June 6, 1939. E. A. HENRY 2,161,573

CRUSHING MACHINE

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Fig. 2.

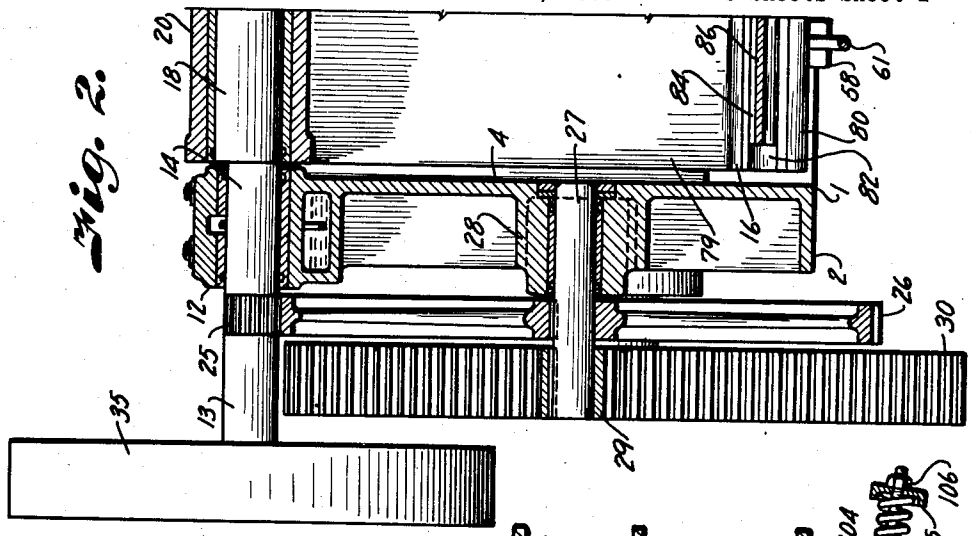
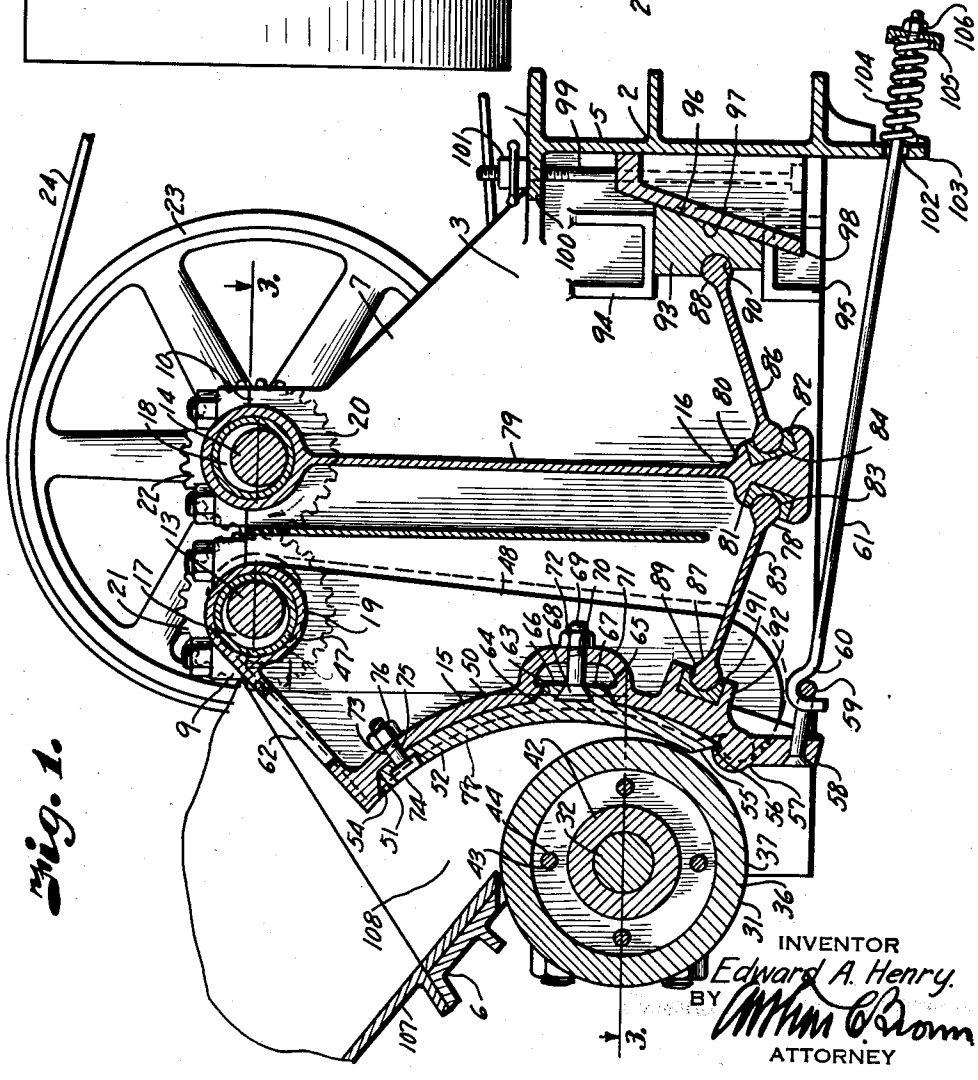


