead of said first mentioned sheet, and means for momentarily widely separating the overlapping ends of said sheets whereby the overlapping may take place without interference of either sheet with the other.

4. In a machine of the class described, apparatus for feeding a sheet of paper through the machine comprising in combination, a device for engaging the advancing edge of the sheet to feed it at normal speed in a normal path, a second device for engaging the body of the sheet to feed it in the same path at a speed higher than normal, thereby creating slack paper between said devices, and means for temporarily deflecting said slack paper to one side of the normal course whereby creasing of the paper of the sheet is prevented while it is passing into said normal speed feeding device.

5. The invention set forth in claim 4 in which said deflecting means is a feed roller in contact with the slack paper of said sheet.

6. The invention set forth in claim 4 in which said second device comprises a pair of feed rolls, said rolls serving also as said deflecting means, substantially as described.

7. In a machine of the class described, in combination, means for feeding therethrough sheets of paper in overlapping relationship, and means for locking the sheets together to preserve said relationship.

8. In a machine of the class described, in combination, means for feeding sheets of paper through the machine, means for moving the sheets into overlapping relationship, and means for locking the overlapped sheets together to preserve said relationship.

9. The invention set forth in claim 7 in which said locking means comprises devices for puncturing the overlapped sheets.

10. The invention set forth in claim 8 in which said locking means comprises devices for puncturing the overlapped sheets.

11. In a machine of the class described, in combination, means for feeding sheets of paper through the machine, means for moving the sheets into overlapping relationship, a pair of rotatable cylinders, means for feeding the overlapped sheets between said cylinders, and a device on one of said cylinders for puncturing the overlapped sheets while passing between said cylinders whereby interlocking burrs are formed on said sheets to preserve their relationship.

12. The invention set forth in claim 11 in which said puncturing device comprises a needle and a cam for reciprocating said needle.

13. The invention set forth in claim 11 in which said puncturing device comprises a needle, a cam for reciprocating said needle through said sheets, and a socket in said other cylinder to accommodate the end of said needle and said burrs during the puncturing operation.

14. In a machine of the class described, in combination, a gripping device, means for opening and closing said device, means for feeding overlapping sheets of paper to overlie said device while said device is open, means for tucking the end of one of said sheets and a portion of the body of the other of said sheets into said open gripper, means for thereafter closing said device to create a fold in said sheet body, said fold enclosing the end of said other sheet, means for mov-

ing said gripped sheets to a predetermined position while gripped by said device, and means for opening said device when said position is reached, substantially as described.

15. The invention set forth in claim 14 in which moving means comprises a rotatable cylinder supporting said gripping device.

16. In a machine of the class described, in combination, a rotatable cylinder, means for feeding overlapping sheets of paper into contact with said cylinder, and means mounted on said cylinder for thereupon gripping the end of one of said sheets and the body portion of another sheet whereby a fold is created in said body portion, said fold enclosing the end of the other sheet.

17. In a machine of the class described, in combination, a pair of parallel rotatable cylinders, a gripping device on one of said cylinders, a tucker blade on the other of said cylinders, means for feeding overlapping sheets of paper between said cylinders whereby said tucker blade is effective to tuck the end of one of said sheets and a portion of the body of the other sheet into said device, and means for actuating said device whereby a fold is created in said body portion, said fold enclosing the end of the other sheet.

18. In a machine of the class described, in combination, a pair of parallel rotatable cylinders, a gripping device on each of said cylinders, a tucker blade on each of said cylinders, means for feeding overlapping sheets of paper between said cylinders, whereby each of said blades is effective to tuck the end of a sheet and a portion of the body of another sheet into the gripping device of the other cylinder, and means for actuating said devices to form folds in said body portions, each fold enclosing the end of another sheet.

19. In a machine of the class described, in combination, a pair of parallel rotatable cylinders, a gripping device on each of said cylinders, a tucker blade on each of said cylinders, means for feeding overlapping sheets of paper between said cylinders, whereby each of said blades is effective to tuck the end of a sheet and a portion of the body of another sheet into the gripping device of the other cylinder, means for actuating said devices to form folds in said body portions, each fold enclosing the end of another sheet, and means for releasing said folded sheets from said devices in interfolded and interleaved relationship.

20. In a machine of the class described, in combination, a pair of parallel rotatable cylinders, a gripping device on each of said cylinders, a tucker blade on each of said cylinders, means for feeding between said cylinders a sheet being partially overlapped at its upper and lower ends by other sheets, whereby each of said tucker blades is effective to tuck into the gripping device of the other cylinder the overlapping sheet ends and the adjacent portions of said first mentioned sheet, and means for actuating said devices to form folds in said first sheet, each of said folds enclosing an end of one of said overlapping sheets.

21. In a machine of the class described, in combination, a pair of parallel rotatable cylinders, a gripping device on each of said cylinders, a tucker blade on each of said cylinders, means for feeding between said cylinders a sheet being partially overlapped at its upper and lower ends by other sheets, whereby each of said tucker blades is effective to tuck into the gripping device of the other cylinder the overlapping sheet ends and the adjacent portions of said first mentioned sheet, means for actuating said devices to form folds in said first sheet, each of said folds enclosing an end of one of said overlapping sheets, and means for discharging said folded sheets from said devices in interfolded and interleaved relationship.

22. In a machine of the class described, in combination, a pair of parallel rotatable cylinders, a gripping device on each of said cylinders, a tucker blade on each of said cylinders, means for feeding between said cylinders a sheet being partially overlapped at its upper and lower ends by other sheets, whereby each of said tucker blades is effective to tuck into the gripping device of the other cylinder the overlapping sheet ends and the adjacent portions of said first mentioned sheet, means for actuating said devices to form folds in said first sheet, each of said folds enclosing an end of one of said overlapping sheets, a pair of oppositely disposed stripping fingers, means for moving said folds in said devices alternately underneath said fingers, and means for actuating said fingers to remove said sheets from said devices in interfolded and interleaved relationship.

23. In a machine of the class described, in combination, a pair of parallel rotatable cylinders, a gripping device on each of said cylinders, a tucker blade on each of said cylinders, means for feeding between said cylinders a sheet being partially overlapped at its upper and lower ends by other sheets, whereby each of said tucker blades is effective to tuck into the gripping device of the other cylinder the overlapping sheet ends and the adjacent portions of said first mentioned sheet, means for actuating said devices to form folds in said first sheet, each of said folds enclosing an end of one of said overlapping sheets, a pair of oppositely disposed stripping fingers, a set of delivery spirals, means for moving said folds in said devices alternately underneath said fingers, means for actuating said fingers to remove said sheets from said devices into control of said spirals, and means for actuating said

spirals to form a stack of sheets in interleaved and interfolded relationship.

24. In a machine of the class described, in combination, a pair of parallel rotatable cylinders, a gripping device on each of said cylinders, a tucker blade on each of said cylinders, means for feeding between said cylinders a sheet being partially overlapped at its upper and lower ends by other sheets, whereby each of said tucker blades is effective to tuck into the gripping device of the other cylinder the overlapping sheet ends and the adjacent portions of said first mentioned sheet, means for actuating said devices to form folds in said first sheet, each of said folds enclosing an end of one of said overlapping sheets, a set of delivery spirals, and means for transferring said folded sheets from said devices into said spirals whereby a stack of interleaved and interfolded sheets is formed.

In testimony whereof I hereto affix my signature.

FREDERICK L. STANTON.