(No Model.)

2 Sheets—Sheet 1.

W. H. LAW.

POWER HAMMER.

No. 477,559. Patented June 21, 1892.

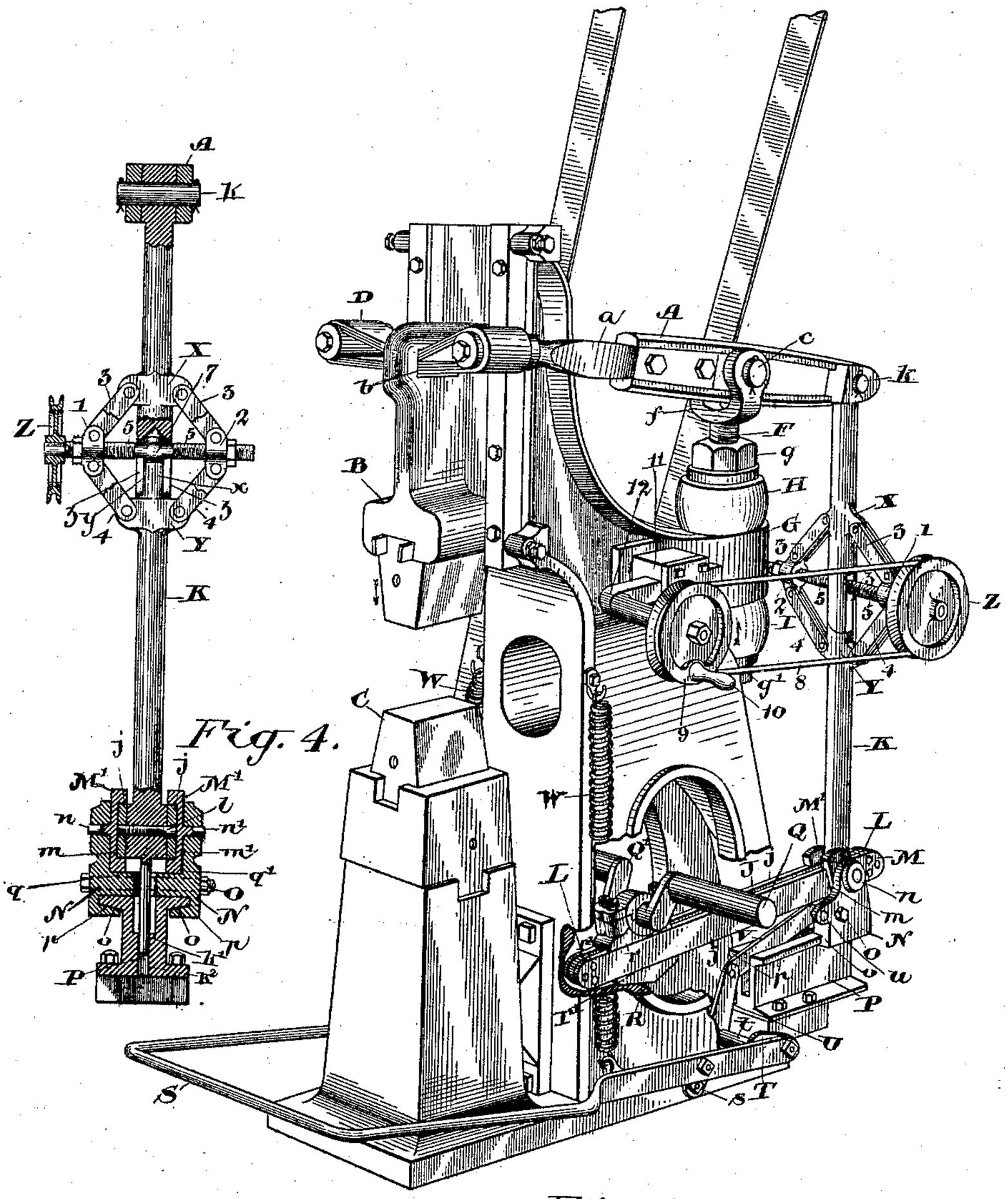

Fig. 4.

Fig. 1.

