Sept. 12, 1967 F. M. ALLEN 3,341,138

ADJUSTING MECHANISM FOR GYRATORY CRUSHER BOWLS

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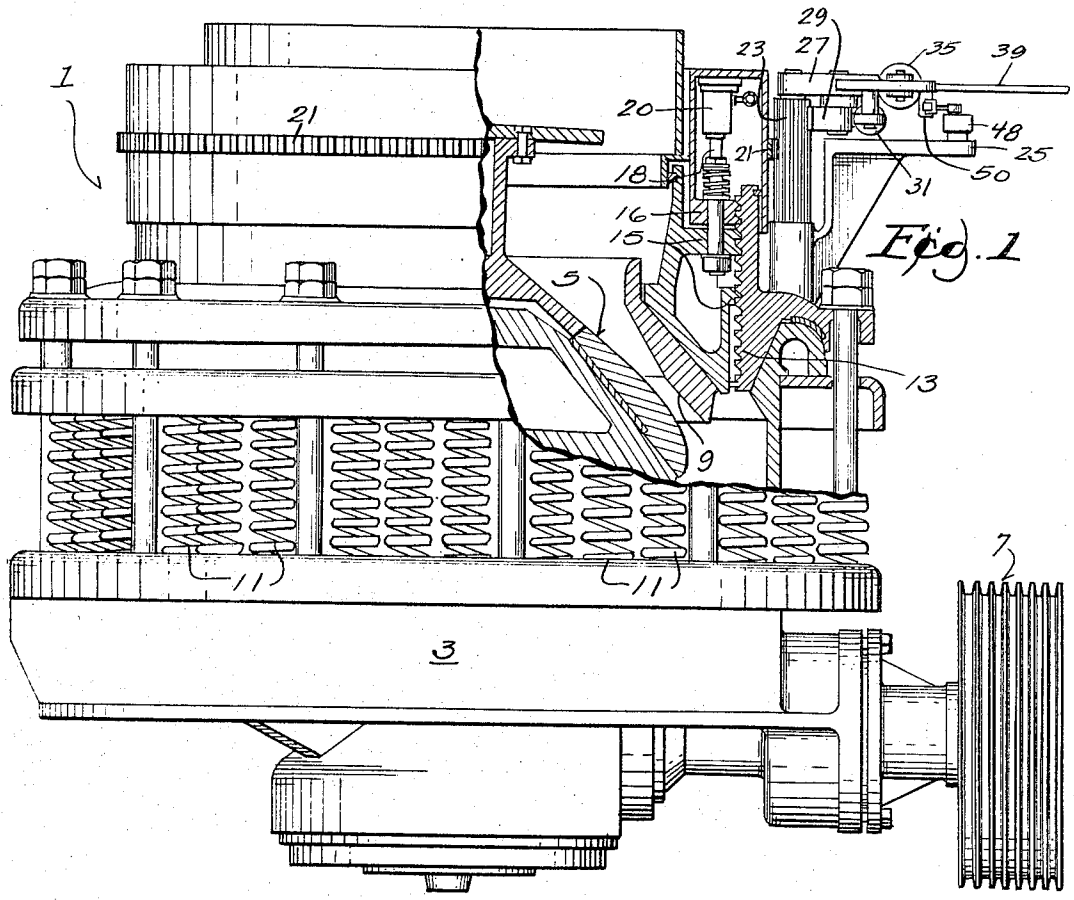


