

**No. 632,115.**

**Patented Aug. 29, 1899.**

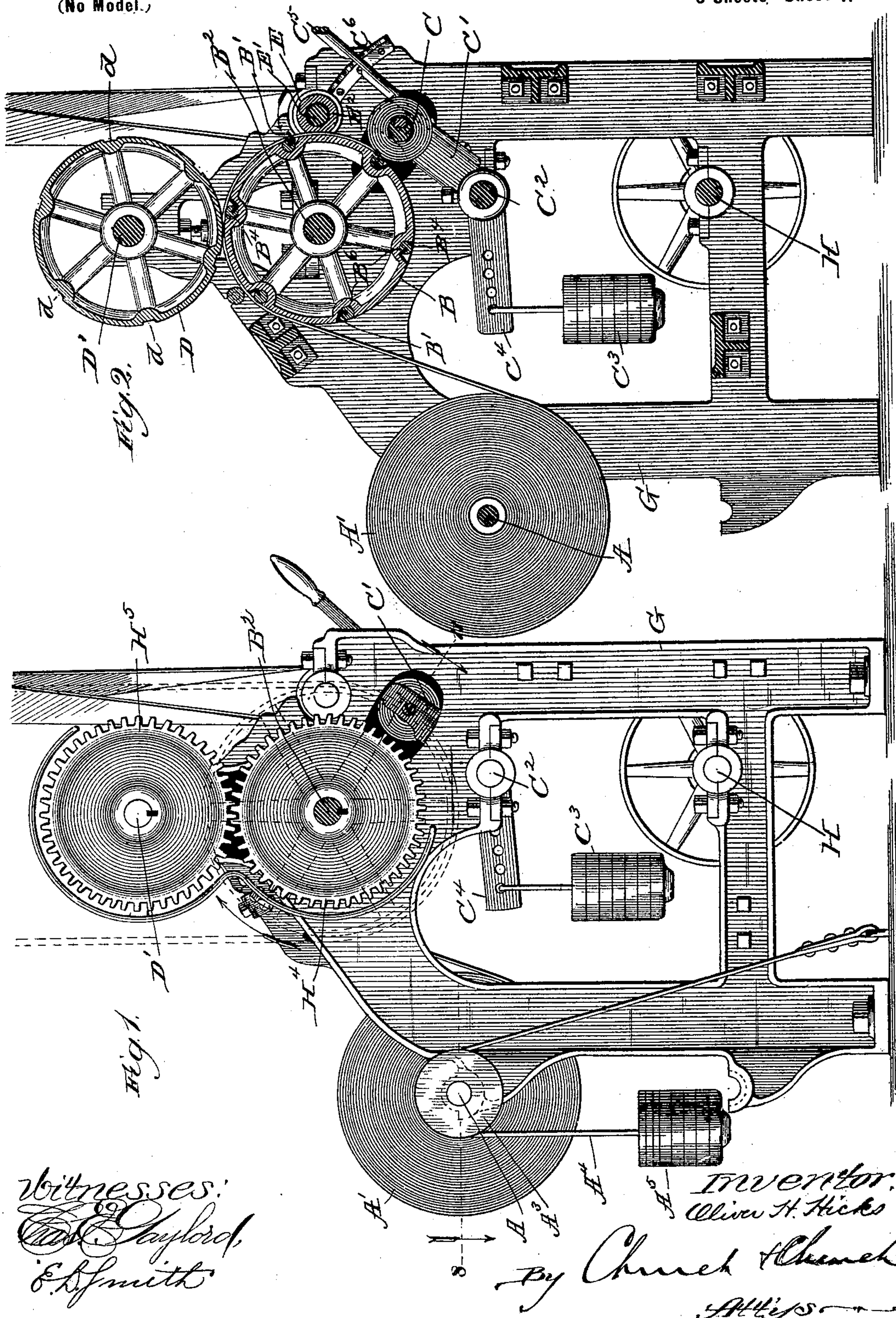
**O. H. HICKS.**

**MACHINE FOR PERFORATING PAPER.**

(Application filed Nov. 19, 1890.)

**5 Sheets.—Sheet 1.**

(No Model.)





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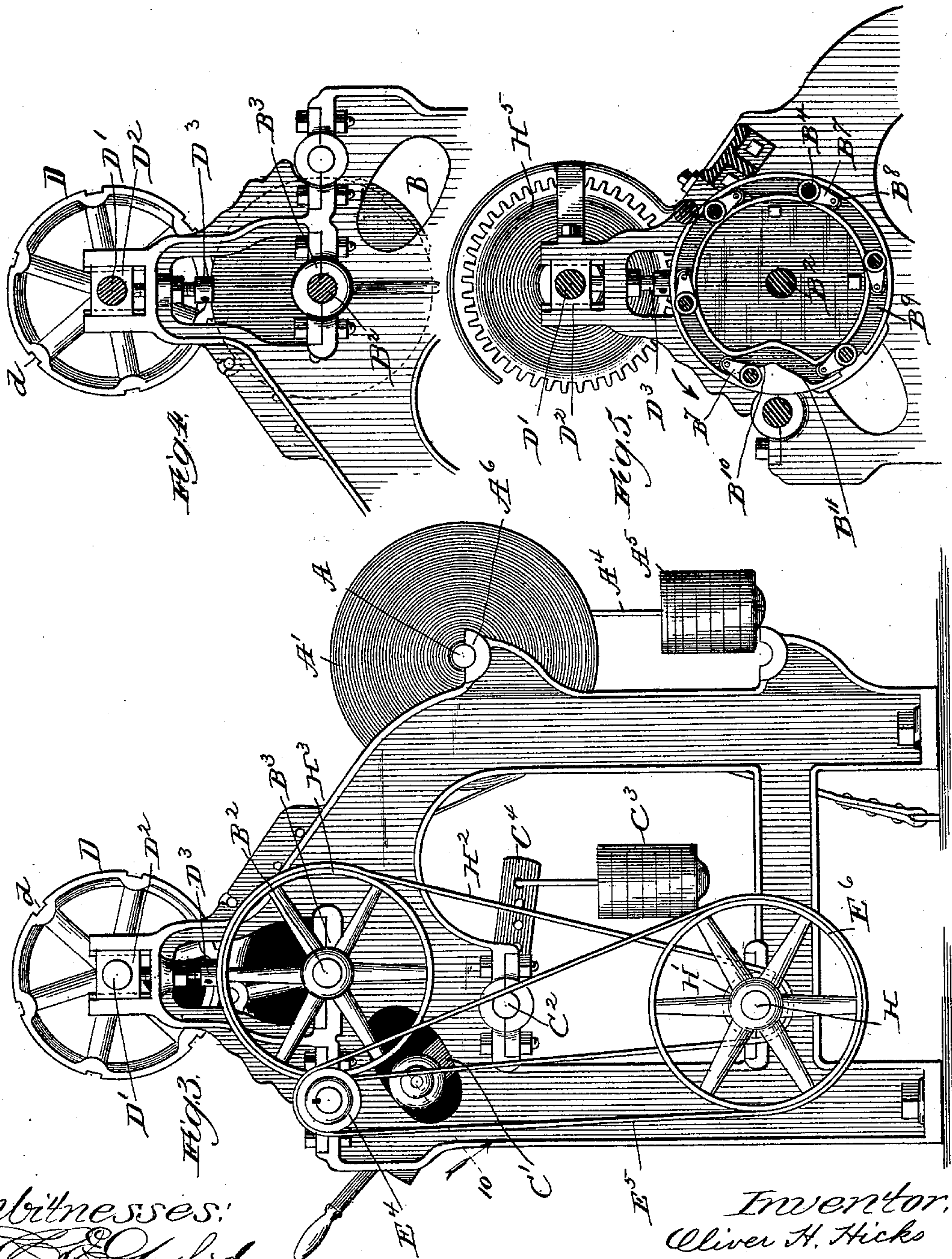
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5 Sheets—Sheet 2.



