No. 693,288.

Patented Feb. 11, 1902.

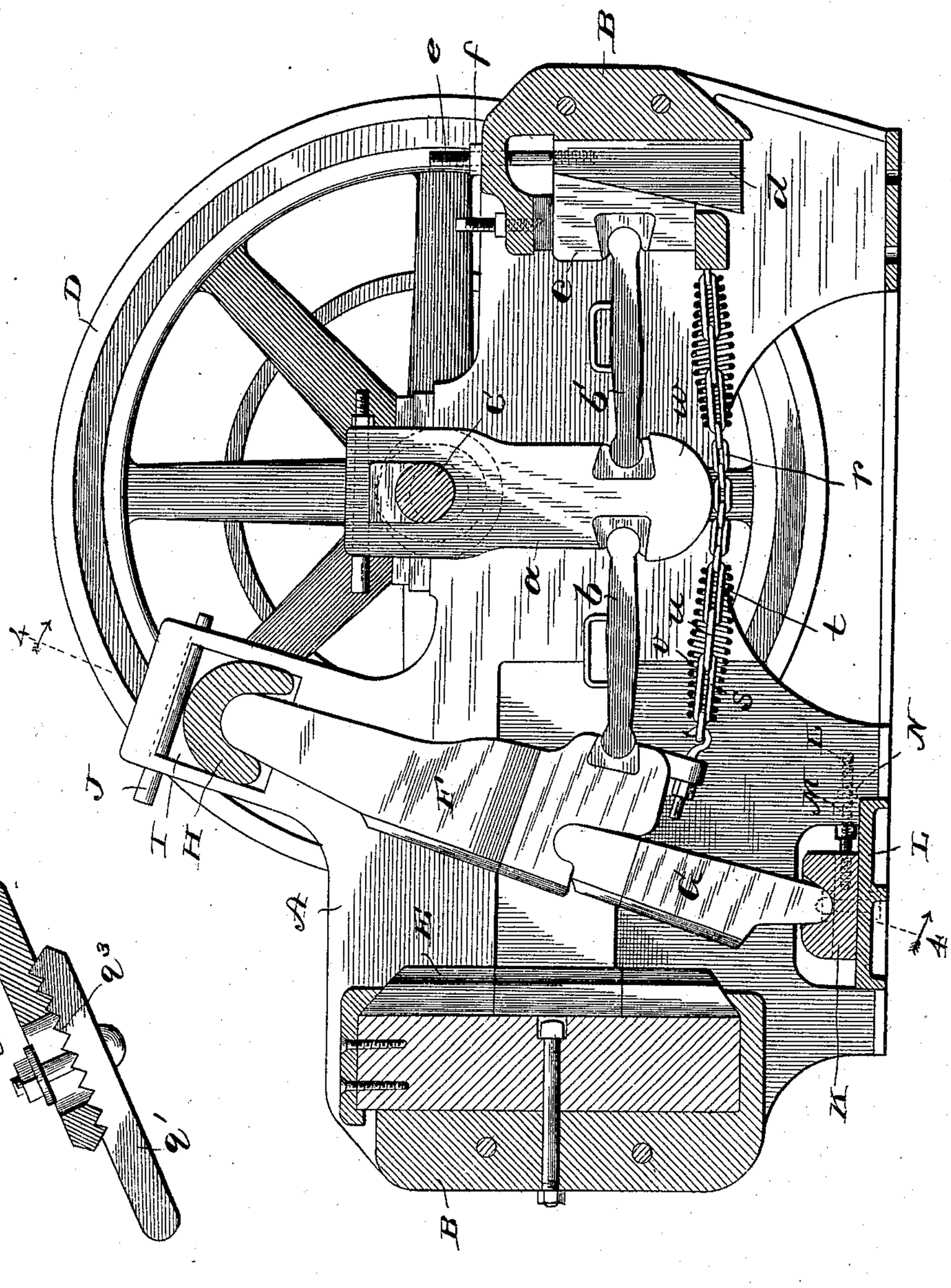
G. LOWRY.

ROCK BREAKER.

(Application filed Nov. 22, 1899.)

(No Model.)

3 Sheets—Sheet 1.



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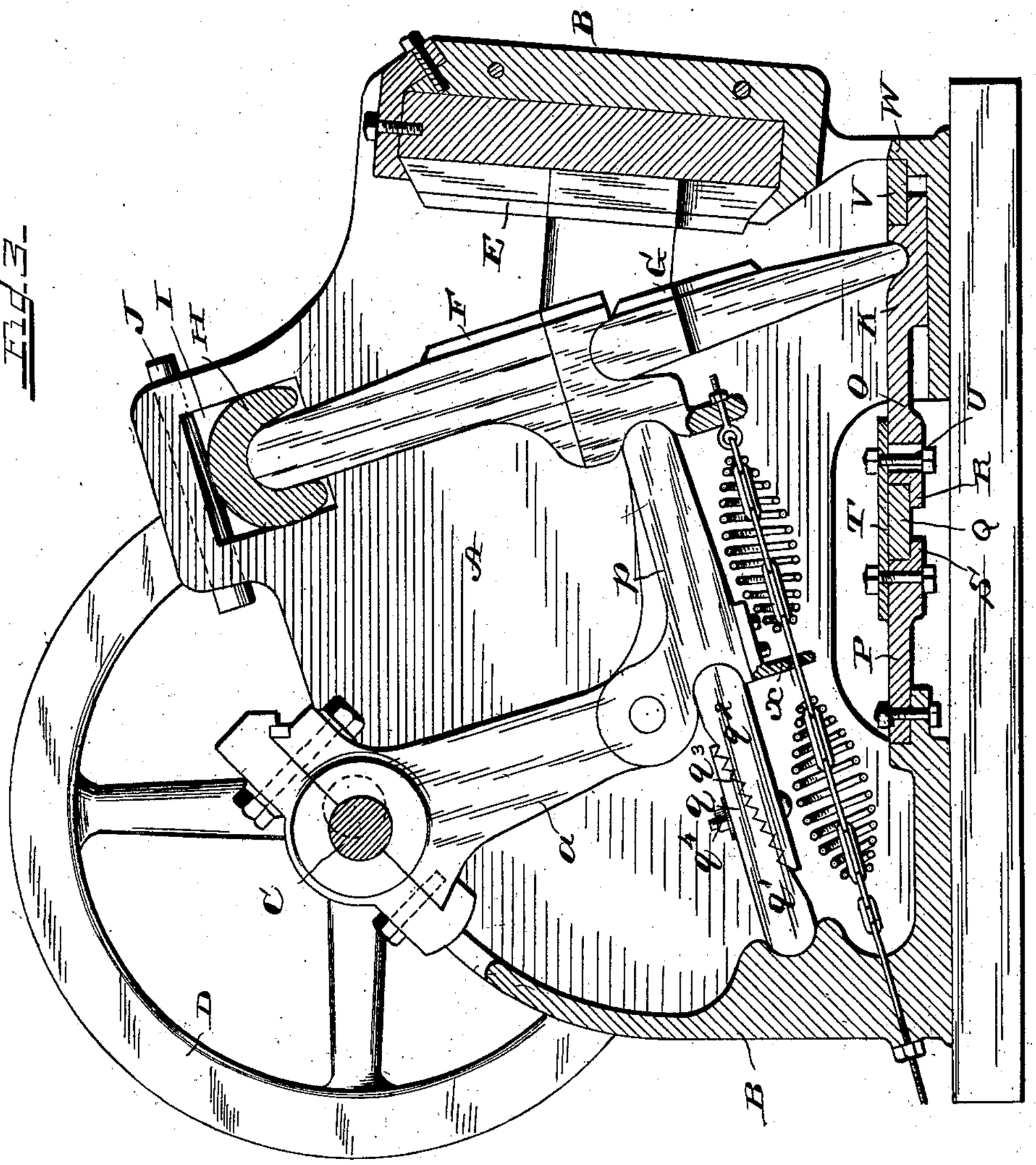
(No Model.) 3 Sheets—Sheet 2.

FIG. 2.



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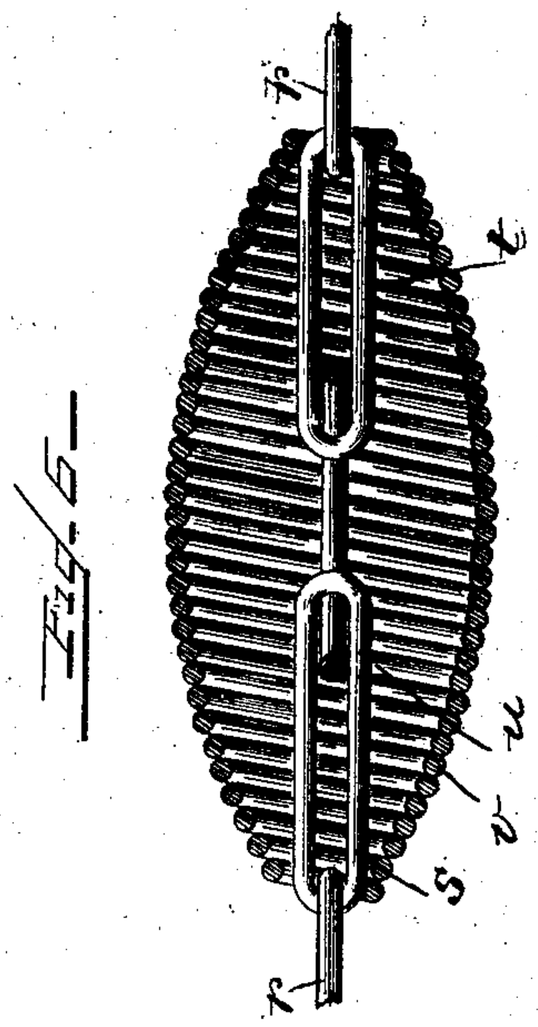
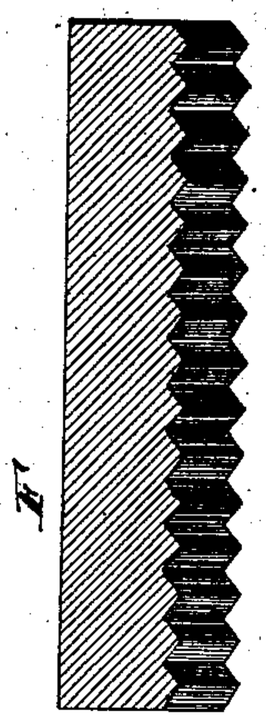
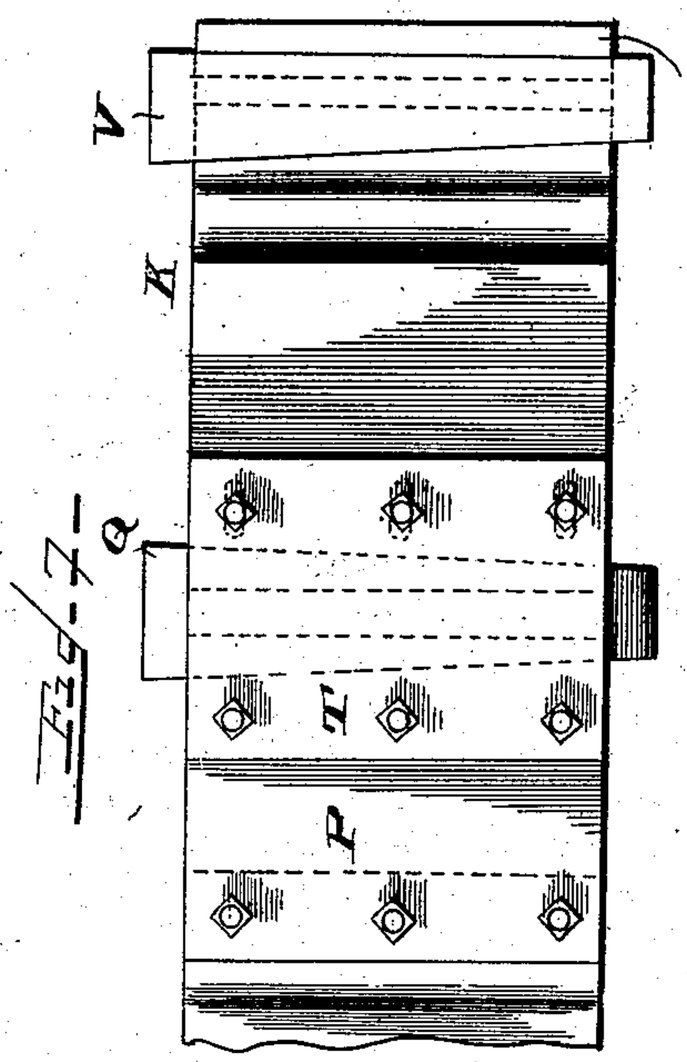
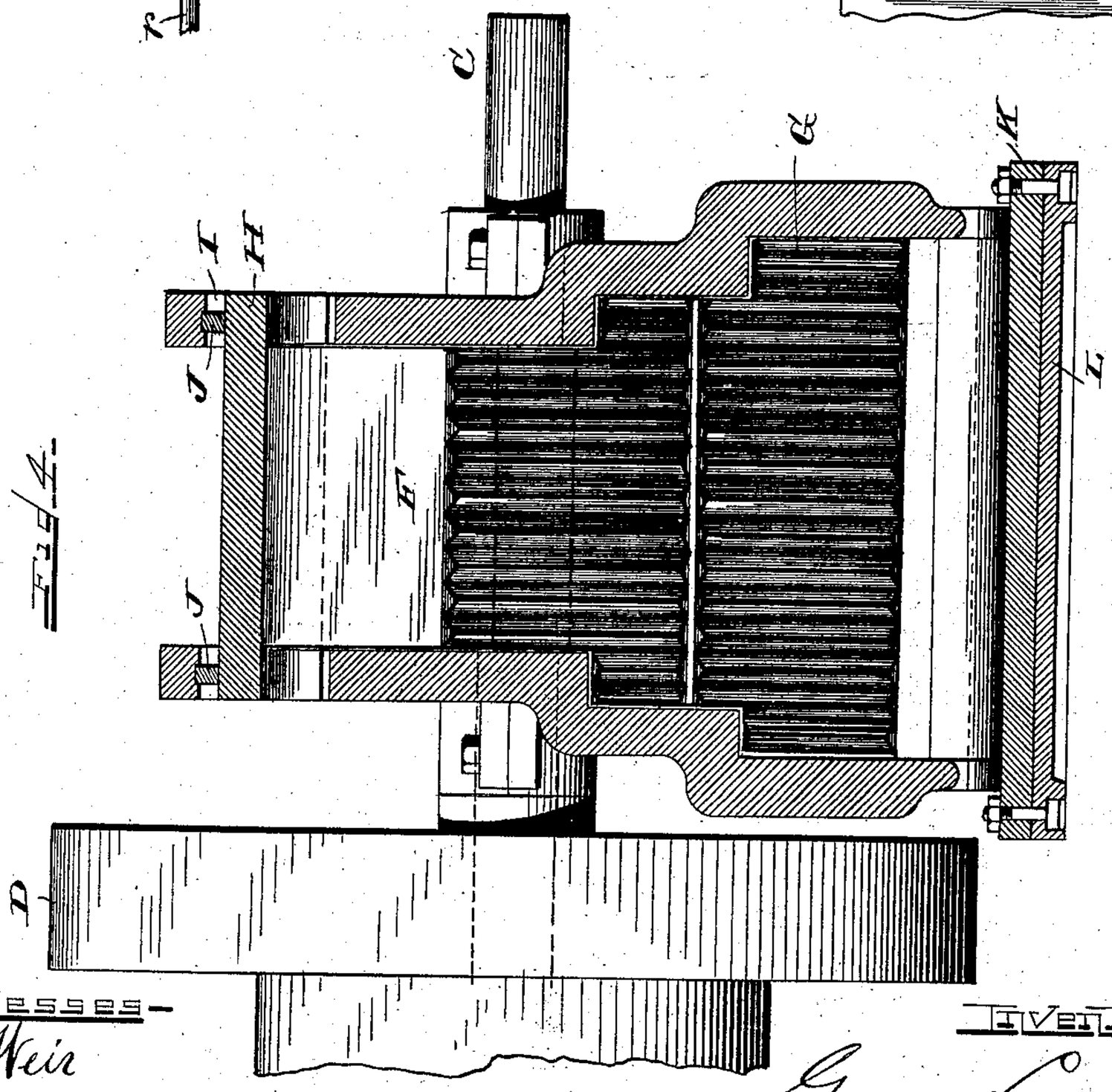
3 Sheets—Sheet 3.









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UNITED STATES PATENT OFFICE.

GEORGE LOWRY, OF TIFFIN, OHIO.

ROCK-BREAKER.

SPECIFICATION forming part of Letters Patent No. 693,288, dated February 11, 1902.

Application filed November 22, 1899. Serial No. 737,934. (No model.)

To all whom it may concern:

Be it known that I, GEORGE LOWRY, a subject of the Queen of Great Britain, residing at Tiffin, in the county of Seneca and State of Ohio, have invented certain new and useful Improvements in Rock-Breakers, of which the following is a specification.

This invention relates to improvements in that class of rock-breakers in which a stationary jaw is opposed by a sectional vibrating or rocking jaw disposed at an angle thereto, so as to gradually break and reduce the size of the rock as it passes between the jaws.

My present invention has for its primary objects, first, the provision of crushing-jaws of such a character that the rock as broken into smaller pieces is afforded ample room to spread, and thus present the larger broken pieces successively to the direct action of the crushing-jaws as they pass therebetween instead of compelling the stones to pack and crush against one another, as heretofore, whereby a more uniformly sized product is produced and the capacity of the machine is greatly increased; second, to insure the retraction of the vibrating sectional jaw after each thrust thereof by direct application of power thereto in the event of the failure of the usual retracting-springs to accomplish this purpose, whereby the operation of the machine is rendered smooth and certain and the danger resulting from skipping of strokes is entirely avoided; third, the dispensing with all pivots for the sectional vibrating jaw without losing the advantage of a toggle action as between the sections of said jaw, whereby the wear of the parts is automatically taken up, the use of expensive and fragile pivots is avoided, and the frequent repair or adjustment of the machine to take up wear is obviated, and, fourth, to provide adjustability for the vibrating or rocking sectional jaw in such manner that the stroke of the jaw and its relation to the fixed jaw, as well as to the other and operating parts of the machine, may be readily and quickly adjusted without dismantling the machine or disturbing any of the parts thereof. These and such other objects as may hereinafter appear are attained by the devices illustrated in the accompanying drawings, in which—

Figure 1 represents a vertical section through a stone-crusher of ordinary construction, showing my invention in one form embodied therein. Fig. 2 is a sectional elevation of a toggle-lever. Fig. 3 is a vertical section through a stone-breaker of novel construction and embodying my invention in its preferred form. Fig. 4 is a transverse vertical section on the line 4 4 of Fig. 1 looking in the direction indicated by the arrows, but showing the vibrating crushing-jaw in elevation. Fig. 5 is a detailed horizontal section through the lower end of the crushing-jaw. Fig. 6 is an enlarged detailed section of a portion of the retracting-spring chain, and Fig. 7 is a detailed plan view of the adjusting device for the vibrating crusher-jaw shown in Fig. 3.

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

The machines illustrated in Figs. 1 and 3, respectively, possess in common the following features—to wit, the side frames A, connected by the end bars B; the crank-shaft C, journaled in suitable boxes on the side frames and having a fly-wheel D on one end thereof, power being applied to said shaft in any suitable way; a fixed crushing-jaw E, rigidly secured by suitable means to one of the cross-bars B, and an opposing vibrating or rocking crusher-jaw consisting of the upper and lower sections F and G, respectively; means for connecting the crank-shaft with the vibrating jaw for operating the same; means for automatically retracting said jaw after each thrust thereof, and means for adjusting said jaw. In both of these machines the vibrating crusher-jaw has the same general shape and construction as that shown in Figs. 4 and 5, the stationary jaw in each machine having the same shape in face view as the combined sections of the vibrating jaw, excepting that I prefer to form the stationary jaw in one piece. The shape of these jaws is novel, so far as I am aware, and of great importance in a machine of this kind, because it presents a gradually-widening jaw to the rock as it is crushed and falls between the jaws toward the bottom or discharge end thereof. Each of the jaws is narrowest at its upper end, where the stones are largest when fed into the jaws. At its middle part each jaw is

somewhat wider than at its upper end, while at its lower end each jaw is widest, the number of gradations between the widest and narrowest parts of the jaw being immaterial and it also being immaterial whether the side edges of the jaws are in steps, as shown, or are formed obliquely, so long as the jaws have a generally-tapering shape from the bottom to the top thereof, so as to present a gradually-widening crushing-face from the top to the bottom of the jaw. The effect of so shaping the jaw is to greatly increase the capacity of the machine, as well as to promote uniformity in the size of the product, because as the stones are broken and fall between the jaws, although the space between the jaws gradually contracts toward the lower discharge ends of the jaws, the jaws gradually widen to compensate therefor and to allow the spread laterally of the broken stone, so that in its passage between the jaws most of the pieces of the stone are directly engaged or crushed between the jaws and pass out at the bottom all substantially of the same size, the various sizes at each stroke of the jaws arranging themselves by gravity at the proper point between the jaws for the next crushing action.

In machines as heretofore constructed as the stone is broken and requires more room the pieces are crowded against each other and of necessity are crushed against each other, crushing some of it very fine and leaving other parts comparatively coarse, while at the same time checking the operation of the machine and making the passage of the material through the machine very slow, thus producing a wide variation in the size of the crushed stone, as well as greatly reducing the capacity of the machine.

In both of the machines the sections of the jaws are supported and maintained in position without the employment of pivots. This is accomplished by providing a rib on the edge of one of the sections—say the upper edge of the lower section G—and a complementary groove along the opposing edge of the other section—say the upper section F—so that the upper section rests upon the lower section, and the parts may rock or vibrate on each other without separation. The upper edge of the upper section F fits within a yoke H, the ends of which project into openings I, formed in the side frames A of the machine, in which it is held against lateral movement by snugly fitting between the side walls of said opening, but is permitted to have movement therein in a line with the jaw by reason of the opening being of greater length than the height of the yoke. The yoke may be held down to its work in position to afford a bearing for the section F by any suitable means, a wedge J being shown in the drawings interposed between the back of said yoke and the top wall of the opening I. It will thus be seen that by a proper adjustment of the wedge the position of the yoke may be correspondingly adjusted so as to accommodate it to any change in the position of the section F due to wear of the parts or to adjustment of the lower section G of the vibrating jaw.

It will be noted that there is no pivot connection between the yoke and the side frames and the upper section F, but that the yoke simply affords a fulcrum therefor. This is also true of the lower section G of the vibrating jaw, the lower edge of which rests in a grooved bar K, adjustably mounted upon a cross-plate L, connecting the side frames of the machine. It will thus be seen that practically the entire weight of both sections of the vibrating jaw rests upon the adjustable foot-bar K, so that all wear between the sections of the jaw and between said sections and the bar and yoke will be automatically taken up, while by proper adjustment of the yoke H and the foot-bar K the relative positions of the sections of the vibrating jaw to each other, to the stationary jaw, and to the other parts of the machine can be quickly and easily changed to suit any conditions, to vary the size of the product, and to modify the crushing operation.

While the same in mechanical operation and result, the means for adjusting the foot-bar K in these machines differs slightly. In the machine shown in Fig. 1 the bar has projecting from the sides thereof, near each end, a threaded bolt L, (shown in dotted lines,) which passes through an ear M, (also shown by dotted lines,) on the side frames A and has nuts N thereon at opposite sides of said ear, by means of which the bar may be moved back and forth and locked in any adjusted position. The adjusting means shown in Fig. 3 is the preferred form, consisting of an extension O from the bar K in the direction of a companion plate P, rigidly secured to a cross-flange connecting the side frames A, and between the opposing edges of the extension and plate is located a transverse wedge Q, resting upon companion lips R and S on said extension and belt, a keeper T connecting the extension and the plate on the top side thereof, said keeper being rigidly bolted to the plate P at one side, while at its opposite side it has a bolt-and-slot connection U with the extension. Thus by driving the wedge Q in and out between the extension and plate the position of the foot-bar K will be correspondingly changed. To provide for the more prompt and certain adjustment and locking of the parts, I provide a companion wedge V, set reversely to the wedge Q and located between the foot-block K and a cross-flange W, connecting the side frames A, so that as the wedge Q is driven in the wedge V must be driven out, and vice versa, one wedge serving to move the foot-block in one direction and the other wedge serving to move it in the opposite direction, and both wedges together constituting a lock for the foot-block in any adjusted position.

The connection between the crank-shaft

and the vibrating jaw, and preferably the upper section of said jaw in each instance, is shown as of a different construction in each of the two machines, although mechanically the same and each producing the same general result—to wit, the vibration of the jaw. The construction shown in Fig. 1 is common and comprises the usual depending arm *a*, loosely journaled at one end upon the cranked portion of the shaft C and at its opposite end connected by toggle-levers *b* with the upper section F of the vibrating jaw and a stationary portion of the frame of the machine, respectively, such as the cross-bars B. With this it generally has an adjustable connection to modify the stroke imparted to the vibrating jaw, in a manner that will be readily understood, as shown in the drawings. One end of the toggle-levers *b* is pivotally connected with a block *c*, sliding in a suitable bearing in the cross-bar B, a wedge-block *d* being interposed between the block *c* and the bar, which is adjusted by a vertically-extended screw-threaded rod *e*, projecting from the upper edge thereof and having a nut *f* thereon, whereby the wedge may be raised and lowered, and thus force the block *c* toward or permit it to recede from the arm *a*, which adjustment of course changes the stroke imparted to the vibrating jaw.

In the construction shown in Fig. 3 the parts are similar in number and arrangement to those shown in Fig. 1, except that one of the toggle-levers—say the lever *p*—is pivotally connected directly with the arm *a*, while the other toggle-lever *q* has its opposing ends respectively socketed in the end of the toggle-lever *p* and the end bar B of the frame of the machine. I have not herein shown any means for adjusting the outer end of the toggle-lever *q*; but it will be understood that either the means shown in Fig. 1 or any other adjustable devices may be applied to this construction.

As a safety device for preventing breakage of the jaws or other parts of the machine when the rocks or some other substance is lodged between the jaws of so highly refractory a character that the jaws cannot crush the same I propose to so construct the rear toggle-lever *q* of Fig. 3, as well as the toggle-lever *b'* of the machine shown in Fig. 1, that it will give way under such abnormal pressure. To this end the toggle-lever is formed in two sections q' q^2, as shown in Figs. 2 and 3, having their inner ends overlapping either on a line parallel with or oblique to their upper and lower faces, and the opposing faces of said sections are provided with interlocking features, such as the transverse ribs or teeth q^3, the faces of which are disposed at an angle of about forty-five degrees. Through the sections q' and q^2 at about their center of length is passed a locking-bolt q^4, one section having a hole therein and the other section having a slot therein or both being slotted, so that when undue pressure is put upon the toggle-lever lengthwise the sections thereof will be caused to move both longitudinally and laterally upon each other, and thus snap the bolt q^4 or strip the nut therefrom. It is intended that the bolt *q* shall be of sufficient strength to sustain the maximum pressure which the jaws may apply before causing a breakage of any other part of the machine. It will also be noted that the depending arm *a* in the construction shown in Fig. 3 instead of standing vertically, as does the arm in Fig. 1, stands obliquely, as do the toggle-levers *p* and *q*, so that said levers when under full stroke stand squarely at right angles to the protruded position of the vibrating crusher-jaw, thus relieving the crank-shaft C of the lateral and downward strain which it suffers at this time when the parts are arranged as shown in Fig. 1, and as reliance must be placed in both instances upon the cap of the bearings both in the arm and in the side frames of the crank-shaft C a very material change is thus gained, and a more powerful and direct stroke of the crushing-jaw is likewise obtained.

I propose to insure the retraction of the vibrating jaw after each thrust by a positive pull in the event the retracting spring or springs fail to work. To this end I connect the ends, respectively, of a chain *r* with the vibrating jaw and a stationary portion of the machine-frame, such as one of the bars B. In the chain is located one or more sets of three links *s*, *t*, and *u*, preferably elongated, and connect the outer links of the trio with a retractile spring *v*, the ends of the springs being rigidly secured in any suitable manner to the outer links *s* and *t*, so that when the spring is fully contracted, as shown in Fig. 6, there is considerable play between the middle link *u* and the end links *s* and *t*; but when the spring is fully expanded, or nearly so, the separation of the end links *s* and *t* resulting therefrom will cause practically all of the play between said links and the middle link *u* to be taken up. In applying this spring-chain to a machine it is intended to be passed under a part directly actuated by the crank-shaft C, and the chain should be of such length that when the vibrating jaw is fully thrust out practically all of the slack will be taken out of the chain, including the slack between the links *s*, *t*, and *u*, and the spring *v* will be fully expanded. If now during the further operation of the machine the toggle is broken, so as to permit the retraction of the vibrating jaw, and the springs *v* fail to promptly retract the jaw, then the part directly actuated by the crank-shaft C will engage the chain between its ends, and as there is at this time practically no slack in the chain the power of such part will be directly applied to the spring-chain and through it to the jaw, forcibly retracting the same. In the construction shown in Fig. 1 the arm *a* is prolonged so as to have the knob *w* on the end thereof to engage the chain and perform this service,

while in the construction shown in Fig. 3 a projection x on the toggle-lever p performs this service. In both constructions, however, the operation and the result are identical.

As before stated, the construction shown in Fig. 3 in its entirety embodies the preferred form of my invention, the other constructions being illustrated simply to show the wide degree of modification which may be made in the various parts of the machine without departing from the spirit of my invention. A most important result of arranging the toggle of this construction at right angles to the crushing-jaws is that I am thus enabled to secure a double stroke or blow with one turn of the crank-shaft, all efforts in this direction having failed hitherto, owing to the toggle not being disposed at right angles to the crusher-jaw. By this preferred arrangement the motion and action of the jaws will be exactly the same whether the toggle is broken from a straight line and depressed or elevated at its center, the distance in each direction in which it will move and the stroke given to the jaws being exactly the same, which would not be the case with either of the constructions shown in Fig. 1 nor with the disposition of the parts shown in any prior machine so far as I am aware. This result also tends to greatly increase the capacity of the machine, which is practically doubled with the same number of revolutions of the crank-shaft, without in any wise affecting the strength or efficiency thereof in other respects.

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

1. In a rock-breaker, the combination with a stationary jaw, of a vibrating jaw comprising a lower section supported and fulcrumed at its lower end, an upper section supported by the lower section and having a bearing upon the upper edge of said lower section, said upper section also being provided with a bearing and fulcrum at its upper edge, and means for operating said vibrating jaw, substantially as described.

2. In a rock-breaker, the combination with a stationary jaw, of a sectional vibrating jaw comprising an upper section provided with a bearing upon said lower section, means for supporting said vibrating jaw, and means for operating the same, substantially as described.

3. In a rock-breaker, the combination with a stationary jaw, of a vibrating jaw composed of two sections placed edge to edge and one resting upon the other, both of said sections being adjustable, substantially as described.

4. In a rock-breaker, the combination with a stationary jaw, of a vibrating jaw composed of two sections placed edge to edge and one resting upon the other, the opposite edges of said sections having socket-bearings and means for adjusting said bearings, substantially as described.

5. In a rock-breaker, the combination with a stationary jaw, of a vibrating jaw composed of two sections placed edge to edge and one resting upon the other, an adjustable yoke provided with a socket for the reception of the upper edge of one of said sections and a foot-block provided with a socket for the reception of the lower edge of the other section, substantially as described.

6. In a rock-breaker, the combination with a stationary jaw, of a vibrating jaw composed of two sections placed edge to edge and one resting upon the other, an adjustable yoke provided with a socket to receive the upper edge of one of said sections, an adjustable foot-block provided with a socket to receive the lower edge of the other section and a wedge interposed between said block and a stationary portion of the machine, substantially as described.

7. In a rock-breaker, the combination with a stationary jaw, a vibrating jaw and means for operating the same, of a retractile spring-chain connected at its ends, respectively, with said jaw and a stationary portion of the machine, said chain when expanded being adapted to be engaged by the means operating the vibrating jaw, substantially as described.

8. In a rock-breaker, the combination with a stationary jaw, a vibrating jaw, a crank-shaft and means connecting said shaft with the vibrating jaw for operating the same, of a retractile spring secured at its ends respectively to said jaw and a stationary portion of the machine and means actuated by said shaft to engage said spring when extended, substantially as described.

9. In a rock-breaker, the combination with a stationary jaw, a sectional vibrating jaw, a crank-shaft and means connecting said shaft with the vibrating jaw for operating the same, of a retractile spring-chain connected at its ends respectively to one section of the vibrating jaw and a stationary portion of the frame of the machine and means operated by said shaft to engage the said chain when expanded, substantially as described.

10. In a rock-breaker, the combination with a stationary jaw, of a sectional vibrating jaw comprising upper and lower sections movably jointed together, said sectional jaw being fulcrumed at its upper and lower edges, a crank-shaft, an arm depending from said shaft and substantially parallel with the vibrating jaw, toggle-levers extending between a stationary portion of the machine and the vibrating jaw, substantially at right angles to said jaw, the end of one of said toggle-levers being provided with a bearing against said vibrating jaw at a point opposite the bearing between the upper and lower sections of said jaw, said toggle-levers being operated by said arm to operate said vibrating jaw, substantially as described.

11. In a rock-breaker, the combination with a stationary jaw, of a vibrating jaw, a crank-shaft, an arm depending from said shaft substantially parallel with the vibrating jaw, tog-

gle-levers extending between a stationary portion of the machine and the vibrating jaw substantially at right angles to said jaw, said arm being pivotally connected with one of said toggle-levers and said levers being socketed at their inner ends in one another and at their outer ends being respectively socketed in the vibrating jaw and a stationary portion of the machine, substantially as described.

12. In a rock-breaker, the combination with a stationary jaw, of a sectional vibrating jaw comprising upper and lower sections movably jointed together, rocker-bearings for the upper and lower horizontal edges of said jaw, and means for operating said vibrating jaw by articulating the upper and lower sections thereof upon each other, substantially as described.

13. In a rock-breaker, the combination with a stationary jaw, of a sectional vibrating jaw comprising upper and lower sections movably jointed together, of supports for the upper and lower ends of said jaw, bearings for said vibrating jaw against said supports, and means for operating said vibrating jaw, substantially as described.

14. In a rock-breaker, the combination with a stationary jaw, of a sectional vibrating jaw comprising upper and lower sections movably jointed together, adjustable supports for the upper and lower ends of said vibrating jaw, bearings for the ends of said vibrating jaw against said supports, and means for operating said vibrating jaw, substantially as described.

15. In a rock-breaker, the combination with a stationary jaw, of a vibrating jaw comprising a lower section and an upper section, a bearing between the adjacent edges of said upper and lower sections, a support for said lower section, a bearing for the upper part of said upper section, and means for operating said vibrating jaw, substantially as described.

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