Fig. 1.



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CRUSHING MACHINE

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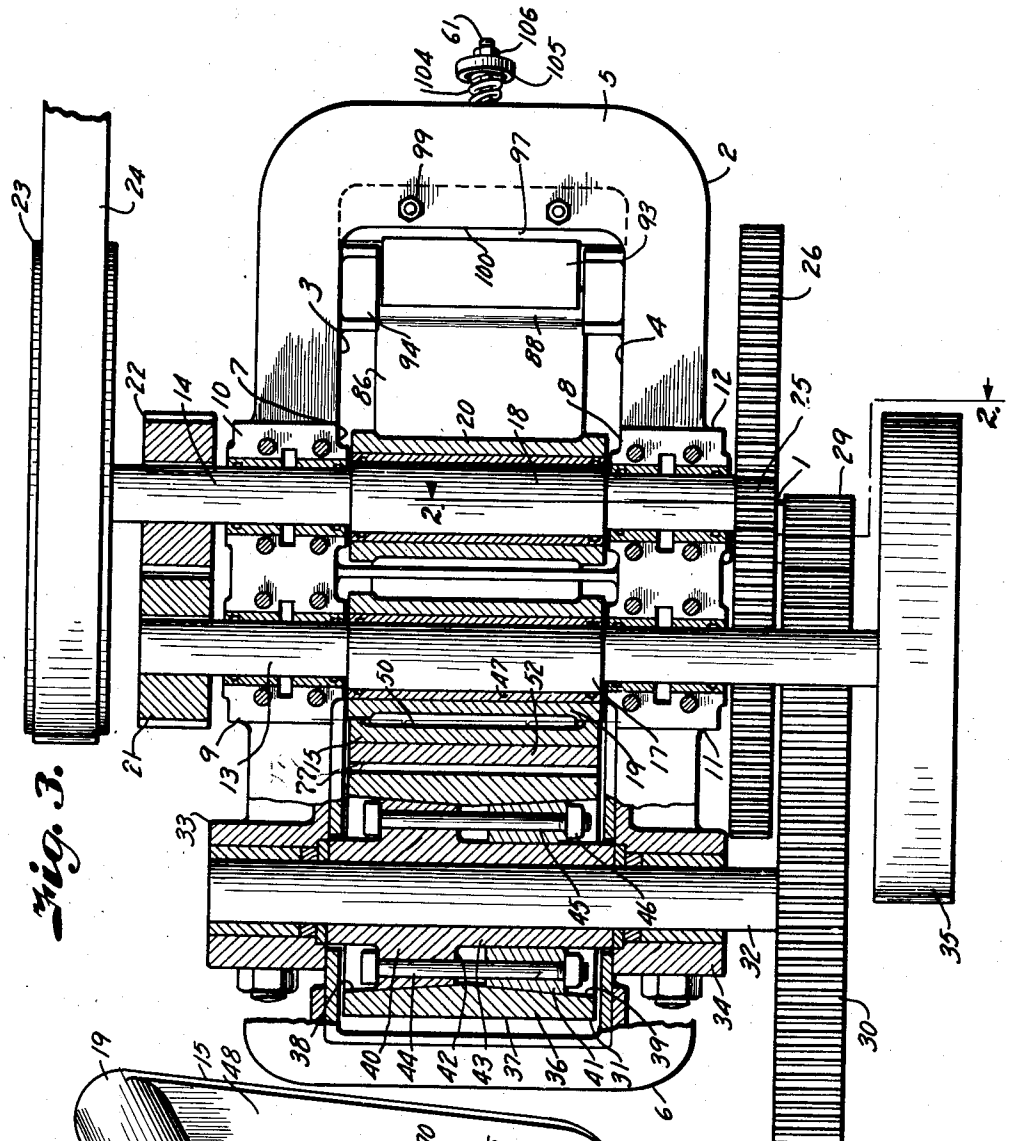

