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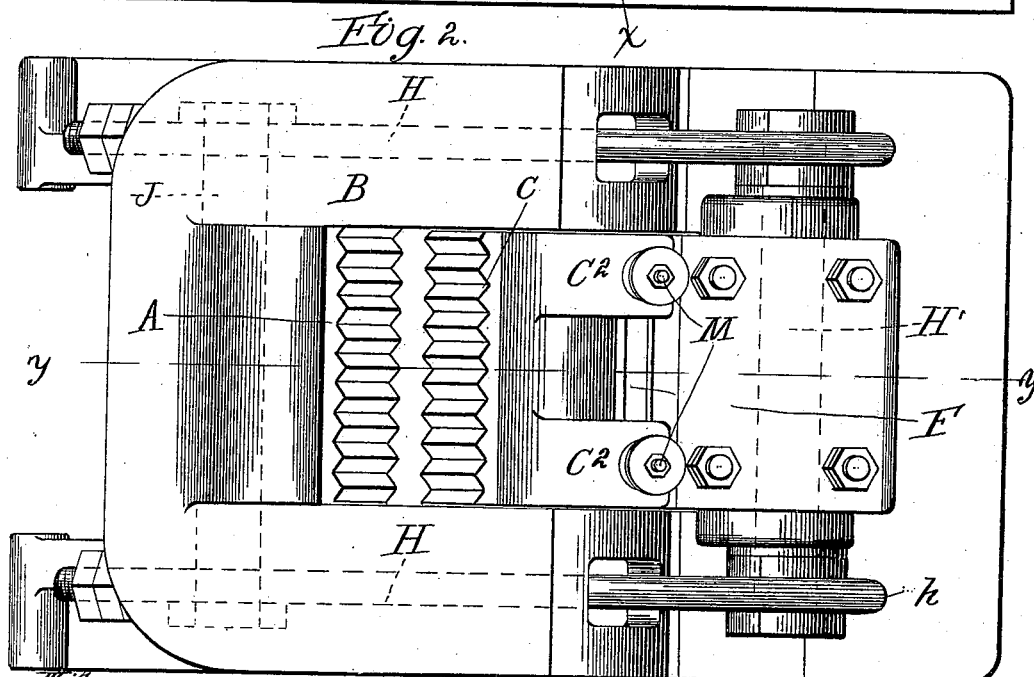
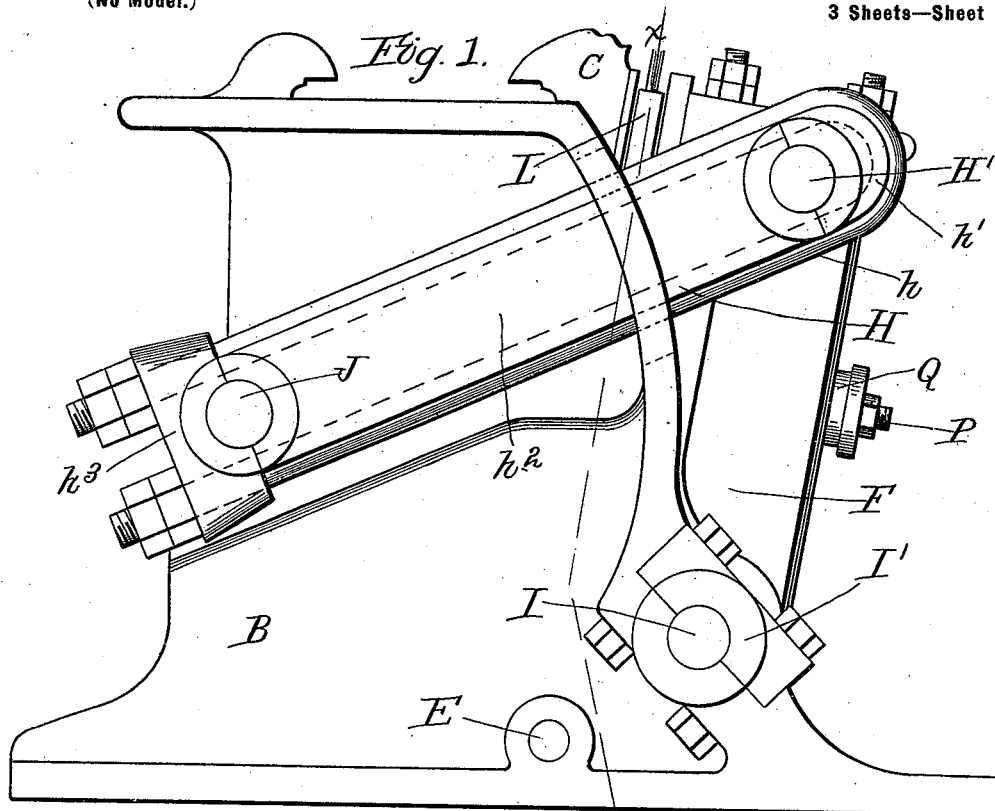
Patented Mar. 20, 1900.

