

April 28, 1953

A. J. ROUBAL

2,636,690

YIELDABLE PITMAN FOR JAW CRUSHERS

Filed Dec. 30, 1949

2 SHEETS—SHEET 1

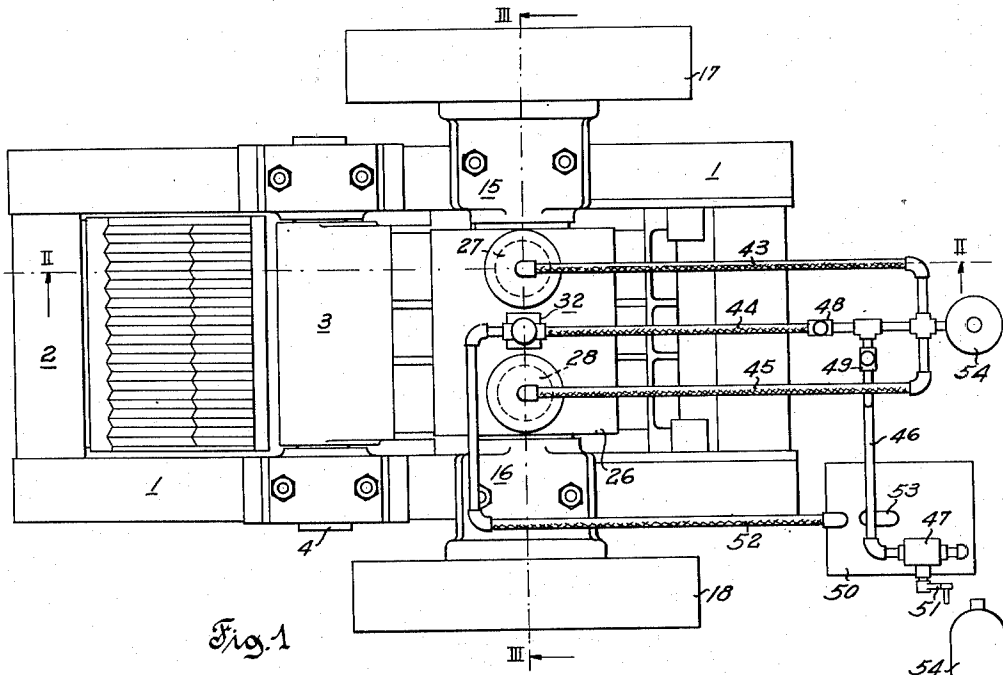


Fig. 1

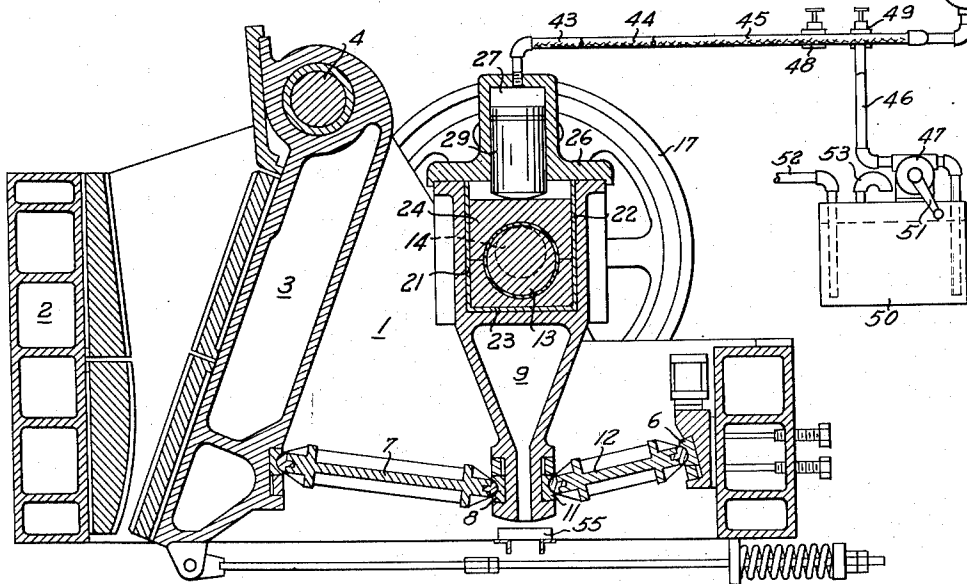


Fig. 2

Inventor
Alexander J. Roubal
by *William F. Latta*
Attorney

April 28, 1953

A. J. ROUBAL

2,636,690

YIELDABLE PITMAN FOR JAW CRUSHERS

Filed Dec. 30, 1949

2 SHEETS—SHEET 2

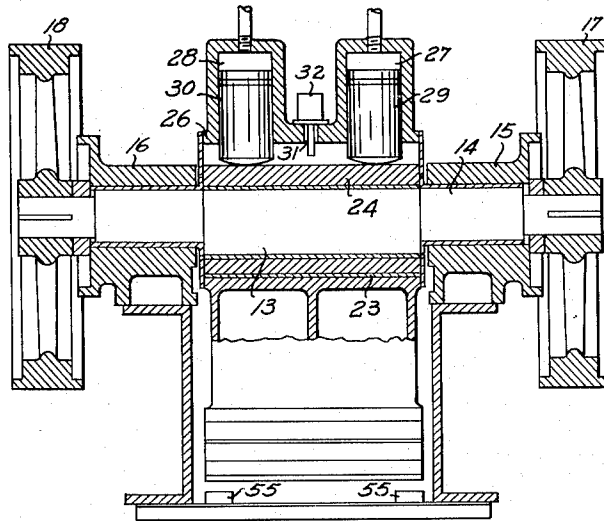


Fig. 3

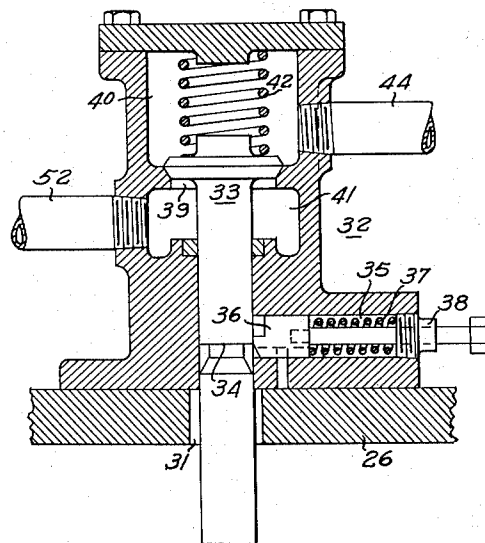


Fig. 4

Inventor
Alexander J. Roubal
by *William S. Felt*
Attorney

UNITED STATES PATENT OFFICE

2,636,690

YIELDABLE PITMAN FOR JAW CRUSHERS

Alexander J. Roubal, Milwaukee, Wis., assignor
to Allis-Chalmers Manufacturing Company,
Milwaukee, Wis., a corporation of Delaware

Application December 30, 1949, Serial No. 136,030

6 Claims. (Cl. 241—269)

1

This invention relates to improvements in crushers, more particularly crushers of the type in which relatively movable jaws are reciprocated with relation to each other to apply crushing forces to objects placed therebetween, and is particularly concerned with the protection of the frame and jaw actuating mechanism from damage by excessive forces resulting from crushing movement with uncrushable material between the jaws.

In crushers of this type, energy is stored in a flywheel on a rotary eccentric shaft and applied to overcome heavy loads occurring during the crushing of rock and the like. When pieces of metal equipment such as tools or the like (known as tramp iron) accidentally get between the jaws, the entire force stored in the flywheel may suddenly be thrown on the frame and parts of the mechanism, subjecting them to serious damage, unless steps are taken to relieve excessive strain until the abnormal condition can be corrected.

The function of protecting the jaw crushers against tramp iron has been served in the past chiefly by using weakened "break pieces" at various points in the mechanism. These can be more or less readily replaced after a break. It has also been served by making one or more parts elastically yieldable to forces in excess of such a force as it is normally expected the parts will transmit, as by use of precompressed springs to hold such parts in normal operating relation and return them after yielding.

