No. 667,022. Patented Jan. 29, 1901.

H. K. KING.

SHEET REGISTERING MECHANISM FOR FOLDING MACHINES.

(Application filed Jan. 12, 1899.)

(No Model.) 7 Sheets—Sheet 1.

Fig. 1.

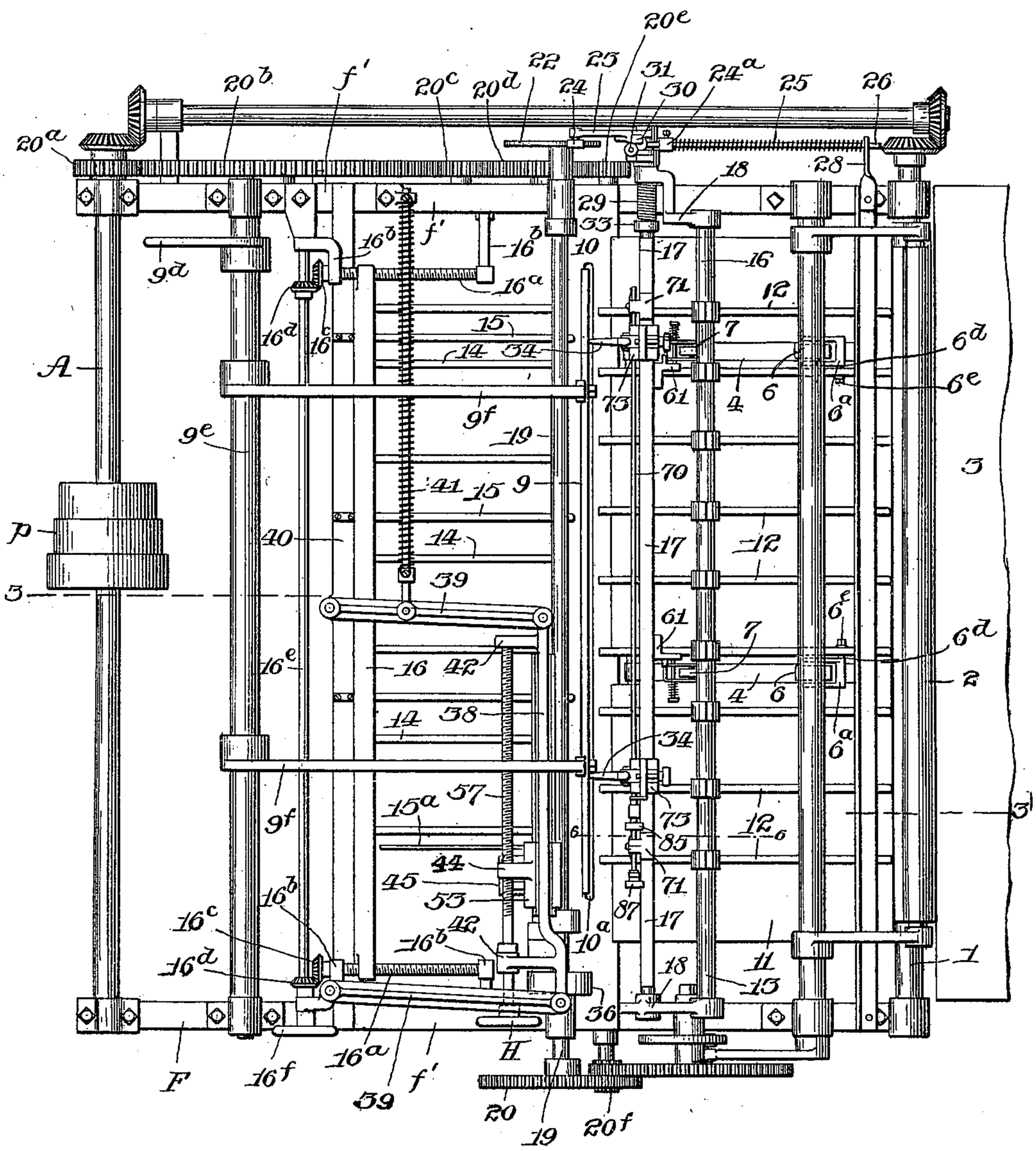

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Fig. 2.

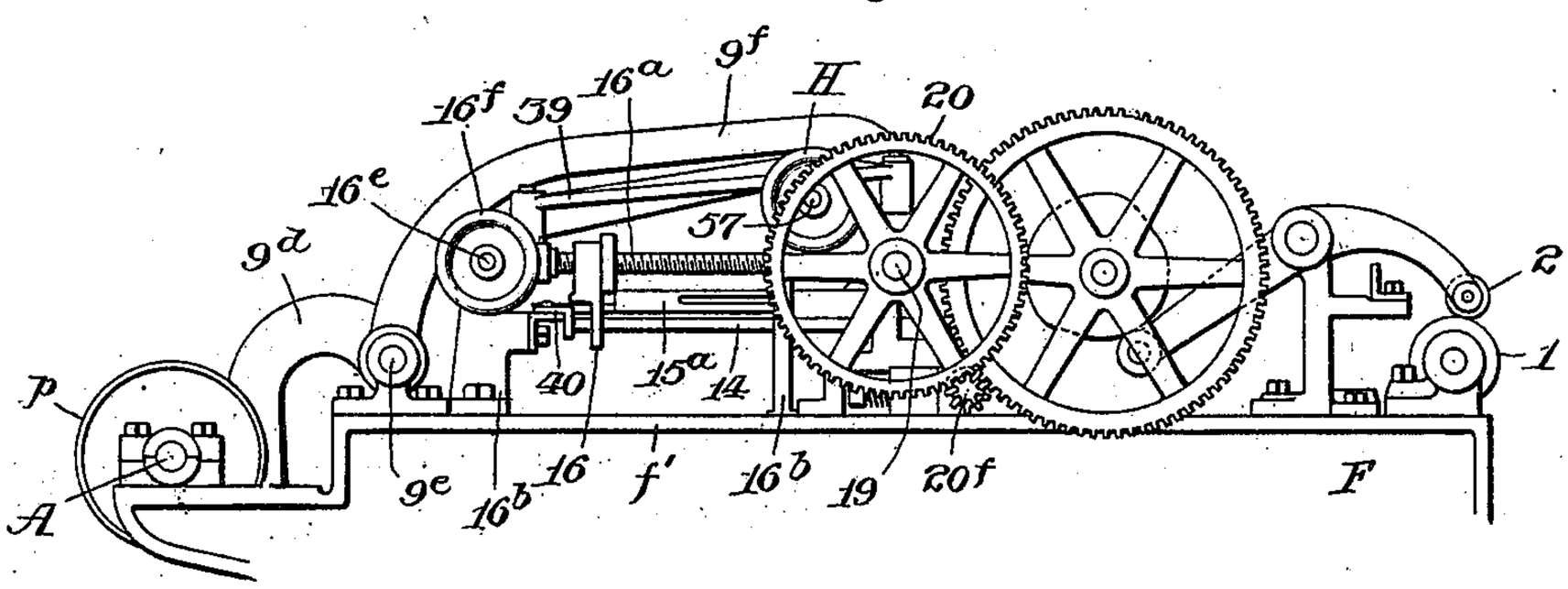


Fig. 3.

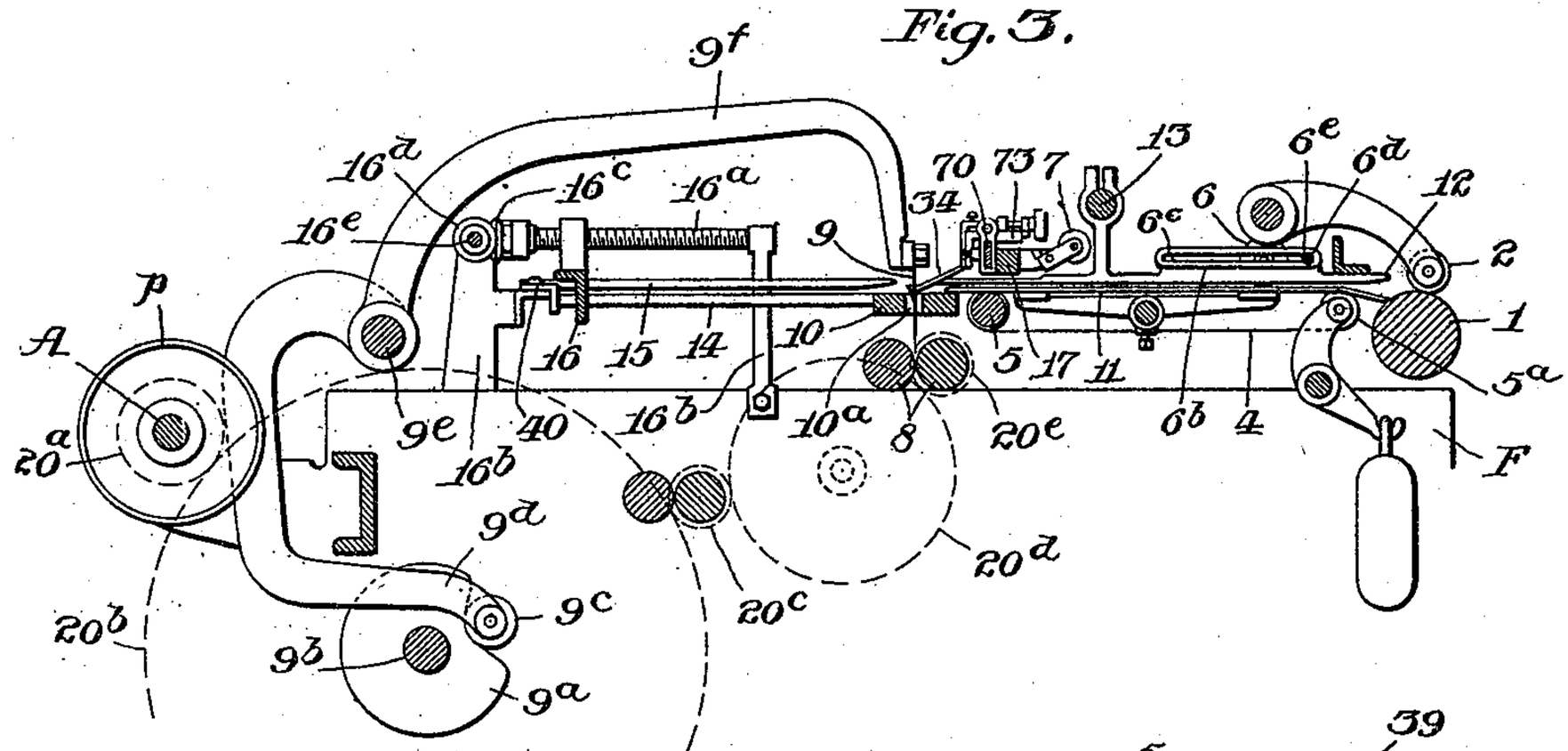


Fig. 4.

