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H. A. STOCKMAN

APPARATUS FOR CRUSHING OR REDUCING MINERALS, ORES, AND OTHER MATERIALS

Filed Feb. 7, 1922

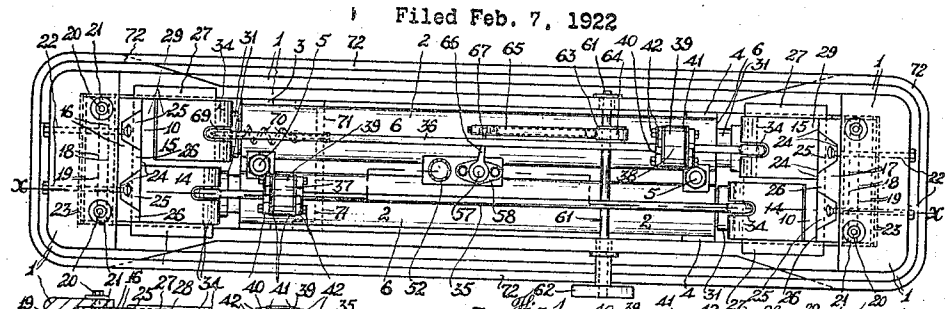


Fig. 1.

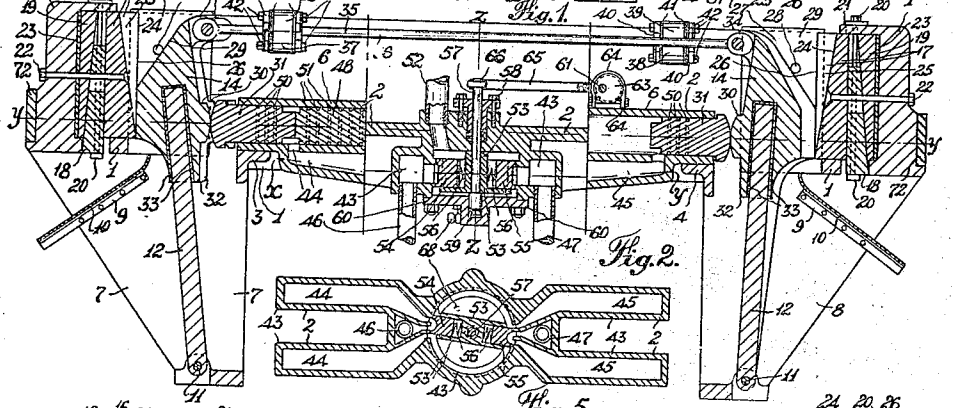


Fig. 2.

Fig. 5.

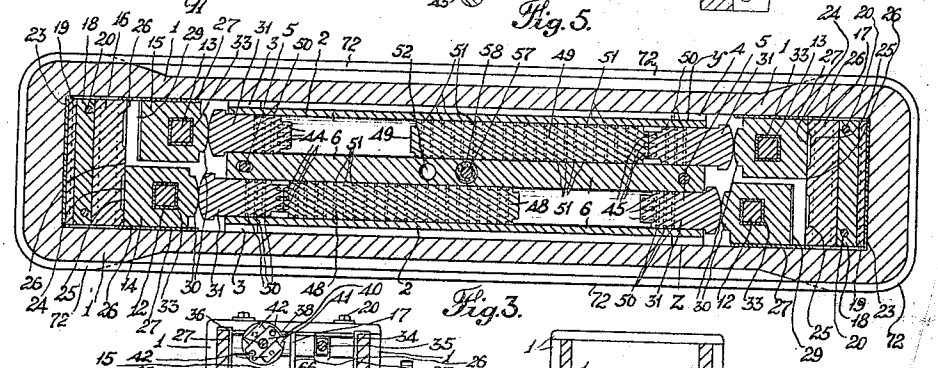


Fig. 3.

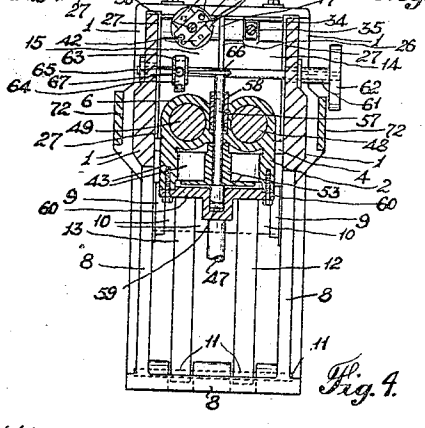


Fig. 4.

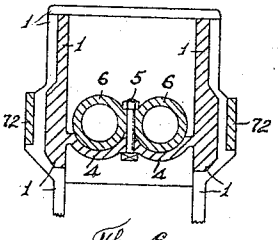


Fig. 6.

Witness:

Arthur Thompson

Inventor:

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Patented Sept. 25, 1923. 1,468,759

UNITED STATES PATENT OFFICE.

HARRY AUGUST STOCKMAN, OF JOHANNESBURG, TRANSVAAL, SOUTH AFRICA, ASSIGNOR OF ONE-HALF TO WILLIAM EDWIN BLELOCH, OF JOHANNESBURG, TRANSVAAL, SOUTH AFRICA.

APPARATUS FOR CRUSHING OR REDUCING MINERALS, ORES, AND OTHER MATERIALS.

Application filed February 7, 1922. Serial No. 534,759.

To all whom it may concern:

Be it known that I, HARRY AUGUST STOCKMAN, a subject of the King of Sweden, and resident of Johannesburg, Transvaal Province, Union of South Africa, have invented certain new and useful Improvements in Apparatus for Crushing or Reducing Minerals, Ores, and Other Materials (for which I have filed applications in Union of South Africa, No. 524 of 1921, filed 20th May, 1921, and 1058 of 1921, filed 3rd November, 1921; Great Britain, No. 17951 of 1921, filed 1st July, 1921; Southern Rhodesia No. 1689, filed 20th September, 1921), of which the following is a specification.

This invention has reference to a means or apparatus for crushing or reducing minerals, ores and other materials or substances, and more especially for the fine or comparatively fine crushing of such materials or substances.

The object of the invention is to construct an efficient apparatus adapted to deal expeditiously with the material and to reduce the same to any desired size of product.

The invention consists of a machine or apparatus in which the crushing of the material is effected between a stationary block or anvil and an opposing crushing jaw or pivoted member which crushing jaw or pivoted member is operated by means of a fluid actuated percussion tool or device, which impacts upon the back of the crushing jaw, et cetera.

The apparatus can include one or any other desired number of double-acting percussion tools.

The invention will be described in detail with the aid of the accompanying drawings wherein it is illustrated embodied in a duplex, double-acting machine. In the drawings,

Fig. 1 is a plan of the complete machine and illustrating certain modifications in dotted lines.

Fig. 2 is a longitudinal section of the apparatus, the plane of section being illustrated by the dotted line *x*—*x*, Fig. 1

Fig. 3 is a sectional plan of Fig. 2 on line *y*—*y*.

Fig. 4 is a sectional elevation on line *z*—*z* of Fig. 2.

Fig. 5 is a sectional plan of the valve chest of the percussion device the plane of section being indicated by the line *x*—*y* in Fig. 2, and

Fig. 6 is a cross section of the main frame and cylinders on line *y*—*z* Fig. 3, the other parts of the machine being omitted.

The machine, constructed as illustrated, comprises a rectangular or other suitably shaped frame 1 between the sides of which frame the duplex, double-acting percussion device 2 is arranged and supported at its ends, as indicated at 3, 4 in Fig. 2; 5—see Figs. 1, 3 and 6—being bolts for fixing the cylinder 6 of the percussion device 2 upon the parts 3, 4 of the frame 1. At both ends of the frame 1 downwardly extending parts 7, 8, are provided which have affixed to them by means of angle iron supports 9, inclined aprons or plates 10 on to the upper end of which the crushed material will fall and by which it will be delivered clear of the machine at both ends of the frame 1. These downwardly extending portions are shown of U shape, and in their lower portions are constructed, as shown at 11, to pivotally support at each end of the frame 1 a pair of upwardly extending bars or rods 12, 13 which form the supporting members for the two pairs of crushing jaws 14, 15.

The ends of the frame 1 at the inside are each constructed to receive or form a housing for a preferably adjustable block or anvil 16, 17, respectively.

The means shown for adjusting the anvils or blocks 16, 17 comprises for each of said anvils or blocks 16, 17, a wedge-shaped member 18 which on the one side engages with the back of the anvil or block 16, 17 and on the other side engages a corresponding wedge-shaped stationary member 19, housed within the back end of the frame 1. The wedges 18 are adjustable by vertically arranged bolts 20 which pass through the top of the rear end of the frame 1, as indicated at 21 in Figs. 1, 2 and 4. The anvils or blocks are secured in the desired position by horizontally placed bolts 22 passing through the blocks 16, 17, wedges 18, tapered members 19 and the end of the frame 1. If desired a quantity of molten metal 23 may be run into the housing to form a bedding for the backs of the members 19.

In the crushing faces 24, of each of the anvils or blocks 16, 17 there are formed two

downwardly tapering recesses 25, one for each of the two opposing crushing jaws 14, 15. The ribs or projections 26 are formed at the sides of and between the recesses 25 serve as contact surfaces for the crushing jaws at the end of their crushing strokes. The depth, if any, of the recesses 25 at the bottom of the anvils or blocks 16, 17 determines the size of the crushed product obtained. By substituting anvil blocks 16, 17 having different depths of recesses 25 any desired size of product can be obtained.

Detachable wearing plates 27 are provided in the frame at the sides of the crushing jaws and anvil blocks, and fixed thereon by countersunk bolts 28.

The crushing jaws 14, 15 of which, in the arrangement shown, two are provided for each end of the frame 1, are placed side by side so that the pair 14, 15, at each end co-operates with the single anvil block 16 or 17 arranged in front of them. Each crushing jaw 14, 15 is shown at 29, inclined or shaped in its upper portion, on the crushing face, to form a hopper-shaped recess with the crushing face of the opposing anvils 16, 17, to receive the material to be crushed, and they are preferably constructed with a boss or projection 30 at the back, against which the corresponding hammer 31 of the percussion device 2 will impact. They are also each constructed at the bottom with an extension 32 and with a recess 33 extending up into the crushing jaw for a suitable distance, into which recess 33 the upper end of the supporting rod or bar 12, 13, respectively, projects and is suitably secured, as for example by a quantity of metal run in in a molten state. If preferred the crushing jaws and their supporting bars may be cast or otherwise made integral, or the crushing jaws may be cast on the ends of the bars.

The crushing jaws 14, 15 at their upper ends, are constructed as indicated at 34, to have pivotally attached to them the ends of a pair of connecting rods or links 35, 36, the crushing jaw 14 at the one end of the frame being thereby connected with the corresponding crushing jaw 14 at the same side in the other end of the frame, by the link 35 and the crushing jaws 15 at opposite ends and the other side of the frame being similarly connected by the other link 36.

In each of these connecting rods 35, 36 there is preferably provided a resilient coupling 37, 38, respectively, which serve to absorb or minimize the shock or stress between the crushing jaws in the operation of the machine. These couplings 37, 38 may also be utilized for adjustment purposes, if required. Each of the couplings 37, 38 may, as shown, comprise a centre portion 39 of india-rubber, positioned between the ends of the two sections of rods 35, 36, the ends of the latter being constructed with T-shaped heads 40 which each rest against a plate or plates 41 placed next the ends of the rubber buffer, and, say, four T-shaped bolts 42 which pass through holes in the T heads 40 of the sections, which latter will be placed at right angles to each other at opposite ends of the coupling. A plurality of the plates may be placed at one (as shown) or both ends of the buffers 37, 38 to provide for any desired adjustment of the coupling.

The percussion device 2 is fashioned with the two parallel cylinders 6, formed integral with a common valve chest 43 positioned centrally of and beneath said cylinders and providing, between said valve chest 43 and the ends of both cylinders 6, induction ports or passages 44, 45, and two exhaust ports 46, 47 which are common to the adjacent ends of both of the cylinders 6. The cylinders 6, as hereinbefore described, rest upon the cross pieces 3, 4 of the main frame 1, which, as shown in Fig. 6, are shaped to accommodate said cylinders, and they are secured in position by the bolts 5 which pass through a web between the cylinders and through said cross pieces—see Fig. 6.

In each end of each cylinder there is arranged the impact block or piece 31, which, at its inner end, receives the impacts of the hammer pistons 48, 49. At their outer ends the impact blocks or pieces 31 transmit the blows to the backs of their corresponding crushing jaws 14, 15. 50 represents suitable packing arranged in grooves around the impact pieces 31. The impact pieces 31 may, as shown, be enlarged and rounded at their outer ends where they strike the crushing jaws, and reduced at their inner ends where they receive the blows of the hammer pistons 48, 49.

The pistons 48, 49, are shown formed with annular grooves 51, placed at suitable distances apart along the length of the same. These annular grooves reduce the area of the pistons in contact with the cylinders, carry and retain lubricant, and break up any leakage of steam or other fluid which may take place past the pistons. This obviates the necessity for piston rings, as the flow of any leakage past the pistons is retarded.

The inlet 52 for the steam, compressed air or other pressure fluid is provided through the top of the valve chest 43 and between the cylinders 6, and the exhaust ports 46, 47 are provided at diametrically opposite sides of the valve chest 43, intermediate and below the cylinders 6, while the inlet or induction ports 44, 45 pass from the valve chest 43 at opposite sides of the central exhaust ports 46, 47, respectively, to the adjacent ends of both cylinders 6—see Figs. 2 and 5. The bottom of the induction ports

or passages are preferably downwardly inclined in the direction of the valve chest 43 so that any water of condensation passes out through the exhaust ports 46, 47 with the exhaust fluid.

The valve comprises a part 53 which forms a housing for two valve members 54, 55 which co-operate with the induction and exhaust ports at opposite sides of the valve chest 43. The valve members 54, 55 are kept on their seatings by means of springs 56 placed between the backs of the valve members 54, 55, and the recesses provided for them in the valve housing 53. 57 is a valve spindle which passes in through a gland 56 positioned at the top between the cylinders 6 and at its inner end is fixed in the valve housing 53 and rests in a footstep or like bearing 59, which is provided with suitable anti-friction means. The footstep bearing 59 may be provided centrally of the valve chest cover 60 which is suitably fixed to the underside of the valve chest 43.

The means shown for actuating the valve through the spindle 57, comprises a shaft 61 journalled in the sides of the frame 1, a pulley 62 for driving said shaft 61, an eccentric 63 on the shaft 61, an eccentric strap 64 and rod 65, and an operating lever 66 which is fixed upon and transmits the movement of the rod to the valve spindle 57. A ball or other suitable universal or like joint 67 is provided between the end of the eccentric rod 65 and the valve actuating lever 66.

A drain cock 68 is fitted in the cover 60 of the valve chest 43 for draining off any water of condensation from the valve chest 43, prior to starting the machine, after which the water of condensation will pass out with the exhaust, as previously explained.

Instead of coupling the crushing jaws together in opposing pairs as shown and described, so as to ensure that as the blow is struck on the one crushing jaw, the connecting rod will draw the opposing crushing jaws away from the anvil block and thereby enable the material to settle or move down to be crushed at the next blow, each of the crushing jaws may, as shown in dotted lines at 69 in Fig. 1, have attached to it one end of a tension spring 70, which is preferably adjustably attached at its other end to a cross member 71 fixed between the sides of the frame 1.

Around the frame 1 there may be shrunk or otherwise secured a strap or band 72 which will serve to strengthen the frame and increase its resistance to shocks resulting from the blows of the pistons 48, 49.

In the operation of the machine the material which is to be crushed is placed in the hopper-shaped feed openings between the crushing jaws and the anvils, and tends to move down or gravitate through the opening between the same. As the back of each of the crushing jaws is struck by the impact pieces or members, the blows are transmitted to the material which is in the openings or passages between the faces of the anvils and crushing jaws and is thereby reduced or crushed. The crushed material falls through the bottom of the openings on to the plates or chutes 10 and may be received in a hopper or any other receptacle placed thereunder for its reception. The action of the crushing jaws allowing the material to fall through the openings between the anvils and crushing jaws after said material has been reduced, permits the supply of material to be replenished and thereby ensure automatic feeding of the material to the crushing faces. The coupling rods 35, 36, or spring 70, by returning the crushing jaws to the position giving the widest feed opening, allows the material to pack in the hopper-shaped opening as it moves towards the crushing faces. The crushing jaws can be set so as to crush or reduce the material to any desired size of granular or fragmentary product.

What I claim as my invention and desire to protect by Letters Patent is:—

1. Apparatus for crushing or reducing minerals, ores and other material, comprising, in combination, a pair of oppositely arranged stationary anvils, an opposing crushing jaw for each anvil, and a fluid actuated percussive device which is positively operated in both directions and arranged between the crushing jaws and adapted to directly impact upon and so actuate one of said crushing jaws at the end of each stroke, as set forth.

2. Apparatus for crushing or reducing minerals, ores and other material, comprising, in combination, a pair of oppositely arranged stationary anvils, a plurality of crushing jaws co-operating with each anvil and fluid actuated percussive devices which are positively operated in both directions and intermediate the crushing jaws and each adapted to directly impact upon and so actuate one of said crushing jaws at the end of each stroke, as set forth.

3. Apparatus for crushing or reducing minerals, ores and other material, comprising, in combination, a pair of oppositely arranged stationary anvils, an opposing crushing jaw for each anvil, a fluid actuated percussive device which is positively operated in both directions and arranged between the crushing jaws and adapted to directly impact upon and so actuate one of said crushing jaws at the end of each stroke, and means resiliently connecting the opposing crushing jaws, as set forth.

4. Apparatus for crushing or reducing minerals, ores and other material, comprising, in combination, a pair of oppositely ar-

ranged stationary anvils, a plurality of crushing jaws co-operating with each anvil, fluid actuated percussive devices which are positively operated in both directions and arranged intermediate the crushing jaws and each adapted to directly impact upon and so actuate one of said crushing jaws at the end of each stroke, and means resiliently connecting the opposing crushing jaws, as set forth.

5. Apparatus for crushing or reducing minerals, ores and other material, comprising, in combination, a pair of oppositely arranged stationary anvils, a plurality of crushing jaws co-operating with each anvil fluid actuated, percussive devices which are positively operated in both directions and arranged intermediate the crushing jaws and each adapted to directly impact upon and so actuate one of said crushing jaws at the end of each stroke, and a frame constructed at each end to provide a housing for a stationary anvil and with extensions to carry the pivotal supports for the co-operaing crushing jaws, as set forth.

6. Apparatus for crushing or reducing minerals, ores and other material, comprising, in combination, a pair of oppositely arranged stationary anvils, an opposing crushing jaw for each anvil, a fluid actuated percussive device which is positively operated in both directions and arranged between the crushing jaws and adapted to directly impact upon and so actuate one of said crushing jaws at the end of each stroke, and a frame which serves as a housing for the stationary anvils, said frame being constructed with extensions to carry the pivotal supports for the co-operating crushing jaws and with parts which carry the percussive devices, as set forth.

7. Apparatus for crushing or reducing minerals, ores and other material, comprising, in combination, a pair of oppositely arranged stationary anvils, an opposing crushing jaw for each anvil, a fluid actuated percussive device which is positively operated in both directions and arranged between the crushing jaws and adapted to directly impact upon and so actuate one of said crushing jaws at the end of each stroke, a frame which serves as a housing for the stationary anvils, said frame being constructed with extensions to carry the pivotal supports for the co-operating crushing jaws and with parts which carry the percussive devices, and a strengthening band placed around the frame, as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HARRY AUGUST STOCKMAN.

Witnesses:
CHAS. OVENDALE,
ARTHUR W. HACKER.