United States Patent

[11] 3,608,840

[72] Inventor **Mark R. Lange**
Joplin, Mo.
[21] Appl. No. **788,808**
[22] Filed **Jan. 3, 1969**
[45] Patented **Sept. 28, 1971**
[73] Assignee **New Byers Corporation**

[54] **NONCLOGGING IMPACT CRUSHER**
6 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **241/167,** 241/187
[51] **Int. Cl.** **B02c 13/09,** B02c 13/282
[50] **Field of Search** 241/166, 167, 185, 187, 189, 285, 286, 102, 88

[56] **References Cited**

UNITED STATES PATENTS

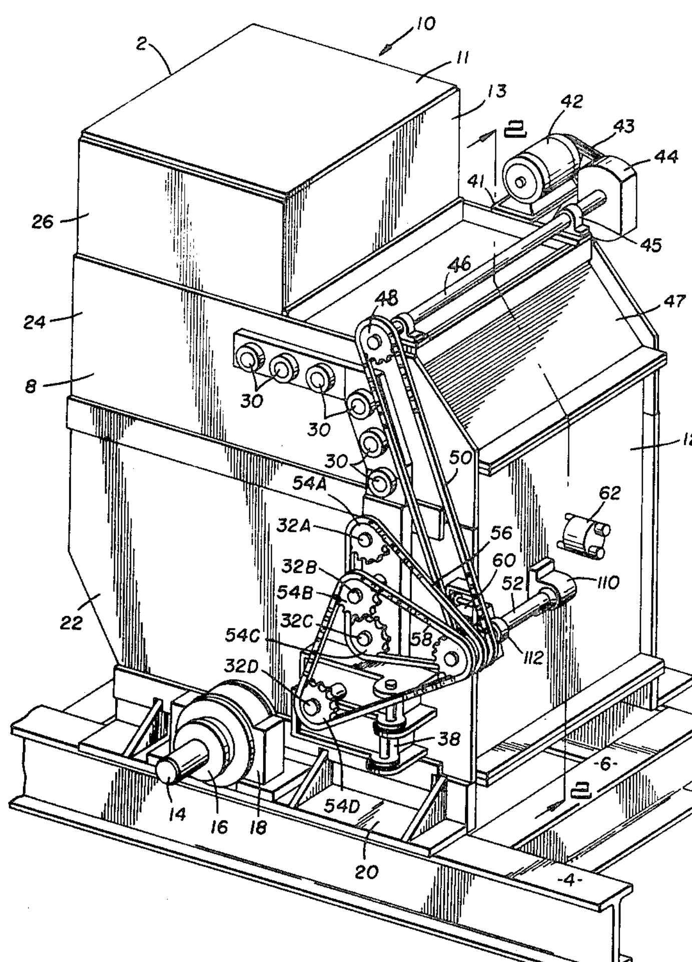
2,045,691	6/1936	Armstrong	241/189
2,993,657	7/1961	Meyer	241/189 X
3,126,014	3/1964	Bonner	241/187 X
3,202,368	8/1965	Nixon	241/189
3,298,620	1/1967	Bertoli	241/285

FOREIGN PATENTS

238,117	8/1925	Great Britain

Primary Examiner—Donald G. Kelly
Attorneys—Frank C. Rote, Jr. and John J. Murphey

ABSTRACT: A rock crusher of the type having a confined chamber in which a heavy rotor, carrying a plurality of hammers, contacts large rocks with sufficient force to fracture the rocks and to impel them against spaced parallel breaker bars for further size reduction is provided with self-cleaning features which permits it to handle wet or sticky feed stock without clogging. At least some of the active breaker bars are slowly rotated during operation of the crusher and the wall of the chamber in back of the bars is vibrated to prevent adherence or sticking of material to the bars and wall. The rotating bars may also be provided with intermeshing lobes or with scraper bars to further assist in the self-cleaning.



