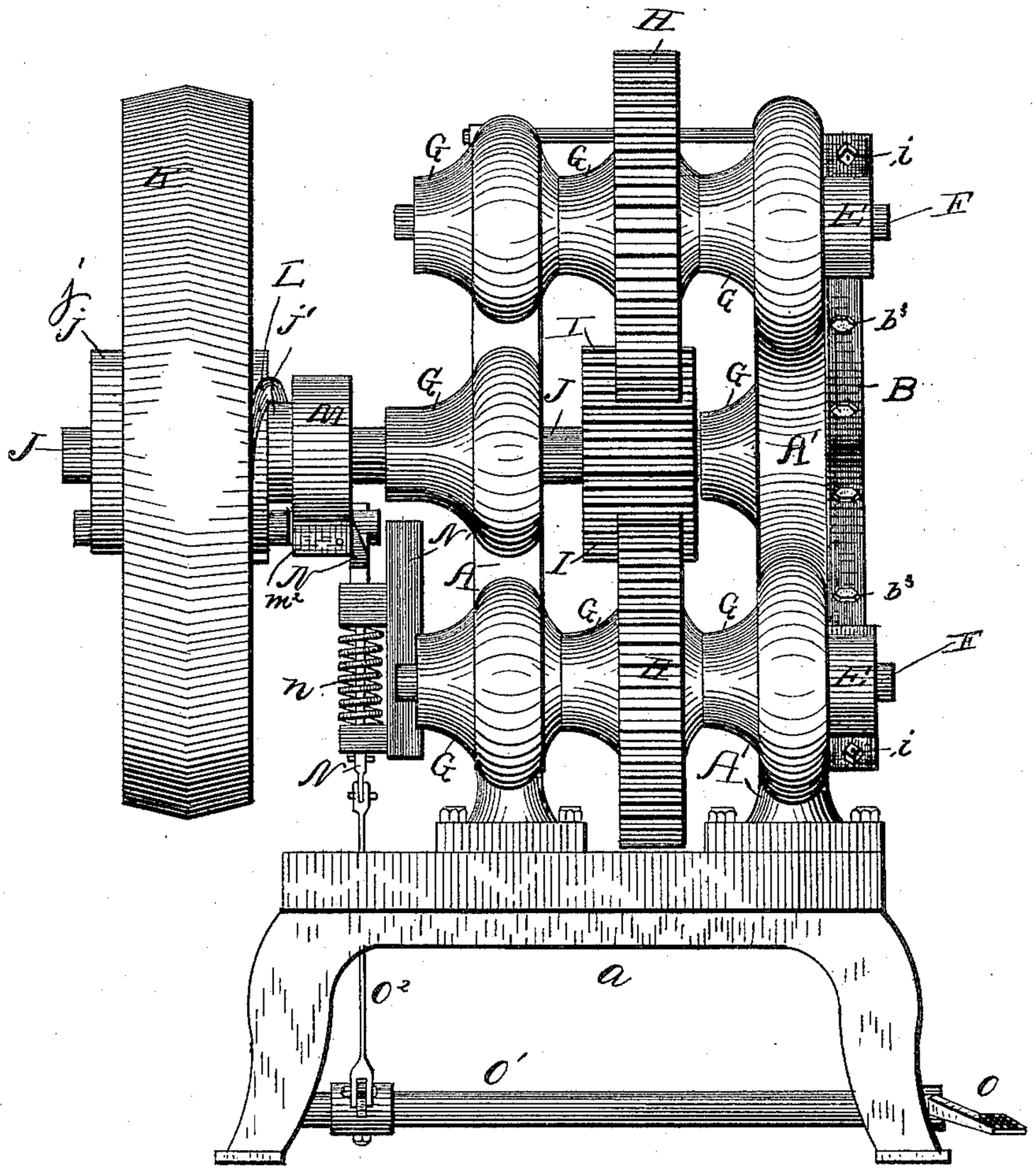
(No Model.) 5 Sheets—Sheet 1.

J. C. RICHARDSON.

RADIAL FORGING MACHINE.

No. 330,262. Patented Nov. 10, 1885.

Fig. 1.