M. G. BUNNELL.  
CRUSHING MACHINE.

(Application filed June 21, 1897.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses:  
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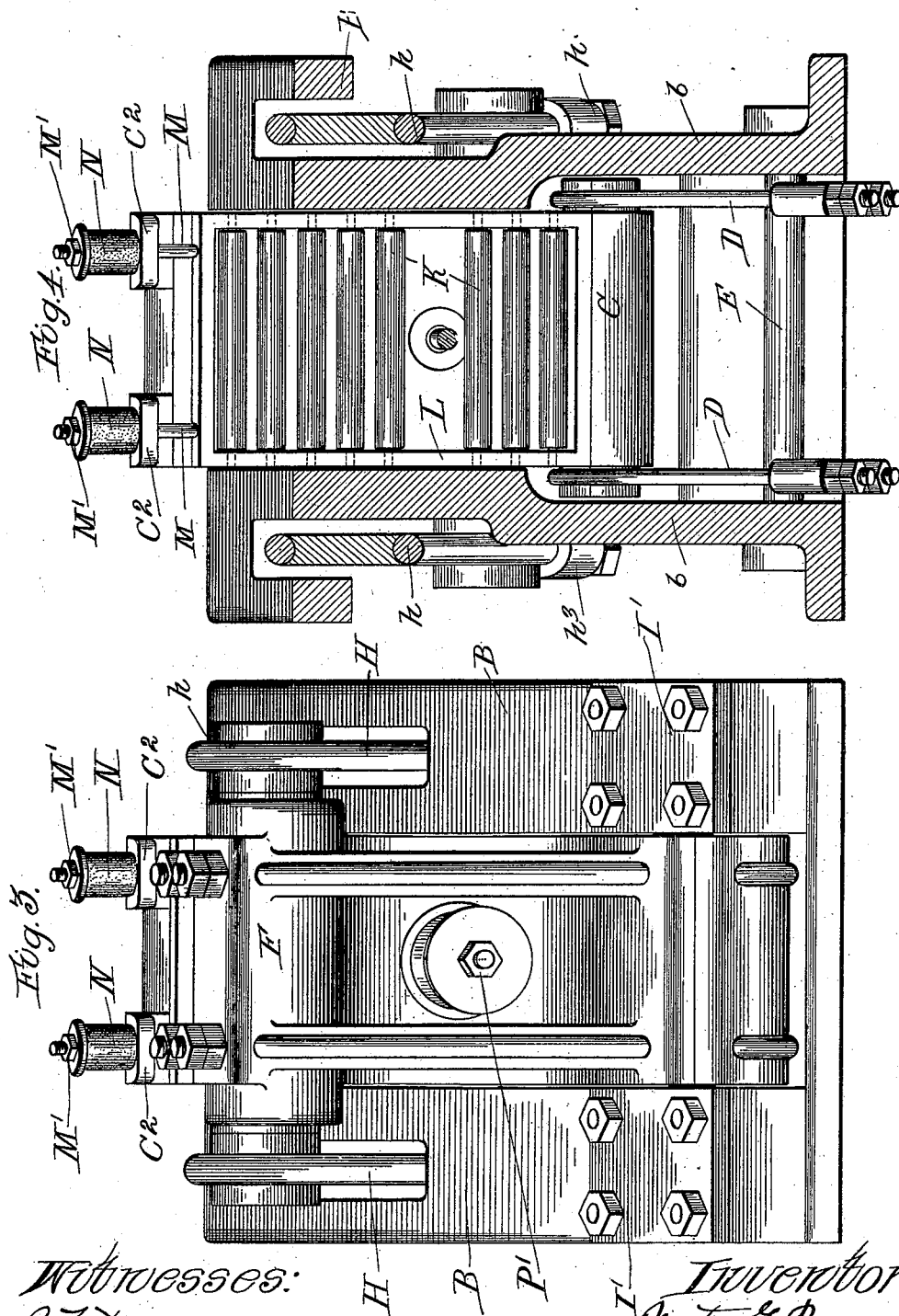
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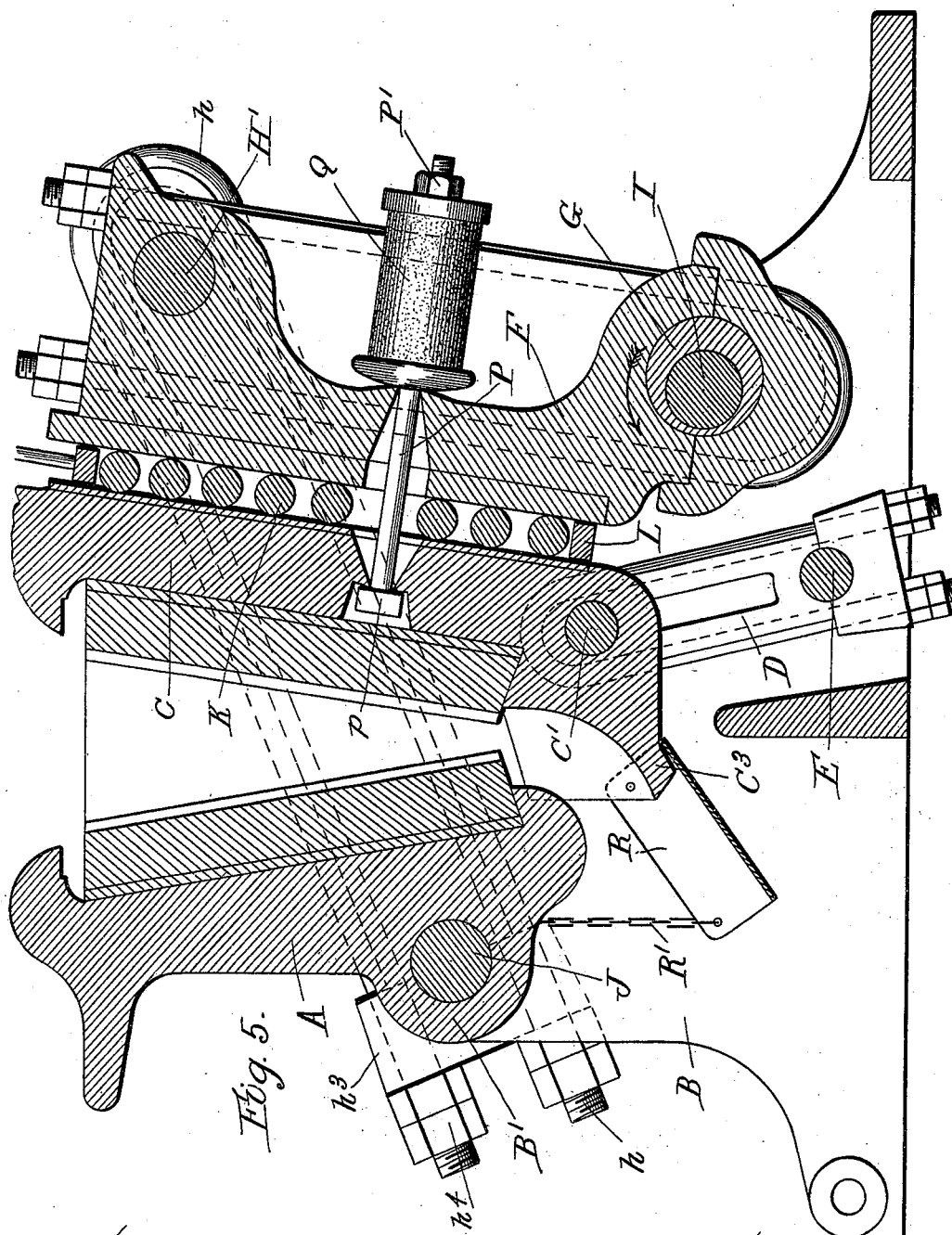