Fig. 3.

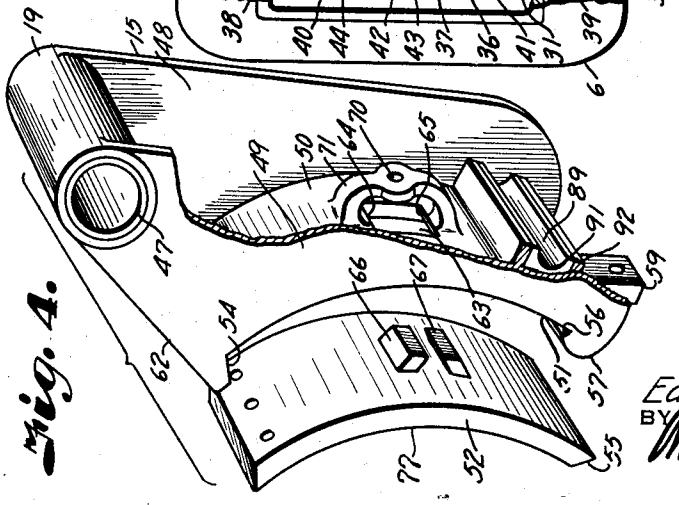

Fig. 4.

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CRUSHING MACHINE

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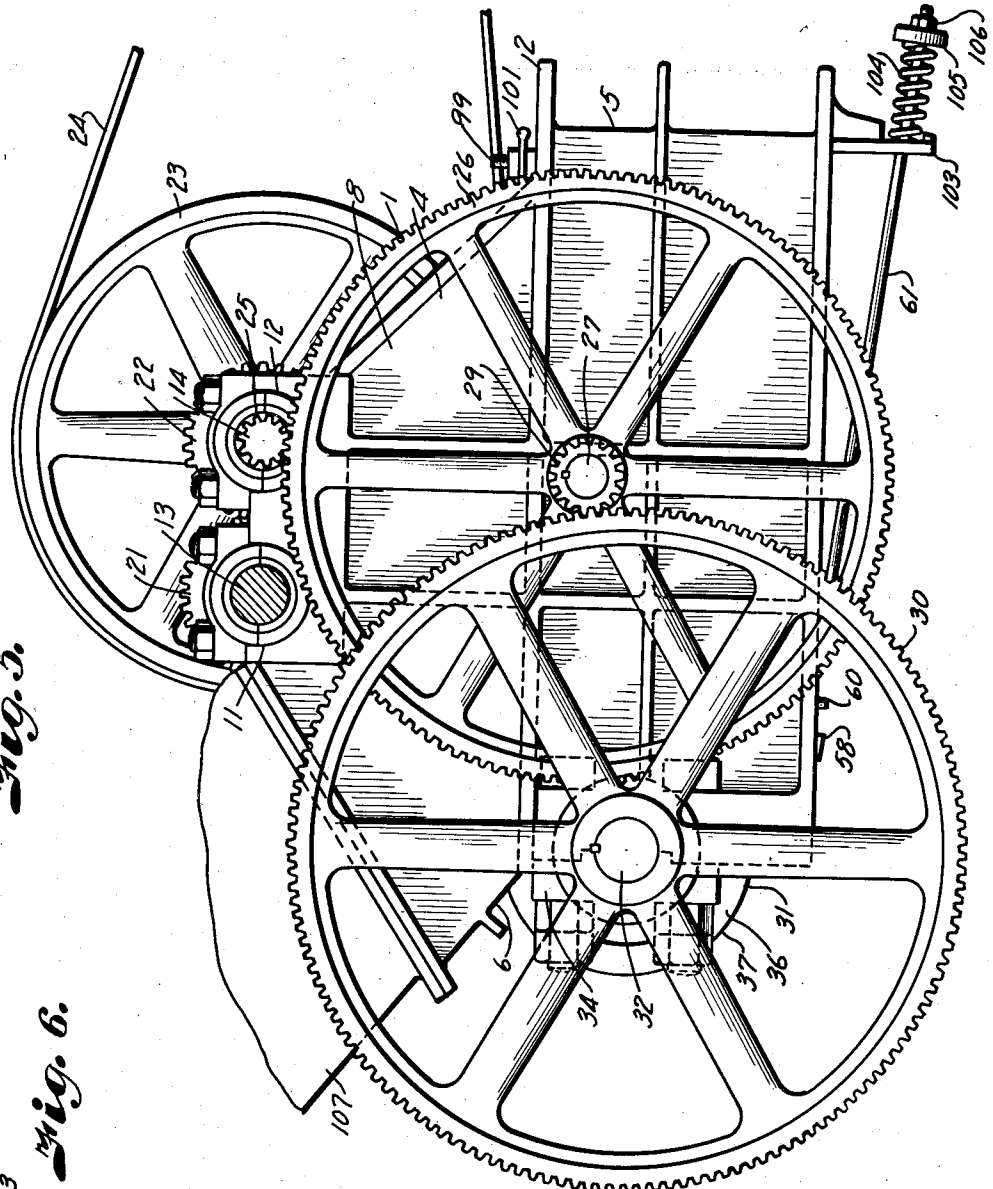

Fig. 5.

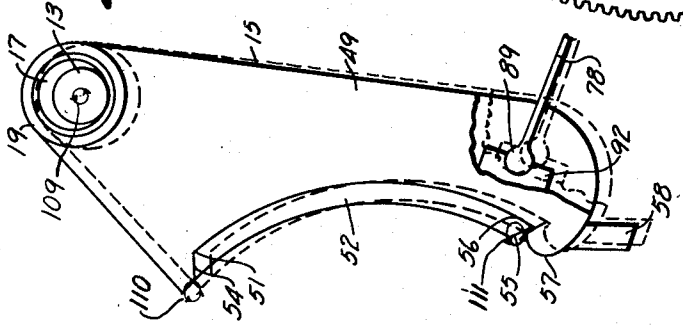

Fig. 6.

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Patented June 6, 1939 2,161,573

UNITED STATES PATENT OFFICE

2,161,573

CRUSHING MACHINE

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Application October 21, 1936, Serial No. 106,794

4 Claims. (Cl. 83—53)

This invention relates to rock crushing machines and particularly those of the roll and jaw type.

The principal object of this invention is to produce a machine which will give a crushed product of more uniform size and increase the amount of work heretofore done by machines of equal capacity.