WITNESSES

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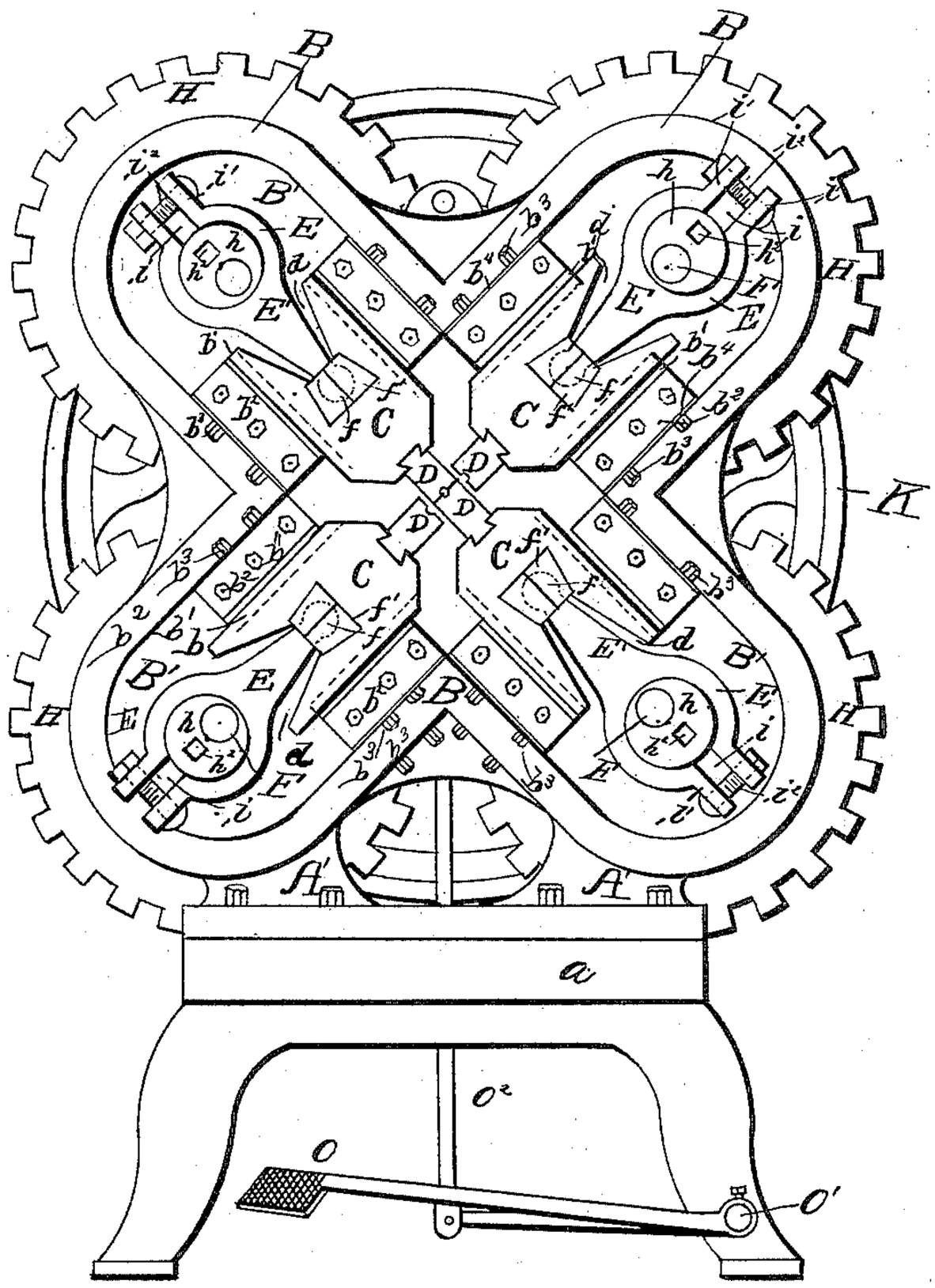
(No Model.) 5 Sheets—Sheet 2.

J. C. RICHARDSON.

RADIAL FORGING MACHINE.

No. 330,262. Patented Nov. 10, 1885.

Fig. 2.



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(No Model.)

5 Sheets—Sheet 3.

J. C. RICHARDSON.

RADIAL FORGING MACHINE.

No. 330,262. Patented Nov. 10, 1885.

Fig. 3.

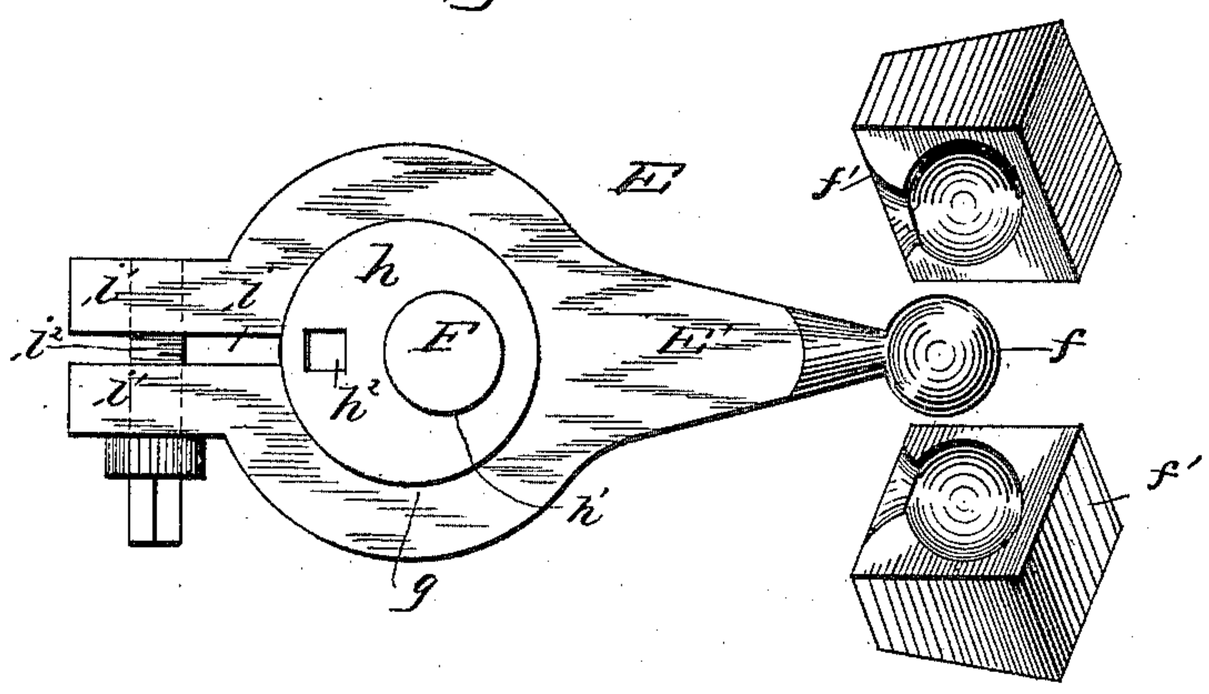


Fig. 4.

