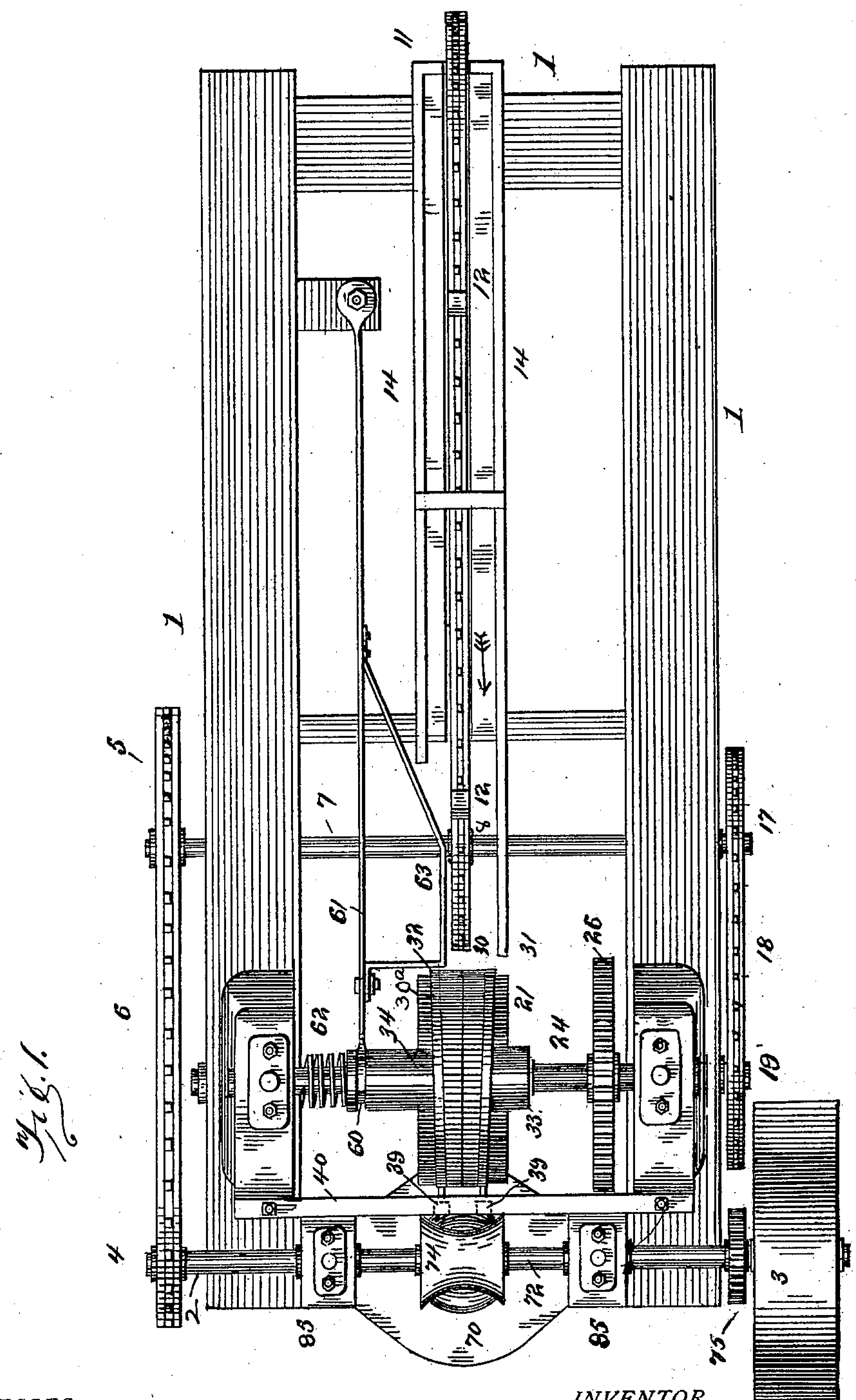
No. 684,884. Patented Oct. 22, 1901.

E. M. THOMPSON.

MACHINE FOR MAKING STAVES.

(Application filed July 17, 1899.)

(No Model.) 5 Sheets—Sheet 1.



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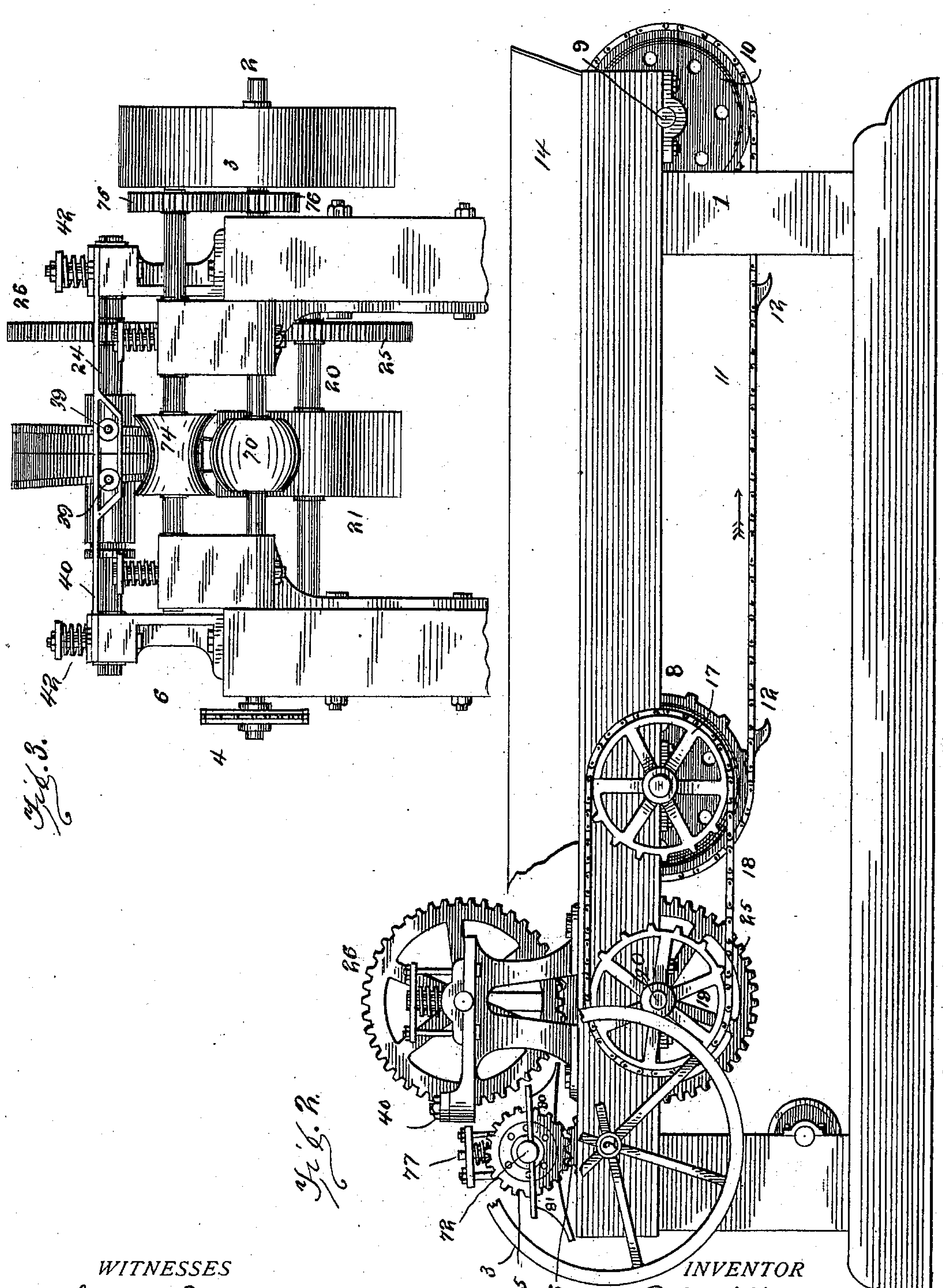

