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Johnson

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[54] **IMPACT CRUSHER**

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[73] Assignee: **El-Jay, Inc.**, Eugene, Oreg.

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Related U.S. Patent Documents

Reissue of:

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Appl. No.: **343,635**
Filed: **Mar. 22, 1973**

[51] **Int. Cl.**[2] **B02C 13/09**

[52] **U.S. Cl.** **241/275**; 241/283

[58] **Field of Search** ..... 241/99, 274, 275, 283, 241/291, 40, DIG. 10

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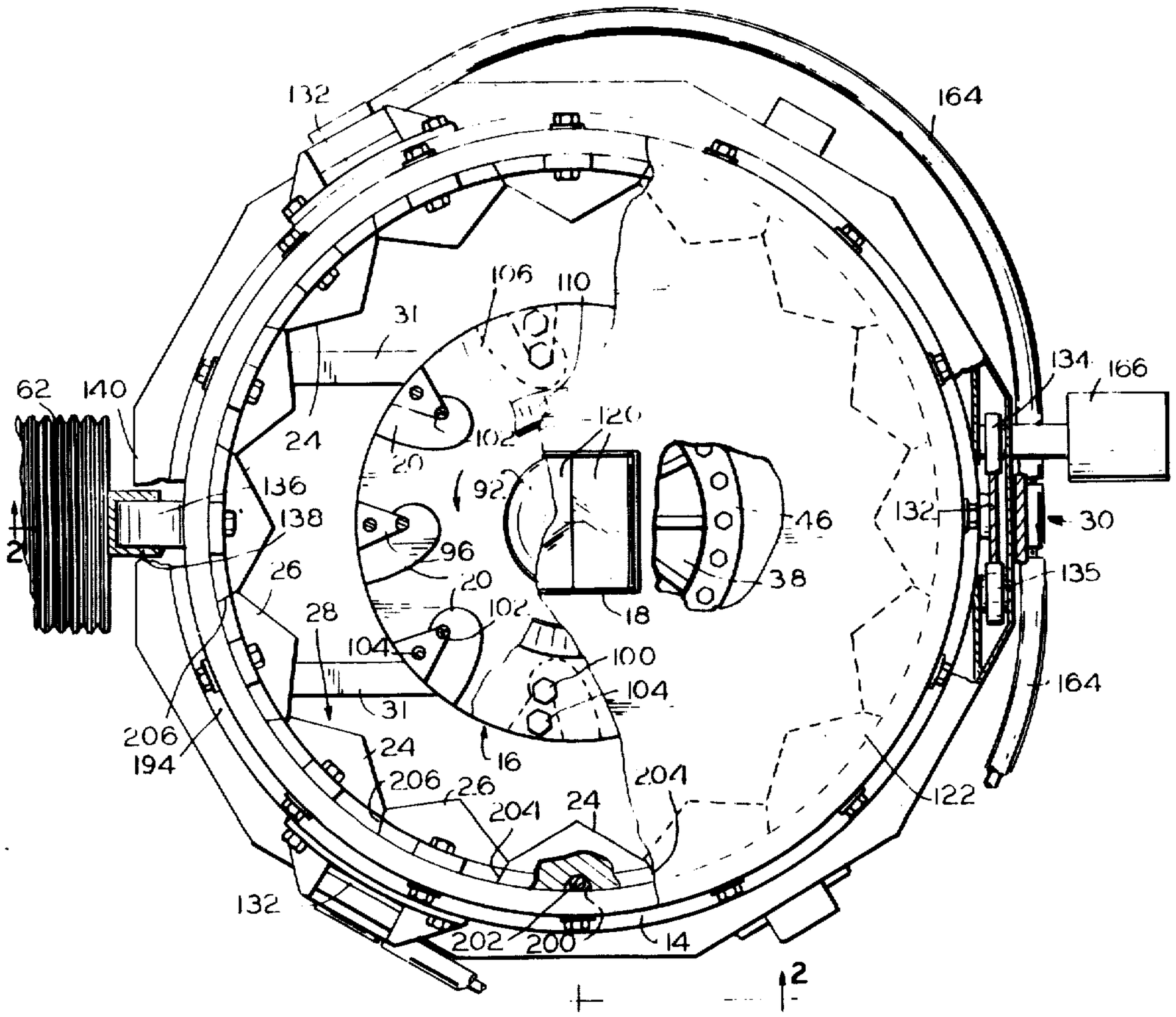
Primary Examiner—Howard N. Goldberg
Attorney, Agent, or Firm—Klarquist, Sparkman, Campbell, Leigh, Hall & Whinston

