H. K. KING.

FOLDING MACHINE.

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1,041,806.

Patented Oct. 22, 1912.

34 SHEETS—SHEET 1.

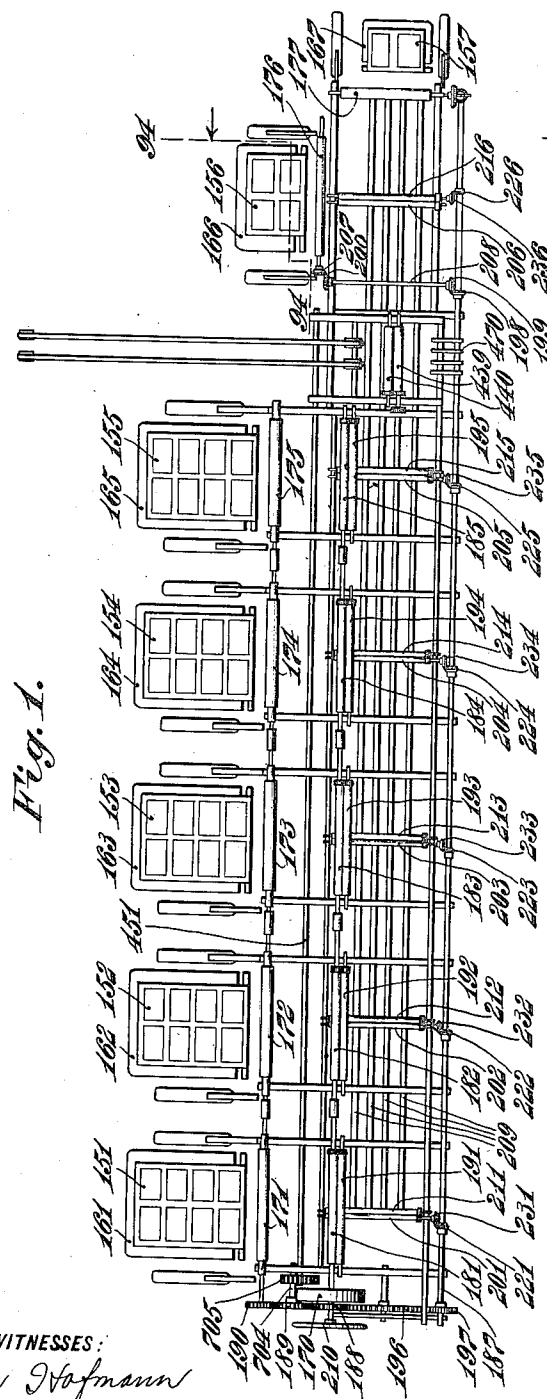

Fig. 1.

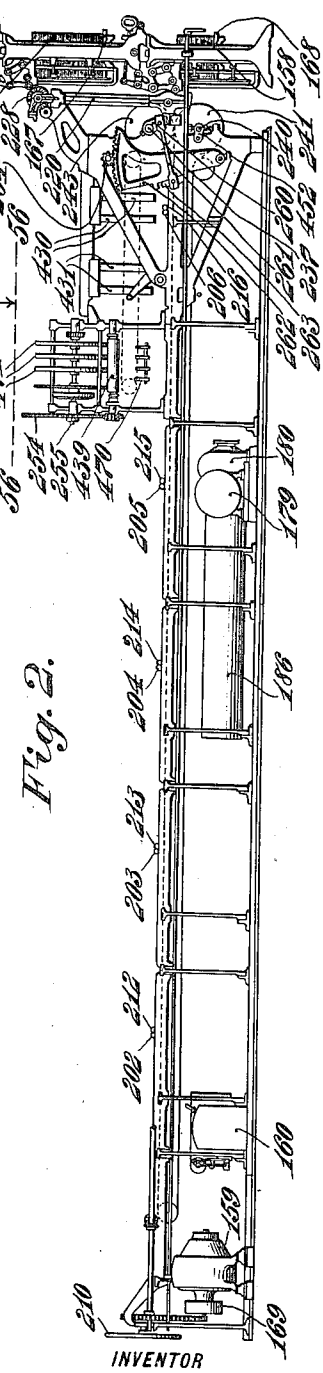

Fig. 2.

WITNESSES:

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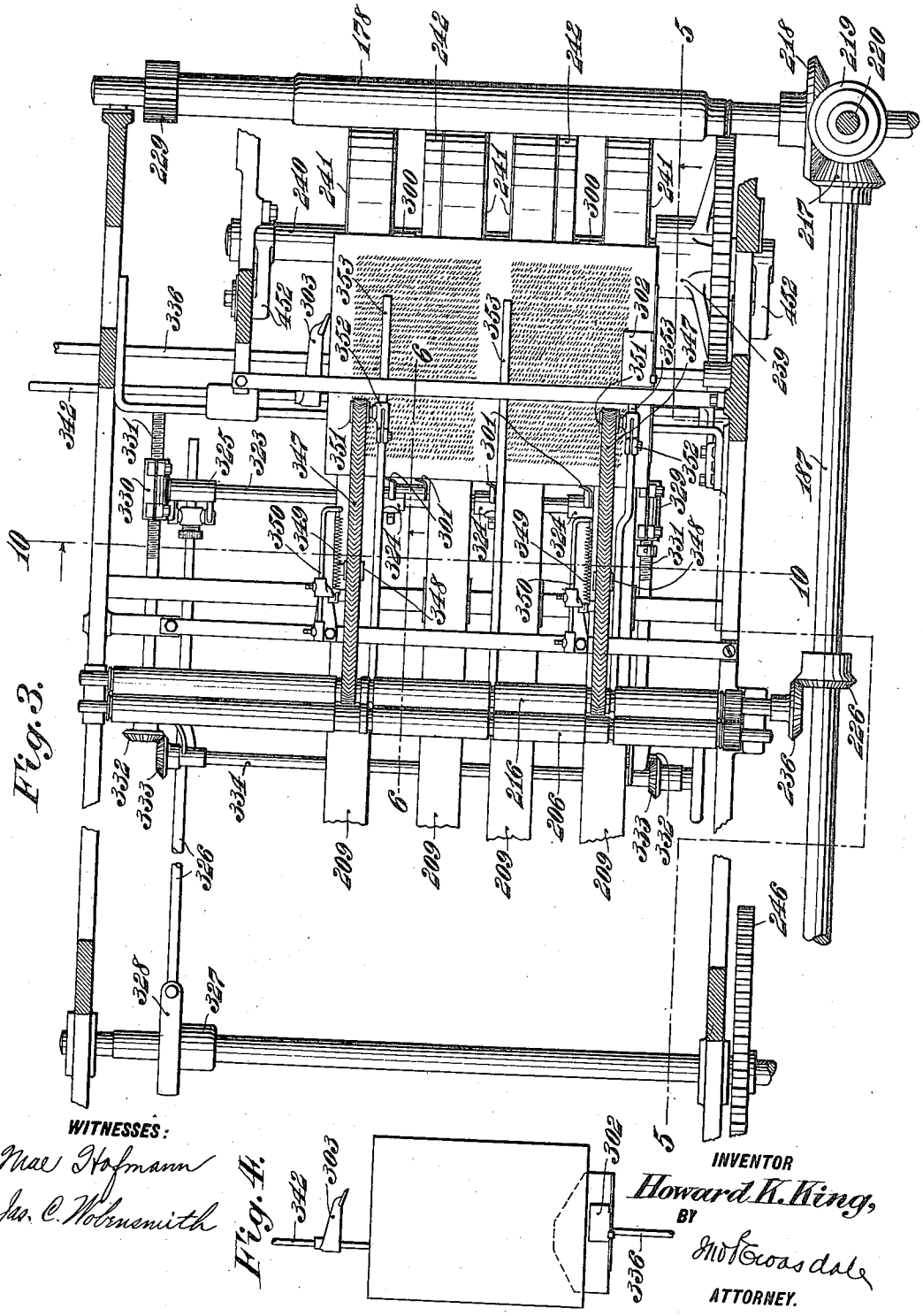

Fig. 3.

Fig. 4.

WITNESSES:

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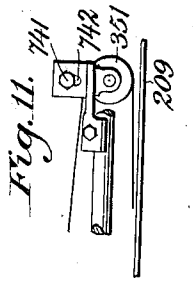
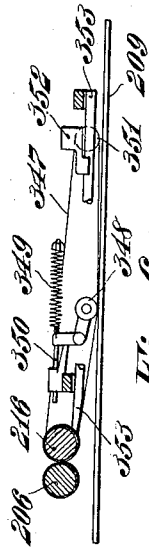


Fig. 11.



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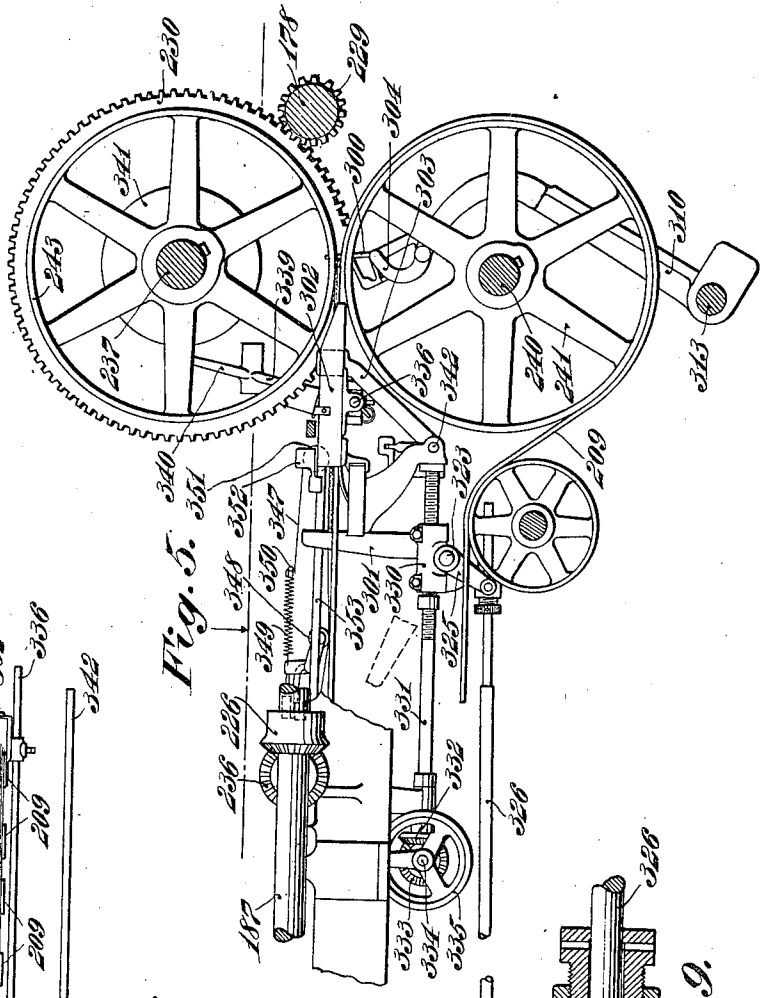

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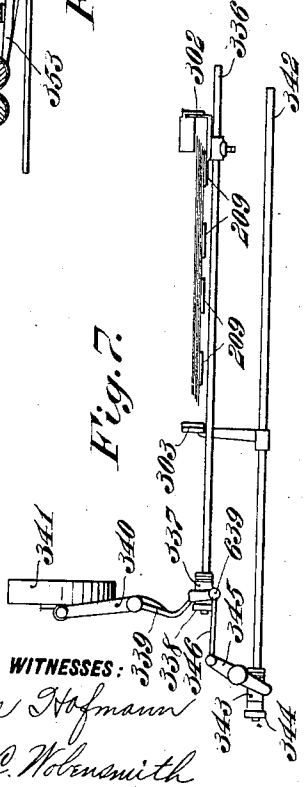
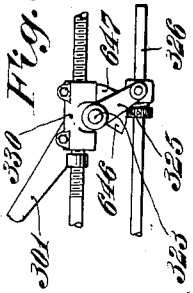


Fig. 7.



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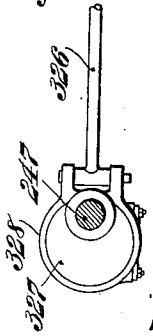

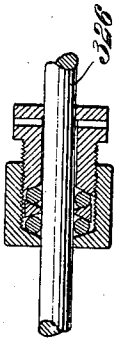

Fig. 9.

WITNESSES:

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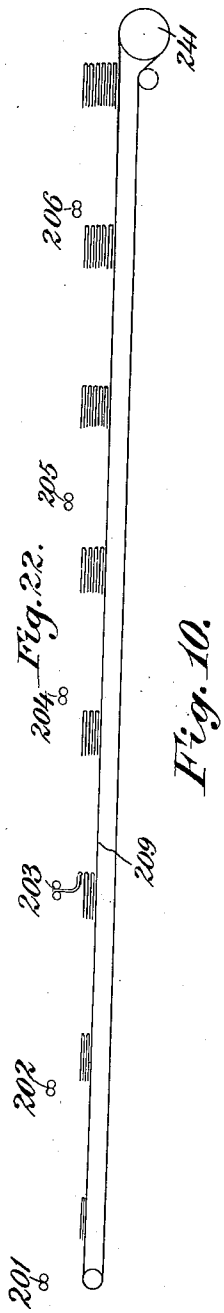
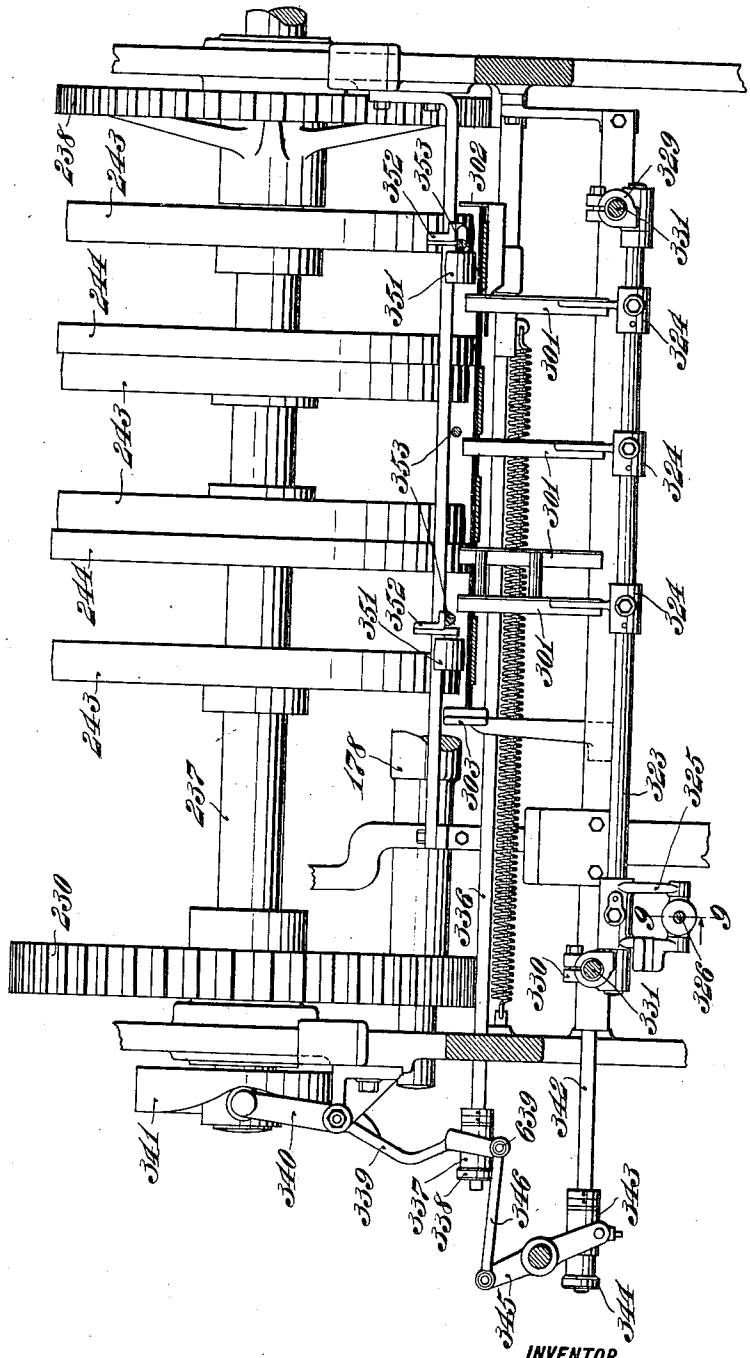


Fig. 22.

Fig. 10.



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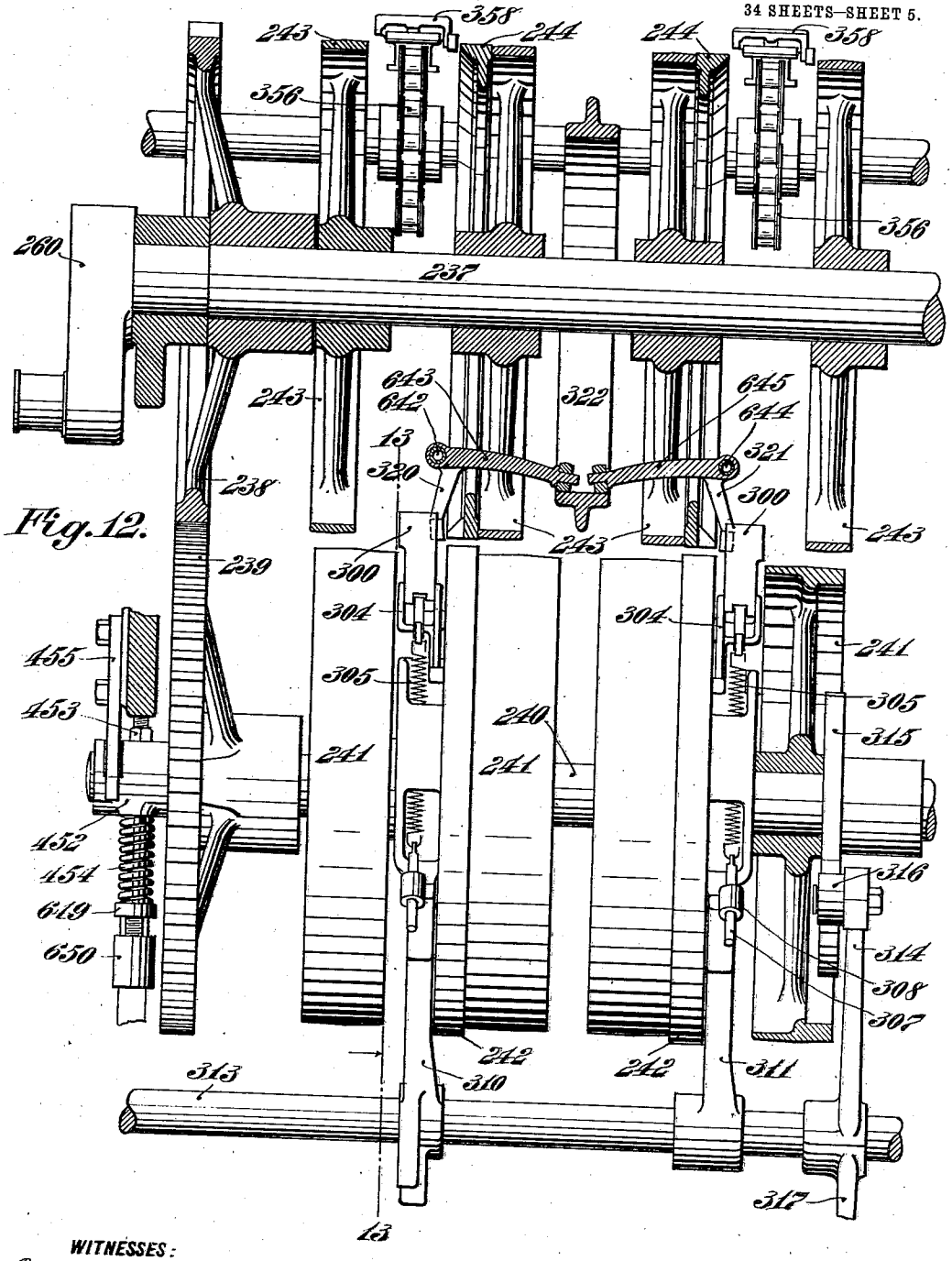

Fig. 12.

WITNESSES:

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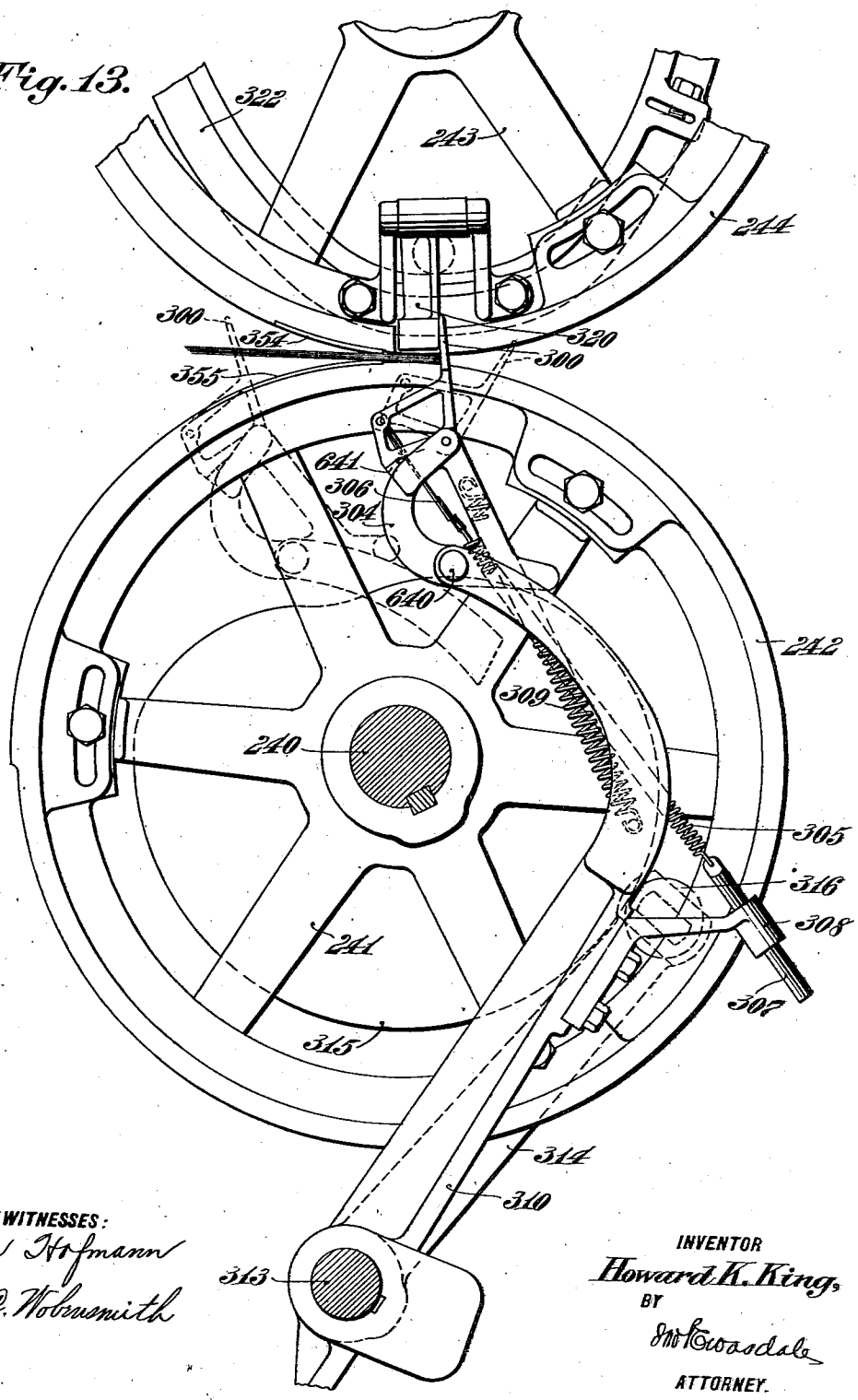
34 SHEETS—SHEET 6.

Fig. 13.



WITNESSES:

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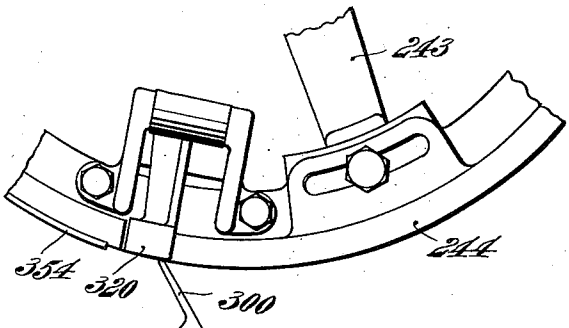

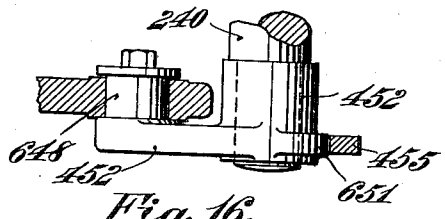

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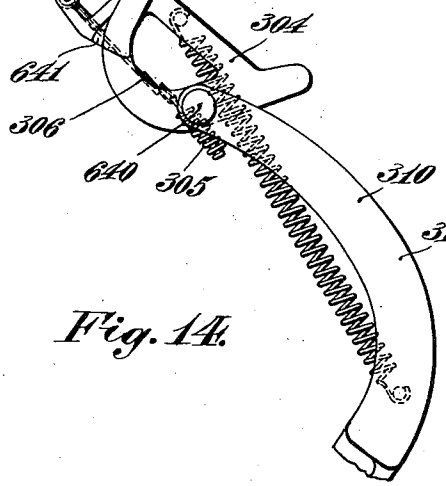
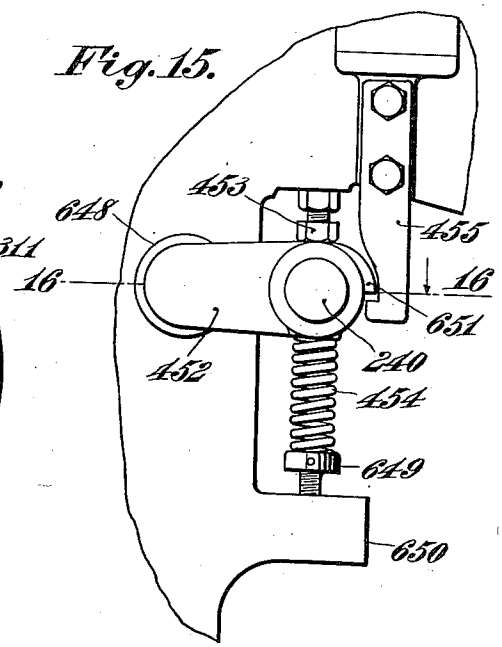


Fig. 14.

Fig. 15.



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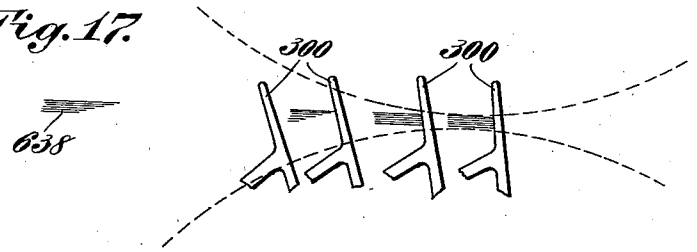

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34 SHEETS—SHEET 8.

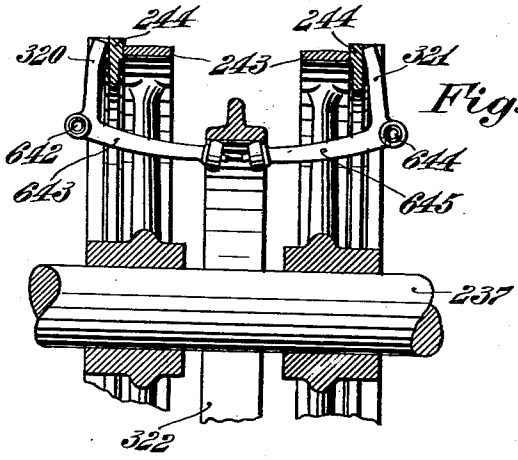
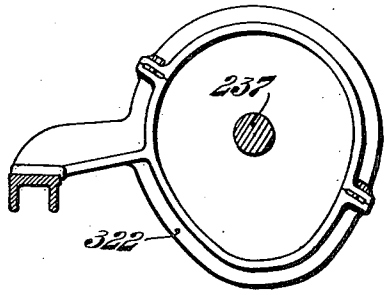


Fig. 19.



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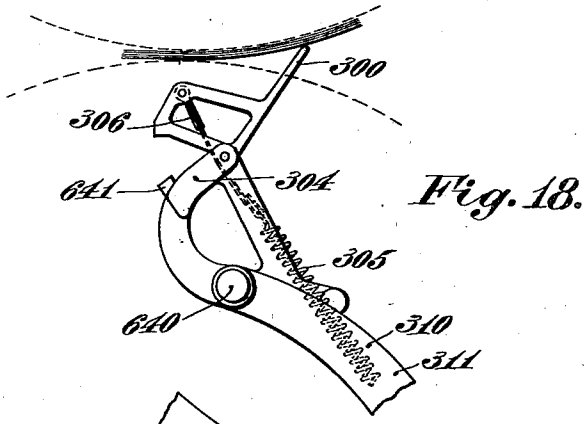
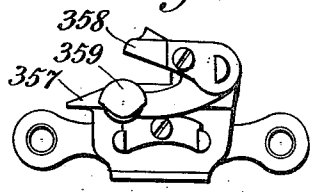


Fig. 18.