A more uniformly sized product is secured by providing two curved face members so placed that they prevent free falling of the pieces of material and cause them to travel by steps along a curved path in which movement they are struck several times by the crushing member. Slabs or flat pieces of the material are thus prevented from passing between the crushing members without being broken. This action is made possible by synchronizing the movements of cylindrical and concave crushing members, as explained later.

Greater capacity and quick discharge of crushed material from the machine are assured by combining an elliptical movement of a concave faced crushing member with a rotary movement of a cylindrical member so that the faces of both members, during the working stroke, move downwardly toward the discharge at approximately the same speed. At the termination of the downward or working stroke, the action of the concave faced member causes its lower end to open more rapidly than the upper, permitting prompt discharge of finely crushed material while coarser pieces move downwardly only slightly.

The movements which effect these results are: (1) any given point on the upper end of the concave crushing member moves in a substantially circular path. (2) The path of any given point at the lower end of the concaved face crushing member is an ellipse whose major axis is greater but whose minor axis is the same as that of a point at the upper end of the crushing member.

These movements, combined with a rotating crushing face moving at a fixed speed, produce a more effective crushing action than is obtained by the single movement embodied in other types of crushers.

It is also an important object of the invention to provide a crusher of this character having greater capacity and less tendency to choke while operating on soft or sticky materials.

Other object of the invention are to prevent slipage between the jaw and its cooperative crushing roller; to provide planetary movements of the upper and lower ends of the jaw; to effect simultaneous approach of the upper end of the jaw with the lower end of the jaw relative to the complementary crushing surface; and to effect a more rapid receding movement of the lower end of the jaw than that at the upper end of the jaw.

Other important objects of the invention are to provide a simple and efficient adjustment of the concave jaw relative to its complementary crushing roller to thereby regulate the size of the desired product.

It is also an important object of the present invention to provide an improved mounting of the concave jaw in its suspending frame.

In accomplishing these and other objects of the invention as hereinafter pointed out I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a section through the longitudinal center of a crushing machine constructed in accordance with the present invention.

Fig. 2 is a vertical cross section through one side of the machine on the line 2—2, Fig. 3.

Fig. 3 is a horizontal section through the machine on the line 3—3, Fig. 1.

Fig. 4 is a detail perspective view of the jaw and jaw supporting frame, part of the frame being broken away to better illustrate its construction.

Fig. 5 is a side elevational view of the machine particularly illustrating the drive gearing for the crushing roller.

Fig. 6 is a diagrammatic side view of the crushing jaw, particularly illustrating the movement thereof.

Referring more in detail to the drawings:

1 designates a crushing machine constructed in accordance with the present invention, and which includes a main frame 2 having spaced parallel sides 3 and 4 connected at their rear ends by an end member 5 and at their forward ends by a cross bar 6. The sides of the frame include upper extensions 7 and 8 supporting journal boxes 9, 10 and 11, 12 for rotatably mounting transverse shafts 13 and 14 to suspend a jaw frame 15 and a pitman 16, respectively.

Formed on the shafts intermediate the journal boxes 9, 11 and 10, 12 are eccentrics 17 and 18 mounting the hubs 19 and 20 of the jaw frame and pitman, respectively. The shafts 13 and 14 project from the journal boxes 9 and 10 to mount intermeshing gears 21 and 22 whereby the shafts are driven in timed relation and to maintain the

throw of the eccentric 17 at a substantially 90° angle to the throw of the eccentric 18.

The shaft 14 projects beyond the terminal end of the shaft 13 to mount a drive pulley 23 that is operable by a belt 24 actuated from a suitable prime mover (not shown). The opposite end of the shaft 14 projects through the bearing 12 to mount a pinion gear 25 meshing with a speed reducing gear 26 that is keyed to a stub shaft 27 rotatably mounted in a bearing 28 carried by the side 4 of the frame at a point below and slightly forward of the eccentric shaft 14, as best illustrated in Figs. 2 and 5.