The present invention resides in a combination of features including, as a principal link in the mechanism, a deformable member with a hydraulically operated expansible chamber device arranged to maintain the deformable member in normal operating form throughout the normal range of crushing pressures encountered but allowing the member to be deformed by excessive thrust forces. The expansible chamber device, upon yielding, pumps a hydraulic fluid (normally trapped in the device) into an accumulator, against a predetermined resistance. The fluid (being incompressible) normally acts as a solid part of the device, transmitting the applied force from one end of the device to the other. The fluid pressure accumulator furnishes resistance to displacement of the fluid and acts to return any fluid displaced into it by deformation of the link member. Provision is also made for complete release of fluid from the device, under exceptional circumstances, temporarily deactivating the mechanism without interfering

2

with the rotation of the drive shaft and flywheel.

An object of the invention is to create a jaw crusher more safe, reliable and efficient as to overcoming of the problem of passing uncrushable bodies (tramp iron) than known jaw crushers.

Another object of the invention is to create a practical safety mechanism for jaw crushers, capable of automatically interrupting transfer of energy from the eccentric shaft to the movable jaw under certain abnormal conditions, while remaining resettable for normal operation by a simple manual adjustment.

Still another object is to create an effective and reliable yieldable pitman for jaw crushers.

The invention having the above mentioned and still other objects and advantages is described hereinbelow with reference to the drawings, in which:

Fig. 1 is a top view of a jaw crusher and hydraulic system embodying the invention;

Fig. 2 is a cross section of the crusher of Fig. 1 taken on line II—II of Fig. 1, with part of the hydraulic system shown in side elevation;

Fig. 3 is a cross section of the crusher taken on line III—III of Fig. 1;

Fig. 4 is a cross section of a detail of the hydraulic system, shown to an enlarged scale;

And in which the same reference characters indicate the same or similar parts throughout the several views.

The drawings illustrate a crusher of a well known type, which has been improved by incorporation of an embodiment of the applicant's invention. The crusher comprises a frame 1 disposed in a generally horizontal plane on a suitable foundation (not shown). At one end of the frame 1 is a stationary jaw structure 2. A swing jaw 3 is operably mounted on a pivot shaft 4 carried by the frame 1. At the end of frame 1 opposite from fixed jaw 2 is an end wall with an adjustably mounted toggle bearing block 6. Actually disposed between the swing jaw 3 and the end of the frame to which the block 6 is mounted, is a variable length pitman comprising a first portion, such as an eccentric bearing block 24, and a relatively movable longitudinally extending second portion, such as a pitman shank member 9. A suitable mechanism such as a toggle plate 7 is arranged between the rear surface of swing jaw 3 and a toggle bearing 8 on one end of the pitman shank member 9. Between a second toggle bearing 11 on the shank 9, and toggle bearing block 6 on the frame, a second toggle plate 12 is arranged. The pitman shank 9 is op-

3

eratively connected, at the end opposite the toggle bearings 8 and 11, with an eccentric portion 13 of an eccentric shaft 14, journaled for rotation in bearings 15 and 16 in frame 1. The details of this connection will be more fully described hereinbelow. Flywheels 17 and 18, either of which may serve as a drive pulley with a driving belt (not shown) engaging its rim, are keyed to the ends of shaft 14.

At the end opposite toggle bearings 8 and 11, the pitman shank 9 is given the form of a channel with side guide surfaces 21 and 22 and a bottom surface 23. This channel extends at right angles to the longitudinal or thrust axis of the pitman; and the side guide surfaces 21 and 22 extend longitudinally of the shank, that is, they are essentially formed of straight parallel lines extending from the bottom surface 23 to the end of shank 9 in a direction generally parallel to the longitudinal or thrust axis of the pitman shank 9. Mounted in this channel is the eccentric bearing block 24 having opposite side surfaces arranged to fit the side guide surfaces 21 and 22. The top of the channel in the pitman shank is closed by an end cap member 25 secured to the shank 9 in any suitable known manner. The depth of the channel, between the inner or lower surface of the cap 25 and the channel bottom surface 23, is arranged to exceed the depth of the eccentric bearing block 24 by at least twice the eccentricity of the eccentric 13 with relation to the rotational axis established by the bearing journals of shaft 14, for a reason which will be set forth hereinafter.