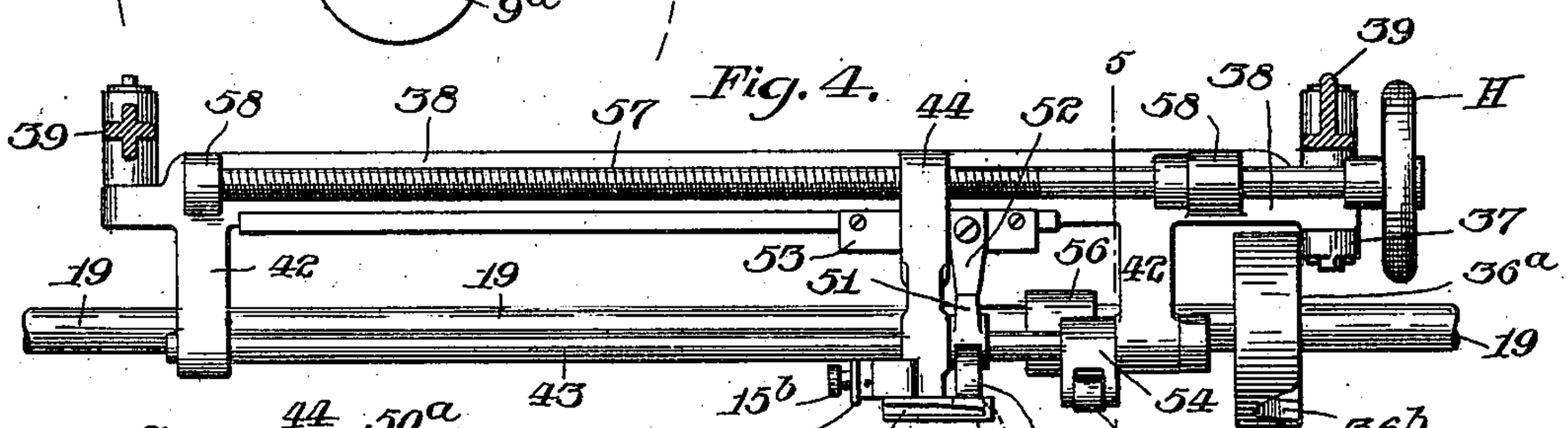


Fig. 5.a

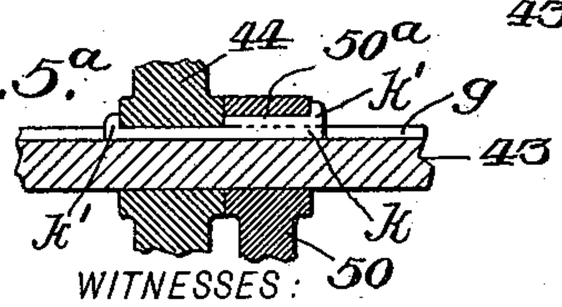
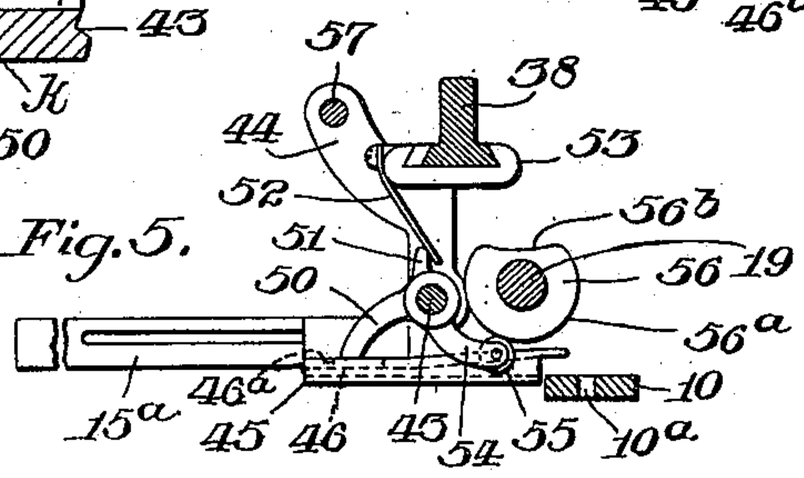


Fig. 5.



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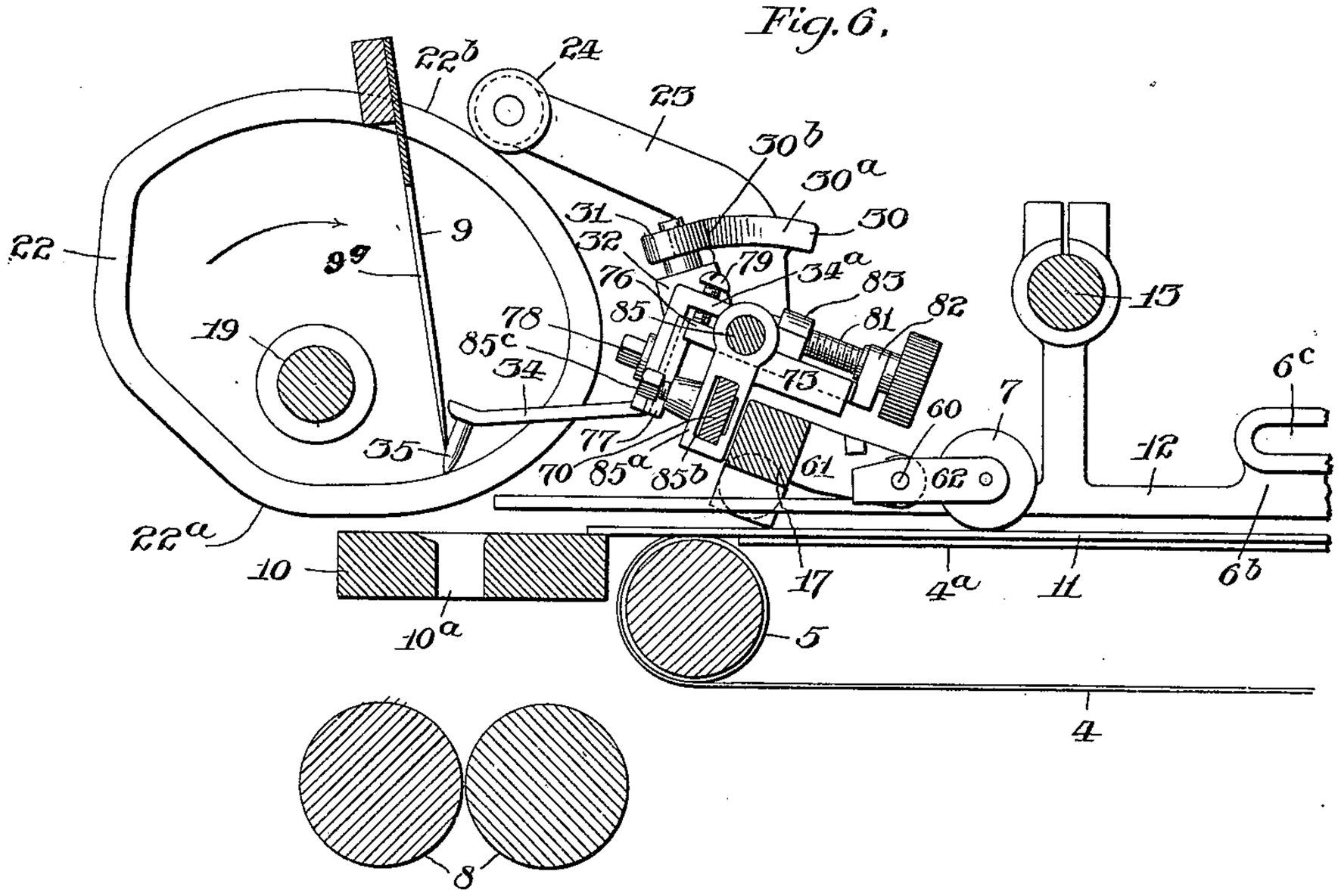
(No Model.) 7 Sheets—Sheet 3.

Fig. 6.



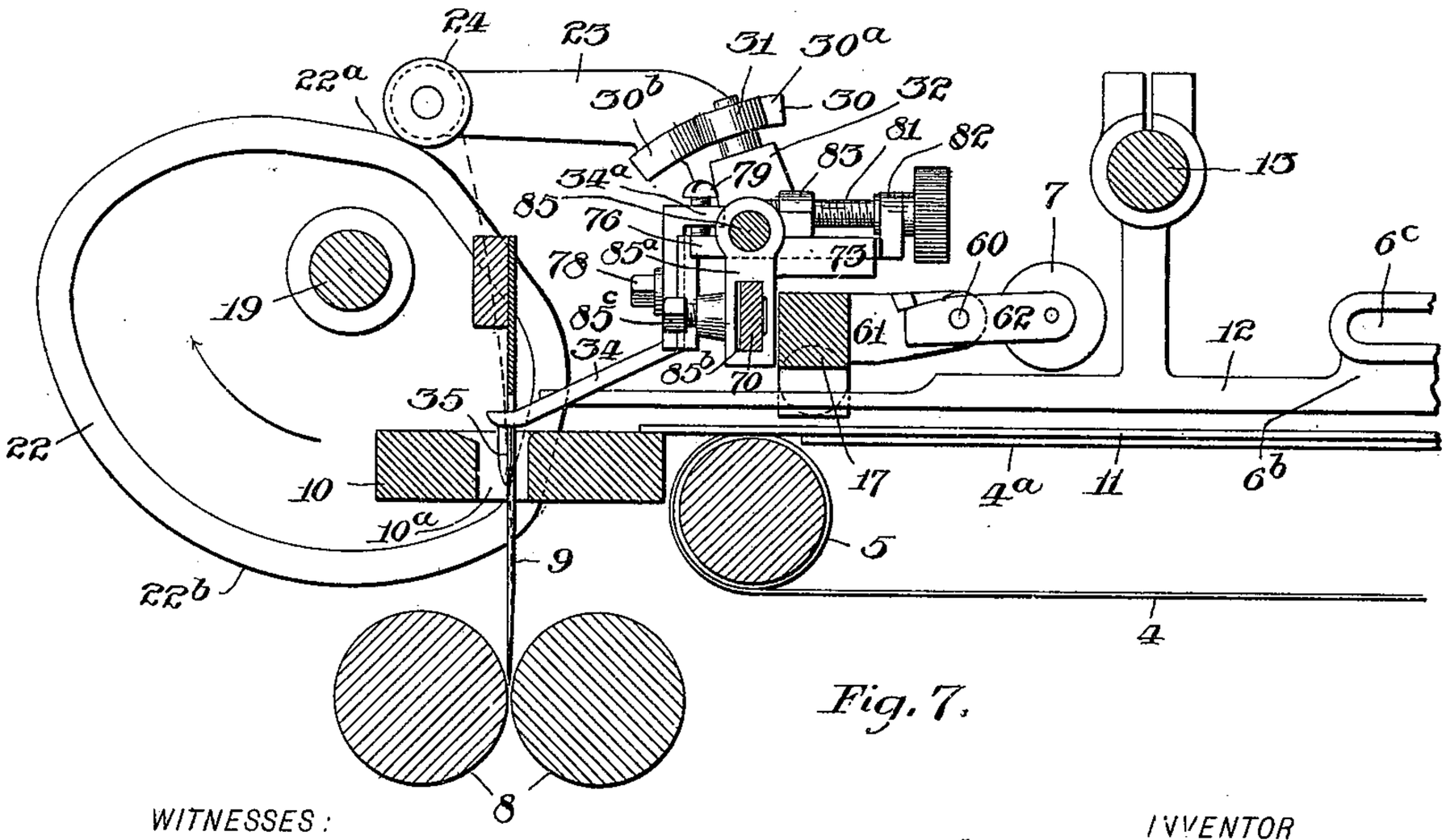


Fig. 7.

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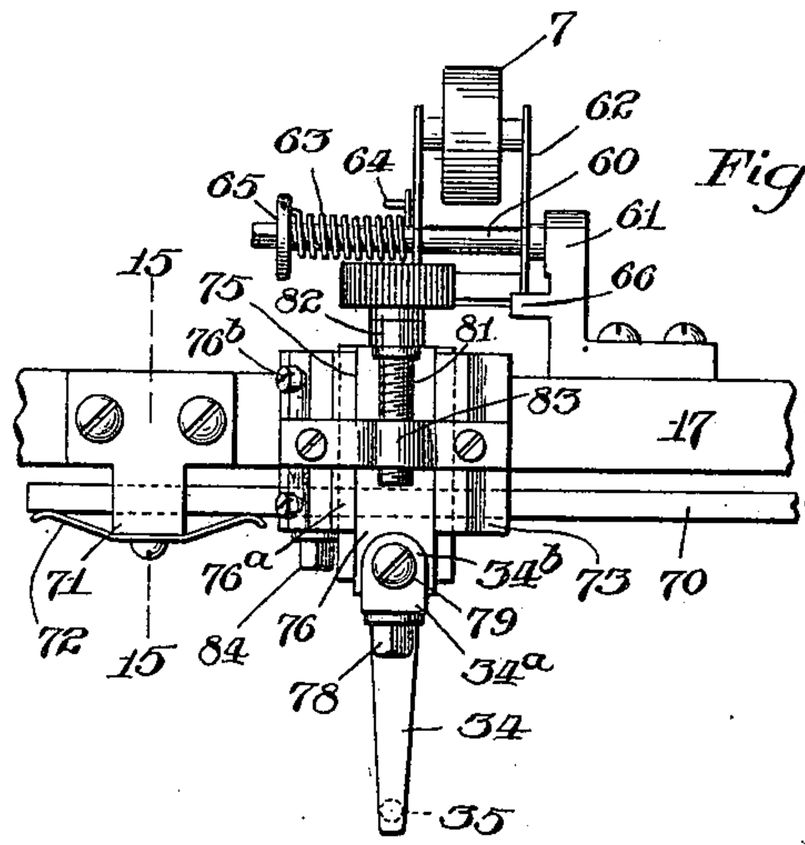
(No Model.) 7 Sheets—Sheet 4.

Fig. 8.