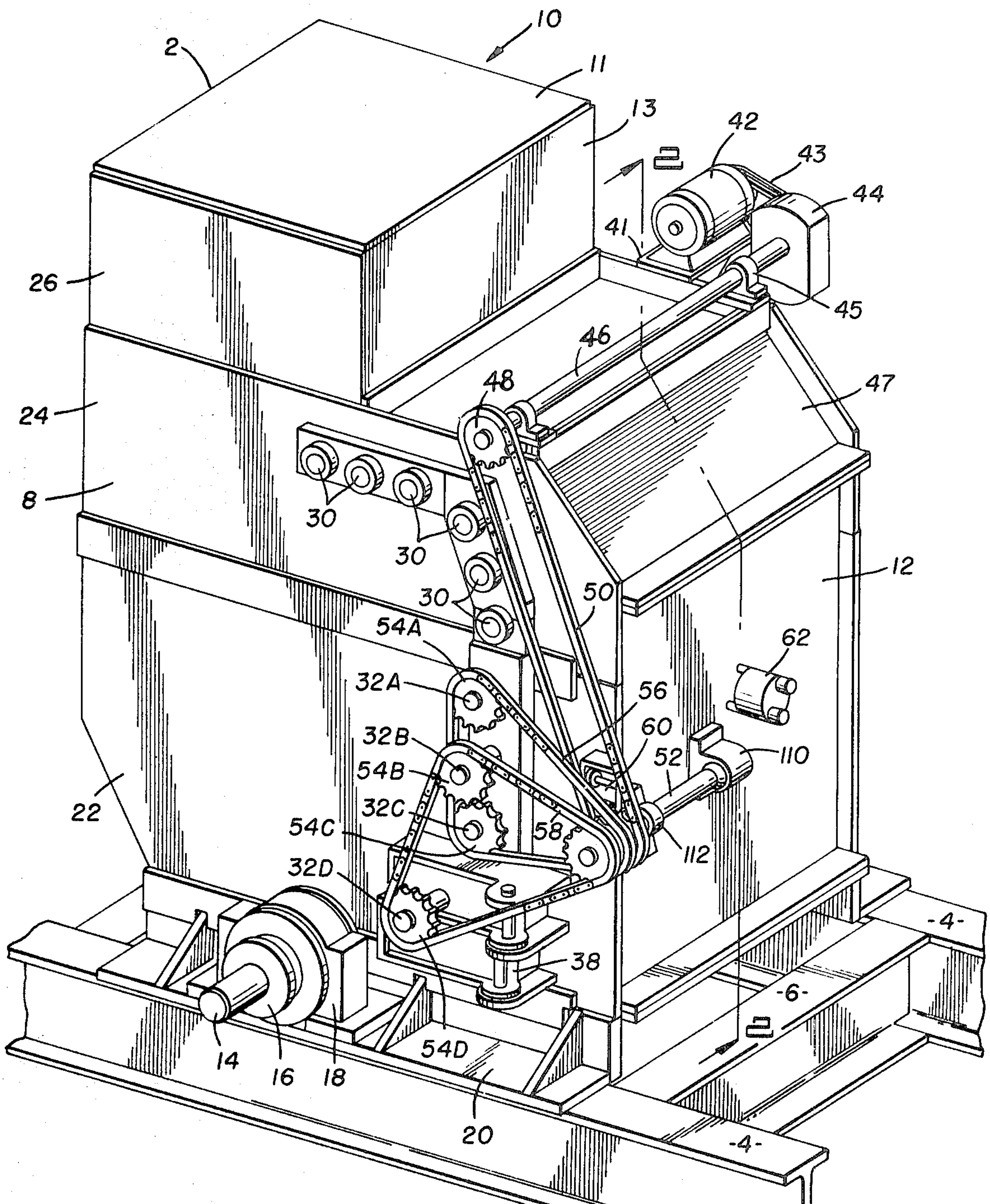
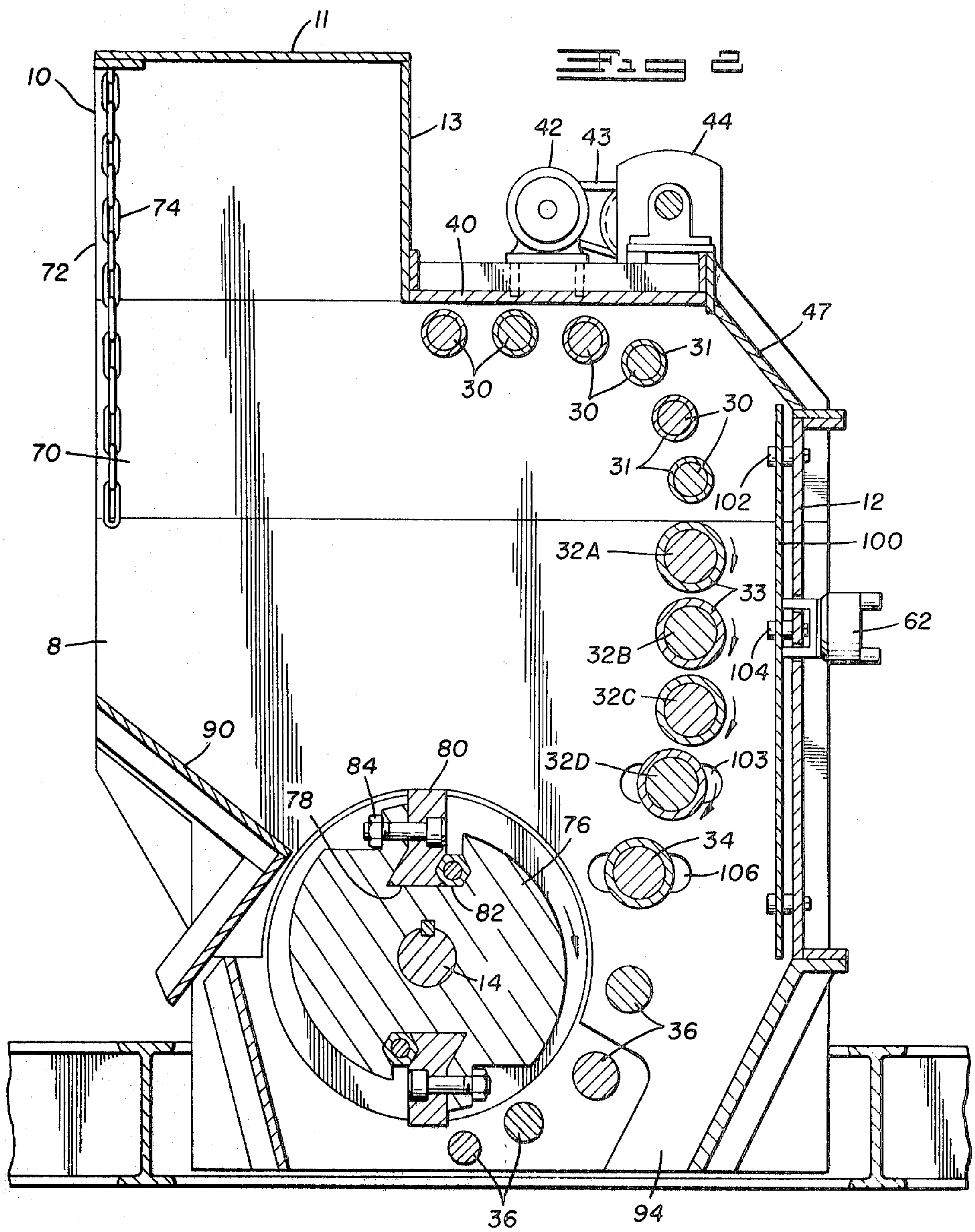


