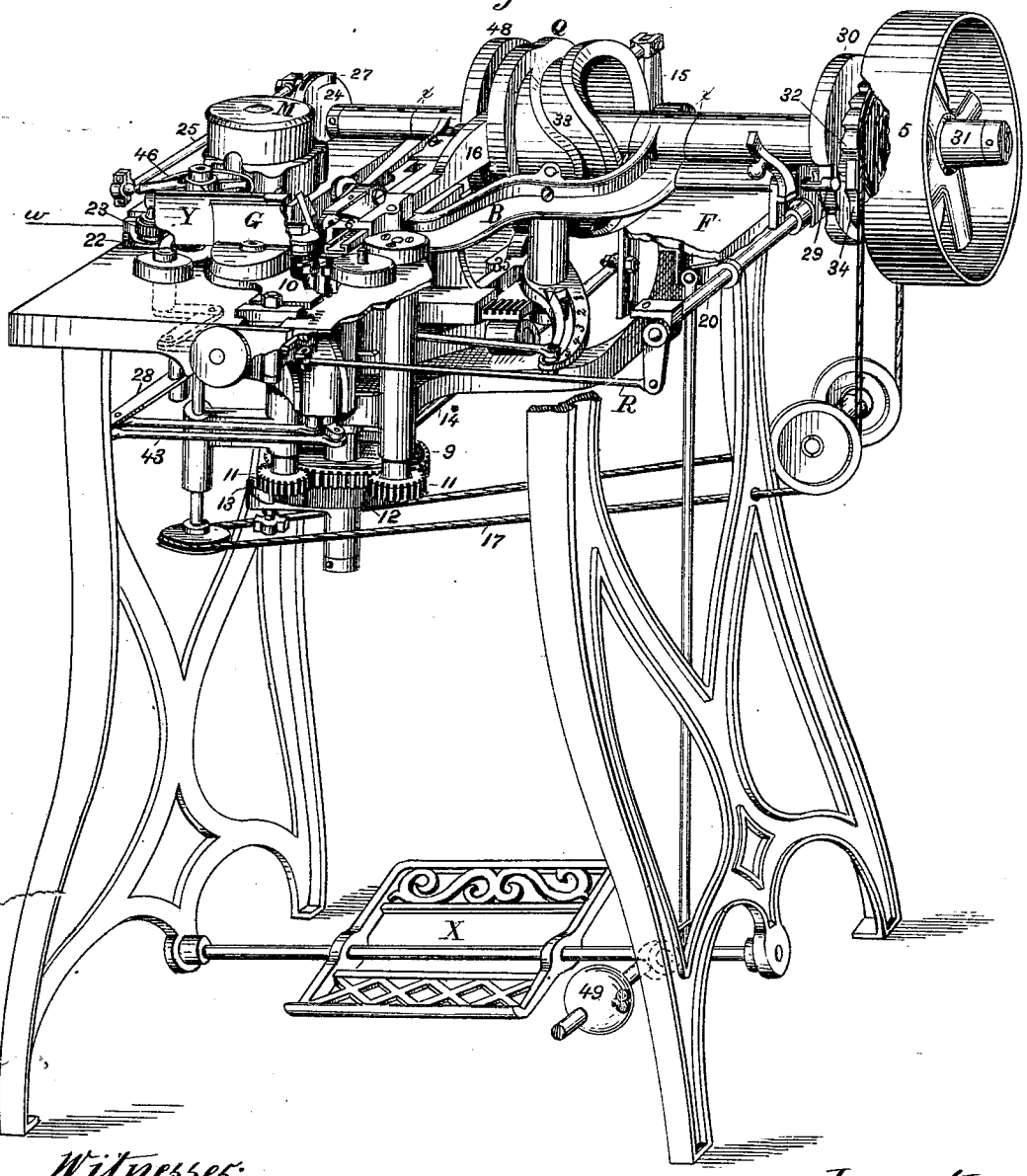
6 Sheets—Sheet 1.

H. R. HEYL.

MACHINE FOR FORMING, INSERTING, AND CLINCHING STAPLES IN BOOKS.

No. 183,670. Patented Oct. 24, 1876.

Fig. 1.



Witnesses:

Louis Wolff

John L. Huber

Inventor

Henry R. Heyl,

by Munson & Philipp,

his Attorneys.

6 Sheets—Sheet 2.

H. R. HEYL.

MACHINE FOR FORMING, INSERTING, AND CLINCHING STAPLES IN BOOKS.

No. 183,670. Patented Oct. 24, 1876.

Fig: 2.

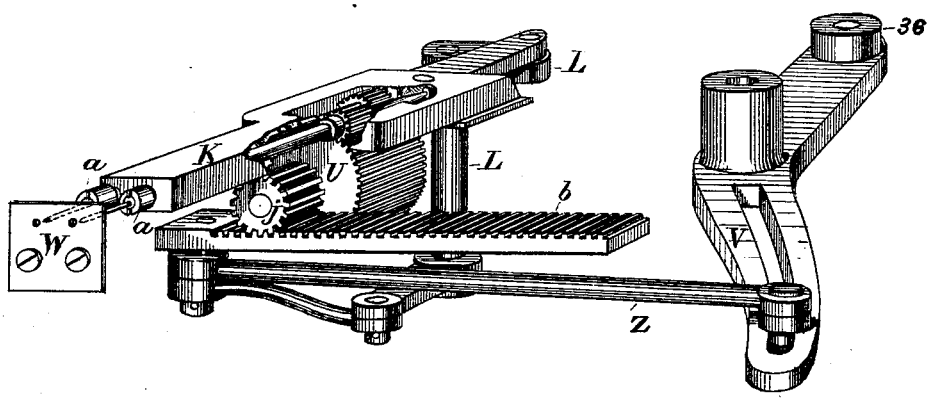


Fig: 3.