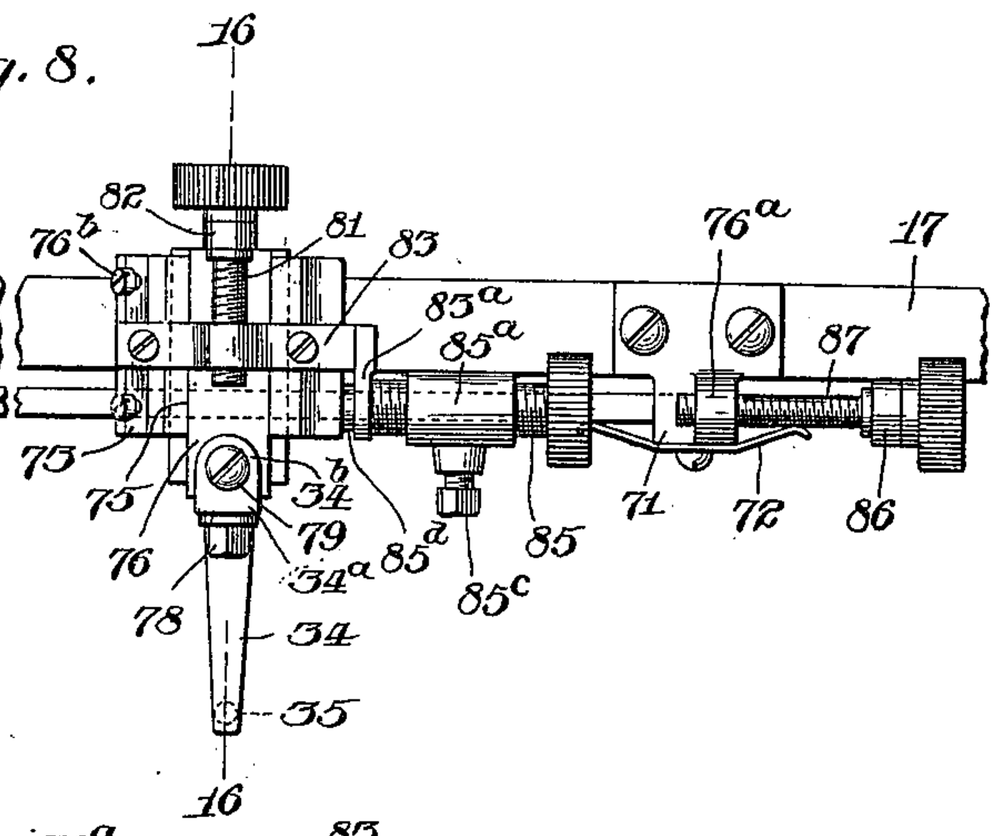
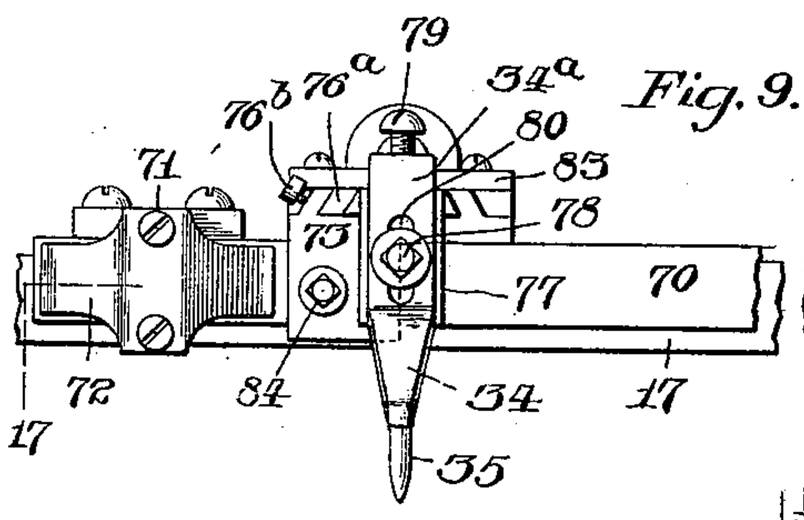


Fig. 9.



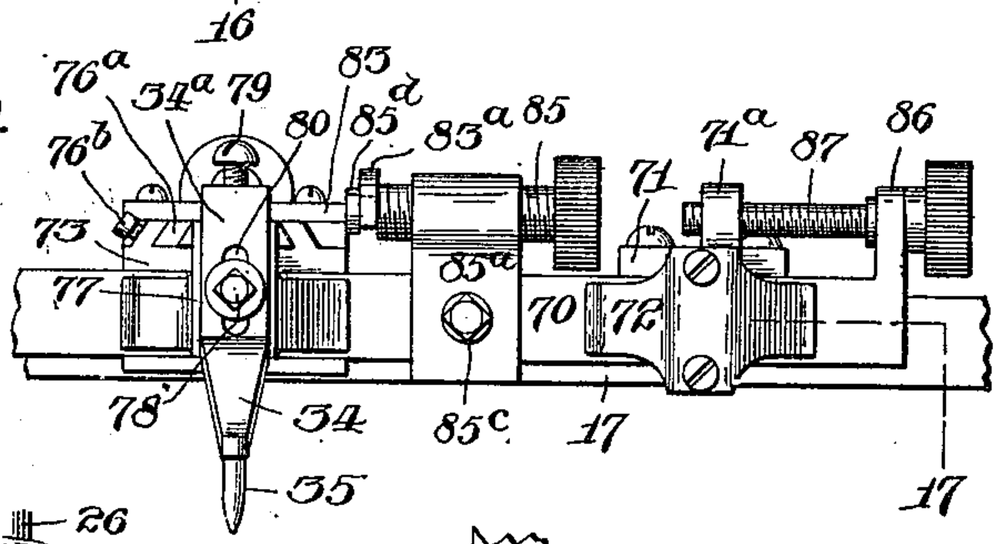


Fig. 11.

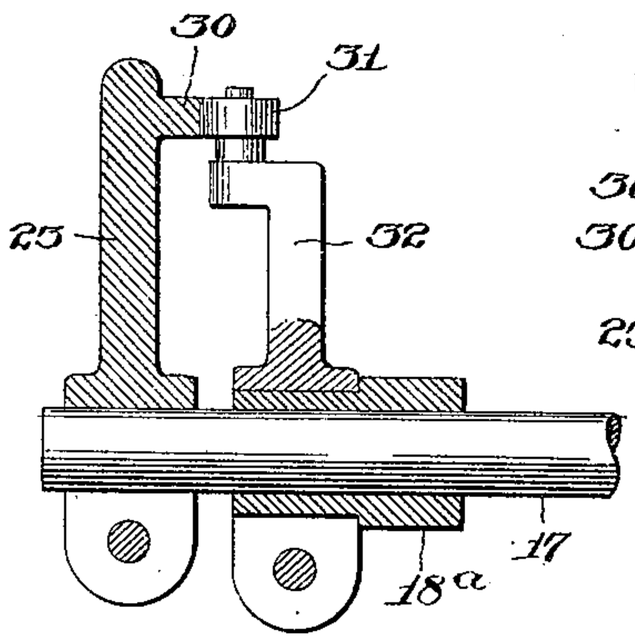
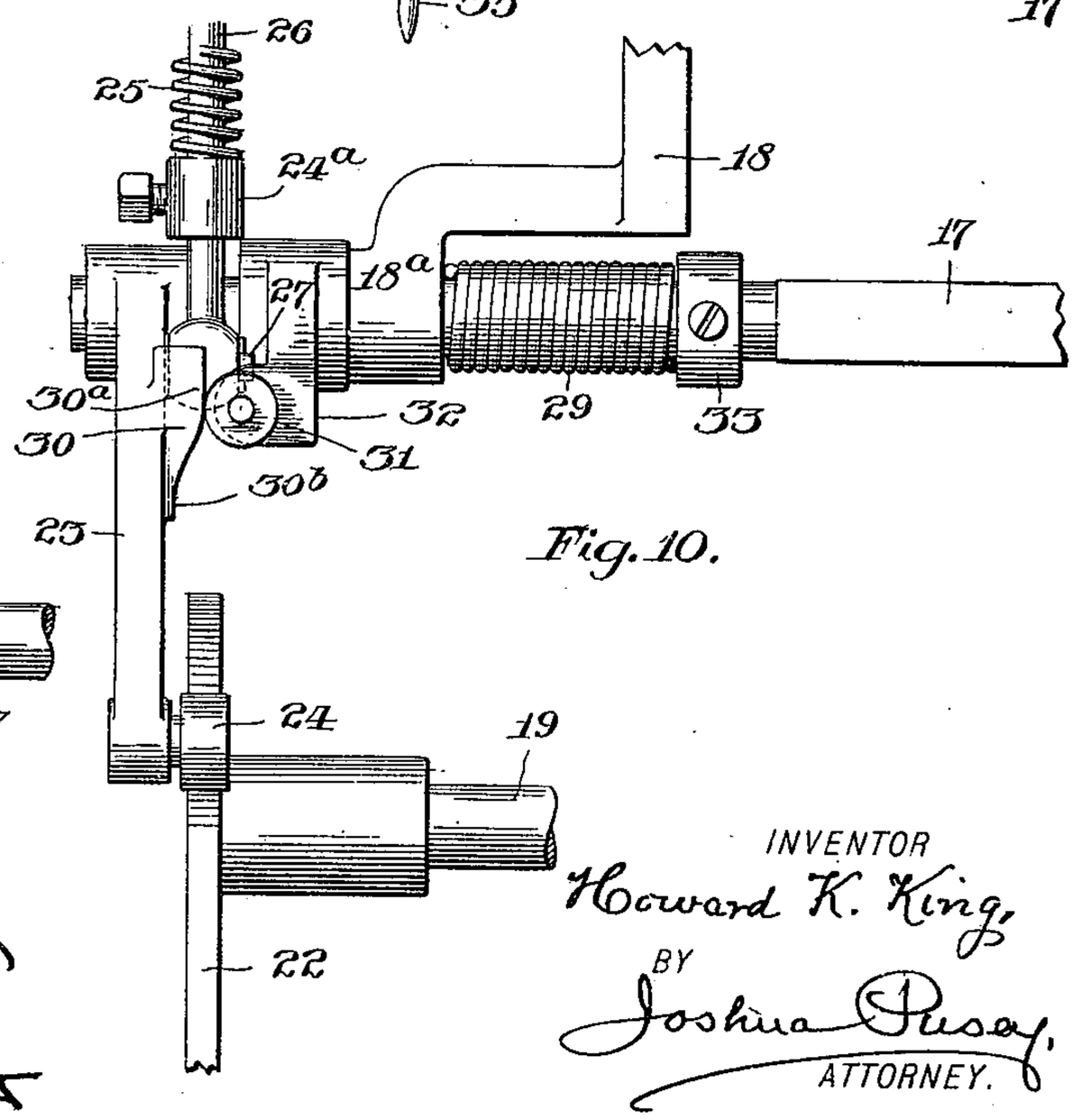


Fig. 10.



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(No Model.) 7 Sheets—Sheet 5.

Fig. 12.

