

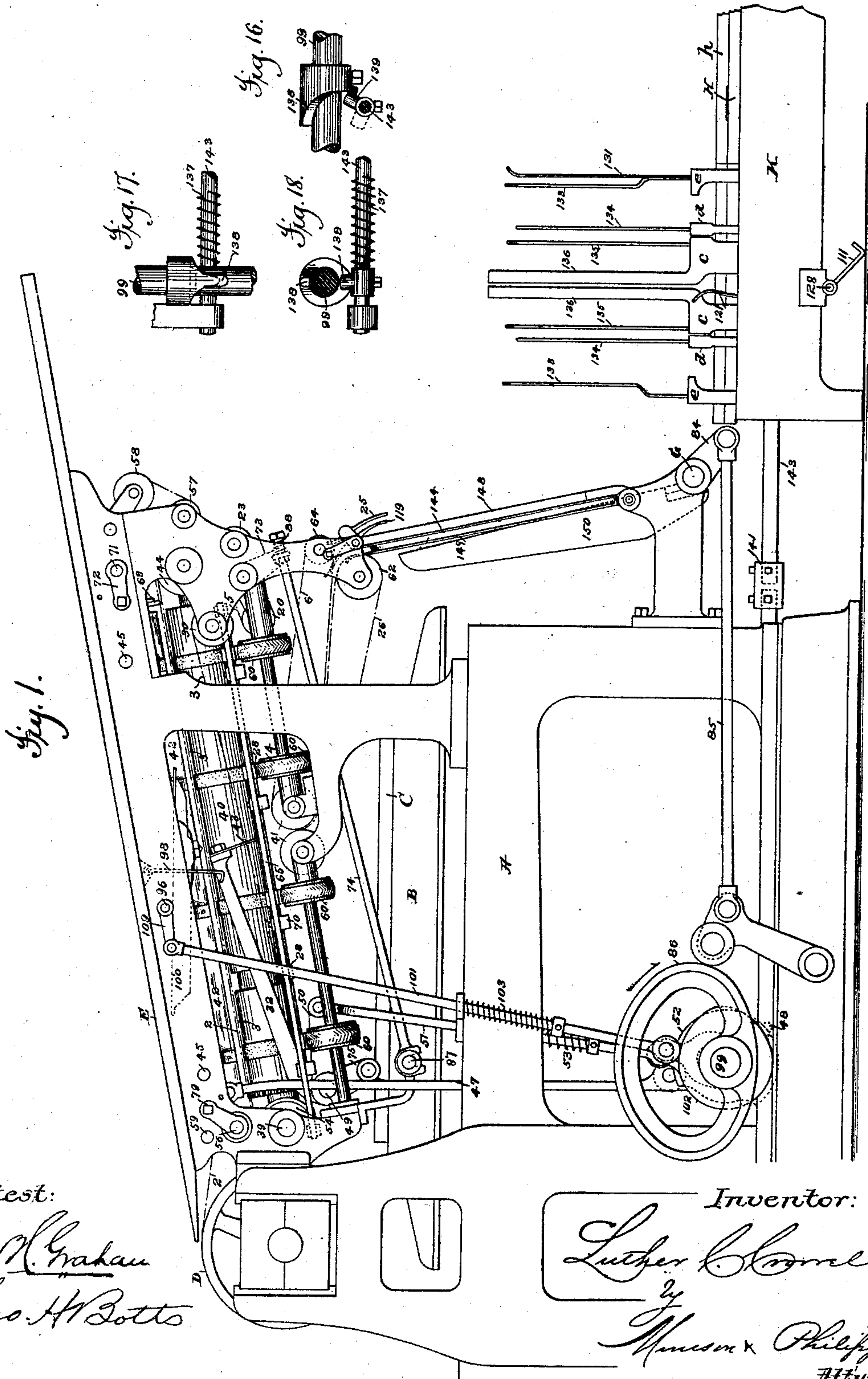
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11 Sheets—Sheet 1.

L. C. CROWELL.
PRINTING AND FOLDING MECHANISM.

No. 509,877.

Patented Dec. 5, 1893.



Attest:

Geo. H. Graham

Geo. H. Batts

Inventor:

Luther C. Crowell

Hanson & Philipp
Attys.