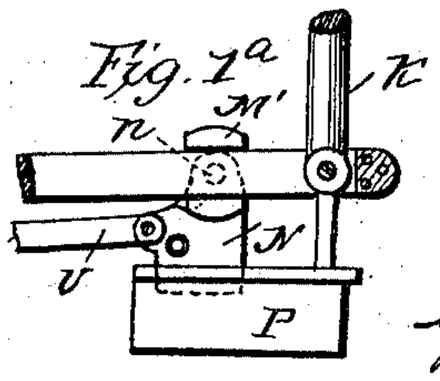

Fig. 1a

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(No Model.) 2 Sheets—Sheet 2.

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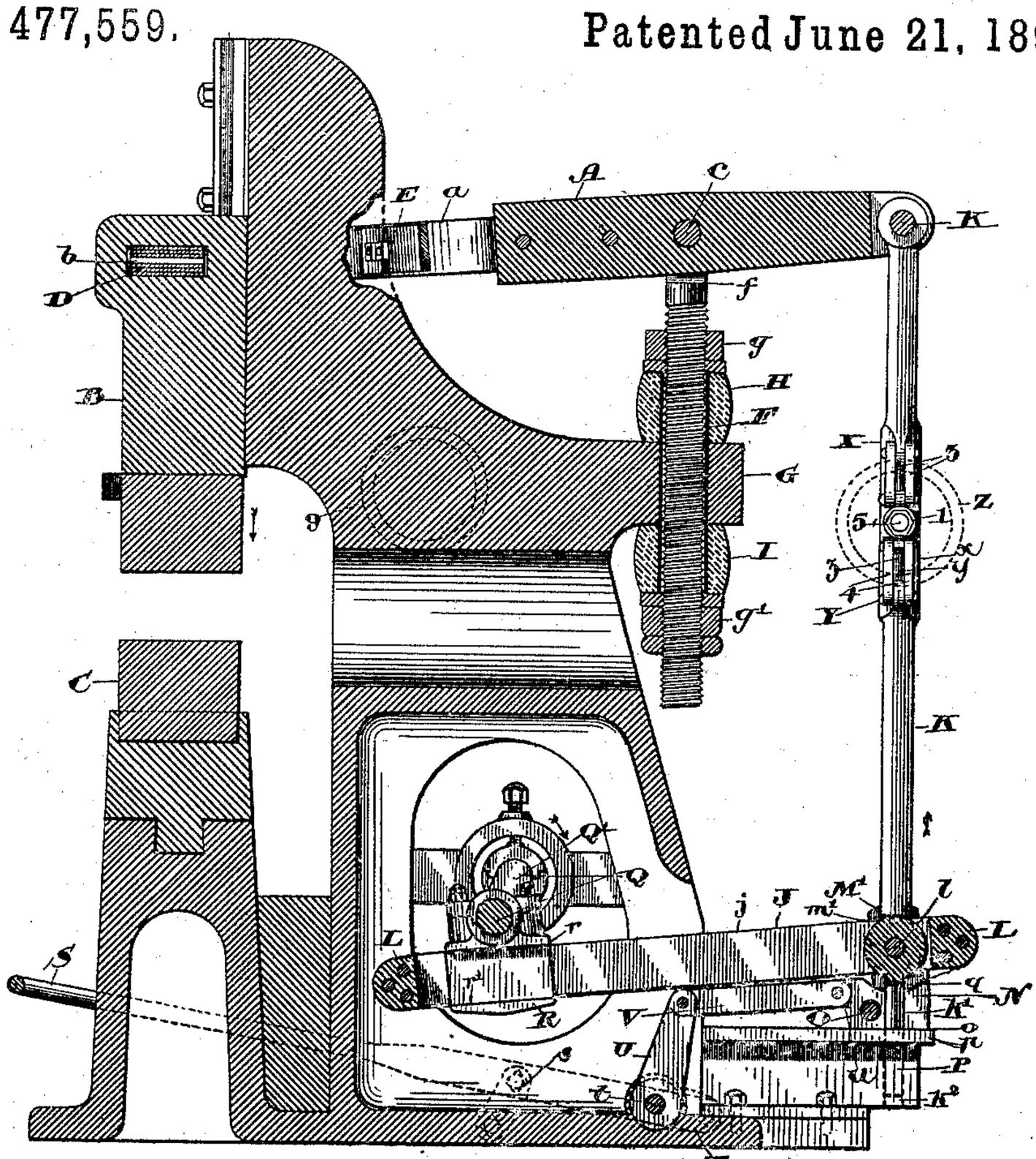

Fig. 2.