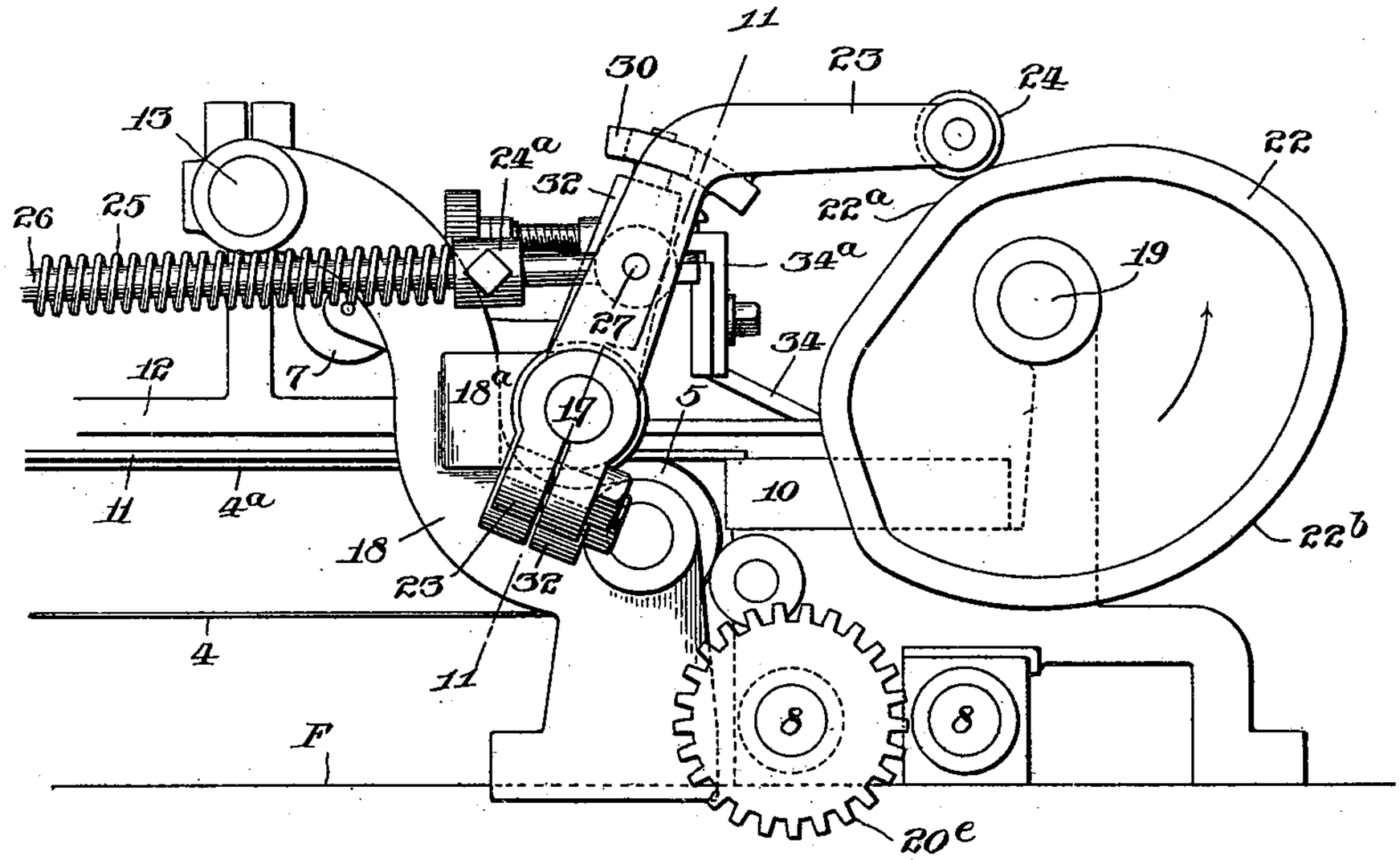
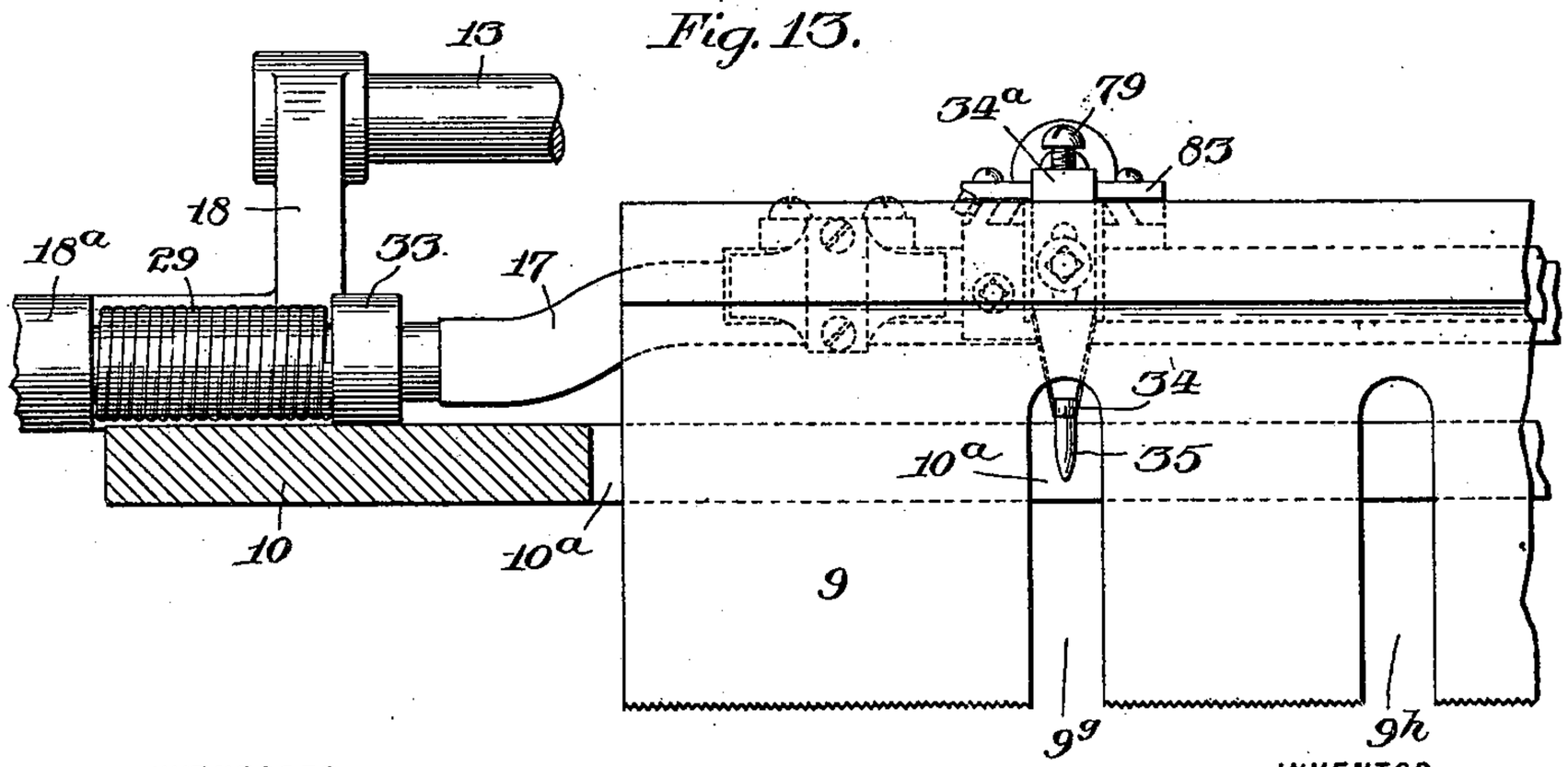


Fig. 13.



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(No Model.) 7 Sheets—Sheet 6.

Fig. 14.

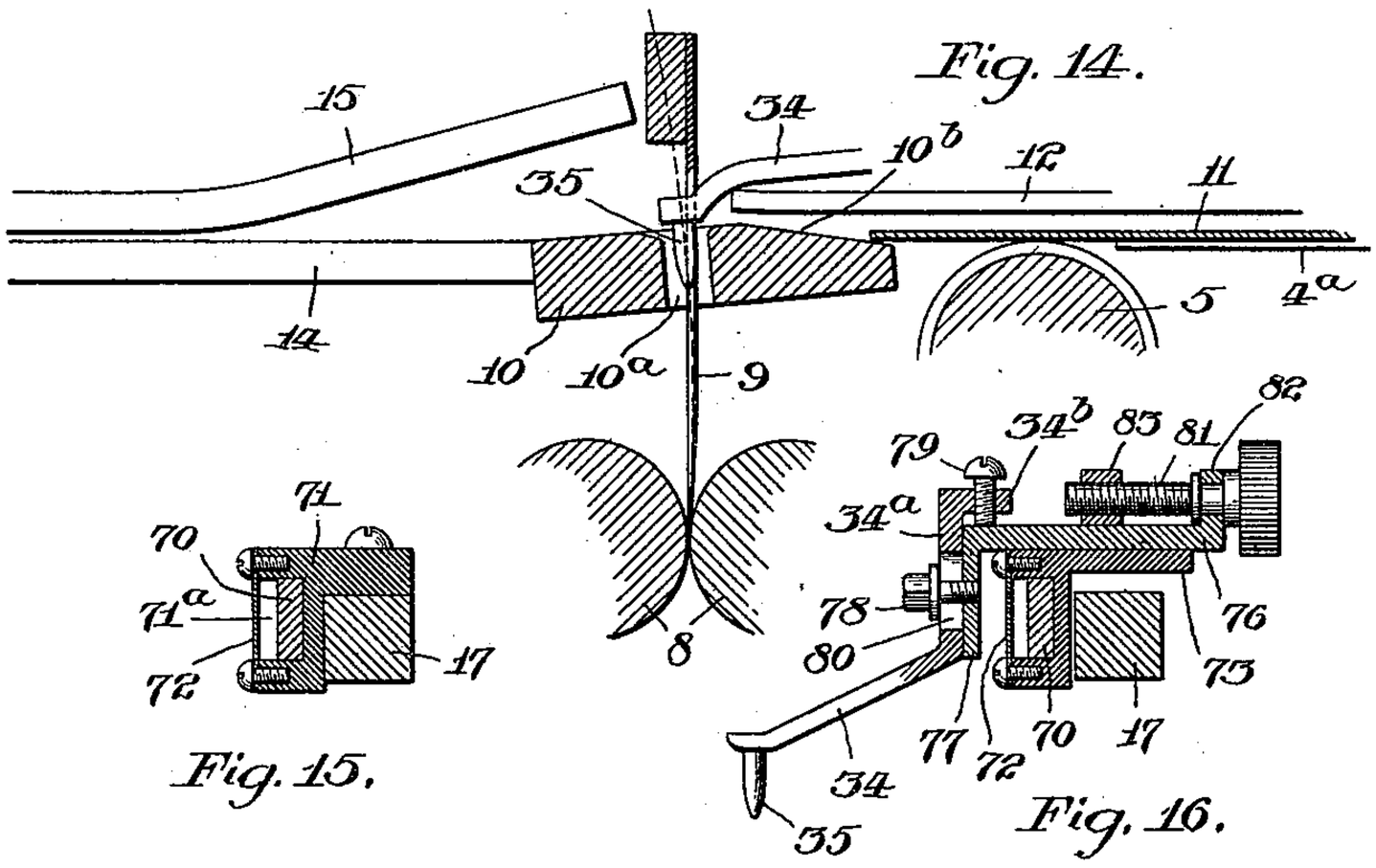


Fig. 15.

Fig. 16.

Fig. 17.

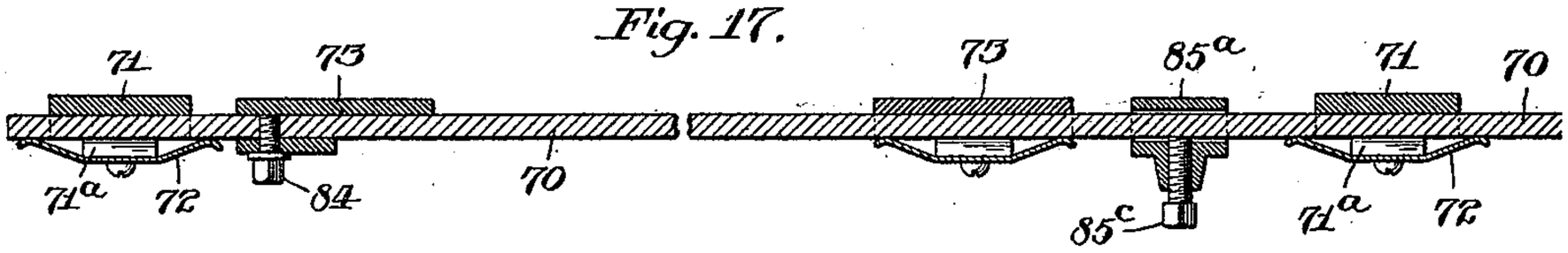


Fig. 18.

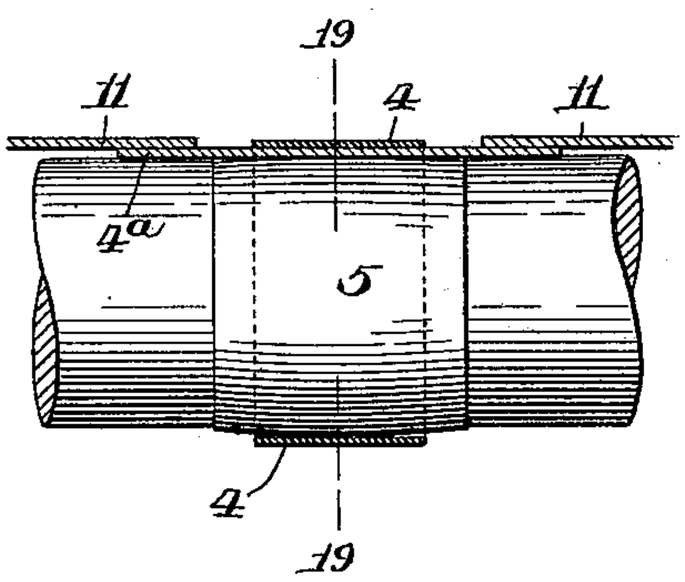
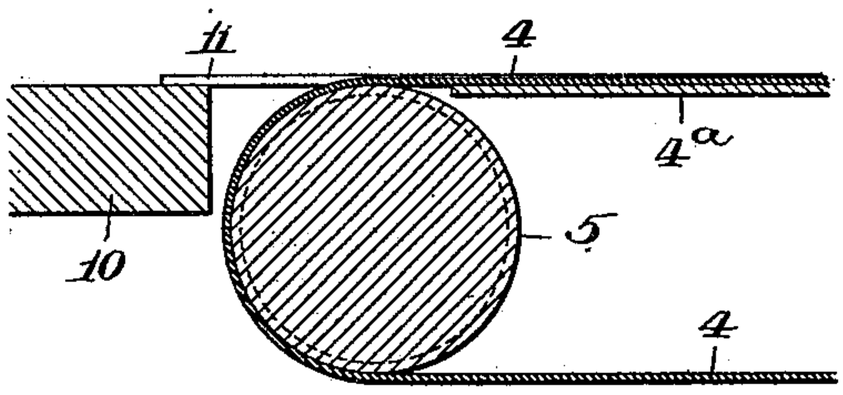


Fig. 19.