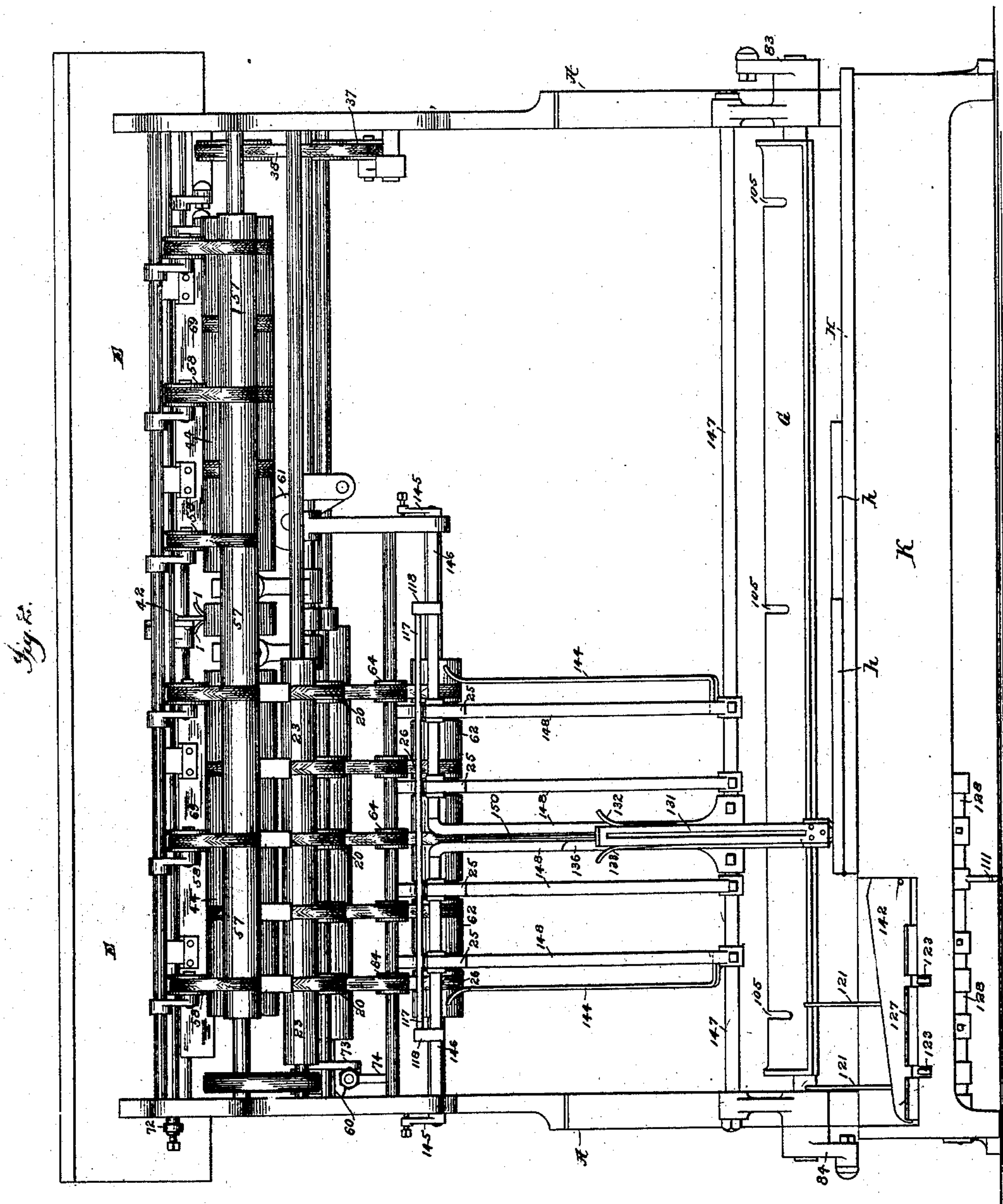
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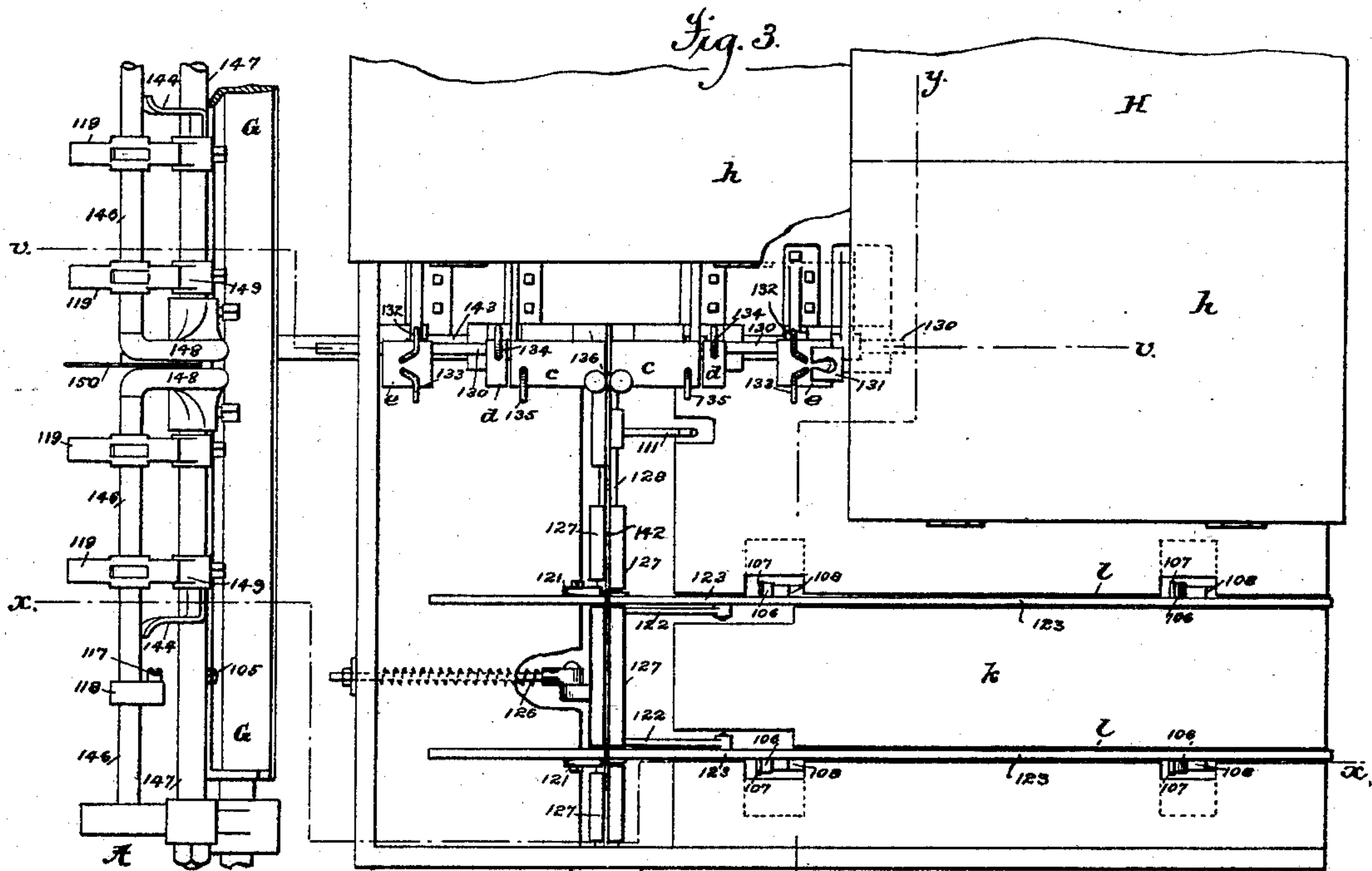
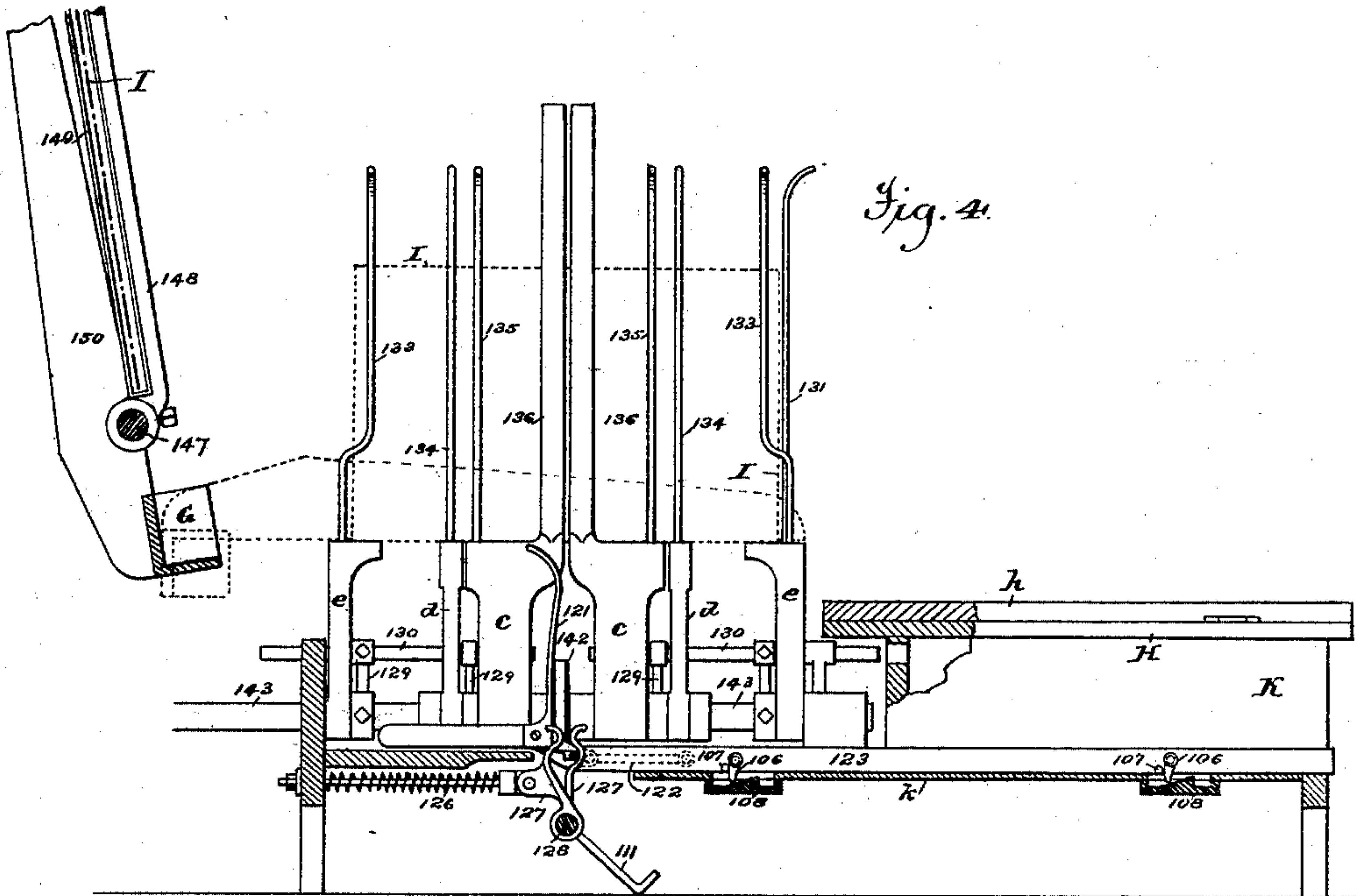
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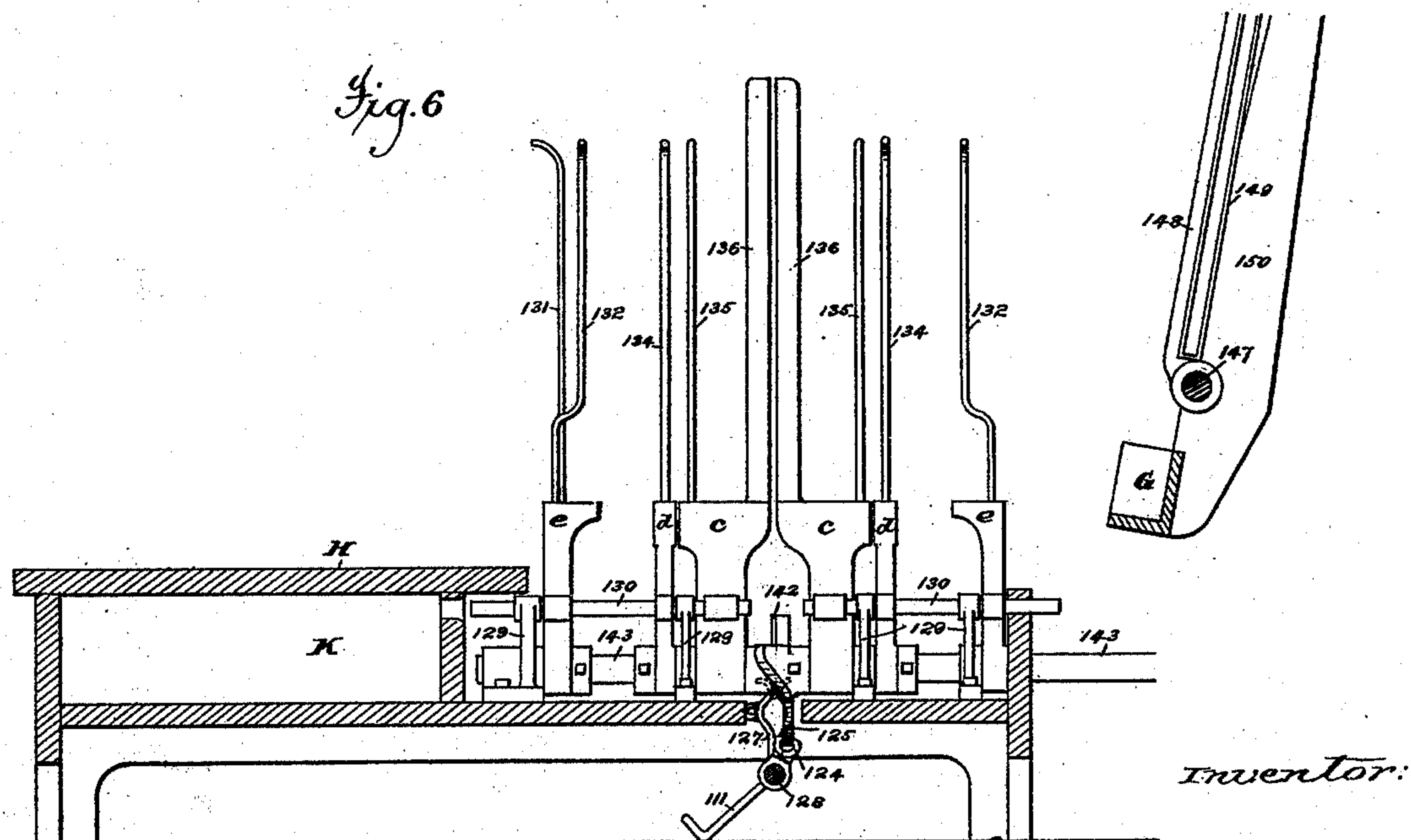
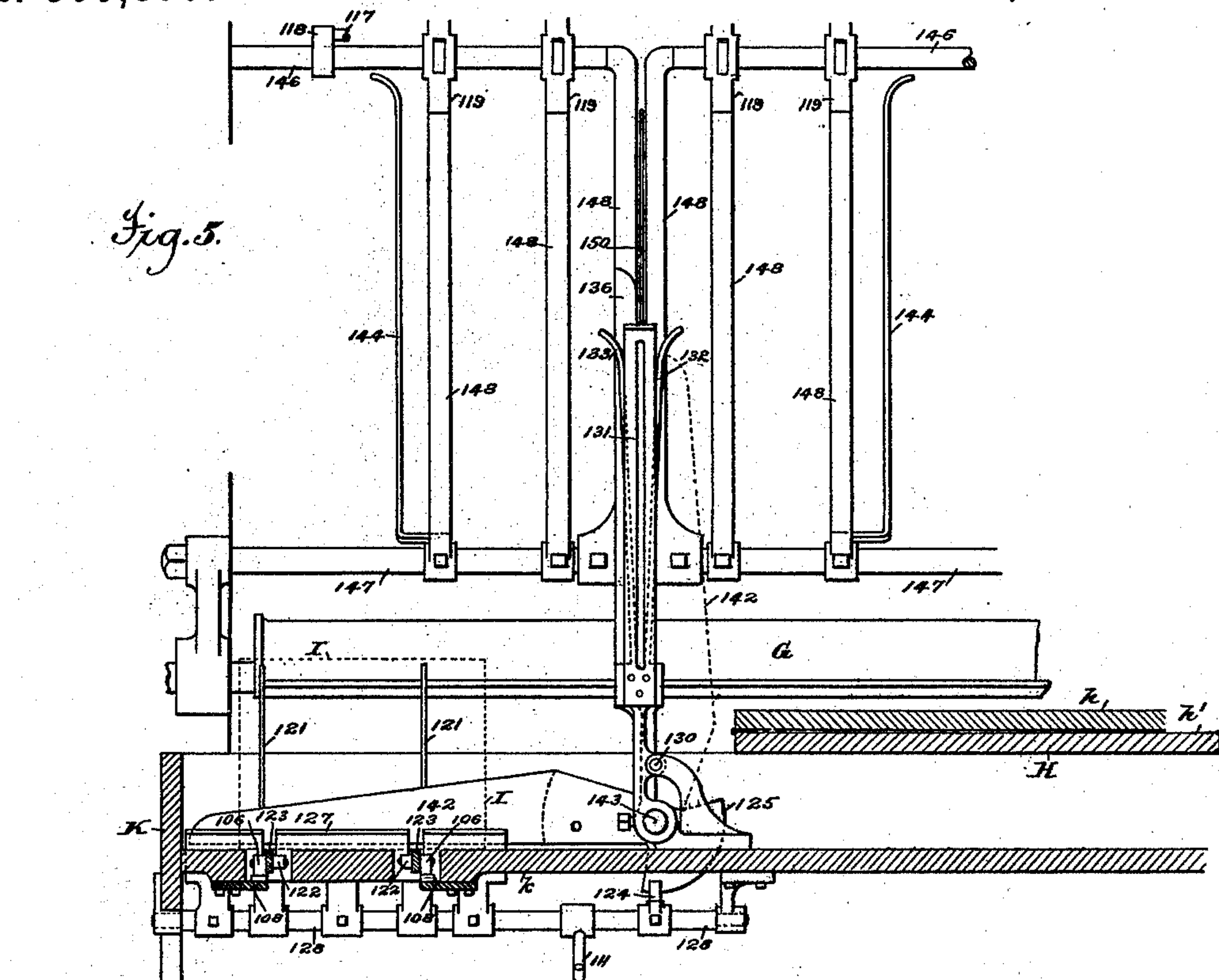
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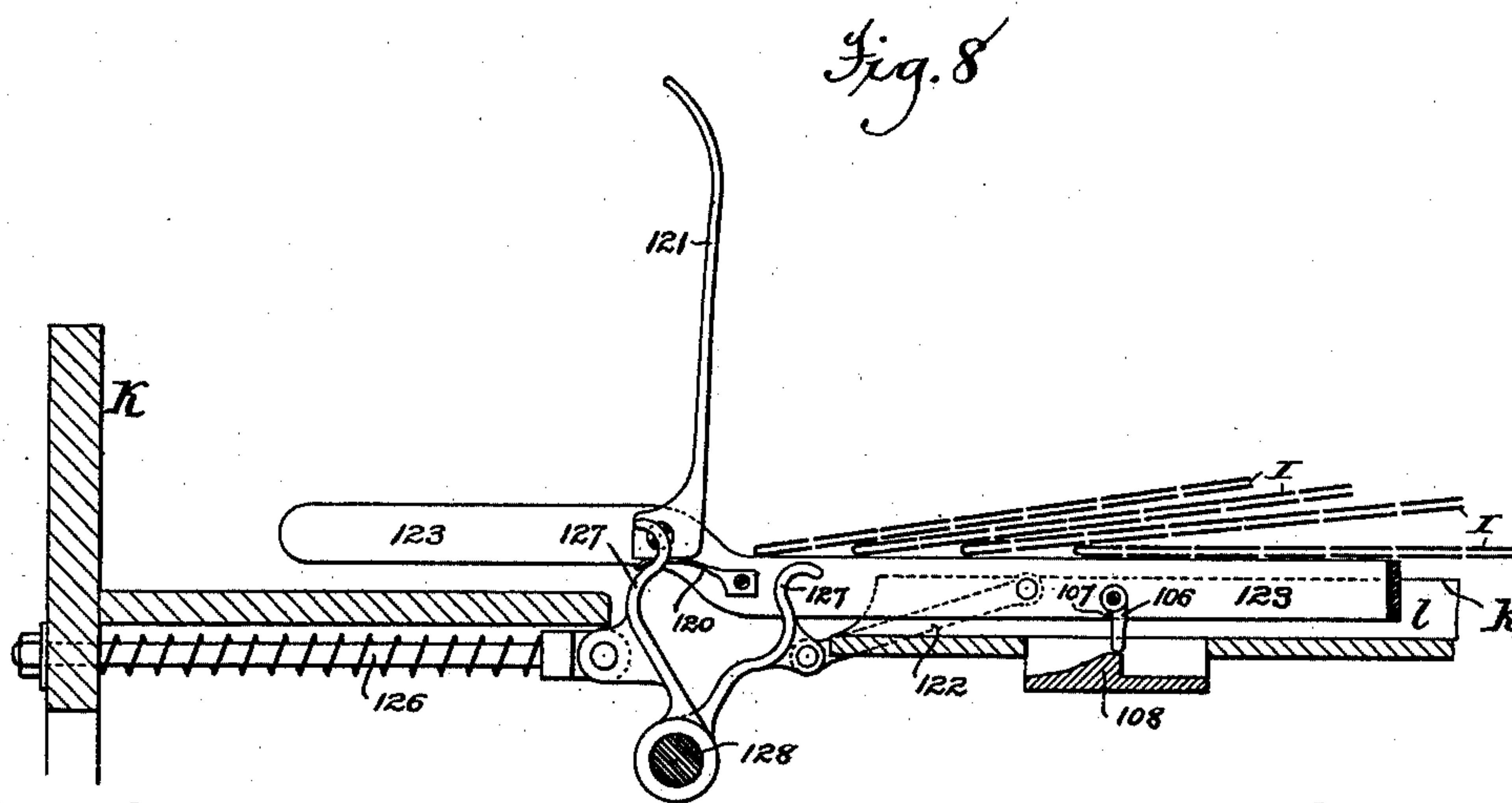
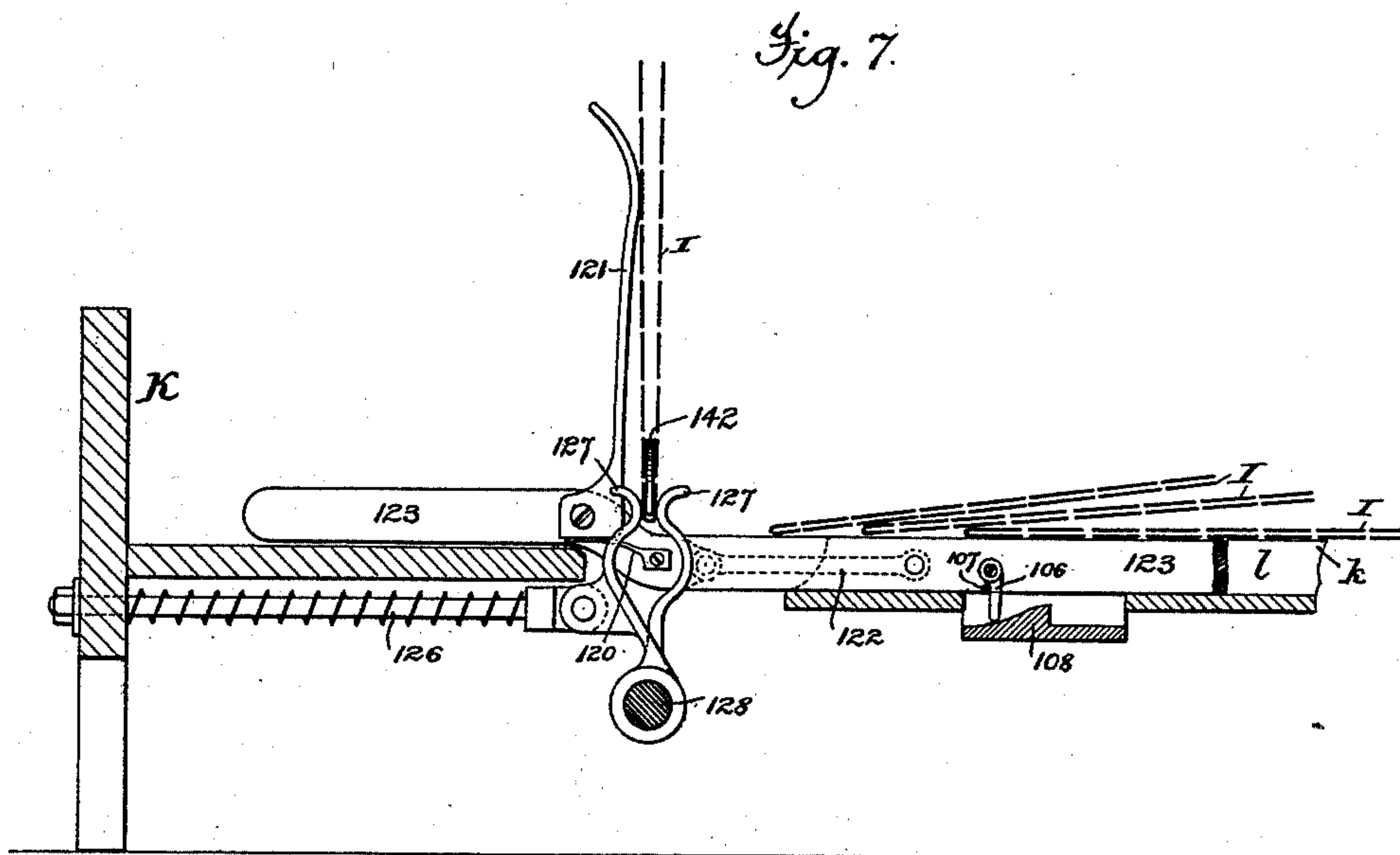
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11 Sheets—Sheet 6.