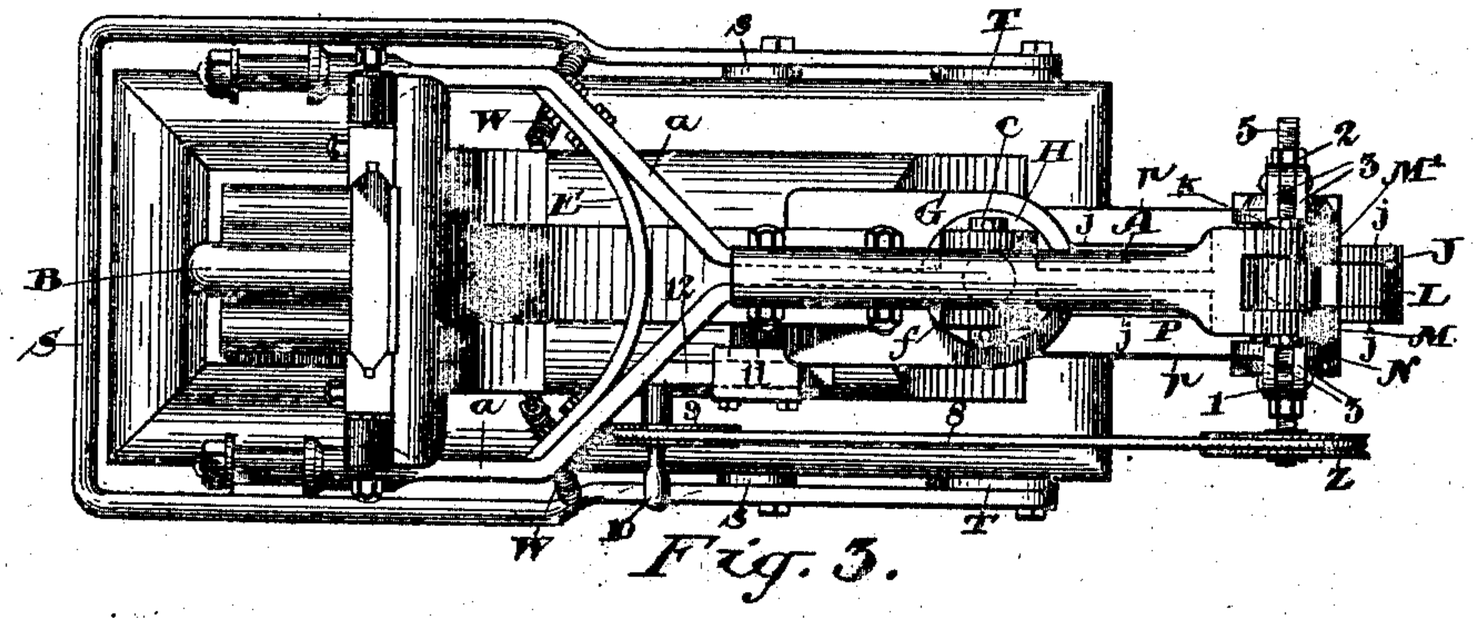

Fig. 3.

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UNITED STATES PATENT OFFICE.

WILLIAM HARTILL LAW, OF PETERBOROUGH, CANADA.

POWER-HAMMER.

SPECIFICATION forming part of Letters Patent No. 477,559, dated June 21, 1892.

Application filed December 11, 1891. Serial No. 414,684. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HARTILL LAW, of the town of Peterborough, in the county of Peterborough, in the Province of Ontario, Canada, have invented certain new and useful Improvements in Power-Hammers, of which the following is a specification.