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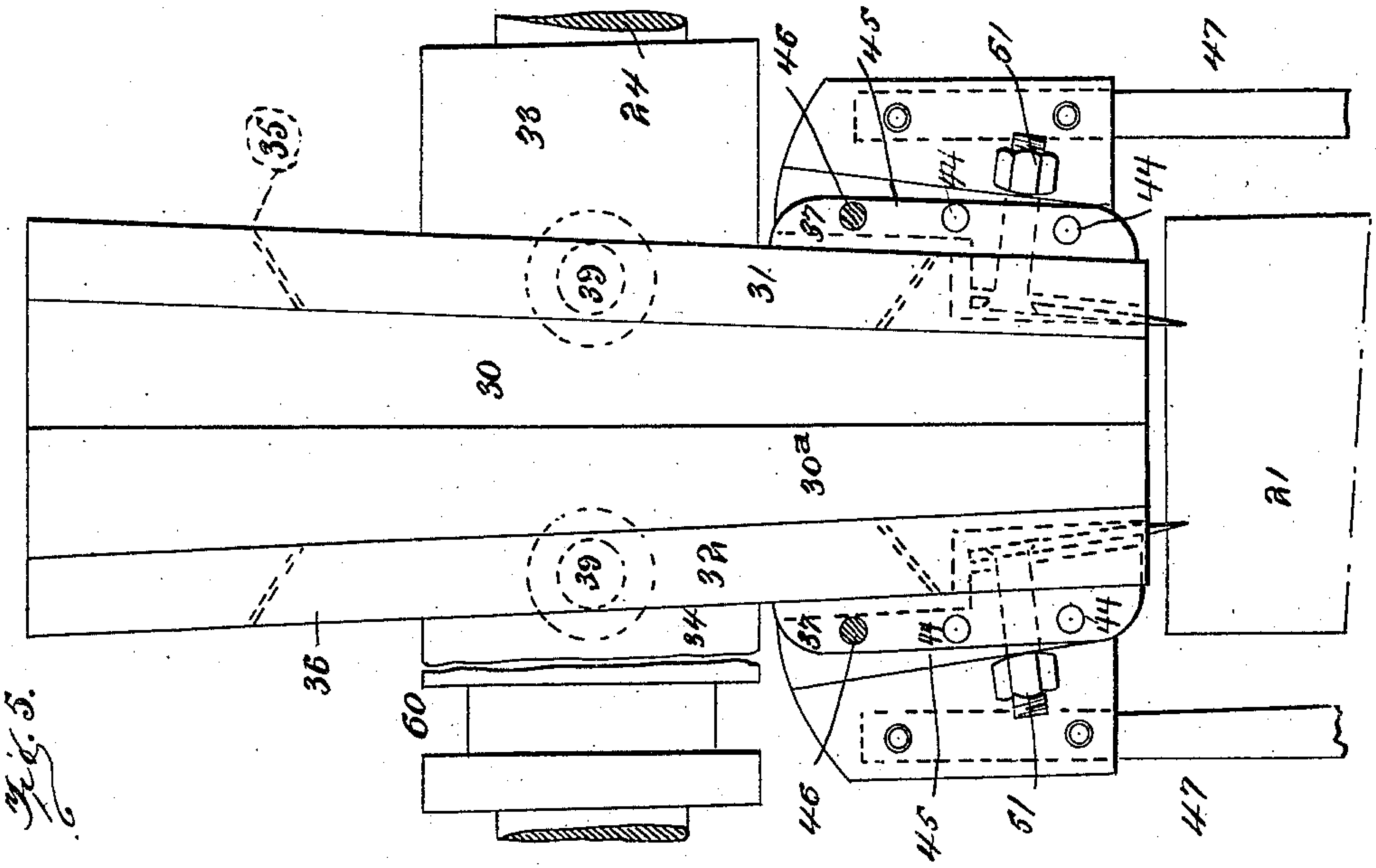

Fig. 5.