Fig. 23.



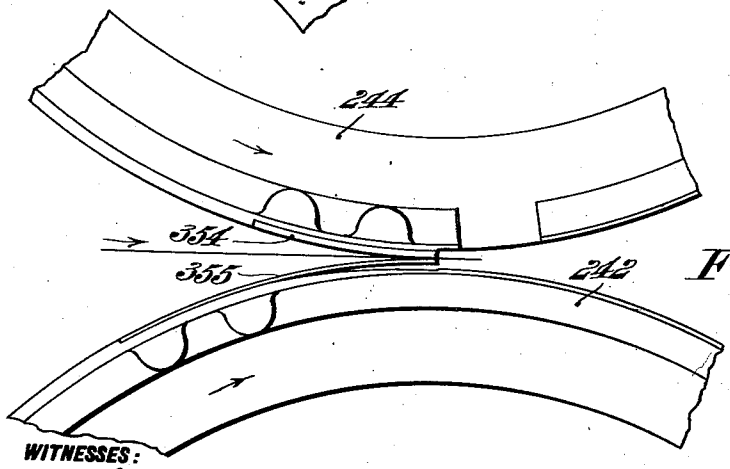


Fig. 21.

WITNESSES:

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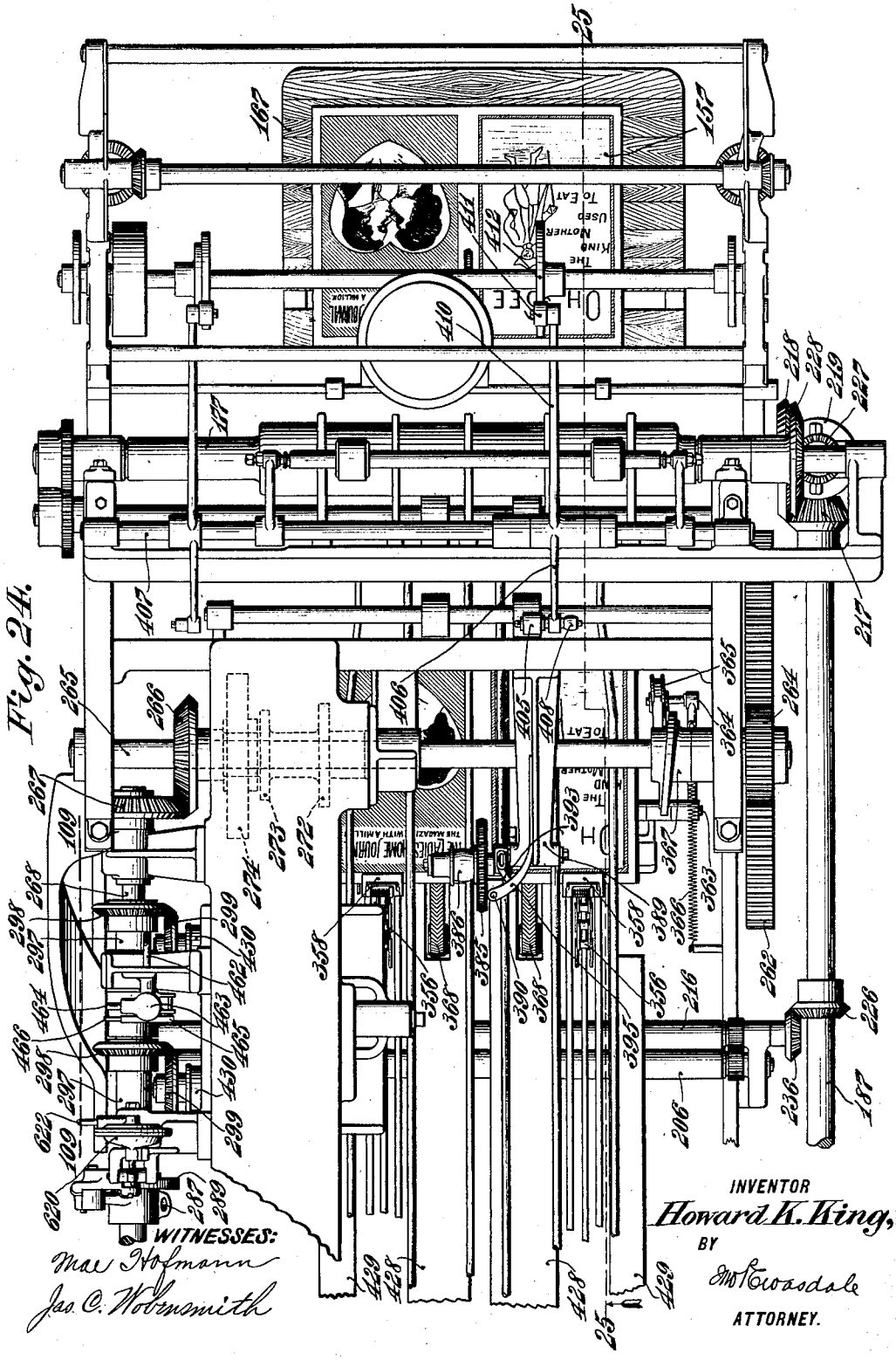
34 SHEETS—SHEET 9.

Fig. 24.



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34 SHEETS—SHEET 10.

Fig. 26.

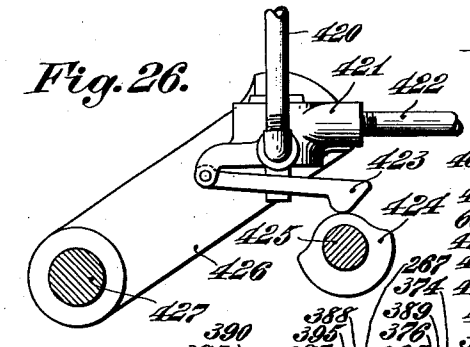

Fig. 25.

WITNESSES:

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34 SHEETS—SHEET 11.

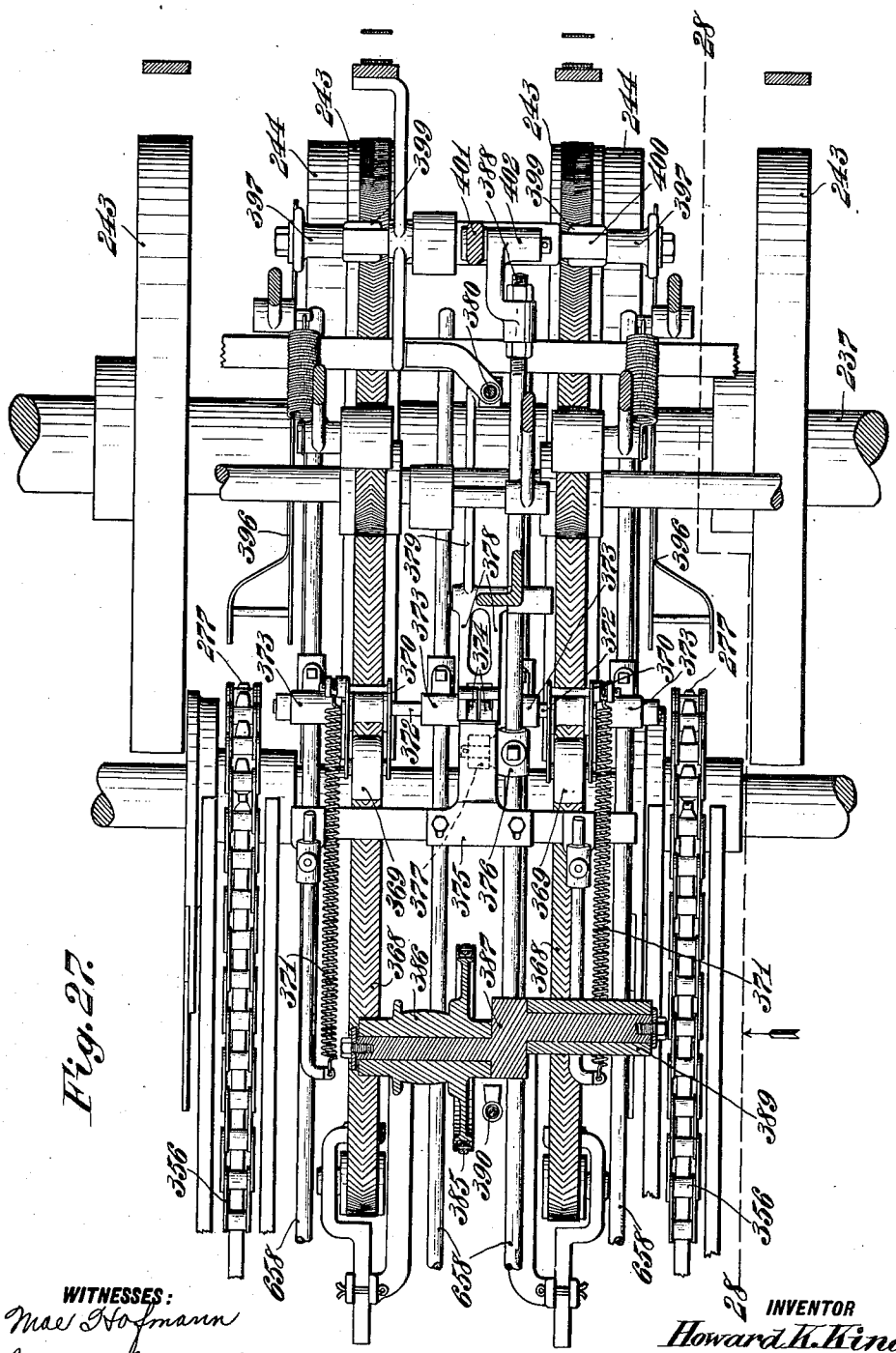

Fig. 27.

WITNESSES:

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34 SHEETS—SHEET 12.

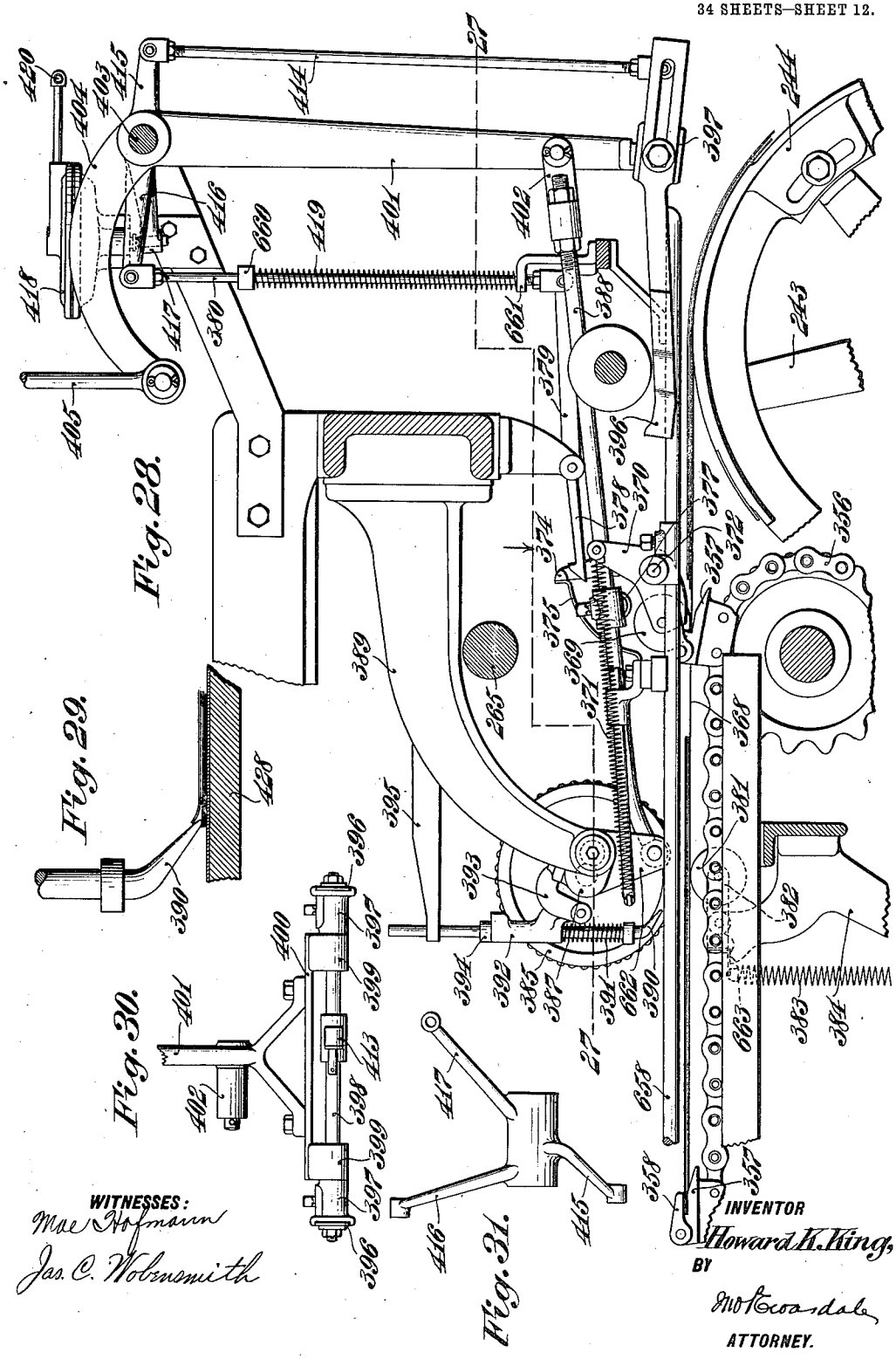

Fig. 28.

Fig. 29.

Fig. 30.

Fig. 31.

WITNESSES:

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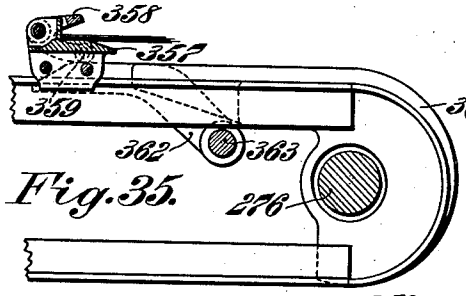
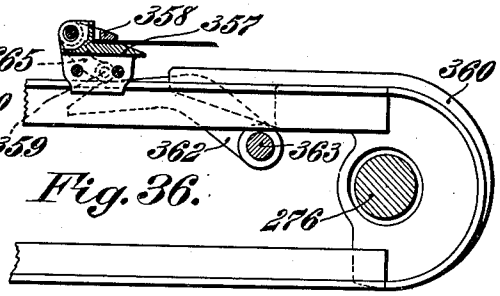


Fig. 35.



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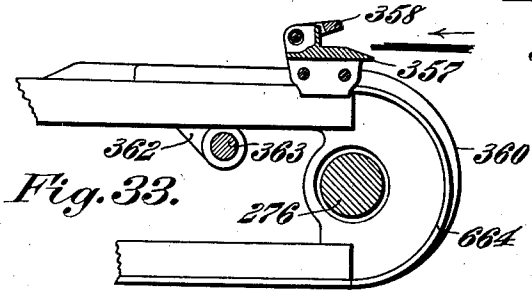


Fig. 33.

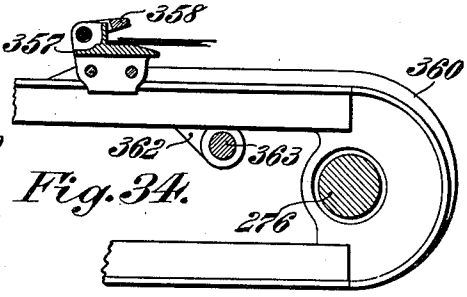
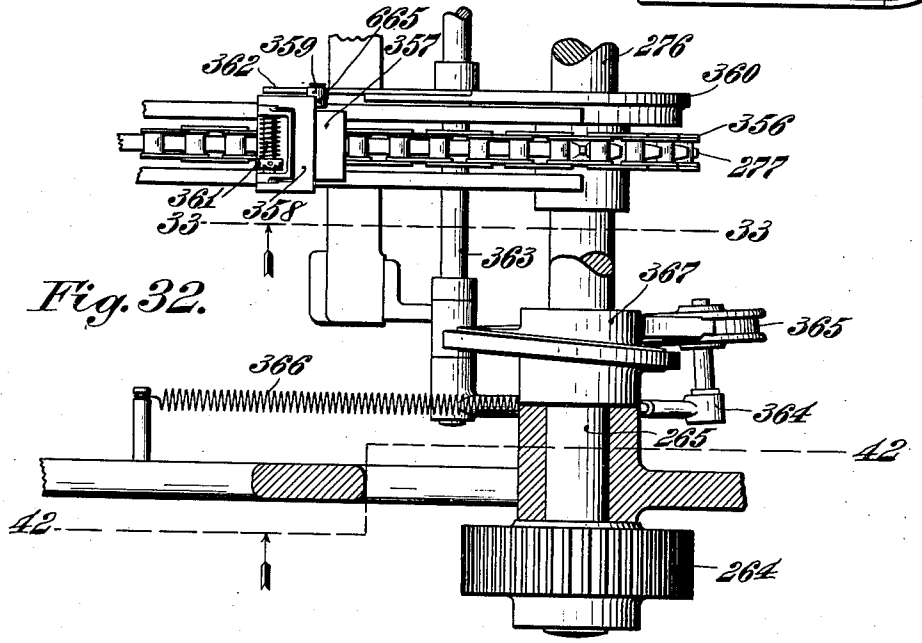


Fig. 34.



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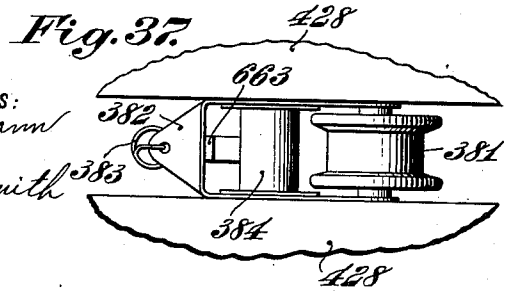

Fig. 37.

WITNESSES:

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34 SHEETS—SHEET 14.

Fig. 38.

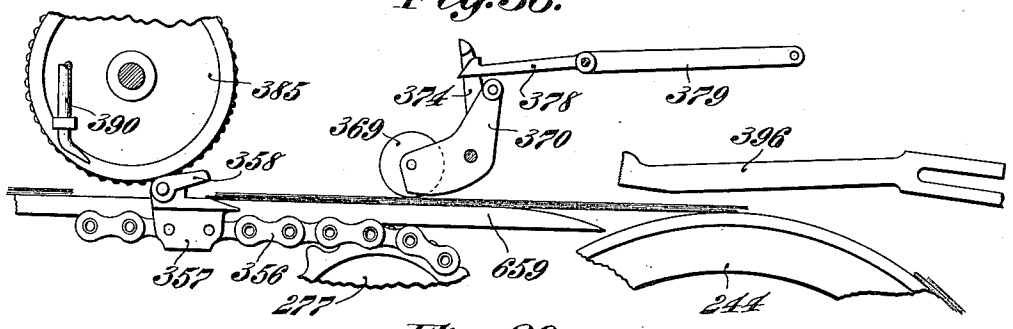
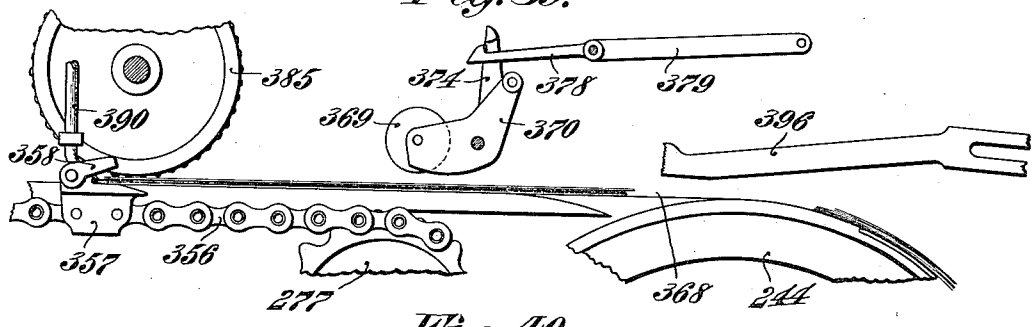


Fig. 39.



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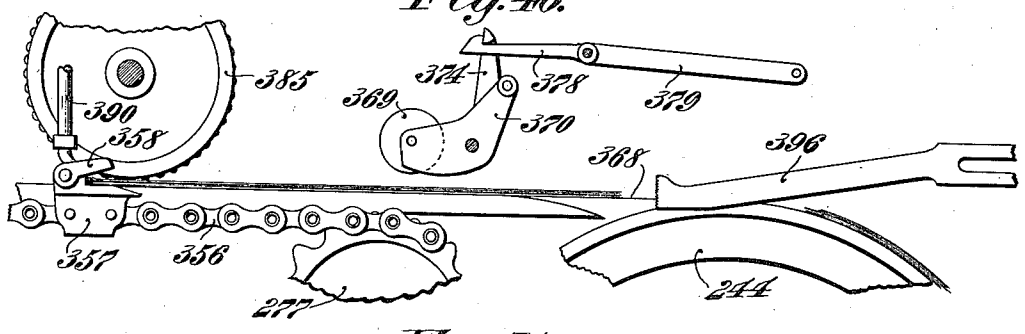
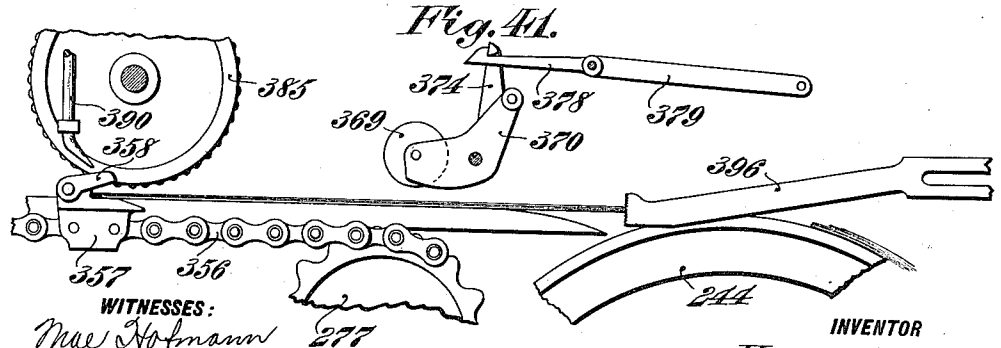


Fig. 41.



WITNESSES:

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34 SHEETS—SHEET 15.

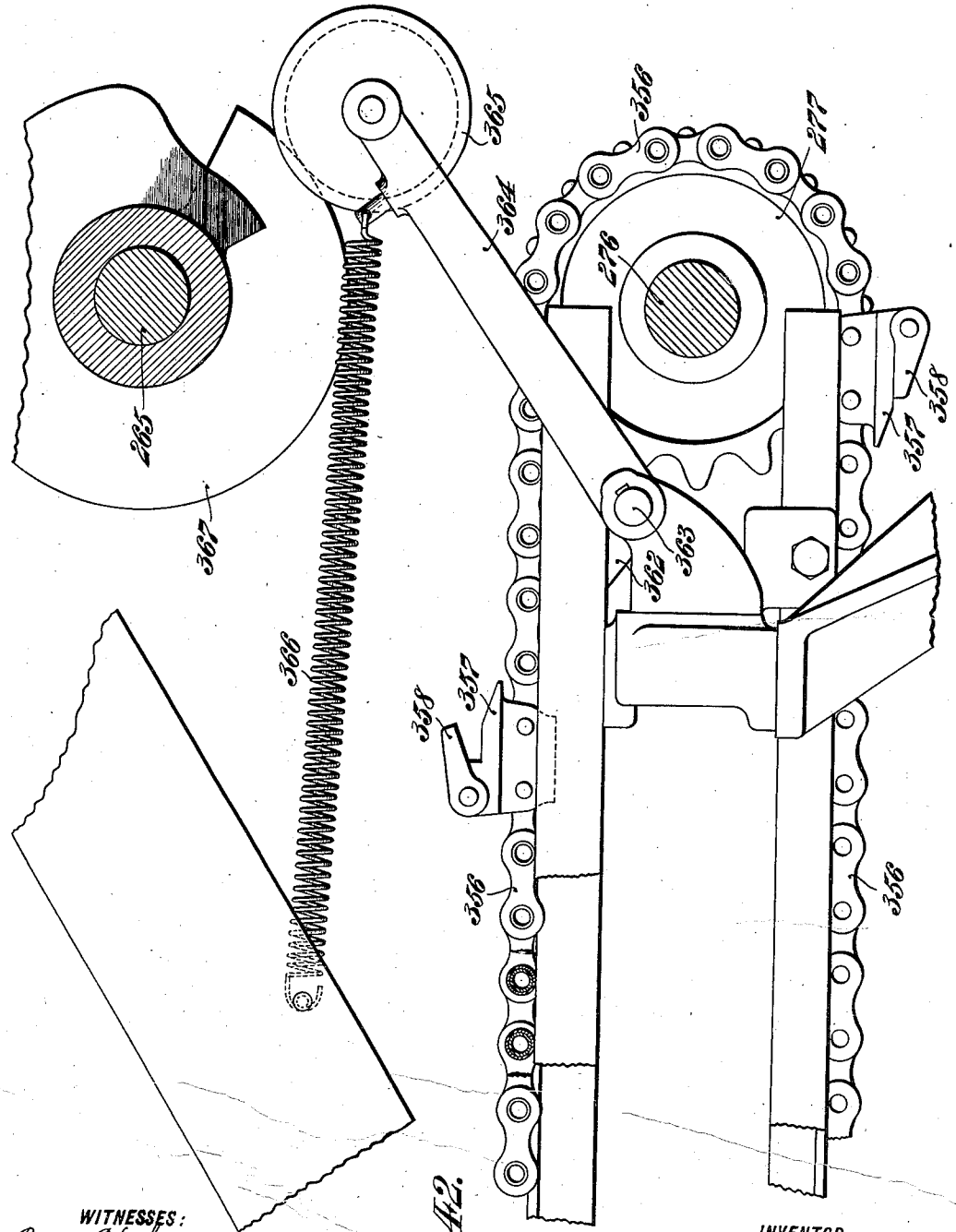

Fig. 42.

WITNESSES:

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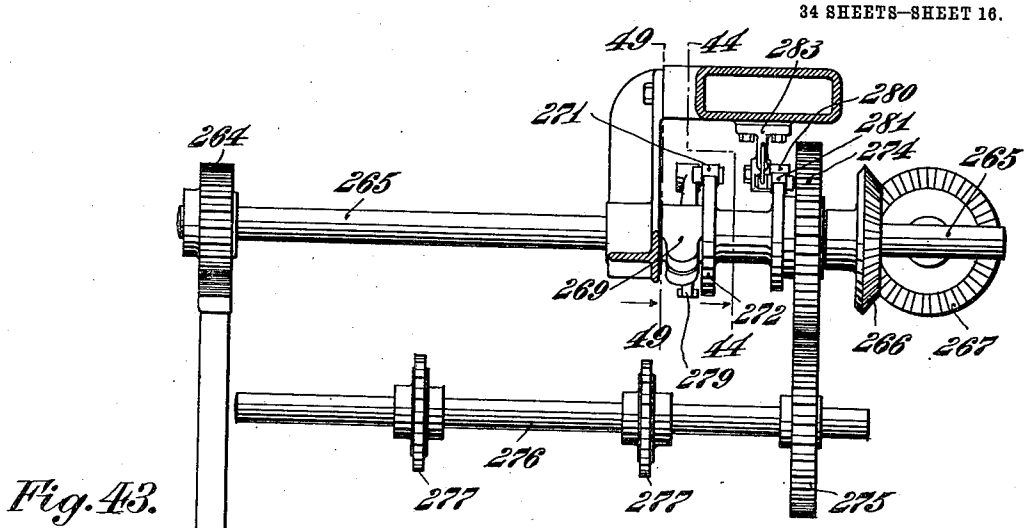
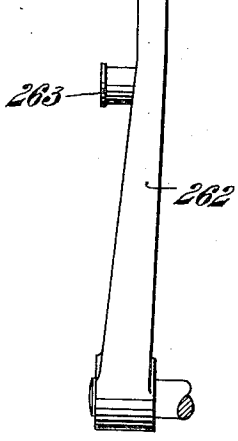


Fig. 43.



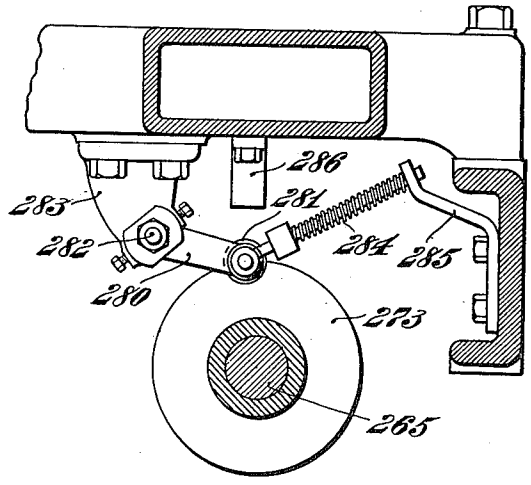


Fig. 44.

Fig. 46.