Fig 1

INVENTOR.
MARK R. LANGE
BY James A. Lucas
ATTORNEY

Fig 2



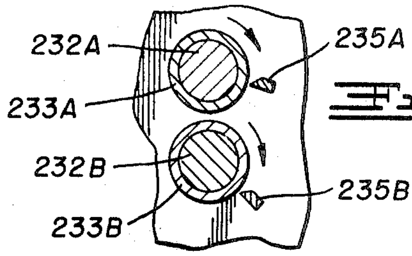


Fig 7

INVENTOR.
MARK R. LANGE
BY James A. Lucas
ATTORNEY

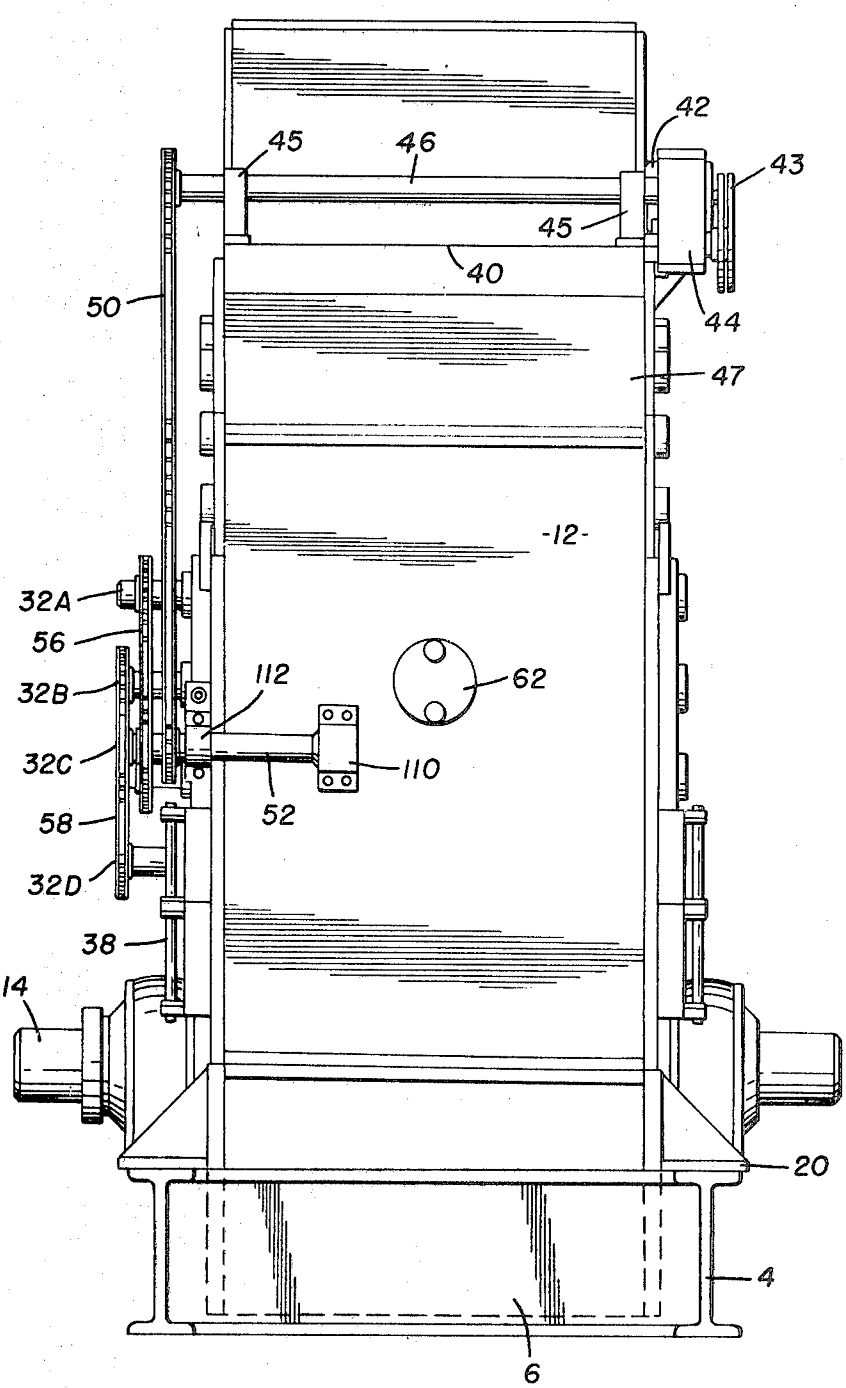


FIG 3

INVENTOR.
MARK R. LANGE
BY James A. Lucas
ATTORNEY

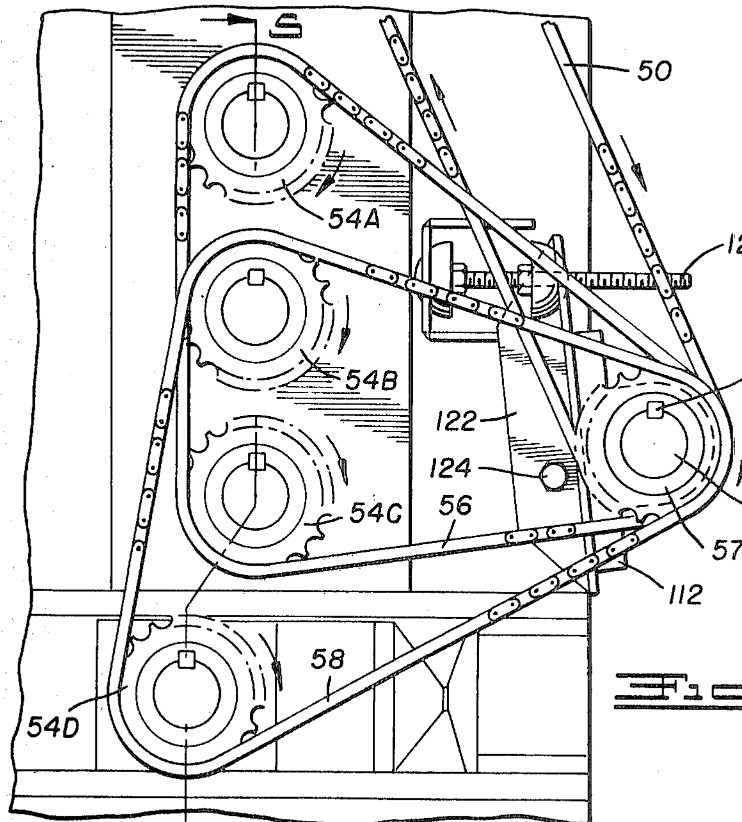
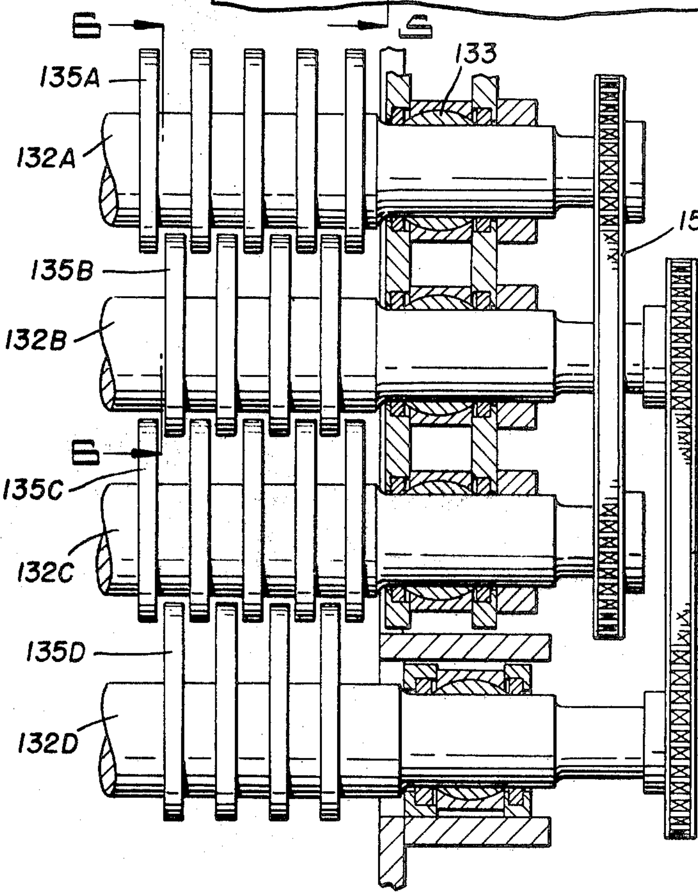


