May 19, 1964 J. B. BOND ETAL 3,133,708

LOCKING MECHANISM FOR CONE CRUSHERS AND THE LIKE

Filed Aug. 15, 1961 4 Sheets-Sheet 1

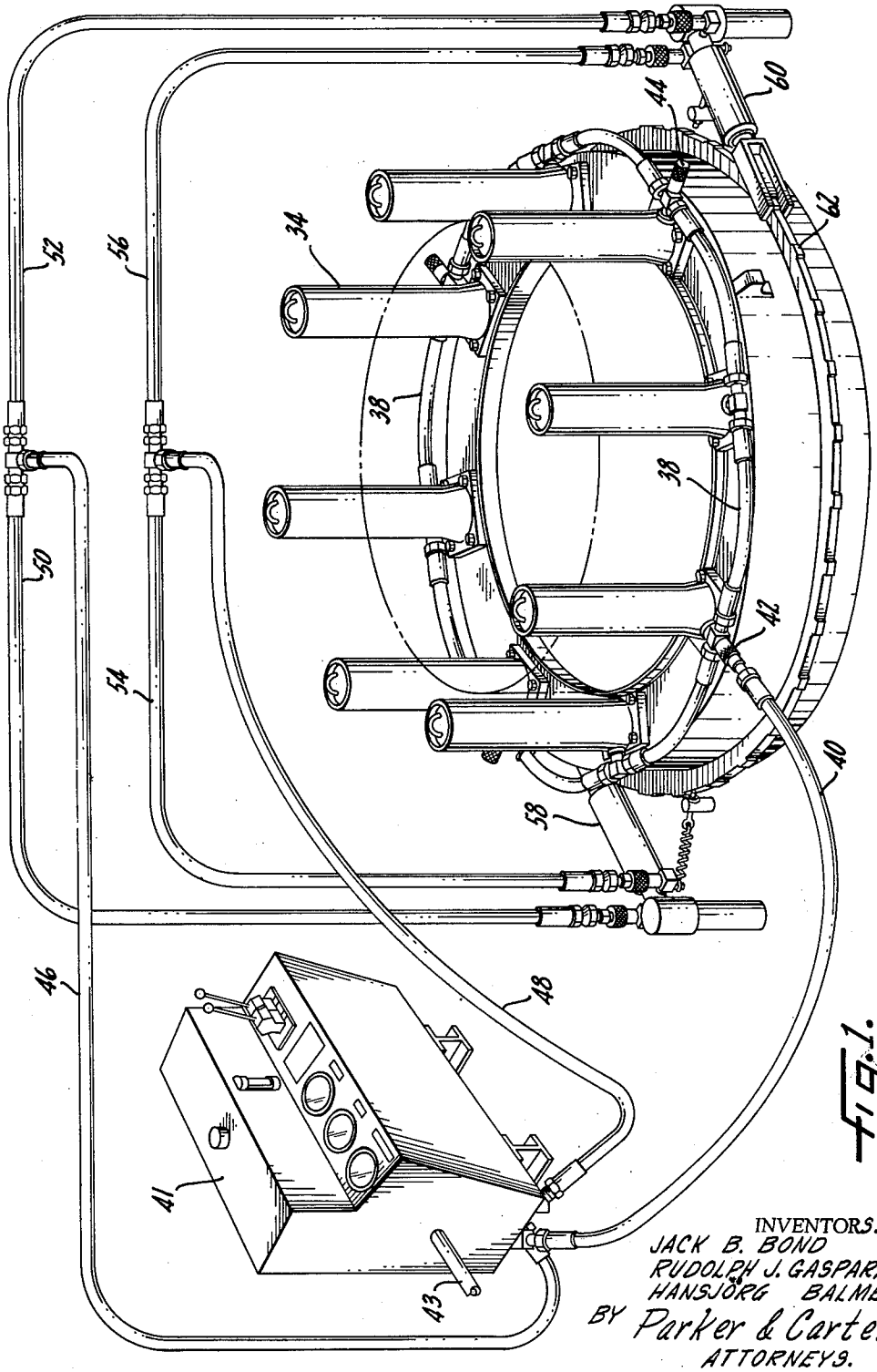


Fig. 1.

INVENTORS.
JACK B. BOND
RUDOLPH J. GASPARAC
HANSJÖRG BALMER
BY Parker & Carter
ATTORNEYS.