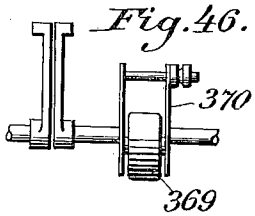
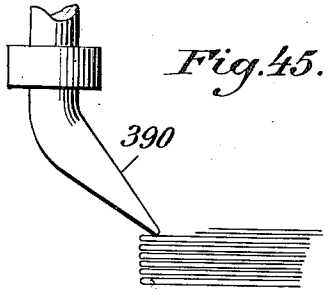


Fig. 45.



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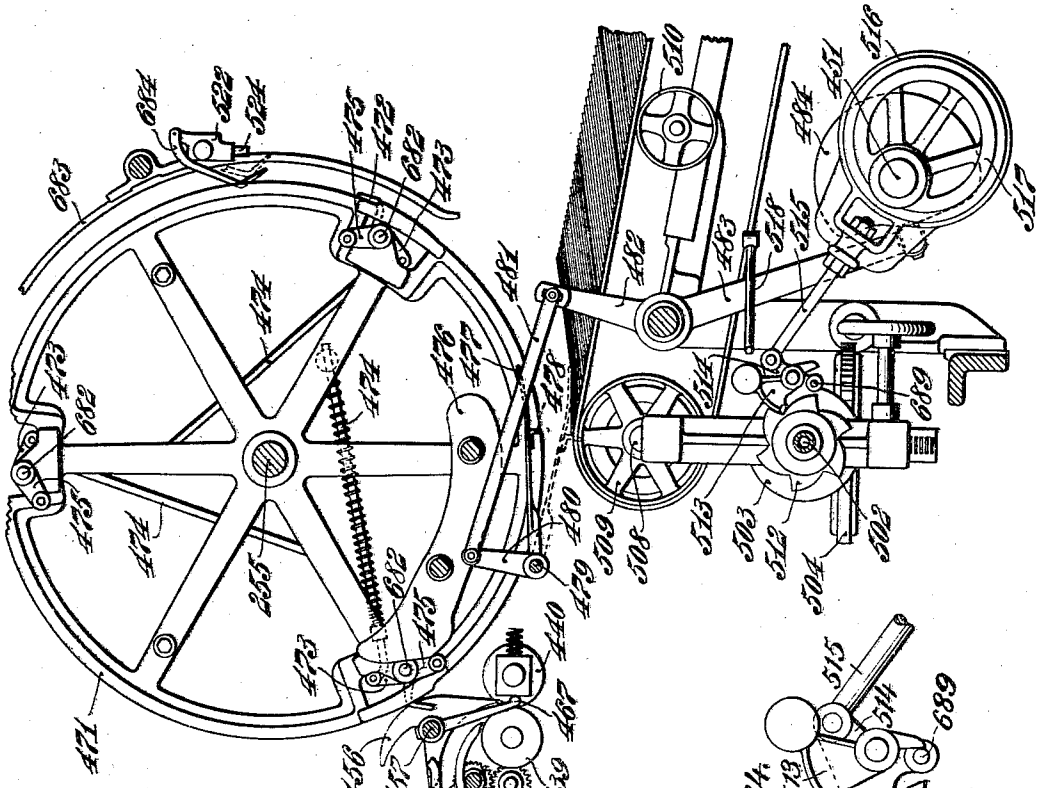


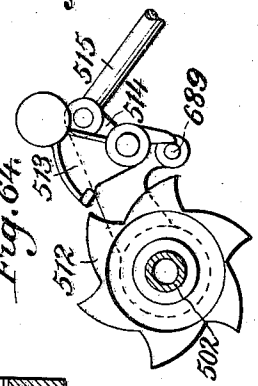
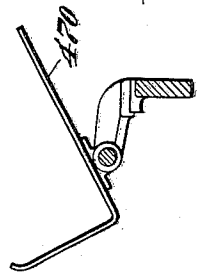


Fig. 64.



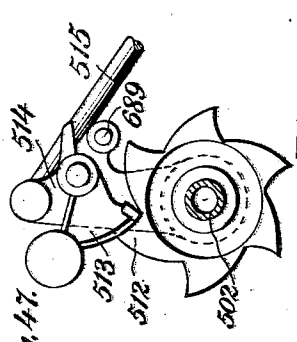


Fig. 63.

Fig. 47.

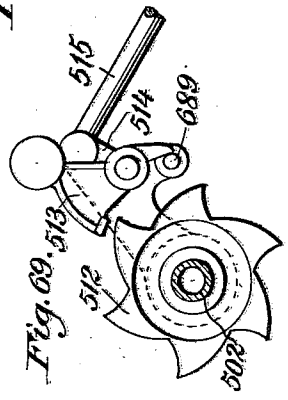


Fig. 69.

WITNESSES:

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Patented Oct. 22, 1912.

34 SHEETS—SHEET 18.

Fig. 48.

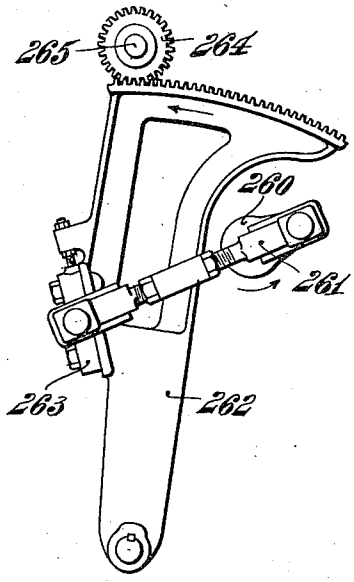


Fig. 50.

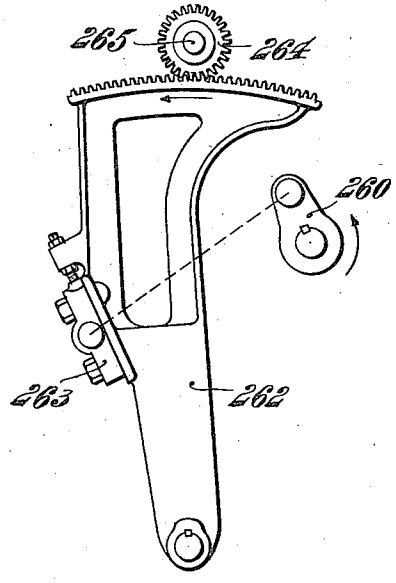
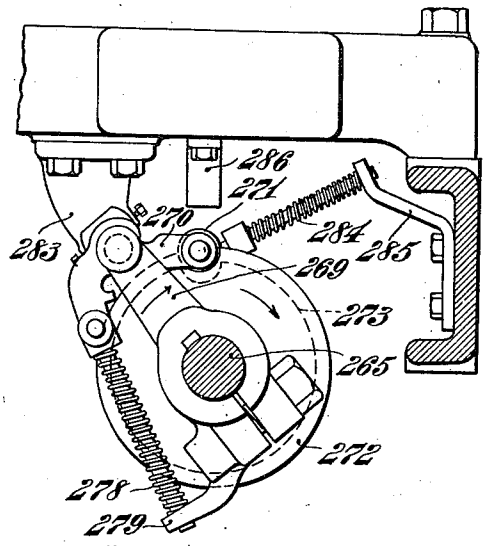


Fig. 49.



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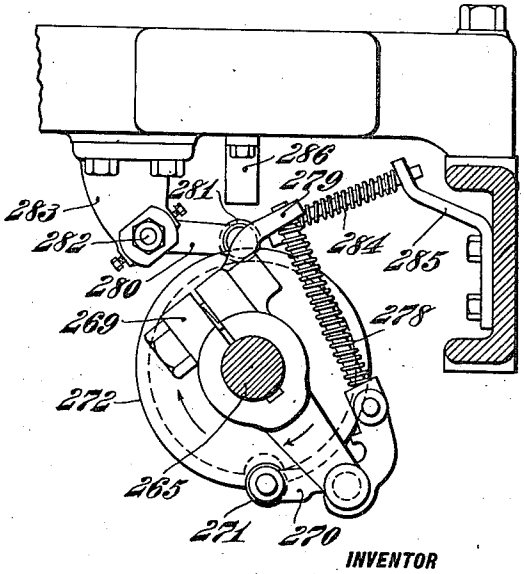

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34 SHEETS—SHEET 19.

Fig. 52.

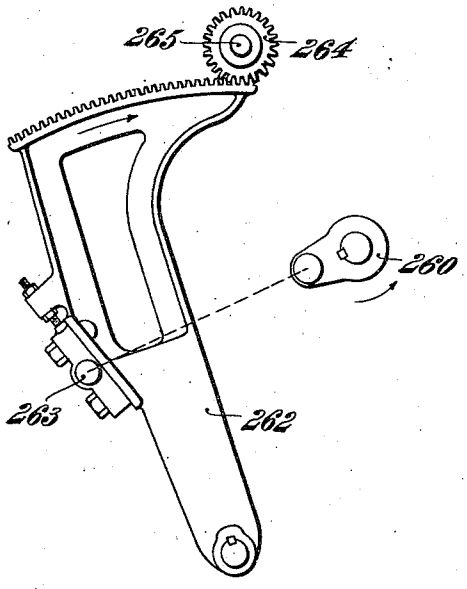


Fig. 54.

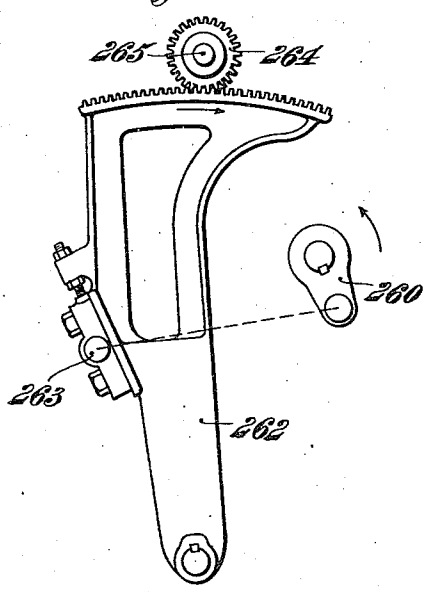
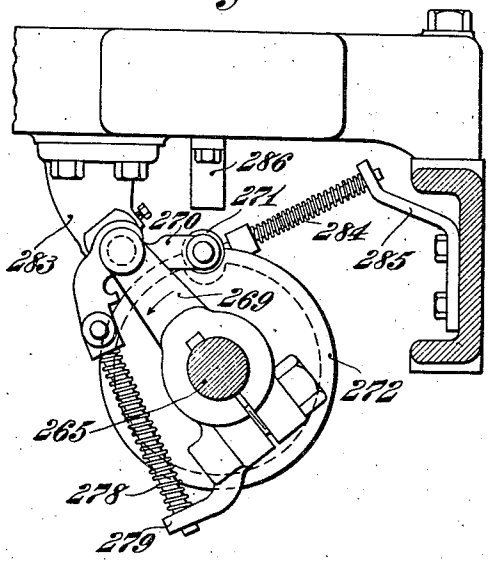


Fig. 53.



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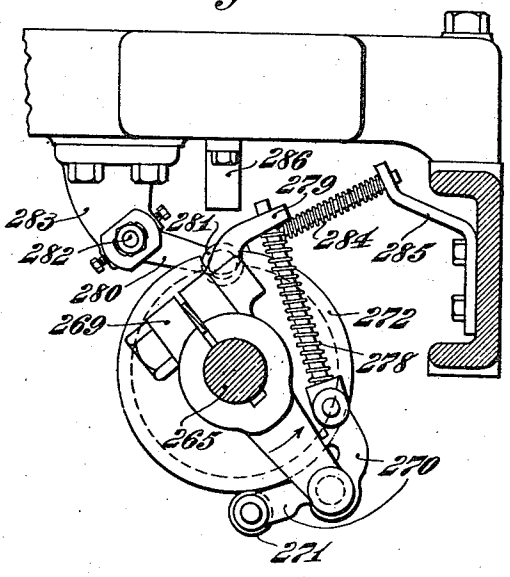

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34 SHEETS—SHEET 20.

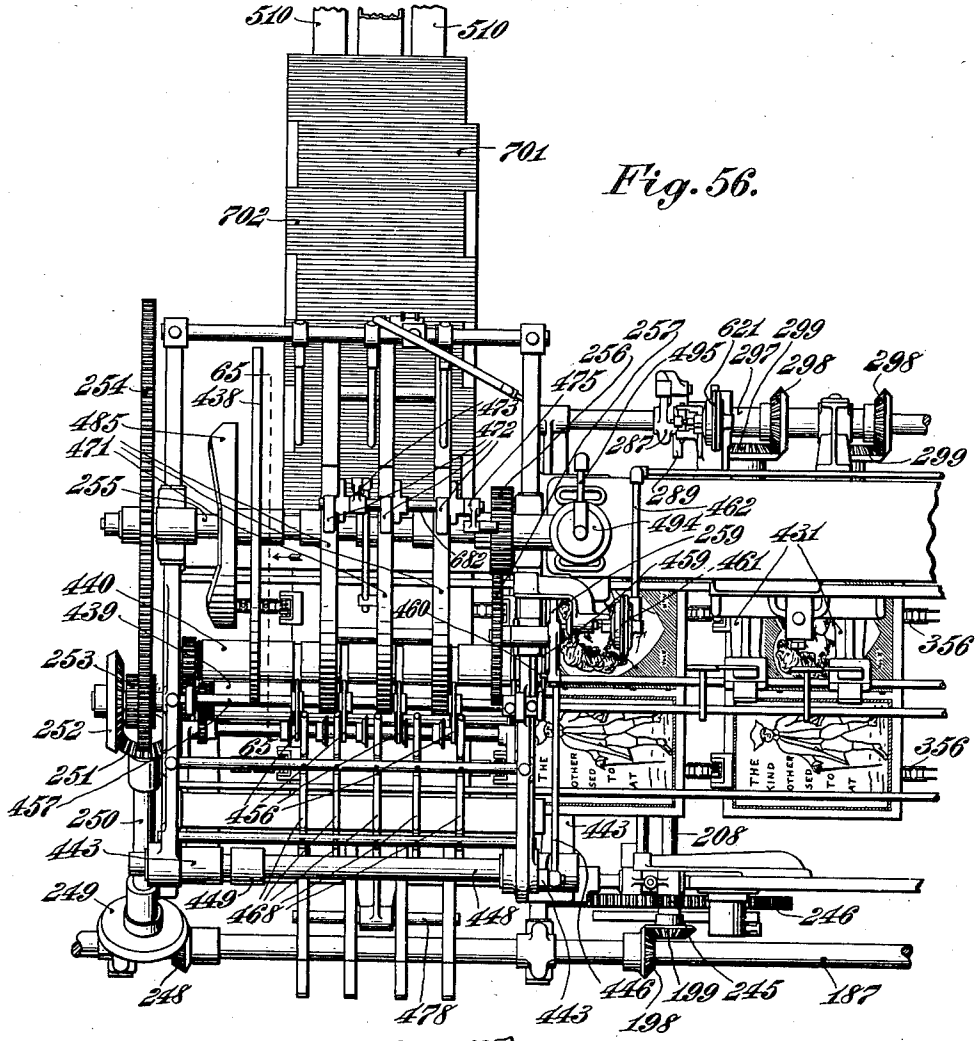

Fig. 56.

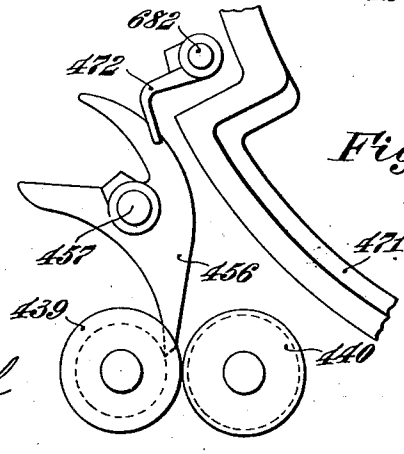

Fig. 57.

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34 SHEETS—SHEET 21.

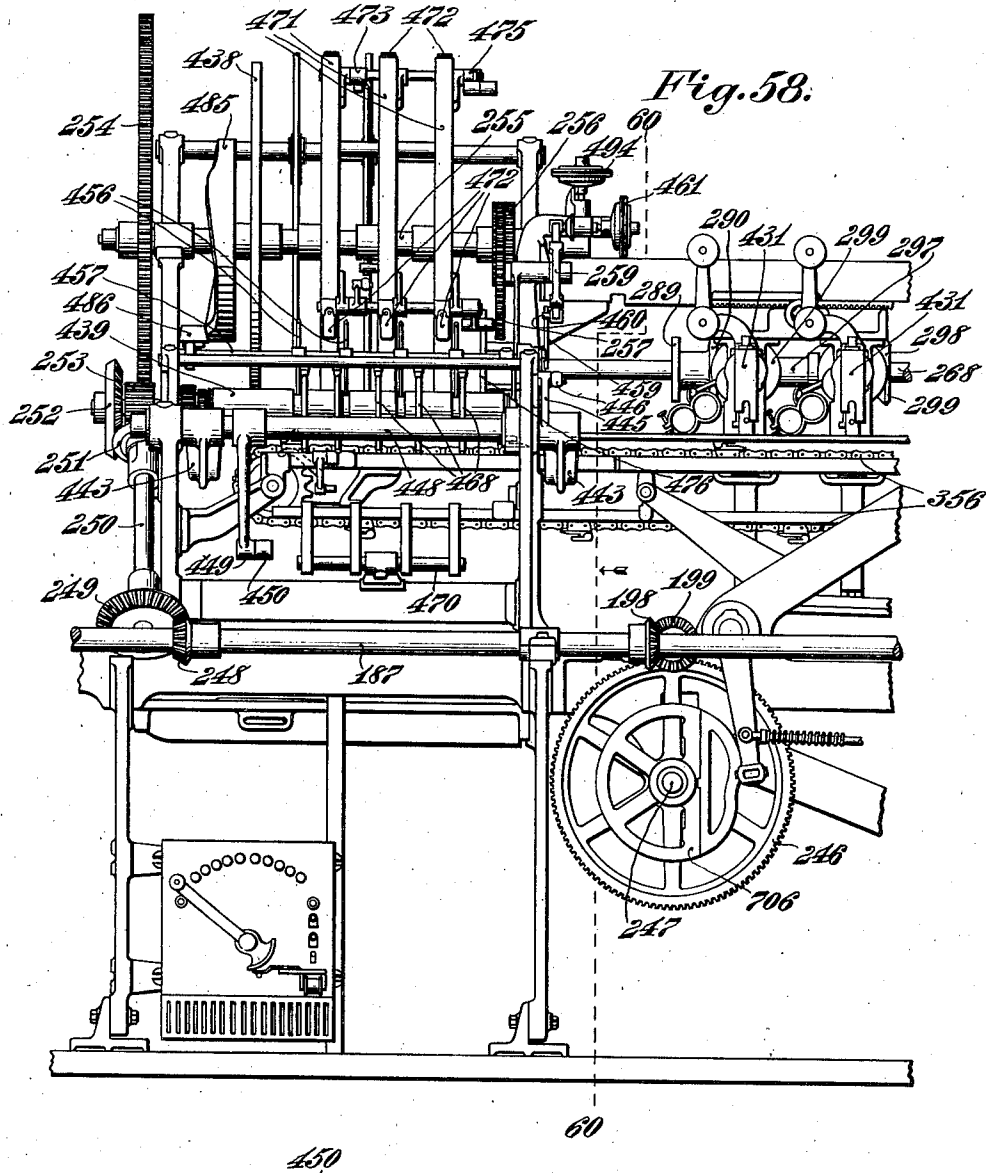

Fig. 58.

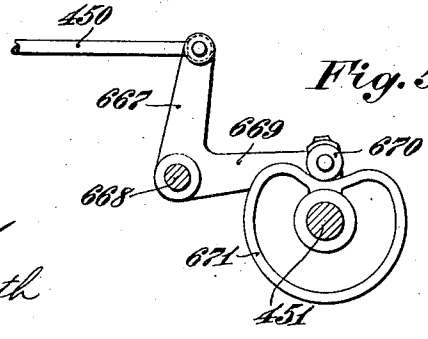

Fig. 59.

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34 SHEETS—SHEET 22

Fig. 60.

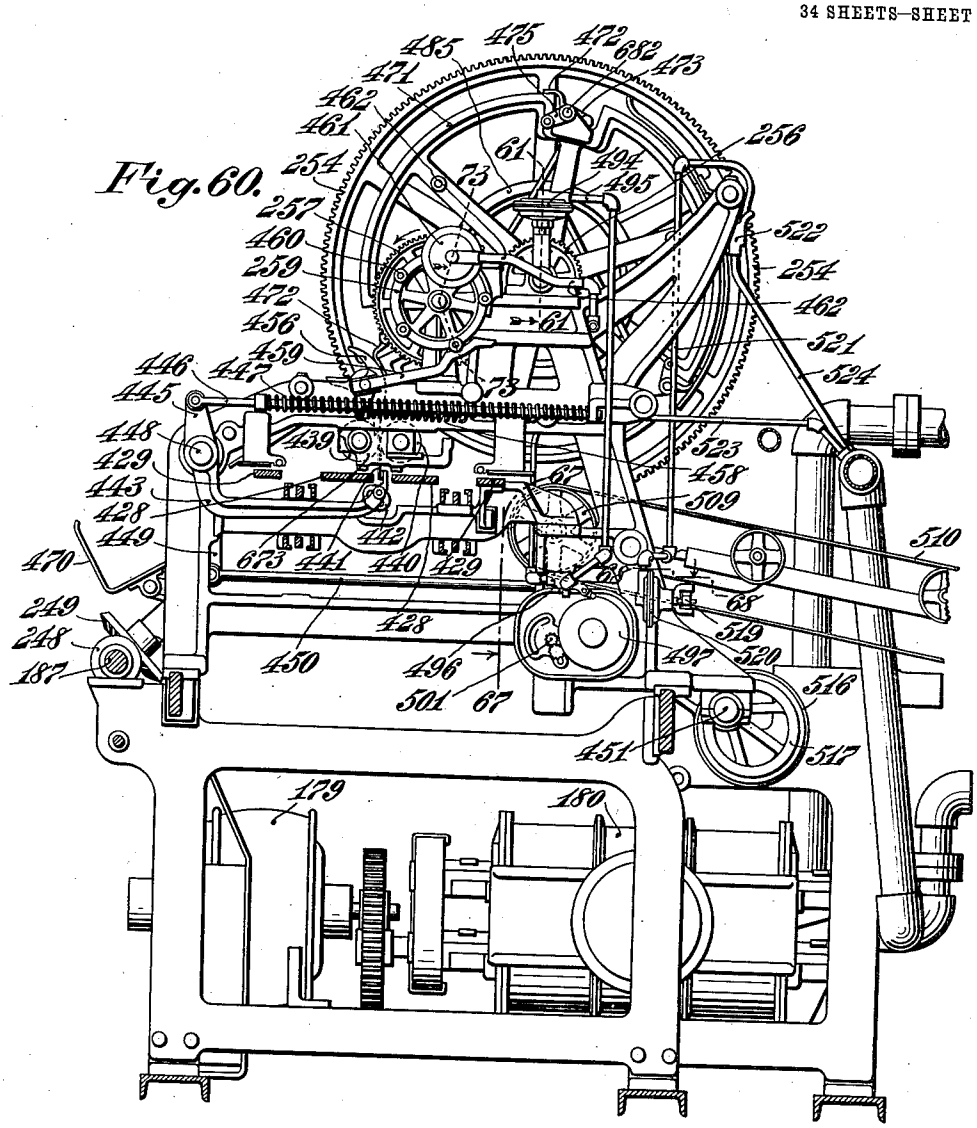


Fig. 61.

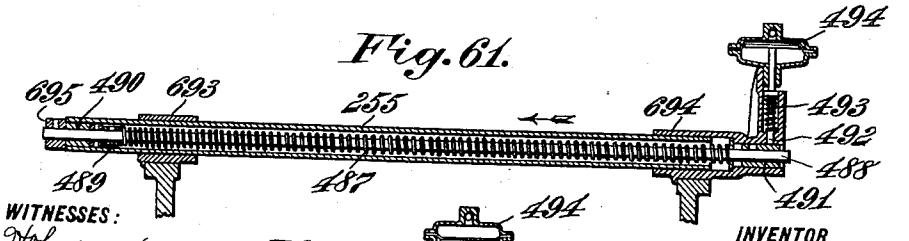
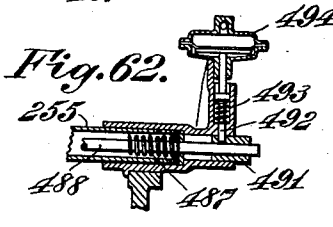


Fig. 62.



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34 SHEETS—SHEET 23.

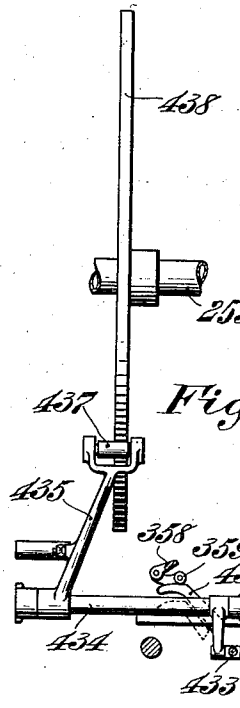
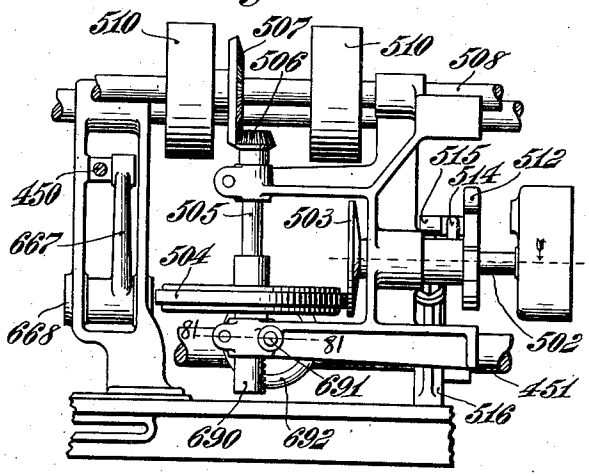


Fig. 65.

Fig. 66.

Fig. 67.



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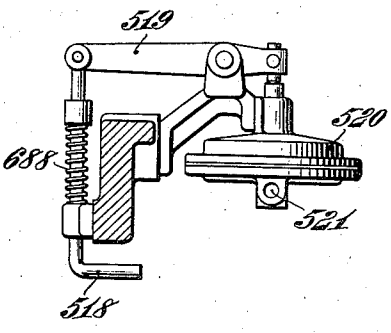
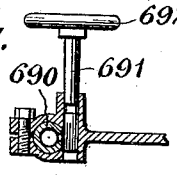


Fig. 81.



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34 SHEETS—SHEET 24.

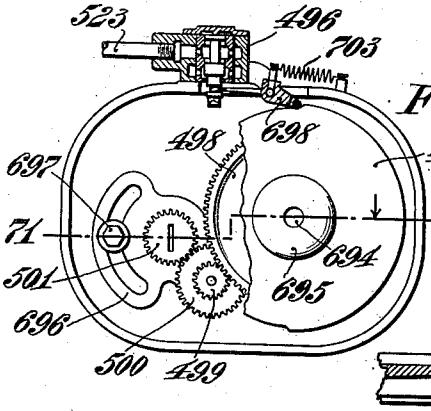

Fig. 70.

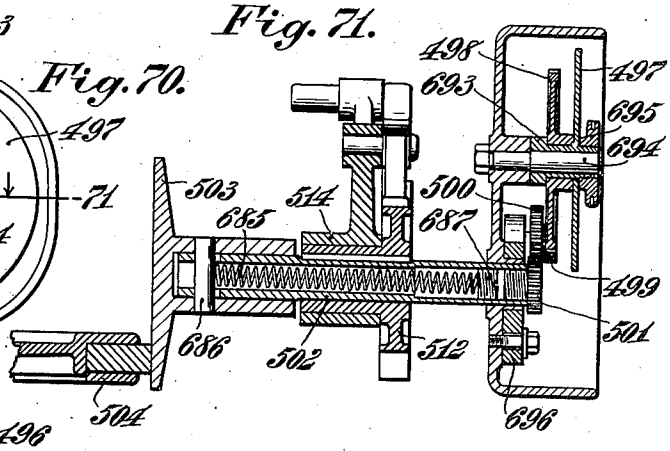

Fig. 71.

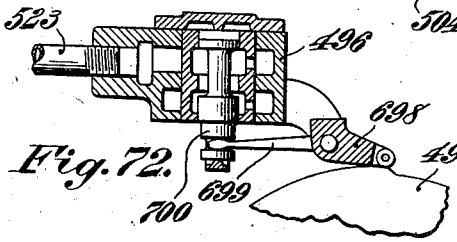

Fig. 72.

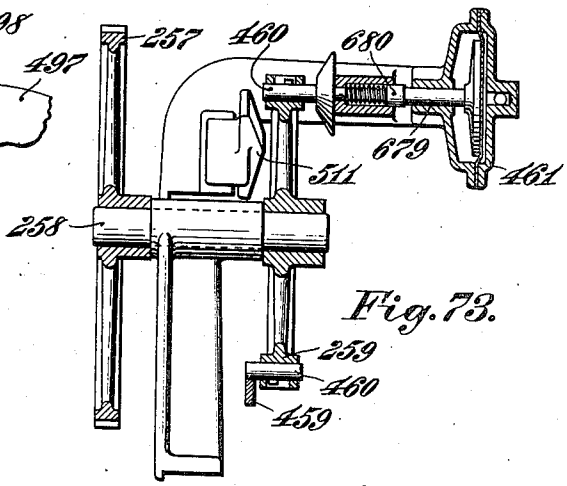

Fig. 73.