Fig. 5.

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# UNITED STATES PATENT OFFICE.

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## CRUSHING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 645,586, dated March 20, 1900.

Application filed June 21, 1897. Serial No. 641,587. (No model.)

*To all whom it may concern:*

Be it known that I, MORTON G. BUNNELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Crushing-Machines, of which the following is a specification.

My invention relates to machines for crushing ore, rock, and the like, and comprises various matters of improvement upon crushing-machines in which the material to be crushed is subject to the action of a movable crushing-jaw, which has a compound motion involving a forward-and-back movement, an up-and-down movement, and a vibratory movement, my said invention being also more particularly an improvement upon crushing-machines in which the movable jaw is operated by a pitman.

Prominent objects of my invention are to avoid clogging at the bottom of the crushing-hopper; to facilitate and increase the crushing action at the upper portion of the hopper; to perform the work rapidly and effectively; to secure greater motion at the lower than at the upper portion of the movable crushing-jaw, and thereby increase the crushing capacity; to further facilitate and increase the crushing by securing almost as much motion at the center as at the upper end portion of the movable crushing-jaw; to place the fly-wheels out of the way; to secure at the lower end portion of the movable crushing-jaw a motion corresponding with that of the eccentric and to relatively position the latter, whereby more direct and stronger action is attained without injury to the driving-shaft; to avoid tensional strain on the main frame or casting and to subject the same in lieu thereof to compression, whereby breakage is avoided; to effectively back and control the movable crushing-jaw; to dispense with toggle members heretofore commonly employed in crushing-machines; to relatively arrange the movable crushing-jaw and pitman in a way to materially shorten up the machine, and thereby render the same compact and effect a substantial saving in cost of the main frame and other component parts of the machine; to provide a simple, quick-acting, powerful, and highly-efficient construction of crushing-ma-

chine, and to provide certain novel and improved matters of detail serving to generally increase the efficiency of crushing-machines.

To the attainment of the foregoing and other useful ends, my invention consists in matters hereinafter set forth.

In the accompanying drawings, Figure 1 is a side elevation of a crusher embodying my invention and having an upper portion broken away for convenience of illustration. Fig. 2 is a plan view of the same. Fig. 3 is a rear elevation. Fig. 4 is an irregular section taken on line *x x* in Fig. 1; and Fig. 5 is a vertical section taken on line *y y* in Fig. 2, on an enlarged scale.

The jaw A of the hopper shown in the drawings rises at the forward end of the frame B and, if stationary, can be rigid with the latter, and in such case it can be conveniently formed integral therewith.