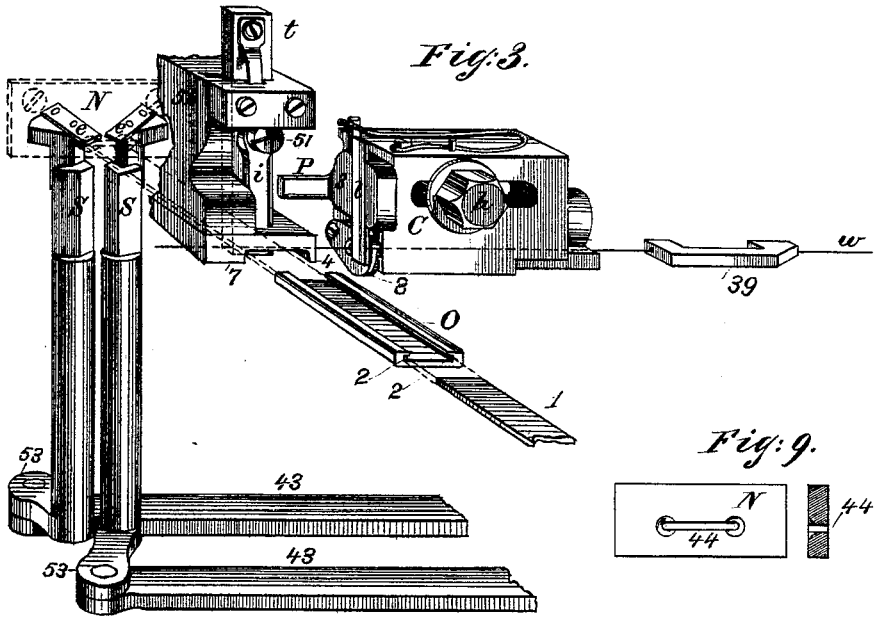


Fig: 9.

Witnesses:

Lucien White,

John C. Kluber.

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6 Sheets—Sheet 3.

H. R. HEYL.

MACHINE FOR FORMING, INSERTING, AND CLINCHING STAPLES IN BOOKS.

No. 183,670. Patented Oct. 24, 1876.

Fig. 4.

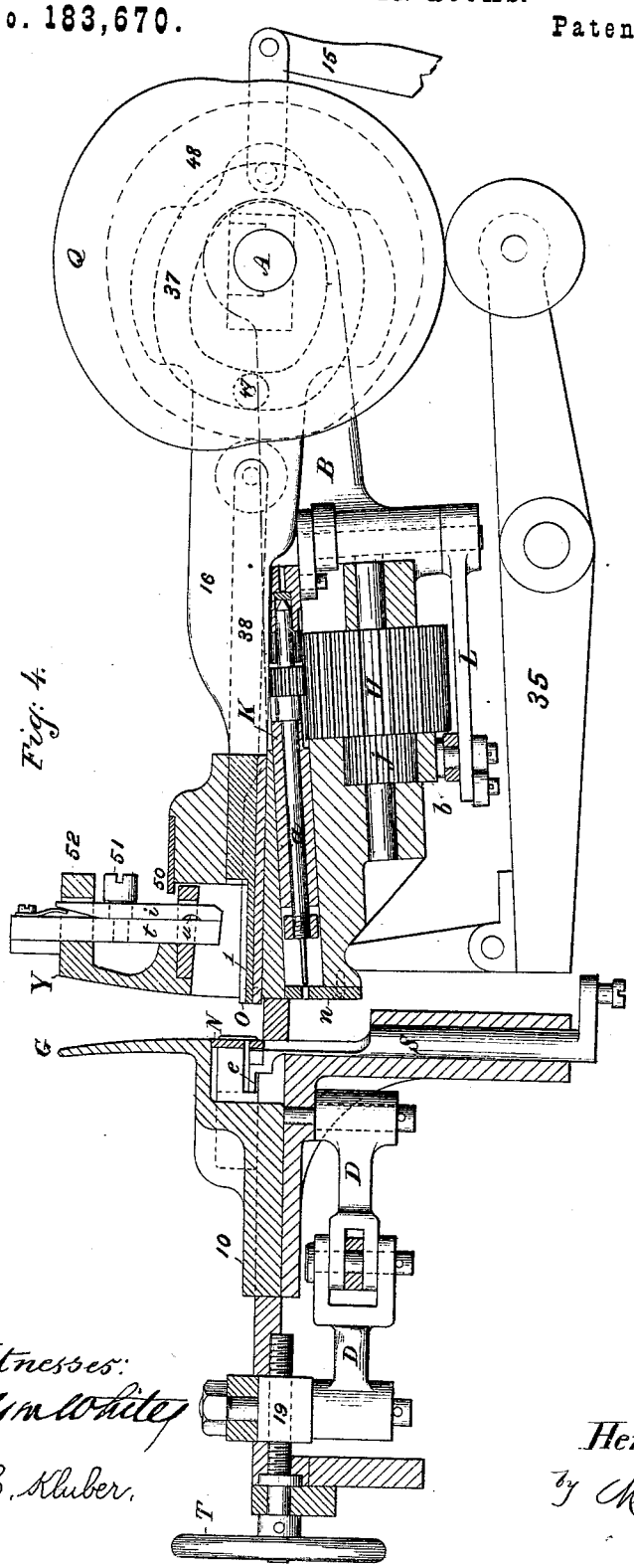
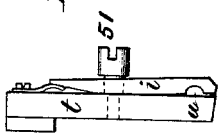


Fig. 11.