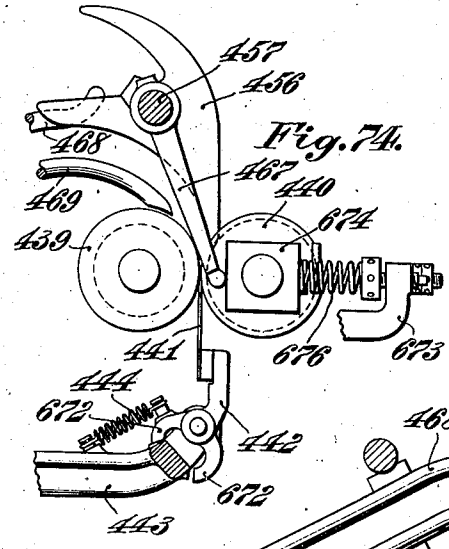

Fig. 74.

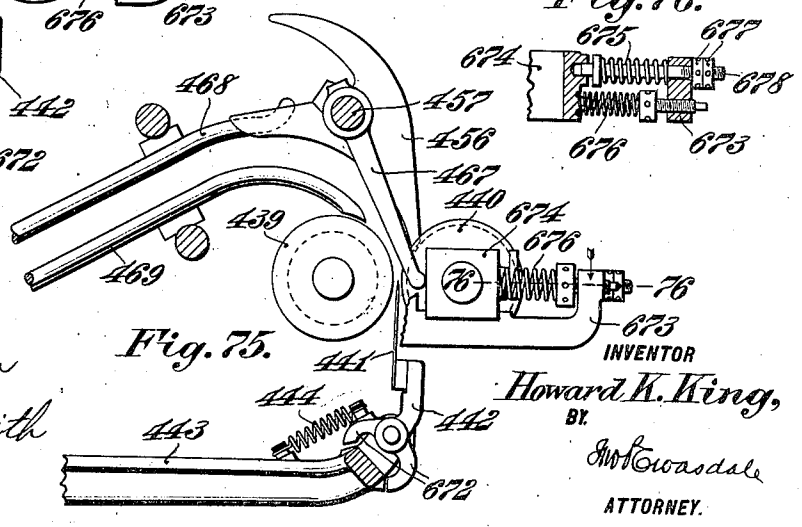

Fig. 75.

Fig. 76.

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34 SHEETS—SHEET 25.

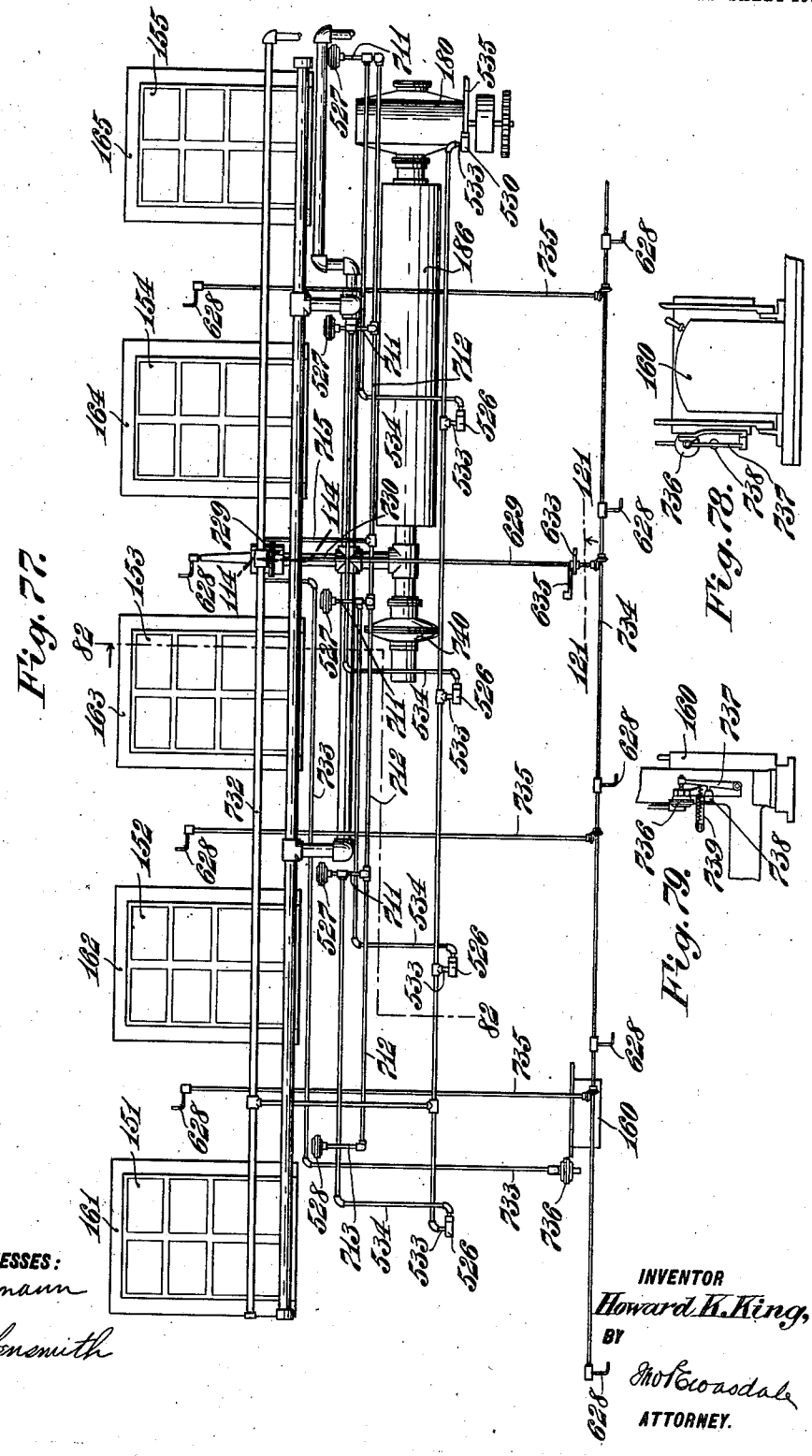

Fig. 77.

Fig. 78.

Fig. 79.

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34 SHEETS—SHEET 26.

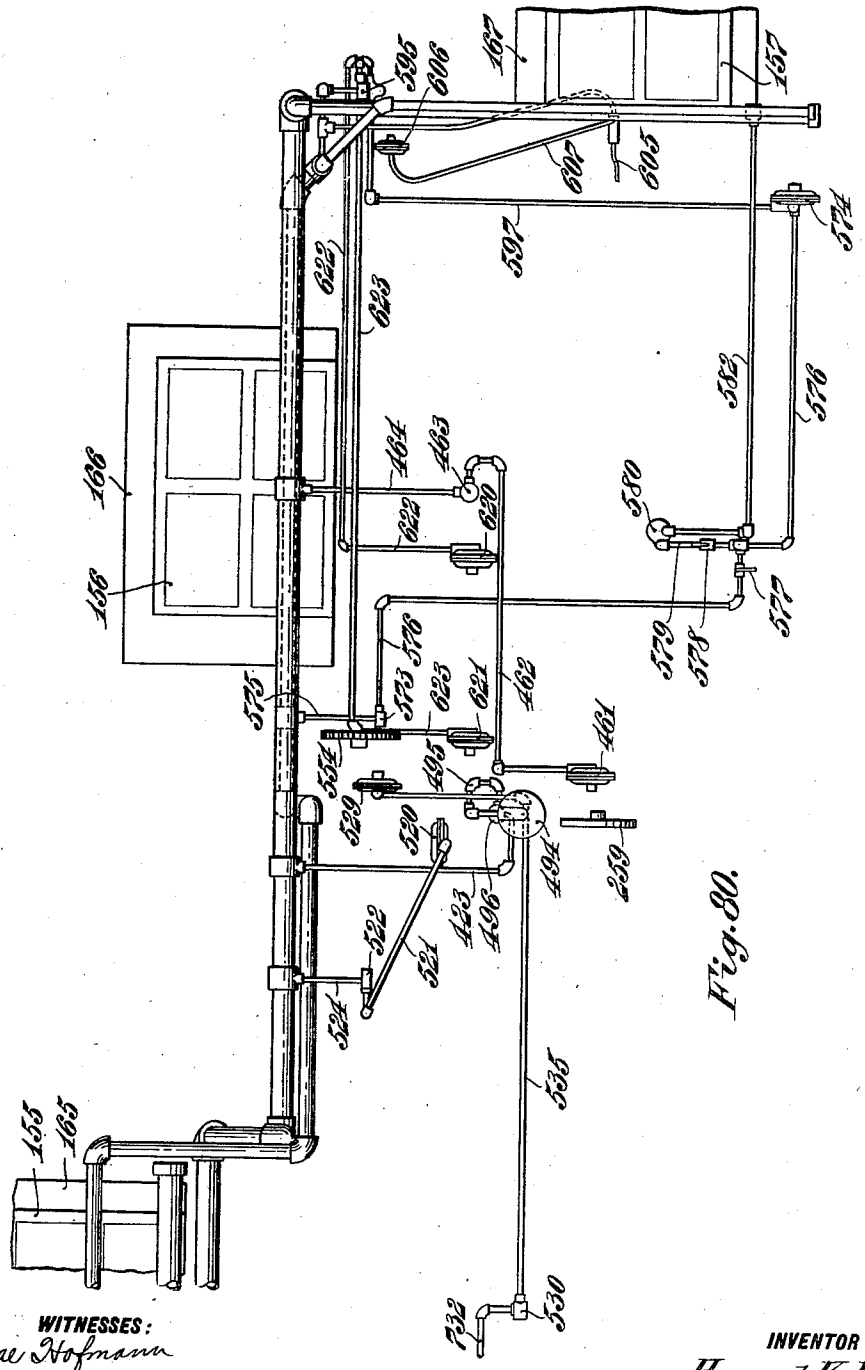

Fig. 80.

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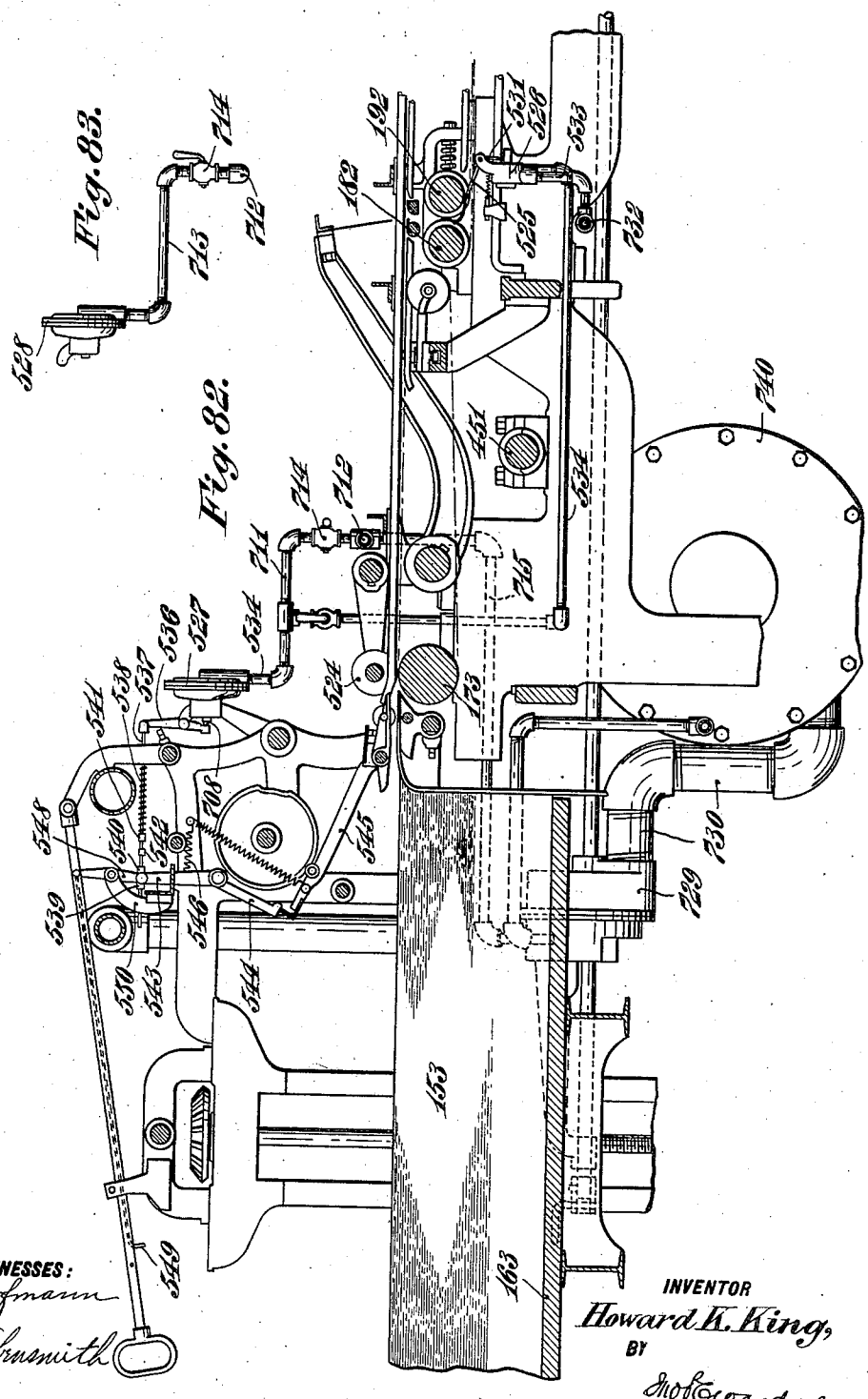
34 SHEETS—SHEET 27.

Fig. 83.

Fig. 82.



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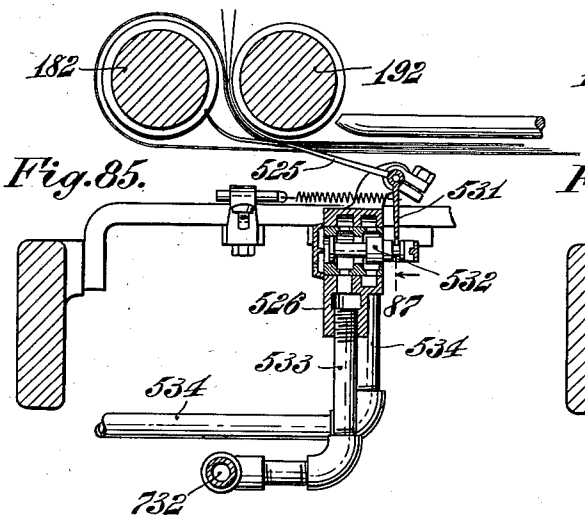
34 SHEETS—SHEET 28.

Fig. 85.



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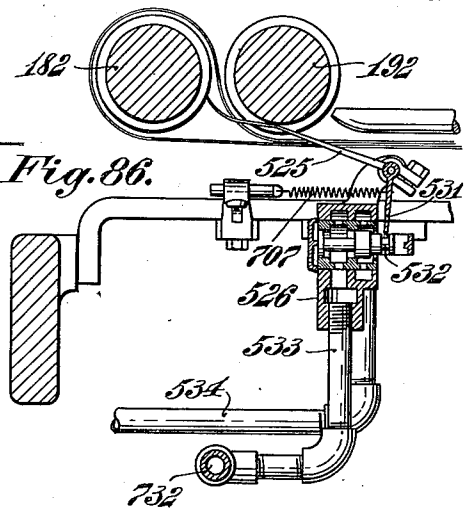

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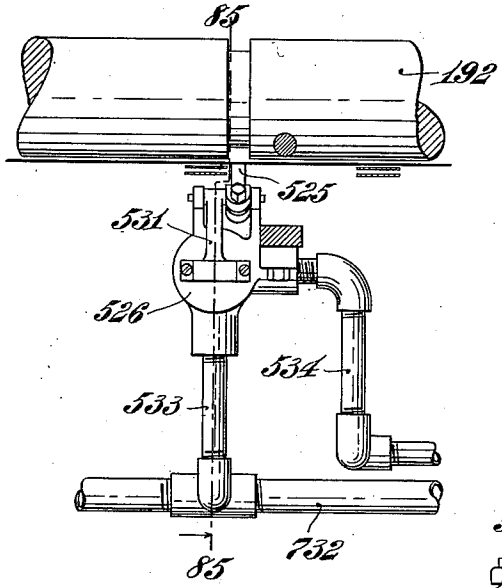

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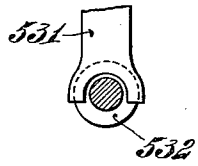


Fig. 88.

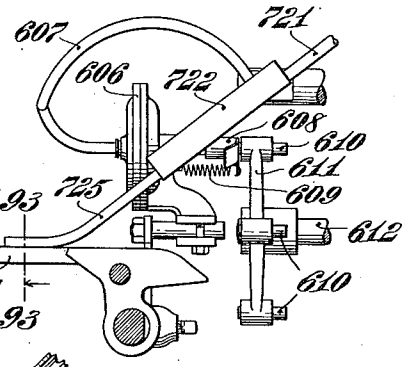
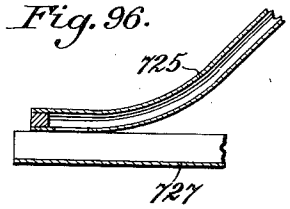


Fig. 96.



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34 SHEETS—SHEET 29.

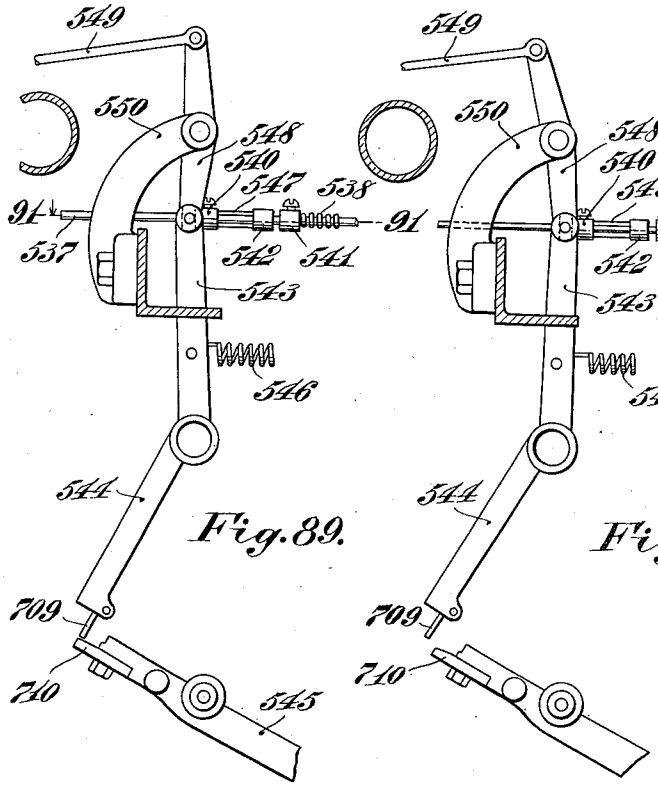


Fig. 89.

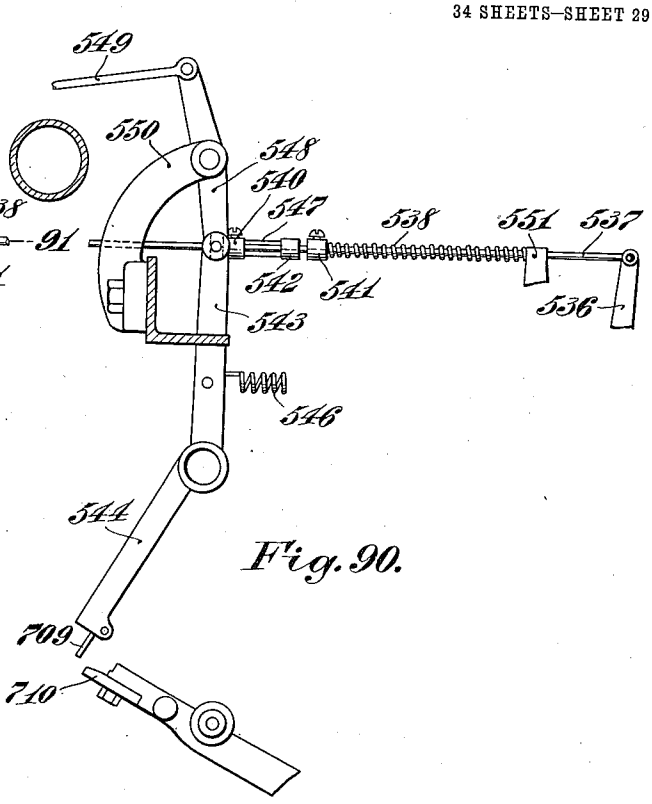


Fig. 90.

Fig. 91.

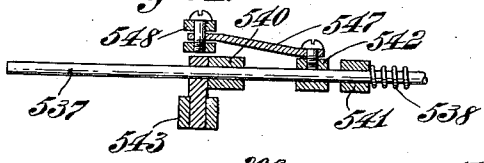
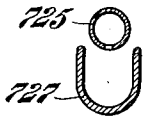


Fig. 93.



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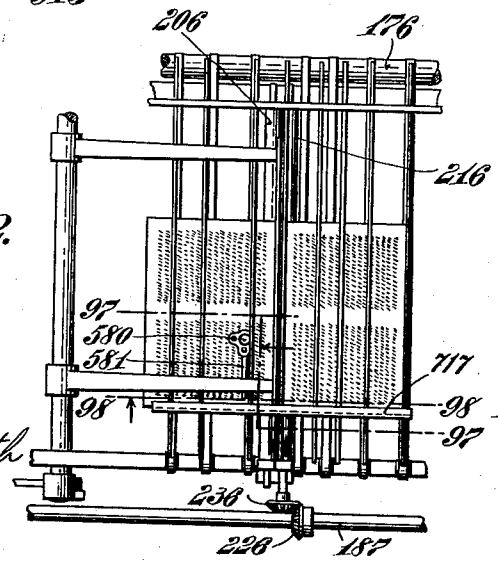

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34 SHEETS—SHEET 30.

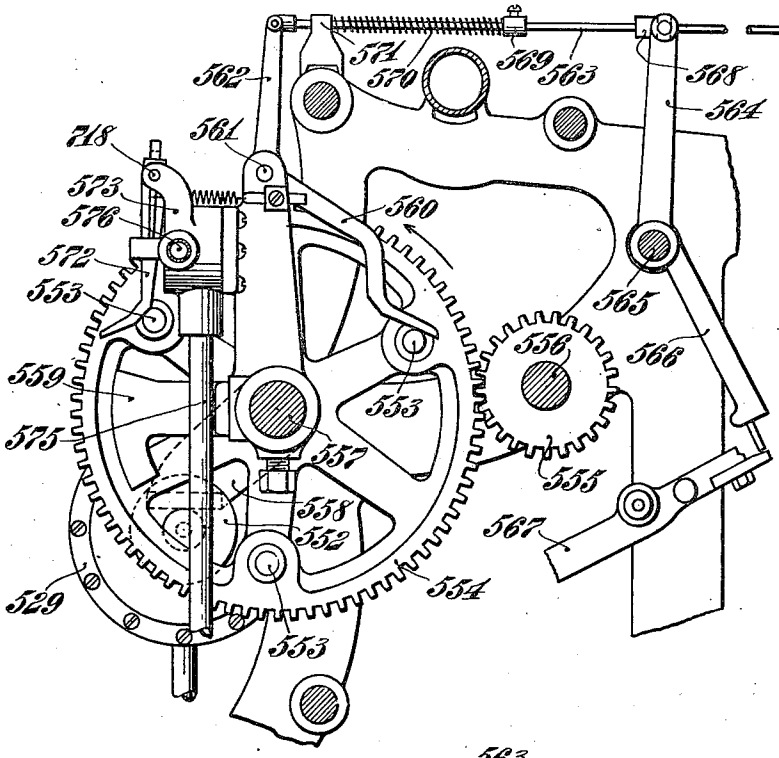

Fig. 94.

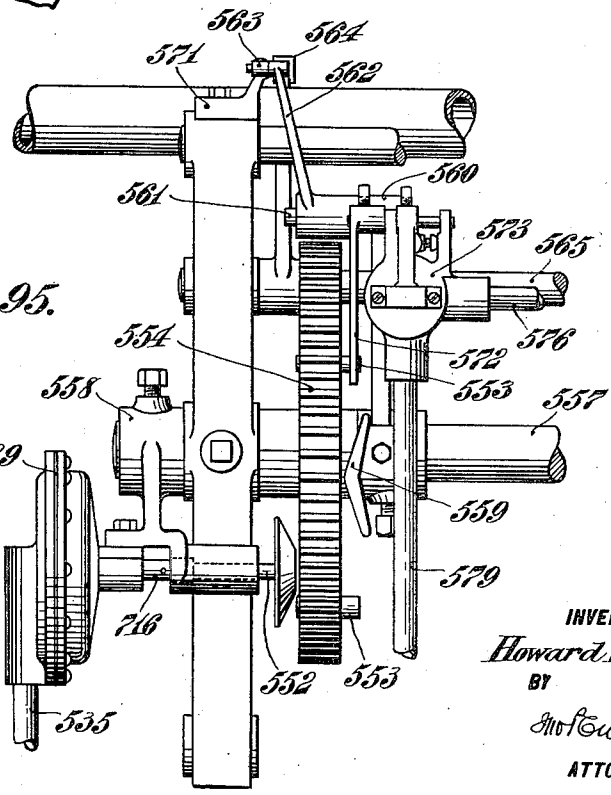

Fig. 95.

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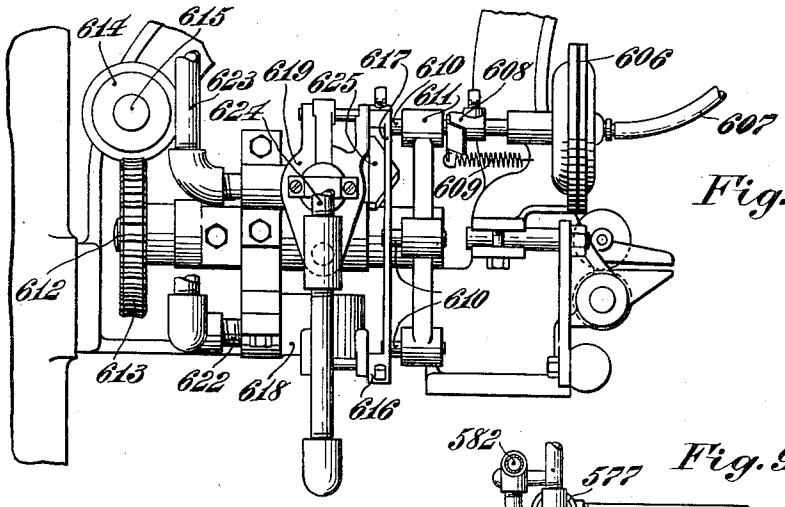
34 SHEETS—SHEET 31.



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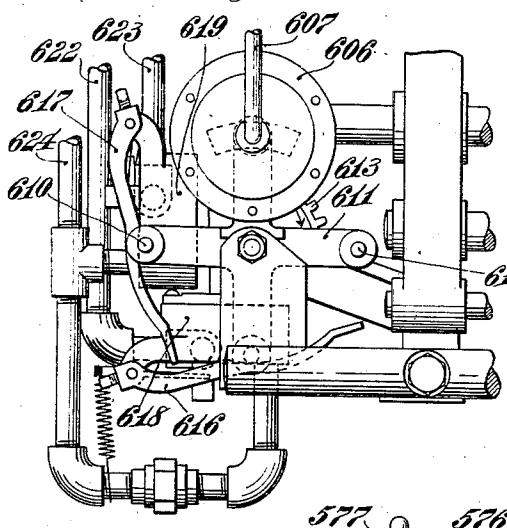
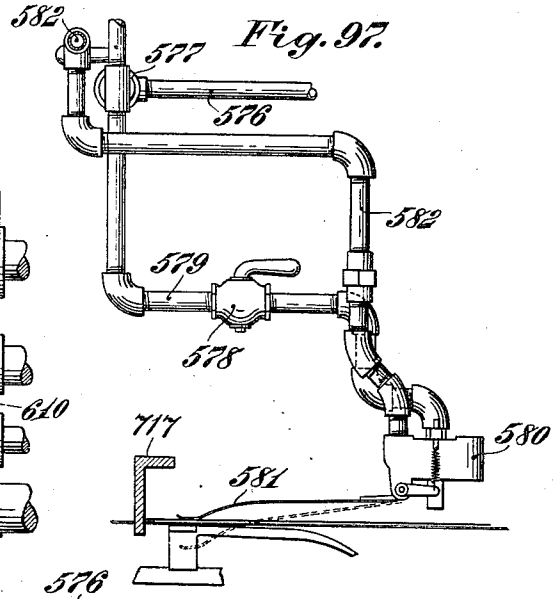


Fig. 100.



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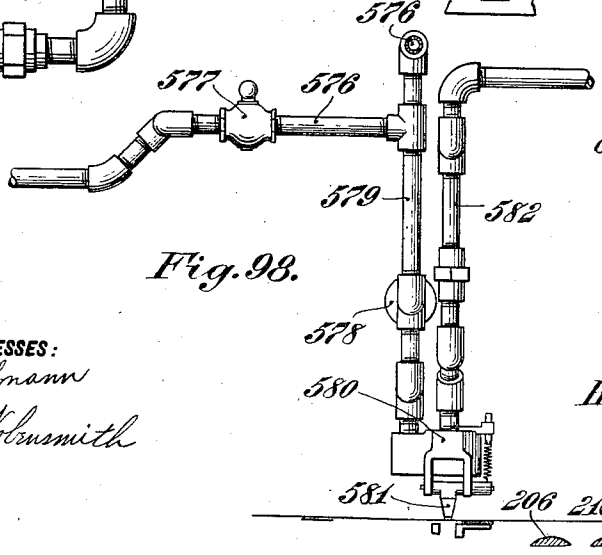

Fig. 98.