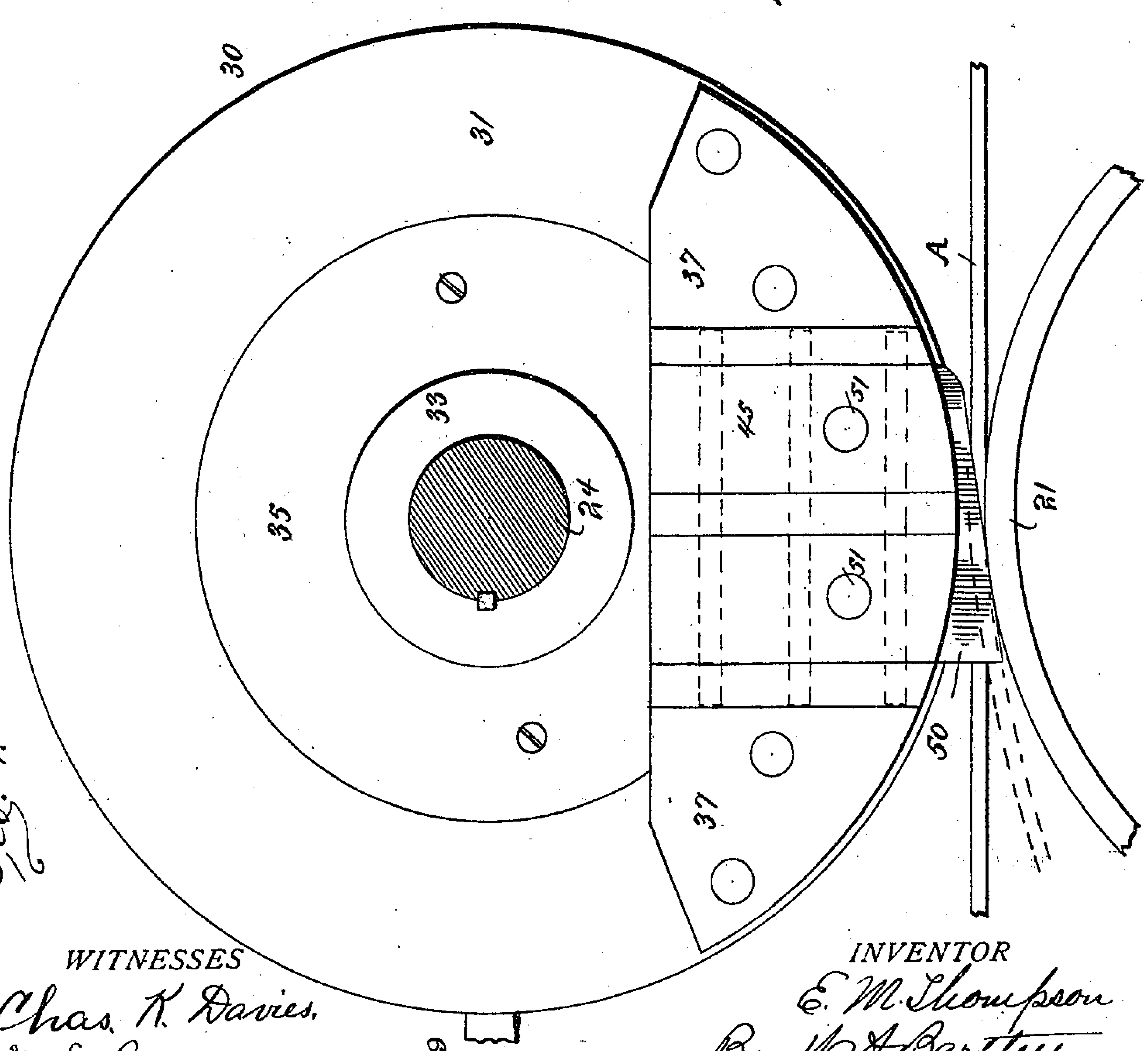

Fig. 4.

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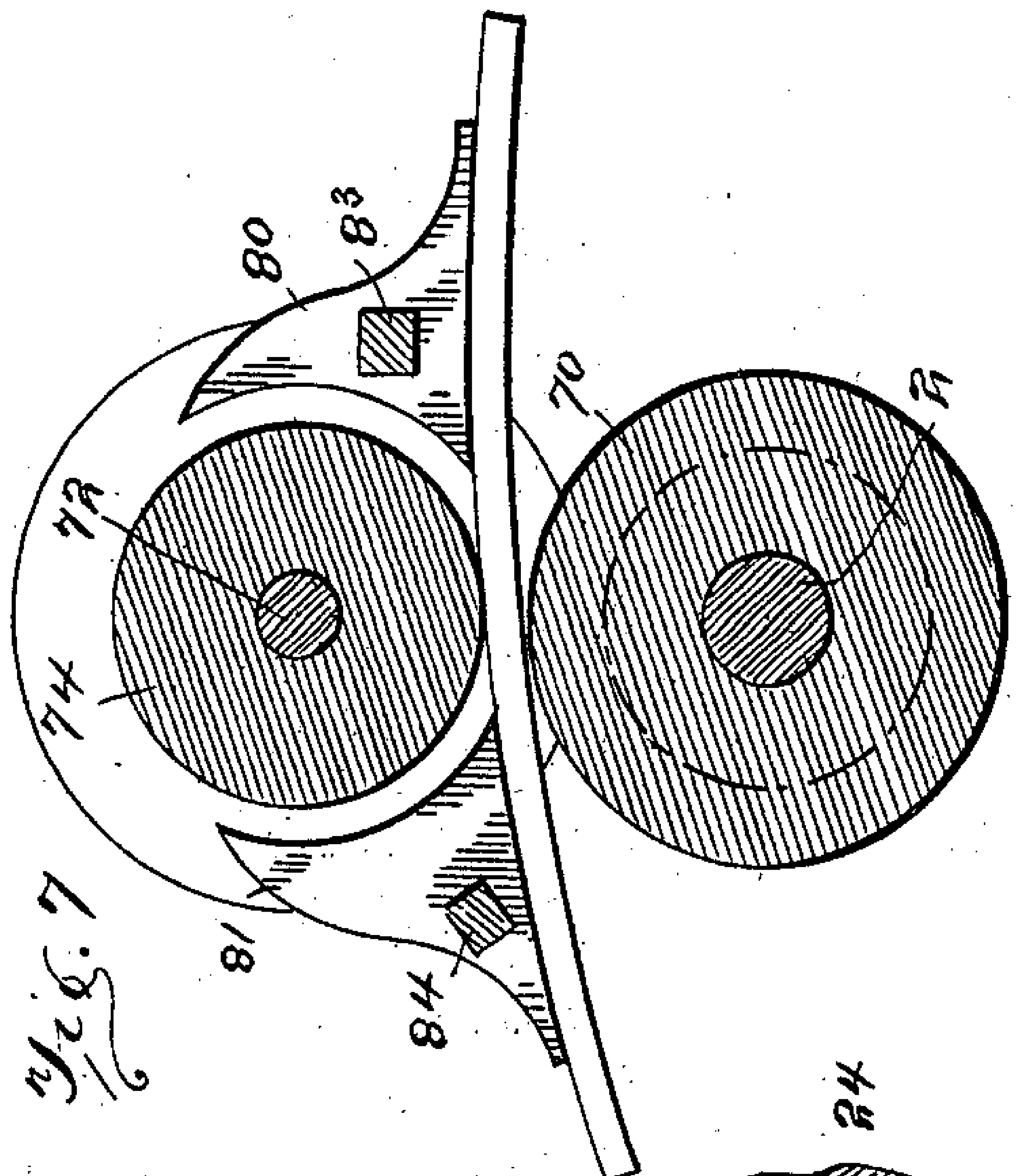