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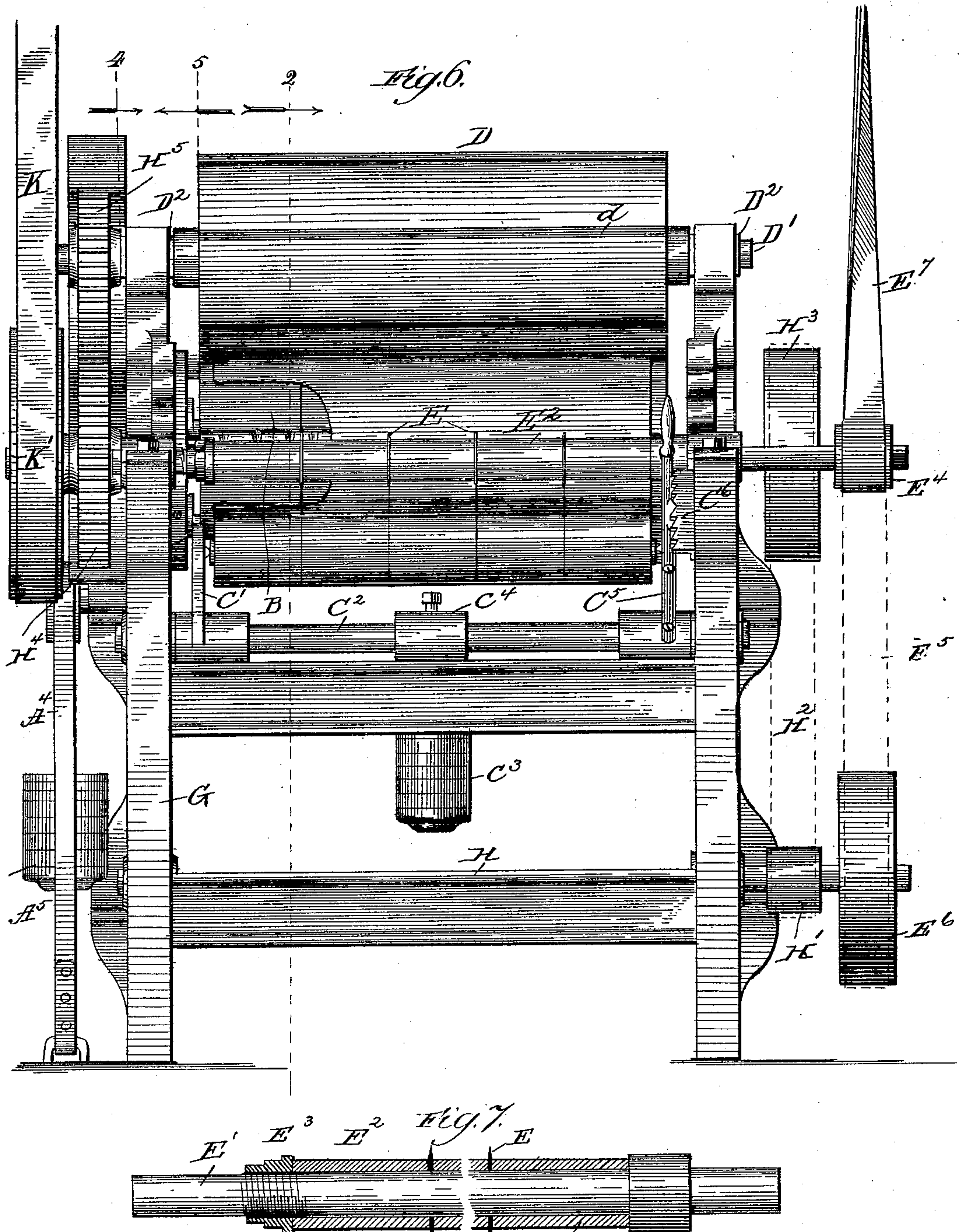
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5 Sheets—Sheet 3.