[57] **ABSTRACT**

An impeller assembly having a hard wear plate has replaceable impeller shoes and is rotated on a vertical axis to throw material against vertically reciprocated, replaceable breaker bars to crush the material. The breaker bars are reciprocated by power driven jacks. The material is supplied to the impeller through a spout having a dust-sealing valve. The impeller has a shaft journalled in a sealed impeller shaft housing mounted resiliently on a base, and the shaft is driven by a double universal joint drive. Lubricant is pumped from a sealed input shaft housing into the impeller shaft housing and back to the input shaft housing.

16 Claims, 4 Drawing Figures



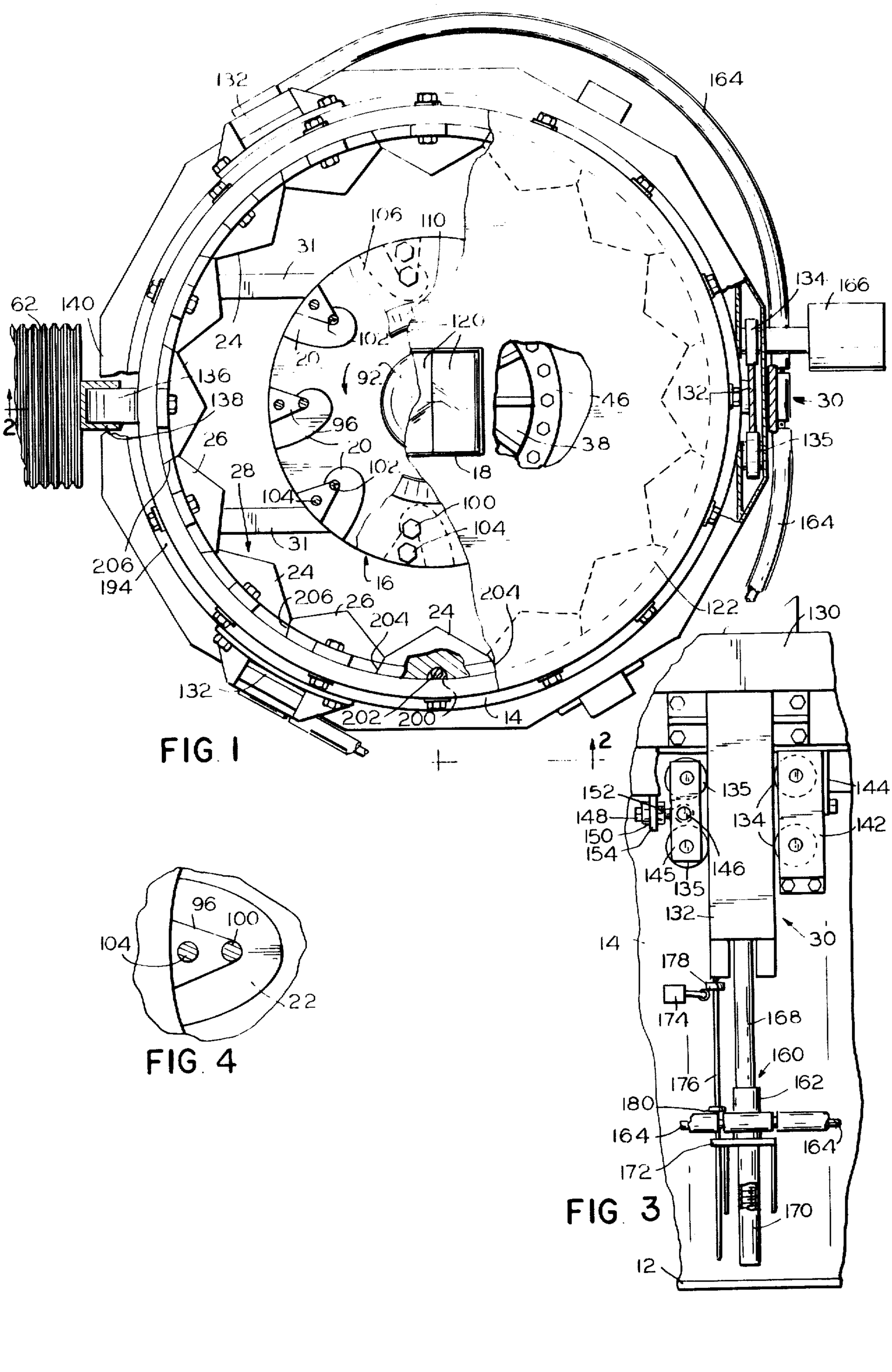


FIG. 1

FIG. 4

FIG. 3

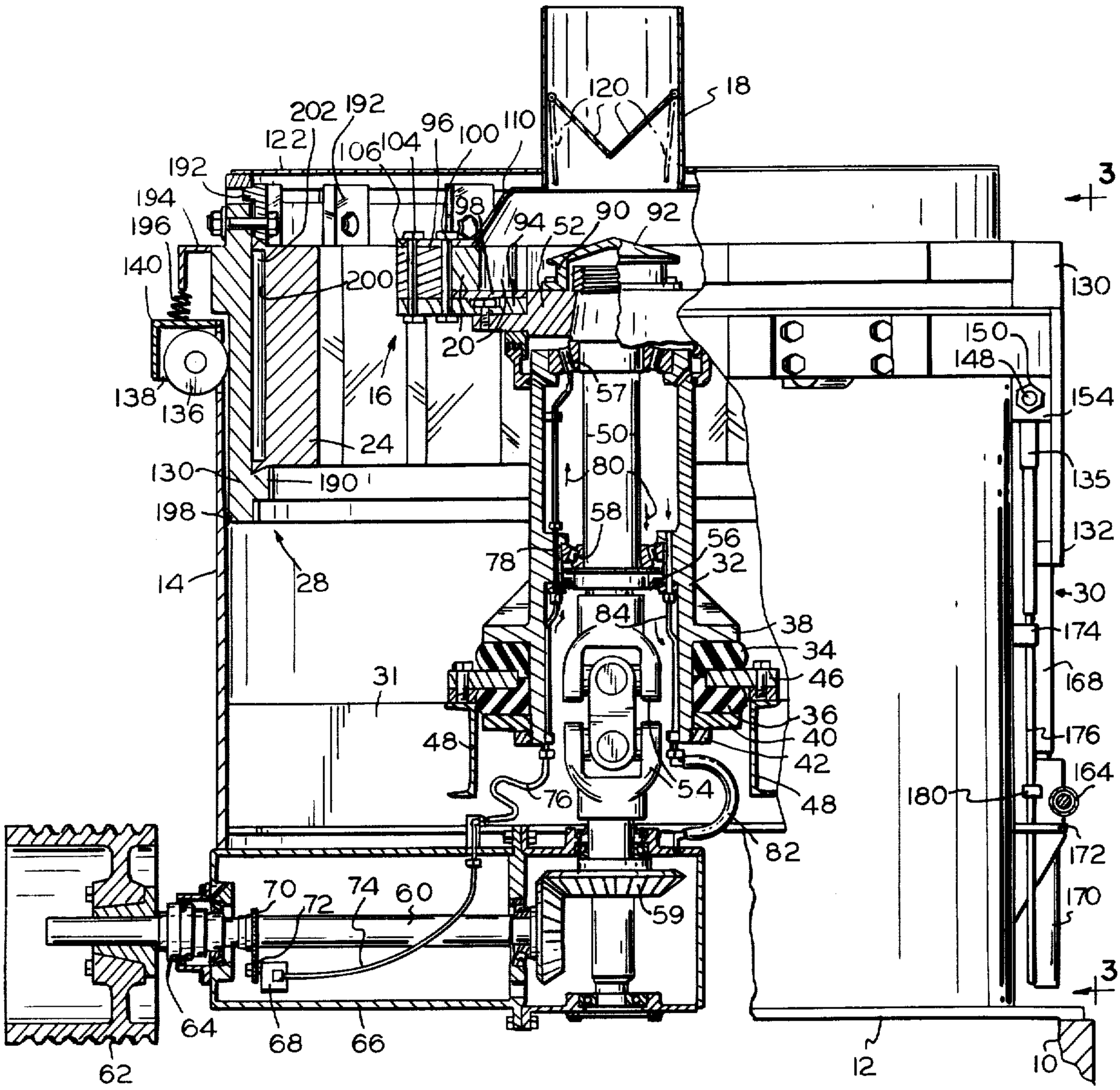

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FIG. 2

IMPACT CRUSHER

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

DESCRIPTION

This invention relates to a new and improved impact crusher and more particularly to a wear-distributing impact crusher. Impact crushers known hitherto have had vertical impeller shafts and horizontal impeller discs on each of which are mounted several impeller hammers or shoes, which throw the material to be crushed against impact bars. Such crushers have demonstrated exceptional crushing capacity to produce fine granular size product. Unfortunately, the wear rate of the metal impeller shoes and impact bars has been so excessive and costly that this type of machine has developed an unfavorable reputation. In a typical prior art impact crusher, rock to be crushed is fed into a central area of the impeller much the same as water into a centrifugal pump, and the impeller hammers sling the rock at high velocity against a ring of breaker bars having faces approximately square