L. C. CROWELL.
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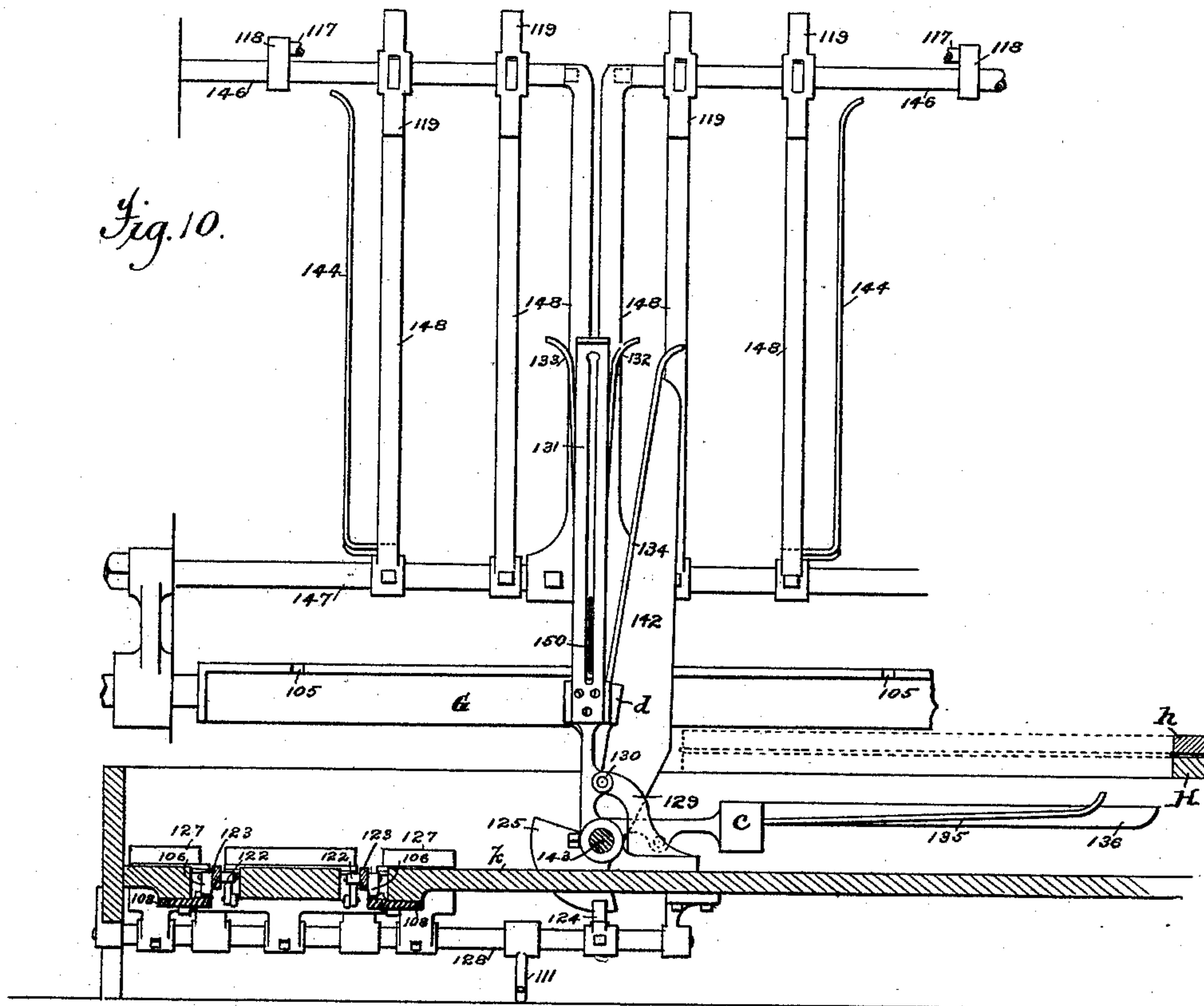
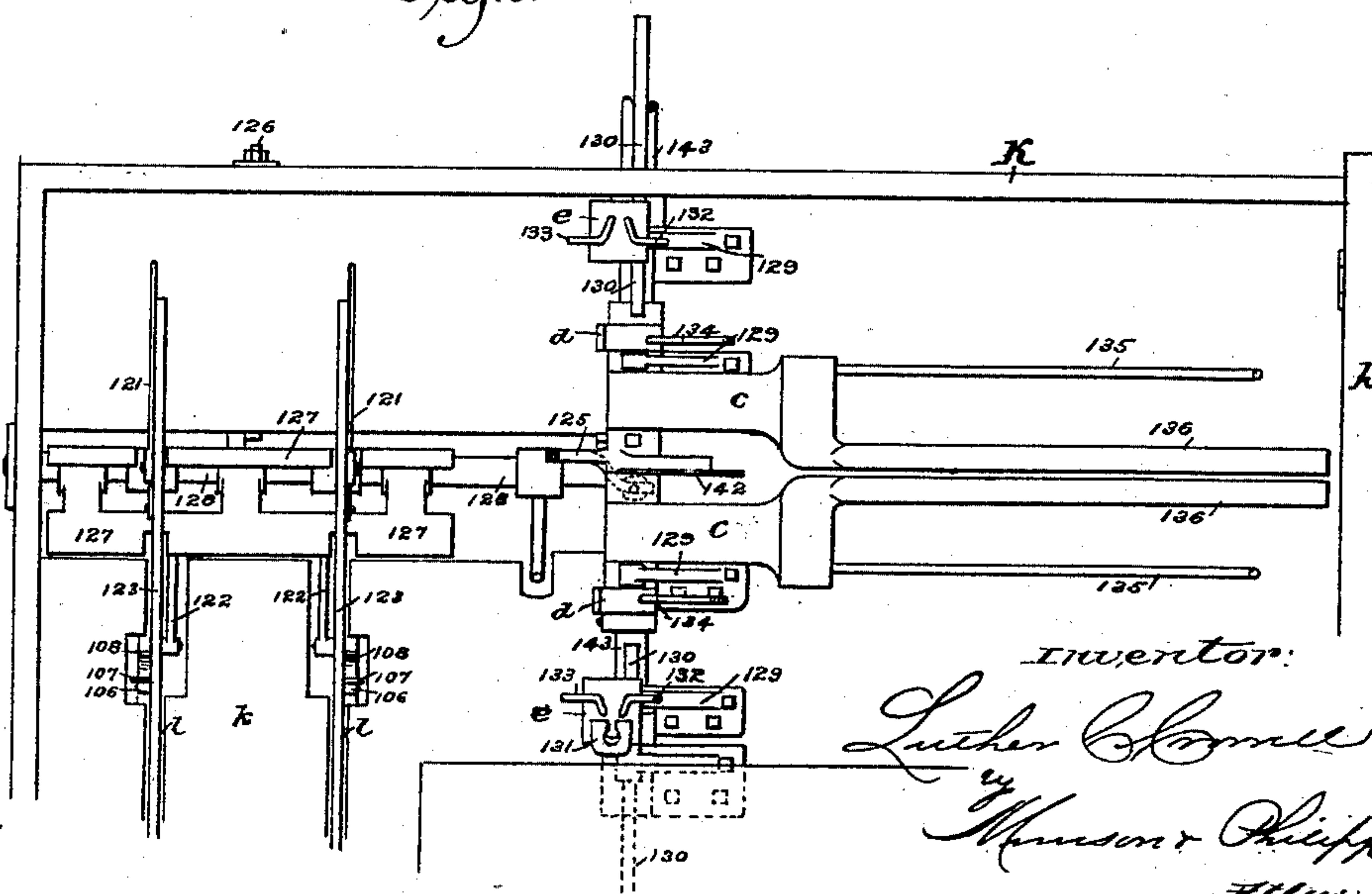


Fig. 9.