The object of the invention is to design a hammer, first, which may be adapted to give blows of varying force without any change in the number given; secondly, which will give the full length of the stroke when operating on any thickness of metal the hammer will admit of; thirdly, to provide a means by which the velocity of the ram in its downward stroke will be considerably increased as compared with the upward stroke, so as to give a better result in the forging of the metal, and, fourthly, to so construct the hammer that its operation may be completely under the control of one man; and it consists, essentially, first, of supporting the ram on the end of the upper lever, which is pivoted at the rear of the machine and has attached to its other end a pitman, the lower end of which is attached to a lever supported on a movable cross-head or fulcrum, which is adjusted longitudinally on a supporting-bed, so as to change the fulcrum of the lever to any desired point, the said lever being connected to or driven from a crank-arm attached to the main driving-shaft; secondly, in providing a threaded spindle and nuts whereby the fulcrum of the upper lever may be raised or lowered, and also in dividing the connecting-rod into two lengths and connecting the lengths together by a double toggle-joint, so as to lengthen or shorten the rod by a right-and-left-hand screwed spindle; thirdly, in connecting the lower lever to a crank, so that when the crank is revolving close to the fulcrum of the lower lever a quick motion is obtained when the arm is descending; but when the crank is in that portion of its revolution which is farther away from the fulcrum of the lower lever a slow motion is imparted to the ram, which during this period is ascending, and, fourthly, in the construction and arrangement of the parts, as hereinafter more particularly explained in detail.

Figure 1 is a perspective view of my power-hammer with the lower portion of the frame broken away so as to show the means of operation. Fig. 1ª is a detail view of the adjustable fulcrum for the lower operating-levers. Fig. 2 is a longitudinal sectional elevation through the center of the machine. Fig. 3 is a plan view of the machine. Fig. 4 is a sectional rear elevation showing the means whereby the pitman is attached to the upper and lower lever and the manner in which the said pitman is lengthened or shortened.

In the drawings like letters and figures of reference indicate corresponding parts.

A is the upper lever, B the ram, and C the anvil-block. The forward end of the upper lever A is forked, the outer ends of the arms *a*, which form the fork, being connected together by the leather belt D, which passes through the hole *b* in the ram B, thereby supporting the ram. The arms *a* of the upper lever A are held apart by the spring E, so as to keep the leather belt D as taut as possible.

The upper lever A is pivoted on the pin *c* in the jaw *f*, which is formed at the upper end of the screw-spindle F. It will be noticed that the screw-spindle F extends through the rear end G of the frame of the machine.

H and I are cushions or springs, preferably made of rubber, situated, respectively, above and below the end G and designed to relieve the frame from any undue strain or shock caused by the blows of the ram B.

g g′ are nuts, which are screwed onto the screw-spindle F and occupy positions abutting the upper and lower cushions H and I, respectively.

J is the lower lever, and K the pitman, which is connected at the top *k* to the end of the lever A and at the bottom to the lever J by the pin *l*. The lower lever J is composed of two parallel bars *j*, connected together at the ends by the blocks L. The pin *l* extends through the end of the pitman K and from outside to outside of the parallel bars *j* of the lever J, as indicated in Fig. 4.

M M′ are trunnions having grooves *m m′*, within which the parallel bars *j* of the lever J slide. The trunnions M M′ are pivoted at *n n′* on the movable cross-head or fulcrum N. Each half of the movable cross-head has formed on its inner side an arc-shaped recess *q*, within which the curved ends of the trunnions M M′ rock, thus relieving the pivoted pins *n n′* of the trunnions from the weight borne by the trunnions. The cross-head N is connected together by the screw-bolt O and has grooves *o* cut in the lower portion of each

part. The cross-head N is supported on the standard-plate P, which has tongues *p* at its upper portion to fit into its grooves *o*, so that the cross-head N may be kept in position laterally, although permitting it to be moved longitudinally.

Q is the main driving shaft of the machine, which is driven by a pulley from any suitable motor and is journaled in bearings secured to the side of the frame of the machine. The shaft Q is a crank-shaft and has its crank Q′ in its central portion sufficiently wide, so as to permit of the vertical movement of the forward end of the lever J through it. The outer end or pin of the crank Q′ is journaled in bearings in the sliding block R. The sliding block R is formed so as to have projecting flanges *r r′*, extending to the outside of the bars *j* of the lever J at the top and bottom, respectively. The flanges *r r′*, however, permit of the block R sliding freely longitudinally within the bars *j* of the lever J as it is caused to move upwardly and downwardly by the revolving of the crank Q.