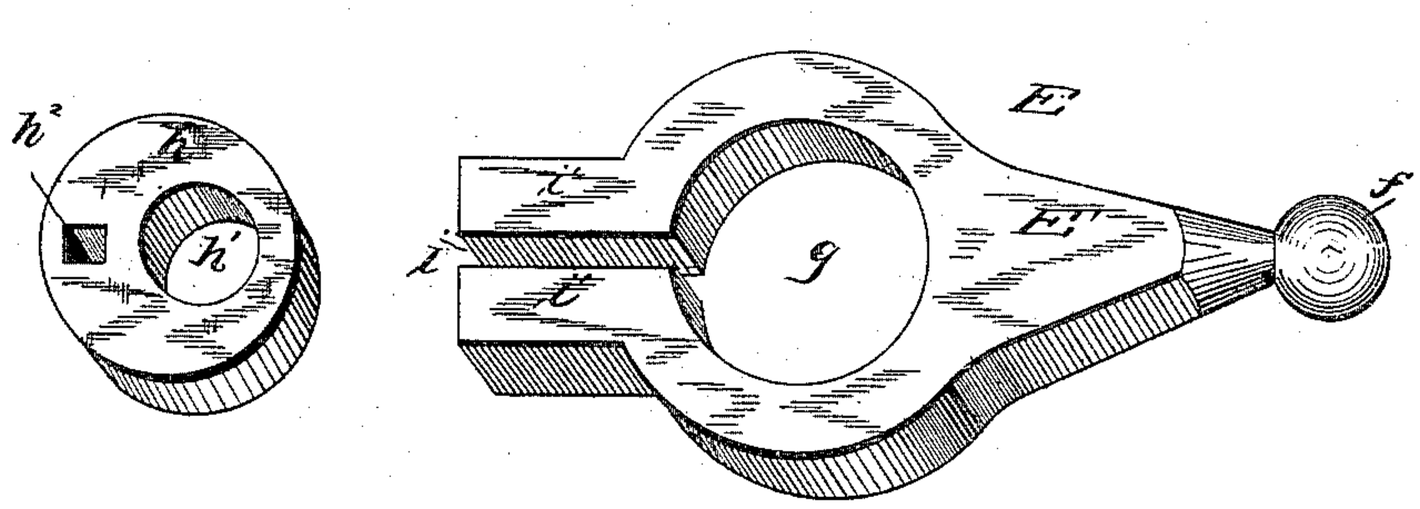
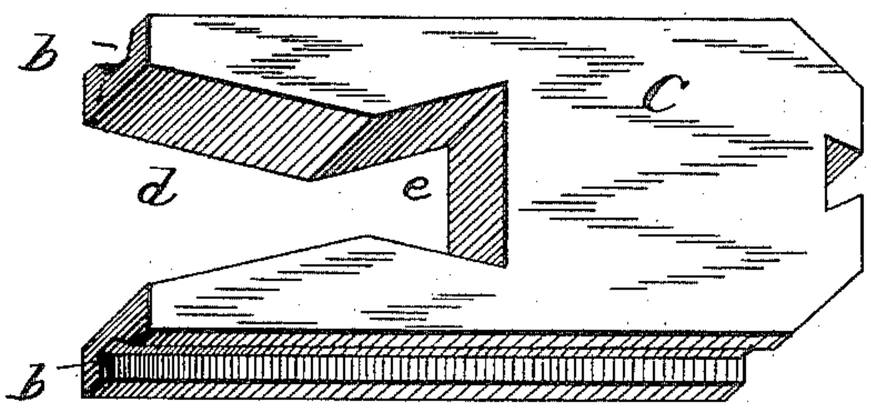


Fig. 5.



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(No Model.) 5 Sheets—Sheet 4.

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RADIAL FORGING MACHINE.

No. 330,262. Patented Nov. 10, 1885.

Fig. 6.