to the vector path of said rock. Upon striking the bars the rock is shattered. The constant impact of rock in one area of the impact bars soon cavitates the bars and forms rounded pockets. The rock no longer hits squarely and crushing efficiency drops dramatically. Normally, bars must be replaced are readjusted every day or two. Impeller shoes also wear rapidly as the rock slides across their faces.

An object of the invention is to provide a new and improved impact crusher.

Another object of the invention is to provide a wear-distributing impact crusher.

A further object of the invention is to provide an impact crusher having breaker bars adjustable to distribute wear.

Another object of the invention is to provide an impact crusher having breaker bars which are continuously adjusted vertically.

Another object of the invention is to provide an impact crusher having breaker bars reciprocated vertically by sychronized jack-like thrust mechanisms.

Another object of the invention is to provide an impact crusher having replaceable hook-like impeller shoes.

Another object of the invention is to provide an impact crusher having an impeller resiliently mounted.

Another object of the invention is to provide a sealed resiliently mounted bearing housing journalling an impeller shaft and driven by a flexible drive.

Another object of the invention is to provide an impact crusher wherein a resiliently mounted impeller shaft is enclosed in a sealed bearing housing and is driven by an impact drive shaft also in a sealed bearing housing and in which a force feed lubrication system includes a lubricant pump in the latter bearing housing serving to lubricate through the housings in series.

Another object of the invention is to provide an impact crusher including a resiliently mounted impeller shaft driven by an input shaft through a double universal joint.