Witnesses:

Chas. M. White

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Inventor:

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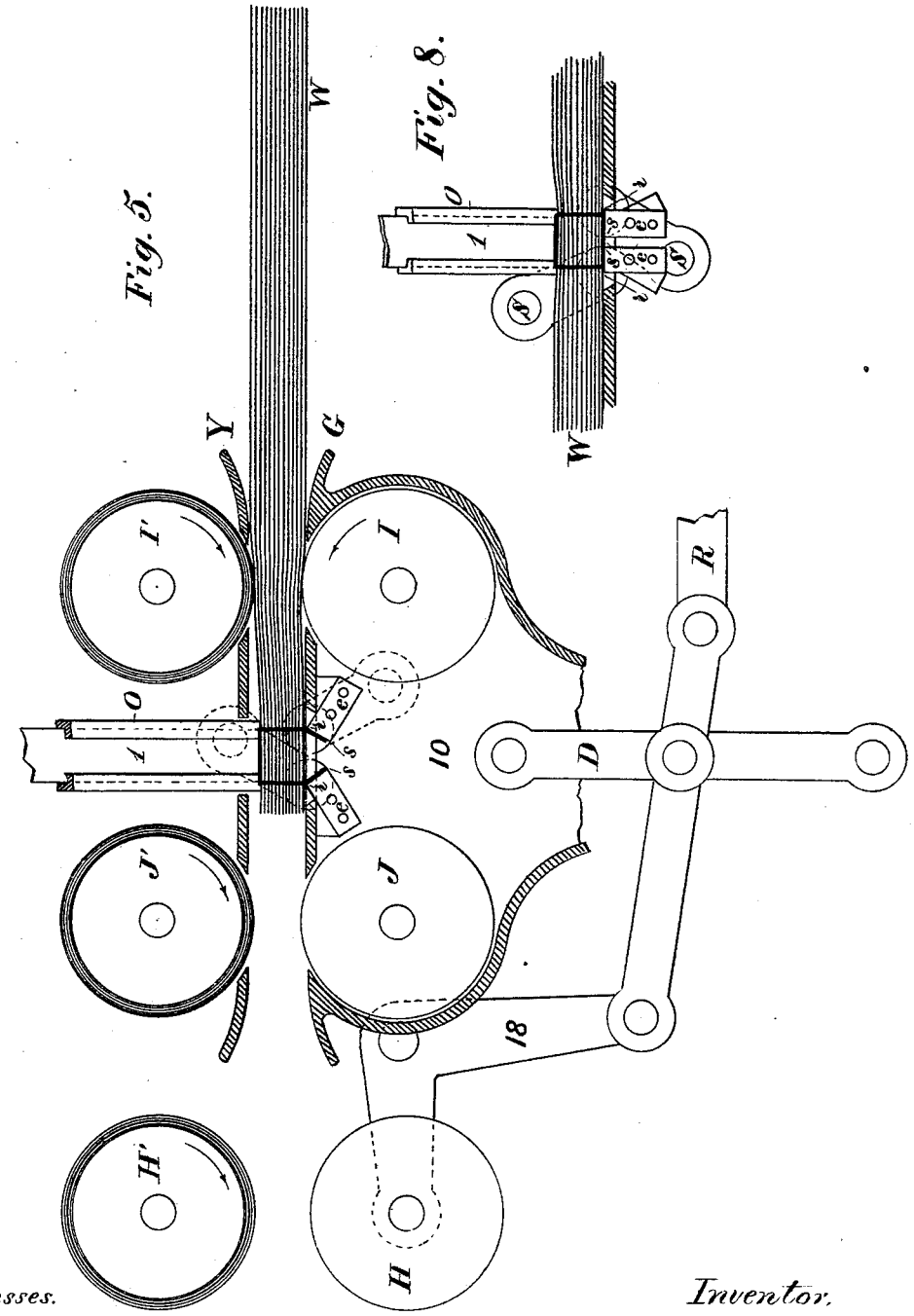
6 Sheets—Sheet 4.

H. R. HEYL.

MACHINE FOR FORMING, INSERTING, AND CLINCHING STAPLES IN BOOKS.

No. 183,670. Patented Oct. 24, 1876.



Witnesses.