The movable crushing-jaw C of the crushing-hopper is arranged opposite the jaw A, which latter is preferably stationary. The jaw C, herein termed the "movable" crushing-jaw, is supported in such manner that when it advances in a direction to contract the discharge-opening of the hopper (formed by the space between the jaws C and A) the said jaw C will have a moderate downward movement for the purpose of facilitating the feed through and from the hopper. This movement is desirably attained by connecting or supporting the lower end of the jaw C upon a shifting axis arranged to shift along an incline or inclined path, and while various devices heretofore proposed for such purpose can be employed I prefer, as a matter of special improvement, to hinge or pivot the lower end of the movable jaw to or upon a vibratory arm or support which is hinged or pivoted to swing about an axis positioned below its connection with the jaw. I also prefer to construct such vibratory arm or support of a couple of links D, suitably connected together. These swinging links D D are arranged below and at opposite sides of the movable jaw C and have their upper ends pivotally connected with the lower end of the latter and their lower ends pivotally supported at points slightly in rear of the points of connection of their upper ends with the jaw C. In this way, while

the movable jaw C can be given a bodily forward-and-back movement toward and away from the stationary jaw A, so as to crush the material in the crushing-hopper, it will have during such bodily movement toward and away from the stationary jaw a moderate extent of fall and rise, and thereby insure a feeding action through the hopper, particularly at the discharge end of the same.

As a simple arrangement for connecting together the swinging links D D, their upper ends are fitted upon the ends of a pivot-rod C', which extends through the lower end of the movable jaw C, and their lower ends are arranged upon a pivot-rod E, which extends across the frame B of the machine near its lower edge and is mounted in suitable bearings formed in the frame sides *b b*.

The movable jaw C is backed and operated by a movable abutment, preferably consisting of a pitman F, which is in turn actuated by an eccentric or like mechanical movement. The movable crushing-jaw and the pitman are tied or connected together in a way to maintain a condition of parallelism between them, whereby during operation the said jaw and pitman will have a like synchronous vibratory movement. The connection between the jaw C and pitman is also arranged to permit a relative sliding or longitudinal shifting movement between such two members—that is to say, there is a relative shift or sliding movement lengthwise of the pitman—and while for the broader purposes of my invention various mechanical sliding connections between the jaw and pitman can be employed I prefer to interpose antifriction rolls or balls between the opposing sides of the movable jaw and the pitman. As a preferred arrangement and matter of special improvement the lower end of the pitman F is arranged upon an eccentric G, mounted on a rotary driving-shaft I, which latter extends across the lower rear portion of the frame of the machine and is mounted in suitable bearings I', formed in the lower rear portion of the same, Fig. 1. In this connection it will be also observed that the usual fly-wheels on said shaft (not herein shown) will be low down and out of the way. The upper end of the pitman is tied to an axis positioned at any suitable point—for example, at a point forward of the movable jaw—and to such end the pitman is shown as being pivotally connected with the rear ends of a couple of swinging tension-links H H, which are conveniently, but not necessarily, arranged outside of the frame of the machine, as best shown in Figs. 1 and 4, and extended forwardly and downwardly from their points of connection with the pitman. The forward ends of these links are conveniently hung upon a transversely-arranged pivot-rod J, which has its bearings in the main frame of the machine. In this way the rotation of the eccentric G in the direction indicated by the arrow in Fig. 5 elevates and lowers the pitman and also swings its lower end forward

and backward, its upper end being caused to move forward by the tension-links H H during its rise and also caused to recede during its descent by said links H H. This movement of the pitman causes a substantially like bodily forward and backward and vibratory movement of the movable jaw C, the lower end of the jaw being reciprocated through a distance substantially equal to the throw of the eccentric G and the middle and upper portions of the jaw being reciprocated through distances substantially equal to one another, for it will be observed that with the foregoing novel arrangement the lines of relative longitudinal shift or travel of the jaw and pitman are at all times parallel and the same distance apart and that the forward surface of the pitman slides up and down the flat rear surface of the movable jaw. Thus while the upper and middle portions of the movable crushing-jaw are given a nearly-equal extent of forward-and-back movement to insure a proper crushing action the lower end of the same will have a greater extent of forward-and-back movement, and thereby effectively prevent clogging in the crushing-hopper and permit, by reason of its excess of movement relatively to that of its middle and upper end portions, the work of crushing the stone or ore to be performed more freely, rapidly, and effectively. This bodily forward-and-backward movement of the movable crushing-jaw is accompanied by a vibratory motion about its longitudinal middle and also by a slight bodily up-and-down movement, both of which operate to feed the material downward in the crushing-hopper.