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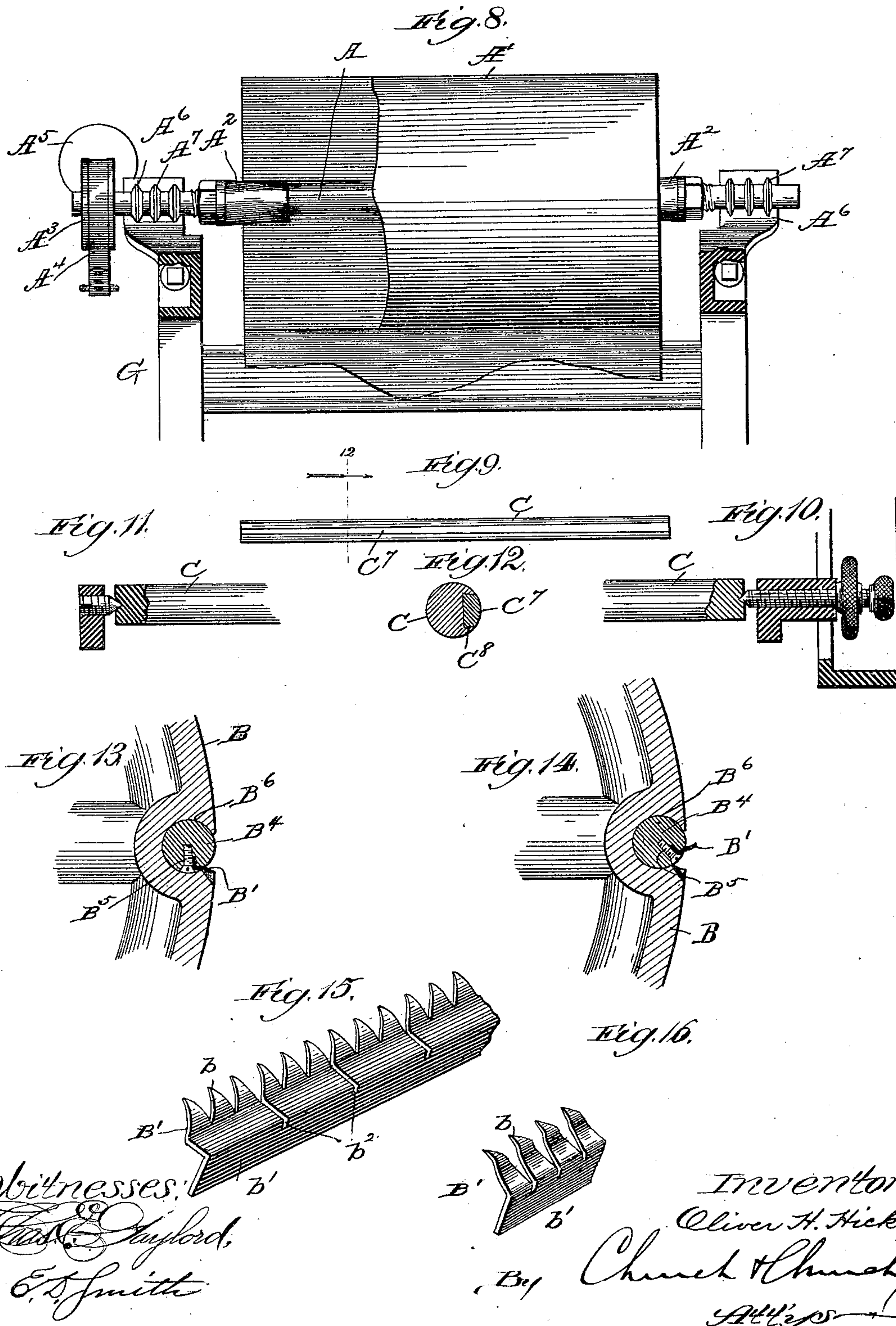
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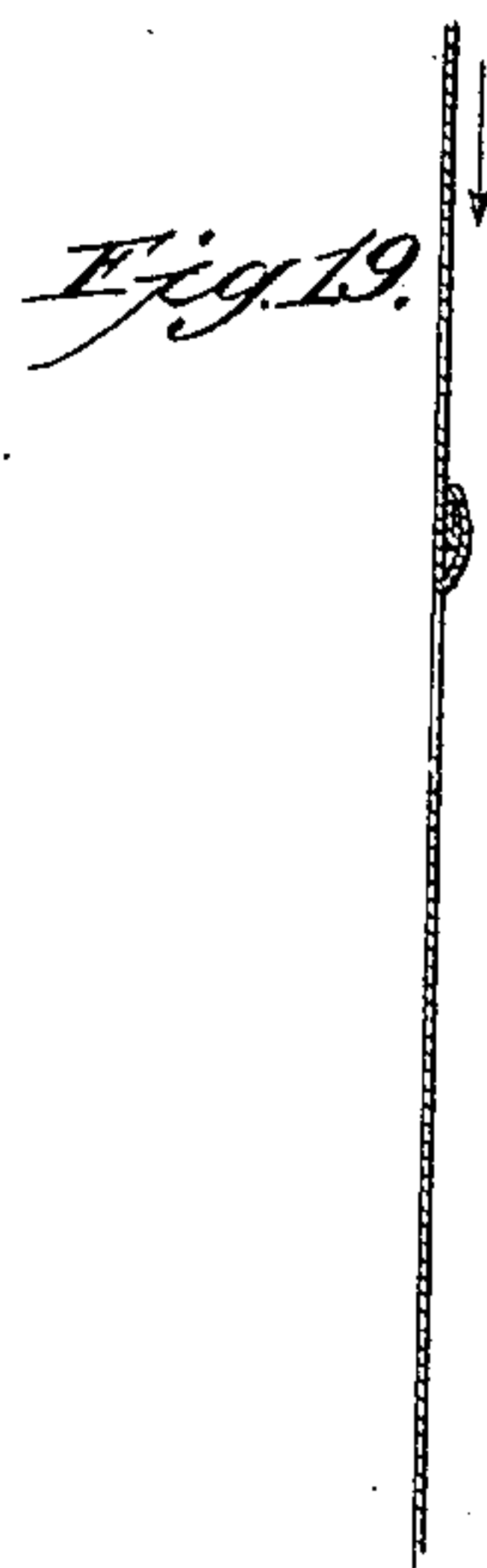
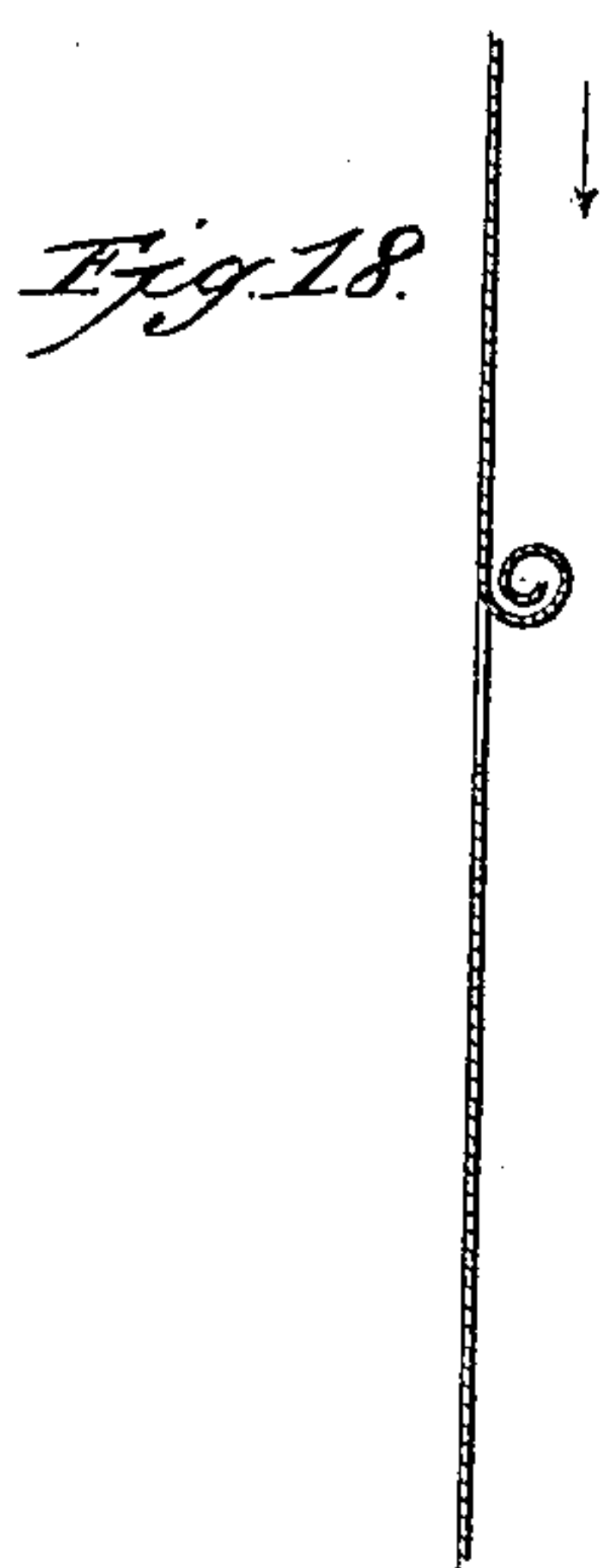
