No. 748,013. PATENTED DEC. 29, 1903.

J. H. RIVERS.

MACHINE FOR MANUFACTURING PULP ARTICLES.

APPLICATION FILED JAN. 2, 1903.

NO MODEL. 5 SHEETS—SHEET 1.

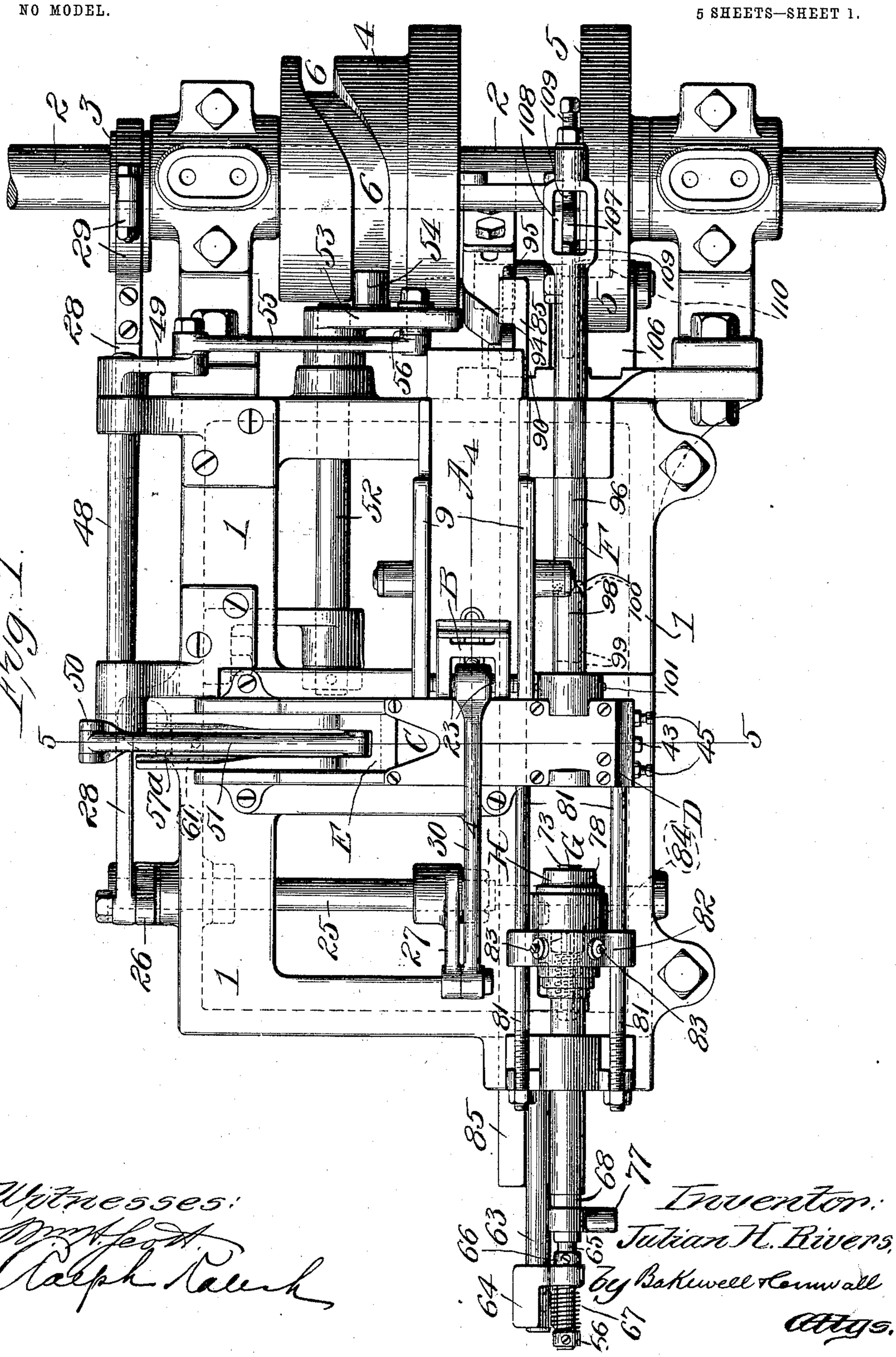

Fig. 1.

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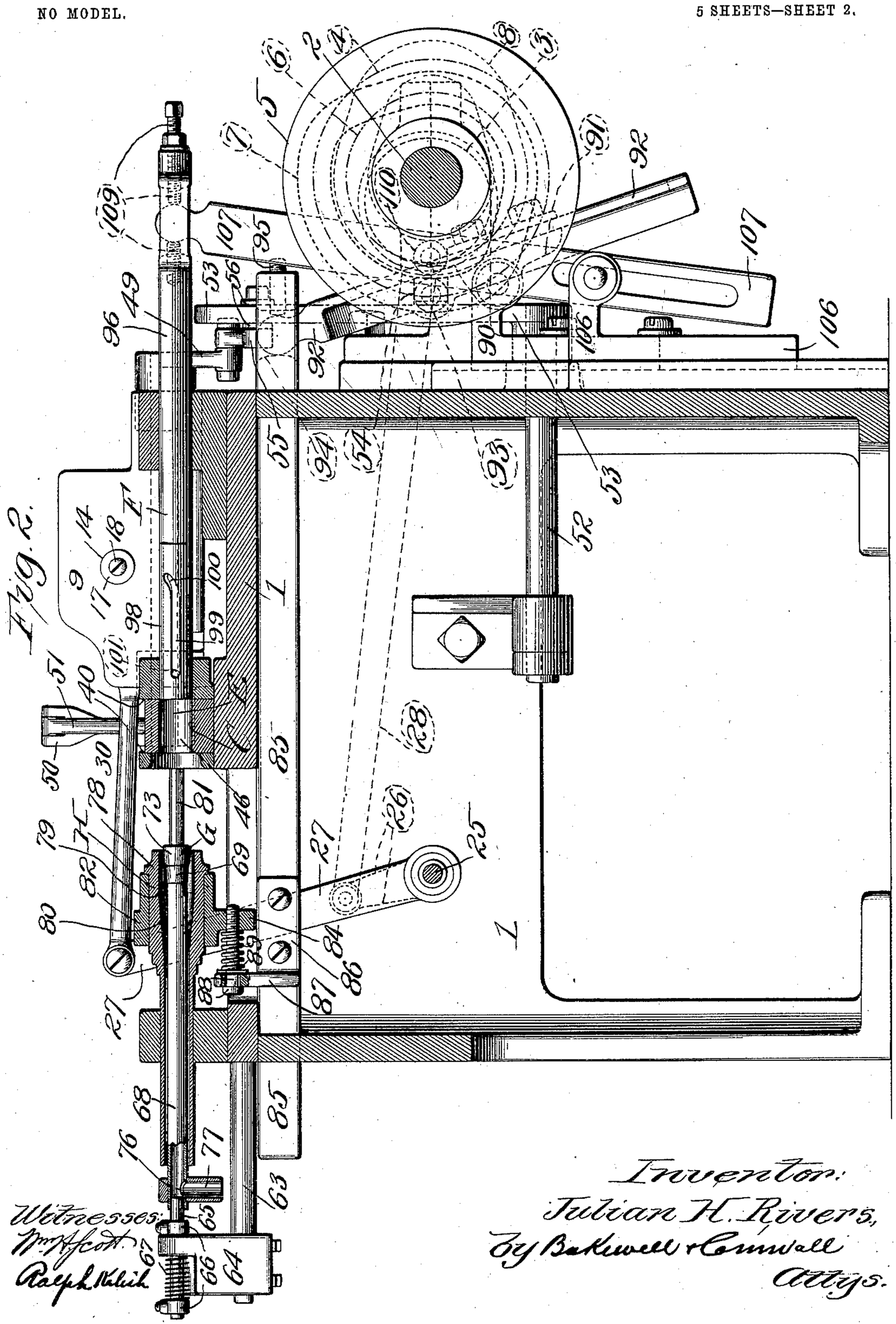
NO MODEL. 5 SHEETS—SHEET 2.