The tension-links H H are conveniently connected pivotally to the pitman F by means of a pivot-rod H' and to the frame of the machine by means of the rod J, which is extended across the forward end of the machine, as shown in dotted lines in Fig. 2, and which has its middle portion confined in and supported by a suitable bearing B', formed on the frame B at the base of the stationary jaw A. When thus arranged, the links H H are easy of access and at the same time are so situated as to be incapable of interfering with the links D D for supporting the movable jaw. Said links are desirably each constructed of a long rod *h*, bent at its middle so as to form in effect two parallel rods having one pair of ends connected together; a couple of blocks *h'* and *h''*, fitted between the parallel portions of the rod *h* and respectively extending from its bent portion to the rod H' and from the latter to the bolt J, and an end piece *h'''* adapted to fit upon the ends of the rod *h* and against the bolt J and to be held in place by suitable set-nuts *h''''*. Any other construction of link can, however, be employed.

As a simple and effective and at the same time almost frictionless form of sliding connection between the movable jaw C and the pitman F a set of antifriction-rolls K are interposed and work between the flat opposing

surfaces forming, respectively, the rear side of the jaw and the forward side of the pitman and which opposing surfaces, it will be observed, are at all times parallel and the same distance apart. These rolls K are desirably mounted in suitable bearings formed in the sides of a rectangular frame L, which latter is arranged between the adjacent faces of the jaw and pitman and suspended by a couple of rods M M, attached to its upper end. In order to permit an extent of movement on the part of the frame L sufficient to allow the proper action of the rolls K, the suspending-rods M M are respectively extended through spring or elastic cushions N N, which are confined between supporting-shoulders C<sup>2</sup> C<sup>2</sup>, formed at the upper end of the movable jaw C, and nuts M' M' on the upper ends of the rods M M, and which when thus arranged are adapted to permit a suitable extent of rise and fall on the part of the frame L.

The movable jaw C and pitman F can be effectively held together, so as to maintain a condition of parallelism between them and at the same time allowed to shift or slide the one upon the other to an extent sufficient to allow the proper rise and fall of the pitman, by means of a tie-rod P, having its head *p* confined within a recess formed in the jaw C and having its body portion extended to the rear through suitable openings or apertures formed in the jaw and pitman and also through a spring or elastic cushion Q, which is confined between the rear face of the pitman and through a nut P' on the rear end of said rod P.

The lower end of the movable jaw C is shown formed with a forwardly-extending portion C<sup>3</sup>, whose forward edge is arranged over a chute or pan R, which latter is conveniently suspended by a chain R' and is adapted to carry the crushed material forward and away from the operating mechanism, which is arranged at the rear of the machine.

With further reference to the parts or members herein designated as the "movable" crushing-jaw C and the pitman F it will be seen that said two members are combined to broadly constitute a combined pitman and crushing-jaw, or, in other words, a pitman provided with a crushing-face, and that as a matter of further improvement the pitman is thus provided with a crushing-face which is adapted to slide relatively to the pitman; also, that the movement of such crushing-face, irrespective of its independent sliding action, is at its lower end portion in correspondence with the movement of the eccentric; also, that by arranging the eccentric at the lower end of the pitman a more direct and powerful action is secured. Broadly considered, therefore, I provide the pitman with a sliding crushing-face which serves as a jaw, the lines of relative longitudinal shift or travel of the jaw and pitman being at all times parallel

and the same distance apart, while more specifically considered I provide a crushing-jaw which is suitably backed by a pitman or like movable abutment with which the crushing-jaw has a sliding or like connection and which sliding connection serves to keep the opposing surfaces of the jaw and pitman at all times parallel and the same distance apart; also, that, broadly considered, I provide between the jaw and the movable abutment or pitman provided for operating the same a set of antifriction rolls or balls.