S is a U-shaped treadle extending from the rear to the front of the machine and pivoted on the free end of the link *s*, which is pivoted at its other end to the frame of the machine. The inner end of the treadle S is attached to the arm T, secured to the spindle *t*, which has its bearings in the lower portion of the frame, as indicated.

U is an arm extending upwardly from the inner end of the spindle *t*. The arm U is connected to the lugs *u*, formed on the forward end of the cross-head N by the link V.

W are spiral springs situated one at each side of the machine and connected at the top to the frame and at the bottom to the forward end of the treadle S. These springs are designed to keep the forward end of the treadle S up, so as to force the cross-head or fulcrum N directly beneath the center of the pitman K and retain it there in its normal position, as shown in Figs. 1 and 2.

It will be noticed that the pitman K is formed in two lengths, the top *x* of the lower length being reduced in diameter, so as to fit into a socket *y*, made at the bottom of the upper length.

z are slots cut in the upper length of the pitman K at each side of the socket *y*.

X and Y are cross-heads formed on the upper and lower lengths, respectively, of the pitman K.

1 and 2 are lug-nuts connected to the upper cross-head X by the links 3 and to the lower cross head by the links 4.

5 is a screw-spindle having a right and left hand thread cut on each end. This right and left hand screw-spindle 5 extends through the lug-nuts 1 and 2, which have female threads cut on them to correspond with the threads on the screw-spindle. In the middle of the screw-spindle 5 is a spherical bearing 7, located within the socket *y*. On the outer end of the screw-spindle 5 I secure a groove-pulley Z, which I connect by the belt 8 to the groove-pulley 9, which is provided with a handle 10 for manipulating the same. The pulley 9 is supported on the end of the L-shaped arm 12, which extends through a sleeve made in the bracket 11 and is adjustable therein. The operator, by turning around the pulley 9 in the direction indicated by arrow, may bring the lug-nuts 1 and 2 inward on the spindle 5, and thereby bring the inner end of the link-arms 3 and 4 also closer to the pitman K. By this means the pitman K may be lengthened as desired. The top end *x* of the lower length of the pitman K moves at the same time longitudinally within the socket *y*, the said top end *x* and socket *y* being of sufficient length, so as to keep the two lengths of the pitman K rigidly in line.

Having now described the principal parts involved in my invention, I shall proceed to describe the manner whereby my hammer is operated and the means of adjusting it to suit the different thicknesses of metal which it may be desired to forge.

My hammer derives motion from a pulley situated on one end of the main driving-shaft Q. The shaft ordinarily is designed to revolve continuously and in revolving imparts to the lever J by means of the crank Q′ an oscillating up-and-down movement upon its pivot-point or cross-head N and pivot-pin *t*, which are now in a direct line with each other. It will consequently be seen that the pitman K and lever A will remain perfectly stationary. The operator may by pressing down the treadle S bring the cross-head N, and consequently the trunnions *j*, forward of the pivot-pin *l* any desired distance, this of course depending on the length of stroke and force of the blow desired. It will now be seen that the lever J will become a lever of the first class and the pitman K will derive a vertical reciprocating motion from the crank Q. The lever J will consequently be rocked on its pivot so as to give a reciprocating motion to the ram B. As the crank-shaft Q is revolved in the direction indicated by arrow, it will be seen that as the crank Q′ passes downwardly with its outer end close to the fulcrum of the lever J a quick motion will be given to the upper movement of the pitman K, and consequently a corresponding motion will be given to the downward movement of the ram B. As the outer end of the crank Q′, however, passes upwardly farther away from the fulcrum of the lever J, it will be seen that a slower motion will be given to the pitman K in its downward movement, and consequently a corresponding motion to the ram B in its upward movement. This I consider a very essential and important change in the movement of the ram B, as by this means the downward stroke of the ram is considerably increased as compared with the upper stroke, thereby giving a much sharper and heavier blow, resulting in a nearer approach to the action of a stroke from the hammer of a blacksmith

than has ever been accomplished in any machine designed for forging of which I am aware.

It will be seen that any moment the operator may desire to stop the operation of the ram he may do so by removing his foot from the treadle S, when the fulcrum or cross-head N will be immediately brought back by the spiral springs W and the trunnions will come directly in line with the pin *l*, and consequently no motion will be imparted to the pitman K and ram B.