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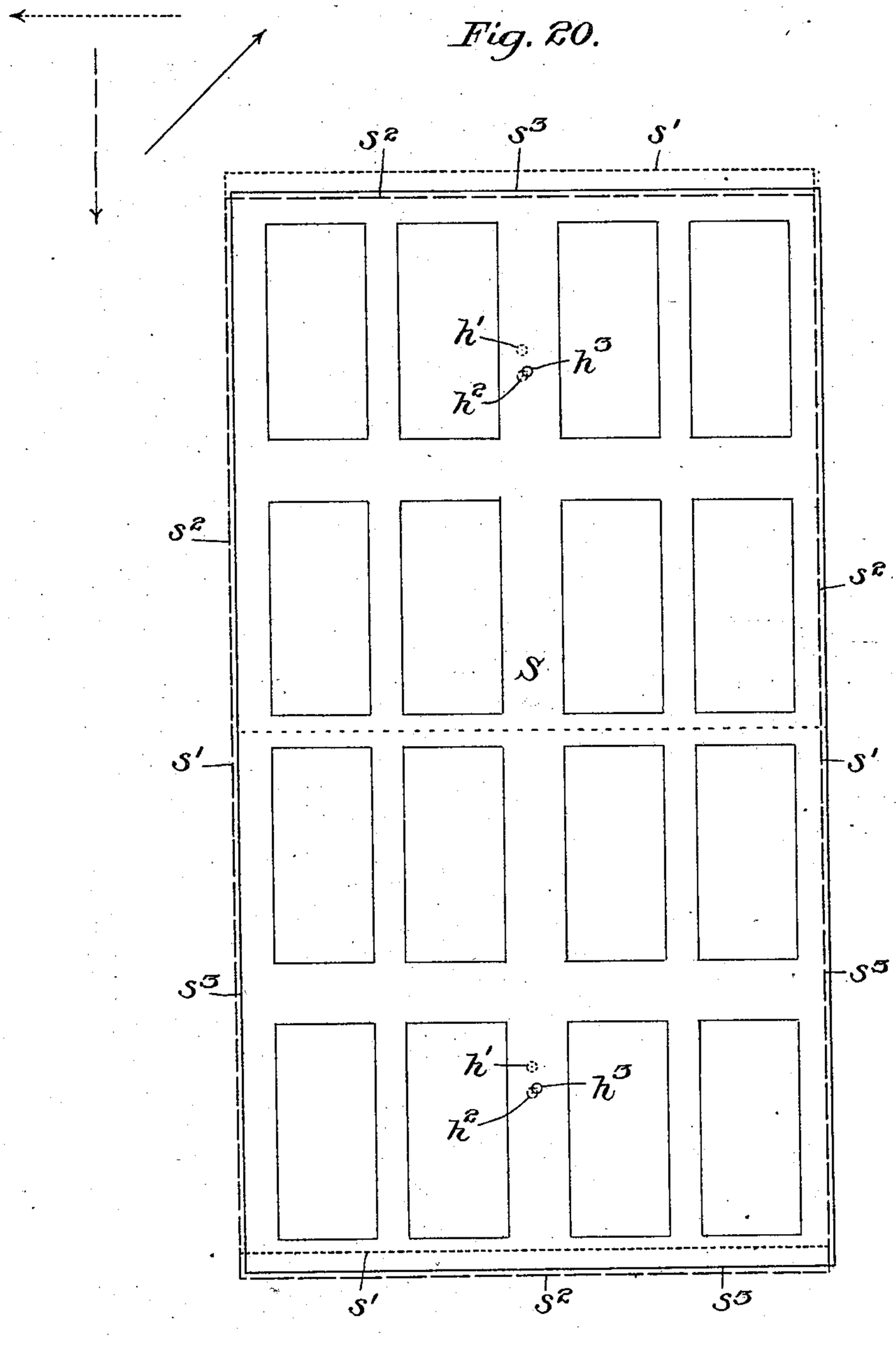
(No Model.) 7 Sheets—Sheet 7.

Fig. 20.



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UNITED STATES PATENT OFFICE.

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SHEET-REGISTERING MECHANISM FOR FOLDING-MACHINES.

SPECIFICATION forming part of Letters Patent No. 667,022, dated January 29, 1901.

Application filed January 12, 1899. Serial No. 701,964. (No model.)

To all whom it may concern:

Be it known that I, HOWARD K. KING, a citizen of the United States, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Sheet-Registering Mechanism for Folding-Machines, &c., of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, of which—

Figure 1, Sheet 1, is a plan view of a folding-machine in which my invention is embodied, only such parts of the machine being shown as are deemed necessary to an understanding of the invention. Fig. 2, Sheet 2, is a partial side elevation of the machine; Fig. 3, a section on line 3 3, Fig. 1; Fig. 4, a front elevation of the side-guide mechanism. Fig. 5 is a section on line 5 5, Fig. 4. Fig. 5[a] is a detail of the nipper rock-shaft and adjuncts, showing the connection of the said shaft, nipper, and side-guide-plate hanger. Fig. 6, Sheet 3, is a section as on line 6 6, Fig. 1, enlarged, but showing the position of the parts when the pins or horns are in the elevated position. Fig. 7 is a view similar to Fig. 6, but showing the position of the same parts when the pins or horns are depressed to the full extent. Fig. 8, Sheet 4, is a plan view, enlarged, of a section of the rock-shaft, broken off, which carries the pins or horns and the frames to which the latter are connected and the adjusting devices. Fig. 9 is a front side elevation of the same. Fig. 10 is a plan view, enlarged, of one end portion of the pin rock-shaft and certain adjuncts and connections. Fig. 11 is a transverse longitudinal section as on line 11 11, Fig. 12. Fig. 12, Sheet 5, is an end elevation, enlarged, of the pin rock-shaft, the cam for oscillating the same, and contiguous parts. Fig. 13 is a section, enlarged, taken immediately in front of the end portion of the folding-blade farthest from the observer in Fig. 1, showing that end of the pin rock-shaft and the slots in the folding-blade. Fig. 14, Sheet 6, is a vertical longitudinal section through the folding-blade, slotted plate, &c., showing a modification in the form and arrangement of said plate. Fig. 15 is a section on line 15 15, Fig. 8. Fig. 16 is a section on line 16 16, Fig. 8. Fig. 17 is a section on line 17 17, Fig. 9, of the bar 70, to which the pin-adjusting mechanism is connected. Fig. 18 is a side elevation, enlarged, of a part of one of the rollers around which passes the sheet-carying tape and showing in transverse section the tape, the underlying plate, and adjacent sheet-supporting plates, whose upper surfaces are above the plane of the upper side of the tape. Fig. 19 is a full section as on line 19 19, Fig. 18. Fig. 20, Sheet 7, is a diagrammatic plan of a printed sheet, showing by dotted, broken, and full lines the several positions successively occupied by it after it has been carried into the machine and before being folded.

The object of my invention, broadly stated, is to provide means for obtaining a positive accurate placement or registry of sheets of paper or the like with reference to a subsequent operation to be performed upon the sheets.

The immediate purpose of the invention is to provide automatic means for securing positive and accurate placement with relation to the folding mechanism of a folding-machine of printed sheets, whereby when the sheets are folded the superposed printed pages will register with each other or as nearly so as practicable.

The leading feature of the invention comprises two or more conical tapering horns or pins having a substantially cylindrical portion above the base of the tapering part and mounted a predetermined distance apart upon a suitable support and means for imparting a vibratory movement thereto, whereby their pointed ends may be caused to enter some part of the area of holes previously cut in the sheet on a predetermined line and a distance apart equal to that of said pins, the diameter of said holes and the diameter of the said cylindrical portion of said pins, respectively, being substantially equal, whereby the position of the sheet is determined by the pins filling the said holes when sufficiently entered therein.

Although not absolutely essential, the most successful result of the operation of the invention as applied to a folding-machine requires that the aforesaid holes of suitable dimensions shall be substantially on the line

upon which the first fold of the (printed) sheet is to be made. If all the printed pages of the sheet are properly placed or alined, this line should be equidistant from the edges of pages adjacent to and on opposite sides of the said line.

The leading feature of my invention as applied to a folding-machine comprises the combination, with the usual or suitable folding devices for carrying forward and supporting the perforated sheet fed into the machine, of the aforementioned conical or tapering pins, means for imparting a certain vibratory movement to said pins with relation to the plane of the underlying sheet at predetermined intervals, and means for guiding and stopping the sheet in a manner to bring it into a position that some part of the said holes will be in the path of the vibration of the pins, whereby when the aforesaid cylindrical part of the latter shall have entered the holes the sheet will thereby be brought into the required position or registry for the operation of the folding mechanism and will be folded on the line connecting the centers of the holes and the centers of the part of the pins occupying the latter or adjacent to such line.

Another feature of the invention as applied in connection with a folding-machine comprises the combination, with suitable mechanism and devices for conveying and supporting the infed sheet provided with two or more suitable prearranged perforations, of vibratory pins whose distance apart is substantially equal to that of said perforations, a side guide for guiding the sheet laterally, a stop for arresting the forward movement of the sheet, which guide and stop are adapted to bring the sheet into a position that the said pins when vibrated will enter some part of the area of said perforations, respectively, and mechanism for imparting a resultant diagonal movement of said pins after they have entered the perforations, whereby the sheet will be freed from contact with said side guide and stop and will also be brought into proper position to be acted upon by the folding devices, as hereinafter described.

The invention also comprises certain devices or combinations of mechanism and details of construction, hereinafter fully described, which are designed to insure as accurate and perfect results as possible.

Referring now to the accompanying drawings, which illustrate my invention (as applied to a folding-machine of usual construction) in a form that I have caused to be put into practical use, 1 and 2, respectively, Figs. 1, 2, and 3, are the ordinary positively-driven feed and drop rollers of the folding-machine, between which the sheets to be folded are successively fed from the feed-table 3, Fig 1, and the sheet is carried forward by tapes 4 to the first folding devices. In the present instance these tapes, two in number, run over a driven roller 5 and a rear tension-roller 5^a, and the incoming sheet is held in close contact with the tapes by means of overlying rollers 6, journaled in a pivoted frame 6^a, the rollers being preferably adjustable to and fro in said frame with relation to the tapes, as hereinafter described. Two other rollers 7, one for each tape, located forward of rollers 6, bear upon the tapes, or rather upon the sheet overlying the latter as it advances, and, coacting with the tapes, enable the latter (in conjunction with rollers 6) to carry forward the sheet. For a purpose and by means hereinafter explained the rollers 7 are caused at fixed intervals to be vibrated out of contact with the tapes.

Immediately underlying the tapes is a plate 4^a, Figs. 6, 7, 18, and 19, to support the tapes against the pressure of rollers 6 and 7.

8 indicates the first folding-rollers, and 9 is the folding-blade, to which the usual vibratory movements are imparted by means of a cam 9^a, in connection with the usual depressing-spring (not shown) on a rotary shaft 9^b, against which cam bears a roller 9^c on the end of an arm 9^d, that is connected to the rock-shaft 9^e, upon which the blade-arms 9^f are mounted.

10 is the customary bar or plate, having the longitudinal slot 10^a, through which the blade descends to crease the sheet and tuck it into the bite of the said folding-rollers. The sheet on its way to be folded passes over supporting-plates 11 and beneath the series of bars 12, which are secured to a fixed shaft 13, thence over the plate 10 and over supporting-bars 14 and under bars 15, until its forward edge strikes against the adjustable stop-bar 16.

The various rotatable shafts of the machine are driven at their respective proper speeds from the main shaft A around a pulley p, on which passes the belt (not shown) from the source of power and by means of gearing shown in Fig. 1, hereinafter referred to.

Adjacent to and to the rear of the slotted plate 10 and parallel therewith is a shaft 17, that is mounted loosely, so that it may slide freely in bearings of the ends of arms 18 of supports, one for each end of the shaft, that are fixed to the top side bar f' of the frame F of the machine. The ends of this shaft within and near its said bearings are round, while the intervening part is square in cross-section and is elevated above the end portions, so as not to obstruct the path of the incoming sheet, as seen in Figs. 6 and 7 and more clearly in Fig. 13. The shaft is adapted to receive an oscillatory motion at certain intervals, and also at predetermined intervals a short longitudinal movement, the purposes of which will be hereinafter fully explained.

The oscillatory motion of the shaft is effected by the following mechanism and devices: Journaled in bearings rising from the top side bars of the frame of the machine is a shaft 19, on one end of which is a gear 20, that is driven in the direction of the arrows, Figs. 6, 7, and 12, by a train of gearing 20^a,

20^b, 20^c, 20^d, 20^e, and 20^f from the main shaft A of the machine. On the other end of said shaft 19 is a cam 22, of the form seen in Figs. 6, 7, and 12. On the end on that side of the the rock-shaft 17 is a crank-arm 23, carrying at its free end a roller 24, that bears on the edge or face of the cam 22 and is maintained in such contact by a compression-spring 25 upon a rod 26, one end of which latter is pivoted on a stud 27, Figs. 1, 10, and 12, on the inner side of the crank-arm 23, and the other end passes through an aperture in an arm 28, Fig. 1, fixed to the machine-frame. One end of the spring bears against an adjustable collar 24^a on the rod 24 and the other end against the arm 28, as seen in Figs. 1, 10, and 12.