Salem White

John C. Kuber

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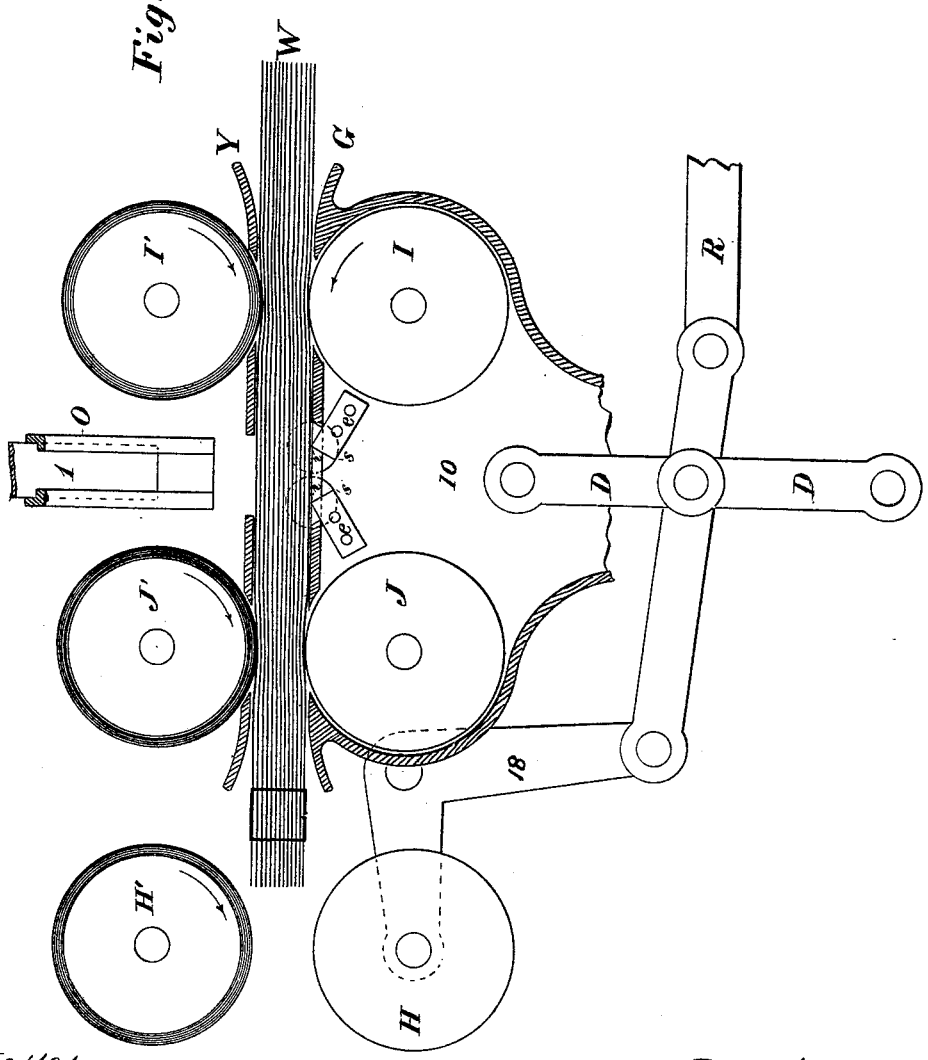
6 Sheets—Sheet 5.

H. R. HEYL.

MACHINE FOR FORMING, INSERTING, AND CLINCHING STAPLES IN BOOKS.

No. 183,670. Patented Oct. 24, 1876.

Fig. 6.



Witnesses.
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his Attorneys.

6 Sheets—Sheet 6.

H. R. HEYL.

MACHINE FOR FORMING, INSERTING, AND CLINCHING STAPLES IN BOOKS.

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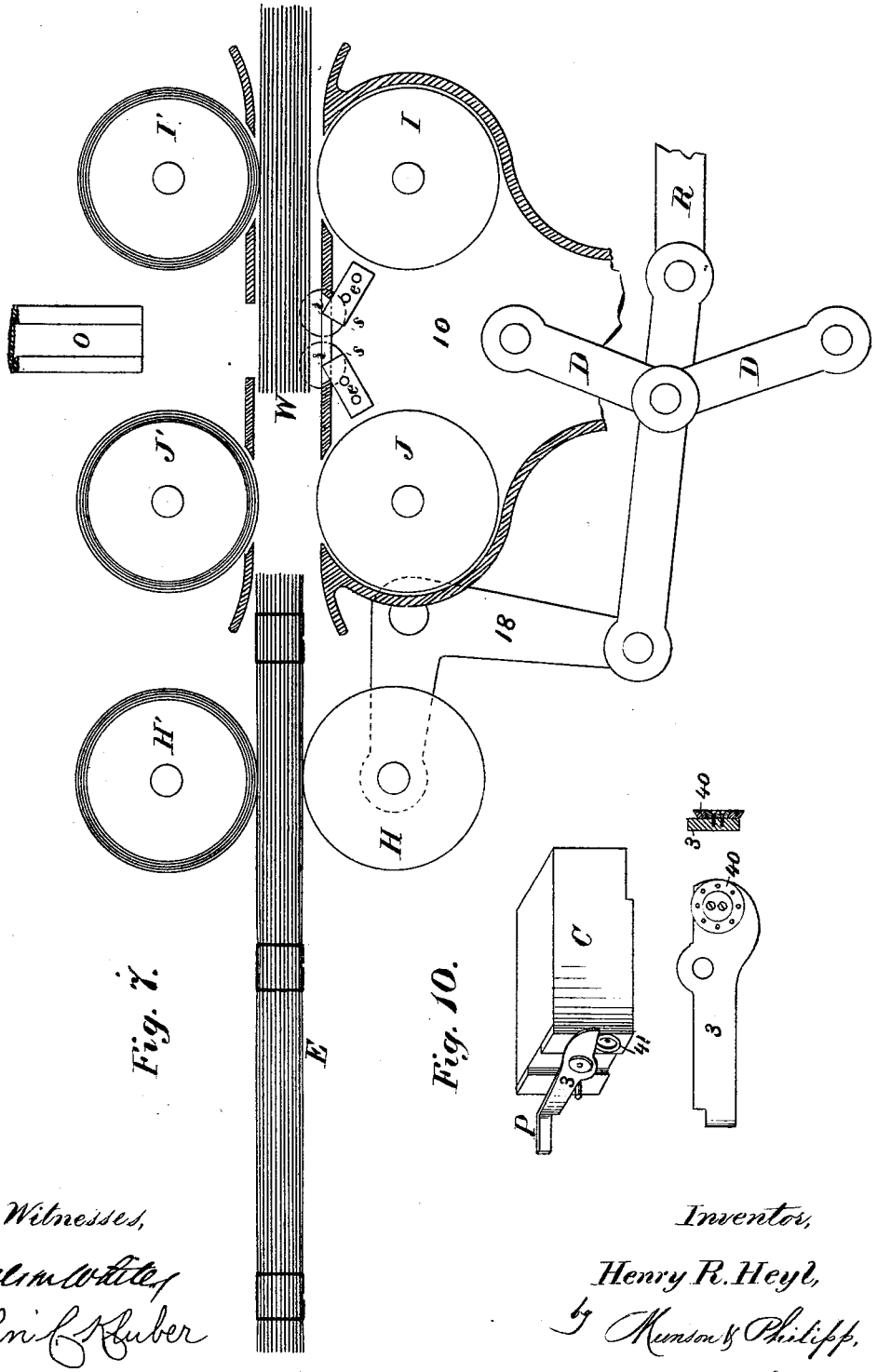

Fig. 1.