Fig 4



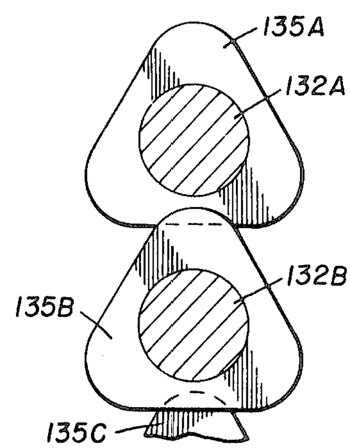


Fig 6

Fig 5

INVENTOR.
MARK R. LANGE
BY James A. Lucas
ATTORNEY

NONCLOGGING IMPACT CRUSHER

BACKGROUND OF THE INVENTION

There are several types of machines that are used for the crushing and size reduction of rocks including jaw crushers, gyratory crushers, cone crushers, pan crushers, roll crushers, and impact crushers. These various machines utilize different principals of operation in accomplishing their desired objective. In an impact crusher, the rocks are struck with a sufficiently hard blow to fracture them into smaller pieces. The present invention deals with rock crushers of this type. Generally an impact crusher uses one or more rotors each having two or more hammers evenly spaced about its periphery. The rock is fed by gravity into the rock crusher where it is struck by a rapidly moving hammer and is impelled against one or more breaker bars. These breaker bars are positioned so as to protect the walls of the chamber that would normally be subjected to the greatest amount of abrasion and wear by rapidly propelled rocks. The breaker bars are generally circular and are typically fabricated from bar stock, several inches thick, normally heat treated so as to provide a wear-resistant surface. When the size of the rock is sufficiently small, it passes between the bars and falls to the bottom of the crusher where it is removed. Thus it can be seen that the spacing between the bars determines the size of the final product.

In the past, quarry rock of relatively high quality and low moisture was used as feed stock for the crusher. This rock contained a relatively small amount of foreign material such as mud and clay and very little moisture. However, as sources of this high quality rock are slowly depleted, it is often necessary in many locations to rework tailings and secondary sources of ore to supply enough crushed rock to satisfy customer demand. The alternative sources of rock normally contain a higher portion of foreign materials or moisture, both of which tend to clog the crusher, thereby preventing proper size reduction and causing a substantial diminution in the efficiency of the crusher.

SUMMARY OF THE INVENTION

One object of the present invention is to improve the operation and efficiency of an impact-type rock crusher.

Another object is to overcome the problems caused by wet feed and foreign materials sticking to the breaker bars and wall in a hammer crusher by rotating certain of the breaker bars and by vibrating the wall behind the breaker bars.

A further object is the provision of lobes for scrapers in conjunction with these rotating breaker bars to further assist in preventing the build up of foreign or wet materials.

These and other objects are accomplished in the manner to be hereafter more fully described with particular reference to the drawings which serve to characterize the invention and to show some of the preferred embodiments thereof wherein

FIG. 1 is a perspective elevational view of a single-rotor impact crusher, as viewed from the side and rear of the crusher;

FIG. 2 is a cross-sectional elevation of the crusher taken along lines 2—2 of FIG. 1 showing the rotor, breaker bars and some of the improved features of the present invention;

FIG. 3 is an elevational view of the back of the brusher;

FIG. 4 is an enlarged partial view of a tension adjustment means for the chains used to rotate various of the breaker bars;

FIG. 5 is a partial cross-sectional view showing a further embodiment of the invention;

FIG. 6 is a view taken along lines 6—6 of FIG. 5, and

FIG. 7 is a partial view showing yet another embodiment of the invention.

The present invention relates to a rock crusher composed of a housing defining a crushing chamber having a front feed opening therein and a backwall spaced opposite said opening. A top, sidewalls and a bottom discharge opening complete the chamber. Rotor means within the chamber have two or more axially extending hammers evenly spaced about the periphery thereof. A plurality of spaced, heavy-duty breaker bars are spaced from the rotor, and are vertically positioned in front of and spaced from the back wall to protect the same. Additional breaker bars may extend along the top of the chamber for added protection. To prevent the accumulation of material around the breaker bars and the wall, at least several of the more active breaker bars, i.e., those close to the rotor that participate to the greatest extent in the fracturing of the rocks, are slowly rotated preferably in the same direction as that of the rotor. At the same time the wall in back of these rotating breaker bars is vibrated at a relatively high frequency to prevent accumulation of material on the wall.

In FIG. 1 the crusher 2 is mounted on a pair of heavy-duty I beams 4 cross braced with additional I beams 6. The enclosed chamber has a feed chute 10, sidewalls 8 (one of which is shown), inclined wall 47, top 40, and a backwall 12. The feed chute 10 is defined by two sides 26, a backwall 13, top 11 and a feed opening having a chain curtain (shown in FIG. 2). A rotor shaft 14 runs in two bearings 16 which are supported in pillow blocks 18 which in turn are mounted on the framework 20 on I beams 4.