The end cap 25 is constructed with a forcibly collapsible normal thrust transmitting means, comprising a chamber means such as a pair of parallel cylinder recesses 27 and 28, in which a hydraulically biased means such as a pair of piston members 29 and 30, respectively are carried, closely fitting their respective cylinder recesses in longitudinally slidable fluid tight relation and having lengths substantially greater than twice the eccentricity of the eccentric 13. Preferably between the recesses 27 and 28, is an aperture 31 through the end cap; and at the outer end of this aperture a valve 32 is secured rigidly to the end cap. Valve 32 has a valve member 33 with an actuating stem projecting through the aperture 31 and having a shoulder 34. The valve body has a lateral bore 35 communicating with the bore in which the stem of member 33 slides and in which is a relatively slidable latch member 36, spring pressed toward the stem 33 by spring 37 and having an actuating stem projecting slidably through plug 38 which closes the outer end of bore 35. The valve member 33 normally closes an opening 39 between valve chambers 40 and 41 and is pressed toward closed position by a spring 42.

To the recesses 27 and 28 and the chambers 40 and 41 of the valve 32 is connected a hydraulic system consisting in part of pipes or conduits 43, 44 and 45, flexible in whole or in part, communicating with recess 27, valve chamber 40, and recess 28, respectively. Pipes 43, 44 and 45 all communicate with each other and are connected, by a pressure fluid supply conduit 46, with the discharge of a high pressure hydraulic fluid pump 47. Stop valves 48 and 49 are placed in conduits 44 and 46, respectively. Pump 47 takes suction from a hydraulic fluid reservoir 50 and may be manually operated as by a handle 51 (as shown), or power operated by any suitable known means (not shown). Chamber 41 of valve

4

32 may be connected as by a flexible waste line 52 with the reservoir 50, which may be vented to atmosphere as at 53. Also in open communication with pipes 43, 44 and 45 is a hydraulic fluid pressure accumulator 54, which may be of a known type (such as the diaphragm type shown in U. S. Patent No. 2,401,791 or the sliding piston type shown in U. S. Patent No. 2,021,895). Hydraulic fluid is permitted to enter the accumulator only against gas pressures greater than an initial charging pressure established by charging the gas side with compressed gaseous or elastic fluid to a predetermined degree.

On the crusher frame 1, and rigidly connected therewith, is a pitman rest, or stop pad 55 (two shown) which will be normally spaced below the lower end of pitman member 9 by a distance such that, with the piston at its lowest operative position, there will be a spacing from the rest less than the excess of permissible movement of the block 24 in the member 9 over twice the shaft eccentricity.

The crusher is prepared for operation by filling the pressure pipes and conduits, the recesses 27 and 28, and valve chamber 40, with hydraulic fluid, charging the gas side of the accumulator with air or nitrogen, or other suitable elastic fluid, to a predetermined degree dependent upon the desired maximum hydraulic pressure in the system, and then closing the valve 48, opening the valve 49 and operating pump 47 to further charge hydraulic fluid into the pipes and recesses until the pistons 29 and 30 force the bearing block 24 down against the bottom surface 23 of the channel in the pitman shank 9. The hydraulic pressure in the pipes and recesses should then oppose the elastic fluid pressure in the accumulator and support the pitman and jaw operating mechanism in operative position. The operator then makes sure that the valve 32 is tripped to its normally closed position, opens valve 48 and closes valve 49, and then the crusher is ready for operation. Suitable air bleeding cocks or filling caps (not shown) may be placed at high points of the system to permit complete filling with hydraulic fluid, free of air, as is well known in the art of hydraulic mechanisms.

Rotation of the shaft 14 and flywheels 17 and 18 will now cause reciprocatory movement of pitman shank 9 and this in turn will move the toggle mechanism to cause swinging of swing jaw 3 toward and away from fixed jaw 2 through a desired arc determined by adjustment of toggle bearing block 6.

