Aug. 28, 1945. E. H. ANDERSON 2,383,457

ROCK CRUSHER

Filed Sept. 12, 1941

Fig. 1

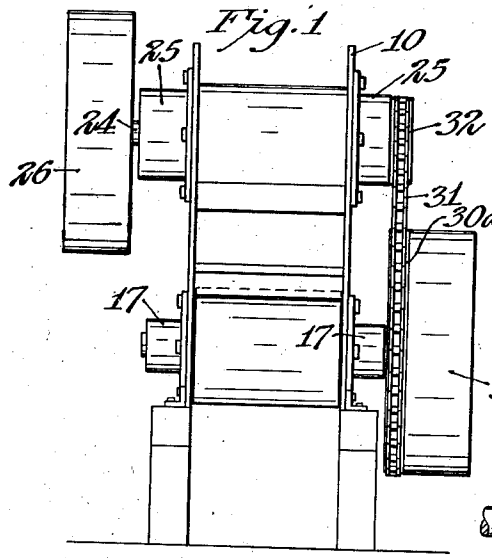


Fig. 3

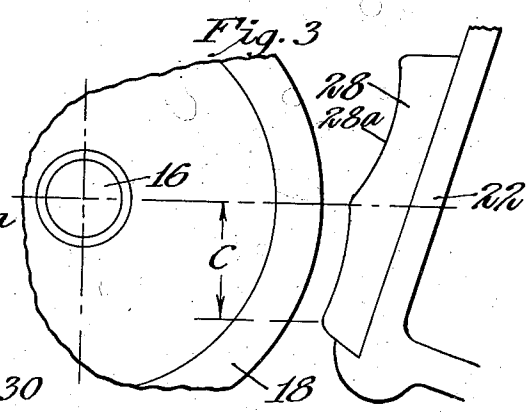


Fig. 4

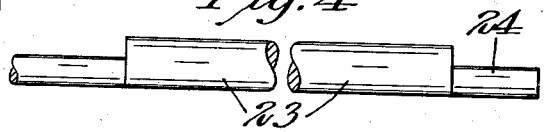
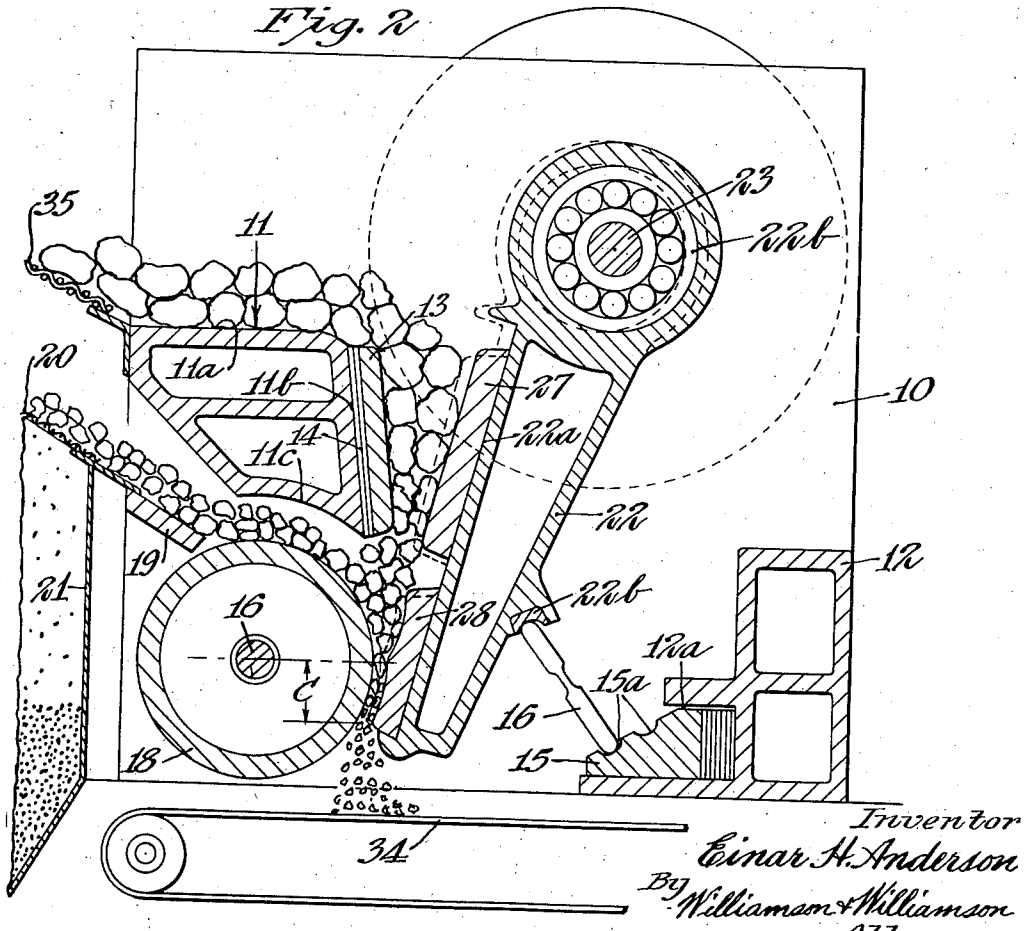


Fig. 2



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2,383,457

ROCK CRUSHER

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6 Claims. (Cl. 241—156)

This invention relates to machines for crushing hard material such as rock and other aggregate used for road surfacing. Such crusher units are often employed in complete crushing and screening plants. It will, of course, be understood that my invention relates to crushing units for rock and other hard materials adapted for wide general use independently or in conjunction with other apparatus.

In the history of crushers for aggregate for road surfacing the original hand production or separation of the material by hammer or sledge was first superseded by crushers of the gyratory type comprising usually a stationary unit installed at a point of unlimited material deposits and there processing and shipping material to the point of use. As highway construction progressed, a demand arose for a crusher of sufficient portability to be hauled to minor gravel deposits close to the proposed construction project. For this purpose was developed what is called the jaw type of crusher adapted to be built much lighter in weight than the gyratory type and yet with sufficient capacity and size of material to crush rock and gravel down to a two inch ring size. In producing the smaller sizes, however, both the gyratory and jaw crushers have proved unsatisfactory and the output dropped rapidly since in both machines material passed through crushers by force of gravity alone. The smaller the particles produced, the more the tendency to pack in the crusher and the less, therefore, the output of the machine.

The increased demand for a finer and more accurately graded material in road construction led to the development of a roll type crusher to supplement the action of the jaw crusher in this class of material. In general the roll crusher consists of a pair of rotating rolls driven in opposite directions, one fixed as to mounting and the other held in position by spring compression, such spring compression making possible adjustment as to the size of material desired and also yielding to permit spreading of the rolls in the event a non-crushable substance gets into the machine. A roll crusher is very satisfactory for the production of small sized materials because the action of the rolls assist in forcing the material therethrough at approximately the speed of rotation, but such roll crushers are very limited as to the size of material which can be fed to the roll for processing.

It is an object of my invention to provide a compact, efficient crushing machine which will have a high capacity, relatively low weight and which will receive the coarser material, crushing the same into the more finely divided and accurately sized particles.

More specifically, it is an object to provide a crusher embodying both the features and benefits of the jaw and roll crushers combined in a single continuous unit of much less size and weight than accumulative size and weight of a jaw crusher and roll crusher working successively.

A further object is the provision of a relatively low cost crusher utilizing a common reciprocating or movable jaw in combination with an opposed stationary jaw for first processing the very coarse material and then cooperating with an opposed roll below the stationary jaw for receiving the material first processed and the finer material to reduce materially the size thereof and continuously turn out accurately sized material of the finer grades.

It is a further and separate object to provide a crusher for rock and other material wherein an efficient and high capacity crushing action is obtained through the cooperation of a revolving roll or crushing cylinder with a reciprocating jaw reciprocated at relatively high speed toward and away from a side of the crushing roll.

These and other objects and advantages of the invention will more fully apear from the following description made in connection with the accompanying drawing, wherein like reference characters refer to the same parts throughout the views, and in which:

Figure 1 is a rear end elevation of a pressure unit embodying my invention;

Figure 2 is a vertical section taken on the line 2—2 of Figure 1;

Figure 3 is a detail sectional view showing on a larger scale the cooperating relationship between the crushing roll and a special concave surface formed on the swinging crusher jaw, and

Figure 4 is a detail fragmentary view showing the eccentric shaft for swingably actuating the pressure jaw.

In the drawing a crusher unit forming a part of a complete crushing and screening plant is illustrated embodying the principles of my invention. The unit comprises a pair of vertical, spaced side members 10 forming the main members of the frame and having rigidly secured therebetween a pair of heavy transverse ties 11 and 12. Said ties are preferably cored out to lessen the weights thereof, and may be in the form of metal castings. The tie 11 is disposed substantially medially of the height of the frame sides 10 and at the rear thereof, and has a sub-

stantially horizontal top surface 11*a* adapted to receive relatively coarse rock or other material to be ground, and the adjacent and inwardly disposed face of said tie is substantially flat and angled at a slight obtuse angle relatively to the top surface 11*a* to form an upper stationary jaw 11*b* of the crusher unit, said jaw being disposed somewhat out of the vertical position inclined somewhat in a rearwardly direction. The jaw 11*b* has removably attached thereto a hardened jaw plate 13, as shown, mounted in spaced relationship relative to said jaw by the use of one or more spacing shims 14 of similar shape to the rectangular jaw plate 13.

The second rigid tie 12 secured to the lower portion of the frame forms a strong reenforcing and base member for the unit and is provided on its inner side with a channel 12*a* in which is mounted an adjustable fulcrum or toggle seating member 15. Toggle seating member 15, as shown, is in the form of a bar having an inclined exposed surface in which two spaced parallel toggle seats 15*a* are formed for receiving the outer and lower end of a toggle plate 16, to be later described.

A rotary axle 16 is mounted transversely across the frame side members 10 journalled in suitable bearings 17 and disposed in a rearward and lower part of the unit frame. Shaft 16 has affixed thereto a relatively large crushing roll 18 constructed of suitable hard material. This crushing roll is disposed below the tie member 11, and the bottom surface of said tie member is concaved at 11*c* concentrically with roll 18 and spaced a short distance thereabove. An inclined guide plate 19 traverses the rear of the frame, receiving from a declined separating screen 20, and the outward surface of tie member 11 is inclined and spaced from plate 19 and the lower edge of screen 20 to form a converging entrance mouth for feeding the less coarse material to the roll. A portion of a receiving hopper 21 disposed below the screen 20 is shown adapted to receive the finely crushed material of the specified size.

Cooperating with the jaw 11*b* and also with the crushing roll 18 is a swinging reciprocatory jaw 22*a* of rectangular shape extending substantially the full width of the machine. Jaw 22*a*, as shown, is integrally formed with a pitman 22 which is cored for lessening the weight thereof and which has a free lower end or edge and a large tubular upper end disposed transversely and horizontally of the frame and having therein a bearing 22*b* in which an elongated cylindrical eccentric 23 is journalled.

Eccentric cylinder 23 is eccentrically mounted upon or integrally formed with a shaft 24 which is journalled in suitable bearings 25 mounted on the side frame members 10. Shaft 24 at one side of the machine has secured to the outer end thereof a large fly wheel 26. The elongated swingable jaw 22*a* has removably fixed thereto two jaw plates 27 and 28 for cooperation with the fixed jaw plate 13 and the crushing roll 18, respectively. Jaw plates 27 and 28 extend substantially the full width of the interior of the frame and, as shown, are independently removable, jaw plate 27 being opposed to the stationary jaw while while the lower jaw plate 28 is opposed to the cylindrical roll and has a concave section C mounted substantially concentric of roll 18 and spaced a relatively short distance therefrom. It is important, for the most successful operation of my crusher, that the area of the concave section of jaw plate 28 bear a substantially definite relationship to the foot travel of the crushing roll 18 and the speed of reciprocation of the movable jaw 22*a*. The area of this concave portion, if too great proportionately, will clog the machine, and if too small, will permit material to slip through in the retracting stroke of the swingable jaw, greatly lessening the efficiency of the machine. I have discovered that for the most efficient results the area of the concave section C must be equal to the foot travel per minute of the crushing roll 18 divided by the reciprocating strokes per minute of the swingable jaw 23*a*.

Crushing roll 18 is driven at relatively low speed and, as shown, is provided with a fly wheel 30 affixed to the rotary shaft 16 at the opposite side of the crusher unit from the fly wheel 26 for the eccentric shaft. Fly wheel 30 may be driven by any suitable means and, as shown, has driving connections in the form of a roller chain 31 connecting an external gear sprocket 30*a* on its periphery with a sprocket 32 mounted on the corresponding end of eccentric shaft 24. Eccentric shaft 24 is thus driven at relatively high speed compared to the roll shaft 16.

The fulcruming toggle 16 seated at its lower end in one of the seats 15*a* extends upwardly and rearwardly and has its upper edge or end seated in a suitable seat 22*b* provided in the forward side and intermediate portion of pitman 22.

The toggle plate 16 is weakened or diminished along approximately its transverse medial portion to permit bending or shearing in the event noncrushable solids are fed to the machine which would otherwise break the pitman or other working parts. The toggle plate 16 may be seated in either of the seats 15*a* of member 15, and seating member 15 may be adjusted horizontally through use of a series of shims 15*b* interposed between said member and the outer end of its seat.

Below the roll 18 and lower end of jaw 22*a* in receiving position is shown a portion of an endless conveyor 34 which in the complete crushing plant conducts the ground material from the crusher to an elevator (not shown) which in turn delivers material to an upper coarse sizing screen 35 declined and disposed in substantially parallel relationship with the finer separating screen 20 previously described.

The crushing unit described embodying my invention, is a part of a complete crushing and screening plant having a feed conveyor (not shown) and having a classifying two-deck screen of which fragments of the upper coarser screen 35 and the lower finer screen 20 are shown in Figure 2. In such a plant the material crushed is conveyed by return conveyor 34 to the screen for finer grading, the finely ground material dropping through screen 20 into the collection bin 21. It will, of course, be understood that my crushing mechanism, including the efficient crushing cooperation between revolving roll 18 and reciprocating jaw 22*a*, per se, may be utilized in many installations and for many purposes, all within the scope of my invention.

Operation

In the operation of the embodiment illustrated, rocks or other hard raw materials are delivered to the two-deck screen upon the top of coarse screen 35 which separates off the larger material to be crushed, in a commercial crushing plant rocks, in excess of two-inch ring size. The smaller rocks and material drop upon screen 20 and are fed thereby into the converging entrance which leads to the crusher mechanism comprising roller 18 and the lower portion of jaw 22*a*. The fines, of course,

drop through screen 20 and are collected in the hopper 21. The larger rocks and material are fed by screen 35 and the top of tie member 11 to the entrance between stationary jaw 11b and reciprocating jaw 22a, where they are crushed and reduced to smaller size, in commercial plants approximately two-inch ring size or less. The crushed material with the movable jaw 22a reciprocating at high speed, drops by gravity to the crushing mechanism below and is fed between the roll 18 and jaw plate 28 of the reciprocating jaw. There this material with the small amount of reduced material screened off by screen 20 is reduced to the finished product, being fed by gravity and the revolution of roll 18 in a downward direction, and the finely ground material drops upon the return conveyor 34 which delivers to an elevator (not shown), which in turn delivers to a feeding conveyor, returning the fines to the double-deck screen. The fines then pass through screens 35 and 20 and are collected in bin 21.

In the crushing of the material between the roll 18 and jaw plate 28, the reciprocating jaw moves at very high speed relatively to the foot travel of the roll, the speed ratio, timing and width of the concave area being such that material will not be released at the lower end of jaw plate 28 until preferably subjected to two crushing strokes of the reciprocating jaw. Thus there is no chance for material to pass downwardly between the roll and reciprocating crushing jaw without being subjected to at least one crushing action, and the product is consequently of substantially uniform size.

The angle at which toggle plate 16 is set to the reciprocating jaw 22a and pitman 22, determines the path of movement of the lower movable jaw plate 28 as well as the jaw plate 27. With my improved construction the jaw 22a moves always in its crushing stroke toward the opposing crushing members and downwardly. This downward factor of movement assists in feeding and moving the material through the crushing space, both in the initial crushing step and in the next successive crushing step between the roll and reciprocating jaw. The adjustments provided in the positioning of the lower end of toggle plate 16, both by changing the seat thereof and varying the spaced relationship of member 15 to its seating channel through use of shims or other spacers 15b, makes possible adjustment for providing any desired spacing between the roll and movable jaw. The spacing means or shims 14 between stationary jaw 11b and jaw plate 13 provide for adjustment in the crushing space in the initial crushing action.

The width of the area of the concave portion C of the lower reciprocating jaw plate 28, as has been stated, is determined by the feet per minute travel of the roll and the number of strokes per minute of the jaw toward the roll. This area must be sufficient so that the material entering the concave portion on the retreating stroke of the jaw will still be in the concave area on the return or crushing stroke of the jaw.

From the foregoing description it will be seen that in a very compact, relatively light crushing unit I have provided the benefits and features of both jaw and roll crushers adapted to continuously operate upon rocks and other relatively large hard materials and producing large capacity of crushed material of relatively fine grade.

It will further be understood that while I have embodied the combination of a cylindrical or roll crushing element with a reciprocating crushing jaw with another successive and related mechanism, that I claim the combination of roll and reciprocating jaw broadly, whether used per se or in combination with the other mechanism here illustrated.

It will, of course, be understood that various changes may be made in the form, details, arrangements and proportions of the parts without departing from the scope of my invention.

As indicated in Figure 3 by the arcuate dotted line, the jaw plate 28 may be made reversible to approximately double the wear thereof. When the lower concave surface becomes worn beyond a predetermined extent, the plate may be detached and reversed and the upper surface, indicated by the dotted line 28a, cooperated with the adjacent surface of roll 18.

What is claimed is:

1. In a machine for crushing rock and other hard materials, a stationary crushing jaw inclined somewhat from vertical position, a crushing roll mounted in spaced relation below said stationary jaw and having one side of its periphery disposed at least close to vertical alignment with the lower edge of said stationary jaw, a common reciprocating jaw opposed to both said stationary jaw and said crushing roll and mounted in converging relationship from top to bottom with said stationary jaw and roll, said reciprocating jaw having a comparatively straight crushing surface for cooperating with said stationary jaw and having a concave crushing surface spaced from and disposed substantially concentrically of said crushing roll, said reciprocating jaw having also means between said crushing surfaces for assisting in guiding material processed behind said stationary jaw to said crushing roll, means for moving said reciprocating jaw toward and away from said stationary jaw and said roll, means for feeding very coarse material to be ground between the upper portions of said stationary jaw and said reciprocating jaw, and means for feeding less coarse material between said roll and the concave crushing surface of said reciprocating jaw.

2. The structure set forth in claim 1, wherein the circumferential width of the area of said concave crushing surface is at least equal to the foot-per-minute travel of the crushing surface of said roll divided by the reciprocating strokes per minute of said jaw.

3. In a machine for crushing rock and other hard materials, a rotary crushing roll, a reciprocating jaw opposed to one side of said roll, a reversible jaw plate removably secured to said jaw and having two spaced concave crushing surfaces, each of which is adapted to be disposed in spaced relation to and substantially concentric of said roll, means for introducing material to be ground between said roll and jaw, and means for reciprocating said jaw toward and away from said roll.

4. In a machine for crushing rock and other hard materials, a stationary crushing jaw inclined somewhat from the vertical position, a crushing roll mounted below said stationary jaw and spaced therefrom for lateral reception of material and having one side of its periphery disposed at least close to vertical alignment with the lower edge of said stationary jaw, a common reciprocating jaw opposed to both said stationary jaw and said crushing roll and mounted in converging relationship with said stationary jaw and roll, means for feeding material to be ground between the upper portions of said stationary jaw and said reciprocating jaw, means for feeding

less coarse material laterally of said machine between said stationary crushing jaw and said roll, means for revolving said roll to convey said last mentioned fed material downwardly between said reciprocating jaw and the opposed surface of said roll and means for bodily reciprocating said jaw toward and away from said stationary jaw and said roll with a compound limited downward movement as said reciprocating jaw approaches said roll, said last mentioned means comprising a pitman opposed to said stationary jaw and said roll and to which said common jaw is secured, a horizontal eccentric shaft having its axis disposed in parallel relation to the axis of said roll and journalled to one end of said pitman for gyrating such end and a fulcruming toggle swingably seated behind said pitman and swingably connected with the intermediate portion of said pitman.

5. In a machine for crushing rock and other hard materials, a rotary crushing roll, a reciprocating crushing jaw opposed to one side of said roll, means for revolving said roll in a direction to cooperate with said reciprocating jaw for material feeding and crushing purposes, means for reciprocating said jaw toward and away from said crushing roll with a compound limited downward movement as said jaw approaches said roll, said last mentioned means comprising a pitman opposed to said crushing roll and to which said reciprocating jaw is attached, an eccentric shaft disposed parallel to the axis of said roll and journalled in one end of said pitman to gyrate the same and a fulcruming toggle swingably seated behind said pitman and swingably connected with the intermediate portion of said pitman, said reciprocating jaw having a pair of juxtaposed crushing surfaces both opposed to a side of said crushing roll, the lower of said crushing surfaces being concavely curved and extending substantially concentric of said roll and the upper of said crushing surfaces diverging angularly from the upper portion of said roll, said two surfaces defining therebetween a narrow longitudinal restricting area opposed longitudinally to the medial portion of the opposing side of said roll.

6. In a machine for crushing rock and other hard materials, a rotary crushing roll, a reciprocating crushing jaw opposed to one side of said roll, means for revolving said roll in a direction to cooperate with said reciprocating jaw for material feeding and crushing purposes, means for bodily reciprocating said jaw toward and away from said crushing roll, said reciprocating jaw having a concavely curved crushing surface adjacent its lower end opposed to the lower portion of said roll at one side thereof and shaped substantially concentric with said roll, and said reciprocating jaw having another concave crushing surface contiguous to said first concave surface and disposed thereabove and diverging from said concave lower surface and angularly from the opposed peripheral surface of said roll, and means for feeding material to be crushed between said roll and the upper portion of said last mentioned surface.

EINAR H. ANDERSON.