By means of the nuts *g g'*, before described, the tension of the cushions H and I may be increased by screwing the nuts *g g'* toward the cushions H and I, respectively. If it is desired to raise the pivot-point of the lever A, so as to allow of the ram B to be brought to forge a greater thickness of metal, I have merely to loosen the nut *g'*, raise the screw-spindle F, and screw the nut *g* home against its rubber washer H. It will also be seen that the fulcrum of the lever A may be lowered by unscrewing the nut *g* any desired distance, and screwing the nut *g'* home against the rubber cushion I the same distance to accommodate the forging of metal of a less thickness.

It will be noticed on reference to Figs. 2 and 4 that I form an extension *k'* on the lower portion of the pitman K, which extension fits within a hole k^2, made in the standard-plate P. This hole is a little loose for the extension of the pitman, so that it may readily work up and down in it. The extension *k'* consequently, although free to move vertically, is prevented from moving laterally by the hole k^2 and is designed to form a stop against which the central portion of the cross-head comes in contact, so as to prevent any liability of the cross-head N and trunnions M M' slipping over the rear end of the standard-plate P or the rear end of the lever L when the foot is removed from the treadle S, and the cross-head is forced back by the tension of the spring W.

Instead of providing the mechanism hereinbefore described for shortening and lengthening the pitman K, I might cut a right-hand thread on the upper length of the pitman and a left-hand thread on the lower length of the pitman and provide a sleeve-nut, connecting the lengths and correspondingly threaded, to the upper and lower lengths.

Heretofore hammers have been constructed with a tightening-pulley acting on the driving-belt or a friction-clutch, either of which is operated by the foot of the workman. In the first case the operator presses the tightening-pulley against the belt, which sets the hammer in motion, and the tighter you press against the pulley the greater number of revolutions are made, resulting in heavier blows and a greater number of them when the hammer is running at the highest velocity. Light blows are produced by allowing the belt to slacken more or less, thereby decreasing the number of blows which are also given irregular and uncertain and contrary to the true principles and requirements of forging. The clutch mechanism operates on the same principle as above described, and therefore is also inadequate to the requirements of forging. It will be seen, however, from the above description that my hammer is constructed on the true principle of forging, is positive, and is completely under the control of one operator, all the parts of the machine where he has to manipulate being brought within easy reach of him.

The normal position of the ram B when at rest can be regulated by means of the hand-wheel Z or by the nuts *g g'*, or by both. To illustrate this should I require to forge a piece of iron or steel three inches thick and reduce it to one-half inch thick I would first open the toggle in the pitman by means of the hand-wheel Z, and then by means of the nuts *g g'* set the ram about four inches above and clear of the anvil. By so placing the ram ample room is allowed for the admittance of the hot metal. The crank is supposed to be in the motion during these changes, or it may be at rest. By pressing on the treadle S the ram is set in motion, and the lower the treadle is depressed the greater is the length of the stroke and also the force of the blow. After repeated blows the piece of metal becomes reduced; but I still want the full stroke and full force of the blow. Consequently I simply turn the hand-wheel Z in the proper direction, and thus close the toggle and lengthen the pitman, thereby bringing the ram down closer to the work. For lighter blows I turn the hand-wheel in the same direction and let the treadle rise.

It will now be seen that by the manipulation of the hand-wheel Z and treadle S any desired force of blow can be obtained from one ounce to the full force the hammer is designed to give, the force of the blow depending upon the weight, fall, and velocity of the ram.

What I claim as my invention is—

1. In combination, the frame, the upper lever pivotally supported thereby, the ram connected to the upper lever, the lower lever, the pitman connecting the levers, and the crank-shaft in sliding connection with the lower lever to operate thereon, substantially as described.

2. In combination, the frame, the upper lever pivotally supported thereby, the ram carried by the said lever, the lower lever, the pitman connecting the two levers, the means for operating the lower lever, and the adjustable fulcrum for the lower lever, movable to and from the pitman, substantially as described.

3. In combination, the frame, the ram and the movable support therefor, the lever J, the pitman connected to said lever and to the movable ram-support, the cross-head movable longitudinally of the lever, the fulcrums of the lever carried by said cross-head, the guide-

ways for the cross-head, and the means for moving the cross-head with the fulcrum along said way to and from the pitman, substantially as described.