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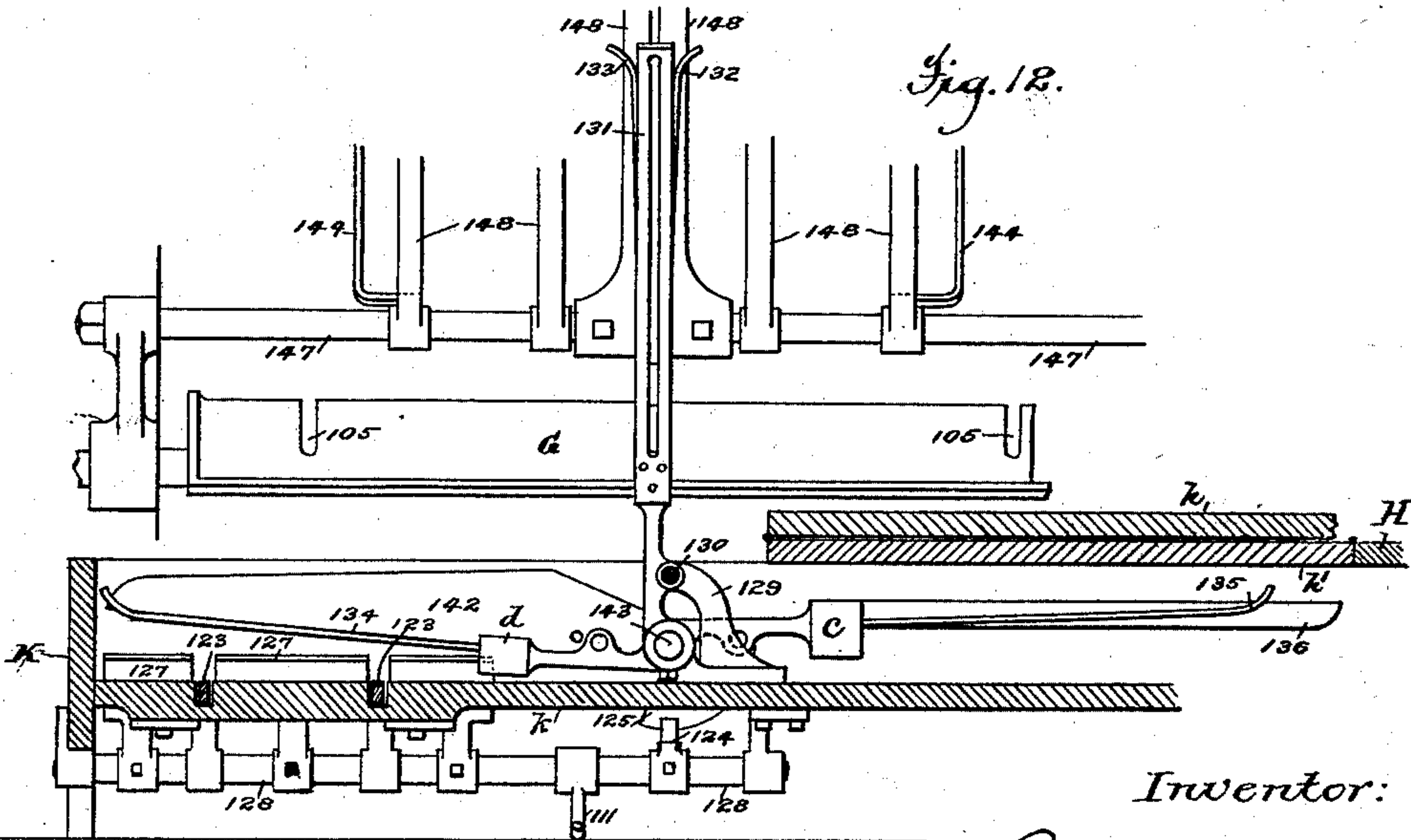
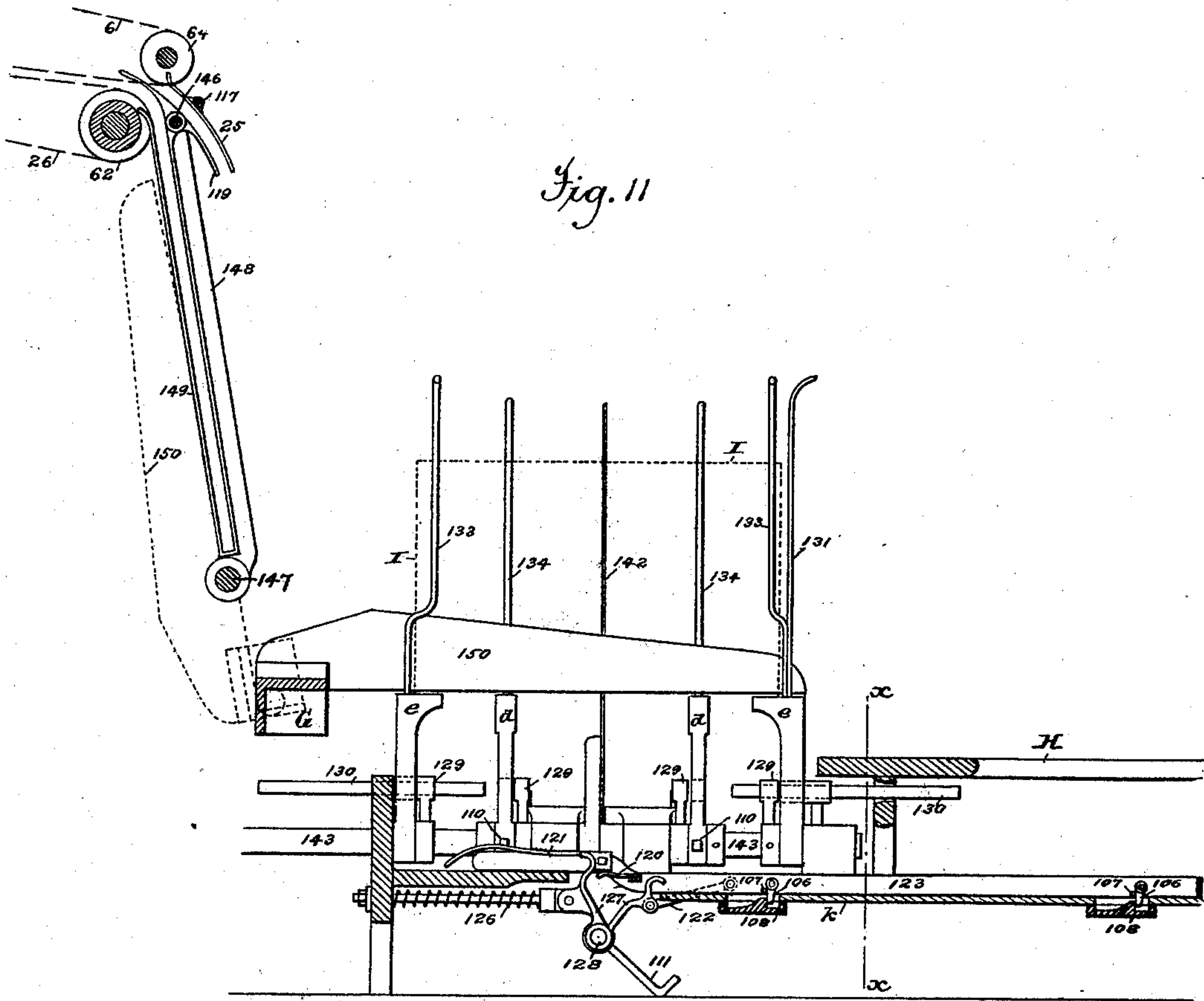
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L. C. CROWELL.
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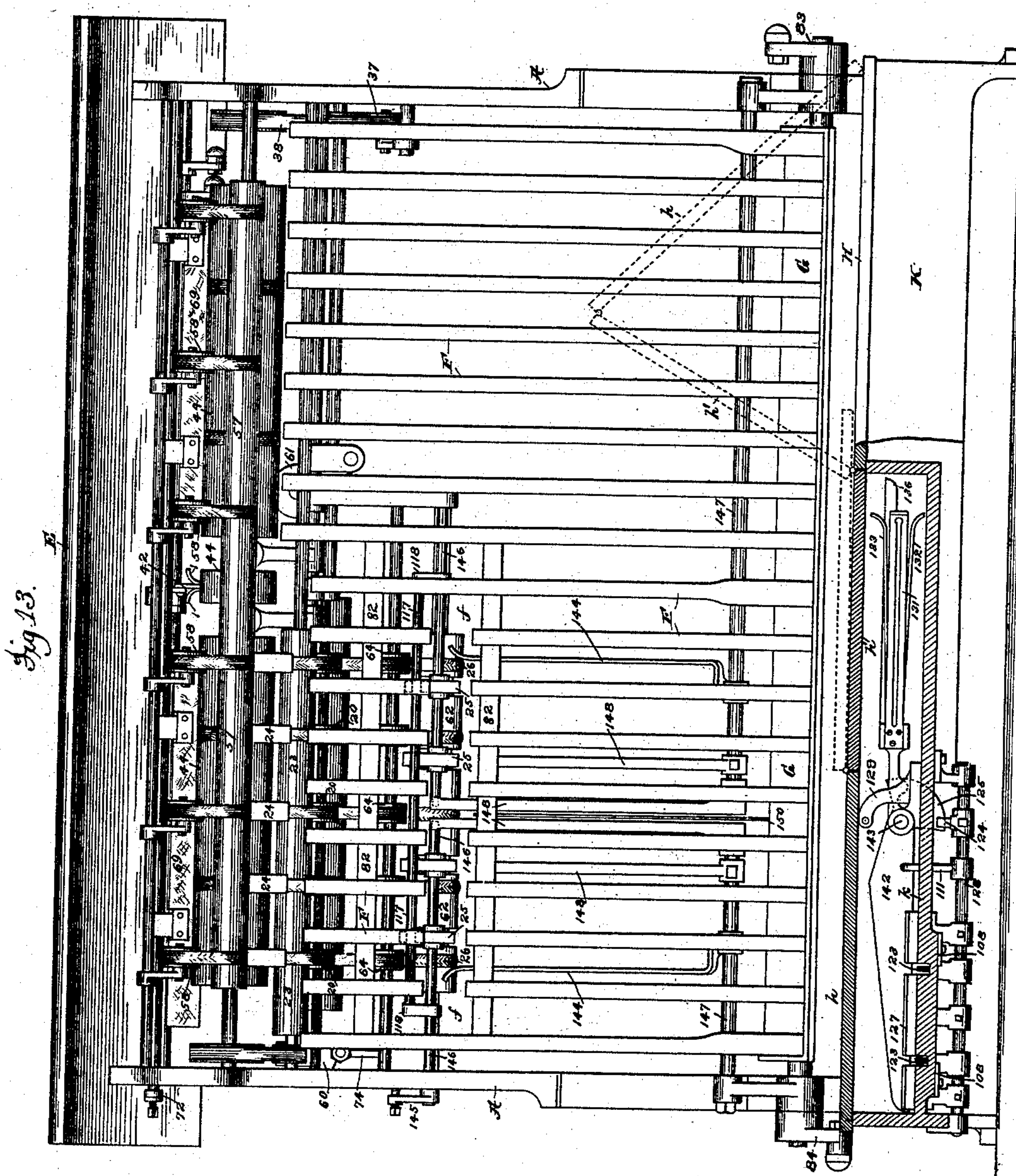
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11 Sheets—Sheet 9.

L. C. CROWELL.
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Fig. 15.

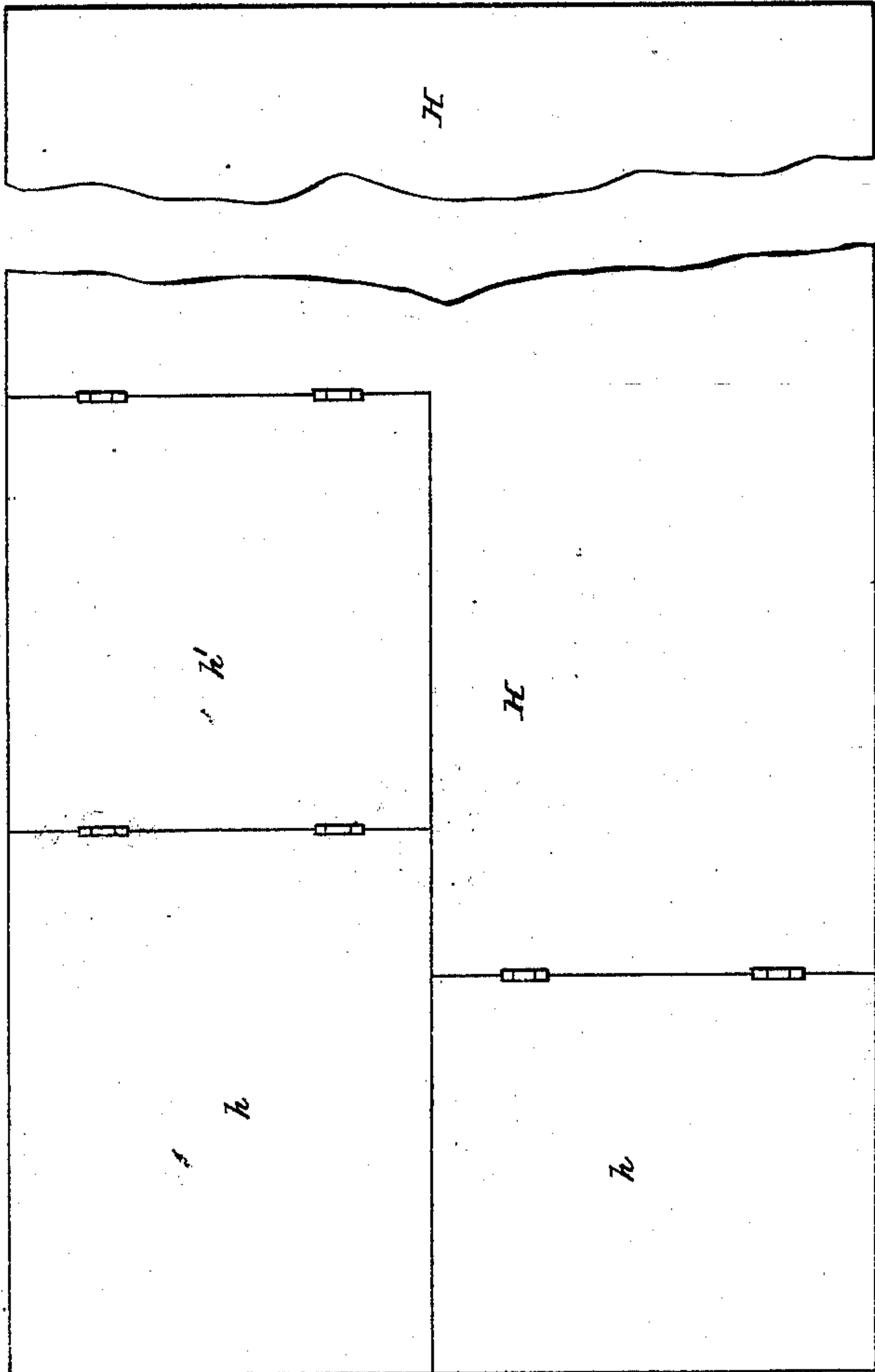
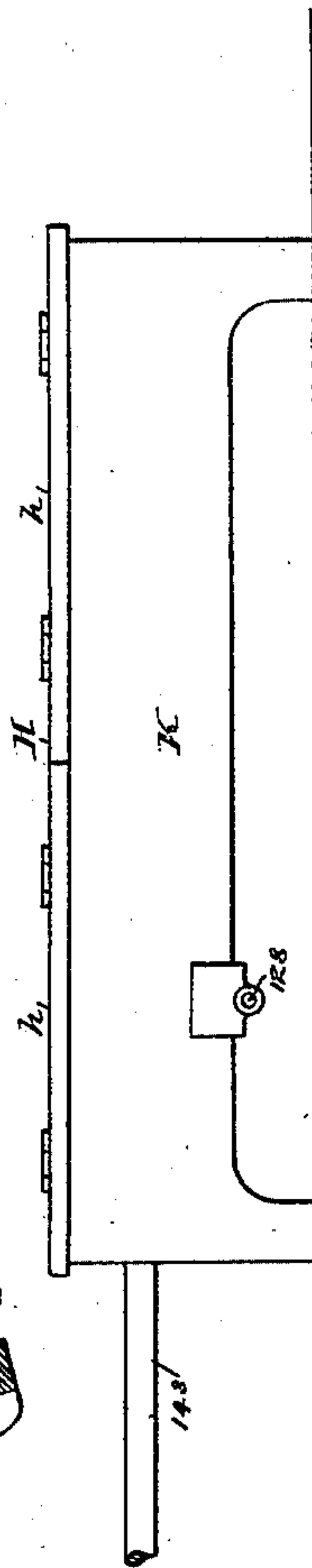
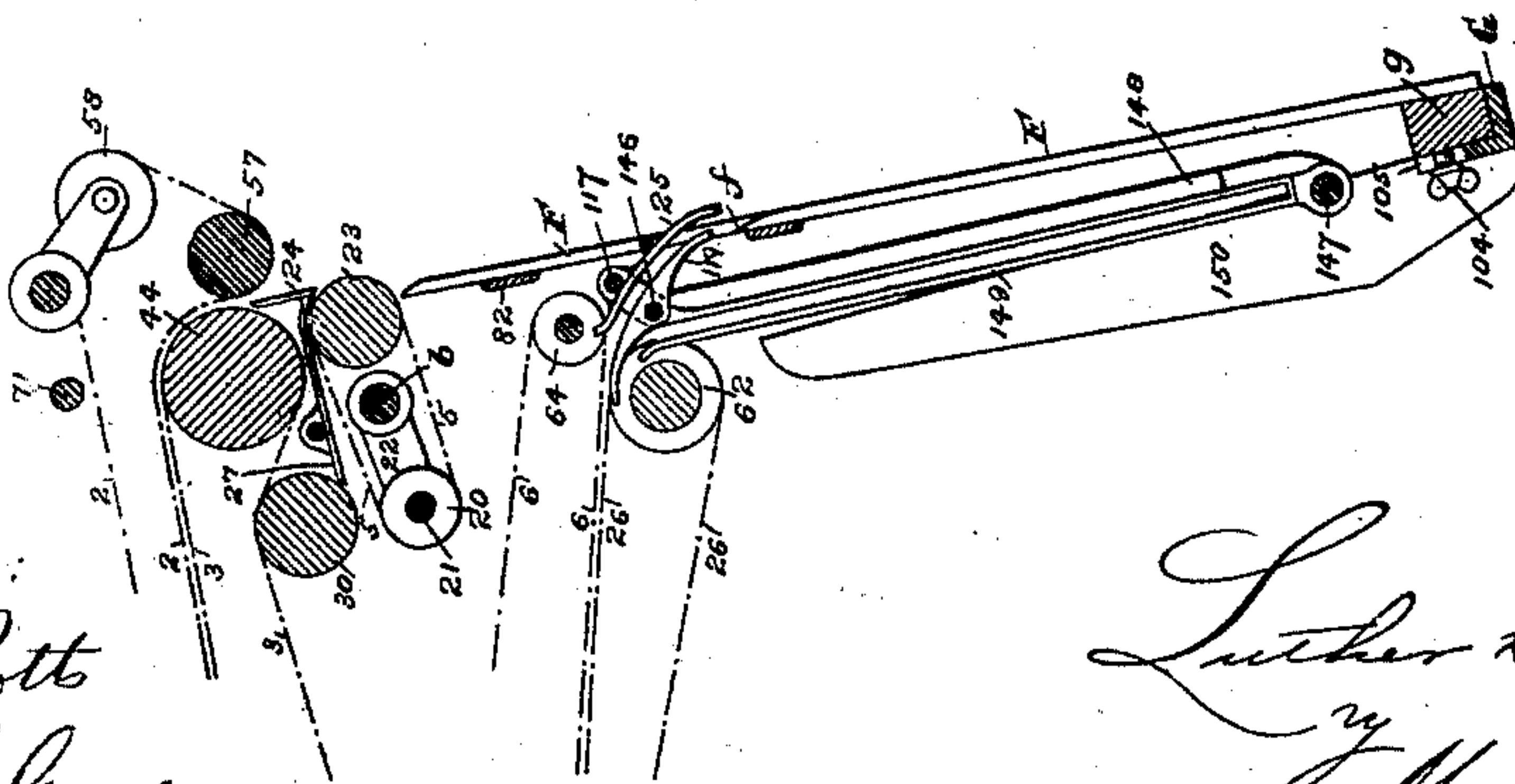