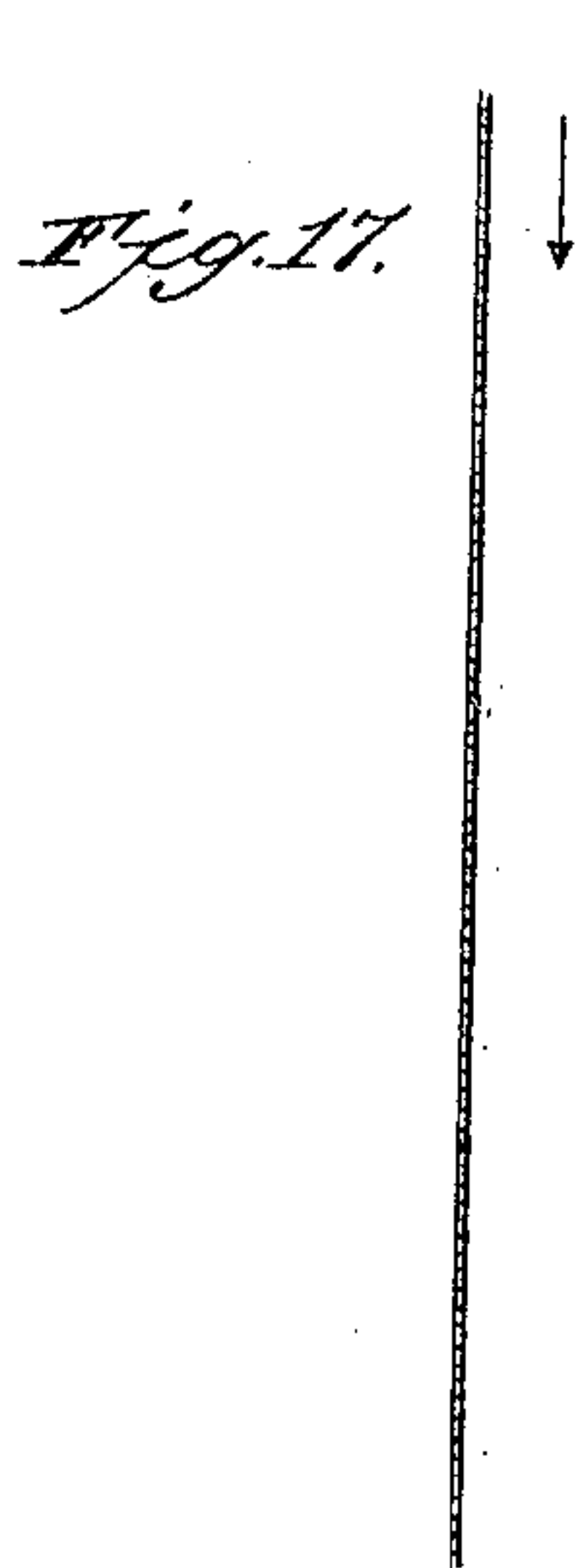
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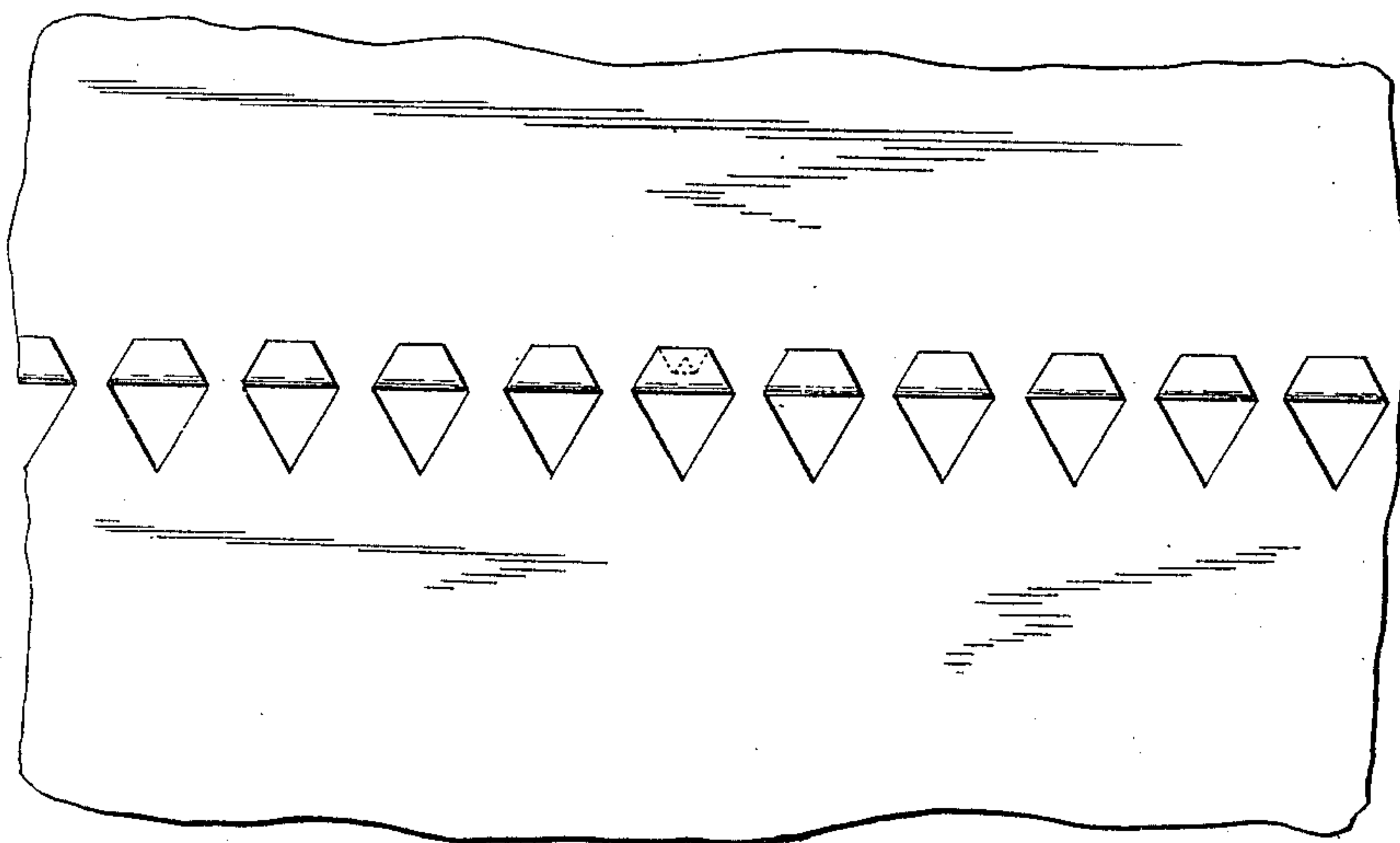
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5 Sheets—Sheet 5.