4. In combination, in a power-hammer, the frame, the ram, the movable support therefor, the operating-lever J, the means for operating said lever, the pitman connected to the lever and the ram-support, and the fulcrum consisting of the trunnions M M′ and the cross-head carrying the same, said cross-head, with the fulcrum, being movable along the lever, substantially as described.

5. In combination, the frame, the ram, the movable support therefor, the operating-lever J, the pitman connected thereto and to the movable support, and the movable fulcrum for the lever, adjustable so as to lie in the vertical plane of the pitman, substantially as described.

6. In combination, the frame, the ram, the upper lever connected thereto and pivotally supported on the frame, the lower lever J, the pitman connecting the two levers, the adjustable fulcrum for the lower lever, and the crank-shaft for operating said lever, connected thereto by the sliding block R, substantially as described.

7. In combination, the frame, the ram, the movable support therefor, the operating-lever J, formed of parallel bars, the pitman connected thereto between the bars and connected also to the ram-support, the adjustable fulcrum engaging the outside of the bars, whereby the longitudinal adjustment along the lever is permitted, and the operating means for the lever J, substantially as described.

8. In combination, the frame, the ram, the movable support therefor, the operating-lever J, composed of parallel bars, the pitman connected to the lever between the bars and connected also to the ram-support, the trunnions M M′, grooved on their inner faces to receive the bars and having journals on their outer sides, the cross-head receiving said journals, the guideway for the cross-head, and the operating means for the lever J, substantially as described.

9. In combination, the frame, the ram, the upper lever pivotally supported on the frame and connected to the ram, the lower lever, the pitman connecting the levers, the cross-head movable along the lower lever, the fulcrum carried by the cross-head, the guideway for the cross-head having tongues *p*, said cross-head being grooved to receive said tongues and formed in two parts, the bolt *o* for holding the two parts together, and operating means for the lever J, substantially as described.

10. In combination, the frame, the ram, the upper lever pivotally supported on the frame and connected to the ram, the lower lever J, the pitman connecting the two levers, the adjustable fulcrum, the guideway, and the operating means for the fulcrum, consisting of the treadle, the rock-shaft, the arm U, and link V.

11. In combination, the frame, the ram, the connections thereto, including the pitman, the lever J, connected to said pitman, the adjustable fulcrum comprising the cross-head, the guideway therefor, and the trunnions pivoted to the cross-head and movably engaging the lever and having rounded lower edges to fit corresponding seats in the cross-head, substantially as described.

12. In combination, the frame, the ram, the upper lever connected thereto, the screw F, to which the lever is pivoted, the said frame having a rear extension G to receive the screw, the nuts *g g′* on the screw, and the cushions H I on each side of the extension G and between the nuts and said extension.

13. In combination, in a power-hammer, the frame, the ram, the upper lever connected to the ram, the pitman connected to the lever for operating it, means for operating the pitman, said pitman being formed of the upper and lower lengths, with the socket connection between them, the right and left hand screw-spindle arranged transversely of the pitman, the nuts 1 2 on the screw, and the links 3 4, connected thereto and to the pitman-sections, said sections having the cross-heads X Y, substantially as described.

14. In combination, the frame, the ram, the pivoted lever connected therewith, the pitman with the operating means therefor for operating the lever, said pitman being formed in two parts, one of which has a socket with slots *y* and the other a reduced end *x*, fitted thereto, the right-and-left screw-spindle extending through the slots and having a ball-bearing 7, engaging with a seat in the end *x*, the nuts 1 2, the links, and means for turning the spindle, substantially as described.

15. In combination, the frame, the ram, the lever A, connected therewith, the pitman, with operating means therefor for moving the lever A, the said pitman being formed in two parts with a sliding connection between them, the transverse right-and-left screw with the toggle mechanism for moving the sections, the pulley Z on said screw, the pulley 9 on the frame, the adjustable support for said pulley, and the belt connection between the pulleys, substantially as described.

16. In combination, the frame, the ram, the operating-lever J, the pitman connected thereto and in connection with the ram, the adjustable fulcrum comprising the cross-head N, and the trunnions movably engaging the lever, the guideway for the cross-head, having the base-plate P, with an opening therein, and the extension *k′* on the pitman to enter an opening in the plate P, substantially as described.

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