What I claim as my invention is—

1. A crushing-machine comprising a movable crushing-jaw; a reciprocating abutment backing and operating the said jaw; and a set of antifriction-rolls or the like arranged between the jaw and the said abutment.

2. A crushing-machine comprising a movable crushing-jaw; a pitman immediately backing and operating the jaw; and means for operating the pitman and thereby causing the same to slide up and down the flat rear surface of the jaw.

3. A crushing-machine comprising a movable crushing-jaw; a pitman backing and operating the jaw; means for operating the pitman and thereby causing the latter's flat forward surface to slide up and down the flat rear surface of the jaw; and one or more antifriction-rolls arranged between the jaw and pitman.

4. A crushing-machine comprising a suitably-operated pitman provided with a face which slides relatively to the pitman and which is adapted to serve as one of the crushing-jaws of a crushing-hopper.

5. A crushing-machine comprising a suitably-operated pitman provided with a face which slides relatively to the pitman and which is adapted to serve as one of the jaws of a crushing-hopper, and one or more antifriction devices arranged between the pitman and its sliding face.

6. In a crushing-machine, a crushing-hopper comprising a suitably-supported and movable crushing-jaw; a suitably-actuated pitman backing and operating the jaw; and one or more antifriction rolls or balls arranged between the jaw and pitman, whereby a relative sliding movement will occur between the jaw and pitman when the latter is actuated for the purpose of operating the former.

7. In a crushing-machine, a crushing-hopper comprising a movable crushing-jaw; a pitman backing and operating the jaw; antifriction rolls or balls arranged between the jaw and pitman, whereby a relative sliding movement will occur between the said jaw and pitman; and means for maintaining the jaw and pitman in a condition of parallelism.

8. A crushing-machine comprising a pitman having a sliding crushing-face arranged to provide one of the crushing-jaws of a crushing-hopper, the pitman and sliding crushing-face being connected to permit a relative sliding or longitudinal shifting movement dur-

ing the operation of the machine, and the lines of relative longitudinal shift or travel of the pitman and its sliding face being at all times parallel and the same distance apart.

5 9. In a crushing-machine, a pitman operated by an eccentric or the like and provided with a sliding crushing-face arranged to form one of the jaws of a crushing-hopper, the pitman being also tied to an axis positioned to  
10 cause its crushing-face to have a forward and back and vibratory movement, and the lines of relative longitudinal shift or travel of the pitman and its sliding face being at all times parallel and the same distance apart.

15 10. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw, and a pitman immediately backing and operating the jaw and having therewith a sliding connection adapted to permit a relative  
20 sliding or longitudinal shifting movement between it and the jaw, the opposing or sliding surfaces of the jaw and pitman being at all times substantially parallel and the same distance apart.

25 11. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw; a pitman immediately backing and operating the jaw and having therewith a sliding connection adapted to permit a relative sliding  
30 or longitudinal shifting movement between it and the jaw; and means for maintaining the jaw and pitman in a condition of parallelism, the two members being also maintained at a fixed distance apart.

35 12. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw; a pitman immediately backing and operating the jaw and having therewith a sliding connection adapted to permit a relative sliding  
40 or longitudinal shifting movement between it and the jaw, the two members being maintained in a condition of parallelism and also at a fixed distance apart; and an eccentric operating the lower end of the pitman.

45 13. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw; a pitman immediately backing and operating the jaw and having therewith a sliding connection adapted to permit a relative sliding  
50 or longitudinal shifting movement between it and the jaw, the lines of relative longitudinal shift or travel of the jaw and pitman being at all times substantially parallel and the same distance apart; an eccentric operating one end of the pitman; and a swinging  
55 connection between the other end of the pitman and the frame of the machine, said swinging connection being pivoted to the frame at a point forward of the said movable jaw.