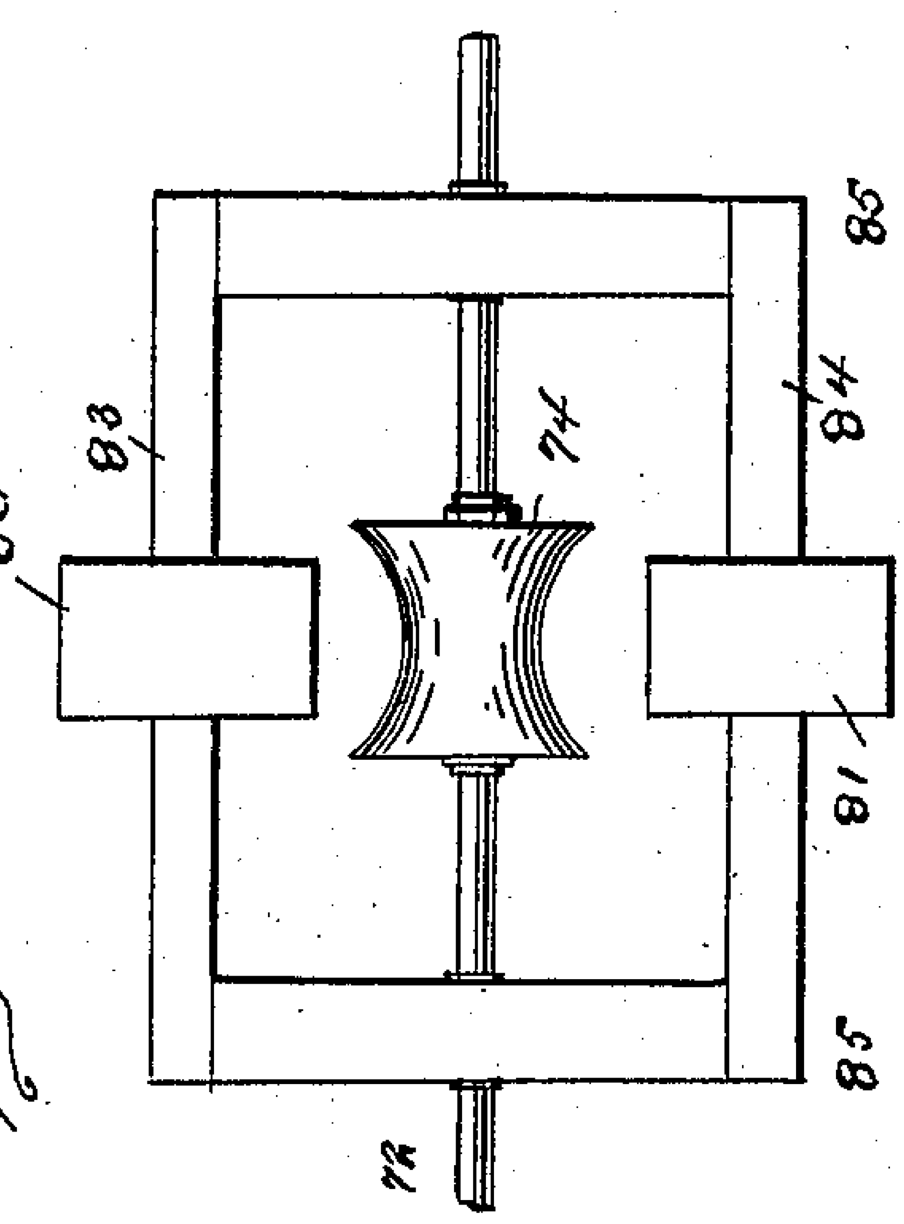

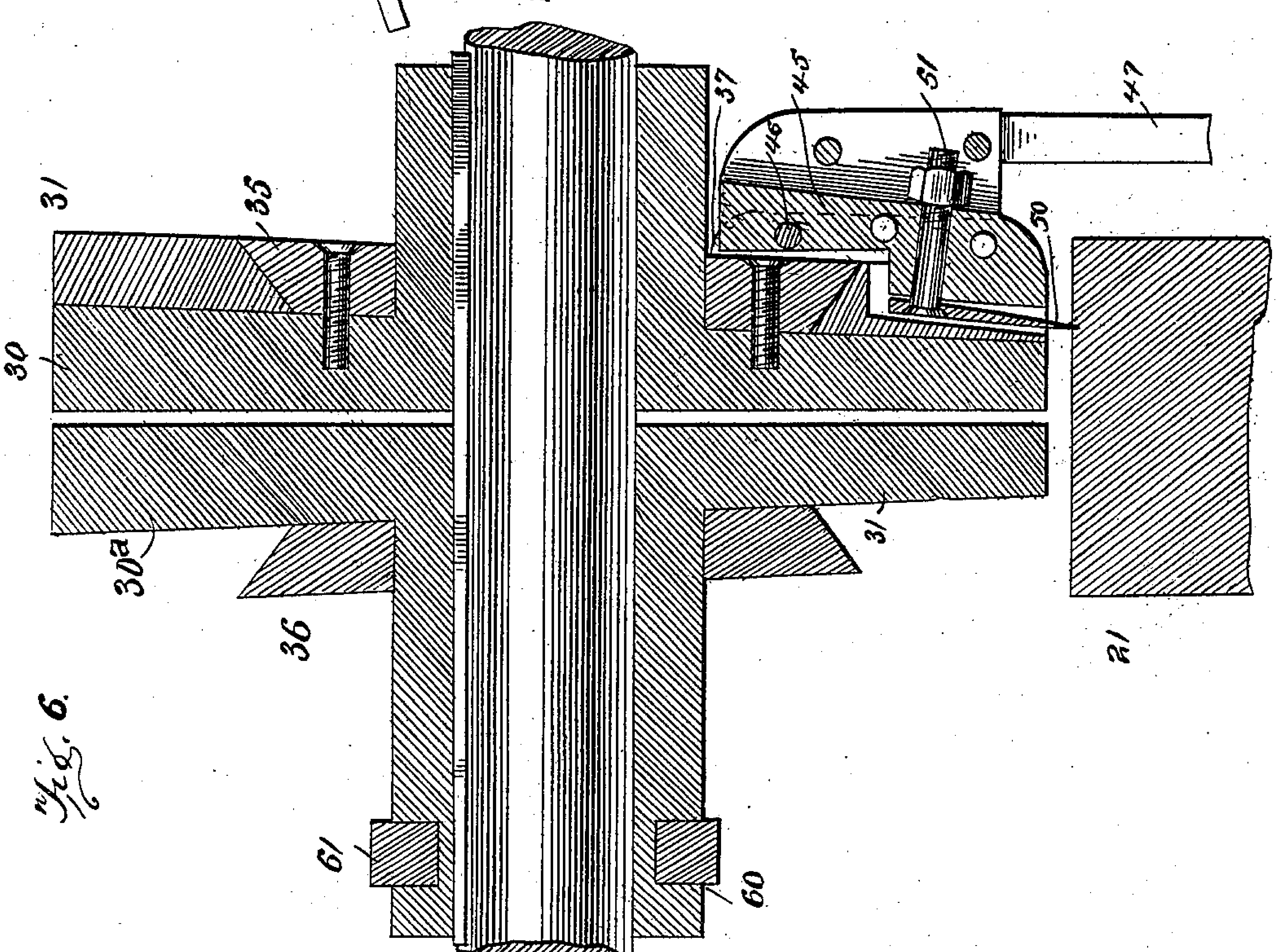

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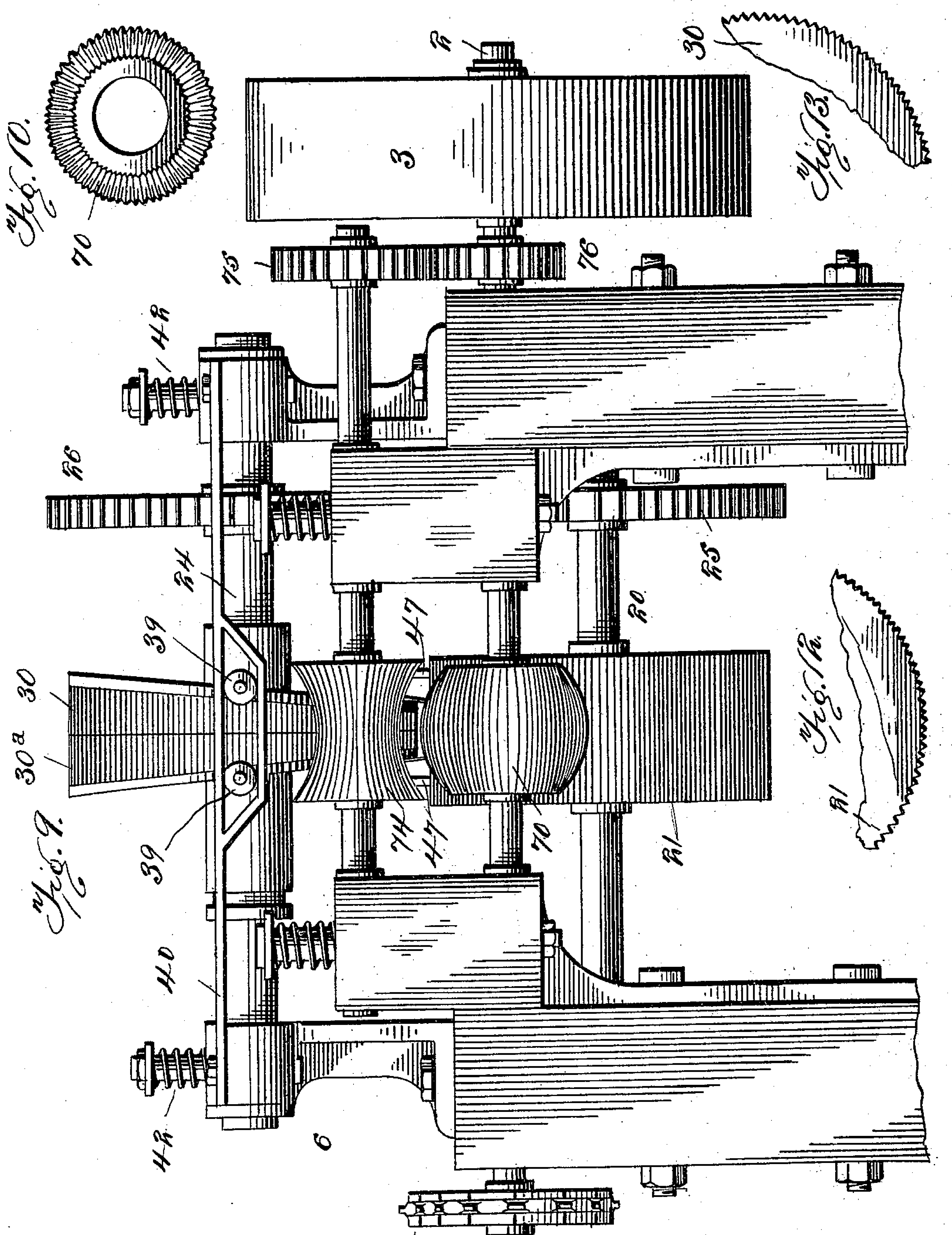

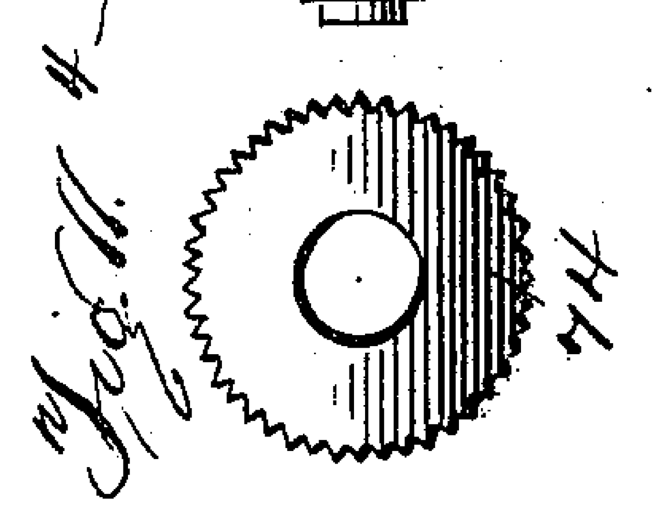

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UNITED STATES PATENT OFFICE.

EVERT M. THOMPSON, OF INDIANAPOLIS, INDIANA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WALLACE A. BARTLETT, TRUSTEE, OF WASHINGTON, DISTRICT OF COLUMBIA.

MACHINE FOR MAKING STAVES.

SPECIFICATION forming part of Letters Patent No. 684,884, dated October 22, 1901.

Application filed July 17, 1899. Serial No. 724,121. (No model.)

To all whom it may concern:

Be it known that I, EVERT M. THOMPSON, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Machines for Making Staves, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to machines for jointing and straining staves, especially for slack-barrels.

The object of the invention is to carry out in an improved way certain steps in the manufacture of such staves as are described in my Patent No. 626,819, of June 13, 1899, and preferably in connection with certain other machines, although it must be understood that modifications may be made in one or more of the various steps or machines without necessarily involving other steps or machines. In the patent and to some extent in the applications referred to I have pointed out the difficulty of producing perfect staves and barrels from "veneer-cut" lumber and the desirability of using such lumber for staves if such objections can be overcome.