The longitudinal movement of the shaft 17 is effected by means of an expansion-spring 29, in conjunction with a cam 30, having a high part 30^a and a low part 30^b upon the inner side of the crank-arm 23, against which cam bears a roller 31 at the end of a fixed arm 32, which in the present instance is secured to the bearings 18^a of the arm 18 on that side through which the shaft 17 passes, as seen in Figs. 1, 10, 11, and 13. The aforementioned spring 29 is upon the said shaft 17, one end pressing against the inner side of the bearing and the other end against an adjustable collar 33 on the shaft.

When the roller 24 of crank-arm 23 rides upon the high portion 22^b of cam 22, as in Fig. 6, Sheet 3, the shaft 17 will be in the normal or retracted position endwise; but as said roller descends to the low part 22^a of said cam, as in Figs. 1, 7, 10, and 12, thereby changing the position of cam 30 with relation to the arm 32, and consequently to roller 31, the shaft will be drawn outwardly against the stress of spring 29.

In order to effect relative adjustments of the arms 23 and 32, I make their ends split and bifurcated and bind the same to the shaft and the shaft-bearing, respectively, by means of clamp-screws connecting the bifurcations, as seen in Figs. 11 and 12.

Mounted upon the rock-shaft 17 in a manner and by means hereinafter described are two forwardly-extending fingers 34, each having on the under side of its free end a conical or tapering pin or horn 35, having a substantially cylindrical portion above the base of the conical part, the diameter of which cylindrical portion is equal or approximately equal to that of the corresponding hole cut in the printed sheet, as hereinbefore referred to. The distance apart of these pins must be substantially equal to that of the said holes, and their position with relation to the slot in the sheet-supporting plate 10 must be such that when, as hereinafter explained, they are vibrated to their lowest point of depression, as in Fig. 7, the lower part of their cylindrical portion will be entered in said slot, and, moreover, (in a folding-machine,) it is preferable that the centers of the diameter of their said cylindrical portion shall be substantially in the line of the path of the edge of the folding-blade as it strikes the sheet to crease it into the slot. The reason for these requirements will be made clear when I come to describe the operation of the machine.

As it is desirable, in fact, practically necessary, that the positions of these pins shall be adjustable in various directions, I have provided means to that end, which are shown in several figures of the drawings, but shall defer describing the same in detail until after having explained the general operation of the machine.

It is necessary to employ a suitable side guiding or adjusting device for the sheets as they advance to be operated upon, or such a device to act upon the sheets at a predetermined time, and in order to attain the most satisfactory results I make use, in combination with my registry devices, of a certain side-adjusting or sheet-placing mechanism, as shown in the drawings, but which, however, I shall not claim herein *per se*, as the same is the subject of an application for United States patent filed by me on the 11th day of December, 1896, the serial number of which is 615,309. The said mechanism is as follows, reference being had more particularly to Figs. 1, 4, and 5: Upon one end of a rotary shaft, which in the present instance is the shaft 19, which carries the cam 22, is a cam-wheel 36, having a plane portion 36^a and a depression 36^b. Against this cam rides a roller 37 on the downturned end of a bar 38 above the plane of the shaft 19. This bar is pivotally connected to the ends of two arms 39, whose other ends are pivoted to a cross-rail 40 of the machine-frame. A spring 41, Fig. 1, one end of which is attached to the top bar f' of the machine-frame and the other end is connected to the inner one of the arms 39, serves to tend to draw the bar inwardly, and thus to always maintain the roller 37 in contact with the cam-wheel 36. Suspended from bar 38 by arms or hangers 42, Figs. 1 and 4, is a shaft 43, hereinafter termed the "nipper rock-shaft," and there is also suspended from the bar by an arm 44 a guide-plate 45, having a horizontal slot 46, closed at the outer end and in the same plane substantially as that of the top surface of the slotted plate 10—in other words, practically coincident with the plane of movement of the sheet of paper in the machine. The nipper rock-shaft passes through an opening in the hub of the guide-plate hanger 4[illegible] On this shaft is mounted a nipper 50, whose free end extends through a vertical opening 46^a, (indicated in dotted lines in Fig. 4,) in the upper wall of the guide-plate slot 46. The nipper rock-shaft 43 is provided with a longitudinal groove g, and the nipper is keyed to the shaft and also to the hub of the guide-plate hanger 44 by means of key k, (seen more clearly in Fig. 5^a, Sheet 2,) which extends into a groove 50^a in the nipper-hub, but is reduced in width or depth where it passes through the

hanger 44, so as not to project beyond the periphery of the said rock-shaft. Projections *k'* of the key maintain the nipper in connection with the hub, so that they may be moved together longitudinally upon the shaft, yet permitting the nipper to rotate, as and for a purpose hereinafter explained. There is also projecting from the nipper-hub a lug 51, against which presses a flat spring 52, whose upper end is connected with the bar 38. In the present instance the spring is fastened to a piece 53, that is adapted to slide longitudinally upon the under side of said bar, in dovetail guideways of the latter, as seen in Figs. 4 and 5. The arm 44 is rigidly connected to the sliding piece 53. Upon the nipper rock-shaft is an arm 54, carrying a roller 55, contacting with a cam 56 on the driven shaft 19, and as the nipper-hub is splined on the former shaft and the spring 52 bearing against the lug 51 of the nipper-hub it tends to maintain the roller 55 against the said cam 56, it (the spring) also tending to rotate the nipper toward the bottom of the guide-plate.

In order to make longitudinal adjustments of the guide-plate and nipper together, I provide a screw-threaded rod 57, journaled in lugs 58 on the side of bar 38, which rod extends through a threaded hole in the upper end of the arm 44, which latter is, as before stated, connected to the sliding piece 53. It will thus be seen that by turning the hand-wheel H on the end of the threaded rod 57 the guide-plate and nipper, with the spring 52, may be adjusted as a unit along the length of the nipper rock-shaft without affecting the operation of the parts.

The operation of the described side-adjusting mechanism without present reference to its coöperation with the pins 35 and their operating mechanism is as follows: Premising that, as shown in Figs. 1, 4, and 5, the guide-plate 45 is in the outward position, at which time the roller on the end of bar 38 is riding upon the plane portion 36^a of the cam-wheel 36, as in Figs. 1 and 4, and the roller 55 is also riding upon the large or circular part 56^a of cam 56, and thus the nipper is elevated out of action, it will be obvious that as the driven shaft 19 continues its rotation the roller 37 on the end of bar 38 will by stress of spring 41 upon the latter be caused to enter the depression 36^b of cam-wheel 36, and the roller 55, carried by the nipper rock-shaft, will, owing to spring 52 pressing against the nipper projection 57, then ride upon the lower portion 56^b of the cam 56 on said shaft 19. As roller 37 enters the depression 36^b, the bar 38 moving inwardly by the stress of spring 41, all the hereinbefore-described parts carried thereby will partake of the lateral movement. This movement is so timed as to begin to take place just prior to the time that the forward or stop edge of the perforated sheet to be operated upon reaches the stop-bar 16. This inward movement of the guide-plate brings the closed end of its slot 46 into contact with the guide edge of the sheet which had or may have entered said slot and the sheet will be pushed inwardly, or it may happen that the edge of the advancing sheet is in such position that the closed end of said slot will just come into contact with the guide edge of the sheet at the end of the inward movement of the guide-plate. However, whatever be the extent of the actual movement of the sheet the guide edge will at the end of the inward stroke of the guide-plate be on a certain line and also against the closed end of the slot 46. At this inward movement of the guide-plate the guide edge of the sheet which has or may have entered the slot 46 in the latter comes into contact with the outer or closed end of the slot, and the sheet is thus pushed inwardly a greater or less distance, according to the proximity of that edge of the advancing sheet; but such edge will when the sheet has been pushed inwardly, as mentioned, be on—that is, shifted to—a predetermined line, or it may happen that that edge as the sheet has moved forward is in such position that the closed end of the guide-plate slot will just come into contact with the said edge without pushing the sheet inwardly at all. During the latter part of this movement of the guide-plate the nipper rock-shaft, and consequently the nipper, owing to the action of the spring 52 as the roller 55 reaches the lower part of cam 56 and just before the guide-plate has attained the limit of its inward throw, (the edge of the sheet being, as before stated, then in contact with the closed end of the slot,) the free end of the nipper is caused to bite the sheet between it and the bottom of the plate, and thus holds the sheet during the time that roller 55 is riding on the lowest portion of cam 56. As the shaft 19 continues to rotate the roller 37 ascends from the depression 36^b, and thus the bar 38, and consequently the guide-plate, with the sheet still held by the nipper-leg, is retracted outwardly, thereby bringing the sheet positively into the required sidewise position. This required position in the present instance is that, as hereinafter described, when the pointed ends of the pins 35 may enter the before-mentioned holes in the printed sheet when said pins are vibrated downwardly, the sole object of employing the described side-guide mechanism in connection with the other mechanism being to insure the proper lateral placement of the perforated sheet with relation to said pins. The nipper is then caused to rise and so release the sheet as the roller 55 of the nipper rock-shaft again rides upon the larger circular part of the cam 56. This release takes place just at a certain time with relation to the descent of the folding-blade and with relation to the downward vibration of the said pins, as described farther on.

Connected to the inner side of the guide-plate 45 is a bar 15^a, whose lower edge is a short distance above the plane of movement of the sheet of paper. This bar takes the

place of and is for the same purpose as the fixed bars 15—*i. e.*, to keep the sheet from rising—but adjacent to the guide edge of the sheet. As the guide-plate mechanism is adjustable, the bar 15ª, being secured thereto, is adjustable with it, and consequently it (bar 15ª) will always be in the proper relation to the said guide edge. In order that the said bar may be adjusted longitudinally, so that its forward end may always escape the stop-bar at any adjustment thereof, I attach the bar 15ª to the guide-plate by means of a set-screw 15ᵇ, that passes through a longitudinal slot in said bar.

Pivoted on a pin 60 of a rearwardly-extending bracket 61, that is attached to the rock-shaft 17, which carries pins 35, is a frame 62, on the outer end of which is journaled the tension-roller 7 hereinbefore referred to. The function of this roller, as before suggested, is to bear upon the top of the sheet overlying the tapes 4 as it advances, and thus to aid in carrying the sheet forward to the stop-bar 16. This function obtains when the roller 24 of crank-arm 23 is riding upon the high part of the cam 22 and the pins are in the elevated position, as in Fig. 6. When the said cam rotates and the roller gradually descends to the lower part of the cam, the roller 7 will as the shaft 17 rocks forward rise out of contact with the sheet, as in Fig. 7; but such rise does not begin to take place until just before the points of the pins have entered the holes in the sheet, as hereinafter described.

The roller 7 is maintained in yielding contact with the tape or sheet by means of a helical torsion-spring 63 at the projecting end of the pin 60, on which the roller-frame is pivoted. One end of the spring bears against a stud 64 on the side of the frame, and for the purpose of making adjustments of tension its other end is secured to a square-apertured nut 65 on the square end of the pin. The roller-carrying frame is stopped by a lug 66, projecting from the bracket 61, against which lug the upper side of a forward extension of the frame is adapted to impinge, as seen in Figs. 7 and 8.

It will be understood that the foregoing description relating to one of the rollers 7 is applicable to the other.

The upper surface of the tapes 4 is slightly below that of the sheet-supporting plates 11, as more clearly seen in Figs. 18 and 19. This is to insure, for a purpose hereinafter appearing, that the sheet will not be in contact with and so not acted upon by the tapes after the rollers 7 are caused to rise out of contact with the sheet by rocking forward of the pin-carrying shaft 17.

Having now described the construction, (omitting some non-essential details,) I shall proceed to describe the mode of operation of the mechanism in effecting the desired final result. This operation is as follows, it being of course understood that the movements of the various parts are relatively properly timed and also that the holes of the several sheets of a "bank" nearest to the guide edge of the sheet are approximately of a uniform distance from that edge: The sheet having the aforesaid perforations on or adjacent to the line upon which the first fold is to be made, or as nearly so as may be, is fed into the machine between rollers 1 and 2 and is carried on by the tapes 4, in conjunction with the tension-rollers 6. At this time the roller 24 of crank-arm 23 is riding upon the high part of cam 22, the pins 35 being in the elevated position and the rollers 7 depressed upon the tapes, and the folding-blade is elevated, all as seen in Fig. 6. At the same time the roller 31 of arm 32 is against the lower part of the cam 30 on the crank-arm 23, and thus the shaft 17 and its adjuncts are in the normal inward position through the stress of spring 29. As the sheet advances its guide-side margin enters the slot 46 of the guide-plate 45, which latter is then at the normal outward position, the roller 37 riding against the plane part of the cam-wheel 36 upon shaft 19, as in Figs. 1 and 4, and the roller 55, carried by the nipper rock-shaft, is riding upon the larger or circular part of the cam 56 on said shaft 19, and consequently the nipper is in the elevated position, as seen in Figs. 4 and 5. As the driven shaft 19 continues its rotation roller 37 will be caused through the stress of spring 41 to enter the depressed part 36ᵇ of cam-wheel 36, and the roller 55 of the nipper rock-shaft will by the stress of spring 52 bear upon the lower part 56ᵇ of cam 56. As the bar 38 moves inwardly when roller 37 enters the depression 36ᵇ the guide-plate, the nipper, and the nipper rock-shaft are carried inwardly as a unit. The timing of this movement is such that it begins to take place just before the forward edge of the advancing sheet of paper reaches the stop-bar 16. At this inward throw of the guide-plate the closed end of the slot 46 of the latter comes into contact with the edge of the sheet which had, as previously stated, entered the slot, and it (the sheet) is pushed inwardly unless the position of the sheet is such, as before referred to, that the said end of the slot merely comes into contact with the sheet. Immediately before the guide-plate reaches the end of its inward throw the roller 55 reaches the low part of cam 56, thereby permitting spring 52 to cause the end of the nipper to bite the sheet between it and the bottom of the guide-plate, thus holding the sheet. As the rotation of shaft 19 continues the roller 37 again rides upon the plane or high portion of the cam-wheel 36, and thus the guide-plate, &c., with the sheet held by the nipper-leg, is retracted, and then the roller 55, again meeting the high circular part of cam 56, rocks the nipper-shaft, and thus elevates the nipper to release the sheet. The relative timing of the meachanism for actuating the shaft 17 is such that this release takes place several degrees of revolution of the cam-shaft 19 before the pins enter the perforations of the

sheet, thus leaving the latter free to be acted upon by the tapes 4, rollers 7, and the stop-bar.

The side-adjusting mechanism is so timed and adjusted that at the end of the described outward or retractive movement of the guide-plate the holes in the sheet will be brought transversely within the range of the points of the vibratory pins 35 on their downward movement, the said holes having been previously brought within such range longitudinally by the stop-bar arresting the sheet at the proper instant.

In Fig. 20 the edge of the sheet S at the bottom of the figure is the guide edge, or that which comes next to the guide-plate 45, the dotted lines s' of the edges of the sheet and of the holes h' thereof indicating the position of the sheet and holes when pushed inwardly to the full extent, and the broken lines s^2 and h^2 indicating the position when retracted to the full extent. In both of these positions the forward edge of the sheet to the left will be against or close to the stop-bar and the edge at the bottom of the figure against or close to the closed end of the guide-plate.

While the foregoing-described side guiding or adjustment of the sheet is taking place the roller 24 of crank-arm 23 is riding upon the high part of cam 22 upon shaft 19, and consequently pins 35 are in the elevated position, as seen in Fig. 6. As cam 22 continues its rotation the roller will gradually reach and ride upon the low part 22^a of said cam, and the pin-carrying shaft 17 will by the force of spring 25 rock forward and so depress the fingers which carry pins 35 until the latter enter the holes in the sheet, and finally their upper cylindrical portions fill, or substantially fill, the holes. The position of the pins, &c., at this time is shown in Figs. 1 and 7. For reasons hereinafter explained it is desirable that the pins shall be carried down so far as to bring a portion of the cylindrical part thereof some distance below the plane of the sheet, as seen in Figs. 7 and 14. As these pins move in the arc of a circle whose center is the axis of the shaft 17 and they are eccentric to that arc, as shown, and also as in the present instance they pass below the horizontal plane of that center, the sheet will be drawn backward a certain distance by the rear side of the pins. Simultaneously with the downward movement of the latter and the corresponding movement of the crank-arm 23 the roller 31, ascending to the high portion 30^a of cam 30 on the side of said arm, as seen in Fig. 7, causes the shaft 17 to be drawn outwardly against the stress of spring 29. Consequently the sheet is shifted laterally to the same extent, the described outward movement of the shaft not beginning to occur until the ends of the pins 35 have entered the holes in the sheet. Immediately before these two movements, backwardly and outwardly, of the sheet are effected the nipper 50 had been caused to release its bite upon the sheet, as before stated, and also the tension-rollers 7 had left the sheet after the rear edge had passed beyond the rollers 6 and just before the pins 35 entered the perforations. Thus the sheet, otherwise entirely free, will at that time be held in place solely by the pins 35 and the slotted plate 10 and the other supports underlying the sheet. The resultant of the aforesaid two substantially simultaneous shiftings of the sheet is a diagonal movement indicated by the difference in the position of the sheet and holes in broken lines s^2 and h^2 and the full lines s^3 and h^3, respectively, in Fig. 20, the full lines indicating the final position of the sheet ready for the folding operation.

I may at this point explain that the distance of the tension-rollers 6 from the stop-bar 16 and the line of folding of the sheet is such that the rear edge of the sheet passes a short distance beyond the said rollers before the forward edge reaches the stop-bar, also that the rollers 7 hold the sheet in yielding contact with the underlying tapes until just before the pins 35 enter the perforations in the sheet, thus maintaining the sheet against the stop-bar, the shaft 17 being oscillated some distance forward before the lug 66 comes into contact with the rear portion of the frame 62, the rollers 7 being held in contact with the sheet by the tension of spring 63. It will be observed, therefore, that the sheet is only a short time previous to the pins 35 entering the perforations entirely free from control of the rollers 7 and their underlying tapes 4, which latter being below the plane of the supporting-plates lose control of the sheet as soon as the rollers 7 rise.

The object and result of imparting the described diagonal movement to the sheet are to always insure the sufficient freeing of the forward or stop edge of the sheet from the stop-bar 16 and the guide edge from the closed end of the slot 46 of the guide-plate in order to avoid buckling of the sheet, which might otherwise occur when a stop-bar and side-guide mechanism such as hereinbefore described are used.

The sheet having been brought into the described final position the folding-blade descends by the operation of the suitably-timed cam 9^a and the usual depressing-spring and so creases the sheet through the slot in plate 10 and into the bite of the subjacent folding-rollers, the blade being provided with vertical slots 9^g, Fig. 12, to permit it to pass by the fingers 34 and pins carried thereby.

As hereinbefore stated, it is desirable that the path of the edge of the folding-blade as it strikes the sheet shall cross the line of the centers of the cylindrical part of the pins then within the holes, or, in other words, the line connecting the centers of said holes. Thus the sheet will as it is tucked through the slot in plate 10 slide directly and freely off the pins 35. It may, however, sometimes happen that the required line of folding will

not be that of the centers of the holes, but may be a short distance beyond it and parallel therewith, or the line of folding may be bisected at an acute angle by that connecting the centers of the holes; but in practice the holes will never be so far away from the required line of folding that the sheet will be unable to slide from the pins without tearing when the sheet is acted upon by the folding-blade.

I here remark that an advantage of the conical or tapering pins having the cylindrical portion of a diameter substantially equal to that of the prearranged holes in the sheet is that the sheet is prevented from shifting in any direction after having been brought into registry, as described. Also when the cylindrical part extends a suitable distance below the plane of the sheet, as before mentioned, it insures the maintenance of the latter in such position of registry until the folding-blade has sufficiently creased it (the sheet) into the slot of the supporting-plate 10, for obviously while the sheet is sliding off—that is, being forced off—the cylindrical portion of the pins it cannot shift its position of registry. The sheet having been brought into the bite of the folding-rollers 8 the blade is elevated by the mechanism that actuates the same, and the shaft 17 will be oscillated backwardly to the original position by the roller 24 riding upon the high part 22^b of cam 22. The various parts and mechanisms will then be in position for repeating the described operations upon a succeeding sheet fed into the machine.

I have shown in Fig. 14, Sheet 6, a modified construction and arrangement of the slotted plate 10, &c., which I have found to be the most desirable in practical use. This form differs from that shown in the other figures of the drawings in that the plate is placed at an angle to the horizontal—that is, the plane in which the sheets move—in a manner to bring the top portion of the slot 10^a practically on a line with the center of the shaft of the folding-blade, so that the sheet will be creased into the slot at right angles to the top of the slot, also so that the pins 35 when depressed to the full extent will be at right angles to the latter and in line with the path of the edge of the folding-blade. The described inclination of the slotted plate also insures, in connection with the beveling of the rear top at 10^b of the plate, the guiding of the forward edge of the rapidly-moving sheet of paper across the gap of the slot without danger of said edge catching in the forward edge of the slot 10^a, which sometimes occurs in the other construction hereinbefore referred to.

I remark that if the holes in the printed sheet be made too small it would practically preclude the attainment of the desired result and if too large it would sometimes be objectionable for the reason that too much of the margin of the folded signature or pamphlet would have to be cut off in order to efface the holes, or rather the half of each hole, (certain of the folds being usually midway across the holes.) I have found in practice that the most desirable or practical diameter of these holes is three-sixteenths of an inch. The length of the pins which I have used is five-eighths of an inch.

Usually in fine bookwork, for which my invention was particularly designed, the printing on the sheets is sufficiently well alined or disposed with relation to the edges of the sheet that the sheet may be brought into proper position by the stop-bar and side-adjusting mechanism for the pins to enter some point within the area of holes of three-sixteenths of an inch diameter. I may remark, however, that as that part of the sheet is supported by the slotted plate 10 if the pointed ends of the pins should happen to strike the paper adjacent to the holes, if not too far therefrom, they will depress the paper and slide into the holes. I may also here remark that it is not absolutely essential that holes be cut or punched entirely through to form holes therein, as the paper may be sufficiently weakened on suitable lines so that the holes will be formed by the pins pushing out the part within the weakened lines, thus, so to say, completing the holes.

It will be readily understood that the various parts of the machine should be made adjustable, so that certainty and accuracy of result may always be attained and also so that the work may be done upon sheets of different sizes. As hereinbefore stated, the stop-bar and the side-adjusting mechanism are adjustable.

I shall now describe the various adjustments of the pins and the manner of effecting the same. The higher bowed part of shaft 17 is square in cross-section, as shown, and on the forward side of the shaft and running parallel therewith is a rectangular bar 70, that is connected to said shaft by means of lugs 71 at each end, the bar being let into front slots 71^a in the lugs and held in place by means of bow-shaped springs 72, Figs. 8, 9, 15, 16, and 17. Thus the bar is capable of being slid lengthwise against the friction of the springs. Upon this bar are mounted frames 73, that carry the pin-fingers 34. Mounted transversely upon the frame 73 and adapted to slide in dovetail guideways 75 in the latter is a piece 76, having a downwardly-projecting arm 77. To this arm is secured by means of a screw or bolt 78 the limb 34^a of the pin-carrying finger 34, which limb is adapted to slide in guideways of the said arm 77. The upper end of limb 34^a has a rearward extension 34^b, through which passes a screw 79, whose end bears on the top of the sliding piece 76. The bolt 78 passes through a slot 80 in the finger-limb 34^a. By loosening the said bolt and turning the screw 79 vertical adjustments of the finger, and consequently of the pin, may be effected. To-and-fro adjustment of the pin transversely to

the shaft 17 is effected by means of a screw 81, one end of which is journaled in a lug 82 of the rear end of the sliding piece 76 and whose other end is screwed into a cross-bar 83, which is fastened to the horizontal part of the frame 73.

In order to take up lost motion from wear or otherwise of the sliding piece 76 in its guideway, I employ on one side a usual gib 76^a, adjustable by set-screws 76^b.

The frame 73 on the left in Figs. 8 and 9 is maintained in any position to which it may have been adjusted on bar 70 by means of a set-screw or bolt 84. The other frame is adjustable longitudinally on the said bar by means of a screw 85, working in a lug 85^a, that is secured to bar 70, which latter passes through a slot 85^b, Figs. 6 and 7, in the lug. A set-screw 85^c maintains the lug in place upon the bar. One end of screw 85 passes through a lug 83^a of the aforesaid cross-bar 83 and has a collar 85^d on its projecting end. By turning the milled head of this screw the frame 73 and its adjuncts may be finely adjusted to bring the pins 35 the required exact distance apart. One end of bar 70, to the right in Figs. 8 and 9, has an upward projection 86, in which is journaled a collared screw 87, that extends through a threaded hole in a projection 71^a of the adjacent lug 71. As said lug is secured to shaft 17 and bar 70 is free to move in said lug and in its fellow at the other end of the bar, as previously described, it will be obvious that by turning the milled head of the screw 87 the bar may be shifted longitudinally in either direction against the friction of the springs 72, and consequently the pins 35 will be shifted accordingly without changing their position with relation to each other.