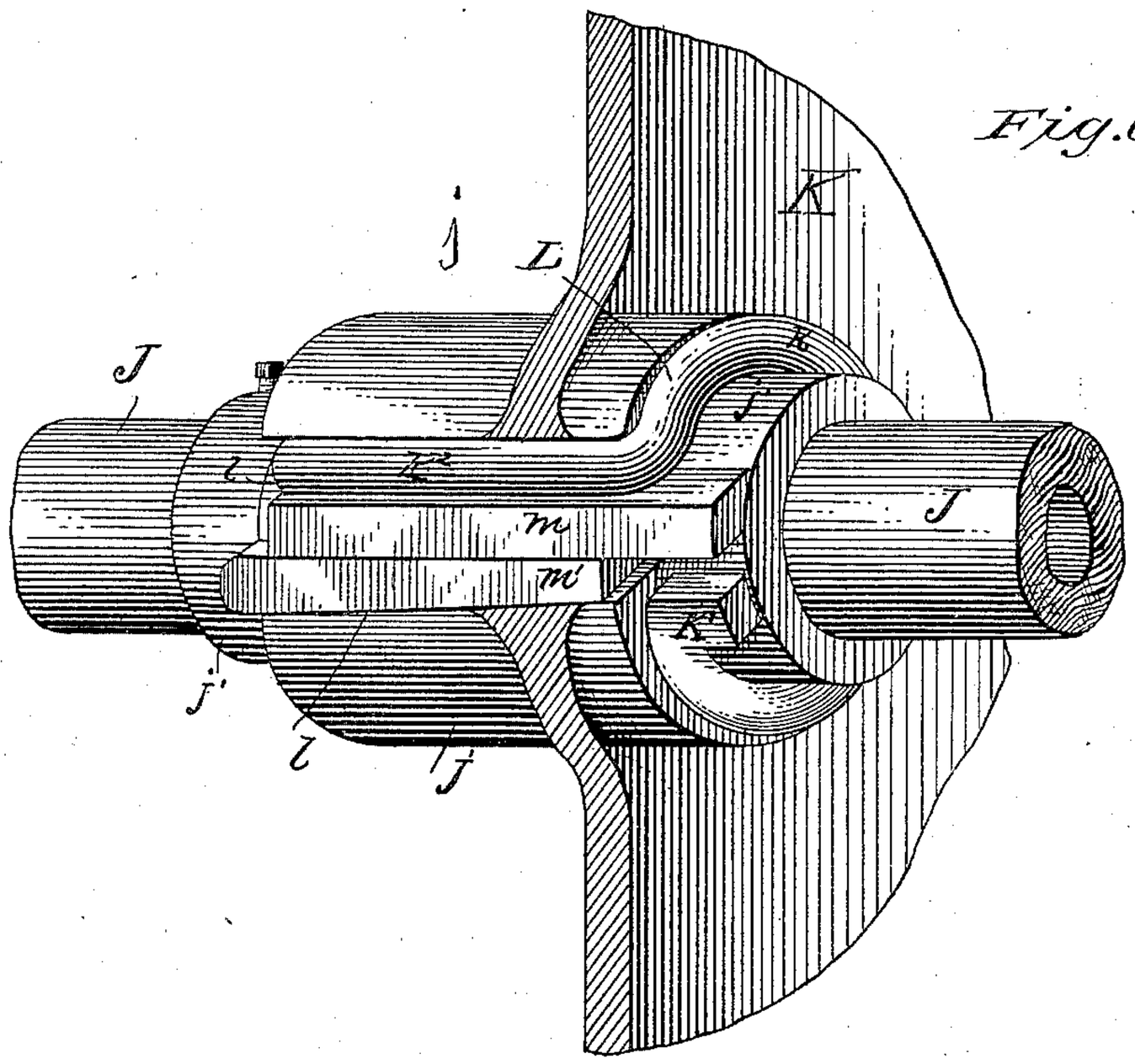


Fig. 9.

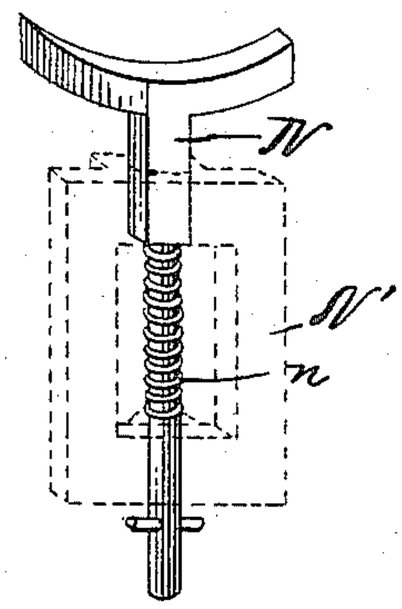


Fig. 7.

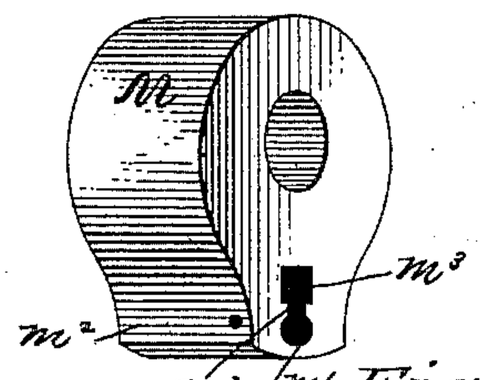


Fig. 8.

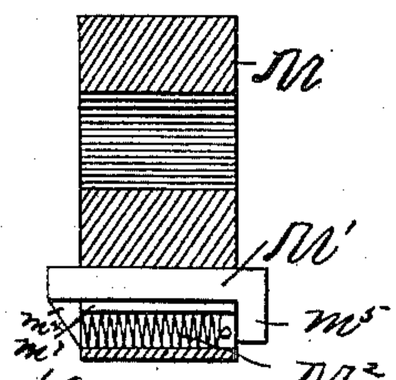
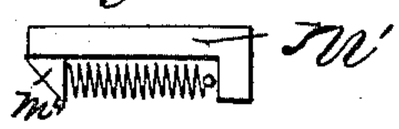


Fig. 10.



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(No Model.) 5 Sheets—Sheet 5.

J. C. RICHARDSON.

RADIAL FORGING MACHINE.

No. 330,262. Patented Nov. 10, 1885.

Fig. 11.