Fig. 2.



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NO MODEL. 5 SHEETS—SHEET 3.

Fig. 3.

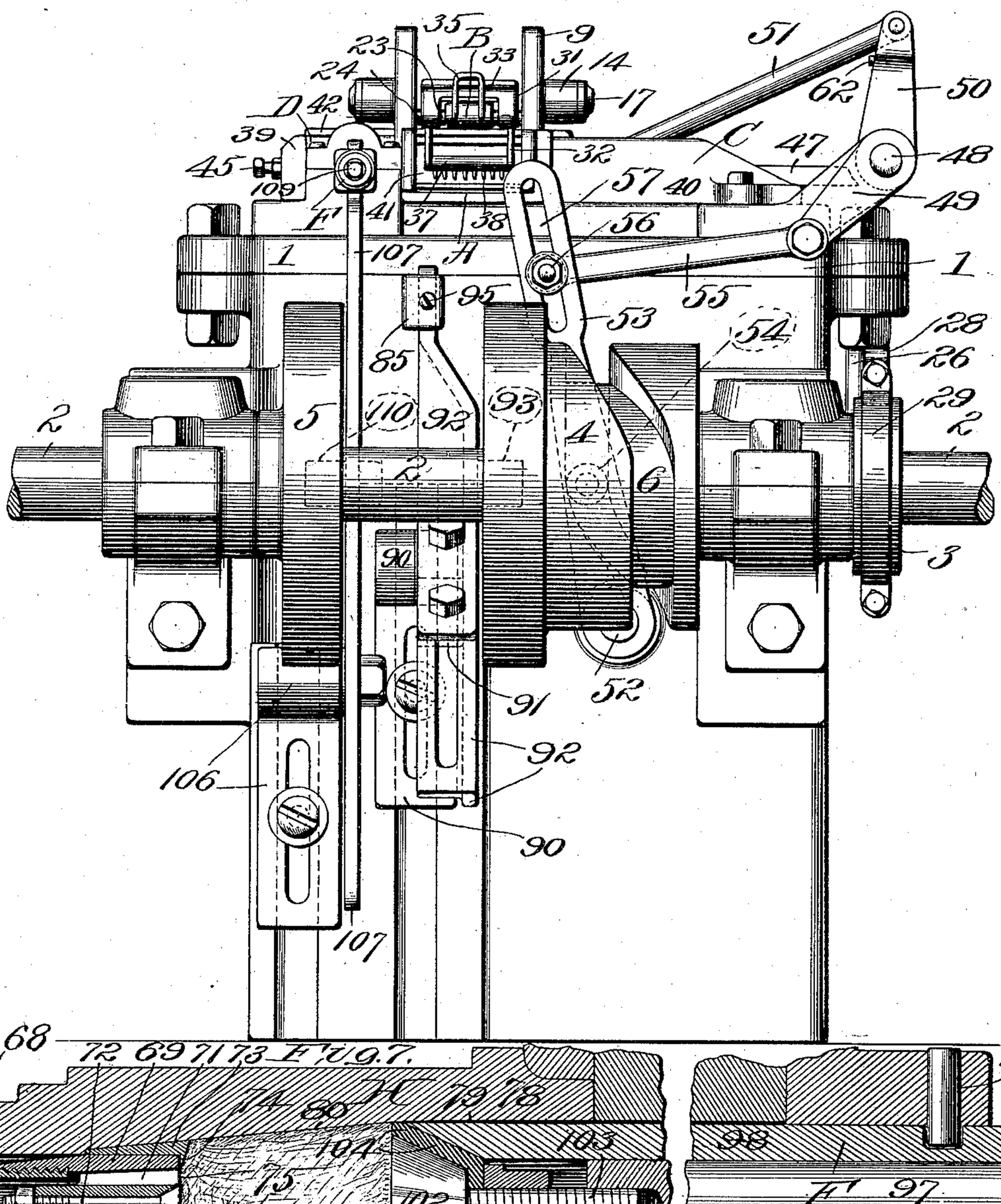

Fig. 7.

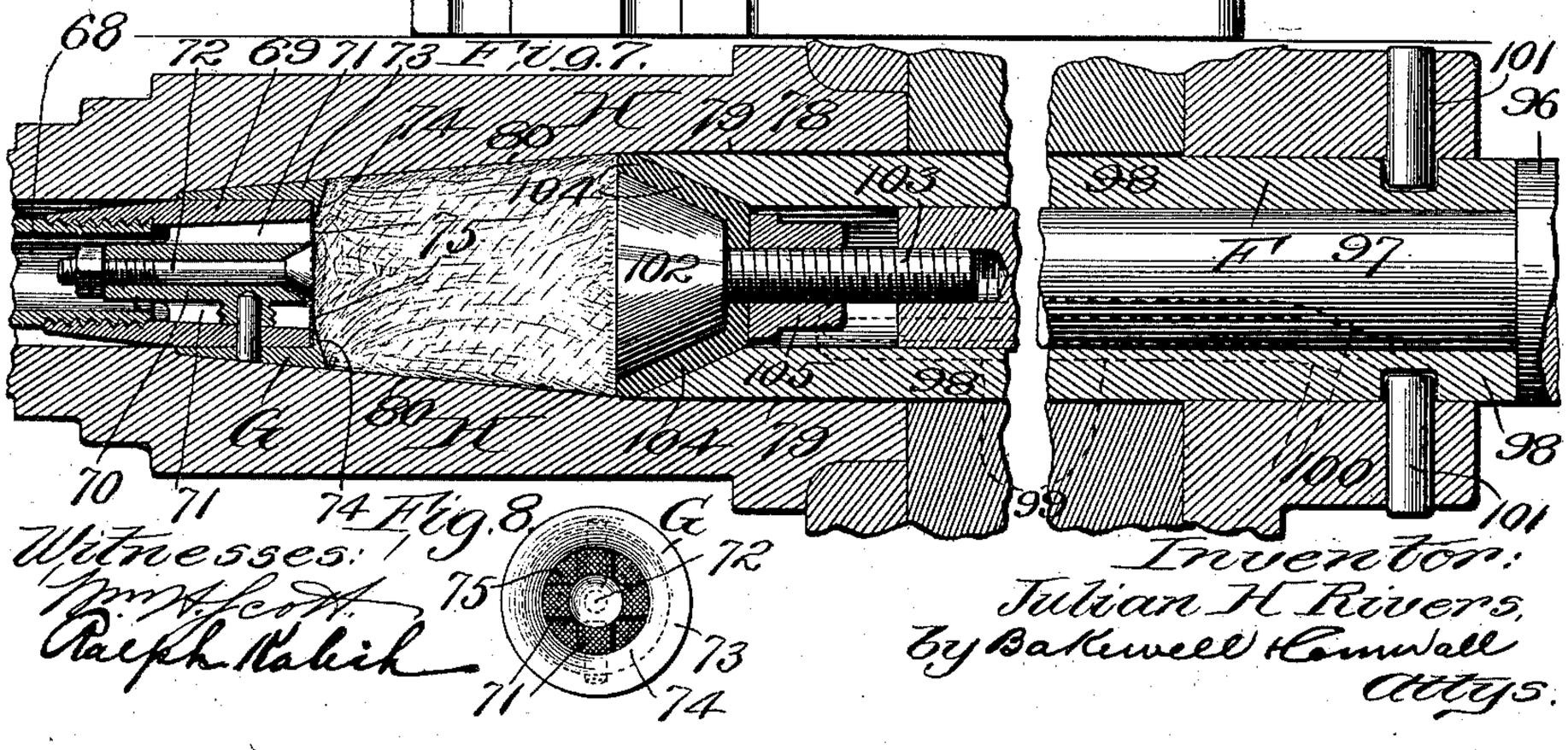

Fig. 8.