*Fig. 20.*



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# UNITED STATES PATENT OFFICE.

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## MACHINE FOR PERFORATING PAPER.

SPECIFICATION forming part of Letters Patent No. 632,115, dated August 29, 1899.

Application filed November 19, 1890. Serial No. 371,960. (No model.)

*To all whom it may concern:*

Be it known that I, OLIVER H. HICKS, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Methods of and Machines for Manufacturing Perforated Paper; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the letters of reference marked thereon.

My invention relates particularly to that class of paper-perforating machines in which mechanism is provided for perforating or weakening a web of paper at intervals, so as to enable it to be readily separated or divided up into sheets of the desired size; and it has for its object to so improve such machines as to render them simpler and cheaper in construction, more durable and less liable to get out of order, more rapid in their action, and adapted to effect the perforation of the paper by a method which avoids entirely the production of litter and which gives a resulting product whose use also involves no litter.

In prior methods of manufacturing perforated paper each line of weakness has usually been produced by punching a series of holes in the web, and the numerous bits of paper, usually in the form of disks, removed by the punching machinery have not only produced a great amount of litter, but have tended to clog and interfere with the action of the machine. Moreover, notwithstanding the exercise of the greatest care in sharpening the punches it has been found practically impossible to maintain them in such condition as to cause them always to entirely cut out and remove the little bits of paper, and the result has been a more or less unsightly product and litter in its use, due to the dropping out of the partially-removed bits referred to. By my improved method of manufacture the bits of paper by whose displacement the perforations are formed are purposely not entirely cut out or severed from the web of paper, but are left attached thereto at one edge, and the instrument which forms them as they are formed folds them back against the body of the web, thereby not only effectually preventing any litter, but reinforcing the edges

of the sections opposite the perforations and preventing the downward diagonal tearing of said sections in the operation of separating them from the web.

I will first describe one form of machine by which my improved method may be practically carried out and will then point out what I regard the novel features of such machine as well as the novelty of my said method in the clauses of claim at the close of this specification.