Fig. 10.

Witnesses,
Wm. Wallace
John L. Huber

Inventor,
Henry R. Heyl,
by Munson & Philipp,
his Attorneys.

UNITED STATES PATENT OFFICE.

HENRY R. HEYL, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE NOVELTY PAPER BOX COMPANY, OF SAME PLACE.

IMPROVEMENT IN MACHINES FOR FORMING, INSERTING, AND CLINCHING STAPLES IN BOOKS.

Specification forming part of Letters Patent No. **183,670**, dated October 24, 1876; application filed September 26, 1876.

To all whom it may concern:

Be it known that I, HENRY R. HEYL, of the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Machines for Forming, Inserting, and Clinching Staples in the Backs of Books and other articles, of which the following is a specification:

This invention is supplementary to certain inventions in wire-stapling machines for which patents have been granted as follows: To Henry R. Heyl and August Brehmer, October 8, 1872, No. 132,078, and to Henry R. Heyl, March 28, 1876, No. 175,457.

The present invention is designed to insert staples of heavier wire in such thicker books or other articles as are beyond the capacity of the former machines patented, as aforesaid, which I employ to staple thin books, as well as paper boxes.

The main features of the within-described improvement consist in the employment, in combination with the staple forming and inserting mechanisms, of rapidly-rotating drills to make holes in the book or other article to receive the staples; in a combination of feed-rollers, some of which rotate intermittingly and others continuously, to pass the book through the machine—first, space by space, to receive the staples, and then to deliver it out of the machine; and in details of construction and modifications, too fully hereinafter set forth to need preliminary description.

In the accompanying drawings, forming a part of this specification, Figure 1 represents a perspective view of the machine; Fig. 2, a perspective view from the front of the perforating mechanism; Fig. 3, a similar view from the rear of the wire-feeding, staple-forming, inserting, and clinching mechanisms; Fig. 4, a longitudinal section taken through the stapling mechanisms; Figs. 5, 6, and 7, views of the work-guiding plates and feeding-rollers; Fig. 8, a detached view of the clinching mechanism; Fig. 9, face and sectional views of the guard-plate through which the clinching mechanism operates; Fig. 10, views of a modification of the wire-cutting apparatus; Fig. 11, a view of the bending-mandrel and nipper detached.

The machine, which has for its primary object the stitching or stapling of pamphlets or small books, is so organized that the principal mechanisms operate horizontally, so that the sheets or signatures composing the pamphlet or book pack may be placed in the machine and rest on their back edges, which insures an even and square back to the pamphlet, and also facilitates the operation of feeding it into and through the machine.

To this end I place or hang the main shaft A in horizontal bearings across the back of the bed or table F, and support upon it a swinging bracket, B, carrying in its forward end the perforating mechanism, the bending-fork O, and the driving-hammer 1, all of which devices are operated by a set of cams also placed upon the main shaft and between the bearings *x x* of the swinging bracket B, while the forming-mandrel *t* (which, with the bending-fork O, constitutes the bending or staple-forming mechanism) and the clinching mechanism are supported upon the bed or table near the front of the machine; and between the said perforating and bending or forming mechanisms and the staple-clinching mechanism upright plates G Y are placed, so as to constitute a horizontal guideway, in which the several leaves, sheets, or signatures to be stitched or stapled are placed in a vertical position, resting on their back edges upon the table ready to receive the first staple.

By thus supporting the leaves, sheets, or signatures constituting the book-pack they will be settled upon the table by gravity, so that their back edges will all be even, and the perforations for the staples will be made in lines parallel with said back edges.

The rear guide-plate Y is fixed in proper position upon the table relative to the staple forming and inserting mechanisms, and the front guide-plate G is fixed to a slide, 10, which is moved toward and from the guide-plate Y by means of a toggle-lever, D, connecting it with a head, 19, which is adjusted by a thumb-screw, T, to set the guide-plates to suit the thickness of the book or pamphlet to be stapled.

The work-feeding mechanism consists of two feeding-rollers, I′ J′, (see Figs. 1, 5, 6,

and 7,) which are journaled on vertical shafts fixed to the bed, so as to protrude through the guide-plate Y, and are rotated intermittingly by pinions 11, which engage with a toothed wheel, 9, moved by a ratchet-wheel, 12, attached to its lower face, and a pawl, 13, actuated by a rod, 14, adjustably connected with a lever, 15, linked to the reciprocating slider 16, which actuates the bending-fork, as will be described. The feeding-roller H′ is driven continuously by a belt, 17, from the main shaft.

The companion feed rollers—viz., I, J, and H—operate as follows: Those marked I and J are journaled on pins fixed in the slide 10, so as to protrude through the guide-plate G, and partake of all of its movements imparted by the toggle-lever D, and the feed-roller H is hung in the end of a bell-crank lever, 18, linked to said toggle-lever D.

The feed rollers H′, J′, and I′ are provided with rubber tires, which construction insures more perfect frictional contact with the book-pack.

The slide 10 is moved forward and back by the toggle-lever D, which is connected to a rod, R, reciprocated by the rock-shaft 20, as will be described.

In the position of this feeding mechanism shown in Fig. 6, which is that occupied by it during the operation of setting and clinching staples, the slide 10 has been moved forward, so as to cause the feeding-rollers I I′ and J J′ to firmly compress the book between them.