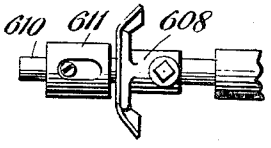

Fig. 101.

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FOLDING MACHINE.

APPLICATION FILED JUNE 29, 1908.

1,041,806. Patented Oct. 22, 1912.

34 SHEETS—SHEET 32.

Fig. 102.

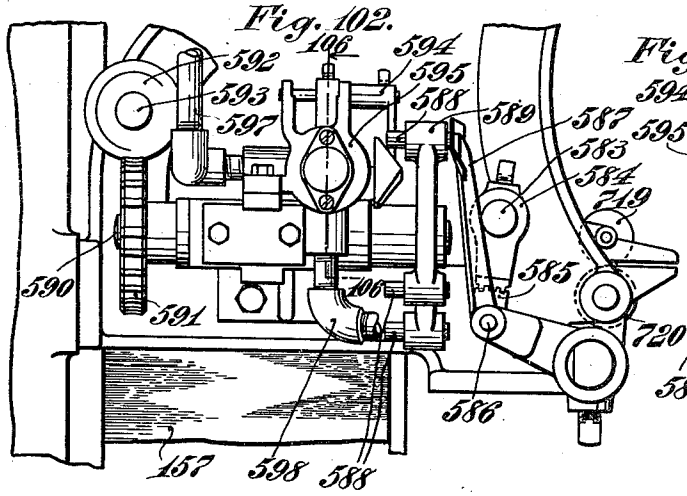


Fig. 104.

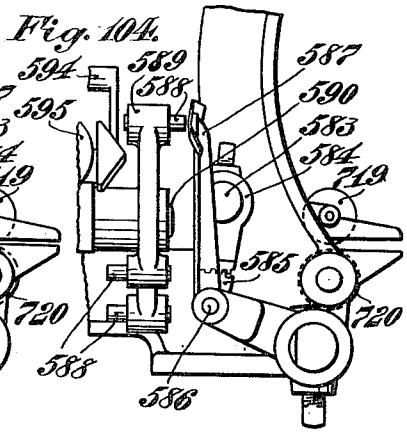


Fig. 103.

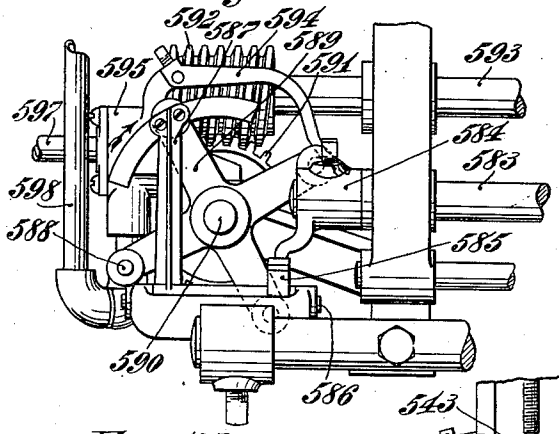


Fig. 106.

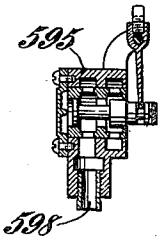


Fig. 107.

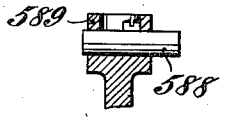
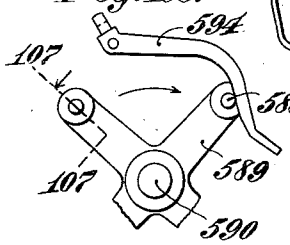


Fig. 105.



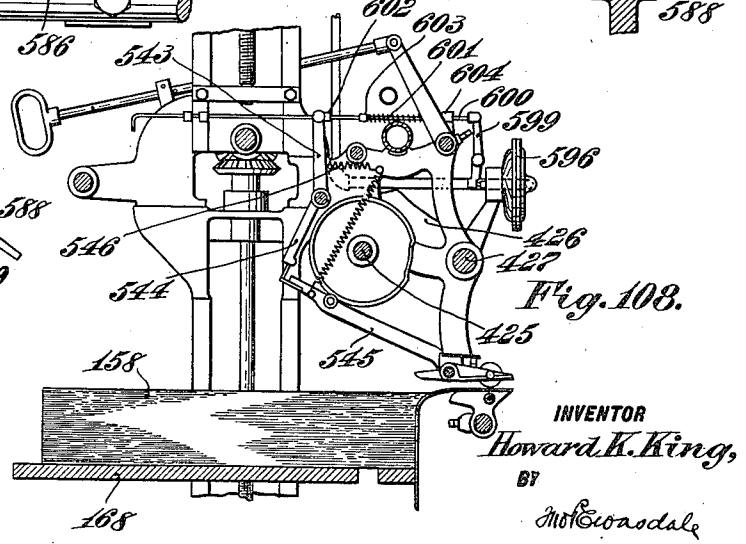


Fig. 108.

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1,041,806.

Patented Oct. 22, 1912.

34 SHEETS—SHEET 33.

Fig. 109.

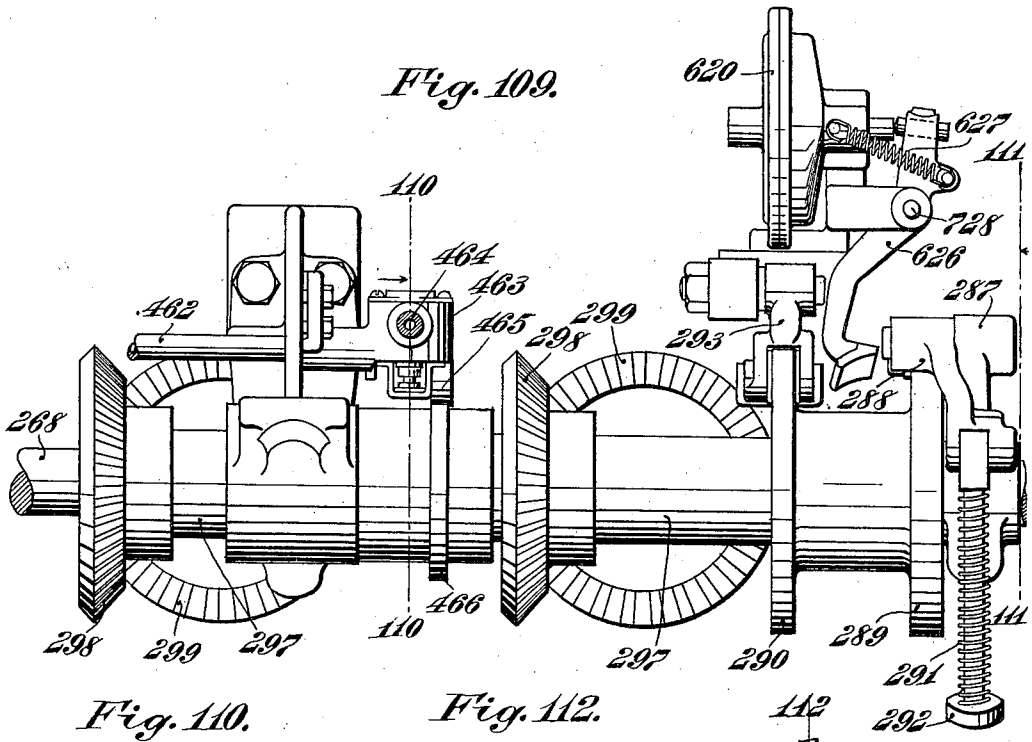


Fig. 110.

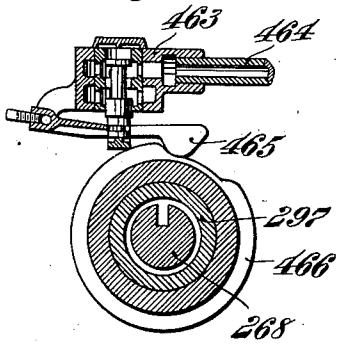


Fig. 112.

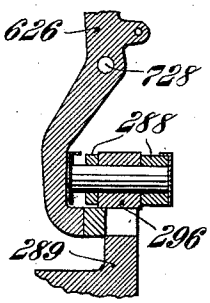


Fig. 111.

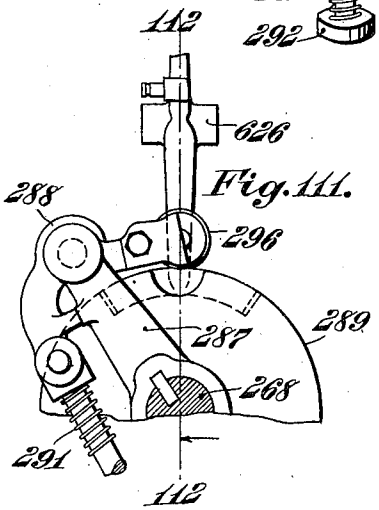
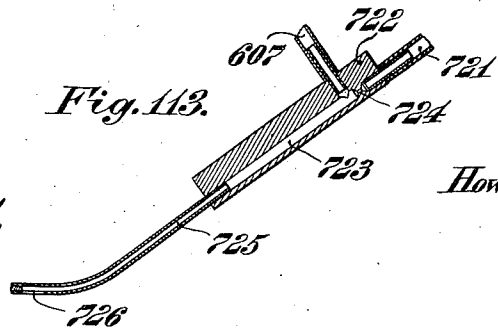


Fig. 113.



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APPLICATION FILED JUNE 29, 1908.

1,041,806.

Patented Oct. 22, 1912.

34 SHEETS—SHEET 34.

Fig. 115.

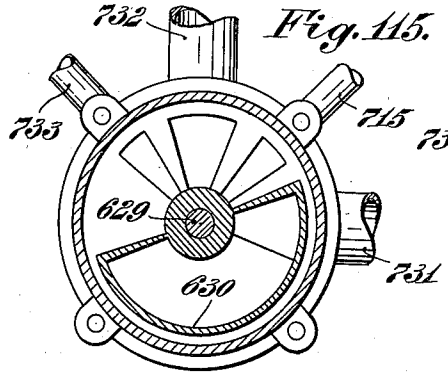


Fig. 116.

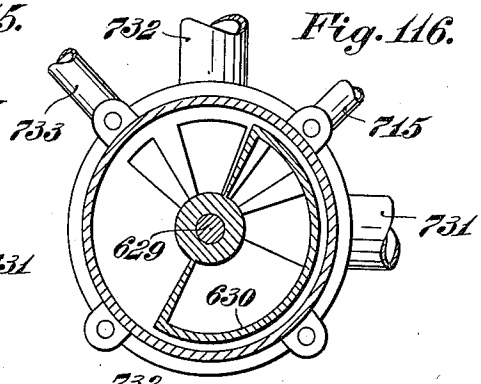


Fig. 117.

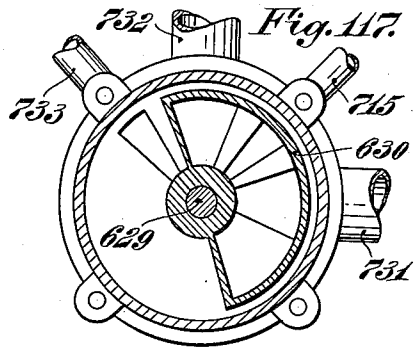


Fig. 118.

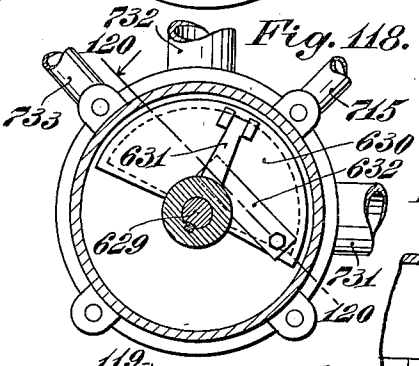
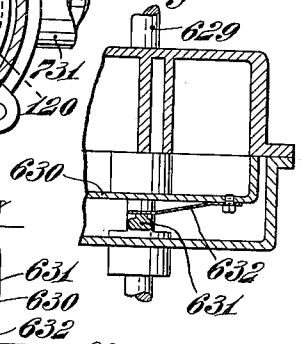


Fig. 120.



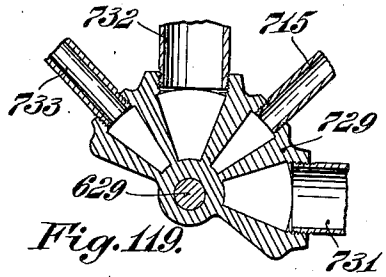


Fig. 119.

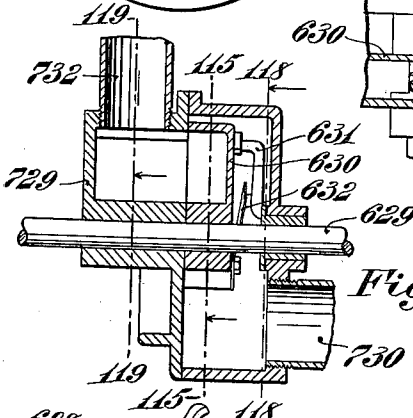
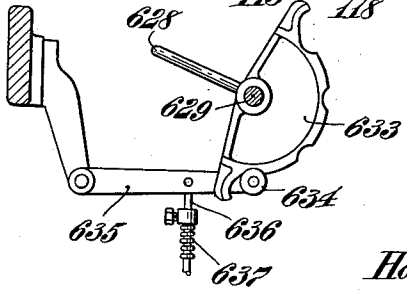


Fig. 114.

Fig. 121.



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UNITED STATES PATENT OFFICE.

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FOLDING-MACHINE.

1,041,806. Specification of Letters Patent. Patented Oct. 22, 1912.

Application filed June 29, 1908. Serial No. 440,936.

To all whom it may concern:

Be it known that I, HOWARD K. KING, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia, State of Pennsylvania, have invented a new and useful Folding-Machine, of which the following is a specification.

My invention relates to improvements in folding machines and comprises improved means for delivering relatively a plurality of sheets and a cover therefor, and improved means for folding, assembling, covering and stitching the same into a book or periodical.

My invention also comprises improved means for counting and delivering complete copies of the periodicals, and means for detecting and throwing out incomplete copies and preventing the stitching of the same.

My invention comprises a plurality of feeding devices arranged in line for delivering sheets to a folder, said sheets being delivered relatively to the folding machine and folded in part independently and in part with each other, and carried on by said folding machine to be assembled with a cover and then stitched together and finally folded along the line of said stitching, and then discharged onto a delivery belt in staggered bunches of any required number.

Referring to the drawings:—Figure 1 is a plan view showing general arrangement of the machine, many details being omitted. Fig. 2 is a side elevation of same. Fig. 3 is a plan view of the part shown in Fig. 5 with the upper drum removed. Fig. 4 is a detail in plan showing the sheets with the side guide and side jogger in a different position from that shown in Fig. 3. Fig. 5 is a section on line 5—5 of Fig. 3, most of the framework being omitted. Fig. 6 is a section on line 6—6 of Fig. 3. Fig. 7 is a detail in elevation showing the sheets with the side guide and side jogger, in the same position as shown in Fig. 4, and the reverse position of that shown in Fig. 10. Fig. 8 is a detail showing the tail joggers in the reverse position from that shown in Fig. 5. Fig. 9 is a section on line 9—9 of Fig. 10 of the frictional clamp shown in Figs. 5 and 8. Fig. 10 is a section on line 10—10 of Fig. 3. Fig. 11, Sheet 3, is a detail in elevation on an enlarged scale of roller 351 and supporting mechanism. Fig. 12 is a section on line 12—12 of Fig. 25, one lower drum element also shown in section. Fig. 13 is a section on line 13—13 of Fig. 12, showing drum stop in normal position. Fig. 14 is a detail showing drum stop in a different position. Fig. 15 is a detail of one of the journal boxes for the lower drum. Fig. 16 is a section on line 16—16 of Fig. 15. Fig. 17 is a diagrammatic drawing showing the movements of drum stop with the bunch of sheets in relative positions. Fig. 18 is a detail showing the position of the drum stops when the bunch of sheets is passing by them around the upper drum. Fig. 19 is a detail showing the stop openers in a different position from that shown in Fig. 12. Fig. 20 is a side elevation of the cam that operates the stop openers. Fig. 21 is a detail showing the spring gripper on the drum in a position for taking a single thickness of paper. Fig. 13 shows a bunch being gripped. Fig. 22, Sheet 4, is a diagrammatic view showing the method of superimposing the folios or folded sheets. Fig. 23, Sheet 8, is an elevation of the gripper shown in Fig. 42, as viewed from the opposite side. Fig. 24 is a plan view of the part of the machine under line 24—24 of Fig. 2. Fig. 25 is a section on line 25—25 of Fig. 24. Fig. 26 is a detail of the air valve mechanism which operates diaphragm in head 418, see Fig. 28. Fig. 27 is a section on line 27—27 of Fig. 28. Fig. 28 is a section on line 28—28 of Fig. 27. Fig. 29 is a detail of clamp foot in a different position from that shown in Fig. 28. Fig. 30 is a rear view of the jogger shown in Fig. 28. Fig. 31 is a plan view of arm operated upon by diaphragm. Fig. 32 is a detail in plan showing one of the chain nippers and cam operated mechanism that permits it to close. Fig. 33 is a section on line 33—33 of Fig. 32, showing the nipper in a different position. Fig. 34 is a section on line 33—33 of Fig. 32, showing the nipper in a still different position. Fig. 35 is a section on line 33—33 of Fig. 32, showing the nipper in a still different position. Fig. 36 is a section on line 33—33 of Fig. 32, showing the nipper in a still different position. Fig. 37 is a plan view of roller 381 under combing wheel. Fig. 38 is a fragmentary view in elevation showing the bunch of sheets with outset and cover being placed into position in the chain nipper by the parts acting thereon. Fig. 39 is a similar view to Fig.

38, the parts in different relative positions. Fig. 40 is a similar view to Fig. 38, the parts in still different relative positions. Fig. 41 is a similar view to Fig. 38, the parts in still different relative positions. Fig. 42 is a section on line 42—42 of Fig. 32. Fig. 43 is a rear view in elevation of the sector and chain and stitcher drive mechanism. Fig. 44 is a section on line 44—44 of Fig. 43. Fig. 45, Sheet 16, is an enlarged detail in elevation showing the presser foot 390 when the parts are in the position shown in Fig. 39 showing the cover and outset free thereof. Fig. 46, Sheet 16, is an end elevation of the roller 369, as shown in Fig. 40. Fig. 47, Sheet 22, is an elevation of the pawl and ratchet in final positions. Fig. 48 is a detail showing crank and sector in one position. Fig. 49 is a detail showing the roller ratchet pawl in corresponding position. Fig. 50 is a detail showing crank and sector in more advanced position. Fig. 51 is a detail showing the roller ratchet pawl in corresponding position. Fig. 52 is a detail showing crank and sector in more advanced position. Fig. 53 is a detail showing the roller ratchet pawl in corresponding position. Fig. 54 is a detail showing crank and sector in more advanced position. Fig. 55 is a detail showing the roller ratchet pawl in corresponding position. Fig. 56 is a plan view of the delivery part of the machine, also showing one pair of stitchers, being plan view under line 56—56 of Fig. 2. Fig. 57 is a detail showing switch in position for delivering complete copies. Fig. 58 is a side elevation of part shown in Fig. 56. Fig. 59 is a detail showing third fold cam and cam arm. Fig. 60 is a section on line 60—60 of Fig. 58. Fig. 61 is a section of the hollow drum shaft on line 61—61 of Fig. 60, showing latching mechanism. Fig. 62 is a similar section to Fig. 61, showing part of shaft, and latch in a different position. Fig. 63 is an end elevation of delivery drum and associated mechanism. Fig. 64, Sheet 22, is a similar view to that shown in Fig. 47, showing the pawl in a different position. Fig. 65 is a section on line 65—65 of Fig. 56, showing chain nipper opening arrangement. Fig. 66 is a side elevation of the parts shown in Fig. 65. Fig. 67 is a section on line 67—67 of Fig. 60, showing mechanism for driving the delivery conveyer belts. Fig. 68 is a section on line 68—68 of Fig. 60. Fig. 69, Sheet 22, is a similar view to that shown in Fig. 64 with the pawl in a still different position. Fig. 70 is a view similar to that shown in Fig. 60 with the valve in section. Fig. 71 is a section on line 71—71 of Fig. 70. Fig. 72 is an enlarged section of the air valve, showing it in the reverse position of that shown in Fig. 70. Fig. 73 is a section on line 73—73 of Fig. 60. Fig. 74 is a detail of the final folding rollers with its blade and switch. Fig. 75 is a view similar to Fig. 74, with the parts in a different position. Fig. 76 is a section on line 76—76 of Fig. 75. Fig. 77 is a plan view of one end of the machine, showing the air piping, valves, hand levers, etc. Fig. 78 is a front elevation of the speed controller. Fig. 79 is a side elevation of the speed controller. Fig. 80 is a plan view of the part of the machine not shown in Fig. 77, showing air piping, valves, hand levers, etc. Fig. 81, Sheet 23, is a horizontal section on line 81—81 of Fig. 67. Fig. 82 is a section of the machine on line 82—82 of Fig. 77. Fig. 83 is an elevation of the diaphragm and connections for No. 1 feeder. Fig. 84 is a plan view of the valve shown in Fig. 82 at a larger scale. Fig. 85 is a section on line 85—85 of Fig. 84. Fig. 86 is a similar view to Fig. 85 with the valve in a different position. Fig. 87 is a section on line 87 of Fig. 85. Fig. 88 is a detail of the pneumatic means controlled directly by the sheet in feeder No. 8. Fig. 89 is an enlarged detail of the feeder latch arm shown in Fig. 82. Fig. 90 is a similar view to Fig. 89, but in a different position. Fig. 91 is a section on line 91—91 of Fig. 89. Fig. 92 is a plan view of No. 6 folder, showing the location of the valve tripped by the sheet. Fig. 93 is a section on line 93—93 of Fig. 88. Fig. 94 is a section on line 94—94 of Fig. 1. Fig. 95 is a side elevation of most of the parts shown in Fig. 94. Fig. 96, Sheet 28, is a longitudinal vertical section on line 96—96 of Fig. 93. Fig. 97 is a section on line 97—97 of Fig. 92. Fig. 98 is a section on line 98—98 of Fig. 92. Fig. 99 is an end elevation of the tripping mechanism located on the right hand side of No. 8 feeder, and operating the switches of both pair of stitchers. Fig. 100 is a side elevation of the parts shown in Fig. 99. Fig. 101, Sheet 31, is a detail in plan view of the pin pusher and supporting piston. Fig. 102 is an end elevation of the tripping mechanism located on the right hand side of No. 7 feeder, and controlling the operation of No. 8 feeder. Fig. 103 is a side elevation of most of the parts shown in Fig. 102. Fig. 104 is a view similar to Fig. 102, showing one of the pins and the pin driver in the reverse position. Fig. 105 is a view of the pin wheel and valve lever shown in a different position from that shown in Fig. 103. Fig. 106 is a section on line 106—106 of Fig. 102. Fig. 107 is a section on line 107—107 of Fig. 105. Fig. 108 is a section through No. 8 feeder. Fig. 109 is a section on line 109—109 of Fig. 24, with the side frame removed. Fig. 110 is a section on line 110—110 of Fig. 109. Fig. 111 is a section on line 111—111 of Fig. 109. Fig. 112 is a section on line 112—112 of Fig. 111.

Fig. 113 is a longitudinal section of the pneumatic tubes shown in Fig. 88. Fig. 114 is a section on line 114—114 of Fig. 77. Fig. 115 is a section on the line 115—115 of Fig. 114. Fig. 116 is a section on line 115—115 of Fig. 114 in a different position. Fig. 117 is a section on line 115—115 of Fig. 114 in a still different position. Fig. 118 is a section on line 118—118 of Fig. 114. Fig. 119 is a section on line 119—119 of Fig. 114. Fig. 120 is a section on line 120—120 of Fig. 118. Fig. 121 is a section on line 121—121 of Fig. 77.

Similar numerals refer to similar parts throughout the several views.

The scale of the drawings in the several figures varies, that is, either enlarged or reduced, to meet the various requirements.

Referring to Figs. 1 and 2, 151 to 158 inclusive, indicate the stacks of paper and 161 to 168 indicate the tables supporting the same, of feeding machines 1 to 8 respectively. That is to say, the last figure of 151 or 161 will indicate the number of the feeding machine as a whole, and it will be understood that when feeder No. 1 is referred to, it will refer to the feeder having table 161 and stack of sheets 151. These feeding machines 1 to 8 inclusive are of the general type of combing wheel feeders, such as is described in two patents to me No. 768,375; Aug. 23, 1904 and No. 789,809; May 16, 1905, and as no claim is made to the specific details of these feeding machines they need not be described in this application. Feeders 1 to 6 are arranged in line delivering in succession to the folding machine or sections of a folding machine, of the striking blade and roller type, while feeding machines No. 7 and No. 8, are at the end of the folder delivering in a direction transverse that of the other feeders and one arranged vertically above the other.

The sheets are delivered from the feeders 1 to 5 respectively, through the feeding rollers 171 to 175 respectively, and are given their first fold through rollers 181 and 191 to 185 and 195 respectively of the folding machine. The second fold is received through the folding rollers 201 and 211, to 205 and 215 respectively, whereupon they are all delivered one upon the other on the belts 209 and carried forward toward the feeding machines 157 and 158, until the five sheets are brought into alinement with feeder 6, whereupon sheet 156 having been delivered therefrom, through feed rollers 176, is struck through folding rollers 206 and 216 and delivered on top of said pile of sheets. It will thus be seen that the said feeders 1 to 5 are arranged in a straight line and adapted to deliver their sheets relatively to their folding mechanisms, so that as the sheets receive the requisite number of folds they are superimposed one upon the other and carried forward on the belts 209 in piles, as shown in Fig. 22. The folder No. 6 is advanced slightly toward the folding mechanism, and is adapted to deliver a sheet to said mechanism which subjects it to a single fold, instead of a double fold, before it is delivered to the pile of sheets from feeders 1 to 5. It will thus be seen that the row of feeders feeds both simultaneously and in sequence. That is, after the machine has commenced working, there is a simultaneous feed to the folders, in order, of the sequential parts of the magazine.

Referring to Fig. 6, it will be noted that the rollers 206 and 216 folding the sheet received from feeder 6, are elevated above the belts 209, which carry the pile of sheets from feeders 1 to 5 inclusive, and upon which said folded sheet from feeder 6 is delivered. This permits the pile of sheets to clear said rollers 206 and 216, but as the pile advances upon said belts 209, and under tapes 347, the pile passes under the spring pressed rollers 348, operating on said tapes 347. This serves to press the pile of sheets together and carry the same forward as one body, and to prevent displacement of the different sheets. It is to be noted that tapes 347 are supported by the rollers 216 and 351. It is also to be noted that rollers 351 are vertically adjustable, by means of the bolt 741 and slot 742 shown in Fig. 11, Sheet 3, and are normally supported slightly above the belts 209 to relieve said pressure on the sheets when they have advanced to the position shown in Fig. 5. Thus, while serving to exert a certain control over the sheets for example, preventing the bouncing of the top sheet, when it strikes the drum stops 300, the pressure on the pile is relieved to permit of the operation thereon of the drum stops and end joggers as well as the side guides. The pile of sheets from feeders 1 to 6 inclusive, is now assembled in substantially the position shown in Figs. 3, 5, 7 and 10. This pile of sheets as first assembled, is stepped off, due to the relative timing of the various feeding and folding mechanisms, so that the uppermost sheet is in advance of the one just beneath in substantially the position shown at 638 in Fig. 17. As the pile travels forward on the belts 209, they finally reach the drum stops 300, which have an independent relative movement with respect to the drums, as will be herinafter described. These drum stops serve to head up the pile from the position shown at 638 in the diagrammatic Fig. 17, to the final position shown at the extreme right of said Fig. 17, being brought squarely against the stops 300. This heading up against the stop 300 is assured by the cooperation of the tail joggers 301 shown in Figs. 3, 5, 8 and 10, supported and operated by the rock shaft 323.

Any suitable number of joggers 301 may

be secured to said shaft 323. The shaft 323 is mounted in the boxes 329 and 330 which are in turn threaded on the threaded rods 331 rotatably secured in the stationary framework and provided with the beveled gears 332 coöperating with the gears 333 on the shaft 334 controlled by the hand wheel 335 so that arbitrary adjustment of said rock shaft 323 may be secured. To rock shaft 323 is secured the yoke arm 325; to the outer end of which is pivotally secured the connecting rod 326, the other end of which is secured to the eccentric strap 328, operated by the eccentric 327 on shaft 247. The connection between connecting rod 326 and yoke 325 is automatically adjustable and is secured by the friction clutch which is clearly shown in Fig. 9, but which is not claimed in this application, since the same is claimed in a prior patent to me No. 844,809 dated Feb. 19, 1907. Integral with yoke arm 325 are the wings or stops 646 and 647, see Fig. 8. These stops are adapted to engage the underside of the journal box 330 to limit the movement of said yoke member 325 in either direction. These stops are so proportioned with respect to the journal box 330 as to exactly permit of a rocking movement of yoke 325 corresponding to the reciprocative movement of connecting rod 326, actuated by the eccentric 327 so that whenever any adjustment is made changing the position of journal box 330, adjustable connection between the connecting rod 326 and yoke arm 325 is automatically made by one or the other of the shoulders or stops 646 and 647 forcing the friction clutch, shown in Fig. 9, along the connecting rod 326.