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NO MODEL. 5 SHEETS—SHEET 4.

Fig. 4.

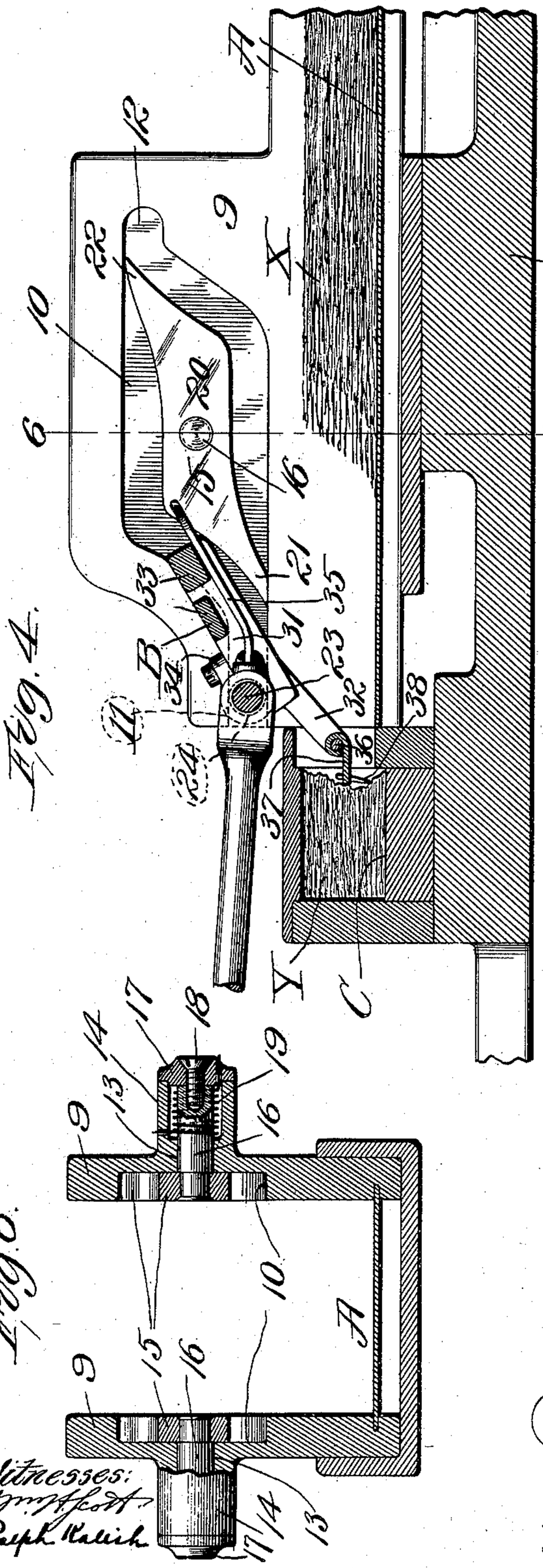

Fig. 5.

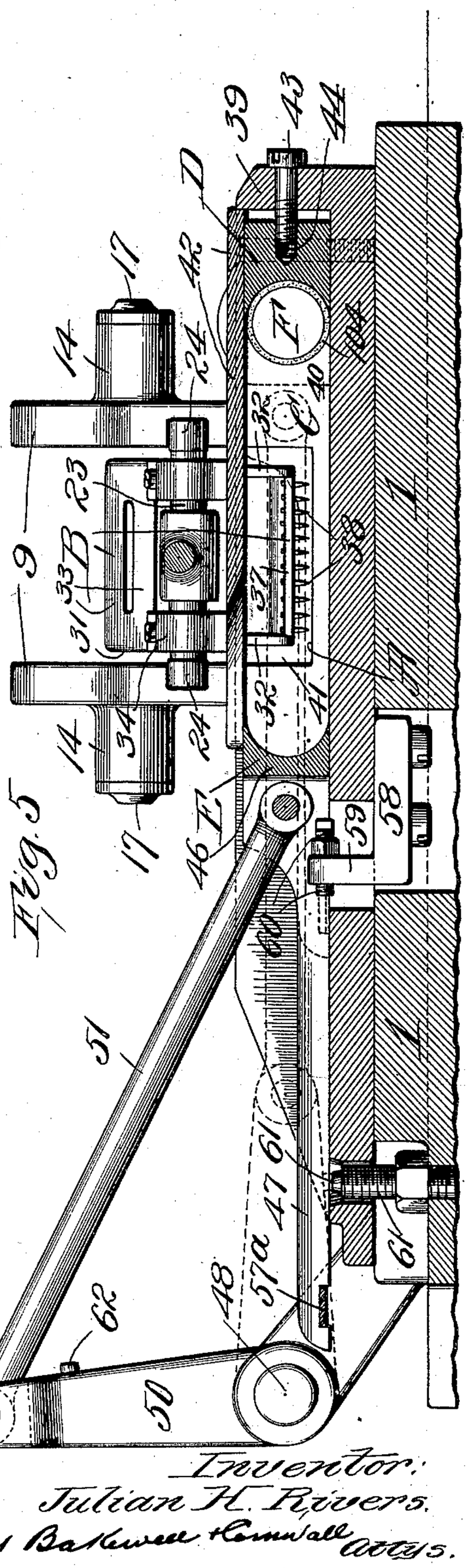

Fig. 6.

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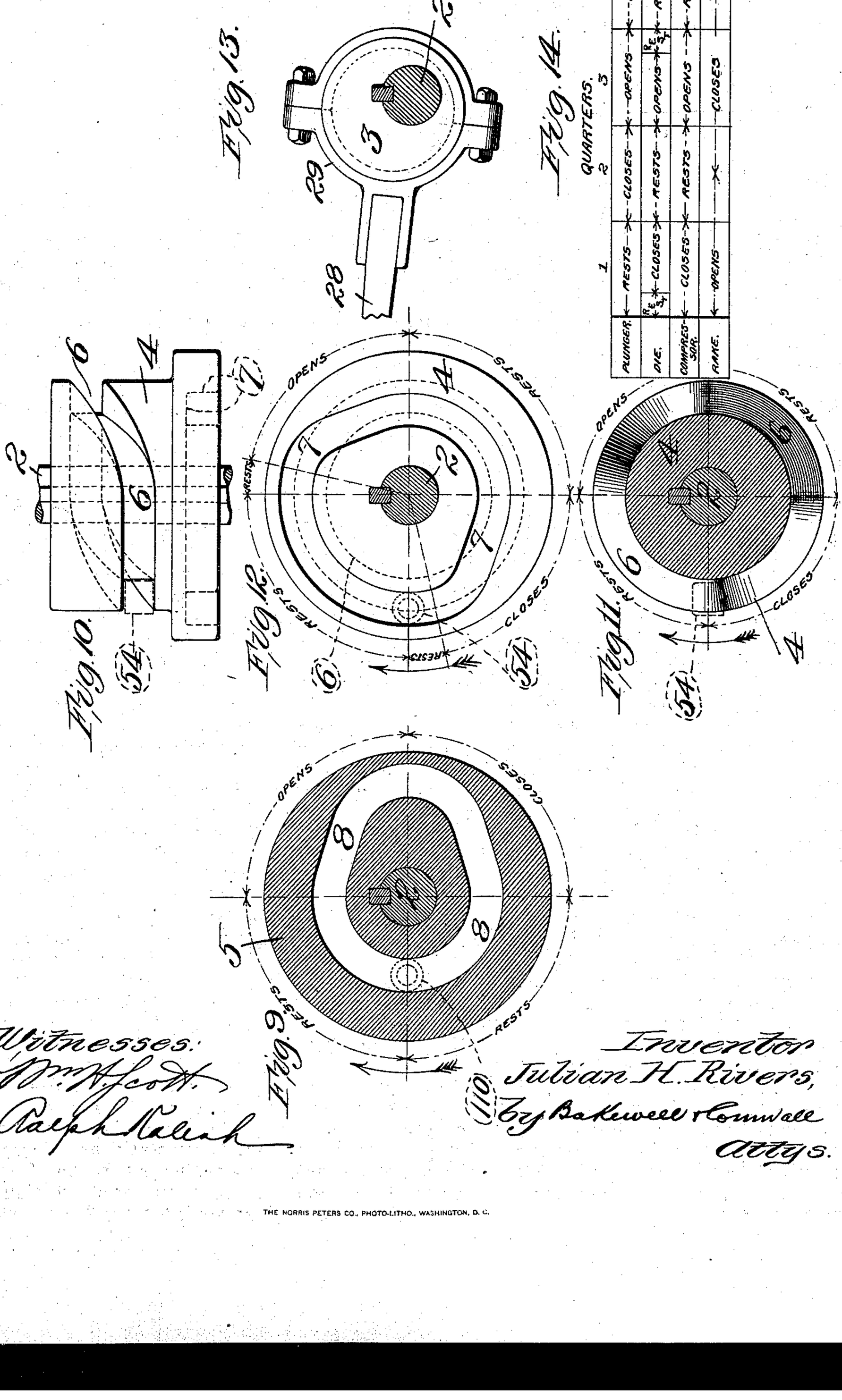
NO MODEL. 5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