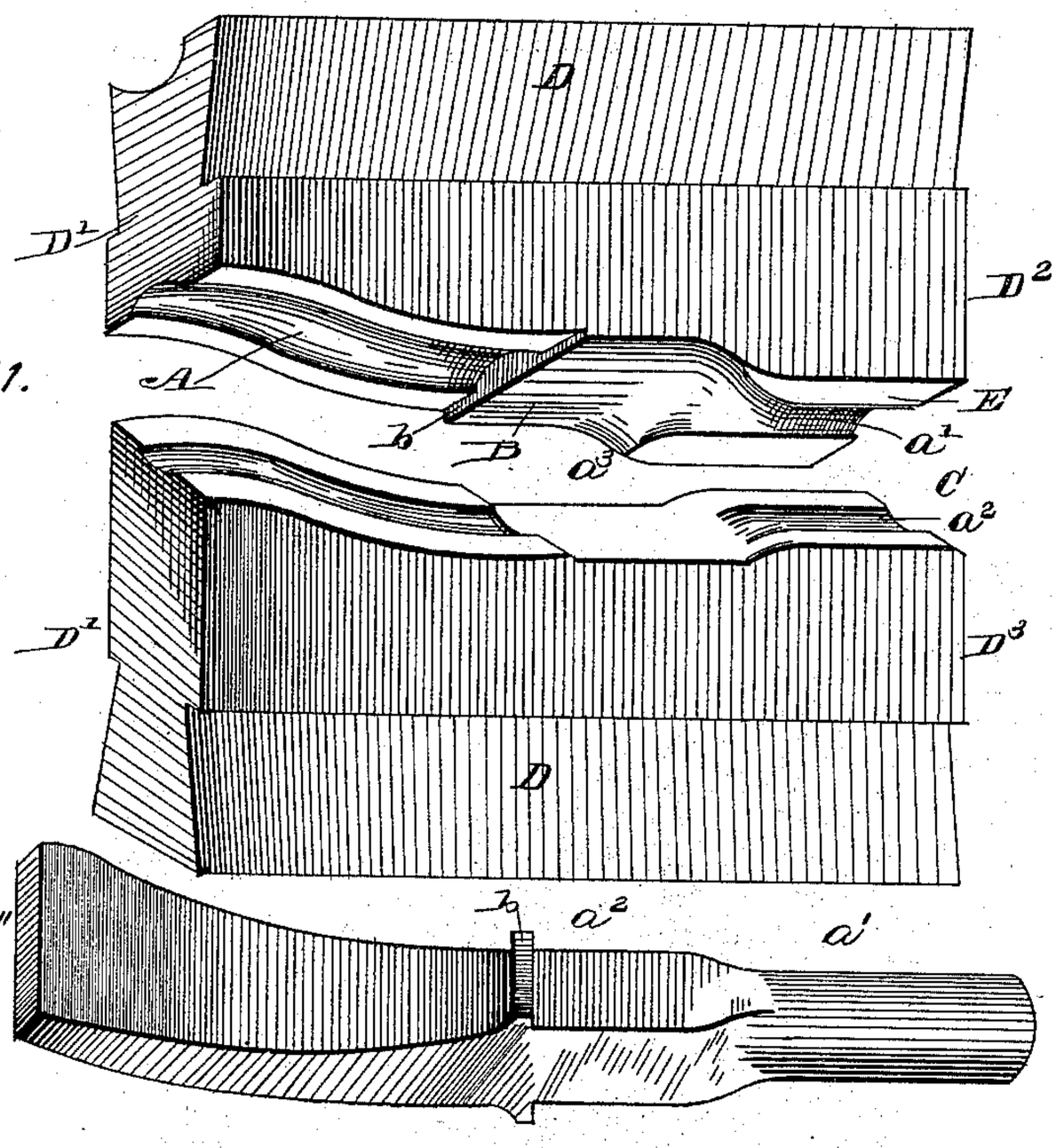
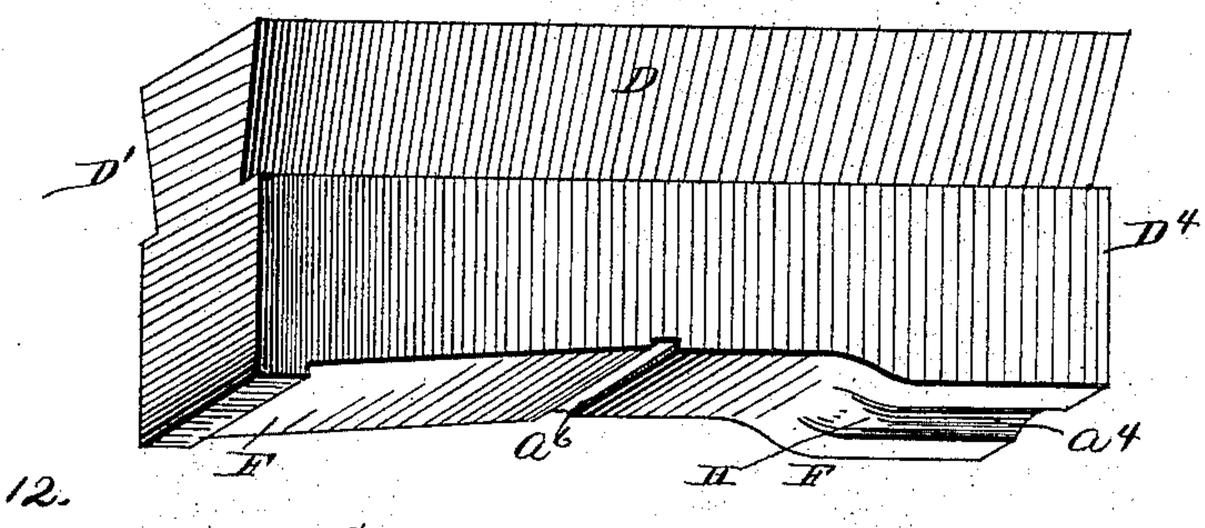
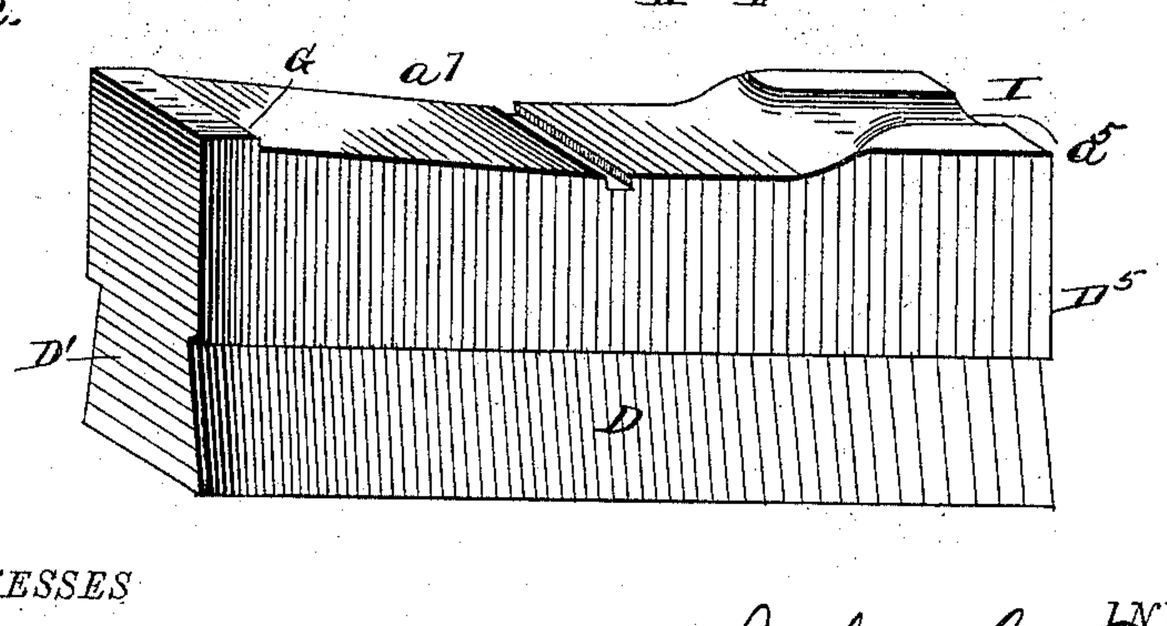