Fig. 14.



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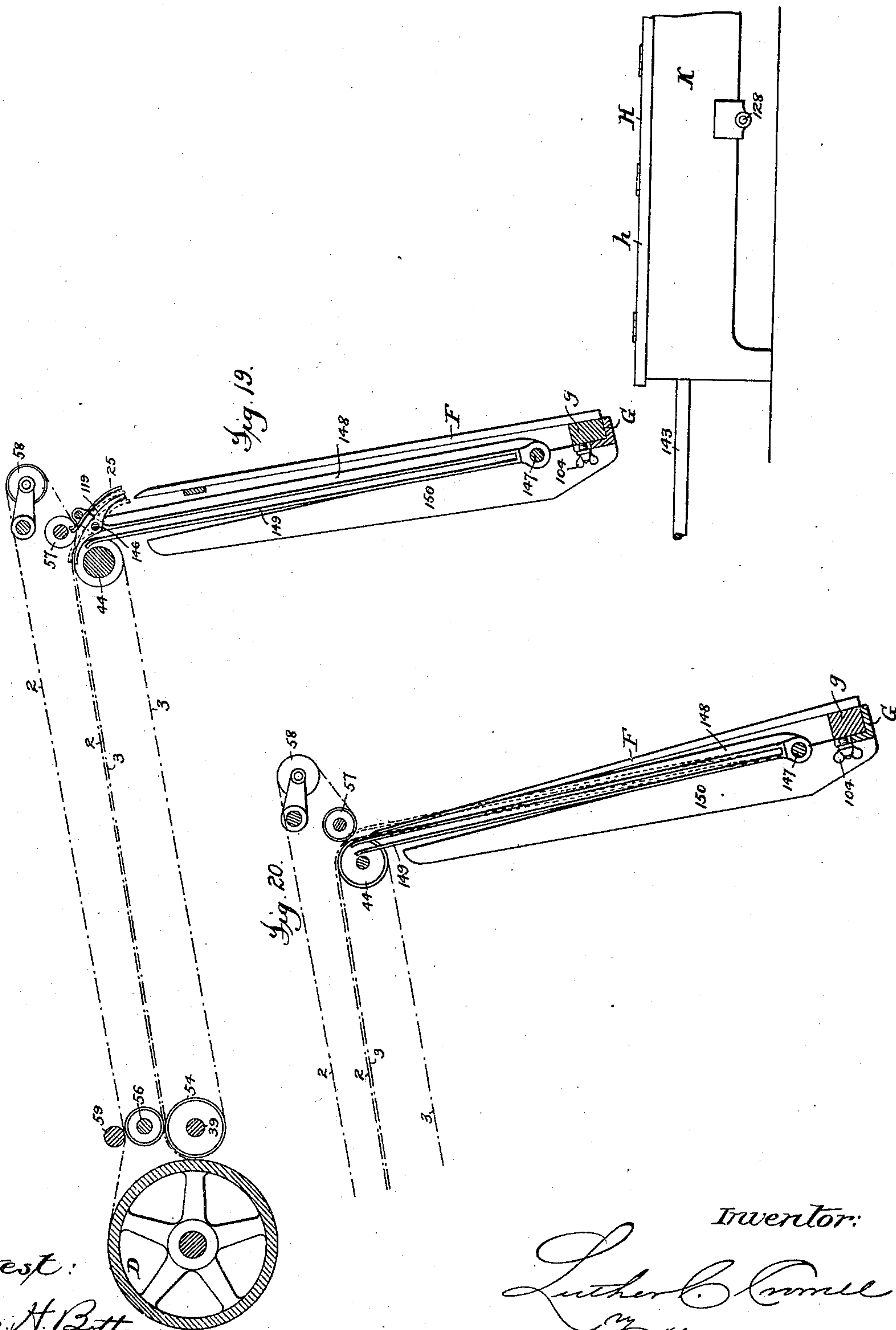
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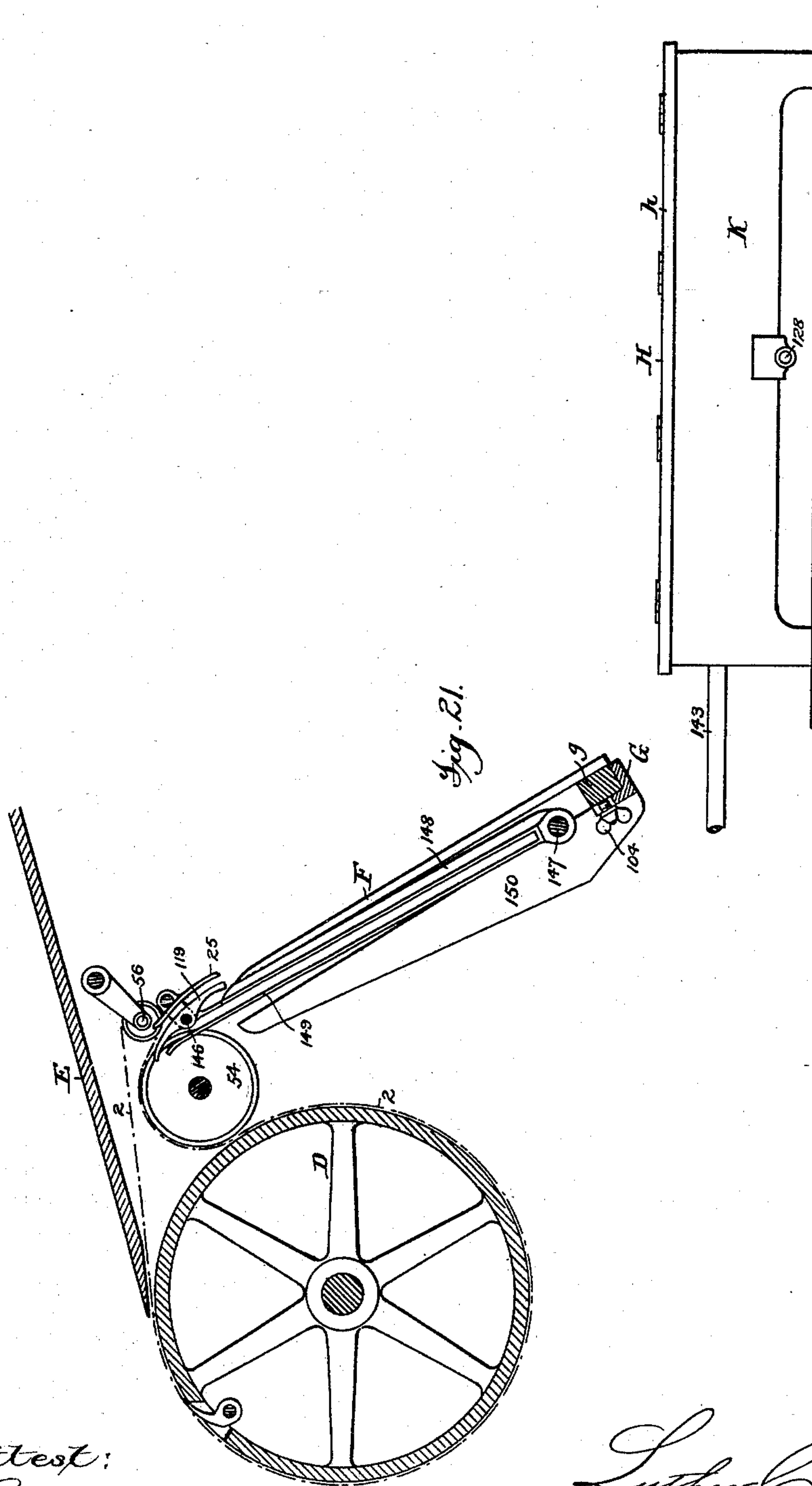
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UNITED STATES PATENT OFFICE.

LUTHER C. CROWELL, OF BROOKLYN, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO ROBERT HOE, STEPHEN D. TUCKER, THEODORE H. MEAD, AND CHARLES W. CARPENTER, OF NEW YORK, N. Y.

PRINTING AND FOLDING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 509,877, dated December 5, 1893.

Application filed January 13, 1887. Serial No. 224,186. (No model.)

To all whom it may concern:

Be it known that I, LUTHER C. CROWELL, a citizen of the United States, residing at Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Printing and Folding Mechanism, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

10 This invention relates to a folding mechanism which is especially designed and adapted to be combined with a printing mechanism of the kind known as a cylinder press.

15 It is the object of the invention to produce a combined press and folding mechanism in which the parts shall be so constructed and organized that the combined press and folder will occupy no more space than that occupied by the press alone, and which shall be capacitated by slight adjustments to deliver the sheets either in an unfolded condition or folded to different dimensions, as for example with one, two, three or four folds.

25 It is also the object of the invention to provide a folding mechanism of this character which shall be so constructed and organized that it can be applied to presses already in existence without the necessity of making material alterations in their organization.

30 As a full understanding of the invention can be best given by a detailed description of the construction and operation of the mechanism embodying the same all further preliminary description will be omitted and a full description given, reference being had to the accompanying drawings in which the principal figures show a combined press and folding mechanism constructed according to the present invention which is capacitated to print and deliver the sheets either in an unfolded condition or with one, two, three or four folds as may be preferred.

45 In said drawings: Figure 1 is a side elevation of said mechanism, only so much of the press, or printing mechanism proper, being shown as is necessary to illustrate the manner in which the folding mechanism is combined therewith. Fig. 2 is an end elevation of the same looking from the right of Fig. 1. 50 Fig. 3 is a plan view upon an enlarged scale of a part of the mechanism shown in Figs. 1

and 2. Figs. 4, 5 and 6 are sectional views taken respectively upon the lines *xx*, *yy* and *vv* of Fig. 3. In the foregoing figures the mechanism is shown as adjusted to deliver the sheets with four folds and the parts are shown in the same position in all of the figures. Figs. 7 and 8 are views similar to Fig. 4, but upon a slightly enlarged scale, showing the parts in different positions to illustrate the operation of the mechanism. Figs. 9, 10 and 11 are views similar to figures 3, 5 and 4 respectively, showing the mechanism adjusted to deliver the sheets with three instead of four folds, the parts being in the same position in all of the figures. Fig. 12 is a view similar to Fig. 10, it being taken on the line *xx* of Fig. 11, but showing the parts in a different position for the purpose of illustrating the operation of the mechanism. Fig. 13 is a view similar to Fig. 2, but showing the piling table in section and the mechanism adjusted to deliver the sheets in an unfolded condition or with one or two folds. Fig. 14 is a view similar to Fig. 11, but upon a somewhat smaller scale, and showing the piling table in elevation, the parts being in the same position as in Fig. 13. Fig. 15 is a plan view of the piling table when it is adjusted as in Figs. 13 and 14 to receive the sheets in an unfolded condition or with one or two folds, and Figs. 16, 17 and 18 are detail views of the cam and connections for transmitting motion from the main shaft to one part of the folding mechanism, Fig. 16 being a side elevation, Fig. 17 a plan view and Fig. 18 an end elevation of said cam, and Figs. 19, 20 and 21 are diagrammatic sections illustrating modifications which will be hereinafter referred to.