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MACHINE FOR MANUFACTURING PULP ARTICLES.

SPECIFICATION forming part of Letters Patent No. 748,013, dated December 29, 1903.

Application filed January 2, 1903. Serial No. 137,527. (No model.)

To all whom it may concern:

Be it known that I, JULIAN H. RIVERS, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Machines for Manufacturing Pulp Articles, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a top plan view. Fig. 2 is an elevation, chiefly in section. Fig. 3 is an end elevation. Fig. 4 is a detail elevation, partly in section, on the line 4 4 of Fig. 1. Fig. 5 is a detail elevation, chiefly in section, on line 5 5 of Fig. 1. Fig. 6 is a sectional elevation on the line 6 6 of Fig. 4. Fig. 7 is a detail sectional elevation showing the die and plunger in the positions which they assume when completing the operation of forming a stopper. Fig. 8 is a front elevation of the ejector. Fig. 9 is a sectional view of the plunger-cam disk. Fig. 10 is a top plan view of the member in which the compressor-cam and the die-cam are formed. Fig. 11 is a detail view, partly in section, showing the compressor-cam in front elevation. Fig. 12 is a face view of the member shown in Fig. 10 and illustrating the die-cam. Fig. 13 is a detail view showing the eccentric which actuates the rake; and Fig. 14 is a diagram indicating the movements of the plunger, die, compressor, and rake.

My invention relates to machines for manufacturing pulp articles, and is more particularly adapted to the manufacture of stoppers for bottles and the like, said stoppers being made from pulp.

One object of my invention is to provide a machine by whose action most of the fibers in the finished article are caused to lie in lines substantially parallel with the longitudinal axis of the stopper.

A further object is to provide means whereby the fibers adjacent the surface of the stopper are matted, interwoven, or felted, whereby a bond is provided about the exterior of the finished article.

A further object is to provide means whereby the surface of the stopper is smoothed, burnished, or calendered.

To these ends and also to improve generally upon machines of the character indicated my invention consists in the various matters hereinafter described and claimed.

I shall first refer to the more important elements of the machine and describe their general movements and functions, explaining the manner in which a stopper is made from the pulp. I prefer to produce the stoppers from pulp as used in paper-making; but it will be manifest that pulp formed from material other than paper can be operated upon by the present machine.

A indicates the raceway or trough into which the pulp is fed from any suitable source, and B represents what I shall term a "rake" or "feeder." Extending transversely to the raceway A is a second trough or raceway C, into which the trough A leads, said trough C having one end beyond the juncture with the raceway A closed by means of a wall or abutment D, which is provided with a substantially semicircular recess or depression in its inner face. A compressor E reciprocates in said trough C and has a substantially semicircular recess or depression in its inner face, which when said compressor and the said abutment D are together coöperates with the said recess in the inner face of the said abutment to produce a cylindrical chamber. The said compressor reciprocates in the said raceway C and has movement across the opening in the said raceway A.

F represents a plunger which reciprocates across the raceway C and in such a line that its inner or material-engaging end travels through the cylindrical chamber produced by the said compressor and its coöperating abutment, said plunger in one position having its inner end at one end of the said cylindrical chamber. Spaced from the opposite end of said cylindrical chamber a distance somewhat greater than the length of the finished stopper is a substantially stationary ejector G, about which is a reciprocatory die H, which is adapted to be moved into such position that its inner end engages a suitable seat at the

side of the before-mentioned compressor and its abutment opposite that upon which the said plunger lies when withdrawn from the said cylindrical chamber. The cavity or operating-chamber of the said die has a substantially cylindrical portion which when the die is in innermost position forms a continuation of the chamber produced by the said plunger and its coöperating abutment, and the said die-cavity also has a tapering portion which extends outwardly from the said cylindrical portion of the cavity to the head of the said ejector when the said die is in innermost position, the said ejector-head thus closing the outer end of the die-cavity when the die is in the position last indicated. The said die has movement from its just-described innermost position to a position in which the said ejector-head is exposed.

In the operation of the machine the rake is elevated to a position above the mass of pulp X in the feed-raceway A and is moved backwardly over said pulp, when it is lowered, separates from the general mass a sufficient amount of pulp Y to form the desired stopper, and then forces said separated mass forwardly and into the raceway C. During the feeding movement of the rake the plunger is in such position that it closes one end of the chamber produced by said compressor and its coöperating abutment, and after the rake has delivered the material to the raceway C the compressor moves forwardly, the die also moving inwardly against the abutment D to a position which places its cavity in alinement with the before-mentioned cylindrical chamber. As the compressor completes its compression-stroke it compresses the pulp in the said cylindrical chamber, expressing some of the moisture from the pulp and producing a pulp-cylinder whose fibers are disposed in lines extending substantially parallel with the longitudinal axis of said cylinder. While the said compressor is in the position last described the said plunger F moves forwardly, and thus forces the pulp-cylinder through the said cylindrical chamber and into the cavity of the said die, the pulp-cylinder first entering the before-mentioned cylindrical portion of said cavity and then being forced into the before-mentioned tapering portion thereof. The said plunger F continues its forward movement until the pulp is forced against the head of the ejector and is compressed between the said head and the head of the said plunger. During the passage of the said pulp-cylinder into the conical part of said die and in its compression between the said plunger and ejector-head more moisture is expressed from the pulp. As the mass of pulp is forced into the tapering portion of the die the fibers adjacent the periphery of said mass are compacted and matted or felted, and as the said mass of pulp is compressed between the ejector-head and the head of the plunger the fibers at the respective ends of the said pulp mass are also compacted and matted or felted. Furthermore, as the pulp mass is forced into the tapering portion of the die-cavity the periphery of said mass is burnished or calendered. During the final portion of the forward stroke of the plunger said plunger is slightly rocked upon its axis, and as the plunger-head is in engagement with the end of the pulp mass during this rocking movement the said end of the pulp mass is burnished or calendered, this said rocking movement also serving to prevent the pulp mass from adhering to the plunger end. After the stopper has been formed as just indicated the plunger and die retreat, the plunger moving out of engagement with the stopper and the die moving backwardly to a point beyond the ejector-head. In this manner the support is removed from the stopper and said stopper falls from the machine. The finished article delivered from the machine has a relatively soft body portion whose fibers are principally disposed in lines parallel with the longitudinal axis of the stopper, and adjacent the entire surface of the stopper is a dense matted or felted portion which serves as a bond and as a relatively hard inclosing jacket, the stopper being burnished or calendered about its periphery and on the surface of its larger end or head.