The sidewall 8 is composed of a plurality of plates 22, 24, 26. This facilitates repair of the wall by replacement, not of the entire wall but rather of individual plates, when they become worn or broken.

Extending through the sidewalls and generally parallel to the rotor are a plurality of heavy round breaker bars including several bars 30 along the upper portion of the chamber, four rotatable bars 32A, B, C and D along the backwall and several bars 36 (shown in FIG. 2) along the lower portion of the chamber. The two breaker bars 32D and 34 immediately above the axis of the rotor are adapted to be moved toward or away from the periphery of the rotor, thereby serving as means to regulate the maximum size of product passing through the crusher. These two bars 32D and 34 are preferably provided with a safety arrangement as generally described in U.S. Pat. No. 3,202,368 assigned to the assignee of the present invention, to prevent serious damage to the crusher in the event that tramp iron or the like becomes jammed between the rotor and either one of the breaker bars.

Mounted on a platform 41 projecting from the top 40 beyond the sidewall 8 of the brusher is a motor 42 which drives a gear reducer 44 by belt 43. This gear reducer transmits rotary motion through shaft 46 to sprocket 48. The shaft is held in place by pillow blocks 45. The sprocket 48 is connected by chain 50 to a similar sprocket on idler shaft 52 mounted in pillow blocks 110, 112 on the backwall 12 of the crusher. The four rotatable breaker bars 32 A, B, C and D extend through the sidewall 8 of the chamber and have sprockets 54A, 54B, 54C and 54D mounted thereon. Chain 56 passes around a second sprocket on idler shaft 52 and then around sprockets 54A and C to drive breaker bars 32A and C while chain 58 passes around a third sprocket 57 on idler shaft 52 and thence around sprocket 54B and 54D to rotate breaker bars 32B and 32D. Adjustment means 60 is used to regulate the adjustment of the tension on the various chains 50, 56 and 58. A vibrator 62 is mounted on the backwall 12 of the crusher and has an oscillator that is connected to an inner wall resiliently connected to the backwall.

FIG. 2 shows the details of the interior of the single-rotor rock crusher of FIG. 1. The crushing chamber is generally defined by the top 40 sidewall 8, backwall 12 and front 70. A feed chute 10 has an entrance 72 which is provided with a row of heavy chains 74 suspended from the top 11 of the chute. These chains permit large rocks to be introduced into the chamber and serve to keep small rocks from flying out of the chamber after being struck by the hammers. The rotor 76 contains a pair of slots 78 in which hammers 80 are positioned, and are securely locked by suitable means such as wedges 82 and bolts 84 details of which are more completely described in U.S. Pat. No. 3,295,773 owned by the present assignee of the subject invention.

Below the feed opening is a feed plate 90. For best results it is customary for the feed plate to form an angle with the axle

14 of the rotor and with the lowermost heavy duty breaker 34 of less than 180°. In this manner, one hammer is passing through the active zone delivering impact blows to the incoming feed, while the other hammer is inactive. This serves to deliver the full energy of the heavy rotor to the impact.

As a rock is struck, it is thrown upwardly against the breaker bars. These bars in the impact zone can be provided with wear-resistant sleeves 31,33 which are adapted to be readily removed and replaced when worn. Breaker bars 32 D and 34 are disposed in slots 103, 106 respectively and can be moved toward or away from the rotor 76 to control the size of the final product. Bars 36 located below the shaft of the rotor participate to some extent in the crushing of the rock but are generally not as active as those above the shaft. Feed stock that is reduced to a sufficiently small size passes between the breaker bars and falls through discharge chamber 94 onto a conveyor, or the like placed beneath the crusher.

A floating wall 100 is joined to the backwall 12 of the chamber by a plurality of elastomeric bushings 102. This floating wall is coupled to the vibrating mechanism 104 of the vibrator 62. When wet feed or feed stock containing foreign materials such as mud and clay is being processed, the material that passes through the breaker bars contacts, adheres to and builds up on the backwall, eventually blocking the passage of properly sized material through the breaker bars and down into the discharge chute. 94. Vibration of the floating wall 100 serves to prevent this accumulation of material on the wall. Rotation of breaker bars 32 A, B, C and D with the use of scrapers or lobes helps to prevent the build up of material between these breaker bars.

An electromagnetic vibrator oscillating at a maximum of 3,600 cycles per minute has been found to be satisfactory in carrying out the teaching of the present invention. By use of a rheostat control, this frequency can be varied as needed. The invention is not limited to the use of electrically operated oscillators; instead mechanically or pneumatically actuated oscillators may be employed. The rubber bushings provide a convenient and preferred means of attaching the floating wall 100 to the backwall without transmitting the vibrations to the backwall. It should be understood, however, that other means may be used to join the two walls together.