Immediately upon the heading up as just described, the pile of sheets is now operated upon by the side guide 302, shown in Figs. 3, 5, 7 and 10, in one direction; said side guide being actuated by the reciprocating rod 336. The pile is also operated upon simultaneously in the opposite direction by the side jogger 303, operated by the reciprocating rod 342.

Figs. 3 and 10 show the side guide and jogger in the closed position while Figs. 4 and 7 show them in the open position. It will also be noted from an inspection of Fig. 7, that the pile of sheets is also stepped in a transverse direction, the upper sheets being nearer to side guide 302. This is accomplished by the relative adjustment of the several stops in the folders, so that when the upper sheet or sheets are encountered by the side guide 302, the lower sheets will be encountered by the side jogger 303, to counteract the tendency of the pile to slide on the moving belts, which will offer less resistance thereto, than exists between the sheets themselves, when acted upon by side guide 302.

The rods 336 and 342 are actuated by the cam 341 on shaft 237 through the rocking cam arm 340 having the extension 339 which is pivotally connected at its free end at 639 with the collar 337 which is adjustably connected with the rod 336, by the nut 338, see Figs. 7 and 10. From the pivotal connection 639 extends the connecting rod 346, which is connected with the rock arm 345, which is pivotally connected in a similar way with the collar 343 of reciprocating rod 342. A similar adjustment is secured by the nut 344 by which mechanism it will be seen that any desired relative reciprocating movement of these two rods is secured.

Drum stop actuation.—It will be understood that the belts 209 are carried by the several sections 241 of the drum which is carried on shaft 240 and has a constant actuation. In referring to the upper and lower drums of this machine, I mean by the lower drum the mechanism comprising the belt pulleys 241 and the gripping pulleys 242 all assembled and carried on the shaft 240 driven from a suitable source of power and operatively connected through gears 238 and 239 with the upper drum, comprising the tape pulleys 243 and the gripping pulleys 244 carried on shaft 237 which carries the gear 238, see Fig. 12.

Drum stops.—The drum stops 300, are two in number and are mounted, supported and operated similarly so that the same may now be described in the singular number. The stop 300 is pivotally connected with the upper end of member 304, see Fig. 13, which in turn is pivotally connected at 640 with the upper end of arm 310. Arm 310 is supported by the rock shaft 313 and is provided with the boss 312 which is keyed to the rock shaft 313, and has adjustable relation with arm 310, see Fig. 25. Arm 311 is in every other respect similar to arm 310, except that it is keyed directly to shaft 313. The adjustable boss is provided for securing the proper relation between said arms 310 and 311. Shaft 313 is provided with the cam arm 314 carrying at its free end cam roller 316 which is adapted to coöperate with the cam 315 on shaft 240. The formation of the cam 315 is such as to cause a reciprocation from the position shown in dotted lines in Fig. 13, to the position shown in full lines in said figure, backward and forward with the required dwell in the position shown in solid lines. The extreme positions to the right and the left and two intermediate positions of this drum stop are shown diagramatically in Fig. 17. The extreme left hand position being the position in which it stops and reverses. The next position is about the position in which the topmost of the pile of sheets encounters it. In the next or third position, all the sheets have practically been engaged and gradually

slowed down. In the final or fourth position, the pile is practically headed up and brought to a stop. It will be understood that the sheets are traveling at a considerable rate of speed on the belts 209, and as they begin to encounter the stops 300, the stops are also moving in the same direction as the belts 209 but at a slower rate of speed so that the sheets will gradually slide into a headed up position and slip on the belts 209.

The engagement of the roller with the cam 315 is maintained by the actuation of spring 318 operating through rod 319 and arm 317, which forms an extension of arm 314, from whence it will be seen that the rotation of the cam 315 causes a rocking movement of shaft 313 which results in a reciprocating movement of the drum stops 300, see Figs. 12, 13 and 25.

As above stated, each drum stop 300 is pivoted to a member 304. And to each drum stop is also secured a spring 305 by a flexible strap or other suitable connection 306, so as to normally maintain said stop in engagement with the shoulder 641, see Figs. 13 and 14. The other end of spring 305 is secured to the rod 307 adjustably connected with the bracket 308. To member 304 is connected one end of spring 309; the other end of which is connected to arm 310. This serves normally to maintain member 304 in the position shown in Fig. 13. Said spring actuated movement being normally limited by suitable stops between members 304 and 310.

It will be noted that the tension of the spring 305 is sufficient to maintain the drum stop in the position shown in Fig. 13, to resist the movement of the sheets and head the same up.

Mounted on the upper drum is a suitable projection or deflector 320, which is provided to encounter the drum stop 300 at the proper moment to push it forward into the position shown in dotted lines in Fig. 13 to permit a preliminary movement of the bunch of sheets about drum 244. In this position the line between the two points of spring connection of spring 305 is brought near the dead-center or the center of movement of stop member 300, so that the resistance of the spring is greatly diminished, and the sheets engaging the stop in the position shown in dotted lines in Fig. 13 are able to push it farther in the position shown in Fig. 18, and readily pass the same. In fact the resistance of the spring immediately prior to and in the position shown in Fig. 18, is so slight that the drum stop can be moved out of the way by the force of a single sheet traveling about drum 244. After the pile of sheets has passed these drum stops, it will be obvious that they will be returned by the actuation of springs 305, to the position shown in Fig. 13.

The purpose of the pivotal joint between member 304 and arm 310, which is spring controlled, by spring 309, as shown in Figs. 13 and 14, is to permit the backward movement of said member 304 with said drum stop 300, when for any purpose, the drum sections 244 are arbitrarily turned backward.

Drum stop deflector mechanism.—There being two drum stops 300, I provide two deflector mechanisms, each being actuated by the single cam 322, see Fig. 12. One deflector element is pivotally connected at 642 to drum element 244 and is provided with the arm 320 and the arm 643. The other element is pivoted at 644 to another drum element 244 and is provided with the arm 321 and the arm 645. The arms 643 and 645 are provided at their free ends with cam rollers adapted to engage in a stationary cam wheel 322, and to be operated thereby as the drum elements rotate.

The form of the cam wheel 322 is such as to actuate the arms 320 and 321 into a position to engage the drum stops at the proper moment, as shown in Fig. 12, and again into the position shown in Fig. 19 to clear the chain nippers of the element 358 and associated parts, as shown in Fig. 12, that is, in one position of the drum elements 244, the arms 320 and 321 will project outward to engage the drum stops 300, while in another position of said drum elements 244, the arms will be withdrawn practically within the rotating drum elements to clear adjacent mechanism. This is due to the special formation of the stationary cam 322 as shown in Fig. 20, about the inner surface of which the cam rollers of arms 643 and 645 travel.

Gripper elements of the drums.—As already pointed out the shafts 237 and 240 are provided with a plurality of drum elements. The two elements 242 on shaft 240 are designated gripper elements and coöperate with gripper elements 244 on shaft 237, see Figs. 12 and 13. These elements have a uni-circular periphery through a greater part of their circumferences, having a center common with shaft 240, while the balance of said circumference or periphery, which is something less than a fourth thereof, lies in a circle of greater diameter but also having a center common with that of the shaft 240. These surfaces or peripheries of enlarged circle are coöperating surfaces, and are adapted to come into contact with each other as the two coöperating drums rotate. Part of the gripping surfaces of the lower drum consists of a spring 355 which normally lies above a depression and above the periphery of the greater portion of the wheel. This spring when not depressed, lies in the same arc of a true circle of the balance of the gripping surface. When depressed it forms an incline between the periphery of a smaller diameter and the periphery of the

greater diameter. Fig. 13 shows this spring depressed while Fig. 21 shows the spring in its normal position. While the two gripper elements of the drums are rotating they will lie sufficiently apart with respect to their coöperating peripheries to permit the free travel or free entrance of the pile of sheets therebetween until the gripping surfaces approach each other, being so adjusted that when the elements assume the position shown in Fig. 21 the spring 355 of the gripping surface of one element will press against the gripping surface of the other drum element 244. At the point of said engagement a shoe or strip 354 of steel, or other hard substance, is provided to prevent undue wear. The purpose of the spring 355 is to provide for variations in the thickness in the sheet or sheets to be operated upon by said gripping surfaces. For example, if the pile composed of several folded sheets is operated upon, the spring will yield to receive the sheets without jar or shock to the various parts of the mechanism, whereupon a cam or incline is formed of the spring 355 from practically the smaller periphery of the wheel to practically the larger periphery which enables the lower drum to become adjusted without undue jar or strain. In case a single sheet is operated upon the efficient engagement of the same between said elements 244 and 242 is assured by said spring 355. This is clearly illustrated in Fig. 21.

Spring controlled support of the lower drum shaft.—To permit the lower gripper elements to descend or drop sufficiently to accommodate a pile of sheets of the required thickness, the shaft 240 is journaled in brackets 452 which in turn are journaled at 648 in the stationary framework, see Figs. 2, 12, 15 and 16. The brackets 452 are supported by the springs 454, the tension of which is adjustable by the set-screw 649 engaging with lug 650 of the stationary framework. The limit of upward spring actuated movement of said brackets 452 is secured by the set-screw 453 also threaded into the stationary framework. The downward movement of the bracket 452 is limited by the catch 455 secured to the stationary framework and adapted to engage with projection 651 of said bracket. It will thus be evident that where a bunch of sheets of considerable thickness is brought between the gripping surfaces of the elements 244 and 242, the shaft 240 will be depressed against the force of springs 454 to accommodate such thickness of sheets. It is to be noted that the gripping surfaces of elements 242 and 244 is of sufficient extent relatively with respect to the extent of the sheet to assure the passage of the sheet far enough around element 244 to become engaged with the tapes 652, see Fig. 25.

Mechanism for assembling the pile of sheets with an outset and cover.—Referring to Fig. 25, two additional feeders are shown, which as before stated, may be referred to generally as feeders 7 and 8. In the specific machine described, feeder 7 provided with the table 167 and the pile of sheets 157, is adapted to deliver the covers of the periodical, while feeder 8, having table 168, with pile 158 is adapted to deliver an outset to the periodical. These feeders are so timed and operated as to deliver the sheet forming the cover between the feed roller 177 and its coöperating drop roller; the same being guided by the guides 653 around the feed roller 177 and between tapes 652 and 654 which are guided by the nearly vertical, but slightly curved bar 655. The purpose of the curve being to afford sufficient tension between the tapes to prevent the slipping of the sheet therein. The sheet is carried downwardly along said bar and around roller 178 to deliver the same onto gripper element 244. The sheets from pile 158 or feeder 8 are delivered between feed roller 178 and its coöperating drop roller and are carried around 178 also onto gripper element 244. The guides 656 and 657 serve to direct the movement not only of the pile of sheets but also of the cover and the outset sheets all onto the upper drum. The feeding and delivering mechanisms from feeder 7 and feeder 8 are timed respectively so that they deliver to the upper drum nearly simultaneously with the delivery thereto of the pile of sheets from feeders 1 to 6 inclusive. The pile being slightly in advance of the outset sheet and the outset sheet being slightly in advance of the cover sheet. As now assembled, the pile is carried between tapes 652 and tapes 368 around and over the upper drum and along on tapes 368 and under rods 658 until arrested by the stop 357 on a chain nipper substantially in a position shown in Fig. 25. As the pile of sheets leaves the control of the double tapes 652 and 368 and simply rests upon 368 it is important to prevent the displacement of the sheets thereon, for which purpose the rollers 369 are provided to press the sheets against the tapes, which are provided with the supports 659 beneath said rollers, see Fig. 38.

It should be noted that the chain grippers composed of the elements 357 and 358 are carried on chain 356 around suitably disposed sprockets 277 and have an intermittent movement from one position to another as hereinafter described.

After the sheets have engaged with the stop on the nipper and the nipper has moved to a position of rest slightly past the combing wheel 385 as shown in Figs. 25 and 39, the presser foot 390 descends upon the pile of sheets, except the outset and the cover

sheet, which outset sheet as above stated, is slightly in advance of the cover, and presses the same firmly against the tape supported by the board 428 shown in Fig. 29, to hold said pile firmly and prevent displacement of the same during the combing up of the outset and cover sheets. The combing wheel 385 now descends and operates upon said outset sheet and cover sheet and brings the same forward square with the pile beneath, and up against the stop on nipper element 357 in the position shown in Fig. 40. It is to be noted that the actuating mechanism which lowers the combing wheel, serves to raise the guide rollers 369 to leave the sheets free to be acted upon by the combing wheel. After the combing wheel has brought the upper sheets square with the pile beneath, the combing wheel and presser foot are raised and, by the same mechanism which raises the combing wheel and presser foot, the jogger 396 is operated to engage the rear of the pile and push the sheets squarely home against the stops of the nipper elements 357 as shown in Fig. 41.

After the sheets are forced home as shown in Fig. 41, the jogger 396 is raised out of the way as shown in Fig. 28, to permit another pile of sheets to pass beneath it. The nipper elements 357 and 358, close upon the pile and are being carried forward as indicated in Fig. 28, being the position indicated by the nipper nearest the left hand side of the sheet shown in Fig. 25, which we will call the second position.

Actuation of assembling mechanism, and mechanism for transferring the pile to the second position.—The rollers 369 are mounted on the brackets 370 which in turn are secured to shaft 372 journaled in the boxes 373 which are mounted on the stationary rods 658, see Figs. 27 and 28. This bracket 370 is connected with the adjustable tension spring 371 for securing the proper tension of the rollers on the pile of sheets. The stop member 375 is adapted to engage with hook arm 374 to limit the downward movement of the rollers 369. This prevents the rollers from actually touching the tapes, so that in case of a single signature being passed thereunder, the same will not be crumpled thereby. The hook arms 374 are also secured to shaft 372, see Figs. 27, 28 and 38 to 41.

Adjustably secured to rod 388 is the bracket 376 upon which is mounted the roller 377, whereby when the rod is reciprocated as hereinafter described, the roller 377 will engage with the hook arms 374 and actuate said hook arms and bracket to which it is connected, to raise the rollers 369 out of engagement with the sheets. In such raised position the latch 378 will normally engage with said hook arm to maintain the roller in the elevated position as shown in Fig. 40. The latch member 378 has an extension 379 beyond its pivot support, which extension is connected at its free end with the connecting rod 380, connected at its upper end with lever 416, which is integral with levers 417 and 415, see Figs. 28 and 31. The rod 380 also serves as a spring rod and is provided with a spiral spring 419 acting between collar 660 secured thereto, and a lug 661 secured to the stationary framework; whereby the pressure exerted by the spring 419 tends normally to maintain the latch in the inactive position.

The arm 417 is actuated downwardly by the actuation of the pneumatically operated diaphragm contained in the pressure head 418. The general construction of said diaphragm and pressure head is clearly shown in Figs. 61 and 62. The downward actuation of arm 417 obviously causes the actuation of the latch 378 into the operative position. The control of the pneumatic operation of the diaphragm is secured by the mechanism shown in Fig. 26, in which a valve lever 423 operates the valve in casing 421, similar to the valve shown in detail in Figs. 70 and 72, to control the flow of compressed air from pipe 422 to 420 leading to the diaphragm. This valve arm 423 is operated by the cam 424 on shaft 425, see also Figs. 26 and 108. This shaft 425 is relatively operated as will be hereinafter described.

Combing wheel and presser foot construction.—The combing wheel 385 is mounted on the crank member 387 which is journaled in the bracket 389 secured to the stationary framework, see Figs. 27 and 28. The crank member 387 is provided with a downward extension 662, to which is connected the connecting rod 388. The bracket 393 is also rigidly secured to the crank member 387, and is pivotally connected with the sleeve 392, in which is slidably mounted the rod of the presser foot 390. This rod has a sliding movement in the fixed bracket 395 and is provided with a collar 394 adapted to engage with the top of the sleeve 392, and is provided with a compression spring 391 operating between another fixed collar and said sleeve 392, whereby when the crank member 387 is rocked as hereinafter described, the sleeve member 392 is pulled down carrying the presser foot with it until the presser foot reaches the pile of sheets whereupon any further downward movement of the sleeve member tends to compress the spring 391 to exert further pressure on said presser foot. The return movement of the crank member would obviously result in the engagement of the sleeve 392 with the collar 394 to raise the presser foot 390 clear of the sheets. The rotating movement of the crank member will also obviously serve to raise and lower the combing wheel into and out of engagement with the

sheets for the purpose hereinbefore described.

Pressure roller.—The pressure roller 381 is mounted on the bracket 382, which is pivotally connected with the stationary framework 384, and is provided with an arm extending beyond said pivotal connection, the outer end of said arm is connected with the spring 383. The lower end of said spring 383 has adjustable connection with the stationary framework 384, see Fig. 25. The spring-actuated movement of bracket 382 is limited by its engagement with the stop 663 on frame 384, see Fig. 37.

The formation of the roller 381 is clearly shown in Fig. 37. That is to say, the roller is channeled or provided with side flanges, as clearly shown in said figure. This roller is so placed as to coöperate in pressing the pile of sheets against the combing wheel, being placed immediately below the combing wheel and adapted to engage the under side of the pile of sheets. It is spring actuated so as to secure a yielding pressure between the pile of sheets and the combing wheel. The purpose of channeling or providing the side flanges is to prevent any engagement between the combing wheel and the roller when there is no sheet present.

It will be noted that the raising and lowering of the combing wheel is a positive movement, and that the yielding tension exerted between the combing wheel and the paper is secured solely by the roller 381. This tension is of course adjusted by the adjustment of the lower support of the spring 383. It may also be noted that this roller 381 is located between two of the supporting boards 428, over which the pile of sheets is moved, see Figs. 24 and 37.

The rocking actuation of the crank member 387 is communicated through the connecting rod 388. This connecting rod 388 is adjustably connected with a boss 402 by nuts as clearly shown in Fig. 28. This boss is pivotally connected with the arm 401 which rocks on the fixed shaft 403. This arm has an extension 404 beyond said fixed shaft 403 to the free end of which is pivotally connected the rod 405. This connecting rod is connected at the other end with the arm 406, see Fig. 24 and also Fig. 25, in which latter figure the said rod 405 is directly back of rod 408, and does not show. Arm 406 rotates on drop roller shaft 407 and has an extension 410 beyond said shaft, provided at its free end with cam roller 411, adapted to coöperate with cam 412 on the cam shaft of feeder 7. It will thus be seen that the actuation of rod 405 will be relative with respect to the actuation of feeder 7.

The spring 409 on rod 408, see Figs. 24 and 25, simply serves to maintain engagement between roller 411 and cam 412. It will thus be seen that by a proper adjustment of the parts, a relative actuation of the feeding device and intermediate carrying mechanism is maintained with the operation of the combing wheel and presser foot.

Joggers, construction and actuation.—On the lower end of arm 401 is bolted the horizontal bar 400, see Figs. 27 and 30. To bar 400 are secured the journal boxes 399, in which is journaled the shaft 398. Secured to the shaft 398 outside of the journal boxes 399, are the bosses 397, to which are adjustably secured the jogger members 396 by means of the bolt and slot construction as clearly shown in Fig. 28.

Rigidly secured to shaft 398 is the horizontally extending arm 413 to which is secured at its free end the connecting rod 414 which in turn is secured to the arm 415, being one of the three arm structures above referred to. It will thus be seen that by the pneumatic head actuation the jogger 396 is raised or lowered out of and into the operative position, and by the cam actuation of 401 as above described, a nearly horizontal forward and back actuation is secured. The arm 401 and the rod 414 being substantially equal in length between points of connection and arms 413 and 415 being similarly of substantially equal length, secure a substantially parallel motion which results in a horizontal movement of the said joggers 396 when actuated by the cam.

Nipper construction and operation.—Referring to Figs. 32 to 36 inclusive, it is to be noted that the pile of sheets travels with a constant speed in the direction of the arrow shown in Fig. 3, while the chain borne nippers have an intermittent movement in the same direction, as will be described hereinafter; said intermittent movement being from the first position to the second position and from the second position to the third position and so on. Fig. 33 indicates the sheet traveling in the direction of the arrow, and the nipper traveling in advance of the sheet in the same direction, but at a slightly slower speed and diminished toward the end of its movement. Fig. 34 shows the pile of sheets having entered the jaws of the nipper, that is, having overtaken the nipper, the nipper having reached a position considerably advanced from that shown in Fig. 33. Fig. 35 shows the nipper having come to rest at the end of its movement in a position slightly advanced beyond that shown in Fig. 34, with the sheets headed up against the stop surface of the lower member 357 of said nipper. Fig. 36 shows the nipper jaws closed on the pile of sheets, ready to move the sheets forward. The nipper elements as above stated, are carried on the chain 356 which is actuated in a manner hereinafter to be explained. This chain besides being supported and actuated by the sprocket 277 is guided on a track. Element 357 forms one

of the links of the chain, while the element 358 is pivoted to element 357. A spring 361 operates between the two elements to maintain them normally in the closed position. Element 358 is provided with an extension 665 upon the other side of its pivot connection, see Figs. 32 and 36, which extension carries at its free end the roller 359 projecting from one side thereof. This roller is adapted to engage with the cam 360 as the nipper passes around the sprocket wheel. The operation of which engagement serves to move said element 358 into the open position as shown in Fig. 33. This cam surface ends before the end of the travel of the nipper elements, and the roller would descend to permit the closing of the nipper element 358 after passing this point were it not for the means provided for preventing the same. This means consists in the arm 362 secured to the rock shaft 363 and having a horizontal extension at its upper end, normally forming a continuation of the cam 360, so that, after the nipper elements come to rest in the position shown in Fig. 35, which is a position beyond the extent of the cam 360, the element 358 is still maintained open by the engagement of the roller 359 with the top of lever 362, so that the sheets may be thoroughly headed up between said nipper jaws, after the nippers come to rest. Upon the completion of this operation however, the rock shaft is actuated to depress the lever 362, and thereby permit the closing of element 358 upon the pile of sheets, said closed position being shown in Fig. 36.

Actuation of the rock shaft.—Referring to Figs. 32 and 42, the rock shaft 363 is mounted in the stationary framework of the machine and is provided with the arm 364 carrying the cam roller 365, which is adapted to engage with the cam 367 operated on shaft 265; the engagement of roller with cam being maintained by the spring 366. Shaft 265 is actuated as will be explained later on.

The proportion and actuation of the cam 367 is such, relatively to the operation of the other parts, as to maintain the rock shaft in one position throughout the greater part of the forward and back revolution thereof, so as to maintain the rock shaft in a position which holds the lever or arm 362 elevated, to prevent the closing of the nippers until just before the same are to be moved into the second position, then the shaft 363 is rocked, permitting the nippers to close upon the pile of sheets, to carry the same away to said second position. As soon as the nippers have cleared arm 362, the shaft is again rocked to bring the arm into the elevated position to repeat the operation just described. It will be noted that this cam is in the form of a screw, and the roller is channeled to track therewith. The roller being slidably mounted on its supporting shaft, as clearly shown in Figs. 32 and 42.

The relative operations of presser roller 369, of the chain nipper, of the presser foot and combing wheel, and of the jogger.—In Fig. 38 the pile of sheets is shown as moving beneath the joggers 396, and the presser wheels 369, and about to enter the jaws of the nipper, which nipper has not yet come to the final position.

In Fig. 39 the nipper has come to the final position, the pile of sheets with the exception of the two upper sheets has been brought into position against the nipper stop. The presser foot 390 and combing wheel 385 have been dropped into the operative position and presser wheels 369 have been elevated.

In Fig. 40 the upper sheets have been combed into final position and the jogger has been dropped into position ready to act upon the pile of sheets.

In Fig. 41, the jogger is shown in the final position of having pushed the sheets home against the nipper stop, and the presser foot and combing wheel have been elevated. From the positions shown in Fig. 41, the parts next assume the positions shown in Fig. 28 in which the presser wheel mechanism has been unlatched and the presser wheels 369 again take the lowered position. The jogger has been elevated so that the next bunch of sheets can pass thereunder, while the next nipper is coming up into the position to receive the bunch of sheets. From this position the parts take the positions shown in Fig. 38, thus completing the cycle.

Chain nipper actuation.—Mounted on the shaft 237 of the upper drum, which as above stated, is driven from the general source of power, is the crank 260, see Figs. 2, 12, 43, 48, 50, 52 and 54. This crank is connected by the connecting rod 261 with the sector gear 262, see Figs. 2 and 43, so that said sector gear is given a rocking movement. This sector gear meshes with the pinion 264 on shaft 265; the parts being proportioned so that with each reciprocation of the sector gear the shaft 265 is given a full revolution first in one direction and then in the other. Shaft 265 carries beveled gear 266, see Figs. 24 and 43, with which coöperates the beveled gear 267 on shaft 268, which drives the stitcher which will be described later on. On shaft 265 is also secured the arm 269, to the outer end of which is pivotally secured the driving pawl 270. On the free end of pawl 270 is mounted the roller 271. This pawl is actuated by the spring 278 pressing between said pawl and the tail 279 of said member 269, see Figs. 43, 49, 51, 53 and 55. Adjacent the member 269 are the wheels 272 and 273 with an intervening sleeve forming one structure, loosely mounted on said shaft 265. Wheel 272 is provided with a

semi-circular depression in its periphery adapted to receive the roller 271 when the wheel is in the position shown in Fig. 49. The wheel 273 is also provided with a similar depression adapted to receive a roller 281 carried on arm 280 forming a lock pawl which is pivotally mounted at 282 on the bracket 283, see Fig. 44. This lock pawl 280 is controlled by the spring 284 operating on the slide rod extending from said pawl 280 through a hole in the bracket 285. The stop 286 is provided to limit the upward movement of said pawl member 280 over the center of actuation.

Assuming the parts driven in the direction shown in Figs. 48 and 49 and Figs 50 and 51, the shaft is starting to move in the direction of the arrow shown in Fig. 49, with the pawl wheel 271 in the depression in wheel 272 which serves to carry the wheel 272 in the same direction. Fig. 51 shows the shaft having turned a half revolution. Fig. 53 shows the shaft having completed the full revolution and about to reverse in the direction indicated in the arrow in Fig. 53. In this direction however the shaft will travel without moving the wheel 272 because the pawl will disengage therefrom; the wheel 273 being locked from rotation in said direction by the lock pawl 280. It will thus be seen that with each rotation of the shaft 265 in the direction of the arrow shown in Figs. 49 and 51 the wheels will be rotated in a similar direction, but with each rotation of the shaft in the reverse direction the wheels will remain stationary. It is also pointed out that Fig. 48 is a view of the relative position of the sector and crank operating the same corresponding to the position of the shaft 265 and the wheels 272 and 273, while Figs. 50 and 51 show similarly corresponding position. Figs. 52 and 53 show positions corresponding with each other, while Figs 54 and 55 also show positions corresponding with each other. It should also be noted that the relative positions of the axis of the pawl 270 and the axis 271 with respect to the pocket in wheel 272 are such as to require considerable force to disengage said roller from the pocket against the pressure of the spring 278. The purpose of this is to prevent accidental disengagement. The same circumstance is also present with respect to the engagement of pawl wheel 281 in the pocket of wheel 273, see Fig. 44. On the sleeve carrying wheels 272 and 273 is mounted the gear 274. This gear meshes with the gear 275 mounted on the shaft 276, on which are mounted sprockets 277. It will thus be seen that with each alternate rotation of shaft 265, the sprocket wheels are advanced to carry the nippers from one position to the next, while during each reverse rotation of shaft 265 the nippers are at rest.

Stitcher driving mechanism.—The means employed for stitching the pile of sheets, comprising the well known form of wire stitching mechanism, is not novel or made part of this application.

For considerations of space the stitching mechanisms are so positioned and actuated as to deliver two stitches to the pile while the pile is in the second position, and then two other stitches to the pile while the pile is in the third position; it being understood that in the specific form illustrated four stitches may be given to the book. A less number of stitches may be delivered to the book by omitting to supply the wires to certain of the machines. The mechanism for operating these stitchers relatively to the operation of the chain nippers, so as to operate upon the pile of sheets while the same is at rest in different positions, may be described as follows:

Referring to Fig. 24, as above stated, the shaft 268 carrying beveled gear 267 drives the stitchers. This shaft 268 is geared to shaft 265 and has the same rotation alternately first in one direction and then in the other direction as shaft 265. That is, the shaft makes a complete revolution in one direction, and then a complete revolution in the other direction, in the same way as shaft 265.

Secured to shaft 268 are the driving pawl arms 287, see Figs. 56, 109, 111 and 112, which are exactly similar in detail, as the pawl arm 269 shown in Fig. 49. These pawl arms 287 carry pawls 288 exactly similar to the pawl 270 in Fig. 49. The ratchet wheels 289, for coöperating with the pawl arms 287, are also of substantially the same form as wheel 272 in Fig. 49. These ratchet wheels 289 are mounted on sleeves 297 which are journaled loosely on the shaft 268. The lock ratchet wheels 290 are also mounted on sleeves 297 and are similar in formation to lock ratchet wheel 273 in Fig. 44, and are operated on by the lock pawls 293 which are also substantially similar in formation and operation to pawl 280 in Fig. 44. This driving mechanism is shown in Figs. 109 and 111. The pawls 288 are actuated by the springs 291 pressing against the lugs 292 on pawl arms 287. The pawls are also provided with anti-friction rollers 296 to engage in the depressions in wheels 289. On sleeves 297 are also mounted the beveled gear wheels 298. By this drive and lock pawl and ratchet mechanism, similar to that described in connection with Figs. 49, 50 and 51, an intermittent rotative movement, in one direction only, is given to sleeves 297. The parts are so directed and have such operative relationship with the backward and forward rotation of shafts 265 and 268, that the sleeves 297 are being actuated while the shaft 276, carrying the sprocket wheels,

is at rest. For example, when the sector is moving in the direction indicated by the arrows in Figs. 48 and 50, the nipper chains are being operated, while when the sector is moving in the direction indicated by the arrows in Figs. 52 and 54, the sleeves 297 which are geared with the stitchers are being operated, and the nipper chains are at rest. That is to say, the stitchers are being operated while the pile of sheets is held stationary.