Also keyed to the stub shaft in driving relation with the gear 26 is a pinion gear 29 meshing with a larger gear 30 for driving a crushing roller 31. The crushing roller and gear 30 are mounted on a cross shaft 32 having its ends rotatably mounted in journal boxes 33 and 34 located at the forward ends of the sides 3 and 4 of the frame at a point below the cross bar 6. The shaft 13 projects through the journal box 11 and extends over the gears 26 and 30 to mount a balance wheel 35, as shown in Fig. 3.

The crushing roller includes a cylindrical tire 36 of sufficient length to extend across the space between the sides of the main frame and is provided with a peripheral crushing surface 37. The inner periphery of the tire bells outwardly from the center thereof toward the ends to provide conical sockets 38 and 39, respectively, receiving a conical faced flange 40 and a similarly shaped collar 41 that are carried on a hub 42 that is fixed to the shaft 32. The face of the collar 41 corresponds to the conical taper of the socket 39 and is wedgingly retained therein by draw bolts 43 having their shanks extending through openings 44 in the flange and through aligning openings 45 in the wedging collar 41. The heads of the bolts engage against the outer face of the flange 40 and the threaded ends of the shanks project through the collar to mount nuts 46 to cooperate with the heads for drawing the collar in the direction of the flange to wedge the tire thereon and prevent relative restoration thereof during operation of the machine.

The jaw frame 15 is best illustrated in Fig. 4 and includes the hub 19 that is provided with an internal bushing 47 to receive the eccentric 17 previously described, and of a length to extend between the side walls of the main frame. Depending from the ends of the hub are arms 48 and 49 connected by an arcuate plate portion 50 having its center of curvature located forwardly and above the axis of the crushing roller shaft 32. Formed in the front of the plate is a recess 51 for seating an arcuate-shaped jaw 52. The upper end of the jaw 52 abuts against a shoulder 54 provided at the end of the arcuate recess and the lower end of the jaw is beveled as at 55 to seat within a groove 56 extending across the lower end of the arcuate plate 50, as best shown in Figs. 1 and 4.

The terminal end of the plate is rounded as at 57 and carries a depending ear 58 mounting an eye 59 to which the hook end 60 of a tension rod 61 is connected. The upper end of the arcuate plate is connected with the hub of the jaw frame by a web 62 to enhance rigidity of the frame. The arcuate plate portion of the jaw frame has an opening 63 in its transverse center, the upper and lower ends of which are beveled as at 64 and 65 to engage beveled lugs 66 and 67 projecting from the rear side of the jaw 52, the lugs being spaced apart to form a dove-tailed groove for receiving the dove-tailed head 68 of a bolt 69. The shank of the bolt projects through an opening 70 in a spider 71 formed as an integral part of the plate. The threaded end of the bolt projects from the spider and mounts a nut 72 for drawing the lugs into seated engagement with the beveled ends of the opening 63. The upper end of the jaw is secured by fastening devices, such as bolts 73 having their heads 74 sunk within the jaw and their shanks projecting through openings 75 at the plate to mount nuts 76.

The concave face 77 of the jaw conforms to the curvature of the plate portion of the frame and is in position to cooperate with the crushing surface of the roller incidental to a substantially circular movement applied to the upper portion of the jaw by the eccentric 17, and an elliptical movement at the lower end of the jaw induced by a toggle 78 actuated by the pitman 16, as now to be described.

The pitman 16 includes a plate-like arm 79 depending from the hub portion thereof to a point substantially in horizontal alignment with the lower end of the jaw, and carries a head 80 having sockets 81 and 82 in the opposite sides thereof for seating the rounded bearing edges 83 and 84 of toggle plates 85 and 86. The opposite side edges of the toggle plates are provided with rounded bearing portions 87 and 88, respectively, seated in sockets 89 and 90 formed in an insert block 91 carried by a transverse lug 92 formed on the rear of the plate 50 and in a sliding wedge block 93, respectively. The wedge block 93 is mounted for horizontal sliding movement between pairs of lugs 94 and 95 projecting inwardly from the side walls 3 and 4, as best shown in Figs. 1 and 3.