Fig. 1

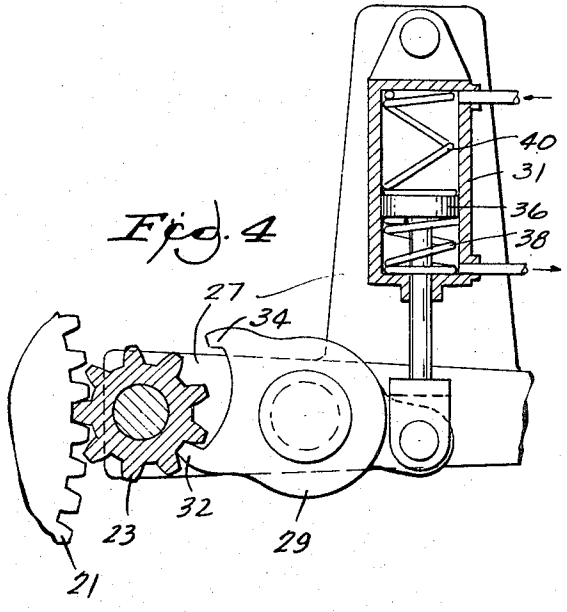


Fig. 4

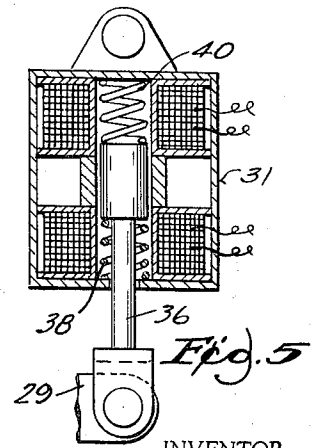


Fig. 5

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Fig. 2

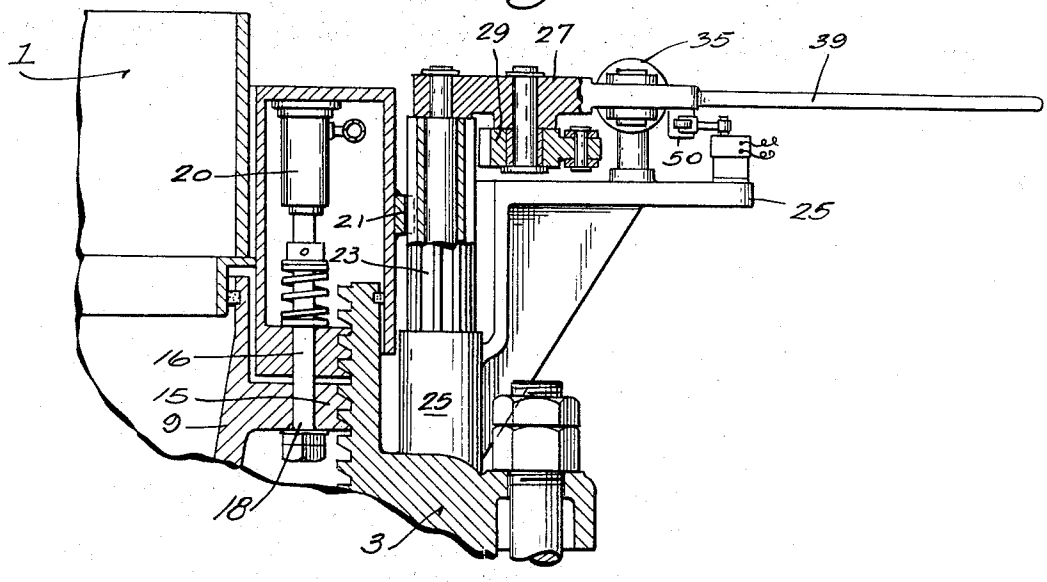
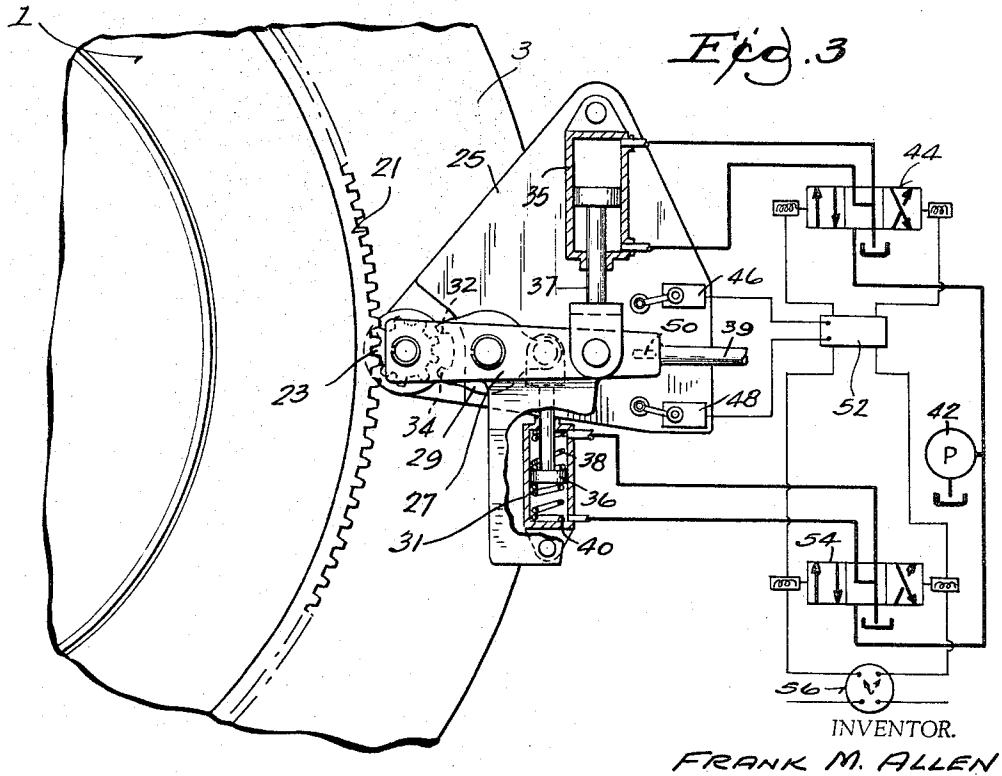