On sleeves 297 are mounted the beveled gears 298 which coöperate with gears 299 of the stitcher mechanism. As stated before, stitcher mechanisms or machines, connected up in the manner just explained, may be located to operate upon the sheets in either or both of the second and third positions. In Fig. 2 the pair of stitchers in the second position are indicated by the numeral 430, while 431 indicates the pair of stitchers in the third position, see also Figs. 25, 56 and 58.

In Fig. 56, the magazine which is indicated at the extreme right of the drawing is shown as in the third position in which the final stitches are received. The magazine shown to the left of this position is in the fourth position or idle position, which position is provided simply for considerations of space in accommodating the various machinery. The next position at a similar distance to the left of the fourth position is the fifth and final position to which the magazine is carried by the chain nippers. In this position the magazine is operated upon by folding blade 441, which gives it the final fold and sends it up between the folding rollers 439 and 440, see Figs. 56, 58 and 60.

It is understood of course that the nippers will be actuated to release the magazine before the folding blade operates upon the same.

Supporting boards.—The supporting boards 428 and 429, flanking chains 356, extend horizontally and parallel with each other, for supporting the sheets from the first position throughout the second, third, fourth and fifth positions, see Figs. 24, 29 and 60. Ordinarily sheets are carried on tapes, but in this case they are moved by chain nippers, so it becomes necessary not only to support the sheet but to maintain it away from the chains which contain oil, and would injure the same. The boards being stationary, it will be obvious that there will be a friction between the under sheet and the supporting boards. This friction is a substantial one, due to the weight of the superimposed sheets. As the surface of the sheet coming in contact with the supporting boards is covered with printed matter, in many cases half tone cuts, which are susceptible to injury by rubbing thereon, it is necessary to provide a contact surface on said boards which will permit the sheet to slide over the same without any injury to the printed matter thereon. I have found that by covering the contacting surface of the boards with a fabric known in the art as "mole cloth," the freshly printed pages can be dragged along the boards, having their surfaces so covered, without any injury to the printed matter thereon. It is believed that the best results are obtained by having the sheet moved in the direction of the nap of the cloth.

Mechanism for releasing the sheet and giving it the final fold.—As above stated, the pile of sheets having been stitched in the second and third positions and carried on to the fourth and fifth positions by the nippers, is now brought to rest and released by the nippers and acted upon by the folding blade to give the same the final fold.

Referring to Figs. 65 and 66 one of the arms 432 is secured to the shaft 434. The other arm 432 is pivotally supported at 666. These two arms are connected by the connecting rod 433, and are in every other respect similar in construction and function. The arm 432 has an upward extension which is adapted to engage the roller 359 of the nipper element 358 when actuated as hereinafter to be described, and when the nipper is at rest in the final or fifth position. To shaft 434 is secured the arm 435 having a roller 437 at its upper extension. This roller is adapted to coöperate with the cam 438 mounted on shaft 255. This cam 438 is so formed as to actuate the lever 435 against the tension of spring 436, with each cycle of the machine, so that when the nippers have brought the pile of sheets to rest in the final or fifth position, the lever 432 is actuated to engage roller 359 to open the nipper jaw 358 and release the sheets; said open position being shown in the said Figs. 65 and 66.

Folding blade construction and actuation.—As above stated, the third and final fold is given to the magazine when the pile has been brought to the fifth position, and after the nippers have released the same.

Referring to Fig. 60, the folding blade 441 is carried by the folding arms 443 which are carried by the shaft 448 journaled in the stationary framework. Secured to shaft 448 is the lever or arm 449 secured at its free end with the connecting rod 450. This connecting rod is secured at the other end with the arm 667 shown in Figs. 59 and 67. This arms is pivotally mounted in the stationary framework at 668. This member 667 has another extension 669 provided with a roller 670 for coöperating with a cam 671 on shaft 451, see Figs. 59, 60 and 67. The said coöperation between cam roller and cam being secured by the spring 447 on rod 446 which is pivotally connected with

arm 445 being an extension of one of the blade arms 443. The said cam being so shaped as to actuate, through connecting rod 450 and arm 449, the folding arm 443, at the proper moment in the cycle of the machine's operation. It will be understood that the said cam 671 is formed and operated relatively to actuate the folding blade 441 at the proper moment to strike the pile which rests upon the boards 428 and 429, through the slit bars to the folding rollers 439 and 440, to give the magazine the final fold.

Folding blade construction.—The folding blade 441 is mounted on the bracket 442, see Figs. 74 and 75, which is pivotallly secured at the free end of arm 443 and has a rocking movement thereon controlled by the spring 444 connected between bracket 442 and arm 443; said bracket 442 is provided with stops 672 adapted to engage with shoulders on arm 443 to limit the pivotal movement of bracket 442 in either direction.

Folding rollers.—The folding rollers 439 and 440 are situated above the folding blade and are journaled as follows: Roller 439 is supported in fixed journals in bracket 673 forming part of the stationary framework. The journal boxes 674 of roller 440 are slidably mounted on the brackets 673, and have a horizontally spring controlled movement, there being a face in the bracket 673 for engaging said journal boxes 674 to limit their spring actuated movement in one direction.

Referring to Fig. 76, I provide the spiral springs 675 and 676; spring 675 being the heavier spring, while 676 is the lighter. Spring 676 is adapted normally to maintain roller 440 in engagement with roller 439, so that in case a single thickness of paper or a single signature is delivered to the folding rollers the same will be taken care of. This spring however is so light that when the normal size magazine is fed to the folding rollers this spring yields to permit roller 440 to be moved away from roller 439 to come within the influence of spring 675 to secure the necessary pressure between said rollers in the folding operation of the machine.

The jam nuts 677 are provided to secure an adjustment of rods 678 to provide for different thicknesses of magazines to be operated upon. When the rollers are close together as shown in Fig. 74, for operating upon a single sheet, the blade 441 should obviously be centered therewith as shown in said Fig. 74. This blade is normally held in the centering position by the spring 444. When however, the rollers are pushed apart in the position shown in Fig. 75, the spring will yield sufficiently to permit the blade 441 to take the central position between said two rollers which is caused by the thickness of the magazine operated upon. The stop 672 on the spring side of bracket 442 normally maintains the position of the blade 441 to the centering position when the rollers are close together. The other stop is merely to prevent accidental displacement of the blade.

Delivery mechanism.—As the magazines are delivered through the folding rollers 439 and 440 they are either carried away by the drum 471 or else switched off by the switch 456 between the guide rods 468 and 469 into the basket 470, depending upon whether or not the magazine is complete.

Switching mechanism, or means for detecting and deflecting incomplete magazines.—The switch members 456 being four in number, are mounted on rock shaft 457, and are normally held in the position shown in Figs. 63, 74 and 75, by spring 458; the spring being shown in Fig. 60, just back of spring 447. In the position of the switch shown in Fig. 63 the magazines are deflected between the guides 468 and 469. The driven serrated wheel 678 being provided for assisting the movement of the magazine between said guide rods. The switch mechanism however, is only allowed to remain in said position shown in Fig. 63, when incomplete copies or no copies of the magazine are delivered thereto in the regular operation of the machine.

Where complete copies are delivered to the folding rollers 439 and 440 certain mechanism is operated to move the switch into the position shown in Figs. 57 and 60, to deflect the magazine so that the same will be delivered to the drum, as follows: It will be understood that as a consequence of the delivery to the stitching mechanism of a complete magazine that is, a pile of sheets having all its component parts, certain mechanism or train of mechanisms will have been actuated which will make it possible for the stitcher to actuate, otherwise the stitcher will be inactive, letting the pile of sheets pass them. These various mechanisms will be described later on. To one of these stitching mechanisms the following device is applied for controlling the actuation of the final switching mechanism.

Referring to Figs. 109 and 110, as already explained, the sleeve 297 is operated by shaft 268 by pawl and ratchet mechanism, for operating the stitching mechanism. On sleeve 297 is provided the cam 466 which is adapted to coöperate with the arm 465 for actuating the piston of the air valve 463, which controls the air supply of compressed air from pipe 464 to pipe 462 to pressure head 461 in which is operated the diaphragm and piston 679, which is adapted to operate the spring controlled pin pusher 680 as shown in Fig. 73.

Referring to Fig. 73 again, the wheel 259

is mounted on shaft 258, upon which is also mounted the gear 257, which is driven by gear 256, which is mounted on drum shaft 255, see also Figs. 58 and 60. Wheel 259 is provided in its periphery with five pins 460, equally spaced apart and slidably mounted in said rim as shown in section in Fig. 73. These pins are moved into the position shown in the upper part of Fig. 73, by the stationary cam 511, and into the position shown in the lower part of Fig. 73, by the pneumatically operated pin pusher 680. When the pin is in the position shown in the lower part of Fig. 73, and the wheel is rotating in the direction of the arrow shown in Fig. 60, said pin will engage lever 459, which is secured to the rock shaft 457 to actuate the switch members 456 in the position shown in Figs. 57 and 60 to guide the magazines onto the drum 471. It will be understood that the magazine which is delivered complete to the second position to be operated upon by the first pair of stitchers has actuated the various tripping mechanisms necessary to secure the actuation of the stitching machine, in which case the shaft carrying the cam 466 has operated, which in turn has operated lever 465 to actuate the piston of the air valve 463. This in turn has resulted in the actuation of the pin pusher 680 to actuate the uppermost pin 460 in wheel 259 when the same is in the position corresponding to the second position of the pile of sheets. This position being opposite the diaphragm 461 as shown in Fig. 60. It will also be understood that this pin which has just been operated upon will maintain a position relatively to the position of the pile of sheets, causing said actuation, that is to say, the pin being actuated in the second position will be carried from thence to the third, fourth and fifth position, when in said fifth position it will actuate the lever 459 at the moment of the delivery of the particular magazine referred to, so that the same will be switched onto drum 471. If, on the other hand, the magazine delivered to the first pair of stitchers, in the second position, is incomplete, it will have failed as a consequence to actuate the various mechanisms necessary to secure the actuation of the stitcher. It then will follow that the cam 466 will not operate and as a consequence the pin 460 representing the second position of that particular magazine, will not be moved to actuate the lever 459, and as a consequence when the said incomplete magazine passes through the folding rollers 439 and 440, it will be guided by the switch 456 around to and between the guide rods 468 and 469, to the basket 470 for receiving incomplete copies.

Delivery drum construction.—Referring to Figs. 2, 56, 58, 60 and 63, the delivery drum is composed of the three wheels or elements 471, mounted on hollow shaft 255. This drum is located substantially above, and to one side of the folding rollers 439 and 440. Each element 471 of the drum is provided with three nippers 472. These nippers are alined so as to make three sets of horizontally arranged nippers. As the construction and operation of these nippers are alike with respect to each set, a description of one set will suffice for the others.

Nipper construction and operation.—The shaft 682 is journaled in journal boxes carried by the three drum elements 471. On the shaft 682 are secured the three nipper elements 472 adapted to be actuated by the shaft to clamp them against the periphery of the drum elements 471, see Figs. 56, 57, 58 and 63. Secured also to shaft 682 is the arm 473 secured at its outer end to the spring actuated rod 474; while in Fig. 63 a spring is shown on one of these rods only, it is to be understood that a similar spring is provided for each rod 474. The other end of said spring rod being slidable in a stud mounted on wheel 471. Secured also to shaft 682 is the arm 475 provided with a cam roller at its free end, adapted to engage with the cam 476, which is secured to the stationary framework of the machine.

The position and formation of the cam member 476, is such, when the wheel rotates in the direction of the arrow shown in Fig. 63, to actuate the shaft 682 to open the nipper 472 to receive the magazine as the same is delivered through the folding rollers 439 and 440; immediately after which, the nipper closes and carries the magazine away, as the same is fed through the folding rollers, it being understood that the speed of rotation of the drum and the rollers is the same. The magazine is then carried around the drum to be delivered to the pile of sheets on delivery belt 510, whereupon the cam again engages the roller of arm 475 to open the nipper 472 sufficiently to release the magazine therefrom. A further rotation of the drum brings the nipper again to the position for receiving the next magazine from the rollers 439 and 440, whereupon the formation of the cam 476 is such as to open the nipper to receive the next magazine. It is to be understood that the nipper is given a greater opening to receive the magazine safely than is necessary for delivering the magazine to the carrying-off belt 510. It is also to be understood that the spring pressed rod 474 serves to maintain the roller on arm 475 in operative relation with the cam member 476, and also to maintain the nipper closed when not in engagement with the cam member 476.

Delivery fly.—Secured to the shaft 479, see Fig. 63, which is journaled to the stationary framework of the machine, are the three fly members 477 provided with the

stops 478. Shaft 479 is also provided with the arm 480 connected through the connecting rod 481 with the bell-crank 482, having an extension 483, with a cam roller at its free end, adapted to engage with the cam 484 on shaft 451. This cam roller is maintained in engagement with the cam 484 in the usual way by a spring not shown. The formation and operation of the cam is such as to give a rocking movement to the flies 477, relative to the movement of the drum elements 471, so that as the nippers 472 reach the position when the sheet is to be released therefrom, and the nipper is opened in the manner above described, the magazine engages the stop 478 and the fly 477 is depressed to assure a positive delivery and an exact position, of the magazine at the proper moment away from the drum to the pile on the off-bearing belt 510. The depressed position of said fly members 477 is indicated by dotted lines in Fig. 63. The guide rod 683 is provided to prevent the magazine from falling away from the drum prematurely.

Air valve control of the delivering and counting mechanism.—The air valve 522 is secured relatively with respect to the drum as indicated in Fig. 63, and is of the usual type of valve which is shown for instance in Figs. 70 and 72. This valve is provided with the trip arm or lever 684, which is adapted to project slightly between two sections or elements 471 of the drum so as to lie in the path of travel of the magazine and to be actuated thereby. The dotted line in Fig. 63 indicates the position of this trip lever in the actuated position. The actuation of the trip lever 684 in the position shown in the dotted line serves to open the valve 522 to permit the passage of compressed air from feed pipe 524 through pipe 521 to pressure head 520, to move the lever 519, actuating finger 518 against spring 688, see Figs. 63 and 68.

The delivering belts 510 are mounted on the pulleys 509 carried by shaft 508, see Figs. 63 and 67. Shaft 508 is provided with the gear 507 driven by gear 506 on shaft 505. Shaft 505 is provided with a friction wheel 504 which is driven by the friction disk 503 on shaft 502. The shaft 502 is made hollow and is provided with the spiral spring 685 as shown in Fig. 71, which is adapted to press against the pin 686, secured to the hub of friction disk 503, which hub has a sliding movement on said shaft 502; the pin 686 working in a slot on a shaft 502. The spring 685 serves to maintain the necessary force of engagement between friction wheels 503 and 504. The adjustment of the spring is secured by the screw 687. The friction wheel 504 is feathered on the shaft 505. The lower journal box 690 of shaft 505 forms a thrust support for the wheel 504; there being the usual antifriction means interposed therebetween. This journal box is slidably seated in the stationary framework and is provided on one side with a rack; a pinion is mounted on shaft 691 for engaging said rack to raise or lower the same to move the friction wheel toward and away from the center of the disk 503 to vary the amount of movement communicated by disk 503 to wheel 504, which results in a variation in the length of the steps between magazines. Mounted on shaft 502 is the ratchet 512. Rotatably mounted on the hub of ratchet 512 is the arm 514, to which is pivotally secured the connecting rod 515 of the eccentric strap 516 which is operated by the eccentric 517 on shaft 451. On arm 514 is pivotally mounted the counterbalanced pawl 513.

By the rotation of the continually rotating shaft 451 it will be understood that the arm 514 is given a to and fro rocking movement carrying the pawl 513 with it. It is to be noted that the pawl is a counterbalanced pawl having a disk or counterweight at its upper extension and a projection at its lower end adapted to engage with the stop pin 689 to limit the counterweighted actuation of the pawl away from the ratchet. It is to be noted that one side of each tooth of the ratchet wheel has a convex surface of such form and extension as to move the pawl when the same is moved back over the surface, pushing its counterweight over its center of gravity into the position which makes its lower extension engage with the stop 689 as shown in Fig. 64. In this position, as the arm 514 is rocked forward, the ratchet engaging end of the pawl moves freely over the top of the pawl tooth, and falls onto it after it passes the edge thereof, and idly slides down the convex surface and back again into the said inoperative position, repeating said movement indefinitely without actuating the ratchet. In Fig. 64 the lower end or tail of pawl 513 engages with the stop 689 at a point substantially in vertical alinement with the axis of the pawl while the counter-balance at the top of the pawl is considerably to the right of this vertical line. As the arm 514 moves upwardly about its axis these relative positions are shifted. In Fig. 69 the center of the counterbalance approaches the position of vertical alinement above the axis of the pawl while the point of engagement between the tail and stop 689 has moved to the right so that the counterbalance is about to pass the center of gravity and as the arm 514 rises or moves slightly farther to the left or counterclockwise direction the counterbalance will pass to the other side of the vertical line passing through the axis of the pawl, causing the pawl to fall onto the back of a tooth and idly slide in the position shown in Fig. 47. This is the normal action

of the pawl as the lever 514 is rocked. When, however a magazine passes the valve trip 684, as above described, the finger 518 is pushed forward against the top of pawl 513 to throw it into the engaging position, as shown in Fig. 63. The actuation of finger 518 is hereinbefore described. In such position it is held by the said counterweight and as the arm 514 is rocked forward the pawl actuates the ratchet one step. From which it follows, from the foregoing description of the connecting mechanisms, that with each magazine that passes the valve trip 684 and consequently that falls on the off-bearing belt 510, the off-bearing belt is given one step in the forward movement.

Counting mechanism.—Referring to Figs. 61 and 62, the shaft 255 upon which the drum elements 471, are mounted, is journaled in the journal boxes 693 and 694. This shaft also has a longitudinal horizontal movement in said journal boxes. Shaft 255 is also hollow and contains within it the spring 487 mounted on rod 488. This spring abuts at one end against the end of stationary journal box 694 and at the other end against the collar 489 secured to the slide rod 488. 490 indicates a sleeve or collar secured to and within the hollow shaft. Between collar 490 and collar 489 is provided an anti-friction bearing. Collar 695 is in turn secured to the slide rod 488 to limit relative movement in the other direction. It will thus be noted that the normal tendency of the spring is to move the shaft to the left in the direction of the arrow in Fig. 61, to maintain the cam 485, mounted on said shaft 255, in continual contact with the roller 486, mounted on the stationary framework see Fig. 58. By this construction it will be seen that the rotation of shaft 255 with its cam 485, which has on its cam face three depressions, corresponding to the three sets of nippers, will cause the shaft to be reciprocated backward and forward as the roller 486 moves into and out of said depressions.

Secured to the right hand end of shaft 488, see Fig. 61, is the collar 491 provided with a hole adapted to receive the latch member 492, which latch is normally held out of engagement with the collar 491, by the spring 493. The said latch is operated against pressure by the pneumatically operated diaphragm contained in the casing 494. The air pressure actuating said diaphragm, is delivered thereto by pipe 495 controlled by valve 496, to which air is supplied from a suitable source through pipe 523, see Figs. 60, 70 and 72. In Fig. 61 the shaft 255 is shown in the farthermost position to the left and the latch out of engagement with the collar 491. Fig. 62 shows the end of the shaft 255 in its farthermost position to the right, with the latch in engagement with collar 491.

To the end of hollow shaft 502, see Fig. 71, is secured the gear wheel 501, having its hub threaded into said shaft. Gear 501 drives gear 500. To gear 500 is secured gear 499 which is concentric therewith, both rotating on a common stud. Gear 498 is mounted on the sleeve 693 which is adapted to rotate on the stud 694. The cam 497 is also mounted on the sleeve 693 and is held rigidly in operative relationship after proper adjustment with the gear 498. The bracket 696, see Figs. 70 and 71, is swiveled around shaft 502 and is adjustably secured by the bolt 697 operating in the arc slot in bracket 696. This bracket 696 carries the pin or stud supporting the gears 499 and 500 and is adapted to be adjustably moved about its axis to accommodate different size gears, which may be substituted to change or vary the number of magazines to be assembled in each bunch.

The cam 497 has approximately half of its periphery in the circle of one diameter, while the other half is in the circle of a lesser diameter. This actuates the lever or arm 698, which carries the finger or lever 699 in engagement with the piston 700, of valve 496, and maintains the piston against the actuation of spring 703, during half of its rotation in the open position, and during the other half of its rotation in its closed position. The open position of this valve is shown in Fig. 72, while the closed position of the valve is shown in Fig. 70. It will thus be seen that while the shaft 255 is latched in the position shown in Fig. 62, the drum will receive the magazines and deliver them in a straight line as indicated by the piles numbered 701 in Fig. 56. When the shaft is not latched but is permitted to move to the left as indicated in Fig. 61, and backward and forward in response to the cam actuation referred to, the books will be taken and piled in a bunch as indicated at 702, see Fig. 56, slightly moved to the left of bunch 701. In this way the respective bunches will be delivered in staggered form as clearly shown in Fig. 56. The number of books delivered in each bunch is determined by the ratio of the gearing between shaft 502 and cam 497.

It will be understood that the books are always received from the folding rollers in the same position, therefore if the shaft of the drum is prevented from having a longitudinal movement the books are delivered to the off-bearing belt also in the same position. Whereas if the drum shaft is permitted to reciprocate in response to the actuation of cam 485 the books will be received by the drum in the first position and carried to the second position and delivered as above indicated.

It will be remembered that the shaft 502, see Figs. 63 and 67, is given a step by step pawl and ratchet actuation, from which it follows that the cam 497 is given a similar step by step movement. By the proper relationship of the gears between the shaft and cam, the number of step movements of the cam 497, with the arm 698 in engagement with either periphery thereof will determine the number of magazines delivered to each pile.

Straight line arrangement.—As above stated, the folding machine is arranged to receive the sheets from a plurality of feeders, arranged in a straight line, which permits the feeders to be arranged close together side by side and deliver the sheets to a series of folding rollers which are arranged in a perfectly straight line, one roller of each pair being coupled together forming a practically continuous shaft. The feed rollers are also arranged in a straight line and driven by a single gear wheel. The second folding rollers are arranged parallel but also in line one in advance of the other so that all of the sheets delivered from a subsequent feeder will fall in the path of travel of the sheet delivered from a prior feeder.

The drive and connections therewith.—The source of power of the machine consists of the motor 159 shown in Fig. 2, being equipped with the usual rheostat shown at 160. On the motor shaft is provided the pulley 169, which is connected by an ordinary belt with the pulley 170. On the shaft of pulley 170 are connected one of each pair of folding rollers namely 181 to 185 inclusive. On this shaft is also mounted the gear wheel 188. This gear wheel 188 drives through gear 189 gear 190. Gear 190 is on the driving shaft for the feed rollers 171 to 175 inclusive. Gear 188 also drives through gear 196 gear 197, which drives shaft 187 which drives through the beveled gears 221 to 225 inclusive and 231 to 235 inclusive the second fold rollers 201 to 205, inclusive and 211 to 215 inclusive. Shaft 187 also carries gear 226, which drives the first folding rollers 216 and 206 which fold the sheets from feeder 156, while gear 198 drives the feed roller 176. Gear 198 drives gear 199, shaft 208, gear 200, and gear 207, which is on feed roller 176. Gear 189 is mounted on shaft 704. Also on shaft 704 is mounted a pinion (not shown) which drives gear 705. Gear 705 is mounted on cam shaft 451. The cam shaft is shown in Figs. 1, 59 and 60.

On the end of shaft 187 is provided the gear 217, which drives through gear 218, feed roller 178 being the feed roller of the No. 8 feeder, see Fig. 3. Gear 218 drives gear 219 on shaft 220. On the upper end of shaft 220 is mounted gear 227 which drives, through gear 228, the feed roller 177 of the No. 7 feeder, see Figs. 2 and 24. At the other end of the shaft of feed roller 178 is provided the pinion 229, see Fig. 3. Gear 229 drives gear 230 on shaft 237, see Figs. 5 and 10. On the other end of shaft 237 is gear 238, which drives gear 239 on shaft 240, see Figs. 10 and 12.

On shaft 208 see Fig. 56, is pinion 245 which drives the gear 246 mounted on shaft 247, see Figs. 3, 5 and 58. On shaft 247 is mounted the cam 706 and also the eccentric 327. On shaft 187 is mounted the beveled gear 248 which drives gear 249 on shaft 250, which is provided at the other end with the beveled gear 251 driving beveled gear 252 on the stem of one of the third fold rollers 439, see Figs. 56, 58 and 60. On the same shaft or stem on which is mounted the beveled gear 252 is the pinion 253, which drives gear 254, being mounted on the shaft 255 of the delivery drum.

General trip mechanism throughout the entire machine and the control through the stop and start lever and compound air valve.—The pneumatically operated trip mechanism is operated by the delivered sheet from one feeder for controlling the delivery of a sheet from the next succeeding feeder thereto. For example, the sheet delivered from the No. 2 feeder, as it passes through the first folding rollers, controls pneumatically operated mechanism which in turn controls the delivery of sheet from No. 3 feeder. Fig. 82 is a vertical cross-section on line 82—82 of Fig. 77, showing the folding rollers of the No. 2 feeder on the right hand, and on the left the No. 3 feeder and controlling mechanism. The view is taken in this manner to show the relative positions and mechanisms respecting both the preceding folder and the subsequent feeder. This view would equally show No. 3 and No. 4, and No. 4 and No. 5. An exception is made with respect to the No. 1 feeder, instead of the double supply pipe as shown in Fig. 82, a single pipe only is shown as in Fig. 83.

As the sheet leaves feeder No. 2, it is struck through the folding rollers 182 and 192 by the folding blade. As it passes around under roller 192 it engages the finger 525 which is normally spring controlled, see Figs. 84, 85 and 86. This finger is normally maintained in the elevated position as shown in Fig. 86, by the tension of the spring 707. This finger 525 is connected with a downwardly extending finger 531 which engages at its lower end with the piston 532 of an air valve 526; the said spring 707 holding the said members 525 and 531 in the position maintaining the valve closed, as shown in Fig. 86. When the sheet from feeder No. 2 is struck between the rollers and carried downwardly under roller 192 and between

the roller and finger 525, the finger 525 is depressed moving the piston 532 into the open position, as shown in Fig. 85. This permits the compressed air to pass from pipe 533 through valve 526 to and through pipe 534 to the diaphragm in head 527. This moves the diaphragm and piston 708 which actuates the rock arm 536 and connecting rod 537; see Figs. 82, 89, 90 and 91. This rod is controlled by the spiral spring 538, pressing at one end against the stationary bracket 551 and the other end against the adjustable collar 541 on said rod, see Fig. 90. This rod also has another adjustable collar 540 which is adapted to engage the upper end of member 543 of the latching member 544. This latching arm 544 is provided with the latching member 709, adapted to engage with the latch 710 of member 545. The spring 546 is adapted normally to control the latching member 544 to move the latch 709 out of engagement with latch 710. The normal action of the spring 538 however, is to press the collar 540 against the upper end of 543 and counteract the tension of spring 546. This prevents the unlatching action between latches 709 and 710. When however, the diaphragm piston 708 is actuated to rock arm 536 the rod 537 is moved against the tension of spring 538 to withdraw collar 540 from the upper end of lever 543, to permit the actuation of spring 546 of said latch member 544 to permit the withdrawal of latch 709 from latch 710. This permits the descent of arm 545 which carries the drop roller of feeder No. 3. A full description of the construction and operation of this latching mechanism and drop roller control is described in detail in patent to me No. 768,375, dated Aug. 23, 1904; latch member 544 being the same as latch member 47 of said patent. Thus it will be seen that as a sheet passes between the folding rollers 182 and 192, from feeder No. 2, the drop roller of feeder No. 3 is actuated to permit the delivery of a sheet therefrom, properly timed with respect to said sheet from No. 2. The same may be said with respect to any other two adjacent folding and feeding devices from 1 to 5, with the exception of feeder No. 1.

Referring to Figs. 82 and 83, I show in Fig. 82 a pipe 534 leading from the valve 526 to the diaphragm head 527. I also show another pipe 711 connected between pipe 534 and pipe 712. Pipe 712 is a supply pipe common to the heads 528 of feeder No. 1 and 527 of feeders 2, 3, 4 and 5. Said pipe 712 is connected through pipe 715 to a source of supply controlled by a compound valve hereinafter described. In Fig. 83, I show the single pipe 713 connected between 712 and the head 528, which is the only connection with head 528 of feeder No. 1. This is because the feeder No. 1, being the first feeder, has no preceding folder to control it, and therefore the pipe 534 from valve 526 is eliminated; there being simply a hand valve 714 inserted between pipe 712 and pipe 713.

Referring to Figs. 82, 89, 90 and 91, I provide the rock arm 548, pivoted to the bracket 550, and connected at its lower end with the connecting rod 547, which rod is connected with the collar 542 on rod 537. The upper end of the rock arm is connected with the rod 549, which has a hook at its other end, see Fig. 82, for manual operation. By drawing this rod toward the operator the rod 537 is moved to carry the collar 540 away from the member 543 against the tension of spring 538. This affords arbitrary means for accomplishing what the pneumatically operated piston 708 would normally do.