Referring to Figs. 1 and 2 it is to be understood that A represents a portion of the frame work, B the reciprocating bed, C the form, D the impression cylinder, E the feed board, G the fly shaft and H the piling table of an ordinary cylinder printing press. The bed B is provided with any of the ordinary connections (not shown) by which it is reciprocated in the usual manner, and the cylinder D is also driven in any of the common ways so as to rotate in unison with the bed at the time the impression is taken. The cylinder is also

provided with the usual sheet grippers (not shown) for holding the sheets to the cylinder during the printing operation. The feed board E is arranged in the usual or substantially the usual position above and at one side of the impression cylinder, and the shaft fly G and the piling table H are also located in the usual positions. From this it will be seen that the printing mechanism is of the ordinary and well known form.

The folding mechanism which is combined with this printing mechanism is in part located beneath the feed board, and in the path which the sheets take in machines of this class in passing from the impression cylinder to the fly, and in part on the fly shaft, and beneath the piling table. The part of the folding mechanism which is located beneath the feed board is capacitated to impart two folds to the sheets and the part which is located on the fly shaft and beneath the piling table is capacitated to impart two additional folds. When it is desired to deliver the sheets in an unfolded condition the whole folding mechanism is rendered inoperative and the sheets after being printed pass to the fly and are laid upon the piling table in the usual manner. When the sheets are to be delivered with one fold, the folding mechanism under the feed board is adjusted so that the sheets receive one fold before they reach the fly. When the sheets are to be delivered with two folds the mechanism beneath the feed board is put into full operation so that they receive two folds before they reach the fly. When the sheets are to receive three folds the fly is removed and the sheets, after being folded twice by the mechanism beneath the feed board, receive one additional fold from the folding mechanism upon the fly shaft and beneath the piling table. When four folds are required the whole folding mechanism is put into operation. That part of the folding mechanism which is located beneath the feed board is the same, except as to one or two minor particulars which will be hereinafter referred to, as that shown in my application for Letters Patent filed July 6, 1886, Serial No. 207,209; a general description and illustration of this part of the mechanism without going into all of its details, will therefore be sufficient in the present case. This part of the folding mechanism consists primarily of two pairs of folding rolls 40—41 and two vibrating folding blades 42—43 which operate to fold the sheets into the bite of the rolls in the usual manner. The rolls 40 are arranged at right angles to the impression cylinder about midway of its length, and the rolls 41 are arranged parallel with the impression cylinder and below and at right angles to the rolls 40 about midway of their length and extend from the rolls 40 outward to one side of the machine. The folding rolls 40 are geared together in the usual manner and receive motion from a gear upon the shaft 39 of the usual delivery pulleys 54 which shaft is

geared to the impression cylinder. The folding rolls 41 are also driven from the shaft 39 by means of a belt 38 which passes around a pulley upon said shaft, thence between pulleys upon the shafts of the rolls and around a pulley upon the shaft of the usual tape pulleys or roll 44, returning beneath a stretching pulley 37. The folding blade 42 is connected to arms extending from a pair of rock-shafts 45, one of which is provided with an arm which is acted on by a spring in such manner as to rock the shafts and hold the blade 42 in its raised position. The other of the shafts is provided with an arm to which is pivoted a vertical rod 47, the lower end of which is acted on by a cam 48 upon the main shaft 99 in such manner as to depress the blade 42 at the proper time to fold each sheet into the bite of the rolls 40. The arm upon the shaft 45 to which the rod 47 is pivoted is connected to the shaft by a clutch mechanism so that when desired the arm can be disconnected from the shaft, thus throwing the blade 42 out of operation and permitting it to remain in its raised position. The folding blade 43 is mounted upon arms 32 extending from a transverse rock-shaft 49 which is provided with an arm 50 to which is pivoted a rod 51, the end of which is acted on by a cam 52 on the shaft 99 in such manner as to hold the blade in its raised position, except at such times as the blade is required to be depressed to fold the sheets into the bite of the rolls 41. The downward movement of the blade 43 to accomplish the folding is effected by means of a spring 53 which is arranged to act upon the rod 51 in such manner as to rock the shaft 49 and depress the blade 43 when, by the movement of the cam 52, it is permitted to do so. The arm 50 is also connected to the shaft 49 by means of a clutch mechanism so that when desired the arm can be disconnected from the shaft. A suitable means is provided, as for example a hook 98 by which the blade 43 can be retained in its raised position when it is not in use.

The folding mechanism thus organized is provided with six sets of sheet conveying tapes, 2—3—4—5—6 and 26, which operate to take the sheets from the impression cylinder and convey them either directly to the fly in an unfolded condition, or to the folding rolls 40, and thence to the fly after being once folded, or to the folding rolls 41 and thence to the fly, or the subsequent folding mechanism, after being twice folded. These tapes are arranged as follows: The tapes 2—3 correspond to and are arranged in substantially the same manner as the ordinary conveying tapes with which this class of cylinder printing machines is usually provided to convey the sheets from the impression cylinder to the fly. The tapes 2 pass between the delivery pulleys 54 and the usual series of co-operating pulleys mounted loosely upon a shaft 56 located above the shaft of the delivery pulleys, thence for-

ward above the folding rolls 40 and over the roll 44, before referred to, which is located above the upper end of the fly, thence around a roll 57 and upward around stretching pulleys 58. From the pulleys 58 all of the tapes except the two marginal ones return directly around the pulleys upon the shaft 56. The two marginal tapes pass beneath a rod 59, and thence around the impression cylinder near its ends returning over the pulleys 54. The tapes 3 pass around the pulleys 54, and thence forward with the tapes 2 around the roll 44. From the roll 44 the tapes upon one side of the folding rolls 40 return directly to the pulleys 54 in the usual manner, while those upon the other side of the rolls 40 return over a roll 30 which extends inward from the side frame to the rolls 40. The tapes 4 pass over one of the folding rolls 40 and downward between the rolls, thence beneath the other of the rolls and outward to the side of the machine, thence around a series of pulleys 60 and inward, returning around a series of stretching pulleys 61. The tapes 5 pass around a series of pulleys 20 mounted loosely on a shaft 21 (see Fig. 14) which is located directly beneath the roll 30 and is rigidly supported in the ends of a pair of arms 22 extending from a transverse shaft *b*, and return around a roll 23 located beneath the roll 44. The tapes 6 pass around the outer one of the folding rolls 41, and thence downward and forward at an incline, returning around pulleys 64.

In the organization shown and described in my prior application hereinbefore referred to, the tapes 6 are provided with a series of cooperating stationary guides which lie beneath the tapes and extend from the rolls 41 to the pulleys 64. In the present case, however, these guides are omitted and in their stead is provided a series of tapes 26 which pass around the inner one of the folding rolls 41, and thence between the rolls and forward and downward with the tapes 6, returning around pulleys or a roll 62 located beneath, or substantially beneath the pulleys 64.

In addition to the various tapes already referred to there may be provided a narrow tape or tapes which pass around the middle of the impression cylinder, at the point where the blank space usually occurs between the printed pages of the sheet, thence above the central one of the pulleys 54 and around the corresponding one of the pulleys upon the shaft 56.

Located above the tapes 4 is a series of stationary guides 28 which extend from the folding rolls 40 outward to the side of the machine. These guides co-operate with the tapes 4 to convey the sheets from the rolls 40 outward above the rolls 41.

Located above the tapes 5 is a series of stationary guides 27 (see Fig. 14) which extend from the roll 30 forward and turn downward over the roll 23. These guides co-operate with the tapes 5 to convey the sheets out-

ward above the roll 23, as will be hereinafter explained. These guides are provided at their outer ends with upward extensions 24 which bridge the space between the rolls 44—23. This part of the folding mechanism is also provided with two sets of adjustable stops 69—70 for arresting the sheets at the proper points for the folding operation. The set 69 is arranged at or near the forward ends of the folding rolls 40 and is mounted upon a transverse rock-shaft 71 which is provided with an arm 72 by which it can be rocked so as to raise the stops when desired. The set 70 is arranged at or near the outer ends of the folding rolls 41 and is mounted upon the rod 65 which supports the outer ends of the guides 28.

The hub of one of the arms 22, in which the shaft 21 is mounted, is provided with an arm 73, the end of which is provided with a swiveled eye-bolt through which extends the end of a rod 74 having a head at its end between which and the eye-bolt is arranged a spring 88. The opposite end of the rod 74 is provided with a yoke which is arranged to embrace a stud on the end of an arm 75 extending from the hub of the arm 50 which operates the folding blade 43. This part of the folding mechanism may be provided with a slit by which the sheets may, when desired, be divided at their centers or on the line of the first fold. This slit is arranged over the central one of the pulleys 54 and mounted upon a shaft which is supported in arms which are rigidly fixed to the shaft 56. The shaft 56 is provided with an arm 79 by which it may be rocked so as to raise the slit and render it inoperative when desired. The shaft upon which the slit is mounted is provided with a gear which, when the shaft is lowered so as to carry the slit into operative position, engages with a gear upon the shaft 39 and thus gives a positive movement to the slit.

The folding blade 42 is provided upon its opposite sides with a number of light spring fingers 1 which are curved to conform to the curvature of the folding rolls 40.

The fly *F* (see Figs. 13 and 14) is of substantially the usual construction, except that those of its fingers which are in front of the folding rolls 41 and pulleys 62—64 are cut away so as to provide an opening *f* in front of the pulleys 62—64. The portions of the fly fingers which are above the opening *f* are supported upon a cross bar 82 which is secured to some of the uncut fingers. The fly is operated to pile the sheets by means of the usual spring (not shown) which acts upon the arm 83 of the fly shaft, and is returned to and held in its raised position by means of the usual arm 84, connecting rod 85 and cam 86 upon the main shaft. The fingers composing the fly frame instead of being attached directly to the fly shaft *G* are secured to a cross piece *g* (see Figs. 13 and 14) which in turn is detachably secured to the shaft *G* by means of bolts 104 which enter slots 105 formed in

the usual flange of the shaft. By this means the fly F can be readily and quickly removed from the shaft and replaced thereon when desired. The purpose of this will be made clear when the operation of the mechanism is explained.

For a more detailed illustration and description of the folding mechanism which has thus been described in a general way, reference is made to my prior application before referred to.

The second part of the folding mechanism, which is located on the fly shaft and beneath the piling table is constructed and arranged as follows: The fly shaft G carries a folding blade 150 which, when in its normal position, extends upward from the shaft inside the fly fingers and terminates somewhat below the pulleys 62. Located just inside the fly fingers and in front of the blade 150 are two series of guides 148—149 which extend from in front of the pulleys 62—64 downward to a point somewhat above the fly shaft G and between which the sheets may be directed as they emerge from between the pulleys 62—64 so as to pass downward in front of the blade 150, as will be hereinafter more fully explained. These guides are supported at their lower ends upon rods 147 which extend inward from the brackets which support the fly shaft and terminate near the blade 150 so as to allow the blade to pass between their ends. The guides 148 afford bearings at their upper ends for a pair of rods 146 which carry a series of switches 119 which are so arranged that they will operate to direct the sheets downward between the guides 148—149 or forward through the opening *f* in the fly. The rods 146 are provided with suitable means, as the arms 145, by which they can be rocked to move the switches to either position as may be required. The rods 146 are provided with arms 118 (see Figs. 1, 2 and 11) which support a rod 117 upon which are mounted a number of guides 25 which cooperate with the switches 119 to direct the sheets through the opening *f* when the switches are shifted to the position shown in Fig. 14. The two guides 148 which are nearest to the blade 150 are comparatively close to each other so that as the blade is rocked forward, as will be hereinafter explained, they operate as folding bars or guides to fold the sheet which has been directed downward between the guides 148—149 across the edge of the blade. The rods 147, in addition to the guides 148—149, may also support a pair of side guides 144 which will act upon the edges of the sheets so as to prevent them from being moved laterally out of proper position in front of the blade 150.

The piling table H is supported upon a rectangular casing or box K and is made so that it can be either wholly removed from the top of the casing or is made in sections so that portions of it can be raised and folded back to expose the interior of the casing.

When the sheets are to be delivered in an

unfolded condition, or with one or two folds, the piling table H is placed upon the top of the casing K or, if it is made in sections, the sections are turned down so as to present a plain surface, as shown in Fig. 15, upon which the sheets are laid by the fly in the usual manner. When the sheets are to be delivered with three or with four folds, the table H is removed or the sections *h* are folded back, as best shown in Figs. 3 and 5, so as to expose the interior of the casing.