I have said that the mass of pulp is fed to the machine, that after being compressed between the compressor and its coöperating abutment the fibers are disposed principally in lines substantially parallel with the longitudinal axis of the cylindrical body of compressed pulp, that owing to the action of the tapering portion of the die upon the periphery of the cylindrical pulp mass and the action of the ejector-head and the head of the compressor upon the ends of said mass the fibers lying adjacent the outer surface of the pulp mass are matted or felted, and the density of this outer portion of the pulp mass is increased, and that owing to the action of the tapering portion of the die against the periphery of the pulp mass and to the action of the head of the plunger against the end of the pulp mass during the time that the plunger is rocked the periphery and the head of the finished product are burnished or calendered. It is believed that the burnishing action of the tapering portion of the die and of the smooth head of the plunger will be readily apparent and that no explanation of the same is necessary in this specification. I shall, however, explain the other actions recited in this paragraph.

For the purposes of the action of the present machine the pulp can be fed to the raceway C with its fibers in any condition whatever, and we will assume that when the pulp is deposited upon said raceway C the fibers extend in lines running at all angles, so that there is no regularity whatever as to the arrangement of said fibers. The fibers which are acted upon in the manner heretofore described are those which have some length and very little thick-

ness. Bearing in mind the fact that when these fibers are deposited upon the horizontal raceway C they are in a measure suspended in a liquid, it will be apparent that there is nothing to induce these fibers to stand on end, and that therefore the fibers will act under the influence of the force of gravity and arrange themselves upon what may be termed their "sides," just as a match supported in a thin mucilage will fall upon its side, and thus lie in a plane substantially parallel with the supporting-surface. Although the fibers upon the raceway C will lie in substantially horizontal planes, they will extend in various directions in these planes. As the compressor moves against one end of the pulp mass in the raceway and forces this mass against the abutment D the fibers will be forced to arrange themselves in lines which extend substantially parallel with the faces between which the pulp mass is pressed, just as if several matches in mucilage extending in all directions were subjected to the pressure of boards at the sides of the mass and moving toward each other said matches would assume positions parallel with the compressing-faces. It will therefore be readily apparent that after the compressing action the mass of pulp is a cylindrical body with its fibers arranged in lines substantially parallel with its longitudinal axis. When now the plunger-head moves against one end of the cylindrical mass, the fibers at said end are compacted in a manner which will be readily apparent, and they tend to arrange themselves in lines substantially parallel with the pressing surface, so that the fibers at the head of the mass are forced out of the lines substantially parallel with the longitudinal axis of the pulp mass and tend to arrange themselves in lines at right angles to the said longitudinal axis. In being thus forced out of their former positions the end fibers are more or less interwoven, matted, or felted, and in the mat thus produced are included the ends of the longitudinally-disposed fibers in the body of the stopper. The compacted, matted, or felted outer portion at the opposite end of the stopper is produced by the ejector-head in substantially the same manner in which the plunger-head produces the compacted, matted, or felted portion at its end of the stopper. As the cylindrical pulp mass is forced into the tapering portion of the die-cavity the peripheral fibers are compacted and tend to arrange themselves in lines substantially parallel with the tapering wall of the cavity, certain of these peripheral fibers moving over the ends of adjacent fibers, which do not move as readily from their longitudinal lines, the peripheral compacted, matted, or felted portion thereby resulting.

I shall now consider the details of construction of the machine shown in the accompanying drawings as an embodiment of my invention.

1 indicates a supporting-frame, upon the top of which are supported the before-mentioned horizontally-disposed raceways A and C, these raceways extending at right angles to each other, and the raceway A extending in line with what may be termed the "longitudinal" axis of the machine. Also supported upon said frame is a main shaft 2, which is conveniently arranged at one end of the frame and extends across the same, said shaft being driven from any convenient source of power (not shown) and having connected thereto to rotate therewith an eccentric 3, a cam-block 4, and a cam-disk 5. The block 4 has a peripheral cam-race 6 and has also a cam-race 7 formed in one of its end faces, (see Fig. 12,) and the disk 5 has a cam-race 8 formed in one of its end faces. (See Fig. 9.) The moving parts of the machine—viz., the rake, the compressor, the die, and the plunger—are driven from the before-mentioned eccentric, cam-block, and cam-disk in a manner to be hereinafter described.

The raceway A has side plates 9, which serve to confine and direct the inwardly-moving pulp, and in the inner face of each of these plates 9 is formed a recess or depression 10, whose walls define a figure of the general character of a rhomboid, the lower forward end of each recess and the upper end being extended, as shown at 11 and 12, respectively. Extending through the wall of and at about the center of each recess is an opening 13, the outer wall of each plate having a cored extension, as shown at 14. In each recess 10 is what I have termed a "double switch-plate" 15, said plate being fixed to a pivot-pin 16, which extends through the before-mentioned opening 13 into the chamber surrounded by the wall 14. A cap 17 closes the outer end of the chamber surrounded by the wall 14 and is connected to the shaft 16 to rotate therewith, this connection being here shown as effected by means of a screw 18. A spring 19, coiled about the portion of said shaft within the chamber encircled by the wall 14, has its ends secured, respectively, to the said encircling wall and the said cap 17, whereby each spring tends to hold its double switch-plate in the position shown in Fig. 4, and if the switch-plate is moved from this position such movement is against the force of the spring, and as soon as pressure is removed from the switch-plate the spring returns the same to normal position. Each switch-plate has a body portion 20, whose sides are substantially parallel with the walls of the recesses 10, and extending from this body portion are projections 21 and 22, the former extending in what may be termed an "inwardly and downwardly" direction and the latter extending upwardly and outwardly, so that when the switch-plate is in normal position the said extensions practically engage the upper and lower walls of the recess.

A cross rod or shaft 23 extends across the raceway A and has its ends seated in the heretofore-mentioned recesses, these ends being

preferably provided with rollers 24. The rake B is connected to said cross-rod, and it will therefore be apparent that as this cross-rod is reciprocated the rake is correspondingly moved. Suitably journaled upon the machine-frame is a transverse rock-shaft 25, whose ends are provided with rock-arms 26 and 27, the rock-arm 26 being pivotally connected to a pitman 28, which carries a strap 29 about the before-mentioned eccentric 3, and a pitman 30 has one end pivotally connected to the rock-arm 27 and its other end connected to the cross-shaft 23. It will therefore be apparent that as the main shaft rotates the rake is reciprocated, the cross-shaft 23 in the outward movement of the rake riding upon the surfaces of the switch-blocks 15, and therefore elevating the rake to a position above the web of fiber in the raceway A until the rake has been moved into rearmost position, the projection 22 of each switch-plate yielding to permit the passage of the cross-bar 23 and its carried rake into such rearmost position. As soon as the said cross-bar has cleared the said projection 22 the springs 19 return the switch-blocks to their normal positions, and in the forward movement of the rake the cross-shaft 23 rides against the rear edge of the switch-block until the rake reaches lowermost position and then rides along the lower wall of the recess until the rake has been carried into innermost position, the projection 21 of each switch-block yielding to permit the passage of the rake and the switch-blocks being then returned to normal position, so that as the rake again moves outwardly it rides upwardly, as previously explained. Manifestly in the outward movement of the rake it is elevated to clear the web of fiber, and in its inward movement the rake descends upon the fiber, separates a portion of this fiber from the remainder of the mass, and then pushes this separated portion forwardly into the raceway C.