Referring to the accompanying drawings, Figure 1 is an elevation of one side of the machine; Fig. 2, a vertical section taken on the line 2, Fig. 6; Fig. 3, an elevation of the other side of the machine; Fig. 4, a detail sectional view taken on the line 4, Fig. 6; Fig. 5, a similar view taken on the line 5, Fig. 6. Fig. 6 is a front elevation of the machine; Fig. 7, a detail view, partly in section, of the paper-cutters and their supports; Fig. 8, a view of the supply-roll and its supports, said roll being represented in part by a section taken on the line 8, Fig. 1. Fig. 9 is a front view of the winding-shaft detached. Figs. 10 and 11 show, respectively, on an enlarged scale, the means for supporting the opposite ends of the winding-shaft. Fig. 12 is a cross-sectional view of the winding-shaft, taken on the line 12, Fig. 9. Fig. 13 is a detail sectional view of the cylinder which carries the perforating-knives, showing one of the knives arranged therein with its cutting-teeth retracted. Fig. 14 is a similar view showing the teeth of the perforating-knife projected. Fig. 15 is a perspective view of one of the perforating-knives detached; Fig. 16, a view of a short knife-section such as may be employed where a sectional instead of a continuous perforating knife is employed. Figs. 17 and 18 are sectional views illustrating the manner in which the bits or particles of paper partially cut out by the knives are folded back. Fig. 19 is a sectional view of the perforated web as it appears when completed and ready for use, and Fig. 20 is a plan view of the same.

Similar letters of reference in the several figures indicate the same parts.

The letter A indicates the shaft upon which the supply-roll of paper A' is supported; B, the cylinder in which the perforating-knives



B' are arranged and over and partly around which the web of paper issuing from the supply-roll extends. C is the winding-shaft upon which the perforated paper is wound, D a cylinder coöperating with the roll or cylinder B to feed the web of paper, and E a series of rotary cutting-disks for dividing or splitting up the web after it has been perforated by the knives and before it is wound upon the winding-shaft C. All these parts are supported in a strong frame G, as shown in the several figures.

The shaft A of the supply-roll has secured to it two conical heads A<sup>2</sup>, one or both of which are made adjustable for centering the roll and tightly clamping it, so as to prevent its rotation independently of the shaft. A friction-pulley A<sup>3</sup> is also secured to one end of said shaft, and over it passes a strap A<sup>4</sup>, that is made fast at one end to the floor and has hung upon its other end a series of removable weights A<sup>5</sup>. By varying the number of these weights the strap is caused to bear with more or less pressure upon the friction-pulley, thus regulating the tension upon the web drawn from the roll.

For convenience in applying and removing the supply-roll shaft it is journaled in open bearings in the frame, as shown at A<sup>6</sup> in Figs. 3 and 8, and to prevent its longitudinal displacement while the roll is being unwound it is provided with a series of circumferential ribs or enlargements A<sup>7</sup>, that enter corresponding grooves in the bearings, as seen in Fig. 8.

The shaft B<sup>2</sup>, on which the lower cylinder B is mounted, is journaled in fixed bearings B<sup>3</sup>, Figs. 4 and 5, and constitutes the main driving-shaft of the machine, while the shaft D', on which the coöperating upper cylinder D is mounted, is journaled in movable bearings D<sup>2</sup>, that are rendered adjustable up and down by means of screws D<sup>3</sup>, so as to enable the two cylinders to be adjusted farther apart or nearer together, as desired.

Motion is imparted to the cylinder D from the cylinder B by means of the equal gears H<sup>4</sup> H<sup>5</sup>, as shown in Figs. 1 and 6, so that both said cylinders will have the same surface speed and draw uniformly upon the web of paper between them. The upper cylinder might be driven by frictional contact alone, if preferred.

Each of the perforating-knives carried by the cylinder B consists, preferably, of a blade B', of thin metal, having a series of projecting and preferably slightly-curved teeth *b* and a shank portion *b'*, that is adapted to enter a corresponding groove or seat in a cross-shaft or holder B<sup>4</sup>, as shown in Figs. 2, 13, and 14, and to be held therein by means of screws B<sup>5</sup> or their equivalents, as also shown in said figures. The knives may be made in one piece extending way across the cylinders, as shown in Fig. 15, or in separate sections, such as shown in Fig. 16, set side by side. If made in one piece, they are preferably provided with slots *b*<sup>2</sup> at intervals, as shown in Fig. 15,

in order to enable them to more readily conform to their holders and to enable their teeth to be more conveniently alined or adjusted if they require it at any time.

The cross-shafts or knife-holders B<sup>4</sup> are preferably cylindrical in form and are fitted so as to turn or oscillate freely in corresponding longitudinal recesses or grooves B<sup>6</sup>, formed in the cylinder B. On the end of each of said holders is fixed a short arm B<sup>7</sup>, (see Fig. 5,) having a lateral stud upon which is preferably mounted an antifriction-roller B<sup>8</sup>, that is adapted to travel in a fixed cam track or groove B<sup>9</sup>, secured to the inside of the main frame, as shown in Fig. 5.

In the machine illustrated in the drawings I have shown the lower or knife cylinder provided with six knives and coöperating appliances; but it is obvious that this number may be varied as desired to suit the fancy of the constructor and according to the work to be done.

While the arms on the ends of the knife-holders are controlled by the circular or concentric portion of the cam-groove B<sup>9</sup>, the said holders occupy the position shown in Fig. 13—that is to say, turned so as to hold the points of the teeth of the knives retracted and flush with or a trifle below the surface of the cylinder; but as soon as the roller on any arm strikes the inclined portion B<sup>10</sup> of said cam-groove the holder connected to that arm will be turned and the teeth of its knife will be projected outward and backward, thereby causing the points of said teeth to partly cut away portions of the web supported by and moving with the knife-cylinder and fold such partly-severed portions backward against the body of the web. The described cutting and perforating operation takes place while the roller on the knife-holder arm is traveling inward along the incline B<sup>10</sup>, and as the said roller begins to travel outward along the incline B<sup>11</sup>, Fig. 5, the knife again begins to be retracted, becoming wholly so when the circular portion of the groove is again reached. Not only do the teeth of the knife operate to fold back the bits or pieces of paper partly removed by them, but owing to the curve given said teeth the ends of said bits or pieces of paper are caused to curl or turn under, as shown in Figs. 17 and 18, and the subsequent operation of winding the perforated web on the winding-shaft C causes all said turned-back portions (which, it will be noticed, are turned backward in a direction opposite that in which the web moves) to be smoothed down flat and to present the appearance exhibited in Figs. 19 and 20.