FIG. 3 is a rear view of the rock crusher, showing the drive arrangement for the rotating breaker bars. The speed reducer 44 is driven by belts 43 connected to motor 42 immediately in back of the reducer, and in turn the reducer drives shaft 36 secured in pillow blocks 45. On the end of the shaft is connected a sprocket that drives chain 50. This chain rotates idler shaft 52 mounted in a self-aligning bearing in pillow block 110 bolted or otherwise secured to wall 12. The idler shaft passes through a second self-aligning bearing in pillow block 112 and is cantilevered therebeyond. Connected to the projected portion of the idler shaft 52 are three sprockets. Chain 50 passes around the sprocket closest to the wall of the crusher. The next adjacent sprocket drives chain 56, which rotates breaker bar 32A and 32C. Chain 58 revolves around the outermost sprocket and passes around sprockets on breaker bars 32B and 32D. Because of the high starting torque that is required to commence rotation of the breaker bars as well as the torque applied by the repeated impact of rock against the breaker bars, it is necessary that a torque control such as a torque coupling between the motor and the load, and/or a torque control integral with the sprockets mounted on idler shaft 52 be used.

Details of the tension adjustment means, as well as the arrangement of the various sprockets for the rotors is shown in FIG. 4. In this figure, sprocket 57 and the other sprockets directly behind it are joined to idler shaft 52 by appropriate means such as a slotted keyway in which key 120 is disposed. As previously mentioned the shaft is supported in two pillow blocks one of which 112 is shown. This pillow block is mounted to a plate 122 pivotally mounted to the sidewall of the rock crusher by suitable means such as bolt 124 and nut. A screw adjustment 126 permits adjustment of the plate 122 toward or away from sprockets 54 A, B, C and D thereby providing means to readily adjust the tension on chain 56 and 58. Such adjustment means are normally necessitated by the chain becoming worn and undergoing a certain amount of elongation and stretching in use.

In a specific embodiment of the invention a five horsepower motor rotating at 1,750 r.p.m. is connected by twin V-belts to a shaft mounted speed reducer. The input r.p.m. of the reducer is maintained at 636 r.p.m. through the sheave ratios of the V-belt drive. The reducer in turn converts this input to an output speed of 25 r.p.m. through the internal gears of the reducer. The output speed is transmitted through a shaft to an 18 tooth sprocket in the end of the shaft opposite the reducer. A chain drive from the output shaft sprocket to a similar 18 tooth sprocket drives the idler shaft. Two other sprockets each having 18 teeth are mounted on the idler shaft next to the existing driven sprocket. These two sprockets differ from the driven sprocket in that they have a torque limiting device, similar to a friction-type plate clutch. These devices protect the idler shaft and chains against the sudden change in torque caused by rocks impacting against the rotating breaker bars. An individual chain drive passes around each of the clutch-type sprockets and to alternative breaker bars having 18 tooth sprockets on their projecting ends. The use of the clutch-type sprockets protects the entire system, from rotating bars to and including the motor, from excessive overload due to the surges in torque caused by rocks being disintegrated against the breaker bars. Each of the clutch-type sprockets are adjustable and their torque limit may be set as determined by existing conditions.

It should be mentioned that the motor shall mean any and all power producing units whatever their configuration may be. Also, the reducer indicates a means whereby the input speed is either increased or decreased for output by whatever means necessary. The clutch-type sprockets shall be any and all means whereby the torque input or output of the sprockets may be adjusted or limited as desired.

It has been found that the optimum results are achieved when the breaker bars rotate in the same direction as the rotor means. In most applications the bars would be rotated at a speed somewhere between 10 and 50 r.p.m. depending upon the application. Rotation of adjacent bars in opposite directions will also help to reduce accumulation of material, but to a lesser extent than rotation in the same direction.

As herein shown, it has been found that effective cleaning is accomplished by rotation of four breaker bars. It should be noted, however, that this number is subject to variation depending upon the type and nature of feed stock and the size of the crusher. In some instances, the rotation of two breaker bars may be found effective. In others, it may be necessary to rotate six or more of the breaker bars.

It should be further noted that the drive arrangement can be varied without departing from the present invention. For example, direct drive from the speed reducer directly to the breaker bars is possible. Furthermore, it is not necessary to utilize two separate sets of chains to drive alternate breaker bars. Instead, each breaker bar may be individually driven. Alternately, all four breaker bars may be rotated by one chain passing over multiple sprockets. Yet, another approach would be to drive one adjacent pair of breaker bars with one chain and a second pair with another. Chains have been found to be particularly effective in that they are highly efficient and are capable of transmitting the required power in a positive manner. However, it should be understood that a gear drive or other means such as V-belts can be used in place of one or more of the chains.

As a further modification it should be noted that other types of torque control can be used between the motor and the load. These may be electrical, mechanical or pneumatic.