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Fig. 2.

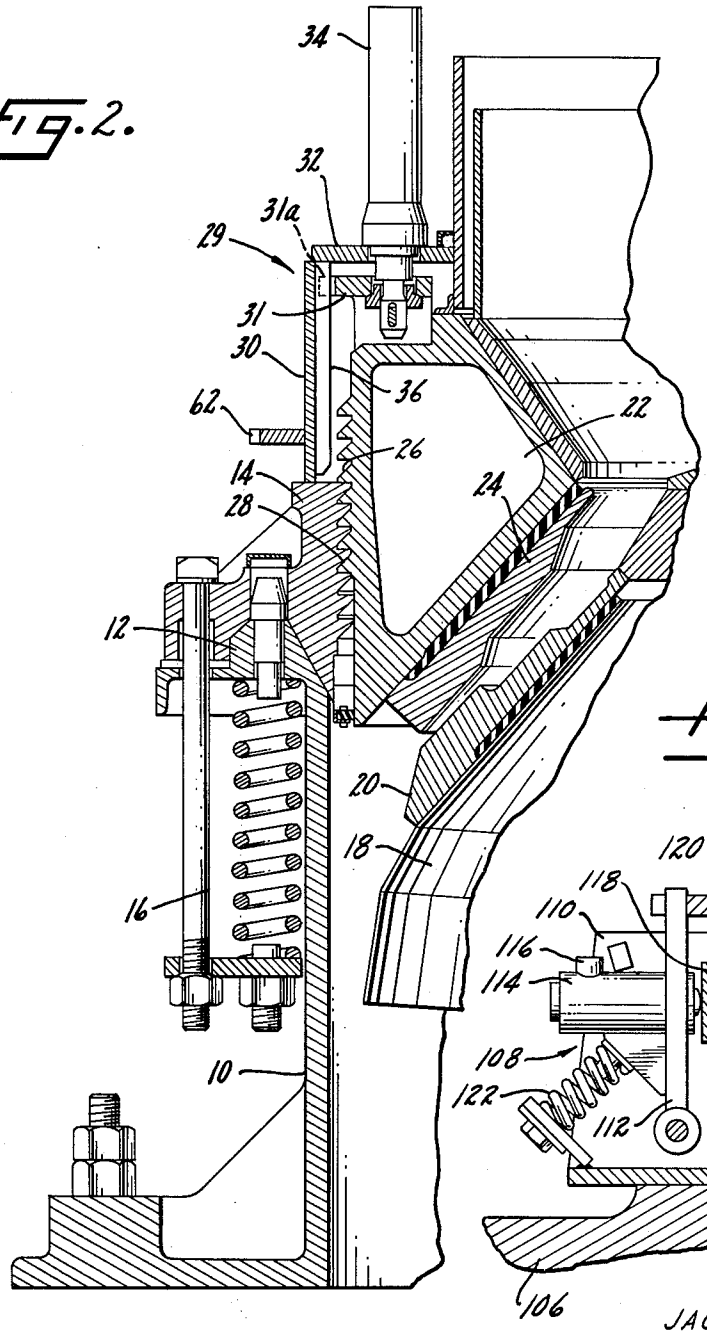
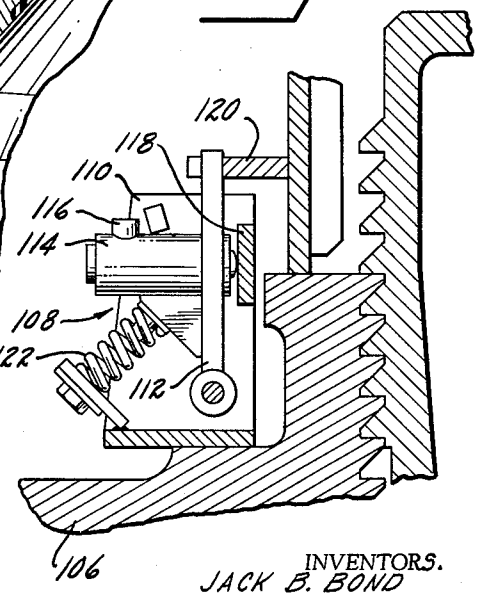


Fig. 5.



INVENTORS.
JACK B. BOND
RUDOLPH J. GASPARAC
HANSJORG BALMER
BY Parker & Carter
ATTORNEYS.