Of course many forms of rakes can be provided. I have here shown a frame having side plates 31, supporting-arms 32, and cross-bars 33 extending between said side plates, the side plates having straps 34, by means of which the rake-frame is attached to the cross-shaft 23. A supporting-bracket 35 extends from the free end of the pitman 30, and one of the cross-bars 33 rests above and upon this bracket in order to hold the rake in proper position. A cross-rod 36 extends between and is connected to the arms 32, and a supporting-plate 37, connected to this cross-rod, has rake-teeth 38 formed upon or secured thereto.

The raceway C has an upturned end or wall 39 and side walls 40, which serve to confine and guide the pulp and also guide the compressor E, one of said walls 40 being provided with an opening 41, which communicates with the inner end of the raceway A. From the said end wall 39 to a point upon the side of said opening 41 opposite the said wall 39 is a cover-plate 42. The abutment is a block D, provided with a substantially semicircular recess in its inner face, and said block is preferably adjustably mounted, the structure being here shown as provided with a central screw 43, which extends through an opening in the wall 39 and enters a threaded opening 44 in the block, and with screws 45, which are located upon opposite sides of the screw 43 and extend through threaded openings in the wall 39, the inner ends of said screws bearing against the outer face of the said block. This is a well-known means of adjustment, and it is thought that no further description of the same is necessary in this specification.

The compressor E has a head-block 46, which has a substantially semicircular recess in its inner face, said recess being such that when the compressor is at the limit of what may be termed its "inward" throw—*i. e.*, toward the abutment-block—the two said semicircular recesses combine to produce a substantially cylindrical chamber. The said head-block moves between and is guided by the bottom wall of the raceway, the side plates 40, and the cover-plate 42. The said bottom and side walls of the raceway C extend rearwardly a considerable distance beyond the point at which the head-block of the compressor rests when said compressor is in retracted position, and extending rearwardly from the said head-block are long guide-feet 47, which bear upon the bottom of the raceway and respectively engage the side plates, whereby the said compressor is given a firm bearing in the raceway.

A longitudinally-extending rock-shaft 48 is suitably journaled upon the machine-frame and is provided at its opposite ends with rock-arms 49 and 50, a pitman 51 having its opposite ends, respectively, pivotally connected to the said arm 50 and the said head-block 46. Pivotally supported upon the end of the machine-frame, as by means of the extended pivot 52, is a lever 53, which has its upper end slotted and is provided with a cam-roll 54, received in the cam-race 6, a pitman 55 having one end pivotally connected to the before-mentioned rock-arm 49 and its other end pivotally connected to the block 56, which is adjustably seated in the slot 57 in the said lever 33. It will therefore be apparent that as the main shaft 2 rotates the compressor is reciprocated through the connections just described, the head-block of the compressor when in what may be termed its "open" position being at a point upon the side of the opening 41 opposite that upon which the abutment D is located and said compressor being given sufficient throw to cause its head-block to pass the opening 41 and rest in substantial engagement with the abutment D, whereby in its inward movement the compressor engages the material delivered to the raceway C by the rake and then compresses said material against the abutment D. In order to prevent the compressor from jamming against the abutment, and thus wear

away the opposing surfaces of said two members, and also to insure against the movement of the compressor beyond such a position that its semicircular recess coöperates with the recess of the abutment-block to produce a cylindrical chamber, I provide a cross-plate 57ª upon the guide-feet or bearing-shoes 47 and secure to the frame of the machine a bracket 58, which has a vertical arm 59 extending in the line of movement of said cross-plate, an adjustable screw 60 being seated in said bracket-arm. This screw lies in the path of travel of the said cross-plate 57ª and forms an abutment for said cross-plate whereby the inward stroke of the compressor is limited notwithstanding the fact that the joints between said compressor and the driving-shaft may wear loose.

In order to cause the compressor and its abutment-block to maintain their proper relationship when the compressor is in closed or innermost position, even under the pressure exerted when the plunger F moves inwardly, the operating connections for the compressor are so proportioned and arranged that the rock-arm 50 and the pitman 51 are upon dead-centers when the compressor is in innermost position, and in order to compensate for wear and to insure that the said rock-arm and pitman assume the desired positions when the compressor is in said innermost position I have provided a set-screw 61 in the path of movement of the said rock-arm 50, (or of a projection 62 upon said arm.)

The ejector is now to be considered. Extending longitudinally from what may be termed the "foot" of the machine-frame is a supporting-arm 63, upon which is a head-block 64, and slidable through said block is a bar 65, which is provided with adjustable collars 66 upon opposite sides of the portion of the block in which the bar is seated, a spring 67 bearing between the outer face of said block portion and the outer collar 66. The inner collar 66 limits the outward movement of the said bar. Brazed or otherwise secured to the said bar to move therewith is a tube 68, which has its inner end threaded to permit the same to enter a threaded sleeve 69, in which is secured a spider-block having a central core 70 and wings 71. The said central core has its inner face countersunk to receive the head of a bolt 72, and about the inner end of the said sleeve is a second sleeve 73, which has a projecting lip 74, adapted to extend over the inner end of the sleeve 69, said sleeve 73 being beveled or otherwise shaped to conform to the shape of the outer portion of the smaller end of the stopper. When assembling the parts, a piece of wire-gauze or the like 75 is placed across the end of the sleeve 69, and a suitable opening being made in the gauze the bolt 72 is inserted, and its head is firmly seated in the countersink in the inner end of the central core 70, thus securing the gauze upon the sleeve. The outer sleeve 73 is then inserted upon the sleeve 69, with the lip 74 extending over the edge of the gauze, whereby said edge is confined between the said lip and the inner end of the sleeve 69. When, therefore, the pulp is compressed between the plunger F and the ejector-head, said head suitably shapes the smaller end of the stopper, and moisture from the pulp passes through the channels between the spider-wings 71 and into the tube 68, said tube having a suitable outlet 76 for the expressed liquid. Preferably a nipple 77 is connected to the said tube, so that a pipe can be attached to the nipple and the expressed liquid can be conveyed to any suitable point.

The die H is tubular and receives the ejector G, said die having a head 78, which has a die-cavity provided with a substantially cylindrical portion 79, corresponding to the cylindrical chamber produced by the compressor E and the abutment-block D, said cavity also having a tapering portion 80, which extends outwardly from the said cylindrical portion 79. When the die is in what may be termed its "open" or "outermost" position, it uncovers the ejector-head, and when the die is in its closed or innermost position its inner end abuts against the compressor-head E and the abutment-block D, so that the portion 79 of the die-cavity forms substantially a continuation of the before-mentioned cylindrical chamber, the outer end of the tapering portion 80 of the cavity being closed by the ejector-head, which fits snugly within the said cavity. When, therefore, the die is in its closed or innermost position, the cylindrical body of pulp between the compressor-head and the abutment-block can be readily forced into the die-cavity and there acted upon, as heretofore explained, and when the said die moves into open or outermost position the finished stopper is without support and can readily fall from the machine.

Suitably supported upon the frame of the machine are longitudinal guide-rods 81, and slidable upon these rods is a cross-head 82, which is firmly secured to the head of the die, as by means of screws 83, said cross-head having a lug 84 depending from its lower side. Slidably supported upon the frame of the machine is a bar 85, which reciprocates longitudinally and carries a bracket 86, through an arm 87 of which bracket loosely extends a threaded bolt 88, having one end seated in the before-mentioned lug 84. A spring 89, coiled about the said bolt, lies between the said lug and the said bracket-arm 87. This spring is so stiff that in the normal operation of the machine it serves to transmit inward motion from the bar 85 to the die H; but after the die has been moved into innermost position the said rod can continue its movement in the same direction, thus compressing the said spring and causing the die to be firmly held in its desired position at all times. This spring is also so adjusted that in the normal actions of the machine the die is car-

ried into exact engagement with the compressor; but in case of abnormal pressure of the plunger, due to excess material or foreign matter in the die or foreign matter getting between the engaging surfaces of the die and compressor, the spring yields, but is firm enough to withstand all normal pressures, this position being shown in Fig. 7. The spring 67 permits the ejector to move inwardly with the die a sufficient distance to slightly compress said spring, the spring then exerting its force to cause the ejector-head to firmly seat against the wall of the die-cavity. These springs 67 and 89 not only serve to hold their respective parts firmly in engagement with the coöperating parts of the machine, but also render unnecessary fine adjustment between the ejector and the die and of the connections which cause the die to reciprocate.

Upon the frame of the machine is adjustably supported a bracket 90, to which is pivotally connected a block 91, and suitably fastened upon this block is a plate 92, the said plate and block thus becoming a lever. I have here shown the plate as an angle-plate, (see Fig. 3,) and upon said plate is a cam-roller 93, which enters the cam-slot 7 in the face of the cam-block 4. The end of said lever is preferably rounded, as shown in Fig. 2, and enters a slot 94 in the slide-bar 85, a set-screw 95 being seated in said bar and adjustably engaging one edge of the said rounded lever end. It will now be apparent that as the driving-shaft 2 rotates the die H is reciprocated.

The plunger F is seated upon the machine-frame to slide longitudinally and includes a cylindrical body portion 96, whose forward end is reduced, as shown at 97, Fig. 7, in order to receive a sleeve 98, which is firmly fastened to the body portion 96. The sides of said sleeve 98 are provided with slots having substantially straight portions 99 and curved portions 100, guide-pins 101, seated in the machine-frame, entering said guide-slots. Therefore at the latter portion of the inward stroke of the plunger and at the first portion of the outward stroke thereof said plunger is rocked upon its axis for the purposes heretofore explained.

The plunger-head 102 has a threaded shank 103, adapted to enter a threaded opening in the end of the reduced portion 97. Before applying this head, however, a leather washer 104 is clamped between the inner face of said head and a suitable nut 105, so that when the plunger-head is placed upon the plunger this washer is clamped between the said head and the outer end of the sleeve 98. Preferably the plunger is of slightly-less diameter than the heretofore-mentioned cylindrical chamber and the cylindrical portion 79 of the die, so that there will be no danger of the plunger wearing the walls of said chamber or said die, and thus changing the shape of the chamber and die-cavity, which would of course result in producing a pulp mass whose cross-section would not be truly circular; but the soft washer 104 projects slightly beyond the periphery of the plunger, and thus fully closes the said cylindrical chamber and the said die-cavity. In its outward or open position the plunger-head lies substantially coincident with the adjacent ends of the compressor E and the abutment-block D, whereby the said plunger-head forms an end wall of the said cylindrical chamber. The inward stroke of the plunger is sufficient to cause it to force the pulp into the tapering portion of the die-cavity and to compress said pulp against the ejector-head.

Supported upon the head of the machine-frame is an adjustable bracket 106, to which is adjustably pivoted a lever 107, the upper end of said lever being rounded and received in a slot 108 in said plunger, said slot being of sufficient width to permit the heretofore-described rocking of said plunger. The opposite edges of said lever-head are engaged by adjustable bearing-screws 109. Upon said lever is a cam-roll 110, which enters the cam-race 8 in the cam-disk 5. (See Fig. 9.) Reciprocating motion is transmitted to the plunger from the driving-shaft 2 in a manner which will now be apparent.

The movements of the various parts with relation to each other can be best understood by reference to Fig. 14. All the views of the drawings with the exception of Fig. 7 illustrate all of the parts except the rake in what may be termed their "fully-open" positions—that is to say, in the positions assumed by the parts when no positive action is being taken upon the pulp and the machine is in such position that a finished stopper can drop therefrom. For the purpose of illustration I shall divide a complete cycle of operations of the machine into four quarters, the main shaft revolving once in order to produce such complete cycle of operations. We will assume that the parts are in the positions illustrated in the drawings, the rake having deposited a quantity of pulp in the raceway C and having retreated slightly from its innermost position. During the first quarter of revolution the plunger remains stationary at the edge of the abutment-block D, the rake moves backwardly preparatory to separating a new charge of pulp from the web in the feed-trough, the compressor moves forwardly in order to compress the pulp in the raceway C, and the die remains stationary for about a quarter of this first quarter of movement of the main shaft and then moves into innermost or closed position, the end of the first quarter of revolution of the main shaft finding the plunger at rest in its open position, the die at rest in its closed position, the compressor at rest in its closed position, and the rake partly through its backward travel. During the second quarter of revolution of the main shaft the die and the compressor remain at rest in the positions last indicated, the plunger moves forwardly or into closed position, thus forcing

the cylindrical body of pulp into the die, the rake completes its backward movement and commences its forward movement, so that at the end of the second quarter of revolution of the main shaft the plunger, the die, and the compressor are all at rest in their closed positions, the stopper having been fully formed, and the rake is commencing its forward travel with a new charge of pulp. During the third quarter of revolution of the main shaft the plunger opens or moves backwardly, the compressor opens, (passing the opening from the feed-trough A before the new charge of pulp has been delivered through said opening by the rake,) the die opens and reaches its fully open position, exposing the head of the ejector at about the end of the third quarter of this third quarter of revolution of the main shaft, and then rests, and the rake continues its forward or closing movement, so that at the end of the third quarter of revolution of the main shaft the plunger, the die, and the compressor are in fully open positions and the rake is moving forwardly. During the fourth quarter of revolution of the main shaft the plunger, the die, and the compressor rest in their open positions, and the rake completes its forward movement and then commences to retreat, so that by the time the compressor moves during the next quarter of revolution of the main shaft into position to engage the charge in the raceway C the rake has moved out of the said raceway. It is to be noted that the die spends only about three-fourths of a quarter of a revolution in either opening or closing, so that it rests in open position during one entire quarter of a revolution of the main shaft—viz., the fourth quarter—and during about one-half of another quarter—viz., one-fourth of the third quarter and one-fourth of the fourth quarter. This relatively long rest in open position is given in order to afford ample opportunity for the finished stopper to drop from the ejector-head.

I am aware that minor changes in the construction, arrangement, and combination of the several parts of my device can be made and substituted for those herein shown and described without in the least departing from the nature and principle of my invention.

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

1. In a machine of the character indicated, a substantially horizontal support for the material, compressing members adapted to act laterally upon material upon said support, a substantially horizontally acting compressing member adapted to act against one end of the mass compressed by said first-mentioned compressing members, means for causing compression by said laterally-acting compressing members, and means for then causing compressing action by said end-acting compressing member; substantially as described.

2. In a machine of the character indicated, a substantially horizontal material-support, substantially horizontally acting compressing members coöperating therewith, a tapering die, and means for forcing endwise into said die the body of material compressed by said compressing members; substantially as described.

3. In a machine of the character indicated, a substantially horizontal material-support, substantially horizontally acting compressing members coöperating therewith, a tapering die whose cavity forms substantially a continuation of the space between said compressing members at one end of the same, and a substantially horizontally acting plunger movable between said compressing members to force endwise into said die the material compressed by said compressing members; substantially as described.

4. In a machine of the character indicated, complementary compressing members, a die having a cavity which forms a substantial continuation of the space between said compressing members when they are in compressing position, said die being movable toward and away from said compressing members, and an ejector in the said die-cavity and over which said die moves; substantially as described.

5. In a machine of the character indicated, means for producing a substantially cylindrical body, and means for compressing said body peripherally to cause the same to taper; substantially as described.

6. In a machine of the character indicated, means for producing a substantially cylindrical body, a tapering die, and means for forcing said body endwise into said die by pressure applied to the end of said body; substantially as described.

7. In a machine of the character indicated, complementary compressing members, a plunger closing one end of the space between said members when they are in compressing position, a die whose cavity forms a substantial continuation of the other end of said space, and an ejector obstructing the end of said die-cavity; substantially as described.

8. In a machine of the character indicated, complementary compressing members, a plunger closing one end of the space between said members when they are in compressing position, a die whose cavity forms a substantial continuation of the other end of said space, an ejector obstructing the end of said die-cavity, and means for moving said die away from said compressing members to permit the article in said die to be ejected therefrom; substantially as described.

9. In a machine of the character indicated, complementary compressing members, a plunger closing one end of the space between said members when they are in compressing position, a die whose cavity forms a substantial continuation of the other end of said space, and a relatively stationary ejector obstructing the end of said die-cavity, said die being

movable away from said compressing members and over said ejector to permit the latter to eject the article from the die; substantially as described.

10. In a machine of the character indicated, a substantially horizontal support for the material to be acted upon, complementary compressing members having substantially semicircular recesses in their operative faces, said members being adapted to exert lateral pressure upon the material upon said support, a plunger adapted to close one end of the space between said compressing members when said members are in compressing position, said plunger being movable between said compressing members, a die provided with a tapering cavity adapted to form substantially a continuation of the said space between said compressing members, said die being movable toward and away from said compressing members and upon the side of the same opposite that upon which the said plunger is located when closing the said end of the said space, and a relatively stationary ejector obstructing the smaller end of said tapering die-cavity, said die having movement over said ejector; substantially as described.

11. In a machine of the character indicated, a substantially horizontal support for the material to be acted upon, a substantially horizontal raceway feeding upon said support and at an angle thereto, and complementary compressing members adapted to laterally compress the material upon said support; substantially as described.

12. In a machine of the character indicated, a reciprocatory feed member, two cam-tracks out of line with each other, and means for causing said feed member to be guided upon one of said tracks during its movement in one direction and upon the other of said tracks during its movement in the other direction; substantially as described.

13. In a machine of the character indicated, a member provided with a recess, a reciprocatory feed member having a part in said recess, and a double switch in said recess and forming a guide for said feed member, whereby said feed member is caused to travel in different paths during its respective reciprocations; substantially as described.

14. In a machine of the character indicated, a reciprocatory feed member, a member having a recess therein, and a pivoted block in said recess and having oppositely-extending projections which are adapted to engage with opposite walls of said recess, whereby said feed member is guided in its reciprocations; substantially as described.

15. In a machine of the character indicated, a member provided with a recess, a switch-plate, a stud upon said switch-plate and extending through an opening in said member, said member having a wall projecting about the extending end of said stud, a cap closing the outer end of the space surrounded by said wall, means for securing said cap to said stud to rock therewith, and a spring coiled about said stud and having its ends secured respectively to said wall and said cap; substantially as described.

16. In a machine of the character indicated, a movable compressing member having separated guide-shoes, a cross-piece extending between said shoes, and an abutment in the path of movement of said cross-piece for limiting the movement of said compressing member; substantially as described.

17. In a machine of the character indicated, a movable compressing member, separated elongated guide-shoes thereon, a supporting member projecting into the space between said guide-shoes, an abutment adjustably supported on said supporting member, and a cross-piece upon said guide-shoes and coöperating with said abutment; substantially as described.

18. In a machine of the character indicated, a movable compressing member, pivoted members connected thereto and having movement to bring them upon dead-centers, and an adjustable stop in the path of movement of one of said pivoted members; substantially as described.

19. In a machine of the character indicated, a reciprocatory rocking plunger, a relatively stationary member, a curved guide-slot in one of said elements, and a projection upon the other thereof and entering said slot; substantially as described.

20. In a machine of the character indicated, a die movable into open and closed positions, a driving member therefor, and resilient driving connection between said die and said driving member; substantially as described.

21. In a machine of the character indicated, a movable die, a relatively stationary member for obstructing the opening in said die, and means whereby said member is held under tension against said die when in obstructing position; substantially as described.

22. In a machine of the character indicated, a movable die, and a yieldingly-supported relatively stationary member adapted to close the cavity of said die; substantially as described.

23. In a machine of the character indicated, a movable die, and a relatively stationary ejector adapted to obstruct one end of the die-cavity, said die being movable over said ejector; substantially as described.

24. In a machine of the character indicated, a movable die, and a relatively stationary and yieldingly-supported ejector adapted to obstruct one end of the die-cavity, said die being movable over said ejector; substantially as described.

25. In a machine of the character indicated, a movable die, an ejector over which said die moves and having a head adapted to obstruct one end of the die-cavity, a relatively stationary support with relation to which said die moves, and a spring between said sup-

port and said ejector and exerting its pressure to hold said ejector-head in obstructing position; substantially as described.

26. In a machine of the character indicated, a die, and a tubular ejector whose passage is in communication with the die-cavity; substantially as described.

27. In a machine of the character indicated, a tubular ejector, a spider member in one end of the tubular opening, a reticulated sheet upon said spider member and having its edge resting upon the end of said ejector, and a head secured to said ejector and clamping the edge of said sheet upon said ejector end; substantially as described.

28. In a machine of the character indicated, a die, an ejector, one of said parts being movable with respect to the other thereof to present said ejector in ejecting position, means for moving said parts, and means whereby said parts are caused to rest in the positions they assume when the said ejector is in ejecting position; substantially as described.

29. In a machine of the character indicated, a compressor having movement into closed and open positions, a complementary compressing member, a plunger movable between said compressing members, means for moving said first-mentioned compressing member into closed position, and means for then causing said plunger to move between said compressing members; substantially as described.

30. In a machine of the character indicated, a compressing member having movement into closed and open positions, a complementary compressing member, a die having a cavity adapted to form a substantial continuation of the opening between said compressing members, said die having movement into open and closed positions, means whereby said die is in closed position when the said compressing member is in closed position, and means for forcing material from between said compressing members and into said die when the parts are in said closed positions; substantially as described.

31. In a machine of the character indicated, a compressing member having movement into open and closed positions, a complementary compressing member, a plunger adapted to operate in the space between said compressing members and movable into open and closed positions, a die having a cavity adapted to form a continuation of the opening between said compressing members, said die being movable into open and closed positions, means whereby said plunger is held in open position until said compressing member has moved into closed position, means whereby said die is in closed position when said compressing member is in closed position, and means for moving said plunger between said compressing members when said movable compressing member and said die are in closed position; substantially as described.

32. In a machine of the character indicated, a compressing member having movement into open and closed positions, a complementary compressing member, a plunger adapted to operate in the space between said compressing members and movable into open and closed positions, a die having a cavity adapted to form a continuation of the opening between said compressing members, said die being movable into open and closed positions, means whereby said plunger is held in open position until said compressing member has moved into closed position, means whereby said die is in closed position when said compressing member is in closed position, means for moving said plunger between said compressing members when said movable compressing member and said die are in closed position, and means for then moving said die into open position; substantially as described.

In testimony whereof I hereunto affix my signature, in the presence of two witnesses, this 31st day of December, 1902.

JULIAN H. RIVERS.

Witnesses:
GALES P. MOORE,
GEORGE BAKEWELL.