In carrying out my invention I produce slats of circumferentially-cut or veneer-cut lumber, each slat having a width at least equal to the mid-width of the proposed stave. These slats may or may not have been curved in the direction of their length. In the present machine the slat A is fed lengthwise of the machine. The end at which the slat enters the machine I will call the "front" and the end from which it emerges the "rear" or "delivery" end of the machine. The slats are fed to the machine in such manner that the outer laminæ of the growth become the outer laminæ of the stave, as in the patent referred to.

Figure 1 is a plan of so much of the machine as is necessary to illustrate the present invention. Fig. 2 is a side elevation of the machine. Fig. 3 is a broken rear end elevation. Fig. 4 is an enlarged side elevation of the stave-jointer cylinder with cutters and a broken detail of lower cylinder or drum. Fig. 5 is an end view of the essential parts of Fig. 4 and details of the knife. Fig. 6 is a sectional detail of part of jointing-cylinder and knife connections. Fig. 7 is a sectional diagram of the stave-arching mechanism. Fig. 8 is a detail plan of the same. Fig. 9 is an elevation of the bending and delivery end of the machine. Fig. 10 is an end view of one of the bending delivery-rolls. Fig. 11 is an end view of the other bending and delivery roll. Figs. 12 and 13 are broken sectional details of corrugated rolls referred to hereinafter.

Let 1 1 indicate the frame of the machine of any suitable construction. A transverse shaft 2, supported in suitable bearings, is driven in any convenient way, as by a belt running on pulley 3. A sprocket-wheel 4 on shaft 2 drives sprocket-wheel or pulley 5 by means of chain 6. Sprocket-wheel or pulley 5 drives shaft 7, which extends across the frame and about midway of the frame bears the sprocket-wheel 8. A shaft 9, parallel with shaft 7, bears wheel or pulley 10. The feed-chain 11 passes around the two wheels 8 10 and is driven by wheel 8, serving as a carrier or conveyer. The feed-lugs 12 on chain 11 carry the slats from the feed-box 14 to the jointer mechanism. The box 14 may be any suitable trough in which a pile of slats may be placed. The slats are preferably hot from the tempering treatment described in another application. The lower slat of the pile is forced along by a lug 12, and these feed-lugs 12 bear a fixed and definite relation to the movement of the jointer mechanism, so that the jointer-cylinder makes one revolution for each stave fed in.

The shaft 7 carries a sprocket-wheel 17, which corresponds with a similar sprocket-wheel 19 on shaft 20, and by means of chain 18 the shaft 20 is driven at the same speed as shaft 7. Shaft 20 carries a drum 21 in line to receive the lower face of a slat fed along by the feed-lugs of chain 11. The drum 21 is equal in circumference to the distance between feed-lugs 12, so that each slat which is fed along by the feed-chain reaches the drum just as it has made a complete revolution. The circumference of drum 21 should be something more than the length of the longest stave on which the machine operates. A shaft 24, parallel with shaft 20, bears the jointer-cylinder. Shaft 24 is geared to move at a uniform speed with shaft 20 by means of gears 25 and 26 on the two shafts engaging with each other. Shaft 24 carries the jointer-pattern jointer-cylinder, and this cylinder is of peculiar construction. In circumference the cylinder is greater than the length of the longest stave to be jointed. The ends of the cylinder are cut off obliquely or on a curve which corresponds to the taper of the stave to be jointed, so that the cylindrical surface of the cylinder is just the width of a jointed stave—that is, a flexible stave or a flexible pattern of the largest face of a stave if coiled around such cylinder will exactly cover the convex face of the cylinder, the edges of the pattern being in line with the ends of the cylinder at all points.

For convenience of description I have referred to the jointer-cylinder as if it were one piece, as it may be. I will hereinafter explain how for convenience in operating on staves of different widths this cylinder may be divided into longitudinal sections or parts which may be spread apart.

The jointer-cylinder may be corrugated on its outer surface to act on the outer surfaces of the staves passing between said cylinder and the drum 21, and by such means the outer surface of the staves may be so roughened or corrugated as to lose the slickness or slipperyness which permits the hoops to slip on some completed barrels in which the staves are not so treated.

As has been stated, the jointer-cylinder may be integral when only one size of staves are made, and in such case the sections 30 and 30^a, as shown in the drawings, may be fastened together by any suitable means; but the preferred form shown has the sections 30 and 30^a independent for longitudinal movement, although both are compelled to rotate with shaft 24. At each end of the jointer-cylinder there is a knife-ring or disk-cutter holder, (shown at 31 and 32.) One of these rings or disk-cutter holders 32 is free to move lengthwise of the shaft 24 along with the cylinder-section 30^a, but both disks are held against rotation on the shaft 24 by means of a cross-bar 40 on the frame, which cross-bar 40 has a slot or mortise into which projections 39 from the disks extend. The projections 39 preferably work in antifriction sleeves in the cross-bar. The disks are thus held against rotation, but by means of their connection to the ends of the jointer-cylinder the disks have a peculiar gyratory or wabbling movement. The disks 31 32 are held against the beveled or oblique ends of the jointer-cylinder by gibs 35 and 36, which are bolted or otherwise secured to the ends of the jointer-cylinder or roll. These gibs are beveled or undercut and overlap the inner beveled edges of rings 31 and 32, thus holding said rings closely against the ends of the jointer-cylinder. The rings 31 and 32 being held against rotation have a wabbling movement as the jointer or pattern cylinder 30 rotates. The rings 31 and 32 are the cutter-carriers, and for convenience of description I will describe ring 31, premising that ring 32 is similar but in reverse relation to the slat or stave. The ring 31 is cut away at its lower face and has lugs 37 at each side of this cut-away portion. A number of holes 44 in lugs 33 permit the knife-block 45 to be pivoted between these lugs by a pin 46, which pin may be placed in either hole of the lugs. The knife 50 is bolted to knife-block 45 by bolts 51 or attached in other convenient manner. The edge of knife 50 is then in position to be nearly in continuation of the plane face of the ends of jointer-cylinder. The position of pin 46 determines the slight variation of the plane of the knife from the plane of the cylinder end, and this determines the bulge of the stave and barrel. The knife-block 45 is connected to a bar 47, which, as shown, extends downward. Bar 47 bears against the knife and holds it to its work. It is free to partake of the wabbling movement of the disk-cutter holder 31.

Knife 50 has its rear edge projecting downward, following the curve of drum 21 and a little distance from said drum. As the knife has the wabbling motion due to its being carried by ring 31 and makes its cut a practical continuation of the end of jointer-cylinder, the knife effects the jointing of the stave by a peculiar cutting action.

The stave-slat A, entering the space between the drum 21 and jointer-cylinder, is firmly gripped between the convex surfaces of these cylinders. The jointer-cylinder has its narrowest edge adjacent to drum 21 at the instant the slat approaches under impulse of the feed-chain. As the slat enters between the cylinders it is then moved along by the cylinders. The knife 50 presents its edge in the path of movement of the slat and enters the slat at such distance from the edge as gives the taper to the joint. As the knife stands at a slight inclination, the lower surface of the stave will be cut narrower than the upper, thus providing for a correct joint when the staves are assembled in a barrel. The knife 50 first enters the stave near the edge and is gradually pressed back by the end of the jointer-cylinder until the middle of the stave is reached. The relatively-fixed knife operates on the moving slat with a draw cut which is very slightly across the grain of the wood if the grain be "true." The knife also lies practically in what may be called the "plane" of its cut—that is, it is a slicing-knife—and while it has some thickness and some bevel its body lies nearly in a continuation of the cutting direction, thus insuring a slicing cut without much friction. The stave-blank is held from being pulled sidewise or from being canted into oblique position by unequal pressures on the sides (as by a knot or twists in the grain of the wood) by the firm bite of the gripping-rolls, and especially by the corrugations on the gripping-rolls when such are used, as is preferable. The cutting edge of the knife enters the slat where it projects at the side of the pattern-roll and cuts away such part as gives the proper bilge to the stave. The first part of the cut is thus a little across the grain, with a tendency to tear the cut-away splint from the edge of the slat. The slat is gripped or bitten so closely between cylinders 30 and 21 that this slight cross cut does not split the slat, but the knife cuts from the slat all that material which projects beyond the ends of jointer-cylinder. After the bilge is reached the knife is again pressed inward, trimming a wedge-shaped piece from the edge of the slat. This draw cut on the stave is toward the median line, so that there is little disposition of the material to split in the jointing of the stave unless the wood be very cross-grained, which is not generally the case with veneer-cut slats. I will now describe a mechanism by which I adapt this jointer to staves of different widths.