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4 Sheets-Sheet 3

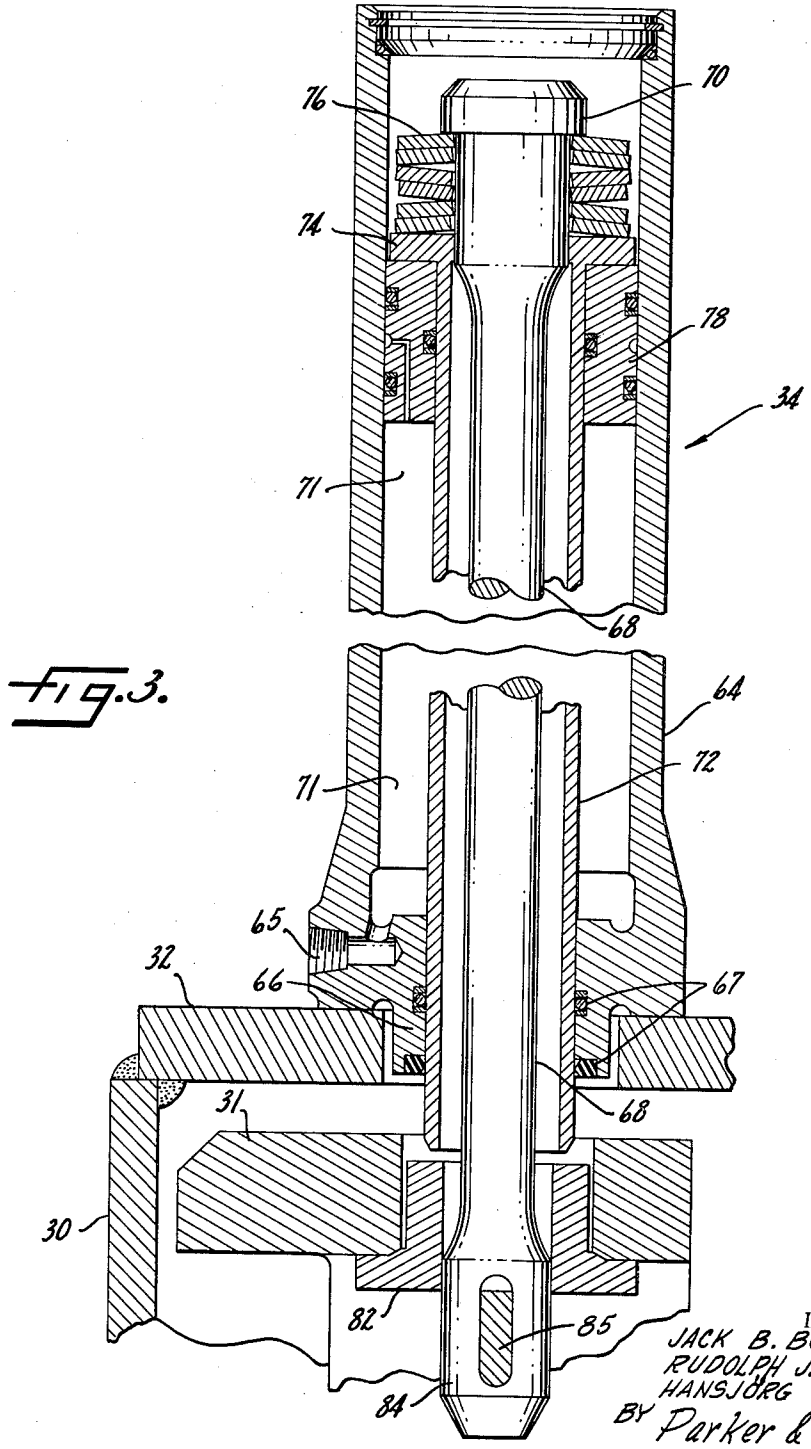


Fig. 3.

INVENTORS.
JACK B. BOND
RUDOLPH J. GASPARAC
HANSJÖRG BALMER
BY Parker & Carter
ATTORNEYS.