As the rollers I′ and J′ are rotated intermittingly the book will be fed forward a proper distance and come to a state of rest, when a staple will be inserted through it, as will be presently explained. The next movement of the feed-rollers will carry the book onward a proper distance, and this operation will be continued as long as the feed-rollers are in the position shown in Figs. 5 and 6. The position of the feeding mechanism (shown in Fig. 7) is that occupied by it when a book-pack has just been inserted, and the book, just stapled, is leaving the machine. The slide 10 has been moved back by the toggle-lever D, which, at the same time, has carried the roller H forward, so as to press the stapled book between it and the constantly-revolving roller H′, the contact of the two propelling the book out of the machine.

Thus the feeding-rollers I I′ and J J′ are brought into position to press the book between them, and are rotated intermittingly between the times that the successive staples are inserted into the book to feed the book along, space by space, until the desired number of staples are inserted in it, when the rolls are separated to release the stapled book, and the feed-roller H′ is carried forward to press the said book between it and the constantly-revolving feed-roller H′ and deliver it out of the machine, during which operation the pack of sheets or signatures for a new book is inserted between the guide-plates G Y, which now stand apart and present a space considerably greater than the thickness of the book-pack which they have been adjusted to receive.

Thus the entire operation of feeding the book-pack for the spacing of the staples, and for carrying the book out of the machine when the stapling has been completed, is performed by these feed-rollers, leaving only for the operator the work of inserting the book-pack in its first position between the guides G Y, which mechanism renders the machine more efficient and rapid than if the entire movement of the book had to be managed by the hand, while the stapling is more uniform and neat.

The perforating mechanism, Fig. 2, consists of a pair of rotating drills, whose spindles or stocks *a a* are supported in a reciprocating carrier, K. The rotary, as well as the reciprocating, movements of these drills are accomplished simultaneously, their reciprocation being effected through the medium of grooved cam 33, in which runs a roller, 36, on a lever, V, which latter is connected, by a rod, Z, with a bell-crank, L, which reciprocates the carrier K in its longitudinal bearings in the forward end of the swinging bracket B; and their rotation is effected through a rack, *b*, reciprocated by the connecting-rod Z meshing into a small pinion, *j*, which is joined to the toothed wheel U, from which, by direct gearing with small pinions on each drill stock or spindle, the latter are rotated. The toothed wheel U has such a width of face that, as the drill stocks or spindles are reciprocated, their pinions are not disengaged from the teeth of the said wheel U.

This combination of rack and pinions gives to the drills a high rotary speed at the same time that, through the medium of the bell-crank lever L, the drill-stock carrier K is moved forward, forcing the drills through the book-pack that stands between the guide-plates G Y. The reverse motion of the lever V also reverses the drills, and draws back the drill-stock carrier, which gives place to the stapling mechanism to insert the staple in the holes just made by the drills, and drive it into the book-pack. By using rotating drills instead of puncturing-awls, a great saving of strain is attained, and, consequently, a much smaller drill can be used, for it has much less thrust-pressure to bear; besides, the drill will always make a straight hole, whereas a non-rotating awl will follow any inclination of its point should it be ever so slightly bent or not centrally ground; but these slight imperfections do not affect the perfect working of a revolving drill.

The wire-feeding mechanism consists of two wheels having polished surfaces, one of which, 22, is shown in Fig. 1. These wheels are hung on vertical shafts, upon which are fixed gear-wheels 23 meshing together, so as to revolve in unison. One of the vertical shafts is driven intermittingly by means of a ratchet-wheel, 46, and a pawl engaging therewith, which pawl is operated by a lever connected with the wheel 24 by arm 25. The wire *w* is di-

rected through a guiding-eye and between these feeding-wheels, thence through a straightening-plate, 39, Fig. 3, through the cutter-block C and between the cutters, and thence passes through a slot in plate 6, and protrudes beyond the forming-mandrel, where it rests in an eye, *u*, of a nipper, *i*, across the face of the forming-mandrel *t*. A proper length of wire to form a staple is fed forward to this position at each movement of the feed-wheels.

The cutting mechanism, Fig. 3, consists of a plate, 8, fixed to the front end of the cutter-block C, and a cutter-blade, *l*, depending from a stock, 3, pivoted so as to vibrate upon the end of the cutter-block C. The wire passes through a perforation in the plate 8, and lies just in front of the blade *l*, which is pressed against it to sever the wire by the swinging bracket B striking a lug, P, projecting from the blade-stock 3, and thus rocking it upon its pivot as the said bracket rises, to present the perforating-awls in operative position. The stapling mechanism consists of a forming-mandrel, a bending-fork, a driver, and clinchers, all of which will be separately hereinafter described.

In its raised position the swinging bracket B supports the staple-bending fork O in operative position, with respect to the forming-mandrel *t*, which is held in a head-block, 52, rising from the table of the machine, and is provided with a spring-seated nipper, *i*, having an eye, *u*, which receives the staple length of wire, and prevents it from dropping or jumping when it is cut off, and also holds it in proper position to be operated upon to form it into a staple.

The bending-fork O, as shown, is a long narrow metal plate, furrowed out to form longitudinal grooves 2 in its inner side walls. It thus has a forked end, which, as it moves forward, strikes the wire, which is supported between the extreme ends of the nipper *i* and forming-mandrel *t*, as in Fig. 11, and bends it into the form of a staple around the forming-mandrel *t*, the legs of said staple lying in the longitudinal grooves 2 of the bending-fork. This bending-fork is at the end of a slider, 16, and lies directly over the reciprocating drill-stock carrier, and as close thereto as is possible, so as to avoid any unnecessary up-and-down motion of the swinging bracket B. The slider 16 is mortised, so as to slide upon the shaft A, and has a reciprocating motion imparted to it by means of the cam 48, which has a grooved face, 37, which receives a friction-roller, 47. When the drills have perforated the book, and the bending-fork has formed the wire into a staple around the mandrel *t*, the swinging bracket B drops down to the position shown in Fig. 4. The staple, as it is formed, lies in the grooves on the inner sides of the bending-fork O, and as the latter is moved down with the swinging bracket B it strips the staple from off the end of the forming-mandrel, the spring-seated nipper *i* giving way to permit its passage. The staple now lies within the end of the bending-fork in position to be inserted into the book-pack. The bending-fork O still continues to move forward until its end reaches the book-pack, by which time the swinging bracket B is down to its lowest position, and the staple-legs stand close to the holes in the book, ready to be driven.

The driving mechanism consists of a hammer, 1, guided in the grooves 2 of the bending-fork, and operated by cam 48. It strikes the staple from behind, and forces it through the book-pack, the projecting legs of the staple passing through an opening, 44, in the guard-plate N, Fig. 9, which is a portion of the front guide G. This opening in the guard-plate N is a narrow slot, 44, with two countersunk enlargements in it at points opposite to the entrance of the staple-legs, through which the staple-legs pass, and as these staple-legs are bent around toward each other, and flat against the book, the narrow slot between the countersunk enlargements serves as a guide to direct the wires in a straight line toward each other.

The clinching mechanism, which bends the projecting legs of the staple flat against the book, is formed of two shafts, S, lying close to each other, and having about a quarter-turn motion in opposite directions, as if they were geared together. These shafts are actuated by a tappet, 27, on the face of the wheel 24, which rocks a lever, 28, connected by means of rods 43 with the cranks 53 on the lower ends of the shafts. The upper ends of these shafts are milled off, to allow them to pass up behind the slotted guard-plate N, while at the same time their centers are directly under and in line with the face of the said plate N. Two thin clincher-plates, *e e*, are mounted on the top ends of these shafts; but they might be a part of the shafts, were it not that they need to be of hardened steel, while the rest of the clincher-shafts are made preferably of untempered metal. The corners *r r* (see Fig. 6) of these clincher-plates are directly on the center-line of the shafts S S, and the corners *s s* (see Fig. 6) are on the periphery-line of the shafts. The diameters of the shafts are of such dimensions that the corners *r r* shall be only a little wider apart than the width of the staples, so that as the legs of the staple project through the book and enter the slotted plate N, they may also pass between the clincher-plates, bear against their inclined faces, and be slightly turned inward, as shown in Fig. 5.

To make a proper clinch of the staple-legs it is very important that the turning-point of the clinchers should be as close behind the staple-legs as possible, and at the same time close to the face of the book-pack, and, to make such clinchers, there is evidently no room to place pivots upon which to turn them at the center-points *r r*. Therefore, to fully avail myself of this true form of clincher, I employ the extended shafts S S, with cranks

at their lower ends, to partially rotate them, and with their upper ends so worked out as to accommodate themselves to the interfering slotted guide-plate N, and at the same time to have the points of contact with the staple-legs of the proper form, and in that close relation, as described, which shall make the most perfect clinch of the staple-legs.

To provide economical cutters for the wire, such as need seldom be sharpened, I employ circular steel disks 40 41, one of which, 41, has a beveled-edged hole through it, (see Fig. 10,) while the other, 40, is beveled around its outer edge.

It is obvious that when these disks are placed in supports, so that the one shall pass across the face of the other, any wire projecting through the hole in the one disk would be cut off by the beveled edge of the other, in passing across the face of it. These little disks are set in supports, so that they may be turned around at pleasure, to present a fresh cutting-edge, so that, until the entire circumference is dulled, they need not be removed. In practice such cutters last about two years before they need sharpening, and are therefore very economical.

Operation: The machine in a state of rest stands with its swinging bracket B in its highest position, the drills being in position to perforate the book-pack, and the bending-fork in position to form a staple. It is set in motion by depressing the treadle X, which, rocking the shaft 20, draws back the locking-bar 29, so as to allow the locking-disk 30 to revolve, and the spring seated pawl 34, carried by it, to engage with a ratchet-wheel, 32, which is fast on the hollow shaft 31, supporting the driving-wheel 5, thus coupling it with the main shaft A. This same movement through the rod R operates the toggle-lever D, and moves the guide-plate G forward, and closes the feed-rollers I and J upon the book-pack W, which is supposed to have been fed to the machine, as seen in Fig. 6.

At each revolution of the main shaft the following operations are effected: The roller 36, running in cam-groove 33, moves the lever V, thus actuating the mechanism for rotating the perforating-awls and reciprocating them forward, guided by the holes in the plate *n* through the book-pack, and retracts them. The bending-fork O is simultaneously moved forward, by the slot 37 of cam 48, a distance sufficient for it to engage the wire and bend it around the forming-mandrel *t*, thus forming it into a staple, the legs of which rest in the longitudinal grooves of the bending-fork O. The swinging bracket now descends by gravity, the cam Q releasing the supporting-lever 35, until it reaches the limit of this movement, and supports the forming-mandrel, as in Fig. 4, in the plane which was occupied by the drills, the bending-fork drawing the staple away from between the forming-mandrel *t* and the spring nipper *i*, and carrying the staple with it, as, descending and still moving forward, it abuts against and compresses the book-pack. The hammer 1, through its stock 38 and the cam 48, is then projected to force the staple-legs through the perforations in the book. The clinching mechanism is then operated by the tappet 27 on the wheel 24, to turn said legs down onto the book, while the hammer still rests upon the staple-head. The bending-fork and hammer are then withdrawn, during which movement the wheel 24, through the arm 25, rotates the wire-feed wheels 22, and protrudes a staple length of wire through the cutter-block C, and the eye *u* of the nipper *i*, and between it and the mandrel *t*, as in Fig. 3. The cam Q then depresses the lever 35, and carries the swinging arm B to its highest position, thus raising the bending-fork O and the perforating-awls into proper positions for a repetition of the operation. In this upward movement of the swinging arm, a plate, 50, which is carried near its front end, engages with the projection 51 on the forming-mandrel and raises it slightly, which movement carries the piece of wire lying in the eye of the nipper *i* snugly against the faces 7 and 4 of the head-block 52, and forces the mandrel and nipper to slightly open and slide over the wire until it rests near the end of the mandrel and between it and the nipper, as in Fig. 11, in which position the wire is ready to be bent into a staple. The end of the swinging arm in its upward movement also strikes the lug P, and operates the cutters to sever the wire. The shaft A will thus have made one revolution, and brought the slot of the locking-disk 30 into a position to allow the locking-bar 29 to move outward, and the shaft 20 to be rocked back by the weight 49, thus opening the guides G Y, and rollers I I′ and J J′, and closing the roller H upon the book, as in Fig. 7, in which position of the parts the stapled book E will be delivered out of the machine, while a new book-pack, W, may be introduced and the operation repeated. The throw of the wire-feed wheels may be varied, and the position of the cutter-block, C be adjusted, by the screw *h*, to make staples of different sizes.

A registering mechanism, M, of any approved construction, the driving-wheel of which is geared to the wire-feeding mechanism, may be applied to the machine, whereby the length of wire consumed may be accurately determined.

By increasing the dimensions of the feeding-rollers, and in some cases their number, so that their peripheries shall have a considerable surface length, the guide-plates may be dispensed with. In this arrangement the feeding-rollers will receive the book between them and form efficient guides.

The wire-guiding eye *u* might be formed in the face of the forming-mandrel, or partly in it and partly in the nipper *i*.

The following is claimed as new:

1. The combination, with staple-inserting mechanism and a work-supporting table, of

work-guides standing at right angles to said table, and forming a way in which the book-pack may rest upon its back or edge by gravity on said table to receive the staple, substantially as described.

2. The combination, with perforating mechanism and a work-supporting table, of work-guides standing at right angles to said table and forming a way in which the sheets or signatures of a book may rest by gravity on the table, so as to be perforated in lines parallel with its edges, substantially as described.

3. The combination, with mechanisms for inserting and clinching staples in the backs of books or similar articles, of reciprocating rotating drills, to perforate the paper or other material to receive the staples, substantially as described.

4. The combination, with staple-inserting and clinching mechanisms and work-supporting table, of two guides movable to fixed positions with relation to each other to adjust the width of the guideway they form, substantially as described.

5. The combination, with book-stapling mechanism, of one or more pairs of compressing feeding-rollers, operating intermittingly to feed the book along a given space after the insertion of each staple, all substantially as described.

6. The combination, with book-stapling mechanism, of one or more pairs of feed-rollers operating continuously, to carry the work operated upon out of the way of the stapling mechanism after the stapling process has been completed, all substantially as described.

7. The combination, with stapling mechanisms, of one or more pairs of feed-rollers having intermittent rotary motion, and one or more pairs of feed-rollers having continuous rotary motion, constructed and operating substantially as described.

8. The combination, with staple-inserting mechanism, of a pair of clinchers, consisting of two rocking-shafts lying parallel to each other, and so shaped at their extremities as to clear the plate N and provide clinching-plates to engage with and bend the staple-legs toward each other, against the book or other article through which the staples have been driven, substantially as described.

9. The guide-plate N, provided with a slot having enlargements at its extremities, in combination with staple-inserting and clinching mechanisms, whereby the staple-legs as they are inserted are guided in the same planes to the clinchers, and in clinching are guided so as to be turned down in straight lines toward each other, substantially as described.

10. A staple-clinching mechanism consisting of two plates, *e*, operating by means substantially as described, so as to stand apart at proper angles to partially bend the staple-legs as they are forced through the work, and then to be swung toward the work upon centers which are slightly outside of the points of protrusion of the staple-legs through the work, whereby the clinching of said legs is effected by simple pressure, substantially as described.

11. A staple forming and presenting mechanism, consisting of a forming-mandrel and an internally-grooved bending-fork, the said mandrel being stationary during the operation of forming the staple around it, and the said bending-fork moving forward, by means substantially as described, to form and deposit the staple within its internal grooves, and downward to strip it from off the forming-mandrel, and forward to carry it into position to be inserted into the work, substantially as described.

12. The combination of the forming-mandrel and nipper, substantially as described.

13. The combination of a forming-mandrel and nipper constructed with a wire-guiding eye, substantially as described.

14. A forming-mandrel provided with a nipper and operated by means substantially as described, so as to be moved over the staple length of wire until said wire rests at a point near the extremity of the mandrel, where it is clamped by the nipper in position to be operated upon by the bending-fork, substantially as described.

15. The combination, with staple-clinching mechanism, of the swinging bracket B, carrying the perforating mechanism and the staple forming and inserting mechanism, substantially as described.

16. The combination of slide 10, toggle D, and rock-shaft 20, substantially as described.

17. The combination of slide 10, toggle D, head 19, and screw T, substantially as described.

18. The combination of rollers H H′, bell-crank 18, and toggle-lever D, substantially as described.

19. The combination of bell-crank L, slider K, rack *b*, pinion *j*, wheel U, and drill-spindles, substantially as described.

20. The combination of a swinging bracket carrying drill-spindles and gears for rotating them, with a reciprocating rack for actuating the spindle-gears, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HENRY R. HEYL.

Witnesses:

HENRY T. MUNSON,

M. B. PHILIPP.