Fig. 12.





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UNITED STATES PATENT OFFICE.

JULIUS C. RICHARDSON, OF ILION, NEW YORK.

RADIAL FORGING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 330,262, dated November 10, 1885.

Application filed April 19, 1884. Serial No. 128,558. (No model.)

To all whom it may concern:

Be it known that I, JULIUS C. RICHARDSON, a citizen of the United States of America, residing at Ilion, in the county of Herkimer and State of New York, have invented certain new and useful Improvements in Radial Forging-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention pertains to improvements in machines for operating dies for forging, among other articles, thrashing-machine teeth, having for its object to effect thorough and quick work; to instantly start and stop the action of the hammer-blocks; to obviate the contact of the faces of opposing dies, which, when the machine is at rest, enables the operator to properly feed the metal into the machine and to withdraw it; to actuate each hammer-block in a simple and effective manner, and to effect the forging of the article without fins or the lateral displacement of metal.

The invention consists of sundry combinations of parts and their construction, substantially as hereinafter fully set forth, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a side elevation of my machine. Fig. 2 is a front elevation thereof. Figs. 3 to 10 are detail views of the same; and Figs. 11 and 12 are perspective views of the two pairs of the hammer-dies.

In carrying out my invention I mount and firmly bolt upon a strong suitable foundation or pedestal, *a*, two supporting upright frames, A. A′, which are bolted together at the top. The front one, A′, has bolted to or cast with it an outwardly-projecting casing, B, forming four communicating compartments, B′ B′, opening into each other at the center, and approximating the letter **X** in arrangement. Within the compartments B′ are arranged hammer-blocks C, radiating from a common center, and provided in their faces or facing ends with dovetailed grooves, into which are fitted the correspondingly-tenoned dies D, which will hereinafter be referred to more fully. The hammer-blocks are provided in their side edges with flared longitudinal grooves *b*, which receive coincidently-shaped tongues *b′* on the inner side edges of the guideways b^2, adjustably connected to flanges b^4, projecting from the inner sides of the casing B, and by set-screws b^3, to permit of the lateral adjustment of the hammer-blocks, with their dies, to keep the dies in alignment to enable them to do effective and perfect work. These hammer-blocks, with their dies, are arranged in alternately-operating pairs, as will appear further on. These hammer-blocks are formed at their outer rear ends with outwardly-flared recesses *d*, which extend at their inner ends from inwardly-flared or dovetailed sockets *e*. (See Fig. 5.)

E E are pitmen with their inner ends ball-and-socket jointed to the hammer-blocks, their tapering portions E′ having at the inner ends balls or spherical extremities *f*, which freely fit into bisected socketed boxes *f′*, adapted to fit snugly into and be held in the sockets *e*, while the tapering portions E′ of the pitmen E extend through the outwardly-flared recesses *d* of the hammer-blocks C, to permit of the requisite independent movement or swing of the said pitmen. These pitmen are provided with circular apertures *g*, carrying eccentrics *h*, slightly tapering in their general outline, and having apertures *h′* to receive the driving-shafts F of the hammer-blocks, and have angular recesses or apertures h^2, against the edges of which a hammer may be struck in adjusting the eccentric to the desired point to vary the strokes of the hammer-blocks with the dies. Each of the extreme outer ends of the ring portion of the pitmen E is slotted, as at *i*, and formed beyond said slot, so as to constitute an extension of the slot, with parallel projections *i′*, into which works a collared screw, i^2, having a surface adapted to be grasped to permit the turning of the screw by a wrench, whereby each arm may be firmly clamped upon its eccentric of the hammer-shaft, and the same be tightened when required. The eccentrics *h* are made, as before stated, slightly tapering in their general outline, and by thus forming the eccentrics the strokes of the hammer-blocks can be varied to the desired extent in connection with the collared screw i^2. When the dies, which will be referred to hereinafter, become worn, they can still be used to the same advantage as before by striking the eccentrics *h*, thus forcing the widened portion of the same farther in the apertures *g* and regulating the

screw i^2, thereby varying the distance of the strokes of the hammer-blocks. The hammer-operating shafts F are extended through the case B and inclosing-sleeves G, and bear in the frames A A′. The shafts F F are also each provided with a gear or cog wheel, H, which gears with and is driven by a single broad-faced pinion, I, secured upon the main driving-shaft J, also embraced by a sleeve, G, and bearing in the upright frames A A′. Upon the main driving-shaft is loosely placed the driving band-pulley K, suitably held thereon as against endwise movement, while it is capable of revolving independently thereof, said pulley having a hub, *j*, which fits upon a sleeve, *j′*, upon and secured (it may be by a set-screw) to the shaft J. (See Fig. 6.)

L is a strong spring, being made of stout cylindric or rod metal, with its single partial coil or ring portion *k* encompassing the shaft-sleeve *j′* and arranged contiguous to one end of the pulley-hub *j*, the free end of said portion *k* being isolated or separated a suitable distance from the other end of said portion *k* to allow of its having movement on the sleeve, and having a right-angularly bent termination or projection, K′. The other end of the ring portion *k* of the spring L is bent or extended in the opposite direction to which the projection K′ extends, being provided thereat with an extension or arm, K^2, of considerable length, which occupies a portion of a longitudinal or horizontal slot, *l*, made in the pulley-hub *j*, which arm or extension is secured therein by a key, *m*, introduced between said arm and a second key, *m′*, driven into said slot, said key *m* having one end projecting opposite the projection K′ of the spring L, as clearly seen in Fig. 6, whereby the action of said spring imparted by the driving-pulley is exerted upon said key or abutment, transmitting said action to the shaft J, which will be again and more fully referred to presently.

M is a collar firmly fastened or keyed upon the shaft J contiguously to the driving or band pulley K, the projecting end of the sleeve *j′* separating them. In an elongation, m^2, of the collar M is an angular passage, m^3, extending entirely through it, within which is located a sliding spring-bolt, M′, with a beveled beak, m^4, on one end, projecting beyond one side of the collar M, and a lateral projection, m^5, on its other end, projecting beyond the other side of said collar.

M^2 is the spring which is arranged in a circular passage, m^6, of the collar M, said passage communicating with the angular bolt-passage m^3 by an intermediate narrow passage, m^7, said spring being held at one end in its chamber formed by the passage m^6, and acting at its opposite end upon one end of the bolt M′, the normal action of said bolt being to hold both the beak and lateral projection of the bolt projected beyond the sides of the collar.

N is a T-shaped clutch-bar with its cross-head slightly curved and beveled to a point at one end, and adapted to enter between the lateral projection m^5 of the spring-bolt M′ and the collar M, to effect, when desired to stop the operation of the hammers and their dies, the retraction of the beak-ended portion of the bolt, in order to withdraw it from contact with the projection *k′* of the spring K, with which it engages to transmit motion to the driving-shaft. The vertical portion or stem of the clutch bar N is fitted to slide in apertured lugs of a frame, N′, (shown in dotted lines in Fig. 9 and in full lines in Fig. 1,) and which is suitably fastened to the rear end upright frame, A. This stem is encircled within the frame N′ by a spring, *n*, and bearing at one end on the frame and at its other end upon a shoulder of the stem, its normal action being to isolate or remove the cross-head of the bar N from the spring-bolt M′. The stem of the clutch-bar N is also connected to a treadle, O, secured to a rock-shaft, O′, bearing in the lower part of the legs of the frame of pedestal *a*, said shaft being connected by a pitman, O^2, to the lower end of the clutch-bar stem for the operation of the clutch-bar N.

To revert to the dies D, I will now describe the same in detail. I cast them of the hardest chilled metal of the desired contour, entirely omitting those portions of the side walls heretofore left on the face of the dies where the body, including the point of the article, is formed, whereby the faces of the dies at that point are left perfectly flat across their entire surface, as clearly shown in the drawings, thus permitting the presentation of the dies to the metal undergoing formation, so as to avoid lateral displacement of the metal, the displacement being effected longitudinally to enable the strengthening of the narrower or weaker portion of the article. The dies D have tenons formed on their outer surface extending the entire length of the dies, and are inserted in correspondingly-shaped dovetailed grooves in the ends of the hammer-blocks.

The principal feature of my improved dies is that the die-faces do not form the "stop" to produce the exact size of the work to be accomplished. I cast the dies on a chill, and by using this principle I make the dies of such hard metal that they can neither be milled, filed, scraped, nor chipped to shape, but can be ground to a finished form by means of solid emery-wheels of different-shaped edges. This form of grinding the dies to the desired contour can be repeated until the dies are worn too short for use.

It will be observed that no parts of the dies come in contact with each other during the forging operation, and that these dies can only be used in a forging-machine of the construction hereinbefore described, inasmuch as the eccentric rings give the exact size of the work to be produced.

Each of the four dies D are tenoned longitudinally at D′ on the reverse side of their faces, the taper of each tenon extending toward the face of the die, the contour being adapted

to the corresponding tenoned grooves of the hammer-blocks C, wherein the tooth is inserted. These dies, as shown, are designed to produce the thrasher-tooth D″, the two dies D^2 and D^3, in forging a tooth, being employed to form its lateral sides, and the dies D^4 and D^5 in like manner to form or impress its face, and the space or area intervening between the four dies at the last stroke of the hammer-blocks in forging each tooth corresponds with the contour of a thrasher-tooth. The thrasher-tooth D″ has the rounded end a'' formed by the corresponding groove, a', and die D^2 and groove a^2 on die D^3. Its contour is square at a^2, and the dies D^2 and D^3, which form the lateral face of the tooth, are correspondingly flattened at a^3. The shoulder b is formed on either face and in the lateral front of the thrasher-tooth, and hence in the formation of the dies D^2 and D^3 they are correspondingly enlarged to the right of shoulder b, the shoulder being formed by such enlargement, which causes the tooth to be smaller to the right of the shoulder, and as the tooth is gradually enlarged by a slight curve from shoulder b to its left-hand terminal point, the die D^2 is sloped off correspondingly and the die D^3 is curved and enlarged. The face-dies D^4 and D^5 are provided with the grooves a^4 and a^5, Fig. 12, which, in conjunction with the grooves a and a^2, Fig. 11, form the round end a'' of the thrasher-tooth, and as the round end a'' of the thrasher-tooth is gradually merged into that part thereof, a^2, where its contour is square, the face of these dies D^4 and D^5 at this point extending from the right is gradually lessened or removed and flattened to produce the requisite contour and enlargement until it reaches the slight recess a^6 on die D^4 and a^7 on die D^5, and as the thrasher-tooth is enlarged to the left of shoulder b and gradually thinned or flattened from shoulder b to the point of the tooth, the thrasher-dies D^4 and D^5 are gradually enlarged up to that point where they terminate in the corresponding shoulders F and G. Thus it will be observed that the dies D^4 and D^5 have their cavities cut from side to side on the face portion thereof, whereby each die is enabled to act throughout its width in the same plane upon the metal to form the prospective die, thus preventing the formation of fins upon the completed article. It will also be noticed that since the face of the die is presented throughout its width in the same plane to the metal, and that as it is designed that the article shall be completely encompassed by the action of the dies in conjunction, therefore the displacement of the metal is longitudinally toward the narrow portion thereof, which tends to compact, strengthen, and toughen the metal at that point.