When a bank of the perforated printed sheets is to be operated upon by the machine, the frames 73 are adjusted on bar 70 and, if necessary, the bar itself is adjusted longitudinally, so as to bring the pins 35 approximately into the required position and distance apart. Finer lateral adjustments of the position of the pins, if the same shall be necessary, as will usually be the case, (the said first adjustments being somewhat roughly made,) may be effected by means of the screws 85 and 87, the former adjusting the distance apart of the pins and the latter their position as a unit. The position of the pins with relation to a horizontal plane may be adjusted, one independently of the other, by the screws 79, and their position with relation to a vertical plane, also independently of each other, by the screws 81. This latter adjustment is especially useful when, as may sometimes occur, the holes in the sheets may not be on a line upon which the fold should be made in order to have correct registery of the printed pages when the sheet is folded, and it then becomes necessary to adjust either or both of the pins so that they may enter the holes when the sheet has been stopped by the stop-bar and it has been properly placed laterally by the side guide or adjusting mechanism. The stop-bar 16 is capable of to-and-fro adjustments by suitable means—as, for example, by the devices seen in Figs. 1, 2, and 3, which are as follows: The said bar is mounted upon screw-threaded shafts 16^a, one at each end, that are journaled in bearings of lugs 16^b, projecting from the top rails of the frame of the machine. On the end of each shaft is a bevel-gear 16^c, that engages a similar gear 16^d on a rotatable shaft 16^e. By turning a hand-wheel 16^f on the end of the latter the stop-bar may be moved back or forth as may be required. The small rear rollers 6 may also be adjusted with relation to distance from the stop-bar—that is, to correspond with the length of the sheets of paper—the frames in which said rollers 6 are journaled being secured to an enlargement 6^b on the upper side of one of the bars 12, which enlargement is provided with a longitudinal slot 6^c, Figs. 3, 6, and 7, through which passes the pivot-pin 6^d of the said frame, the said pin having a tightening-nut 6^e, Fig. 1, on its projecting end. By loosening the nut the roller-frame may be moved to and fro to the required position with relation to the stop-bar or practically with relation to the length of the sheet.

The folding-blade may, and usually will, be provided with two, or possibly more, sets of slots to enable the blade to escape the pin-fingers 34, whereby the machine is adapted to be used for different sizes of sheets, other parts of the mechanism of the machine being, of course, also correspondingly adjustable. In Fig. 13, for example, the slot 9^g is one of the two of one set and the slot 9^h is one of another set for smaller sheets. By means of the aforementioned roughly-adjusting devices for the pins 35 the latter may be shifted from one set of slots to the other and the necessary fine adjustments be then made.

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

1. Means for bringing sheets of paper, or the like, provided with suitable prearranged holes, into required registry, comprising conical or tapering pins corresponding to said holes, as described, and having a cylindrical portion above the base of the tapering portion whose diameter is substantially equal to that of said holes, respectively, and means for imparting a vibratory or reciprocatory motion to said pins, whereby they may be caused to enter said holes respectively, up to the said cylindrical portion when the sheet is brought into such position that some part of the area of said holes is in the path of movement of the pins across the plane of the sheet, substantially as set forth.

2. In a sheet-registering mechanism for folding-machines of the character described, adapted to operate upon sheets of paper having prearranged perforations, the combina-

tion with means for conveying, guiding and stopping the sheet, of the rock-shaft, the pins connected thereto and eccentric to the arc in which they are caused to move when said shaft is oscillated, substantially as and for the purpose set forth.

3. Means for bringing sheets of paper or the like, provided with suitable prearranged holes, into required registry, comprising the combination of a suitable support for the sheet, a shaft mounted above the plane of the top of, and parallel with said support, conical or tapering pins connected to said shaft, and having cylindrical portions above the base of the tapering portions, whose diameters are substantially equal to the diameter of said holes, respectively, and whose relative position corresponds with that of said holes, and means for imparting at predetermined times an oscillatory motion to said shaft whereby the said pins are caused to move in the arc of a circle and to enter said holes respectively, and to pass below the top of said support and below the plane of the axis of said shaft, whereby a retractile movement is imparted to the sheet, substantially as set forth.

4. In a sheet-registering mechanism, the combination with a sheet-support having a suitable opening therein below prearranged perforations of the sheet, of conical or tapering pins having a cylindrical portion whose diameter corresponds to that of said perforations respectively, in the sheet, and which pins are movable into and from said perforations, and means for actuating said pins.

5. In a mechanism for registering sheets of paper, or the like, provided with suitable prearranged perforations, means for securing accurate registry of the sheet, consisting of the combination of a suitable support for the latter, vibratory conical or tapering pins mounted above said support, and corresponding with the said perforations in the sheet, and having the cylindrical portion whose diameter is substantially equal to that of said perforations, respectively, means, respectively, for conveying, side guiding, or adjusting, and stopping the sheet in such position upon said support that some part of the area of the perforations will be in the path of movement of said pins when vibrated toward and below the plane of the sheet, whereby when said pins have entered the perforations up to their said cylindrical portion, the sheet may thereby be shifted positively into the required registry and maintained in that position, substantially as set forth.

6. In a sheet-registering mechanism for folding-machines adapted to operate upon sheets of paper, or the like, having suitable prearranged perforations, the combination of the folding-rollers, the vibratory folding-blade, the slotted sheet-supporting plate above the rollers, the conical or tapering pins corresponding with the said perforations of the sheet, and having cylindrical portions above the base of the tapering portions whose diameters correspond substantially to those of said perforations, respectively, and which pins are adapted to be vibrated into the slot in said sheet-supporting plate and to enter the perforations when the sheet is brought into suitable position within the path of vibration of the pins, substantially as described.

7. In a sheet-registering mechanism for folding-machines adapted to operate upon sheets of paper, or the like, having suitable prearranged perforations, the combination of the folding-rollers, the overlying slotted plate, the vibratory folding-blade, means for conveying the sheet into the machine, means, respectively, for arresting the forward movement of the sheet, and for laterally adjusting the same at predetermined times, the rock-shaft, the conical or tapering pins carried thereby and corresponding with the said perforations in the sheet, and having cylindrical portions above the base of the tapering portions whose diameters are substantially equal to those of said perforations, respectively, and means for imparting an oscillatory and also, substantially simultaneously therewith, a longitudinal movement to said shaft at predetermined times, substantially as and for the purpose set forth.

8. In a sheet-registering mechanism for folding-machines, adapted to operate upon sheets of paper, having prearranged perforations, the combination of means for incarrying, supporting, side-guiding and stopping the sheet, respectively, of the vibratory pins adapted to enter said perforations, respectively, and means for shifting said pins diagonally in a horizontal plane while entered into said perforations, in order to simultaneously free the guide and stop edges of the sheet, substantially as set forth.

9. In a machine for registering sheets of paper in a folding-machine, which sheets are provided with suitable prearranged perforations, means for conveying the sheets into the folding-machine, conical or tapering pins suitably mounted above the plane of movement of the sheet, and corresponding with the said perforations, respectively, and having cylindrical portions above the base of the tapering portions whose diameters are substantially equal to those of said perforations, respectively, the folding-blade, the folding-rollers, means for imparting a vibratory movement of said pins with relation to the plane of the sheet, whereby when the larger diameter of the pins and the folding-blade respectively reach the plane of the sheet, the centers of such diameter and the line of the edge of the folding-blade will substantially coincide, together with means, respectively, for stopping and side guiding or adjusting the sheet in position to bring some part of the area of said perforations in the path of the movement of the pins, substantially as set forth.

10. In a sheet-registering mechanism adapt-

ed to operate upon sheets of paper or the like, having suitable prearranged perforations, the combination of a support for the sheet having a slot or opening therein, means for conveying the sheet over and upon said support, the rock-shaft mounted above the plane of the latter, the fingers secured to said shaft, the conical or tapering pins on the free ends of said fingers, and having cylindrical portions above the base of the tapering portions, whose diameters are substantially equal to those of said perforations, respectively, the stop-bar for arresting the forward movement of the sheet when the said perforations overlie the slot in said support, mechanism for lateral guiding or placement of the sheet to a predetermined position, means for imparting an oscillatory motion at predetermined intervals to cause the said pins to enter some part of the area of said perforations respectively, up to their larger diameter, which perforations had been previously brought into proper position by the said stop-bar and lateral adjusting mechanism, and means for imparting a longitudinal movement to said shaft when the pins have entered said perforations, the construction, arrangement and timing of the parts being such as described, whereby the resultant of the movements imparted to said pins to the position of required registry is in a diagonal direction away from the stop-bar and the side-adjusting mechanism, substantially as and for the purpose set forth.

11. In a sheet-registering mechanism adapted to operate upon sheets of paper having two or more prearranged perforations, the combination of a suitable open or slotted support for the sheet, the stop-bar, side guiding or adjusting mechanism, the oscillatory and longitudinally-slidable shaft mounted above the plane of said sheet-support, the tapering or conical pins carried by said shaft, means for imparting an oscillatory movement to the latter whereby said pins are, at predetermined intervals, brought below the top surface of said support and below the plane of the sheet, and then retracted above said support and plane, means for imparting at predetermined intervals a longitudinal movement to said shaft and means for conveying the sheet onto and over said support and into position to be acted upon by said stop and side guiding or adjusting mechanism, substantially as and for the purpose set forth.

12. In a sheet-registering mechanism for folding-machines, adapted to operate upon sheets of paper, or the like, having suitable prearranged perforations, the combination with the usual folding devices, and the devices for conveying, guiding and stopping the sheet into position for folding, of the slidable rock-shaft, 17, the pins connected thereto, the crank-arm thereon, a revoluble shaft, as 19, the cam thereon upon which a roller of the free end of the crank-arm is adapted to ride, the spring tending to maintain shaft, 17, in the inward position longitudinally, the cam on said crank-arm against which a roller on a fixed arm is adapted to bear, and mechanism, substantially as described for shifting the sheet laterally into a predetermined position, the operation of said parts and mechanism being as described and timed with relation to each other and the folding mechanism as set forth.

13. In a sheet-registering mechanism of the character described, the combination of a suitable support for the sheet, means, respectively, for conveying, stopping and side guiding or adjusting of the sheet, the slidable rock-shaft, the pins carried thereby, the crank-arm on said shaft, the revoluble shaft, 19, the cam mounted thereon against which the free end of said crank-arm is adapted to ride, the cam, 30, upon said crank-arm, the fixed arm, having the roller, adapted to bear against the last-mentioned cam, the spring tending to force said rock-shaft inwardly, together with the spring for maintaining the said crank-arm in contact with the said cam upon the revoluble shaft, substantially as and for the purpose set forth.

14. In a sheet-registering mechanism of the character described, the combination of the oscillatory shaft, the pins carried thereby, the stop-bar, the sheet-carrying tapes, and the tension-rollers connected to said shaft, adapted to operate substantially as and for the purpose described.

15. In a sheet-registering mechanism for folding-machines, the combination of the vibratory folding-blade, the oscillatory shaft, the pins connected thereto, the slotted sheet-supporting plate inclined with relation to the plane of movement of the sheets to be operated upon, and having the slot whose center is in line substantially with the path of movement therein of the folding-blade, substantially as and for the purpose set forth.

16. In a sheet-registering mechanism for folding-machines of the character described, the combination of the oscillatory shaft, conical or tapering pins connected thereto, the tension-rollers mounted upon said shaft, the sheet-supporting plates, 11, the carrying-tapes in line respectively with said rollers, and having their upper surfaces below the plane of adjacent plates, substantially as and for the purpose described.

17. In a sheet-registering mechanism of the character described, the combination of the oscillatory shaft, the bar secured thereto and parallel therewith, the pins connected to said bar, and means for effecting longitudinal adjustment of said bar upon the shaft, substantially as and for the purpose specified.

18. In a sheet-registering mechanism of the character described, the combination of the oscillating shaft, the pins connected thereto, and means for effecting to-and-fro adjustments of said pins in planes at right angles to said shaft, substantially as and for the purpose specified.

19. In a sheet-registering mechanism of

the character described, the combination of the oscillatory shaft, the pins connected thereto, and means for effecting adjustments of said pins in planes parallel with said shaft, substantially as and for the purpose specified.

20. In a sheet-registering mechanism of the character described, the combination of the oscillatory shaft, the fingers connected thereto, the pins on the free ends of said fingers, and means for vertically adjusting said fingers, substantially as and for the purpose specified.

21. In combination with the paper-conveyers, a vertically-movable registering-pin sustained temporarily stationary and in elevated position, means arresting and disposing said paper with the perforation therein under said pin while in its aforesaid position and mechanisms actuating the pin to enter it into the aforesaid perforation and subsequently shifting the entered pin in a horizontal direction and thereby registering the paper.

22. In combination with the paper-conveyers and a gage arresting the movement of the paper, a vertically-movable registering-pin formed with a conical point to enter a circular perforation in the underlying arrested sheet and with a cylindrical portion immediately above said point to occupy said perforation, and mechanism moving said inserted pin laterally relative to its axis and thereby causing the cylindrical portion thereof to carry the sheet to its registering position as set forth.

23. The improved paper-registering pin formed with a conical point for entering into a circular perforation in the paper and a cylindrical portion immediately above said point to occupy said perforation as set forth.

In testimony whereof I have hereunto affixed my signature this 4th day of January A. D. 1899.

HOWARD K. KING.

Witnesses:
WALTER C. PUSEY,
JOSHUA PUSEY.