Fig. 3



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ADJUSTING MECHANISM FOR GYRATORY CRUSHER BOWLS

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This invention relates to gyratory crushers and more particularly to an improved means for adjustably positioning the crushing bowl in the crusher frame.

Gyratory crushers employ a rotating member carrying a crushing head mounted off center from the axis of rotation, so that the head wobbles or gyrates when rotated inside a surrounding concave bowl. The crushing action takes place in the gap between the crushing head and the bowl.

The particle size of the crushed product produced by the crusher depends on the size of the gap between the bowl and head, and hence to vary the particle size, it is necessary to change the dimension of the gap. This is commonly done by adjustably mounting the crushing bowl on the frame of the crusher so that it may be moved toward the crushing head to decrease the gap and the particle size or away from the head to increase the gap and the particle size. While many structures have been utilized to accomplish this, the one presently in general use employs a threaded flange on the exterior of the crushing bowl engaging a surrounding threaded adjusting ring on the crusher frame. The bowl is moved toward or away from the crushing head by rotating it within the threaded adjusting ring, causing the threaded flange of the crushing bowl to follow the helix of the threads on the adjustiny ring.

Gyratory crushers employing this structure therefore require a mechanism for rotating the crushing bowl, This mechanism must be capable of rotating the heavy, ruggedly constructed crushing bowl with its attendant apparatus over the resistance of friction between the adjusting ring and the threaded flange and between the dust and moisture seals on the movable crushing bowl and the crusher frame. Rapid operation is desirable to eliminate costly and time-consuming delays while adjusting the crushing gap size. Additionally, the mechanism must provide for rotation of the crushing bowl in both directions to increase or decrease the crushing gap.

It is a primary object of this invention, therefore, to provide an improved adjusting mechanism for rotating the crushing bowl to adjustably position the bowl on the crusher frame.

Another object of this invention is to provide a simple, compact adjusting mechanism which is capable of rapidly rotating the bowl in either direction.

An additional object of this invention is to provide an adjusting mechanism which is capable of being quickly and easily changed from powered to manual operation.

Yet another object of this invention is to provide an adjusting mechanism for rotating a gyratory crusher bowl which is capable of substantially trouble-free operation for a substantial period of time.

These and other objects of this invention are obtained by providing a gear ring on the exterior periphery of the crushing bowl, a pinion gear intermeshing with the gear ring, a pawl to engage the pinion gear, means to ratchet the pinion gear and the pawl to rotate the gears and the crushing bowl. This means may be power operated or manually operated. The pawl is designed to rotate the pinion gear in either direction, and means are provided to select the desired rotational direction.