Another object of the invention is to provide an impact crusher having an impeller and a breaker plate assembly enclosed to contain dust formed during crushing and supplied with material to be crushed through a feed spout having a normally closed valve and opened by material being fed through the spout into the crusher.

IN THE DRAWINGS

FIG. **1** is a fragmentary, top plan view of a new and improved impact crusher forming one embodiment of the invention;

FIG. **2** is a partially sectional, elevation view taken along line **2—2** of FIG. **1**.

FIG. **3** is a fragmentary, vertical sectional view taken along line **3—3** of FIG. **2**, and

FIG. **4** is an enlarged, fragmentary, top plan view of an alternate impeller shoe construction of the impact crusher of FIG. **1**.

Referring now in detail to the drawings, there is shown therein a new and improved impact crusher mounted on a support **10** (FIG. **2**) and including a generally annular flange **12** stiffening a cylindrical wall or housing **14**. The impact crusher includes an impeller assembly **16** supplied with material to be crushed from a feed spout **18** and having hammers or impeller shoes **20** (FIG. **1**), which strike and throw the material against elongated, pentagonal breaker bars **24** and **26** of a breaker bar assembly **28** to crush the material. The breaker bar assembly is reciprocated vertically by reversible jack-like thrust mechanisms **30** during the operation to distribute wear evenly over the lengths of the breaker bars.

As shown in FIG. 2, the impact faces of the breaker bars are flat and parallel to the vertical axis of rotation of the impeller and thus are square to thrown material, and present flat impact surfaces for maximum crushing efficiency.

The cylindrical wall **14** (FIG. **2**) is stiffened by the flange **12** and beams **31** to form the main frame. A vertical impeller shaft housing **32** is resiliently supported by elastomer rings **34** and **36** which are clamped between flange **38** of the housing **32** and ring plate **40**. A nut **42** presses ring plate **40** against the lower elastomer ring to obtain any desired preload. A ring plate **46** is located between the elastomer rings. The ring plate **46** is bolted to beams **48** secured to the beams **31**. An impeller shaft **50** is journalled within the housing **32** and has its upper end tapered and threaded to receive an easily attached and easily removable heavy hub **52**. At its lower end is attached a double universal joint coupling **54** which could be replaced by any of several forms of flexible couplings. I prefer the double universal joint. A seal **56** prevents leakage of oil by having spring loaded faces in lightly loaded contact. Radial and thrust bearings **57** anad **58** journal the impeller shaft in the housing **32**.

A right angle bevel gear drive **59** couples to the coupling **54**, and is driven by an input drive shaft **60** driven by a drive sheave **62**. A seal **64** excludes outside contaminants and retains lube oil in a gear case or input drive shaft housing **66**. A unidirectional pump **68** in the housing **66** and driven by the shaft **60** through gears **70** and **72** always pumps oil in one direction regardless of its rotation. The sheave **62** is driven by a suitable source of power (not shown) through V-belting. The source of power preferably is selectively reversible to drive the crusher in either direction.

An oil line **74** joins pump **68** to a flexible line **76** which, in turn, joins to a rigid line **78**. At the upper open end of the line **78**, oil sprays into the upper bearing **57** on shaft **50**. A small hole in the line **78** sprays oil onto the lower bearing **58** providing immediate lubrication be-

fore the oil draining from the upper bearing can pass through the lower bearing. Arrows **80** (FIG. **2**) show the oil rising in the oil lines and draining back toward the gear case **66**. A flexible hose **82** connects rigid drain line **84** to the oil filled gear case **66** from which the pump **68** picks up the oil.

A nut **90** forces hub **52** tightly onto the impeller shaft **50**. A cap **92** protects the nut **90** and the shaft **50** against the rock falling through the feed duct or spout **18**. Bolted to the hub **52** is heavy impeller disc **94** having several brackets **95** (FIG. **1**) attached thereto. These brackets **96** are very firmly attached by welding and bolting because they must cope with the tremendous energy of high horsepower, centrifugal forces, and pressure of slinging the rock being crushed.

Secured to the top of the disc **94** is a metal wear disc **98** made of wear resistant material. The disc **98** absorbs the wear of sliding and falling rock and may be replaced as required. The disc **98** is shaped to closely fit around each of brackets **96**, and a boss on the hub **52**, and extends to the rim of the impeller disc **94** and yet has sufficient clearance to be easily installed or removed by hand.

Bolts **100** and **104** mount hammers or impeller shoes **20** on the brackets **96** and on top of wear disc **98**. Bolts **100** (FIG. **1**) are supported rigidly radially by fitting against the inner faces of the brackets **96** and pass through holes in the disc **94** and thread into nuts beneath the disc. Inner radii or hook portions **102** of the hammers **20** fit snugly around these bolts. The hook portion of each hammer holds it against the enormous centrifugal force. The hammers **20** are reversible for opposite rotation of the impeller.

The design of this machine is for either rotation of the impeller as dictated by the wear pattern of breaker bars **24** and **26**.

The bolts **104** pass through the brackets **96** and the disc **94** and thread into a nut beneath the disc.

A cap plate **106** is a ring of wear resistant metal placed above the hammers. Bolts **100** and their companion bolts **104** pass through the cap plate **106** and the brackets **96** and the disc **98** and are tightened. The cap plate **106**, the hammers **20** and the disc **98** are firmly held against all stresses. A conical frustum **110** (FIG. **2**) is part of the cap plate **106** and guides incoming rock into the passageways between the hammers.

The hammers may be all "full" hammers **22**, as shown in FIG. **4**, which permit either hand rotation without repositioning as is required of hammers **20**, or the hammers may be all "half" hammers **20**. However, the hammers **22** should have fewer brackets to permit the wider spacing required to provide adequate passageways.

One of the advantages of my design is the easy replacement of the disc **94**, which will permit the operator of this machine to use either the disc **94** designed for the hammers **20** or another having more widely spaced brackets for the hammers **22**.

Because of the spinning action, the impeller assembly **16** acts as a very effective blower, which would, if not prevented, discharge great clouds of dust, as fine rock granules, into the ambient air. To control and minimize this, I have two plates **120** (FIG. **2**) in the feed spout **18**. Plates **120** are hinged at the opposite of two sides of the spout and are spring loaded. Spring tension is sufficient to bias the plates upwardly and together against the slight air pressure, but the weight of incoming rock pushes the plates apart. This valve restricts air flow and reduces the pumping action of the impeller to the extent

that blowing dust is not a problem. A sectionalized cover **122** further restricts air currents and acts as a safety shield to internal parts and prevents rocks being thrown out of the top of the machine.

A heavy walled cylinder **130** (FIG. **2**) fits inside the housing **14** with adequate clearance uniformly around its full circumference to prevent rubbing contact. The cylinder **130** has three or more parallel guide rails **132** (FIG. **3**) bolted to its reinforcing wall and evenly spaced apart around the cylinder and projecting downwardly outside of the housing **14**. The guide rails are exactly parallel to the center line of the cylinder. On each side of each guide rail are rollers or slides **134** and **135** defining guideways or slides. The rollers **135** are adjustable to aid in centering the cylinder **130** in the housing **14** and to control clearances on each rail. The rollers **134** are mounted by a frame **142** (FIG. **3**) bolted to lug **144** welded to housing **14**. The rollers **135** are carried by a frame **145** pivoted on pin **146** supported by an eye bolt **148** adjustably secured by nuts **150** and **152** to a lug **154** welded to the housing **14**.

Three or more rollers or slide pads **136** (FIG. **2**) assist in keeping the cylinder **130** centered in the housing **14**. The rollers **136** are mounted by brackets **138** under an overhanging flange **140**.

At the lower end of each guide rail **132** is attached an in line, jack-like, thrust mechanism or ram **160** (FIG. **3**) shown in the form of a jackscrew but which may be a hydraulic ram. FIG. **3** shows a ballscrew drive **162** driven by a worm gear reducer. A flexible cable drive **164** connects each gear reducer of all such reducers. A motorized gear reducer drive **166** (FIG. **1**) is connected into the flexible cable drive **164**. The drive **166** is of reversible rotation design. The rams **160** are shielded from contamination by telescoping shields **168** and cap shields **170** (FIG. **2**). A bracket **172** supports each ram. A limit switch **174** (FIG. **3**) is mounted on the housing **14** and has reversing and adjustable time delay characteristics. Rods **176** are attached to guides **132**. On rods **176** are adjustable stops **178** and **180**, which can be set to contact the switch **174** at any length of travel. A comparable control can be used with hydraulic rams, valves, valve stops, hydraulic lines, and a pump replacing the mechanical system. I have shown mechanical design because it is easier to maintain equal travel on all units.

The cylinder **130** (FIG. **2**) has a lower dovetail flange **190** upon which rest the breaker bars **24** and **26**. The upper end of these bars are held against the cylinder **130** by clamps **192** bolted through the cylinder **130**. Wedge bolts could be used as well as threaded bolts. A flange **194** encircles the cylinder **130** and acts both as a stiffener and a means of attaching a flexible curtain **196** to act as a dust seal. Dust must be kept away from the space between the housing **14** and the cylinder **130** to prevent build-up and binding. A flexible scraper seal **198** keeps dust from entering from below.

Each of the breaker bars **24** has a recess or groove **200** (FIGS. **1** and **2**) parallel to centerline. A cleat **202** is welded to the cylinder **130**. The bars **24** have outward angled edges **204** (FIG. **1**) and they are installed first over each cleat. The bars **26** have inward angled edges **206** (FIG. **1**) to permit installation and they fit snugly against bars **24** but do contact the inner face of the cylinder **130** with a slight clearance between the bars **24** and **26**. These bars are made of the hardest, most abrasion resistant material that is economical to use. The hammers **20** and **22** are made of similar material.

OPERATION

Having described the construction of the machine, I now describe how it operates.

The machine is installed on the suitable support or foundation **10** (FIG. **1**) either stationary or portable. A means of feeding rock to it and removing the crushed product are obvious and always provided. Adequate power is connected to drive sheave **62** by belting or possibly direct connection. It is very useful to provide a means of varying the speed either by changing engine speed or changing pulley ratios. As the drive sheave **62** turns, it drives bevel drive gear **59** which, in turn, drives through coupling **54** and shaft **50**, and, finally, spins the impeller assembly **16**.

Rock is fed into spout **18**, plates **120** opening to whatever extent necessary. The hammers **20** accelerate the rock to high speed and fling the rock against the bars **24** and **26**, which shatters the rock. This is basic to improved crushers, but where my design is unique now comes into effect. The drive **166** is energized, and very slowly the entire assembly of the cylinder **130** and its attached parts rise[.] *to effect progressive wear of the breaker bars.* When the lower stop **180** contacts the limit switch **174**, upward travel ceases. A time delay of whatever period is desired now occurs. At the termination of the time delay, the drive **166** reverses and lowers the assembly until the upper stop **178** contacts the limit switch. Again the time delay occurs. A complete cycle can be programmed to be of short travel, full travel, or concentrated in one area to achieve uniform wear along the entire length of every breaker bar. *Thus, the flat impact surfaces are maintained substantially flat by the uniform and constant wear during rotation of the impeller so as to maintain crushing efficiency at an optimum. The jackscrews 160 and the motor 166 are primary parts of a drive means for the breaker bars. The switch 174 and the stops 178 and 180 are primary parts of a control means for the motor means 166.* This system eliminates the pocketing of the prior art impact crushers. Efficiency is greatly improved and wear parts can work to maximum utilization. Impeller rotation can be reversed and the other faces of the breaker bars **24** can be used. If the hammers **20** are used, they are flopped over and set on the other side of the brackets **96**.

In the event of uneven wear on the hammers, or the loss of a hammer, the center of rotation of the impeller assembly **16** will no longer be concentric with the shaft **50**, the resulting vibration force is very great in other makes of machines that have their shaft housing rigidly attached to their main frame. My design eliminates this problem due to the resilient mounting in elastomer pads **34** and **36**, as previously described. When unbalance occurs, the resilient material flexes and permits unbalanced operation without problems. The constant velocity of the double universal joint **54** eliminates varying speed waves as would occur with a single joint.

The spout **18** is held in fixed relation to the main cylindrical wall or housing **14** by a support (not shown) which bridges over the rising and lowering breaker bar assembly. This is necessary to properly receive feed and distribute the feed into conical frustum **110**.

If desired, the guide rollers **134**, **135** and **136** could be replaced by guides of a non-metallic low friction material such as, for example, micarta, teflon or the like.

What is claimed is:

1. In an impact crusher:

base means,

a rotary impeller mounted on the base means for rotation on a vertical axis,

drive means for rotating the impeller to centrifugally throw material to be crushed through a predetermined annular zone around the impeller,

annular breaker bar means,

mounting means mounting the breaker bar means [adjustably] *movably* on the base means in positions surrounding said annular zone,

said breaker bar means presenting flat impact surfaces parallel to the vertical axis and normal to the path of thrown material to achieve maximum impact,

and [adjustment] *drive* means for moving the breaker bar means *during rotation of the impeller and as the breaker bar means is being worn* [relative to the base means], *said drive means including motor means for driving the breaker bar means, and control means automatically effecting reversal of the motor means at periodic intervals to cause reciprocation of the breaker bars so that the breaker bars are progressively moved* to vary the portion of the breaker bar means impacted by the thrown material to distribute wear *evenly* over a large area of the breaker bar means *so that the breaker bar means continues to present to thrown material impact surfaces that are substantially flat for maximum impact efficiency.*

2. The impact crusher of claim **1** wherein the [adjustment] *drive* means moves the breaker bar means vertically relative to the impeller.

[**3**. The impact crusher of claim **2** wherein the adjustment means reciprocates the breaker bar means.]

4. The impact crusher of claim [**3**] *2* wherein the [adjustment] *drive* means comprises a plurality of expansible thrust mechanisms mounted in spaced positions around the impeller.

a drive mechanism.

and drive coupling means connecting the drive mechanism to the thrust mechanisms to drive the thrust mechanisms at the same rate of speed.

5. The impact crusher of claim **4** wherein each thrust mechanism comprises a reversible jack screw.

6. The impact crusher of claim **5** [including reversing means, and] *wherein said control means comprises* adjustable stopping means moving with and attached to the breaker bar means.

7. The impact crusher of claim **2** wherein the mounting means includes vertical guide means mounted on the base means and guide rail means on the breaker bar means guided by the guide means.

8. The impact crusher of claim **7** wherein the guide rail means comprises a plurality of guide rails spaced around the breaker bar means.

the guide means including a plurality of pairs of rollers engaging opposite sides of the guide rails and a plurality of radial thrusting rollers engaging the breaker bar means.

9. The impact crusher of claim **1** wherein the base means includes a vertical, cylindrical housing,

the breaker bar *means* having a cylindrical exterior and extending loosely into the cylindrical housing, *said breaker bar means having a portion projecting from said housing, said drive means being connected to said projecting portion.*

10. The impact crusher of claim **9** including [a flexible scraping ring mounted on] *sealing means between* the lower end of the breaker bar means and [engaging the inner wall of] the cylindrical housing, *and sealing*

means between the upper end of said breaker bar means and said housing.

[11. The impact crusher of claim 9 including extensible sealing curtain means secured to the upper portion of the breaker bar means and to the upper portion of the housing.]

12. The impact crusher of claim 2 wherein the breaker bar means includes an outer, hollow cylinder, segmental breaker bars, and releasable fastening means securing the breaker bars to the inner surface of the hollow cylinder.

13. The impact crusher of claim 12 wherein the breaker bars and the hollow cylinder have lower interlocking dovetail portions, and the fastening means includes clamps bolted to the hollow cylinder and having dovetail portions interlocking with upper dovetail portions of the breaker bars.

[14. The impact crusher of claim 12 wherein each breaker bar is pentagonally shaped to form an angular impact surface, the drive means being reversible.]

[15. In an impact crusher,

a base,

a rotary impeller,

means mounting the rotary impeller on the base for rotation about a vertical axis.

reversible drive means for selectively rotating the impeller in opposite directions,

non-rotating annular breaker bar means surrounding the impeller and having a first series of impact surfaces substantially normal to the path of material thrown by the impeller when the impeller is rotated in one direction and also having a second series of impact surfaces substantially normal to the path of material thrown by the impeller when the impeller is rotated in the opposite direction,

and means to elevate and lower said breaker bar means repetitiously within adjustable limits.]

[16. The impact crusher of claim 15 wherein the impact surfaces of the breaker bar means are arranged in angular positions.]

17. In an impact crusher,

an impeller shaft,

an impeller mounted on the impeller shaft,

a vertical shaft housing,

bearing means in the housing journaling the shaft in the housing,

annular impact means surrounding the impeller,

drive shaft means for driving the impeller shaft,

flexible coupling means connecting the drive means to the impeller shaft,

a base,

means mounting the impact means on the base,

resilient means mounting the impeller shaft housing on the base,

and means mounting the drive means on the base.

18. The impact crusher of claim 17 wherein the flexible coupling means includes double universal joint means.

19. The impact crusher of claim 17 wherein the shaft housing has an annular flange and the resilient means includes a pair of elastomeric discs on the shaft housing, an annular plate positioned between the discs and supported by the base, a washer-like plate bracketing the discs with the annular flange, and a nut threaded on the shaft housing to press the washer-like plate toward the annular flange to clamp the discs and the annular plate between the washer-like plate and the annular flange.

20. The impact crusher of claim 17 including upper rotary sealing means between the upper ends of the housing and the shaft, lower rotary sealing means below the bearing means and between the shaft and the housing, a lubricant supply pipe fixed to the interior of the housing and having an outlet near the upper end of the housing, a lubricant drain pipe in the housing extending downwardly from a point above the lower seal means to a point below the lower seal means, a flexible supply conduit connected to the supply pipe, and a flexible drain conduit connected to the drain pipe.

21. The impact crusher of claim 20 wherein the drive means includes drive shaft means connected to the flexible coupling means, a sealed drive shaft housing connected to the drain pipe, a pump driven by the drive means and having an outlet connected to the supply pipe and an inlet connected to the housing.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : REISSUE No. 29,798
DATED : October 10, 1978
INVENTOR(S) : LOUIS W. JOHNSON

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 34, "are" should be --or--.

Column 2, line 53, "anad" should be --and--.

Column 3, line 11, "95" should be --96--.

Column 7, claim 13, line 6, "of" should be --on--.

Column 8, claim 17, line 8, "drive shaft means" should be --drive means--.

Signed and Sealed this

Second Day of *January 1979*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

DONALD W. BANNER
Commissioner of Patents and Trademarks