When abnormal crushing pressure reactions occur, as when tramp iron gets between the jaws, and the pressure transmitted from the drive or flywheels through the bearing block 24 and pistons 29 and 30 to the hydraulic fluid in recesses 27 and 28 exceeds the predetermined degree of pressure at which it has been determined that yielding should occur to protect the rigid parts of the mechanism, the hydraulic pressure will exceed the initial charging pressure of the accumulator and hydraulic fluid will be displaced from the recesses 27 and 28 (and connected pipes) into the accumulator. The eccentric bearing block 24 will then move relative to the pitman shank 9 so that no further movement of the jaw 3 will occur until the pressure on block 24 is reduced below the predetermined degree. If the abnormal condition is alleviated, the swing jaw will resume its normal motion. However, if the stoppage is of such magnitude that the block 24 moves sufficiently, relative to shank 9, so that it contacts valve stem 33 and moves the same

5

enough to open the valve 32 appreciably, the latch member 36 will move in and engage the shoulder 34, holding the valve open against the spring 42 and the pressure in chamber 40, and the pressure will rapidly drop to atmospheric, allowing the pitman shank 9 to fall so that its lower end rests and rocks on the rest or stop pad 53. The shaft rotation will then cause movement of bearing block 24 and oscillation of the shank 9 without substantial movement of swing jaw 3.

To reset the crusher for operation, after the tramp iron is removed, or other abnormal conditions cleared up, the valve 48 will be closed, the valve 49 will be opened, and the lost hydraulic fluid will be restored to the hydraulic system by operation of pump 47 until the block 24 is again forced against the bottom 23 of the pitman shank channel. Valve 32 will then be tripped to normally closed condition; and the opening of valve 48, and closing of valve 49, then reconditions the crusher for normal operation.

It will be readily understood that what occurs in the crusher protected by the present invention is not merely a resilient yielding of precompressed springs, but under certain conditions, a definite deactivation of the jaw actuating mechanism so that it cannot continue to act under severe stresses, or resume action, until reset intentionally, as by an operator or by whatever known automatic device might be available to perform the functions of an operator in detecting clearance of the abnormal conditions and resetting the jaw actuating mechanism in response to such clearance. The pitman, which, when set for normal operation, will yield only to a predetermined stress on the pitman, will, after a predetermined degree of yielding, condition the hydraulic system in such a manner that yielding may occur at no-load; and the jaw moving mechanism is thus completely deactivated by some abnormal conditions, until deliberately reset to resume normal operation.

Although but a single embodiment has been described and illustrated, it will be apparent to persons skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. In a crusher of the type described, the combination comprising: a frame; relatively movable jaws operably mounted in said frame; means operably engaging said frame and jaws and including a pitman and a rotatable shaft journaled in said frame and having a rotatable eccentric connection with said pitman for giving said jaws a crushing movement, said pitman having two relatively movable portions interengaged for guided sliding movement, longitudinally of the pitman shank, between two limiting positions, one for normal operation and the other to be assumed only under abnormal conditions, differing by at least twice the eccentricity of the eccentric shaft connection; and a hydraulic fluid operated mechanism operably connected with and having expansible chamber forming, relatively movable parts engaging said portions and operable by hydraulic pressure to thrust said portions to said normal operating position in a direction to tend to close said jaws; pressure fluid accumulator means hydraulically connected with said expansible chamber and operable to receive fluid therefrom at fluid pressures above a predetermined degree normally caused by

6

crushing reaction on said chamber forming mechanism; and, a fluid release valve hydraulically connected with said chamber and mechanically actuable by a predetermined relative positional movement of said pitman portions away from said normal operating position to release fluid from said expansible chamber.

2. A jaw crusher comprising: a frame; a fixed jaw in said frame; a movable jaw operably mounted in said frame for crushing movement relative to said fixed jaw; a rotatable eccentric shaft journaled in said frame; and a mechanical movement mechanism connecting said shaft to said movable jaw to convert rotation of said shaft into reciprocating motion of said movable jaw, characterized by a reciprocating power transmitting member of variable length carrying a hydraulic mechanism operable by hydraulic fluid under pressure to give said member a normal effective operative length; a hydraulic system including said hydraulic mechanism and normally containing a predetermined quantity of fluid; a hydraulic accumulator in said system for receiving a portion of the fluid from said hydraulic mechanism under a degree of pressure greater than a predetermined pressure created in said mechanism by normal operation of said crusher and returning same upon a drop in pressure; normally closed valve means connected with said hydraulic mechanism for releasing a portion of said fluid therefrom under abnormal conditions; and means connected with said valve means actuable by a predetermined change in effective length of said member to open said valve means.