The wedge block extends across the space between the side walls and has an inclined face 96 abutting against the inclined face 97 of an adjusting wedge 98. The adjusting wedge is slidably mounted on the end member 5 of the frame and is actuated by screw shafts 99 projecting upwardly through a horizontal rail 100 on the end wall, and which carries a hand wheel 101 having the hub thereof internally threaded to engage the threads of the screw shaft. It is obvious that rotation of the hand wheel will effect vertical movement of the adjusting wedge to position the wedge block in a fore and aft direction relative to the machine to vary the effective spacing between the crushing surface of the jaw and that of the roller, which spacing governs the size and character of the product produced in the machine.

The toggle is held in compression by the tension rod 61 which has its free end projecting through an opening 102 in a depending lug 103 on the end member 5 of the frame. The projecting end of the rod carries a coil spring 104 having one end bearing against the lug and its opposite end against a stop collar 105 retained on the rod by a nut 106.

Carried above the cross bar 6 and seated against the inclined faces of the sides of the frame is a feed hopper 107 for directing material into the reducing space 108 that is provided between the jaw and the crushing surface of the roller, as shown in Fig. 1.

In using a machine constructed and assembled as described the eccentric of the shaft 14 is positioned on top dead center and the hand wheel 101 is then adjusted to effect such movement of the wedge block that is necessary to effect the desired spacing for passing the crushed material.

The pulley 23 is then operated to drive the shaft 14 in a clockwise direction, Fig. 1, and the shaft 13 in a counter clockwise direction by reason of its geared connection with the shaft 14. Upon rotation of the shafts the eccentric 17 will produce gyratory movement of the upper end of the jaw as illustrated by the arrows at 109, while the upper end of the plate 52 moves in a path of substantially circular shape, as shown by the arrows 110. Reciprocatory movement of the pitman by the other eccentric actuates the toggle plates to alternately move the lower end of the crushing jaw to and from the direction of the crushing roller. Simultaneously with this movement the reciprocatory movement imparted by the eccentric 17 imparts a similar elliptical movement to the lower end of the jaw as shown by the arrow 111, the path of movement having its minor axis substantially equal to the throw of the eccentric but its major axis is longer, depending upon the length of the movement imparted by the eccentric 18 and the angle of the toggle plates. In the illustrated form of the invention the major action of this movement will be in the general direction of the center of the crushing roller.

Attention is directed to the fact that when materials of abrasive character are to be reduced the length of travel and rate of reciprocatory movement of the jaw should correspond to the linear speed of the crushing roller, which crushing roller is driven from the shaft 14 through the pinion gear 25, gear 26, pinion gear 29 and gear 30, the gears having the proper ratio to maintain the desired speed. In the approaching period of the concave surface of the jaw with the roller, the face of the roller moves downward one-half the vertical distance of the eccentric stroke of the shaft 13 and in the receding movement of the concave jaw the face of the roller advances the other half of the vertical stroke. The gear ratio is the circumference of the roller divided by the amplitude of the total travel of the jaw eccentric shaft. It is necessary that this ratio be maintained even after wear occurs in the surface of the crushing roll. This may be accomplished by removing the original set of gearing and substituting a new set having the proper pitch diameters to maintain the desired ratio. When materials of a soft or sticky nature are to be reduced it might be desirable to increase the relative speed of the crushing roller so as to effect a shredding or grinding action thereon.