I have described the jointer-cylinder as a short cylinder with beveled ends. In fact, this cylinder may be cut in two in direction transverse to the axis, as indicated in other figures and clearly shown in Fig. 6. Both parts 30 and 30^a are made to rotate with shaft 24 by any usual means; but the part 30^a may also have a longitudinal movement on said shaft. Hub 34 of the part 30^a has a groove 60, and a forked lever 61 lies in said groove in a manner common in shifting pulleys, clutches, and the like. A strong spring 62 forces the part 30^a toward the part 30. Lever 61 lies in the plane of travel of the slats and has an inclined bearing-piece 63, against which the side of the slat presses in moving toward the jointer, provided the slat be more than minimum width. The bearing of the edge of the slat against piece 63 (the other edge of the slat bearing against fixed guide 14) forces back lever 61, moving the section 30^a away from the section 30 against the force of spring 62. This of course carries knife-ring 32 and its knife with the movable part 30^a of the cylinder and causes the stave to be cut as wide as the slat allows. The pivot of lever 61 can be so located or a slight elasticity or lost motion allowed, so that the part 30^a will be moved exactly in proportion to the width of the slat A. When the cylinder-sections are thus forced apart, the bite or pressure of the part 30^a on the slat will prevent its closing to narrow the slat even after the slat has passed the end of bearing 63. Should the cylinder-sections 30 and 30^a be corrugated, it follows that when the part 30^a be spread for a wide stave the middle portion of the stave will not be corrugated by the jointing-cylinder. This is not very material, as the corrugation is merely a slight furring of the surface, and if a part of the staves be so roughened or furred externally the hoops will be held against slipping on the barrel.

The rotating drum 21 is a most convenient gripper-piece to coact with the jointer-cylinder; but a fixed cylinder or bar might be utilized to the same purpose.

The jointer-cylinder, if corrugated, will act with greater force to push the stave against the resistance of the jointer-knives. This is also true of the cylinder 21 unless such cylinder be fixed.

Staves made from veneer-cut lumber are normally stiff and slippery, as has been explained in other applications referred to. To overcome the rigidity and "reset" the cellular structure of the wood, so as to give a tendency to staves to arch circumferentially, is the object of the mechanism next to be described. The arch of the staves in the direction of their length I call the "long" arch and the arch in direction of their width I call the "short" arch of the stave. If this short arch be not maintained in the barrel, the structure is greatly weakened, and if, as often happens, a stave "cups in" instead of arching out the barrel is very apt to go to pieces under strain. It is to avoid the possibility of cupping in and to compel the staves to arch out that I subject the staves to the straining treatment I will now describe.

Shaft 2 carries a forming-pulley or former 70, which is convex in the direction of its length. Shaft 72, parallel with shaft 2, carries a forming-pulley 74, which is concave in direction of its length. The shafts 2 and 72 are geared together by gears 75 and 76, so as to move at the same speed. Shaft 72 is held down by strong springs 77, so as to yield slightly when abnormally thick staves are fed through the machine. The stave A, forced by the feed-chain or by the jointing cylinders, or by both, enters endwise between the concave and convex formers 70 and 74 and by the shape of these formers is arched in the direction of its width, the wood being at the same time compacted and partly crushed, especially on its inner face. The arch of the formers is preferably more curved—that is, curved on a shorter arc than the arch of the completed stave—and while the stave may spread out flat after passing the formers it will always thereafter be much more pliable and more ready to take the arch in trussing the barrel. This straining or resetting of the cellular structure of the material of the staves I consider a very important part of my invention. By such treatment such wood as sweet gum, heretofore found almost worthless for cooperage, may be made a very pliant and serviceable timber for staves.

It will be noticed that while the shafts 2 and 72 rotate with the same speed, yet the surface speed of the formers 70 and 74 varies as the distance of the moving parts from the respective centers increases or diminishes. Thus these formers have a crimping or breaking down and planishing action on parts of the cellular matter of the wood, as well as a straining action to form the short arch of the stave.

Besides the short arch of a barrel-stave the stave is also arched in direction of its length.

In the machine under consideration a permanent long arch is given to the stave, preferably while passing between the formers just described. To effect this curvature, fixed bearers 80 and 81 are placed in close relation to the formers 70 and 72. These bearers may be sustained by bars 83 and 84, properly connected to the bearing-pieces 85 of the frame, or may be connected in any other suitable manner. The bearers 80 and 81 are set at such angle or curvature relatively to the line of travel of the stave that the stave in its movement must assume the lengthwise curvature compelled by the bearers. The curvature is preferably a little in excess of the completed long arch of the stave. When the stave is forced under the bearers, the inner laminæ of the wood are under pressure and are then broken down and compacted to a greater extent than the outer laminæ, the formers 70 and 74 acting as compacting-rolls. As the fibers of wood cannot be extended lengthwise, the curvature is believed to be entirely effected by the compression of the inner laminæ of the wood. It will be observed that the bending or crimping delivery-rolls 70 and 74 are driven with a speed exactly in unison with the rest of the machine by reason of the sprocket trains and gears heretofore referred to. This is highly important, since if rolls 70 74 did not grasp and draw the stave with uniform speed to pull it from the gripping-rolls after the latter have about lost their bite there would or might be an imperfect jointing of the stave at the very extreme of the jointing cut. A too-quick pull of the stave would not permit the stave to be reduced to proper width. A too-slow delivery would cause the knives to "gouge" in the edges instead of making a perfect joint. As the concave and convex bending and delivery rolls 70 74 seize the stave while its body is still gripped between the true cylinders constituting the pattern and gripping rolls 30, 30^a, and 24, the wood is subjected to a peculiar racking strain both lengthwise and crosswise. This is a part of my system of depriving the wood of its stiffness and rendering it more pliable and amenable to the operation of producing a perfect finished barrel. The corrugation of the gripping-rolls also insures that the stave enters the bending-rolls centrally and in straight line and that the center of the stave be not diverted from the central line of the machine, as any deviation would cause the stave to be distorted by the bending and practically rendered useless.

It will be understood that my invention is capable of many modifications. The order of the steps or processes and mechanisms might be changed. The construction of parts will frequently vary, according to the circumstances of the case. By actual construction, however, I have demonstrated the practical features of my invention and have constructed barrels in quantities at a less cost, as I believe, and of greater strength and serviceability than any similar barrels known in the market, and this from timber heretofore believed worthless for the purpose of slack-barrel construction.

It has been explained that the operations of jointing and breaking down or conforming the staves take place while the staves are hot from steam tempering described in a separate application. The entire series of operations must be effected while the stave is hot, as a resteaming tends to brittleness of the wood.

To understand the theory of my jointing operation and mechanism, it must be understood that the perfect joint at the edge of a stave is theoretically that plane which is the resultant of a plane drawn through the axis of a barrel and radially bisecting both arches of the circumference of the barrel. Thus the joint is itself a plane intersecting many curves. The material of the stave is to be considered in making the joint, as the hoop-pressure is external to the barrel. A joint may be slightly undercut, so that the pressure will be sure to close the outer seams if the pressure be insufficient to close the entire joint, thus preventing external cracks and the appearance of looseness. This is provided for by pin 46 in my jointer. As the jointing-knife, by reason of its inclined edge, operates always with a draw cut, there is no splitting or breaking out of splinters at the edge of the stave, as is the case with most stave-jointers heretofore used in this art.