The knives may be so set and operated as to cause them to turn the partially-removed bits or pieces toward instead of away from the direction in which the paper moves; but I prefer the construction shown.

By reference to Figs. 1, 2, and 3, and particularly to Fig. 2, it will be seen that the winding-shaft C, upon which the paper after per-



foration is wound, is mounted upon arms C', projecting from a rock-shaft C<sup>2</sup>, and is kept pressed toward the knife-cylinder B by means of weights C<sup>3</sup>, suspended from other arms C<sup>4</sup>, attached to said rock-shaft. By this construction the winding-shaft and the forming roll or rolls upon it are rotated by frictional contact alone.

In this connection I would call attention to the fact that inasmuch as the web during the perforating operation moves with the surface of the knife-cylinder and is supported thereby on both sides of the acting knife and as the sharp points of the knife in passing through the web do not subject the latter to any appreciable strain either outwardly or longitudinally it is important that the winding-roll be driven by frictional contact between it and the knife-cylinder, for by doing so no strain or tension is put upon the web after perforation, and however much the web may have been weakened by the perforating operation it can be wound up into rolls of the requisite degree of compactness without rupture.

Connected to the arms C', which support the winding-shaft, is an arm C<sup>5</sup>, which enables the winding-roll to be thrown out of contact with the knife-cylinder when desired. A ratchet-segment C<sup>6</sup> is provided for locking said arm C<sup>5</sup> at any desired point.

Where it is desired to put up paper in the form of small rolls or bundles I provide the series of circular cutters E, working in suitable peripheral grooves in the cylinder B, for cutting up the web into longitudinal strips after it is perforated and before it has been wound upon the winding-shaft. These cutters are mounted upon the cutter-shaft E', are properly separated and spaced by means of sleeves E<sup>2</sup>, and are secured by the adjustment of a screw nut or head E<sup>3</sup>, as shown in Fig. 7. The slitting-knives are preferably arranged in line with the slots in the perforating-knives, so as to pass the said perforating-knives without danger of interference.

Rapid rotation is given the cutter-shaft by means of a pulley E<sup>4</sup> on its end, a belt E<sup>5</sup>, pulleys E<sup>6</sup> and H' on the shaft H, and a belt H<sup>2</sup> and a pulley H<sup>3</sup> on the driving-shaft, as shown in Fig. 3 and by the dotted lines in Fig. 6, or directly by means of a belt E<sup>7</sup>, as shown in full lines, Fig. 6.

The winding-shaft consists of the main shaft C and a removable strip or section C<sup>7</sup>, fitted into a longitudinal groove or recess C<sup>8</sup> in said shaft, as shown in Figs. 9 and 12.

In winding the perforated web its end is pasted or otherwise secured to the removable section C<sup>7</sup>, so that a start may be made, and when a sufficient quantity of it has accumulated the shaft is removed from the supports or centers upon which it has been revolving (see Figs. 10 and 11) and the strip or section C<sup>7</sup> is driven out longitudinally, thus severing all positive connection with the roll and enabling the shaft proper to be drawn out.

From the foregoing description it is believed

that the operation of the machine will now be readily understood. Power being applied to the main shaft B<sup>2</sup> by a belt K and pulley K', (see Fig. 6,) the cylinders B and D are rapidly revolved and draw the web of paper from the supply-roll A against the resistance offered by the tension device A<sup>4</sup> A<sup>5</sup>. As the cylinder B revolves each knife in turn is oscillated by the action of the cam track or groove before described, perforates the web, and turns back the bits of paper displaced to form the perforations, after which the cutters E operate to split up or divide the web, and the latter in sections is then wound upon the winding-shaft by the frictional contact between the winding-roll and the said cylinder B, the bits of paper folded back by the knives being smoothed down and completed by the winding operation.

It will be noticed that the upper cylinder D is provided with a series of recesses or cavities *d* in its periphery. Should the winding-roll slip or should from any cause the paper be fed faster than it is wound up, the tension on the feed-roll will take up the slack each time one of the said recesses or cavities comes over the lower cylinder. A flat place on the upper cylinder, or in either cylinder for that matter, would have the same effect.

It is evident that knives constructed to cut straight cross-slits in the web might be employed in my machine; but I prefer the knives shown. Straight knives may also be employed to divide the web longitudinally instead of the circular ones shown, if desired.

I claim as my invention—

1. In a machine for perforating paper and folding back the partially-severed material away from the perforations, the combination with paper feeding and supporting mechanism, of means for partially removing or cutting away portions of the web to form the perforations and giving such partially removed or severed portions a set or elevation above the plane of the body of the web, substantially as described.

2. In a machine for perforating paper and folding back the partially-severed material away from the perforations, the combination with paper feeding and supporting mechanism, of means for partially removing or cutting away portions of the web to form the perforations and giving such partially removed or severed portions a set or elevation above the plane of the body of the web, and means for subsequently pressing such portions down against the body of the web away from the perforations; substantially as described.

3. In a machine for perforating paper and folding back the partially-severed material away from the perforations, the combination with paper feeding and supporting mechanism, of perforating-knives operating from one edge of the perforation to elevate the partially-removed material and roll the same back away from the perforation whereby the ends of the partially-removed portions are



curled under, and means for flattening such portions down against the body of the web with the ends turned under; substantially as described.

5 4. In a machine for perforating paper, the combination with a support for the paper, of an oscillating toothed knife operated to pass the teeth through the web to partly remove portions of the paper of substantially the  
10 shape of the teeth to form the perforations; substantially as described.

5. In a machine for perforating paper the combination with a support for the paper, of a toothed knife operating to partly remove  
15 portions of the paper to form the perforations and passing over the outside of the web to turn said partly-removed portions back upon the paper; substantially as described.

6. In a machine for perforating paper, the  
20 combination with a support for the paper, of an oscillating toothed knife having curved teeth operated to pass the teeth through the web to partly remove portions of the paper to form the perforations and to pass over the  
25 outside of the web to fold back said partly-removed portions with the ends of said portions turned under, substantially as described.