In the timing of the eccentrics the upper end of the jaw moves forwardly at the same time the lower end approaches the roller and the lower end recedes from the roller more rapidly than the upper end to effect quick release of the crushed material. Since the axis of the roller shaft is somewhat lower than the horizontal center of the concave jaw, the curved face of the roller is nearest the lower end of the jaw and the curves of the respective faces diverge upwardly toward the feed hopper to form a gradual constricted crushing chamber 108. When material to be reduced is delivered in the feed hopper 107, it passes over the bar 6 and any large pieces of material will be engaged between the bar and the upper end of the concave plate to effect initial reduction thereof so that the parts are readily carried into the space between the crushing roller and jaw to effect their final reduction to the desired size. Since the concave jaw travels downwardly and forwardly in the direction of the roller, and the simultaneous rotative movement of the roller is in a downward direction, the material is crushed when being carried downwardly therebetween so that there is little slippage relatively to the respective jaws.

From the foregoing it is obvious that I have provided a crushing machine which is capable of operating upon various types of materials by operating the crushing surfaces in the same directions and at the same linear speed or by varying the relative speeds as the type of material may require. The particular suspension and drive of the concave jaw also effects more efficient and uniform crushing of the product being produced.

What I claim and desire to secure by Letters Patent is:

1. A crushing machine including a frame, a crushing roller supported on the frame, a crushing jaw cooperating with the crushing roller, means mounting one end of the jaw for movement in an approximately circular path, means supporting the other end of the jaw for oscillatory movement to and from the crushing roller in an elliptical path, means for moving said ends of the jaw at substantially the same rotational speed to effect feed of material between the crushing jaw and crushing roller, and means for constantly rotating said crushing roller at a peripheral speed to effect advance of the material at the same rate as effected by said crushing jaw.

2. A machine of the character described including a frame, a crushing roller supported on the frame, a crushing jaw cooperating with the crushing roller, means including an eccentric for mounting the upper end of the jaw for movement in an approximately circular path, means supporting the lower end of the jaw for oscillatory movement to and from the crushing roller in an elliptical path, an eccentric for effecting movement in said elliptical path, means for rotating said eccentrics at the same rotational speed to effect feed of material between the crushing jaw and the crushing roller, said eccentric operating the upper end of the jaw being set in advance relatively to the upper dead center position of the eccentric effecting movement of the lower end of the jaw, and means for constantly rotating said crushing roller at a peripheral speed to effect advance of the material at the same rate as effected by said crushing jaw.

3. A crushing machine including a frame, a crushing jaw, an eccentric mounting the upper end of the crushing jaw for movement in an approximately circular path, a crushing member having a crushing face cooperating with the crushing jaw, supporting means cooperating with said eccentric to support the lower end of the crushing jaw for oscillatory movement in an elliptical path to and from the crushing face of said crushing member, an eccentric having connection with said supporting means for effecting said movement in said elliptical path, means for rotating said eccentrics at the same rotational speed to effect feed of material between the crushing jaw and crushing member, said eccentric operating the upper end of the jaw being set in advance relatively to the upper dead center position of the eccentric effecting said movement of the lower end of the jaw, and actuating means for moving the crushing member to cause said crushing face to advance the material at the same rate as effected by said crushing jaw.

4. A crushing machine including a frame, a crushing jaw, an eccentric mounting the upper end of the crushing jaw on the frame for movement in an approximately circular path, a crushing bar fixed on the frame and cooperating with

the upper end of the jaw to initially crush material delivered into the machine, a crushing roller rotatably supported on the frame below said crushing bar and in cooperative relation with the lower end of the crushing jaw to complete crushing of said material, supporting means connected with the lower end of the crushing jaw and cooperating with the eccentric to mount the lower end of the crushing jaw for oscillatory movement in an elliptical path to and from said crushing roller, an eccentric having connection with said supporting means for effecting movement of said lower end of the crushing jaw in said elliptical path, means for rotating said eccentrics to effect feed of the material between the crushing bar and crushing jaw, and actuating means for rotating the crushing roller at a peripheral speed to effect advance of the material at the same rate as effected by the crushing jaw.

EDWARD A. HENRY.