The rolls by which the arch or arch tendency of the stave is produced are preferably slightly corrugated; but whether so or not it is apparent that the wood of the stave while under bending tension must bunch or protrude on its inner face, and such bunches or protrusions must be mashed down by the rolls, producing a readjustment of fibers, at least of the inner layers of the wood of the stave. This crimp and compression will be least at the median line and greatest at the edges of the stave, and my method of tempering the staves permits the yielding and readjustment of fibers without undue strain on the material or on the machine.

I do not herein claim the method of jointing staves by the action of slicing-knives acting on the wood while under compression, nor the method of breaking down the cellular structure of the wood, so that the original tendency to warp and buckle is largely overcome, as such methods are held by the Patent Office to be separate inventions, and I expect to claim them in separate applications, believing the same to be patentable and original with me.

What I claim is—

1. A stave-jointer having rotary gripping-cylinders between which the stave-blank is gripped while jointing, one of said cylinders having pattern ends, and slicing jointing-knives lying practically in the plane of cut,

and conforming in position to the pattern ends of the pattern-cylinder, in combination.

2. A stave-jointer having a rotating pattern-roll and a complementary gripping-surface, a knife lying substantially in the plane of its cut and following the pattern of the pattern-roll, and a force-feed mechanism by which the staves are fed to the pattern-roll, in combination.

3. A stave-jointer having rotating gripping-cylinders between which the blank is grasped, pattern ends to one of the gripping-cylinders, slicing-knives, and means connected to the pattern-cylinders by which the knives are held to cut in the general plane of the ends of the pattern-cylinder, being the plane of cut.

4. In a stave-jointer, two parallel gripping-rolls, one having oblique ends, non-rotating rings held against the ends of said oblique-ended roll, slicing-knives carried by said rings, means for holding the rings against rotation, and means for holding the rings against the oblique ends of the pattern-roll, all combined.

5. In a stave-jointer, a shaft carrying two cylindrical sections having oblique outer ends, slicing-knives lying substantially in their planes of cut and held in the planes of the oblique cylinder ends, and means for spreading and closing the cylinder-sections, in combination.

6. In a stave-jointer, a rotating pattern-cylinder in sections separable from each other, non-rotating slicing-knives held in proximity to the pattern ends of said cylinder, and means whereby the slat automatically spreads the sections of the pattern-cylinder and knives if the slat be above minimum width.

7. In a stave-jointer, the jointer-cylinder in sections having beveled ends, the slicing jointer-knives held in proximity to said cylinder ends, the feed-chain, and a lever in the path of movement of a slat fed by said chain, said lever connected to a section of the pattern-cylinder, whereby a wide slat automatically spreads the cylinder-sections and knives, substantially as described.

8. In a stave-jointer, the combination of a slat-feeder, a jointer-cylinder having beveled ends, knife-carrier rings held against the ends of the jointer-cylinder and held against rotation, knives pivotally connected to the carrier-rings, and knife-blocks to which the knives are connected and whereby they are held in proximity to the rings.

9. In a stave-jointer, a jointer-cylinder having oblique ends, non-rotating cutter-carriers held against the cylinder ends by projections therefrom, means for holding the cutter-carriers against rotation so that the carriers gyrate as the cylinder rotates, and slicing-knives carried by the cutter-carriers close to the end of the jointer-cylinder, all combined.

10. In a stave-jointer, the combination of a pattern-cylinder with beveled ends and undercut gibs secured to said ends, knife-carrying rings having undercut edges and held against the cylinder ends by said gibs, means for holding the rings against rotation, and knives carried by said rings with their cutting edges in practical continuation of the beveled ends of the pattern-cylinder.

11. In a stave-jointer and in combination, a rotating shaft, a divided pattern-cylinder thereon having oblique ends, means for spreading or closing the cylinder-sections while rotating with the shaft, a pair of disks on the pattern-cylinder shaft having non-rotating knives supported from the rotating shaft, and means for retaining these knives in proximity to the cylinder ends, so as to trim the edges of the staves to pattern while under the grip of the pattern-cylinder, substantially as described.

12. In a stave-jointing machine, a pair of gripping-cylinders moving at uniform surface speed, one of said cylinders having a pattern end, a slicing-knife held in proximity to the pattern end of the cylinder, and operating with a slicing draw cut toward the surface of the other cylinder, and means for holding the slicing-knife into working relation with the pattern end of the cylinder.

13. In a stave-jointing machine, a pair of gripping-rolls moving at uniform surface speed, one of said rolls being longitudinally corrugated, a pattern end on one of the gripping-rolls, and a slicing-cutter held against the pattern end of said cylinder and slicing with a draw cut toward the surface of the other cylinder while the stave is in the grasp of both rolls.

14. In a stave-jointer, a pair of gripping-rolls moving with uniform surface speed, one of said rolls having oblique or pattern ends provided with gibs, a pair of disks held to said oblique ends by the gibs, separate mechanism to hold the disks against rotation so that they are compelled to wabble as the pattern-roll rotates, and a knife pivoted to each disk and having its face extending toward the other gripping-roll, all combined.

15. In a stave-jointer, a pattern-cylinder having an oblique end, a disk held in contact with this end by a gib thereon, means for holding the disk against rotation thus causing it to wabble as the cylinder rotates, lugs on said disk having movable pivots, a knife-block movably pivoted to said lugs, and a knife carried by said knife-block with its edge nearly in continuation of the plane of the pattern end of the cylinder, all combined.

16. In a stave-machine, a pair of gripping-cylinders, one of them having a pattern end, a slicing-knife held to cut in a practical continuation of the pattern end of the cylinder, and delivery-rolls moving with the same surface speed as the gripping-cylinders, so as to complete the cut at the proper speed after the gripping-cylinders lose their grip, all in combination.

17. In a stave-machine, a pair of gripping-cylinders, one having a pattern end, a slicing-

knife held to cut in practical continuation of the pattern end of the roll, and a pair of bending-rolls having convex and concave faces as described, in position to grasp and bend one part of the stave while another part is still held flat by the gripping-cylinders, all combined.

18. In a stave-machine, a pair of convex and concave bending-rolls, and a pair of longitudinally-corrugated gripping-cylinders in close proximity thereto, whereby the stave is in part under transverse bending strain while in part held flat, substantially as described.

19. In a stave-machine, a pair of longitudinally-corrugated gripping-cylinders, and a pair of longitudinally-corrugated concavo-convex bending-rolls in close proximity thereto, so that both pairs of rolls operate on different parts of the stave simultaneously, to place the same under strain, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

EVERT M. THOMPSON.

Witnesses:
ALBERT E. METZGER,
BEN F. GOODHART.