Control of No. 6 feeder.—Referring to Figs. Nos. 94 and 95, I show a head 529 having a diaphragm, and a diaphragm piston 716 operated by compressed air passing through pipe 535 and controlled by the valve 530, see Fig. 80, and operated by the sheet from the No. 5 feeder, in exactly the same way as above described. The piston 716 however, instead of actuating a lever as above described, is adapted to actuate the pins 553 in gear wheel 554. These pins are actuated exactly in the manner described in connection with the pins in wheel shown in Fig. 73, and need no further description here; the pin pusher 552 and the returning cam 559, being identical with the structure shown in said Fig. 73. The gear pin wheel, or sometimes called the time wheel, rotates on the tie rod 557 and is driven by the pinion 555 on shaft 556, see Fig. 94. The tie rod 557 is the equivalent of the tie rod 233 shown in Fig. 13 of my Patent No. 768,375; Aug. 23, 1904. The shaft 556 is the equivalent of shaft 81 in Fig. 13 in my said former patent, and also shown in Fig. 35 of said former patent. Fig. 13 shows so clearly the relative positions of this shaft and tie rod, that a further description of these would seem unnecessary. The lever 560 is pivoted at 561 and has an upward extension 562 connected with the rod 563, which is controlled by the spring 570 operating between the collar 569, adjustably secured to said rod and the fixed bracket 571. The collar 568 also is mounted on rod 563 and is adapted to abut against the upper end of 564, which is keyed to the lever 566 in the manner and for the purpose clearly described. It will thus be seen that when the sheet passes through the first folding rollers of feeder No. 5, it will actuate the trip lever 525 to open the valve 530, similar to the valve 526 of the other feeders, to permit the actuation of piston 716, causing the operation of the pin pusher 552 to push the pin 553 into the position shown in Fig. 95; this being the lower pin of the wheel. By the

rotation of the wheel from the lower position to the position in which this actuated pin 553 encounters the lever 560, see Fig. 94, the lever is actuated at the proper moment to cause or permit the disengagement of the latching members 566 and 567. The arbitrary actuation of these members is also secured by the manual operation of the rod 563 as already described with respect to rod 549 in the other feeders.

The control of feeder No. 7 by feeder No. 6.—It is to be noted that the sheet fed by feeder No. 6 operates the controlling mechanism for feeder No. 7, in a slightly different way from that heretofore described. That is to say, that as the sheet is fed over the folding rollers 206 and 216 toward the stop 717, see Fig. 92, it encounters the finger 581, see Fig. 97, of the valve trip of valve 580 to cause the actuation of the valve piston in substantially the same manner as described with respect to the other valves 526 and 530. This valve controls the flow of air from pipe 582 to and through pipes 579 and 576, to head 574 of feeder No. 7, see Fig. 80. This head contains a diaphragm piston operating a rock lever which normally controls the actuation of the latch arms 544 and 545 substantially as described in connection with feeder No. 6, or similar to the structure illustrated in Fig. 108.

Control of feeder No. 7 by folder No. 5.—In case the requirements of the periodical operated on, do not need the No. 6 feeder and folder, these mechanisms may be cut out of the operating parts of the machine, in which case it is necessary to shift the control of No. 7 feeder from No. 6 to the No. 5 folder, for which purpose I provide the following mechanism.

Referring to Fig. 80, the hand cock 577 is shown closed and cock 578 open, being the position in which No. 7 is controlled by No. 6. To cut out No. 6, we open cock 577 and close cock 578. This connects pipe 576 of head 574 with pipe 576 of valve 573, and cuts out the valve 580 which is controlled by folder No. 6. The pin 553 of time wheel on feeder No. 6 which is actuated by the valve 530 of folder No. 5, upon the further travel of said time wheel past lever 560 encounters lever 572 as shown in Fig. 94. This lever 572 is pivoted at 718 and operates the piston of air valve 573 to permit the flow of air from pipe 575 to and through pipe 576 to head 574 to actuate the latch controlling mechanism as already described, see Fig. 80.

Control of feeder No. 8 by feeder No. 7.—Referring to Figs. 102, 103 and 104, I show in elevation a portion of the feeding mechanism of feeder No. 7, being positioned and arranged relatively, with respect to its associated mechanisms, substantially as shown in Figs. 2 and 4, of my said former Patent No. 768,375, looking at the same in the opposite direction. The drop roller 719 is actuated in substantially the same way as shown and described in my said former patent, to coöperate with its feed roller 720, see Fig. 102. Secured to the rock-shaft 583 which actuates the drop roller 719, is the arm 584 at the lower end of which, is a sector gear coöperating with the gear 585 on shaft 586. Connected with gear 585 is the arm 587; the upper end of which is adapted to engage the pin 588 on the spider 589. The spider 589 is mounted on shaft 590 provided with worm gear 591 actuated by the worm 592 on shaft 593 being one of the shafts of the No. 7 feeder, being substantially the same as shaft 77 in Fig. 5 of my said prior patent. With the rocking movement of shaft 583 it will be seen that the lever 587 is moved to engage pin 588 when the arm of the spider comes in alinement therewith: it being understood of course that the drop roller arm and shaft 583 will not be permitted to rock unless the machine is tripped by the preceding folder or feeder as above described. It may also be noted here, that this drop roller of feeder No. 7 is always actuated if properly tripped, whether it is feeding sheets or not, when the pin 588 is pushed forward. It will also be understood that where a sheet is being fed by the combing wheel the drop roller will not work until the sheet is squared up in proper position as fully described in my said former patent. Where, however, no sheets are being fed, the combing wheel is maintained elevated, and the drop roller will be free to operate, if properly tripped by the preceding feeding or folding mechanism. When the pin 588 is pushed forward as shown in Fig. 102, it is adapted to encounter lever 594 which controls the flow of air from pipe 598 to and through pipe 597 to head 596 to permit the operation of the latching mechanism of feeder No. 8, as shown in Fig. 108, through lever 599, rod 600 and arm 543, as already described. A detail of the pin 588 is shown in Fig. 107, and a detail of 595 is shown in Fig. 106.

The control of the stitching mechanism by the No. 8 feeder.—Referring to Figs. 25, 88, 93 and 113, I provide the following pneumatically operated mechanism controlled directly by the sheet as the same is delivered from feeder No. 8. The pipe 721 is connected with a suitable source of air pressure supply. This pipe is connected with the body 722 which is suitably supported by the stationary framework. This pipe 721 communicates with the channel 723 through the reduced opening 724, see Fig. 113. Channel 723 communicates with the first inclined and then horizontally extending tube 725. Tube

725 has provided in the lower side of its horizontal extension the slot 726. This lower end of tube 725 is so positioned as to lie upon the sheet which is being fed by said feeder No. 8, so that when the sheet passes beneath the horizontal portion of pipe 725, and over the guide member 727, which is U-shape in cross section as shown in Fig. 93, the sheet is held firmly against the underside of said horizontal portion of pipe 725 so as to close the opening through slot 726. Connected also with channel 723 in member 722 is the pipe 607 which leads to the head 606 containing a pneumatically operated diaphragm, see Figs. 88 and 99; which diaphragm operates a piston upon which is secured the pin pusher 608, normally controlled by spring 609, which is adapted to operate pins 610 on spider 611 mounted on shaft 612. Shaft 612 is provided with gear 613 driven by worm 614 on shaft 615, being the corresponding shaft of feeder No. 8, to the shaft 593 of feeder No. 7. Referring again to Fig. 113, it is to be noted that the opening 724 is very much smaller than the opening 726, so that when opening 726 is unobstructed the pressure which would normally be communicated to 723 and 607 is relieved by the opening 726. When, however, a sheet passes beneath the horizontal tube 725 and closes the opening 726 a pressure is then created in 723 which is communicated through 607 to the diaphragm in head 606 to operate the pin pusher 608 to move the pin 610 to the right as shown in Fig. 88, or to the left in Fig. 99, so as to encounter the levers 616 and 617 as the spider 611 rotates in the clockwise direction in Fig. 100. The engagement of lever 616 by the pin 610 actuates the piston of valve 618 for the purpose hereinafter described. The engagement of the pin 610 with lever 617 operates valve 619 for the purpose hereinafter described.

Under the title "Stitcher driving mechanism" we describe the normal actuation of the stitchers or the mechanism for normally actuating the stitchers, as though there were no locking devices to prevent such actuation. There is however provided a catch 626, see Figs. 109, 110, 111 and 112, which holds the pawl 288 out of operative engagement with the wheel 289, unless said catch is withdrawn by the pneumatically operated piston in head 620, due to the tripping of valve 618 as hereinabove described, that is to say, the valve 618 controls the flow of air from pipe 624 to and through pipe 622 to the diaphragm in head 620. It will thus be seen that only by the travel of a sheet, at the proper time, from feeder No. 8, beneath pipe 725, to cause the actuation of the piston in head 606, to operate pin pusher 608 as above described, to operate lever 616, to operate the piston in valve 618, will the first pair of stitchers designated by No. 430 in Fig. 2, and the operating mechanism of which is shown in Figs. 109 to 112 inclusive, be permitted to operate. In a similar way, by the actuation of lever 617, the piston in valve 619 is operated to actuate the catch 626 to release the pawl to permit the actuation of the pair of stitchers No. 2 indicated in Fig. 2 by the numeral 431.

Construction and actuation of catch mechanism.—Referring to Figs. 109 to 112 inclusive, the catch which normally maintains the pawl 288 out of the operative position is indicated by 626 pivotally mounted at 728 and controlled by the spring 627 against the actuation of the piston in head 620 operating against the upper extension of said catch member 626. This catch member has a hook at its lower end which is adapted normally in response to spring actuation to catch under the roller 296 of a pawl member 288 to prevent the same from falling into the recess of wheel 289. The hook end of this catch is indicated by dotted lines in Fig. 111, and has its roller engaging surface of considerable extent corresponding to the periphery of the wheel 289 so that when in engagement with said roller 296 the pawl may be rocked backward and forward without falling into the recess in wheel 289. When, however, the piston in head 620 is operated in the manner above described, the catch is withdrawn and the operation of pawl 288 and ratchet wheel 289 proceeds in the manner already described.

It will be understood that the actuating mechanism of the pair of stitchers No. 2 is substantially the same as the actuating mechanism of the pair of stitchers No. 1 as above described, in connection with the Figs. 109 to 112 inclusive.

Compound air valve.—Referring to Fig. 77, the compound air valve for controlling the flow of air from the main source of supply to the various pneumatic devices is shown at 729. This compound valve is connected with the air reservoir 186 through the pipe 730.

Referring to Figs. 114 to 121 inclusive, this compound valve comprises a casing 729 to which is connected the supply pipe 730, the exhaust pipe 731 and the three conducting pipes 715, 732 and 733. Within the casing is mounted on the shaft 629 the valve 630. Said valve is mounted loosely on the shaft 629 which is operated by the arm 631, which is keyed to said shaft 629 and engages between lugs on valve member 630. This leaves valve member 630 free to seat itself in response to the actuation of spring 632 and also the air pressure exerted thereon. This valve is adapted to cover the four openings or ports communicating respectively

with 731, 732, 715 and 733, and is adapted to assume four different positions with respect to these several ports as shown in Figs. 115 to 118 inclusive. In Fig. 118 the valve member is shown as covering all four ports which closes the same against the supply pipe 730. In this position the conducting pipes 715, 732 and 733 are all open to the atmosphere through pipe 731, so as to relieve the several pneumatic devices communicated with said pipes 715, 732 and 733, of any air pressure. In Fig. 117 the valve is shown in the position leaving the port of pipe 733 communicating with the supply pipe 730. In Fig. 116 the valve is moved to the third position, opening pipes 732 and 733 to supply pipe 730; while Fig. 115 shows pipes 715, 732 and 733 open to the supply pipe 730. On shaft 629 is also secured the sector member 633, see Fig. 121, and also Fig. 77. This sector member is provided with four recesses adapted to receive the roller 634 of spring controlled arm 635. The position of the shaft shown in Fig. 121, is exactly corresponding to the position of valve member 630, shown in Fig. 118, that is, when the sector is in the position shown in Fig. 121 the valve 630 is in the position shown in Fig. 118, covering all the ports. The second position would indicate the sector with roller 634 in the next notch which corresponds to the position of the valve, in Fig. 117. The third position of the sector would show it with the roller in the next notch and corresponds to the position shown in Fig. 116, while the fourth and last position, would be with the sector moved so that the roller 634 would be in the last notch and would correspond to the position shown in Fig. 115. The two extremes of the arc part of sector member 633, are provided with curved extensions serving as inclines which operate upon the roller affected by spring 637, to serve as gradual or spring cushion stops to limit the movement of the shaft 629 in either direction.

The actuation of the shaft 629, for shifting the position of the valve 630, is accomplished in the following way. Shaft 629 is suitably mounted in the stationary framework, see Fig. 77, and provided at one end with the handle 628 and at the other end with a beveled gear meshing or coöperating with the beveled gear on shaft 734. This shaft 734 is provided with a number of handles 628, and a number of beveled gears coöperating with beveled gears on transversely extending shafts 735, also provided with handles 628. These of course may be multiplied indefinitely and extended to any points desired for the convenience of the operator.

Pipe 733 leads to thead 736, see Figs. 77, 78 and 79, containing a diaphragm operating a piston for the actuation of lever 737. This lever is provided with a projection about midway its extension which operates the push button 738, in response to the actuation of spring 739. When this push button 738 is depressed as just described, the motor 159 as shown in Fig. 2, is cut out of circuit. When the arm 737 is actuated in the opposite direction to such spring actuation, by the diaphragm and piston in pneumatic head 736, the push button 738 assumes a position in which the motor can be brought into the rheostat controlled circuit. Thus it will be seen that the motor cannot be made to operate, until the valve member has assumed the second position to open communication between air supply and pipe 733 as shown in Fig. 117.

The pipe 732 leads to valves 526 of folders Nos. 1, 2, 3, and 4, and 530 of folder No. 5, see Fig. 77, and valve 573 of feeder No. 6, valve 580 of folder No. 6, and valve 595 of feeder No. 7, see Fig. 80, and valves 618 and 619 of feeder No. 8 see Fig. 100.

Pipe 715 leads through pipe 712, to the diaphragm head of the leading feeder which may be 528 of feeder No. 1 or 527 of feeder Nos. 2, 3, 4 or 5, as the case may be, whichever feeder may be the leader.

The source of supply above referred to consists in reservoir or tank 186 to which is connected the blower 180 which is operated by the motor 179, to maintain a substantially uniform required pressure of air in said reservoir; said pressure being controlled by the regulator valve 740, see Fig. 77.

Operation.—By the compound valve and the leads and mechanisms connected therewith, as above described, the machine will operate as follows: When the valve is in the position shown in Fig. 118, pipes 715, 732 and 733 are all shut off from the source of supply, and the machine is brought to a standstill. Before starting the machine the valve is moved to the position shown in Fig. 117. This throws the motor 159 into the rheostat circuit so that it may be strated in the usual way by cutting out the resistance. In the position shown in Fig. 117 the machine may be run without feeding sheets. When the trip of any feeder is operated manually, the sheet from that feeder will be delivered alone and will be delivered into the basket for incomplete copies. This is the position used when setting individual sheets to register.

When the valve is moved to the position shown in Fig. 116, the machine will be run without feeding sheets. When in this position the leading feeder may be manually tripped, thereby getting one or more complete copies and delivering onto the delivery belts, stitched and counted. When the valve is moved into the position shown in Fig. 115 the machine is in full operation, but if any feeder should miss the succeeding

feeders will not feed and the incomplete copy will be delivered into the basket, not stitched or counted.

What I claim is:—

1. In combination with a plurality of folding devices arranged in alinement and adapted to deliver folded sheets in sequence directly into a common path of travel, a plurality of sheet feeders delivering to the folding devices, said feeders arranged in a row side by side all feeding in the same direction and in sequence, and means whereby the passage of a sheet from one feeder controls the passage of a sheet from another feeder.

2. In combination with a plurality of folders adapted to deliver folded sheets directly into a common pile, a plurality of sheet feeders delivering to the folders simultaneously and in sequence, said feeders arranged in a row side by side, and means whereby the passage of a sheet from one folder controls the operation of a feeder.

3. In combination with feeding and folding means, means for carrying away, or delivering complete numbers, comprising a delivering drum operatively connected with the feeding and folding mechanism, gripper elements operatively connected with the delivering drum, a switch for diverting imperfect numbers adjacent said drum, and mechanism connected with the operating parts of the machine for controlling the switch.

4. In combination with a plurality of folding devices having one element of each folding device on a continuous shaft, a plurality of feeding devices arranged in line, and delivering in parallel for delivering a plurality of sheets to the folding machine simultaneously, said sheets upon their passage from the folding devices, adapted to be delivered into a comon path of travel.

5. In combination with folding devices comprising a plurality of pairs of folding rollers arranged end to end in line, one of each pair of rollers mounted on a continuous shaft, a plurality of adjacent feeding devices arranged in line and delivering in parallel for delivering a plurality of sheets thereto simultaneously, and means between adjacent devices for controlling the delivery of sheets from the feeding to the folding devices.

6. In a sheet feeding and folding machine the combination of a plurality of pneumatically operated latching devices for controlling the operation of said feeding and folding machine, and a manually operated compound valve for the arbitrary control of the pressure operating said latching devices.

7. In combination with a folding machine, comprising a plurality of pneumatically operated latches, a compound valve and leads therefrom to the source of air pressure, and to the pneumatic latches, whereby the several operative parts of a machine may be arbitrarily controlled.

8. In combination with a feeding and folding machine, comprising a plurality of pneumatically operated latches, a compound air valve for controlling said pneumatically operated latches, whereby the feeding mechanism may be controlled independently of the folding mechanism.

9. In a folding and feeding machine, the combination of a plurality of feeding devices, arranged in a straight line, and adapted to deliver sheets in parallel, one feeder delivering sheets into the line of travel of sheets from another feeder, and one feed roller of each of several feeding devices being mounted on a continuous shaft.

10. In a folding machine, the combination of a plurality of folding devices and a plurality of feeding devices adapted to deliver sheets thereto, simultaneously and in parallel, said feeding devices having their feeder rollers arranged in line and said several folding devices having their first pair of folding rollers in substantial alinement, parallel with the feeder rollers, and the second pair in parallel beneath the first pair.

11. In a folding machine, the combination of a plurality of sheet feeding devices adapted to deliver sheets in parallel, said feeding devices having their feeder rollers arranged in line upon a continuous shaft, folding devices arranged in a straight line, adapted to receive said sheets and operate upon the same to fold them first between folding rollers parallel with the feeder rollers and then between rollers at right angles thereto and beneath said first mentioned rollers.

12. In a folding machine, means for assembling and moving a pile of sheets, comprising a set of feeding devices arranged in line side by side, having their feeder rollers connected with and operated by a continuous shaft, and adapted to feed sheets simultaneously and in parallel, one feeder delivering sheets into the path of travel of sheets from another feeder, and a set of folding mechanisms for operating on said sheets, so timed and operated as to assemble the several sheets and fold them together in the desired order.

13. In a folding machine, means for assembling and moving a pile of sheets, said pile stepped off, the upper sheet in advance of the under sheet, coöperating drums for receiving said pile and stops having operative relationship with the drum elements for heading up said pile.

14. In a folding machine, means for assembling and moving a pile of sheets, said pile stepped off, the upper sheet in advance of the under sheet, coöperating drums for receiving said pile and stops having operative relationship with the drum elements, and cam actuated for heading up said pile.

15. In a sheet folding machine, the combination of coöperating drum elements for operating upon a pile of sheets delivered thereto, a stop having operative relationship with a drum element for heading up the sheets, a spring, for controlling said stop, so connected with respect to the center movement of the stop as to assume an approximately neutral position when the pile of sheets is about to pass beyond the control of the stop.

16. In a sheet folding machine, the combination of coöperating drums adapted to operate on a pile of sheets, a pivotally mounted stop for heading up the pile of sheets, and a spring for controlling same, said stop having a double joint to permit the arbitrary back movement of same.

17. In combination with a sheet folding machine, means for advancing the sheets in stepped relationship, coöperating drum elements adapted to operate upon the sheets, a pivotally mounted spring controlled stop for heading up the sheets before being operated upon by the drum elements, and mechanism for deflecting the stop into the inoperative position at the required moment.

18. In a sheet folding machine, the combination of carrying tapes, a jogger mechanism, the jogger having a movement parallel with the movement of the carrying tapes, and nipper elements, and means for intermittently moving said nipper elements step by step.

19. In a sheet folding machine, the combination of carrying tapes, a jogger mechanism, and nipper elements, and means for intermittently moving said nipper elements step by step, means for opening and closing the nipper elements at proper intervals, a combing wheel, a presser foot, and means for controlling their relative actuation.

20. The combination of a combing wheel, means for positively raising and lowering the same, and a spring controlled tension wheel adapted to engage the underside of the sheet for coöperating with the combing wheel.

21. In combination with a sheet feeding and folding machine, a combing wheel, a stop, and a jogger adapted to be moved toward and away from the stop, and means for actuating the combing wheel and the jogger relatively.

22. In combination with a sheet folding machine having carrying tapes, nippers operating between and in the plane of the carrying tapes for engaging the pile of sheets, and means for intermittently moving said nippers from one position to another.

23. In combination with sheet feeding and folding means, carrying tapes and nipper means operating in the plane of the tapes for moving the sheets from one position to another, and longitudinally extending flat stationary strips or boards, flanking the nipper means, for supporting said sheets during said movement.

24. In combination with a sheet folding machine, means for moving the sheets containing printed matter from one position to another, longitudinally extending stationary strips, flanking said moving means, for supporting said sheets while being moved, having a frictional engagement therewith, and a covering for said strips of mole cloth or similar material.

25. In combination with a sheet folding machine, means for moving the sheets, containing printed matter, from one position to another, stationary strips, flanking the moving means, for supporting said sheets as the same are moved, and a covering for said strips of a material which shall not mark or mar the freshly printed sheets.

26. In a sheet folding machine, the combination of intermittently movable nipper means engaging with the sheet for moving the same, means for causing the nipper to disengage therefrom, longitudinally extending stationary strips, flanking the nipper means, for supporting the sheets during their movement and also in the state of rest, a pair of folding rollers and a folding blade, operating between said strips, for striking the sheets upwardly from the strips into the rollers.

27. In combination with a folding machine having a series of folding rollers which are arranged in a perfectly straight line, one roller of each pair being coupled together forming practically a continuous shaft, a plurality of feeders arranged in a straight line so as to permit the feeders to be arranged close together and side by side, having feed rollers also coupled together in the same way, the folding machine also having a second series of folding rollers arranged parallel and also in line one in advance of the other.

28. In combination with a folding machine and eight feeders, means whereby the sheets passing through the first folding rollers of feeder No. 5 will control the operation of feeder No. 6 and whereby the sheet fed by feeder No. 6 operates the controlling mechanism for feeder No. 7 and means whereby, when feeder No. 6 is not in operation, the operation of sheets from feeder No. 5 will control feeder No. 7, and means whereby the movement of a sheet from feeder No. 7 will control feeder No. 8.

29. In a machine for feeding and folding sheets, the combination of a motor, a rheostat and circuit controller, pneumatic means for operating the controller, an air pressure supply, a compound valve connected therewith, leads from said compound valve, latches controlling the operations of the several feeding and folding devices, pressure

heads connected with the leads and controlling the latches, sheet controlled valves connected with said leads for controlling the pressure at the pressure heads, and means for operating the compound valve whereby the entire mechanism may be brought to a standstill or whereby the rheostat may be brought into circuit to start the motor and whereby the folding elements may be run without the feeding mechanism and whereby the entire mechanism may be put in full operation.

30. In combination with a sheet folding machine, employing pneumatically operated mechanisms, a pipe connected with a suitable source of air pressure supply, a channel connected with said pipe through a reduced or minute opening, a conductor leading from the channel to the pneumatically operated mechanism, and a downwardly and then horizontally extending tube connected with said channel, provided, at the lower side of its horizontal extension, with an elongated slot, whereby when the elongated slot is open no pressure will be developed in the channel to operate the pneumatic device.

31. In combination with a feeding and folding machine, employing a plurality of pneumatically operated devices, a compound valve, between said pneumatically operated devices and the source of air pressure supply, for controlling said various devices, a shaft for operating said valve, gearing and countershafts extending to different parts of the machine, with handles secured thereto, for enabling the operator to control the machine from any desired point.

32. In a folding machine, the combination of a series of folders delivering in sequence into a common path of travel for the folded sheets, means whereby succeeding folders of the series deposit folded sheets upon folded sheets from preceding folders of the series, means connected with a preceding folder for controlling the delivery of a sheet from a succeeding folder, means for preventing the delivery of a sheet from a folder, and means connected with another folder for effecting the control normally effected by the folder from which the delivery of the sheet is prevented.

33. In combination with a folding machine, a series of sheet feeders, pneumatically operated trip mechanisms, operated by the delivered sheets and adapted to control the delivery of sheets from succeeding feeders, independently of the pneumatically operated trip mechanisms for controlling the delivery of sheets from succeeding feeders of the series.

34. In combination with a folding machine, a series of folding devices, pneumatically operated trip mechanisms connected therewith, operated by advancing sheets and adapted to control the passage of sheets from succeeding folding devices, independently of the pneumatically operated trip mechanisms connected therewith.

35. In a feeding and folding machine, the combination of a plurality of folding devices adapted to deliver in sequence, said folding devices adapted to fold separate sheets, means whereby the folded sheets from the different folding devices are delivered, one after another, directly into a common moving pile, and a feeding device for feeding a sheet to the pile.

36. In a feeding and folding machine, the combination of a plurality of folding devices adapted to deliver in sequence, each folder adapted to fold a separate sheet, means whereby the folded sheets are delivered one after another in a single pile, and a feeding device controlled by the sheet from a folding device for feeding an unfolded sheet to the pile.

37. In a feeding and folding machine, the combination of a plurality of folding devices adapted to twice fold separate sheets, a folding device adapted to subject a separate sheet to a single fold, means whereby the folded sheets are deposited one after another in a pile, and a feeding device for feeding a sheet to the pile.

38. In a folding machine, means for carrying a pile of folded sheets, retaining tapes superimposing said carrying means, vertically adjustable supporting rollers therefor, and means, independent of the carrying means, for moving the sheets beneath the rollers.

39. In a sheet feeding and folding machine, the combination of a plurality of folding devices, a drum, means for delivering the folded sheets to the drum from one side, and feeding devices for delivering sheets to the drum from the other side.

40. In a sheet feeding and folding machine, the combination of a plurality of folding devices, a drum, means whereby the folded sheets from the different folding devices are deposited one after the other in a pile and delivered to the drum from one side, means for heading up the pile, and means for delivering a sheet to the pile from the other side of the drum.

41. In a sheet feeding and folding machine, the combination of a plurality of folding devices, a drum, means whereby the folded sheets from the different folding devices are deposited one after the other in a pile and delivered to the drum from one side, means for heading up the pile, feeding devices for delivering sheets to the pile from the other side of the drum, tapes between said feeding devices, and a bar parallel to one of said tapes.

42. In a sheet folding machine, the combination of a carrying tape, means for preventing the displacement of the sheets there-

on comprising a vertically movable pressure roller and a rod or bar extending above the sheets, and a jogger having operative relationship with the vertically movable pressure roller, for moving the sheets upon the carrying tape.

43. In a folding machine, the combination of a combing wheel, nipper elements for moving the pile of sheets, means for moving the nipper elements to a position adjacent the combing wheel, means for causing the nipper elements to release the pile and means for preventing the displacement of the pile during the combing operation.

44. In a folding machine, the combination of a combing wheel, a crank member connected therewith, a bracket connected with the crank member, a sleeve pivotally connected with the bracket, a presser foot member slidably mounted in the sleeve, and means for moving the crank to actuate the combing wheel and the presser foot.

45. In a folding machine, means for carrying a pile of sheets, a roller for preventing the displacement of the pile, means for withdrawing the roller from the pile, a jogger for operating upon the pile when the roller is in the withdrawn position, and lever mechanism operatively connected with the roller for moving the jogger.

46. In a feeding and folding machine, the combination of a set of folding devices for folding different sheets and a set of feeding devices associated therewith for simultaneously delivering sheets thereto in sequence, one series after another, the folded sheets of each series adapted to be delivered in a common pile from succeeding folders of the set upon the folded sheets from preceding folders of the set.

47. In a feeding and folding machine, the combination of a set of folding devices for folding different sheets and a set of feeding devices associated therewith for simultaneously delivering sheets thereto in sequence, one series after another, the folded sheets of each series adapted to be delivered in sequence, one upon another, in a common path of travel, and means whereby the passage of a sheet from one feeding device controls the passage of a sheet from another feeding device.

48. In a feeding and folding machine, the combination of a set of folding devices for folding different sheets and a set of feeding devices associated therewith for simultaneously delivering sheets thereto in sequence, one series after another, the folded sheets of each series adapted to be delivered directly, in order, in a common pile, and means whereby the passage of a sheet from one folding device controls the operation of a feeding device.

49. In a feeding and folding machine, the combination of a set of folding devices for folding different sheets and a set of feeding devices associated therewith for simultaneously delivering sheets thereto in sequence, one series after another, the folded sheets of each series adapted to be delivered in sequence directly into a single common path of travel.

HOWARD K. KING.

Witnesses:
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HOWARD S. OKIE.