Mounted in the casing K beneath the table H is a shaft 143 which is arranged at right angles to the fly shaft and in line with the blade 150, and is provided with a folding blade 142 similar to the blade 150. The shaft 143 extends beneath the fly shaft and to a point beneath the main shaft 99 and is made in two parts which are connected by a coupling consisting of a collar 141 and suitable set screws. The shaft 143 is provided with a spring 137 (see Figs. 17 and 18), the tendency of which is to hold the shaft in such position that the blade 142 will stand in a vertical position, as shown in Figs. 9, 10 and 11. The shaft 143 is provided with a stud 139, (see Figs. 16, 17 and 18) which is acted on by a cam 138 on the main shaft 99 in such manner as to periodically rock the shaft 143 against the tension of the spring 137 and vibrate the blade 142 from the vertical position shown in Figs. 9, 10 and 11 down to the horizontal position shown in Figs. 3, 4, 5, 6, 7 and 12. In addition to the blade 142 the shaft 143 is provided with six arms *c d e* which are mounted loosely upon the shaft so as to assume either a vertical or a horizontal position. The arms *c* which are the middle ones of the series are provided with two upwardly or outwardly extending bars or rods 136 which are comparatively close to each other and in such position that the blade 142 will pass between them as it is vibrated from its vertical to its horizontal position. The arms *c* are also provided with two rods 135 which are arranged in or substantially in line with the rods 136. The rods 135—136 are so positioned that when the arms *c* are in their vertical position and the folding blade 142 is in its normal position it will be somewhat in the rear of the rods. The arms *d* are provided with upwardly or outwardly extending rods 134, similar to the rods 135, but so located that when the arms are in their vertical position the folding blade 150 will, when it is vibrated to its horizontal position, pass between them and the rods 135—136. The arms *e* are provided with a pair of rods 133 which are arranged in line with the rods 135—136 and with a second pair of similar rods 132 which are arranged in line with the rods 134. The outer one of the arms *e* is also provided with a slotted guide 131 which serves as an edge guide for the sheet and also as a guide for the end of the folding blade 150 when it is vibrated from its vertical to its horizontal position. The rods 132, 133, 134, 135 and 136

serve as side guides or supports to receive the sheets from the blade 150 and to support them in position to be acted on by the blade 142 and the rods 136 also serve as folding bars or guides to fold the sheets across the edge of the blade 142. The arms *c d e* carrying the rods and guide just described are held in their vertical position by means of sliding rods 130 which are supported in brackets 129 and pass through openings in the arms, as shown.

Located at right angles to the shaft 143 and directly in front of the blade 142 is a shaft 128 which is provided with a pair of upwardly projecting jaws 127, one of which is rigidly fixed to the shaft while the other is pivoted to the shaft and is normally held pressed against the rigid jaw by means of a pivoted spring pressed rod 126. The shaft 143 is provided with a cam 125 (see Figs. 5, 6, 10 and 12) which acts upon a bifurcated arm 124 extending from the shaft 128 in such manner that, as the shaft 143 is rocked to vibrate the blade 142 from its vertical to its horizontal position, the shaft 128 will be rocked so as to close the jaws 127, while, as the shaft 143 is rocked in the reverse direction to return the blade 142 to its vertical position, the shaft 128 will be rocked in the reverse direction so as to open the jaws 127. The bottom *k* of the casing K is provided with two channels *l* in which is located a pair of bars 123 which bend upward at their inner ends and pass through openings in the jaws 127 and are arranged to be moved freely longitudinally in the channels *l*. These bars are connected by pivoted links 122 with the rigid jaw 127 so that each time the shaft 128 is rocked to close and open the jaws 127, the bars 123 are reciprocated in the channels *l*. The bars 123 are provided just in the rear of the jaws 127 with a pair of pivoted arms 121 which are arranged to be turned up to a vertical or down to a horizontal position. The pivoted ends of the arms 121 are provided with square shoulders, as shown, which are acted on by springs 120 in such a manner as to retain the arms in either their vertical or their horizontal position. Each of the bars 123 is also provided with a pair of pivoted dogs 106 which are arranged to swing freely outward, but are limited in their inward movement by stops 107 formed on the bars. These dogs extend below the lower edges of the bars and their lower ends are arranged to act upon inclines 108 formed in the bottoms of the channels *l*. The inclines 108 are so arranged that, as the bars 123 are moved outward by the rocking of the shaft 128 to open the jaws 127, the dogs 106 will ride up the inclines and thus raise the upper edges of the bars above the surface of bottom *k* of the casing, until the bars arrive at the limit of their outward movement, as shown in Fig. 8, when the dogs 106 will drop off the ends of the inclines and allow the bars to fall back into the channels. As the shaft 128 is rocked in the reverse di-

rection and the bars make their return movement, the dogs 106 will turn upon their pivots and pass idly over the inclines without raising the bars.

The especial purpose of the various features of construction which have been described will more fully appear when the operation of the combined press and folding mechanism is described.

The combined press and folding mechanism is herein shown as provided with a pasting mechanism by which, when desired, a line of paste can be applied to one half of the sheet in such position that when the sheet is folded the two halves will be united to each other along the line between the printed pages. This pasting mechanism is of the form shown and described in my prior application for Letters Patent filed June 25, 1886, Serial No. 206,195, and consists of a cylinder having a contracted nozzle or discharge opening which is arranged in position to discharge a fine line of paste upon the sheet as it passes beneath it in being folded between the folding rolls 40. This cylinder is arranged in a paste fountain or vat 100, and is provided with a reciprocating piston or plunger which operates upon its suction stroke to draw a supply of paste into the cylinder and upon its force stroke to eject the paste through the contracted discharge opening of the cylinder onto the moving sheet. This piston is operated by arms extending from a rock-shaft which is provided with an arm 109 to which is pivotally connected a rod 101 which is acted on by a cam 102 mounted on the main shaft 99. These parts are so arranged that the piston will be moved downward by the cam at the proper time to discharge the paste from the cylinder while the sheet is moving beneath the nozzle in the proper position to receive it. The movement of the shaft 96 in the opposite direction is effected by means of a spring suitably arranged for that purpose. For a full description and illustration of this pasting mechanism, as well as of the devices with which it is, or may be, provided to prevent the paste from being discharged from the cylinder when no sheet is present to receive it, reference is made to my prior application before referred to.

The operation of the combined press and folding mechanism thus constructed and organized is as follows: The operation of the mechanism when adjusted to deliver the printed sheets with four folds will be first described. When it is desired to deliver the sheets with this number of folds, the piling table H will be removed from the casing K, or if the table is made in sections the sections *h* will be folded back, as shown in Fig. 3, so as to expose the interior of the casing; the arms *c d e* will be turned up to their vertical position and secured in that position by the rods 130, and the arms 121 will be turned up to their vertical position; the fly F will be removed from the shaft G; the switches 119 and

guides 25 will be turned to the position shown in Figs. 1 and 11, so as to direct the sheets from the pulleys 62—64 downward between the guides 148—149; the stops 69 will be lowered so as to be interposed in the path of the sheets as they pass forward between the tapes 2—3; the clutch upon the shaft 45 will be adjusted so as to throw the folding blade 42 into operation; the clutch upon the shaft 49 will be adjusted so as to throw the folding blade 43 into operation, and the rod 74 will be disconnected from the arm 75 and hooked onto a stationary stud 87 provided for that purpose so as to cause the pulleys 20 to remain idle (all as shown in Figs. 1 to 8). With the mechanism thus adjusted the sheets fed from the feed table E will be taken by the grippers upon the impression cylinder and presented to the form C and printed in the usual manner, after which they will be carried off the cylinder by the tapes 2 and the center tape or tapes hereinbefore referred to, and pass into the control of the tapes 2—3 by which they will be carried outward above the folding rolls 40 until their leading ends arrive at the stops 69. As the leading end of each sheet arrives at the stops 69 the folding blade 42 will be operated so as to fold the sheet into the bite of the rolls 40, and after being thus folded the sheet will be carried outward by the tapes 4 above the folding rolls 41 until it is arrested by the stops 70. As the sheet is thus arrested the folding blade 43 will be operated to fold the sheet into the bite of the rolls 41, thus imparting the second fold, after which the sheet will be carried to the pulleys 62—64 by the tapes 6—26. The operation thus far described is the same as that of the mechanism described in my prior application hereinbefore referred to. As the leading end of each sheet arrives at the pulleys 62—64 it will be directed downward by the switches 119 and pass downward between the guides 148—149 in front of the folding blade 150, as shown by dotted lines in Fig. 4. As the sheet I arrives in the proper position in front of the blade, the shaft G will be rocked so as to vibrate the blade 150 downward from its vertical to its horizontal position, and, as the blade is thus vibrated it will strike the sheet at its center and carry it between the central ones of the guides 148, and these guides co-operating with the blade a folding bar will double the sheet across the edge of the blade, thereby giving it a third fold. As the blade continues its forward and downward movement it will carry the folded sheet between the vertical rods 132—134 and 133—135—136 until its folded edge is brought to rest upon the upper ends of the arms *c d e*, as shown by dotted lines in Fig. 4. When the sheet is in this position it will be supported by the rods 132, 133, 134, and 135 and will lie between the rods 136 and the folding blade 142. As the shaft G is vibrated in the reverse direction, the blade 150 will be carried out from between the plies of the folded sheet and the sheet will be left standing in a verti-

cal position between the rods 136 and the blade 142. As the blade 150 is thus vibrated back to its original position, and after it has been withdrawn from between the plies of the folded sheet the cam 138 will rock the shaft 143 so as to vibrate the blade 142 from the vertical position shown by dotted lines in Fig. 5 down to the horizontal position shown by full lines in said figure. As the blade 142 is thus vibrated it will strike the sheet upon its central line and carry it between the rods 136 and these rods co-operating with the blade as folding bars will double the sheet across the edge of the blade, thereby imparting to it its fourth fold, and as the blade 142 is thus vibrated the cam 125 will, as already explained, rock the shaft 128 so as to close the jaws 127 and draw the bars 123 inward so that as the blade arrives at its horizontal position it will force the newly folded edge of the sheet into the bite of the closed jaws, as shown in Fig. 7 and by dotted lines in Fig. 5, the pivoted member of the jaws yielding sufficiently against its spring to permit this. As soon as the folded edge of the sheet has been thus inserted into the bite of the jaws 127 the shaft 143 will be rocked in the reverse direction so as to carry the blade 142 back to its vertical position, and as the blade is thus carried back to its vertical position and after it has been withdrawn from between the plies of the folded sheet the cam will, as already explained, rock the shaft 128 so as to open the jaws 127 and move the bars 123 and the arms 121 carried by the bars outward, as shown in Fig. 8. When the sheet is left standing in the bite of the jaws 127, as just explained, it will be supported on one side by the arms 121 but will be unsupported upon the other side so that the sheet will have a tendency to fall over onto the bars 123. From this it will result that as soon as the jaws 127 are opened the sheet will fall over into a flat position upon the bars. As the bars are moved outward they will, by the action of the dogs 106 upon the incline 108, be raised, as already explained, and as shown in Fig. 8, so that they will lift the sheet and carry it outward a short distance. This operation will be repeated as each sheet is printed and carried off the impression cylinder. As the jaws 127 are closed preparatory to receiving each sheet the bars 123 will be drawn inward, but the dogs 106 having passed beyond the ends of the inclines 108 will turn upon their pivots and move back idly over the inclines so that the bars will not be raised and as a consequence the sheet or sheets which have already been moved outward will remain in that position and thus the sheets as they are successively folded will be moved away from beneath the blade 142 and gradually carried outward to the edge of the platform formed by the bottom *k* of the casing from which they can from time to time be removed by an attendant. If it is desired to deliver the sheets with three instead of four folds the arms 121

will be turned down to the horizontal position shown in Figs. 9 and 11; the rods 130 will be withdrawn from the arms *c d*, as shown in Fig. 11; the arms *c* will be turned down to the horizontal position shown in Figs. 9, 10 and 12, which can be done by raising the section *h'* of the piling table, as indicated by dotted lines in Fig. 13; the arms *d* will be fixed rigidly to the shaft 143 which can be done by means of the set screws 110 and the coupling 141 will be loosened and the portion of the shaft 143 upon which the blade 142 is mounted will be turned so as to cause the blade 142 and rods 134 to stand farther to the rear when in their vertical position, as shown in Fig. 10. In other respects the adjustment of the mechanism will remain the same as already described. When the mechanism is thus adjusted the rods 134 and the blade 142 become a fly. The first, second and third folds will be imparted to the sheets in the manner already described, and the sheets will be carried by the blade 150 down onto the upper ends of the arms *d e* the same as already described and as indicated by dotted lines in Fig. 11. When the shaft 143 is rocked after the withdrawal of the blade 150 from between the plies of the folded sheet, the blade 142 and the arms *d* and rods 134 will be vibrated down to the horizontal position shown in Fig. 12 and the sheet, instead of being folded between the rods 136 by the blade 142, will be simply carried forward and downward by the blade and the rods 134 and laid upon the bars 123 without receiving its fourth fold. If it is desired to deliver sheets with only two folds the fly *F* will be placed in position upon the shaft *G*, as shown in Fig. 13, and the switches 119 and guides 25 will be shifted to the position shown in Fig. 14 so as to direct the sheets through the opening *f* and allow them to pass downward in front of the fly. The rods 130 will be withdrawn from the arms *e* and these arms and the arms *d* and the rods which they carry will be turned down to a horizontal position. The folding blade 142 will also be turned down to its horizontal position and secured by means of a hook 111, or other means and the sections *h* of the piling table will be folded down so as to entirely cover the casing *K* containing these mechanisms, all as shown in Figs. 13 and 14. The piling table will then present a smooth top the same as an ordinary piling table, as shown in Fig. 15. In other respects the adjustments will remain the same as last described. The sheets after receiving their second fold will pass forward between the tapes 6—26, but instead of being directed downward between the guides 148—149 they will be directed outward through the opening *f* to the front of the fly so that when the fly shaft *G* is vibrated the sheets instead of being folded by the blade 150 between the guides 148 will be simply taken by the fly and laid upon the piling table *H*. The sheets may also be delivered with two folds by

omitting the fly and leaving the switches 119 in the same position as when the sheets are to receive three or four folds. In such case the sheets will be folded between the guides 148 by the blade 150 and then carried down onto the piling table by the blade. As the blade is raised and carried upward out from between the plies of the sheets the plies will fall outward in opposite directions thus leaving the sheets with two folds and creased upon the line of the third fold. If it should be desired to always operate the mechanism in this manner when delivering the sheets with two folds then the switches 119 may be replaced by stationary guides. If it is desired to deliver the sheets with only one fold the adjustments will be the same as when delivering with two folds, as first described, except that the clutch upon the shaft 49 will be shifted so as to throw the folding blade 43 out of operation and the blade will be secured in its raised position by means of the hook 98, or in any other suitable manner, and the rod 74 will be hooked onto the arm 75 so as to vibrate the pulleys 20. The sheets then, as they are carried outward by the tapes 4 and brought to rest against the stops 70, instead of being folded between the rolls 41 will be taken by the pulleys 20 and tapes 5 and carried over the roll 23 so as to pass downward in front of the fly by which they will be piled upon the table once folded. If it is desired to deliver the sheets in an unfolded condition the adjustments will remain the same as last described except that the clutch upon the shaft 45 will be shifted so as to throw the folding blade 42 out of operation. The rod 74 will be unhooked from the arm 75 and hooked onto the stud 87 and the stops 69 will be raised out of the path of the sheets. The sheets then will simply pass forward between the tapes 2—3 and be delivered from between the rolls 44—57 and pass downward in front of the fly and be laid upon the piling table in an unfolded condition. If at any time it should be desired to divide the sheets upon their longitudinal centers, or upon the line corresponding to the line of the first fold, the slitter can be put into operation in the manner described in my prior application before referred to, and in such case the two halves of the sheet can be delivered in an unfolded condition or can be associated by the folding blade 42 and fingers 1 and delivered in that condition, or with one, two or three folds by adjusting the mechanisms in the different ways already described. If it should be desired to unite the sheets upon the line of the second fold, or upon the line corresponding to the second fold, the pasting mechanism can be put into operation. Otherwise that mechanism will be allowed to remain idle.

The organization which has been described embodies the invention in its most complete and desirable form; but the mechanism may be modified in many particulars without departing from some of the principal features

of the invention and parts of the mechanism may be omitted and yet preserve certain features of the invention.

That part of the folding mechanism which is located beneath the feed board may be changed widely from what is shown, and it may be capacitated to impart only one fold to the sheets, which single fold will be either at right angles or parallel to the impression cylinder, or it may be capacitated to impart two or more folds, either parallel with or at right angles to each other, or the part of the folding mechanism which is beneath the feed board may be entirely omitted without wholly departing from the invention. In such case the first fold will be made by the blade 150. Figs. 19 to 21 illustrate two organizations of this character. The organization shown in Fig. 19 is the same as that already described except that the part of the folding mechanism located beneath the feed board is omitted, which reduces the capacity of the mechanism to two folds; the first fold being imparted by the blade 150 and the second by the blade 142. In this case the guides 148 149 are extended upward to the rolls 44 57 and the switches 119 are arranged to direct the sheets as they emerge from between these rolls. The blade 150 is made longer than in the organization first described and is, of course, located in a central position widthwise of the machine. The position and size of the parts located beneath the piling table are also, of course, changed to correspond.

The operation of the mechanism when thus organized is as follows: If it is desired to deliver the sheets in an unfolded condition the switches 119 will be turned to the position shown in full lines, the fly F will be secured on the shaft G and the parts beneath the piling table will be turned down and the table will be folded out so as to cover the casing K. The sheets will then be taken from the impression cylinder and carried outward beneath the feed table by the tapes 2 3 and as they arrive at the rolls 44 57 they will be directed outward by the switches 119 and will pass down in front of the fly and be piled upon the table in the ordinary way. If the sheets are to receive two folds the fly F will be removed and the switches 119 turned to the position shown by the dotted lines and the table H will be folded back and the parts beneath it adjusted to the same positions as shown in Figs. 1 to 8. The sheets will then be directed downward between the guides 148 149 and will receive the first and second folds from the blades 150 142 and be laid upon the bars 123 the same as when they receive the third and fourth folds and are laid upon the bars in the organization first described. If the sheets are to receive only one fold the parts beneath the piling table will be adjusted to the same positions as in Figs. 9 to 12. The sheets will then receive their first and only fold from the blade 150 and be laid on the bars

123 by the blade 142 and rods 134 the same as when they receive their third fold and are laid upon the bars in the organization first described.

Fig. 20 shows a modification of the organization just described in which the switches 119 and guides 25 are omitted. To accomplish this the guides 148 149 are supported so as to have a slight oscillating movement and the fly is set at such an angle to the shaft G that the sheets, as they emerge from the rolls 44 57 will pass downward outside of the fly, without the aid of special guides. When the sheets are not to be folded by the blade 150 the guides 148 149 are moved inward as shown in full lines so that the sheets will pass outside of them and of the fly fingers, but when the sheets are to be folded by the blade 150 the fly is removed and the guides 148 149 are moved outward to the position shown in dotted lines so that the sheets will pass downward between them.

In Fig. 21 the mechanism illustrated in Fig. 19 for imparting two folds to the sheets is shown as applied to that form of cylinder press known as a "drum cylinder press." In this style of presses the impression cylinder is of larger size and the fly is located nearer to the cylinder. The sheets in this case instead of being conveyed outward beneath the feed board by tapes pass directly from the pulleys 54, which are of somewhat larger size, to the fly or between the guides 148 149. In other respects the operation of this organization is the same as of that shown in Fig. 19. In this case also the switches 119 may be omitted and the guides 148 149 arranged to oscillate the same as in Fig. 20 and for the same purpose.

If in any case it should be desired that the folding mechanism which is located upon the fly shaft and beneath the piling table should be capacitated to impart but one fold to the sheets the folding blade 142 and its auxiliaries may be omitted, the jaws 127 being arranged to co-operate with the blade 150. The bars 123, although very useful, are not essential and may be omitted, but in that case the attendant will have to remove the sheets more frequently.

It will sometimes happen that it will not be desired to have the machine capacitated to deliver the sheets with less than four folds or with less than three folds or with less than two folds, and in such cases the provisions for adjusting the mechanism to produce the results not desired may be omitted and in those cases where it is not desired to have the machine capacitated to deliver the sheets in an unfolded condition or with only one fold the fly G need not, of course, be provided.

In conclusion it is to be remarked that I do not limit the scope of my invention to the precise details of the organization shown, as it is manifest that these details may be varied in many particulars without departing

from the essential features of the invention or losing its advantages.

What I claim is—

1. The combination with a cylinder printing press, of the folding bars 148 and the folding blade 150 arranged to vibrate in the arc of a circle from a position on one side of said bars to a position on the other side so as to fold the sheets across its edge, and means for taking the sheets from the impression cylinder and delivering them between said blade and bars, substantially as described.

2. The combination with a cylinder printing press, of the folding bars 148 and the folding blade 150 arranged to vibrate in the arc of a circle from a position on one side of said bars to a position on the other side so as to fold the sheets across its edge, means for taking the sheets from the impression cylinder and delivering them between said blade and bars, and means for receiving the folded sheets from said blade, substantially as described.

3. The combination with a cylinder printing press, of the folding blade 150 arranged to vibrate in the arc of a circle so as to fold the sheets across its edge, means for taking the sheets from the impression cylinder and delivering them in front of said blade, means for receiving the sheets from the blade, and means for piling the sheets as they are delivered by the blade, substantially as described.

4. The combination with a cylinder printing press, of the folding bars 148 and the folding blade 150 arranged to vibrate from a position on one side of said bars between them and to a position on the other side so as to fold the sheets across its edge, means for taking the sheets from the impression cylinder and delivering them between said blade and bars, means for receiving the sheets from the blade, and means for piling the folded sheets as they are delivered by the blade, substantially as described.

5. The combination with a cylinder printing press and its fly, of the blade 150 arranged upon the fly shaft, and means for taking the sheets from the impression cylinder and delivering them either in front of said blade or fly, substantially as described.

6. The combination with a cylinder printing press, its fly, and the blade 150 arranged upon the fly shaft, of means for taking the sheets from the impression cylinder and conveying them to said fly or blade, and the switches 119 for directing the sheets either in front of the fly or in front of the blade, substantially as described.

7. The combination with a cylinder printing press, its fly, and the blade 150 arranged upon the fly shaft, of the folding bars 148 and means for taking the sheets from the impression cylinder and delivering them either in front of the fly or between the bars and blade, substantially as described.

8. The combination with a cylinder printing press, of a folding mechanism located be-

neath the feed board thereof and capacitated to impart one or more folds to the sheets as they pass from the impression cylinder, the folding blade 150 arranged to vibrate in the arc of a circle so as to fold the sheets across its edge, and means for delivering the sheets from said folding mechanism to a position in front of said blade, substantially as described.

9. The combination with a cylinder printing press, of a folding mechanism located beneath the feed board thereof and capacitated to impart one or more folds to the sheets as they pass from the impression cylinder, the folding blade 150 arranged in a vertical or substantially vertical position and to vibrate in the arc of a circle so as to fold the sheets across its edge, means for conveying the sheets from the impression cylinder to a position in front of said blade, and means for receiving the sheets from the blade, substantially as described.

10. The combination with a cylinder printing press, of a folding mechanism located beneath the feed board thereof and capacitated to impart one or more folds to the sheets as they pass from the impression cylinder, the folding bars 148 and the vertical folding blade 150 arranged to vibrate in the arc of a circle from a position on one side of said bars to a position on the other side so as to fold the sheets across its edge, and means for taking the sheets from the impression cylinder and delivering them between said blade and bars, substantially as described.

11. The combination with a cylinder printing press, of a folding mechanism located beneath the feed board thereof and capacitated to impart one or more folds to the sheets as they pass from the impression cylinder, the folding bars 148 and the vertical folding blades 150 arranged to vibrate in the arc of a circle from a position on one side of said bars to a position on the other side so as to fold the sheets across its edge, means for taking the sheets from the impression cylinder and delivering them between said blade and bars, and means for receiving the folded sheets from said blade, substantially as described.

12. The combination with a cylinder printing press, of a folding mechanism located beneath the feed board thereof and capacitated to impart one or more folds to the sheets as they pass from the impression cylinder, the folding blade 150 arranged to vibrate in the arc of a circle so as to fold the sheets across its edge, means for taking the sheets from the impression cylinder and delivering them in front of said blade, means for receiving the sheets from the blade and means for piling the folded sheets as they are delivered by the blade, substantially as described.

13. The combination with a cylinder printing press, of a folding mechanism located beneath the feed board thereof and capacitated to impart one or more folds to the sheets as they pass from the impression cylinder, the folding bars 148 and folding blade 150 ar-

ranged to vibrate from a position on one side of said bars between them and to a position on the other side so as to fold the sheets across its edge, means for taking the sheets from the impression cylinder and delivering them between said blade and bars, means for receiving the sheets from the blade, and means for piling the folded sheets as they are delivered by the blade, substantially as described.

14. The combination with a cylinder printing press and its fly, of a folding mechanism located between the impression cylinder and the fly and capacitated to impart one or more folds to the sheets, the blade 150 arranged upon the fly shaft, and means for delivering the sheets either in front of said blade or fly, substantially as described.

15. The combination with a cylinder printing press and its fly, of a folding mechanism located between the impression cylinder and the fly, the blade 150 arranged upon the fly shaft, means for conveying the sheets either to said fly or blade, and the switches 119 for directing the sheets either in front of the fly or in front of the blade, substantially as described.

16. The combination with a cylinder printing press and its fly, of a folding mechanism located between the impression cylinder and the fly, the blade 150 arranged upon the fly shaft, the folding bars 148, and means for delivering the sheets either in front of the fly or between the bars and blade, substantially as described.

17. The combination with a cylinder printing press, its fly and piling table, of the folding blade 150 carried by the fly shaft and co-operating devices located beneath the piling table, and adapted to be rendered inoperative substantially as described.

18. The combination with a cylinder printing press, its fly and piling table, of a folding mechanism located in part beneath the feed board, in part upon the fly shaft and in part beneath the piling table, substantially as described.

19. The combination with the fly F and the piling table of the blade 150 carried by the fly shaft and means located beneath the piling table for receiving the sheets from said blade, said means being adapted to be rendered inoperative substantially as described.

20. The combination with a cylinder printing press, of the vertical blade 150, means for delivering the sheets in front of said blade, means for receiving the sheets from the blade 150, and the blade 142 arranged to fold the sheets as they are delivered by the blade 150, substantially as described.

21. The combination with a cylinder printing press, of the blade 150, means for delivering the sheets in front of said blade, and the vibrating rods 134 arranged to pile the sheets as they are delivered by said blade, substantially as described.

22. The combination with a cylinder printing press, its fly, and the blade 150 carried by the fly shaft, of means for delivering the sheets either in front of the fly or in front of the blade, the piling table H wholly or partly removable, and vertical guides arranged to be turned up to receive the folded sheets from the blade or down so as to be beneath the piling table when the sheets are delivered to the fly, substantially as described.

23. The combination with a cylinder printing press, of the folding blade 150 carried by the fly shaft, means for receiving the folded sheets from said blade, and means for piling the sheets as they are received from the blade or for imparting an additional fold to them as may be desired, substantially as described.

24. The combination with a cylinder printing press, of the folding blade 150 carried by the fly shaft, means for receiving the folded sheets from the blade, the folding blade 142 arranged to impart a second fold to the sheets as they are delivered by the blade 150 and means for receiving the folded sheets from the latter blade, substantially as described.

25. The combination with the blade 150 and means for receiving the folded sheets from said blade, of the folding blade 142 and the movable folding guides 136 whereby the sheets may be folded by the latter blade or piled without being folded thereby, substantially as described.

26. The combination with the folding blade 150, of the folding blade 142 and guides 136 &c. and means for turning said blade and guides down out of operative position, substantially as described.

27. The combination with the blade 142, of the jaws 127 and the rods 121, substantially as described.

28. The combination with the blade 142, of the jaws 127, the rods 121, and the reciprocating bars 123, substantially as described.

29. The combination with the blade 150 and guides 136 &c. of the blade 142, the jaws 127 and the rods 121 arranged to fold down, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

LUTHER C. CROWELL.

Witnesses:

J. A. HOVEY,

J. J. KENNEDY.