In operation, the piece of steel or metal from which the tooth or other article is to be forged is secured between the jaws of a clamp, (not here shown, the same forming a part of another patent of mine,) adjusted with relation to the dies, the metal or steel blank being adjusted between and so as to be subjected to the action of the dies. The treadle O is now pressed by the foot of the operator, when the clutch-bar N will be withdrawn from the spring-bolt M′, allowing the projecting of the beak-ended portion of said bolt beyond the collar M, which, as the projection K′ of the spring L is brought around in line, (the pulley K being in motion,) will act upon said projection K′ and force it against the key m, which will prevent further movement of the spring projection K′, and thus transmit the motion of the pulley K to the shaft J, while at the same time, by causing the bolt to first come in contact with the spring projection, the movement thereby caused of the spring will counteract or neutralize all shocks or concussions that would otherwise be produced, the spring serving to elastically cushion the bolt. This arrangement also allows the ready retraction of the bolt from the spring to effect instantly the stopping of the action of the hammer-blocks without jarring or jerking, the spring quickly sliding along and past the beveled beak of the bolt. The motion transmitted, as aforesaid, to the shaft J will of course drive the pinion I, which in turn will rotate the gear-wheels H of all four of the hammer-block eccentric-shafts, whereby the hammer-blocks, with the dies, will, as before mentioned, be caused to move in alternately-operating pairs, two dies thus acting upon opposite sides of the metal at the same time, while the four sides of the metal will be alternately acted upon two at a time, the dies striking the same with great rapidity and powerful blows throughout the entire widths of their body portions, about six blows of each pair of dies transforming the metal into the desired shape when the completed article is produced. These dies are so adapted by the reduction of their face portions that they are prevented from the least contact with each other at any part of their strokes.

By reason of the action of the foregoing parts the produced article—which, for instance, as in the present case, may be a thrashing-machine tooth—is possessed of great toughness and strengthened at its normally outer end, where the greatest capability of resistance is needed, due to longitudinal displacement, which greatly compacts the pores or fibers of the metal, whereby is also obviated susceptibility to the entrance of frost in extreme cold temperatures, as experienced in the use of teeth I have been acquainted with, which, in consequence thereof, have snapped in two or broken off, being exceedingly brittle. Further, the formation of fins, as heretofore, upon the article along its longitudinal edges is prevented, only a light fin being formed at the extreme normally outer end of the article. As before intimated, in the formation of the dies I am enabled to cast the same of the hardest metal, whereby I am enabled to grind the faces of the dies to perfect smoothness with

solid emery-wheels rapidly and at little cost, thereby preserving the faces of the dies in perfect shape.

In the casting of the dies they necessarily leave the mold in a comparatively rough condition, which roughness I am enabled to readily and expeditiously remove.

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

1. The hammer-blocks having longitudinal grooves and dovetailed sockets with outwardly or oppositely flared recesses, in combination with the tongued guide-blocks adjustable upon the supporting-frame or casting, and in the radial compartments eccentric-shafts, the eccentric, and the eccentric-arms having at the ends of their portions spherical extremities embraced by bisected or two-part dovetailed boxes having ball-sockets, substantially as and for the purpose set forth.

2. The pitmen E, having their tapering portions provided with spherical extremities fitted in bisected socketed boxes *f'* and held in sockets *e*, substantially as shown and described.

3. The hammer-block-actuating shaft, in combination with a loose pulley with a spring applied thereto, one end of said spring being isolated from the point where the resistance is received on the pulley and engaged by a bolt connected to the shaft, said bolt engaging said spring and moving it to said point of resistance, substantially as and for the purpose set forth.

4. The hammer-block-actuating shaft having its sleeve encompassed by the partial coil of a spring, with an arm or extension keyed to the pulley-hub arranged upon said shaft, and its other end provided with a lateral projection isolated from a key upon which the resistance is received, in combination with the fixed collar of said shaft, having a spring-bolt with one end engaging the lateral projection of said spring and its other end engaged by a clutch-bar actuated by a treadle, substantially as and for the purpose set forth.

5. In a forging-machine, the four tenoned dies, D^2, D^3, D^4, and D^5, having the contour shown, for forming thrasher-teeth, substantially as shown and described.

6. The combination of the tenoned dies D^2, D^3, D^4, and D^5, having the contour shown, for forging in the intermediate space formed by their approximate junction a thrasher-tooth, substantially as shown and described.

7. The combination of the hammer-blocks C, having dovetailed grooves C', and the tenoned dies D^2, D^3, D^4, and D^5, substantially as shown, and for the purpose described.

8. In a forging-machine, the lateral dies D^2 and D^3 and the face-dies D^4 and D^5, having cavities extending from side to side, for acting upon the metal presented throughout their entire widths in the same plane to produce a finless tooth with its narrow portion toughened, substantially as shown and described.

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

JULIUS C. RICHARDSON.

Witnesses:
J. NOTA MCGILL,
W. M. RHEEM.