The invention, both as to its structure and mode of operation, will be better understood by reference to the

following specification and drawings, forming a part thereof, wherein:

FIGURE 1 is a partially sectionalized view of a crusher employing the adjusting mechanism of this invention;

FIGURE 2 is a detailed section view of the adjusting mechanism;

FIGURE 3 is a partially sectionalized plan view of a crusher employing the adjusting mechanism including the associated hydraulic and electric circuits; and

FIGURES 4 and 5 are section views of a portion of the adjusting mechanism showing alternative embodiments thereof.

Referring now to FIGURE 1, the numeral **1** indicates a gyratory crusher employing an adjusting mechanism of the present invention. The numeral **3** indicates the frame or base of gyratory crusher **1**. The gyrating crushing head **5** is mounted inside frame **3** and gyrates about a vertical axis. Crushing head **5** is driven by a motor and belt drive (not shown) connected to grooved pulley **7**. Concave crushing bowl **9** is also mounted on frame **3** and forms the other crushing surface of crusher **1**. The crushing action takes place in the space or gap between crushing head **5** and crushing bowl **9**. Relief springs **11** are mounted on frame **3** to provide protection to the crushing surfaces of the head **5** and bowl **9** should uncrushable matter, such as scrap iron, enter the crushing gap. Relief springs **11** permit the crushing bowl **9** to shift under these conditions, expanding the gap, and allowing the uncrushable material to pass through.

As previously mentioned, the particle size of the crushed material produced by crusher **1** is determined by the size of the crushing gap between crushing head **5** and crushing bowl **9**. If it is desired to change particle size, it is necessary to change the dimensions of the crushing gap. This is done by raising or lowering crushing bowl **9** on crusher frame **3** relative to crushing head **5**. Crusher **1** provides for raising or lowering crushing bowl **9** by employing a threaded adjusting ring **13** mounted on frame **3**. Crushing bowl **9** has threaded flange **15** which engages the adjusting ring **13**. Rotating crushing bowl **9** causes flange **15** to follow the helix of the threads of adjusting ring **13**, raising or lowering the bowl.

Crusher **1** is provided with means to prevent rotation of crushing bowl **9** when the desired gap has been selected and the crushing operation begun. This means includes a threaded jamming ring **16** mounted on crusher bowl **9** adjacent threaded flange **15**, a plurality of bolts **18** extending through threaded flange **15** and jamming ring **16**, and a plurality of hydraulic cylinders **20** to draw threaded flange **15** and jamming ring **16** together by means of bolts **18** to prevent rotation of crusher bowl **9** on frame **3**. When it is desired to rotate crusher bowl **9**, hydraulic cylinders **20** release bolts **18**, freeing the threaded flange **15** and the locking or jamming ring **16** on the threads of threaded adjusting ring **13** and allowing crusher bowl **9** to rotate.

The adjusting mechanism of this invention which provides rotation to crusher bowl **9** includes a gear ring **21** on the exterior periphery of crushing bowl **9**. See FIGURES 2 and 3. A pinion gear **23** meshes with gear ring **21**. Pinion gear **23** is rotatably mounted on frame **3** by support member **25**. Pinion gear **23** is elongated in form to engage gear ring **21** throughout the entire range of raised and lowered crushing positions of bowl **9**. Also rotatably mounted on support **25** is a base member **27** extending outwardly from crushing bowl **9**. Pawl **29** is rotatably mounted on base **27** and is moved into a position to engage pinion gear **23** by cylinder **31**. Cylinder **31** may be a hydraulic means, as in FIGURE 4, connected to

a source of hydraulic pressure 42, capable of moving pawl 29 a short distance in either direction about its center, or an electric solenoid, as in FIGURE 5, connected to a source of electric power capable of performing the same operation. In either case, the piston 36 of cylinder 31 is centered by springs 38 and 40 so that when no hydraulic pressure or electric current is applied thereto, piston 36 is returned to the centered postion shown in FIGURES 3 and 5. Pawl 29 contains two ratchet teeth 32 and 34 designed to engage pinion gear 23 upon the rotation of pawl 29 by piston 36 of cylinder 31.