3. A pitman for a jaw crusher of the type described comprising: a shank having reciprocating mechanism operating bearings at one end; a bearing guide channel extending through the opposite end of said shank in a direction at right angles to the longitudinal axis of said shank and having side guide surfaces extending longitudinally of said shank; a bearing block mounted in said bearing guide channel, having side surfaces fitting said side guide surfaces and a bearing bore extending through said block perpendicular to the designed plane of motion of said shank and open at both ends of said channel; a cap closing the channel end of said shank; a cylinder formed in said cap with its longitudinal axis parallel to said side guide surfaces; and a piston slidably mounted in said cylinder and having a portion engageable with said bearing block and arranged to be slidable in a direction to force said block in a direction longitudinal of said shank and toward the said reciprocating mechanism operating bearings, the depth of said channel along the longitudinal axis of said shank being sufficient to permit substantial movement of said block in said side guide surfaces.

4. In a crusher of the type described: a frame; relatively movable jaw members operably mounted in said frame; a rotatable eccentric shaft journaled in said frame; a variable length pitman having an eccentric engaging bearing portion and a longitudinally extending second portion relatively movable through a limited distance in a longitudinal direction relative to said bearing portion; a hydraulically biased means interposed between said bearing and said second portion of said pitman in such a manner that a jaw closing force from said eccentric shaft will tend to oppose said hydraulically biased means; hydraulic fluid pressure accumulator means hydraulically connected with said biased means to

receive fluid therefrom at pressures induced by crushing pressures in excess of a predetermined degree and to return said fluid against lesser inferior pressures; a fluid release valve hydraulically connected with said biased means and normally preventing escape of fluid therefrom, said valve being actuatable to release fluid from said biased means when said bearing portion moves a predetermined distance relative to said second portion.

5. A variable length pitman member for a jaw crusher, comprising: an eccentric bearing portion; a second portion having longitudinally extending guide surfaces engaging matching surfaces on said eccentric bearing portion in limited longitudinally slidable relation in a manner to provide for movement of said second portion toward and away from a normal pitman-operating-length-determining position with relation to said bearing portion; hydraulic pressure expandable chamber means operably engaging said bearing and second portion in a manner to thrust said second portion toward said normal position; a hydraulic accumulator hydraulically connected with said expandable chamber means to receive fluid therefrom under pressures in excess of a predetermined pressure; a normally closed hydraulic fluid release valve connected to said expandable chamber means for releasing fluid therefrom; and means operably connected with said pitman portions for opening said valve upon a predetermined movement of said second portion relative to said bearing portion.

6. A jaw crusher pitman assembly comprising: a shank member having toggle end bearings formed thereon at one end and a transverse channel formed at the opposite end, the bottom of said channel extending parallel with said toggle end bearings and its side walls being parallel and extending longitudinally of the thrust axis; a parallel-sided, eccentric-engaging bearing member mounted in said channel and slidably guided therein for relative movement

longitudinally of the thrust axis of said shank member; an end cap secured to said shank member in bridging relation to said channel and serving to limit movement of said bearing member in said channel; a cylinder recess in said end cap, opening into said channel; a piston operable by fluid pressure in said recess and having a portion engageable with said block to urge the same along the thrust axis of said shank member in the direction of said toggle bearing end; a normally closed valve member mounted in said end cap and having a movable actuation element extending longitudinally of said thrust axis of said shank member into the path of movement of said bearing member relative to said shank member, said valve being hydraulically connected with said cylinder recess and openable by said actuating member to release fluid therefrom in response to a predetermined degree of relative movement of said bearing member in the direction of said end cap.

ALEXANDER J. ROUBAL.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
Re. 10,085	Krom	Apr. 11, 1882
120,784	Smith	Nov. 7, 1871
160,682	Johnson	Mar. 9, 1875
419,294	Spiers et al.	Jan. 14, 1890
419,460	Krom	Jan. 14, 1890
446,658	Buchanan	Feb. 17, 1891
844,350	Hale	Feb. 19, 1907
1,256,289	Bernhard	Feb. 12, 1918
1,761,268	MacLennan	June 3, 1930
2,205,632	Schwarz	June 25, 1940

FOREIGN PATENTS

Number	Country	Date
13,556	Great Britain	Aug. 3, 1901
19,827	Great Britain	Sept. 15, 1903
536,672	Great Britain	May 22, 1941