60 14. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw; a pitman immediately backing and operating the jaw and having therewith a sliding connection adapted to permit a relative sliding  
65 or longitudinal shifting movement between it and the jaw, the lines of relative longitudinal shift or travel of the two members

being, by reason of the sliding connection, at all times substantially parallel and the same distance apart; an eccentric supporting  
70 the pitman and operating its lower end, and tension-links having their rear ends pivotally connected with the upper end of the pitman and their forward ends pivotally supported at points forward of the movable crushing-  
75 jaw.

15. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw, and a vertically-disposed pitman operating the jaw and having a sliding connection there-  
80 with so as to impart to the said jaw a forward-and-backward movement substantially in synchronism with the forward-and-backward motion of the pitman, and one or more antifriction-rolls interposed between the said  
85 jaw and pitman.

16. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw; and a pitman-and-eccentric arrangement for operating the jaw, the eccentric being ar-  
90 ranged to operate the lower end of the pitman, and the pitman having a sliding connection with the jaw so as to impart to the latter's lower end an extent of movement substantially equal to the throw of the eccentric,  
95 the flat forward surface of the pitman forming a backing for the flat rear surface of the jaw.

17. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw,  
100 a pitman immediately backing the jaw and having a sliding connection therewith, and an axis-link connected with the lower end of the jaw and arranged below the same in a position to cause the jaw to move bodily down-  
105 ward as it advances, and at the same time to allow its upper end to advance and recede independently of its lower end; and the said pitman and jaw having by such arrangement like and simultaneous vibratory and bodily  
110 forward-and-back movements, but having unlike or dissimilar up-and-down movements.

18. In a crushing-machine, the crushing-hopper comprising a crushing-jaw arranged for a bodily forward-and-back and vibratory  
115 movement; swinging supporting-links therefor having their upper ends pivotally connected with the lower end of the jaw and their lower ends pivotally supported at stationary points to the rear of their points of  
120 connection with the jaw for the purpose of causing the latter to move bodily downward as it advances and at the same time to allow its upper end to advance and recede independently of its lower end; and means for  
125 operating the jaw.

19. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw; swinging supporting-links having their upper ends pivotally connected with the lower  
130 end of the movable jaw, and their lower ends pivotally supported below the jaw and to the rear of their points of connection therewith; a pitman backing and operating the jaw and

having a sliding connection therewith; an eccentric operating the lower end of the pitman; and tension-links having their rear ends pivotally connected with the upper end of the pitman, and their forward ends pivotally supported at points forward of the movable crushing-jaw.

20. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw supported by suitable connection with the crusher frame or body; a pitman backing and operating the jaw; antifriction-rolls arranged between the jaw and pitman; and a holder carrying the antifriction-rolls and having a spring or elastic connection with the movable jaw, as set forth.

21. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw suitably supported from the crusher frame or body; a pitman backing and operating the jaw, and having a sliding connection therewith; and a tie-rod connecting the jaw and pitman and having a spring or elastic connection with the latter, as set forth.

22. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw

having a shifting connection with the crusher frame or body; a pitman backing and operating the jaw and having a sliding connection with the same; a tie-rod connecting the jaw and pitman; and an elastic cushion confined between the rear of the pitman and a nut on the tie-rod.

23. In a crushing-machine, the crushing-hopper comprising a movable crushing-jaw; swinging supporting-links having their upper ends pivotally connected with the lower end of the jaw, and their lower ends pivotally supported below the same and to the rear of their upper ends; a pitman backing and operating the jaw; antifriction rolls or balls arranged between the jaw and pitman; an eccentric applied to the lower end of the pitman; and tension-links having their rear ends pivotally connected with the upper end of the pitman and their forward ends pivotally connected with the frame at points forward of the movable crushing-jaw.

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