7. In a machine for perforating paper, the combination, with a rotary cylinder over  
30 which the paper passes and upon which it is supported, of a toothed knife carried by said cylinder and operating when moved in one direction to partly remove portions of the paper of substantially the shape of the teeth  
35 without severing the web and when moved in the opposite direction to withdraw its teeth from the paper; substantially as described.

8. In a machine for perforating paper, the combination with a cylinder over which the  
40 paper passes and by which it is supported, of a series of oscillatory toothed knives carried by said cylinder, each operating, when turned in one direction, to partly remove portions of the paper, and, when turned in the opposite  
45 direction, to withdraw its teeth from the paper, and means for automatically operating said knives in succession; substantially as described.

9. In a machine for perforating paper, the  
50 combination, with a cylinder over which the paper passes and by which it is supported, of a series of oscillatory toothed knives carried by said cylinder and operating, in a curved path when turned in one direction, to partly  
55 remove and turn back against the body of the paper, portions of the paper, and, when turned in the opposite direction, to withdraw its teeth, and means for automatically operating said knives in succession; substantially as de-  
60 scribed.

10. In the herein-described machine for perforating paper, the combination with the rotary cylinder having the series of longitudinal grooves or recesses for receiving the os-  
65 cillatory knife-holders, of said knife-holders, the knives having curved teeth carried by said holders, and means, substantially such

as described, for causing the oscillation of the knife-holders and the consequent projection and retraction of the teeth of the knives, 70 whereby the paper is perforated at intervals during the continuous rotation of the cylinder; substantially as described.

11. In a machine for perforating paper, the combination with a pair of cylinders by which 75 a web of paper is fed, of a series of oscillatory knives having curved teeth in one of said cylinders and means for oscillating said knives to cause their teeth to partially remove portions of the web and then to withdraw 80 from said web; substantially as described.

12. In a machine for perforating paper, the combination with a pair of cylinders coöperating to feed a web of paper, of an oscillatory toothed knife or series of knives arranged in 85 one of said cylinders and means for oscillating said knife or knives to cause them to partially remove portions of the web and fold back said portions against the body of the web, substantially as described. 90

13. In a machine for perforating paper, the combination of a rotary cylinder carrying a series of toothed perforating-knives, means, substantially such as described, for project- 95 ing the teeth of said knives through the paper to partly remove portions of the same and for then retracting said knives and a shaft or roll for winding up the perforated paper by frictional contact with said cylinder; substan- 100 tially as described.

14. In a machine for perforating paper, the combination of two rotary cylinders for feed- 105 ing a web of paper, one of said cylinders being provided with a series of oscillating toothed knives, substantially such as described, and a winding shaft or roll held in frictional contact with said last-mentioned cylinder and turned thereby substantially as described.

15. In a machine for perforating paper, the 110 combination of a perforating-cylinder for perforating the web of paper passed over it, a rotary cutter or cutters coöperating with the cylinder to divide the web into longitudinal sections after it is perforated, and a winding 115 shaft or roll driven by frictional contact with the perforating-cylinder; substantially as described.

16. In a machine for perforating paper, the combination with a rotary cylinder, of a series 120 of oscillating toothed knives arranged in said cylinder, means for oscillating said knives to cause them to perforate the paper web upon said cylinder by partly removing portions of said web and then retracting said knives, and 125 rotary cutters coöperating with said cylinder to divide the said web longitudinally after it has been perforated; substantially as described.

17. In a machine for perforating paper, the 130 combination with a rotary cylinder, of a series of oscillatory toothed knives arranged in said cylinder, means for oscillating said knives so as to project their teeth through the paper web



upon the cylinder and then retract said teeth, substantially as described, rotary cutters co-operating with the cylinder to divide the web, and a winding shaft or roll driven by frictional contact with said cylinder, substantially as described.

18. In a machine for perforating paper, the combination with a pair of coöperating cylinders for feeding the web of paper, of a series of oscillatory toothed knives arranged in one of said cylinders, means for oscillating said knives so as to project and retract their teeth as described, rotary cutters coöperating with said knife-cylinder to divide the web longitudinally and a winding shaft or roll driven by frictional contact with said knife-cylinder, substantially as described.

19. In a machine for perforating paper, the combination with a paper-supply roll, of a tension device applied to said roll, a rotary cylinder over which the web of paper from the supply-roll passes, a winding-roll driven by frictional contact with the rotary cylinder, a series of oscillatory toothed knives, arranged in the cylinder, means for automatically projecting and retracting the teeth of said knives through and out of the web of paper upon the cylinder, substantially as described.

20. In a machine for perforating paper, the combination with a paper-supply roll, of a tension device applied to said roll, a rotary cylinder over which the web of paper from the supply-roll passes, a second rotary cylinder coöperating with the first-named rotary cylinder to draw the web from the supply-roll, a winding-roll driven by frictional contact with the cylinder over which the web passes, a series of oscillatory toothed knives in said last-mentioned cylinder and means for automatically projecting and retracting the teeth of said knives through and out of the web of paper, substantially as described.

21. In a machine for perforating paper, the combination of a paper-supply roll, a tension device applied thereto, two rotary cylinders for drawing the web from the supply-roll, one of said cylinders being provided with recesses or cavities in its surface, as described, and the other of said cylinders being provided with a series of oscillatory toothed knives, means for projecting and retracting the teeth of said knives successively through and out of the paper web on the knife-cylinder and a winding shaft or roll revolved by frictional contact with the knife-cylinder; substantially as described.

22. In a perforating and slitting machine, the combination with the main cylinder, and the series of knives carried thereby for perforating the web transversely and, having the transverse slots therein, of the series of slitting-knives in line with said slots, whereby knives pass without striking; substantially as described.

23. In a perforating and slitting machine, the combination with the main rotary cylinder and perforating-knives carried thereby having transverse slots therein, of the rotary slitting-knives located in line with and adapted to pass through the slots in the knives when the main cylinder is rotated.

24. In a perforating-machine, the combination with the main cylinder and transversely-slotted perforating-knives carried thereby with means for advancing and retracting the same, of the rotary slitting-knives located in line with the slots in the knives and the winding-roll bearing against the main cylinder in rear of the rotary slitting-knives; substantially as described.

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