Base member 27 and pawl 29 are rotated in a reciprocal manner on support 25 by ratchet cylinder 35 mounted on the outer end of base 27. Ratchet cylinder 35 may be of the self-reciprocating, hydraulic type and is mounted on frame 3. The reciprocating motion is transferred to base 27 and pawl 29 by piston extension 37 connected to base 27. In typical application utilizing a three-inch diameter piston operating under one thousand pounds per square inch hydraulic pressure, provided by a hydraulic pressure source 42, hydraulic cylinder 35 will operate at approximately seventy strokes per minute and provide a six-inch stroke to base 27. A removable handle 39 may be inserted in a socket in the outer end of base 27 to allow operation of the adjusting mechanism manually in the event of a loss of hydraulic pressure.

A typical hydraulic system which may be employed to operate the adjusting mechanism of this invention is shown in FIGURE 3. Hydraulic pump 42 generates hydraulic pressure for the system. Solenoid operated valves 44 and 54 are connected between pump 42 and ratchet cylinder 35 and pawl cylinder 31 respectively. The solenoid operating valves 44 and 54 are actuated through relay 52 which is operated by limit switches 46 and 48 mounted on support 25. Limit switches 46 and 48 are actuated by stud 50 on base member 27 and energize the solenoids in valves 44 and 54 to provide a repeatedly reversing hydraulic pressure to cylinder 35, thus reciprocating piston 37. The limit switches 46 and 48 are also connected through relay 52 to solenoid operated valve 54 which supplies hydraulic pressure to cylinder 31. The motion of piston 36 in cylinder 31 may be controlled from its spring-maintained center position and driven selectively to either end of its cylinder 31 by selecting the position of selector switch 56.

To operate the adjusting mechanism, hydraulic cylinders 20 are first energized to unlock bowl 9 from crusher frame 3. Cylinder 31 is then actuated, by switch 56 connected to solenoid operated valve 54, to engage one or the other of pawl teeth 32 or 34 in pinion gear 23. For example, if it is desired to move the bowl 9 in a counterclockwise direction, as viewed in FIGURE 3, the piston in cylinder 31 is retracted. This engages pawl tooth 34 in pinion gear 23. Hydraulic cylinder 35 is then energized to extend piston 37 causing pawl tooth 34 to move pinion 23 in a clockwise direction and gear ring 21 and crushing bowl 9 in a counterclockwise direction. When stud 50 actuates limit switch 48 an electric signal is sent through relay 52 to cause valve 44 to reverse the pressure on hydraulic cylinder 35 and retract piston 37. Relay 52 also de-energizes solenoid operated valve 54 removing hydraulic pressure from cylinder 31 and allowing springs 38 and 40 to center piston 36. This removes pawl tooth 34 from engagement with pinion 23.

Near the end of the retraction of piston 37 stud 50 hits limit switch 46 and solenoid operated valve 44 is actuated by relay 52 to extend piston 37. Solenoid operated valve 54 is also actuated by relay 52 to re-engage pawl tooth 34 in pinion 23 to again move the pinion in a clockwise direction as piston 37 is extended. This ratchet operation is repeated until the desired amount of rotation is obtained. Rotation of crushing bowl 9 will raise or lower the bowl depending on the threads on adjusting ring 35 and threaded flange 15.

To reverse the direction of rotation of pinion gear 23, the piston of cylinder 31 is extended, and engages tooth 32 of pawl 29. Hydraulic cylinder 35 is then energized to provide a similar ratcheting action to pinion gear 23 but in an opposite direction.

When crushing bowl 9 is in the desired position on crusher frame 3, hydraulic cylinder 35 is de-energized causing a cessation of the ratcheting action. Cylinder 31 is also de-energized, and springs 38 and 40 cause pawl tooth 32 or 34 to disengage pinion 23. The crushing bowl may then be locked in the desired position on crusher frame 3 by hydraulic cylinders 20 and bolts 18.

It will be appreciated from the foregoing that there has been provided a simple, compact adjusting mechanism for rotating the crushing bowl of a gyratory crusher. The mechanism is capable of rotating the bowl in either direction and is capable of being operated by mechanical power or manually. While the structure of the adjusting mechanism has been shown and described herein in considerable detail, it is not intended thereby to unnecessarily restrict the invention, since various modifications within the scope of the appended claims may occur to persons skilled in the art to which the invention pertains.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In a crusher having a frame, a gyratory crushing head mounted in said frame, and a concave crushing bowl mounted on the frame and adjustable by rotation to form an adjustable crushing gap with the crushing head; means to rotate the crushing bowl comprising,
   a gear ring mounted on the exterior of the crushing bowl;
   a pinion rotatably mounted on the frame to intermesh with the gear ring;
   a pawl normally disengaged from said pinion gear;
   means to engage said pawl with said pinion gear; and
   means to ratchet the pawl and the pinion gear to rotate the ring gear and the crushing bowl to adjustably position the crushing bowl on the frame.

2. Means to rotate the crushing bowl according to claim 1, wherein the means to ratchet the pawl and the pinion gear comprises a reciprocating hydraulic cylinder operatively connected to the pawl.

3. Means to rotate the crushing bowl according to claim 1, wherein the means to ratchet the pawl and the pinion gear comprises a lever means suitable for manual operation operatively connected to the pawl.

4. Means to rotate the crushing bowl according to claim 1, including means connected to the pawl to provide selective engagement of the pinion gear by the pawl to rotate the gear ring and crushing bowl in either direction.

5. In a crusher having a frame, a gyratory crushing head mounted in said frame, and a concave crushing bowl mounted on the frame and adjustable by rotation to form an adjustable crushing gap with the crushing head; means to rotate the crushing bowl comprising,
   a gear ring mounted on the exterior periphery of the crushing bowl;
   a pinion gear rotatably mounted on the frame to intermesh with the gear ring;
   a base rotatably mounted on the frame;
   a pawl mounted on the base;
   means to move the pawl into operative relation with the pinion; and
   hydraulic means mounted on the frame and to said base to reciprocally rotate the base and ratchet the pawl and the pinion gear to rotate the gear ring and the crushing bowl to adjustably position the crushing bowl on the frame.

6. In a crusher having a frame, a gyratory crushing head mounted in said frame, and a concave crushing head

mounted on the frame and adjustable by rotation to form an adjustable crushing gap with the crushing head; means to rotate the crushing bowl comprising,

a gear ring mounted on the exterior periphery of the crushing bowl;

a pinion gear rotatably mounted on the frame to intermesh with the rig gear;

a base rotatably mounted on the frame;

a pawl mounted on the base;

means to selectively move the pawl into operative relation with the pinion gear to ratchet the pinion gear in a desired direction of rotation; and

hydraulic means mounted on the frame and to said base to reciprocally rotate the base, thereby to ratchet the pawl and the pinion gear to rotate the gear ring and the crushing head in the desired direction to adjustably position the crushing bowl on the frame.

7. Means to rotate the crushing bowl according to claim **6**, wherein the means to selectively move the pawl into operative relation with the pinion gear comprises a hydraulic cylinder mounted on the base and connected to the pawl.

8. Means to rotate the crushing bowl according to claim **6**, wherein the means to selectively move the pawl into operative relation with the pinion gear comprises an electric solenoid mounted on the base and connected to the pawl.

9. In a crusher having a frame, a gyratory crushing head mounted in said frame, and a concave crushing bowl mounted on the frame and adjustable by rotation to form an adjustable crushing gap with the crushing head; means to rotate the crushing bowl comprising,

a gear ring mounted on the exterior periphery of the crushing bowl;

a pinion gear rotatably mounted on the frame to intermesh with the ring gear;

a base rotatably mounted on the frame;

a pawl mounted on the base;

means to move the pawl into operative relation with the pinion; and

lever means detachably mounted on the base to manually reciprocally rotate the base and ratchet the pawl and the pinion gear to rotate the gear ring and the crushing head to adjustably position the crushing bowl on the frame.

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ANDREW R. JUHASZ, *Primary Examiner.*