FIGS. 5 and 6 show another embodiment of the invention constituting a further means of preventing the build up and accumulation of foreign material between and around the breaker bars and the backwall of a rock crusher. Breaker bars

132 A, 132 B, 132 C and 132 D are mounted in and extend through suitable bearings 133. To one end of each breaker bar is secured a suitable sprocket. Chain 156 passes around the sprockets on breaker bars 132 A and C while chain 158 passes around the sprockets on the other two rotating breaker bars, to drive the bars in generally the same manner as previously described. At spaced intervals along the breaker bars within the chamber are triangular lobes 135 A, 135 B, 135 C and 135 D. These lobes are connected to the breaker bars by welding or other suitable means. The lobes 135 B on breaker bar 132 B are adapted to mesh with the lobes 135 A on the breaker bars 132 A and with the corresponding breaker bars 132C. Lobes 135D on breaker bars 132 D mesh with the lobes 135 C on breaker bars 132 C. These lobes form the rock contact surface of the breaker bars. Because of the triangular shape of the lobes, they create a pulsating motion during rotation of the breaker bars, insuring build up of material between the breaker bars. Lobes with other cross-sectional shapes such as square or oval can be used in place of triangular lobes.

As a further variation, the sprockets on breaker bars 132 A and 132 C can have a different number of teeth than those on breaker bars 132B and 132 D or alternatively, chain 156 can move at a different speed than chain 158 thereby providing a differential of movement between adjacent breaker bars further assisting in the cleansing action.

Another variation, instead of lobes on the breaker bars, would be in the use of stationary knives located in proximity to the periphery of the rotating breaker bars to prevent accumulation of material thereon. As shown in FIG. 7, these knives or scraper blades 235 are placed near the periphery of the breaker bars 232 A, 232 B to continually remove the accumulation of material that adheres to the breaker bars. These scraper blades generally extend the full width of the chamber and are secured to the sides thereof by welding or other means. Alternatively, they may extend through slots in the sides of the chamber, and may be secured by suitable means permitting their easy removal from the chamber when not in use. Normally, they are positioned behind the breaker bars so as to be at least partially protected from damage by flying rocks. They are positioned as closely as possible to the breaker bars.

Although the invention has been described with reference to a single-rotor impact crusher it should be clearly understood that it is applicable to multiple rotor crushers and to other types of equipment used to process ores and other materials in which there are problems of accumulation of material.

There are other departures that can be made in practicing the teachings of the present invention without deviating from the teachings of the present invention defined by the claims appended hereto in which I claim:

1. In a rock crusher comprising a housing defining a confined crushing chamber having a feed opening and a backwall spaced opposite said feed opening, rotor means within said chamber having a plurality of hammers evenly spaced about the periphery thereof and a plurality of spaced breaker bars at least some of which are in front of and spaced from said backwall, the improvement for preventing the accumulation of material around and between the breaker bars and the backwall including means for slowly rotating at least some of the adjacent breaker bars in the same direction at a speed of between about 10 and about 50 revolutions per minute, and a floating wall spaced from and resiliently mounted to said backwall and a vibrator connected to said floating wall to vibrate the same, said rotating breaker bars each provided with a plurality of lobes spaced apart from one another along the periphery of the breaker bars, with the lobes of adjacent breaker bars intermeshed with one another.

2. In a rock crusher comprising a confined chamber containing a rotor including a pair of hammers evenly spaced around the periphery thereof, said chamber defined by a front feed opening, a top, backwall, two side walls and a discharge chute below said rotor, and further including a feed chute below the feed opening for directing feed stock into contact with the hammers of the rotor, the shaft of the rotor extending through the sidewalls of the chamber generally parallel to and between the feed chute and the backwall, a plurality of breaker bars extending generally parallel to said rotor shaft with the ends thereof secured between the sidewalls, said breaker bars being spaced from one another and extending at least vertically from a position between the rotor and the backwall up to the top of the chamber, the improvement for preventing the build up of material around and between at least some of the breaker bars and the backwall comprising means for rotating at least two adjacent breaker bars, at a speed of between about 10 and about 50 r.p.m. in the same direction as the rotor, and a floating wall resiliently connected to said backwall and coupled to a source of vibration, each of said rotating breaker bars provided with a plurality of spaced-apart triangular lobes, with the lobes of one breaker bar intermeshing with those on the next adjacent breaker bar.

3. The improvement of claim 1 wherein these lobes in the plane perpendicular to the axis of the breaker bar are generally in the shape of an equilateral triangle.

4. The improvement of claim 2 further defined in that one end of each rotating breaker bar extends through and beyond one sidewall of the chamber and has a sprocket mounted thereon, and rotational movement is transmitted to the bars by a chain engaging said sprocket.

5. The improvement of claim 4 wherein said chain engages a sprocket on an idler shaft which is connected to a power source through a torque drive and gear reducer.

6. The improvement of claim 5 wherein two breaker bars are connected by a first chain engaging a first sprocket on said idler shaft, and two other breaker bars are connected by a second chain engaging a second sprocket on said idler shaft and power is transmitted to the idler shaft by a chain drive from the torque drive and gear reducer.

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,608,840 **Dated** September 28, 1971

Inventor(s) Mark R. Lange

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 60, the word "brusher" should read --crusher--.
Column 2, line 42, the word "brusher" should read --crusher--.
Column 3, line 54, the word "projected" should read --projecting--
Column 4, lines 59-60, the word "alternately" should read --alternatively--.
Column 5, line 17, the phrase "insuring build up" should read --insuring against build up--.

Signed and sealed this 21st day of March 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents