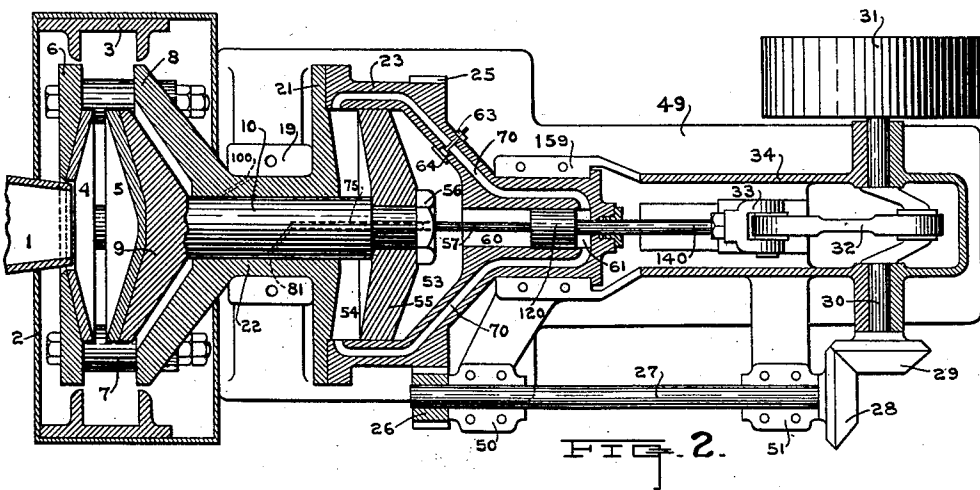
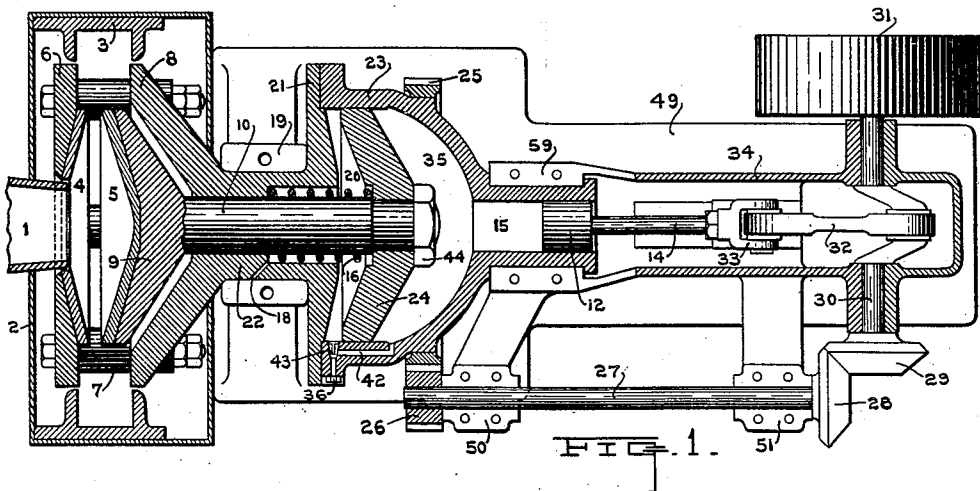


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CRUSHER.
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1,065,535.

Patented June 24, 1913.



WITNESSES-

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CRUSHER.

1,065,535.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WILLIAM H. LIEBER, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvements in Crushers, of which the following is a specification.

This invention relates to improvements in the construction of crushers for rock, ore, and similar substances.

An object of the invention is to provide a crusher in which material is crushed by the direct approach of one of a pair of crushing members toward the other, the feeding of the material through the crusher chamber being accomplished by so rotating the crushing members that centrifugal force will automatically act upon the material to advance same from the feed to the discharge end of the crusher.

Another object of the invention is to provide various detail improvements in a crusher in which the crushing is accomplished by admitting fluid under pressure between opposed surfaces carried by the crushing members.

The primary features of the crusher disclosed but not claimed herein are claimed in a co-pending application Serial No. 711,333, filed July 22, 1912.

A clear conception of several embodiments of the invention may be had by referring to the drawing accompanying and forming part of this specification in which like reference characters designate the same or similar parts in the various views.

Figure 1 is a transverse horizontal section through a single acting fluid pressure actuated crusher. Fig. 2 is a transverse horizontal section through a double acting fluid pressure actuated crusher.

The fluid pressure actuated crusher consists essentially of a pair of opposed crushing members 6, 9, provided with wearing liners 4, 5, respectively, see Figs. 1 and 2. The crushing chamber formed between the wearing liners 4, 5, has a feed hopper 1 directed into its mid portion and is provided with a free annular discharge opening adjacent the peripheries of the liners 4, 5. The housing 2 which supports the feed hopper 1 incloses the crushing elements and has a free discharge opening at its lowest end. The housing liners 3 are

secured to the housing 2 and are adapted to arrest the motion of material discharged from the crushing chamber.

The hollow outer shaft 22 is supported in the bearing 19 of the frame 49 and has an outwardly projecting flange 8 formed integral with one of its ends. The crushing member 6 is fixed to the outwardly projecting flange 8 of the hollow shaft 22 by a series of through bolts which pass through the member 6 and flange 8 and clamp these elements against the ends of distance pieces or sleeves 7. The inner shaft 10 is supported in the central bore of the outer shaft 22 and has the crushing member 9 formed integral therewith. The inner shaft 10 is free to rotate as well as reciprocate within the central bore of the outer shaft 22.

The outer shaft 22 is provided with an outwardly projecting flange 21 to which the cylinder or casing 23 is secured. The driving gear 25 is secured to the casing 23 and meshes with a pinion 26 carried by the countershaft 27. The countershaft 27 is carried by suitable bearings 50, 51, formed in one with the main crusher frame 49. A bevel gear 28 is secured to an end of the countershaft 27 and meshes with a second bevel gear 29 carried by the crank shaft 30. The crank shaft 30 is carried in suitable bearings formed in one with the main frame 49 and is adapted to be rotated by means of a pulley 31.

In the single acting crusher, see Fig. 1, the crusher actuating piston 24 is secured to the end of the inner shaft 10 by a suitable locking device, such as a nut 44. The piston 24 fits snugly within the bore of the casing 23 and divides the interior of the casing 23 into a pair of chambers 20, 35. The overhanging end of the casing 23 which is supported in the stationary bearing 59, is provided with a bore 15 which communicates directly with the pressure chamber 35. The displacement piston or plunger 12 closely fits the bore 15 of the casing 23 and is adapted to be reciprocated within this bore 15. The displacement plunger operating rod 14 is connected with the crosshead 33 which is adapted to be reciprocated within a suitable crosshead slide 34 carried by the main crusher frame 49. The reciprocation of the crosshead 33 is effected by the crank shaft 30 through the connecting rod 32. The helical spring

16 is compressed between opposed surfaces formed on the piston 24 and the outer shaft 22 respectively, and tends to separate the crushing members 6, 9.

5 A passage or port 42 formed in the casing 23 connects the chamber 35 with the chamber 20. The valve 43 which is manually operable by loosening the retaining nut 36, controls the port 42. The chamber 20 is connected with the main bearing 19 by means of a port 18.

10 In the double acting crusher, see Fig. 2, the crusher actuating piston 55 is secured to the end of the inner shaft 10 by means of a nut 56. The piston 55 fits snugly within the bore of the casing 23 and divides the interior of the casing 23 into a pair of pressure chambers 53, 54. The overhanging end of the casing 23 which is supported in the stationary bearing 159, is provided with a bore 60, the one end of which communicates directly with the chamber 53 and the other end portion 61 of which is connected by means of a series of large ports 70 with the chamber 54. The displacement piston or plunger 120 closely fits the bore 60 of the casing 23 and is adapted to be reciprocated within this bore 60. The plunger 120 prevents communication between the chambers 53, 54, through the bore 60 and ports 70. The displacement plunger operating rod 140 is connected with the crosshead 33 which is adapted to be reciprocated in the stationary slide 34 by means of the crank shaft 30 and connecting rod 32. The joint between the rod 140 and casing 23 is packed by means of a suitable stuffing box. The compensating rod 57 projects from the plunger 120 in a direction opposite to that of the rod 140. The compensating rod 57 is adapted to reciprocate within a bore 75 in the inner shaft 10. The bore 75 connects with the bearing between the outer and inner shafts 22, 10, through an open conduit 81. The bearing between the outer and inner shafts 22, 10, is connected with the main bearing 19 by means of a conduit 100. One of the large ports 70 is adapted to be directly connected with the chamber 53 through a valve 64. The valve 64 is manually operable by loosening the nut 63. When the valve 64 is open, a direct communication is established through the port 70 between the chambers 53, 54.

55 During the normal operation of the single acting crusher, the pressure chamber 35 and the bore 15 formed in the casing 23, are filled with a fluid preferably oil, see Fig. 1. The crushing member 6 is positively rotated by means of power applied through the crank shaft 30, bevel gears 29, 28, countershaft 27, pinion 26, and gear 25. The crushing member 9 is not positively rotated but will rotate at substantially the speed of the crushing member 6, due to the friction between co-

acting portions of the members as well as the wedging of material being crushed between the liners 4, 5. The displacement plunger 12 is reciprocated within the bore 15 of the casing 23 simultaneously with the rotation of the crushing members, by the crank shaft 30 which connects with the plunger 12 through the connecting rod 32, crosshead 33 and operating rod 14. As the gear 25 is very large compared to the pinion 26, the plunger 12 will complete a number of reciprocations during each revolution of the crushing members.

The material to be crushed is admitted to the mid portion of the crushing chamber formed between the liners 4, 5, through the inlet hopper 1. The reciprocating plunger 12 alternately forces fluid from within the bore 15 into the pressure chamber 35 during its forward or crushing stroke and withdraws the fluid on the return stroke. The forcing of fluid from within the bore 15 into the chamber 35 during the crushing stroke, causes the piston 24 and crushing member 9 to move forward and approach the crushing member 6, thereby crushing the material between the liners 4, 5. During the return stroke of the plunger 12, the spring 16, assisted by the wedging of the material within the crushing chamber between the liners 4, 5, by the action of centrifugal force thereon, causes the piston 24 and crushing member 9 to recede from the member 6. During this recession of the crushing members, the material within the crushing chamber is forced to a position nearer the peripheries of the liners 4, 5, by the action of centrifugal force thereon. After successive crushing strokes have been applied, the material is eventually sufficiently reduced to permit its discharge from the crusher. The crushed material discharged from the crushing chamber is precipitated against the liners 3 of the casing 2 from which it flows by gravity through the discharge opening.

If it is desired to vary the size of the discharge from the single acting crusher, it is necessary to vary the volume of the oil within the chamber 35 and bore 15. This may easily be done by manually operating the valve 43 so as to establish a direct communication between the chambers 35, 20, through the passage 42. By drawing the plunger 12 away from the piston 24, fluid will be drawn from the chamber 20 through the port or passage 42 into the chamber 35, thereby increasing the volume of the fluid within the chamber 35 and bore 15 and reducing the crusher discharge opening. By moving the plunger 12 toward the piston 24, with the valve 43 open, fluid will be forced from the chamber 35 through the passage 42, into the chamber 20, thereby decreasing the volume of the fluid within the chamber 35 and bore 15 and

increasing the crusher discharge opening. After the discharge opening of the crusher has been properly adjusted, the valve 43 should again be closed. The fluid admitted to the chamber 20 during adjustment as well as the leakage fluid entering this chamber 20, is forced through the conduit 18 to the main bearing 19 during the forward motion of the piston 24. During the normal operation of the double acting crusher, see Fig. 2, the pressure chambers 53, 54, the bore 60, and the ports 70 are filled with a fluid, preferably oil. The crushing members 6, 9, are respectively positively and frictionally driven as in the operation of the single acting crusher. The displacement plunger 120 is reciprocated within the bore 60 of the casing 23 simultaneously with the rotation of the crushing members 6, 9.

The material to be crushed is admitted to the mid portion of the crushing chamber formed between the liners 4, 5, through the inlet hopper 1. The reciprocating plunger 120 alternately displaces fluid in the pressure chambers 53, 54, causing the piston 55 and crushing member 9 to reciprocate. During the forward motion of the plunger 120, fluid is forced from within the forward end of the bore 60 directly into the chamber 53 while at the same time a definite amount of fluid is withdrawn from the chamber 54 through the ports 70 into the opposite end portion 61 of the bore 60. This displacement of the fluid causes the piston 55 and crushing member 9 to approach the crushing member 6, thereby crushing the material between the liners 4, 5. During the return stroke of the plunger 120, fluid is forced from within the rear portion 61 of the bore 60 into the chamber 54 through the ports 70, while at the same time a definite amount of fluid is withdrawn directly from the chamber 53 into the forward end of the bore 60. This displacement of fluid causes the crushing members to recede from each other and permit the material within the crushing chamber to move nearer the peripheries of the liners 4, 5. After successive crushing and return strokes of the piston 55, the material is eventually reduced and discharged as in the single acting crusher.

If it is desired to vary the size of the product discharged from the double acting fluid pressure crusher, it is necessary only to open the manually operable valve 64 and move the plunger in either direction as for adjustment in the single acting crusher. If the plunger 120 is moved forward, fluid will flow from the chamber 53 through the port 70 into the portion 61 of the bore 60. This adjustment will increase the size of the discharged product. If the plunger 120 is moved away from the crushing members, fluid will flow from the portion 61 of the bore 60 through the port 70 into the cham-

ber 53. This adjustment will decrease the size of the crusher discharge. After proper setting of the crushing members 6, 9, the valve 64 should be closed.

Any fluid which may leak past the compensating rod 57 is forced through the conduits 81, 100, to the various bearings. Such leakage must also be replenished by a suitable supply means, but as such supply means forms no part of my present invention, same has been omitted from the disclosure.

It should be noted that by reciprocating the displacement plungers 12, 120, directly within the rotating members, the number of stuffing boxes required is reduced to a minimum. The reciprocation of the plunger within a rotating part also tends to prevent uneven wearing of the members along the bearing surfaces. The means for permitting adjustment of the crusher discharge is also a simple and effective means for varying the size of the discharged product.

It should be understood that it is not desired to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

It is claimed and desired to secure by Letters Patent,—

1. In a crusher, a plurality of crushing members, a casing connected with one of said members, a piston connected with another of said members and dividing said casing into a plurality of chambers, means for establishing pressure in one of said chambers to effect crushing of material, and manually operable means for permitting the passage of fluid from one of said chambers to another to adjust the size of the crusher discharge.

2. In a crusher, a plurality of crushing members, a casing connected with one of said members and having a normally closed passage formed therein, a piston connected with another of said members and dividing said casing into a plurality of chambers, means for establishing pressure in one of said chambers to effect crushing of material, and manually operable means for opening said passage to vary the relative volumes of said chambers to adjust the size of the crusher discharge.

3. In a crusher, a plurality of crushing members, a casing connected with one of said members, a piston connected with another of said members and dividing said casing into a plurality of chambers, means for establishing pressure in one of said chambers to effect crushing of material, and a manually operable valve controlled by-pass from one of said chambers to another.

4. In a crusher, a plurality of crushing members, means for forcing fluid between opposed surfaces of said members whereby said members are caused to approach each

other to crush material, and manually operable means for permitting change of amount of fluid from between said surfaces to adjust the size of the crusher discharge.

5 5. In a crusher, a plurality of rotatable crushing members, means for forcing fluid between opposed surfaces of said members whereby said members are caused to approach each other to crush material, and
10 means for adjusting the extent of approach of said members, said fluid forcing means being operable directly in one of said crushing members.

6. In a crusher, a pair of rotatable crushing members, and means operable directly in one of said members for forcing fluid between opposed surfaces of said members to effect crushing of material.

7. In a crusher, a pair of rotatable crushing members, and means carried by and coaxial with one of said members for forcing fluid between opposed surfaces of said members to effect crushing of material.

8. In a crusher, a plurality of crushing members, a casing connected with one of said members, a piston connected with another of said members and dividing said casing into a plurality of chambers, means for establishing pressure in one of said
30 chambers to effect crushing of material, and means operable in said casing for forcing fluid into at least one of said chambers.

9. In a crusher, a plurality of crushing members, a casing connected with one of
35 said members, a piston connected with another of said members and dividing said casing into a plurality of chambers, and means operable in a portion of one of said members and movable coaxially with said
40 piston, for forcing fluid into at least one of said chambers to effect crushing.

10. In a crusher, a plurality of crushing members, means for forcing fluid between opposed surfaces of said members whereby
45 said members are caused to approach each other to crush material, and manually operable means for permitting change of amount

of fluid from between said surfaces to adjust the limits of stroke of said crushing members.

11. In a crusher, a plurality of crushing members, a casing connected with one of said members, a piston connected with another of said members and dividing said casing into a plurality of chambers, means
55 for establishing pressure in one of said chambers to effect crushing of material, and means operable from the outside of said casing for permitting the passage of fluid from one of said chambers to another to adjust
60 the size of the crusher discharge.

12. In a crusher, a plurality of crushing members, a casing connected with one of said members, a piston connected with another of said members and dividing said
65 casing into a plurality of chambers, means for establishing pressure in one of said chambers to effect crushing of material, and means operable from the outside of said casing for varying the relative volumes of
70 said chambers to adjust the size of the crusher discharge.

13. In a crusher, a plurality of crushing members, means for forcing fluid between opposed surfaces of said members whereby
75 said members are caused to approach each other to crush material, and means operable from the outside for adjusting the extent of approach of said members.

14. In a crusher, a plurality of crushing
80 members, means for forcing fluid between opposed surfaces of said members whereby said members are caused to approach each other to crush material, and means operable from the outside for adjusting the limits of
85 stroke of said crushing members.

In testimony whereof, the signature of the inventor is affixed hereto in the presence of two witnesses.

WILLIAM H. LIEBER.

Witnesses:

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