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4 Sheets-Sheet 4

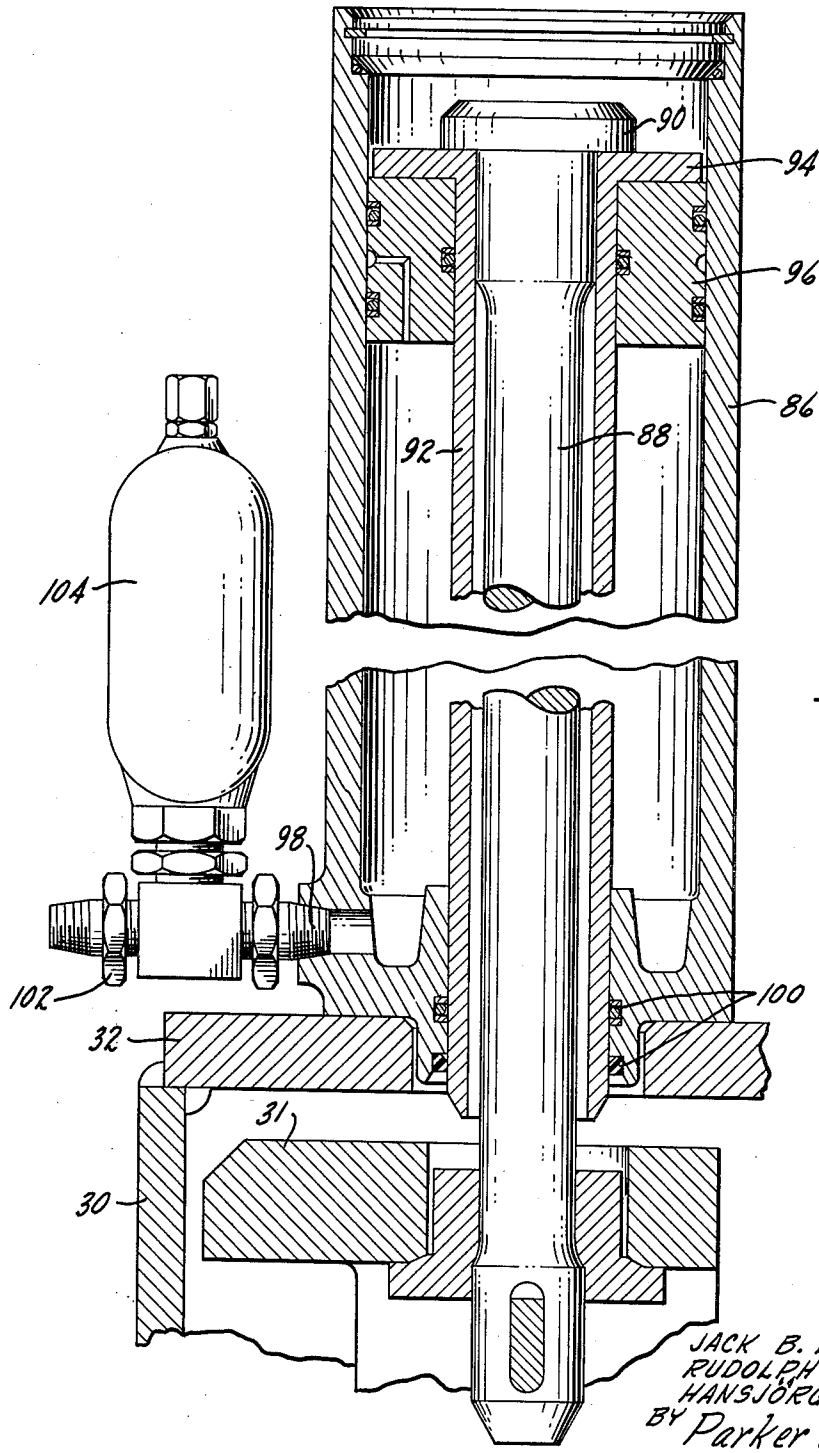


Fig. 4.

INVENTORS.
JACK B. BOND
RUDOLPH J. GASPARAC
HANSJÖRG BALMER
BY Parker & Carter
ATTORNEYS.

United States Patent Office 3,133,708 Patented May 19, 1964

3,133,708

LOCKING MECHANISM FOR CONE CRUSHERS AND THE LIKE

Jack B. Bond, Hales Corners, and Rudolph J. Gasparac and Hansjörg Balmer, Milwaukee, Wis., assignors to Nordberg Manufacturing Company, Milwaukee, Wis., a corporation of Wisconsin

Filed Aug. 15, 1961, Ser. No. 131,629
19 Claims. (Cl. 241—290)

This invention is in the field of cone crushers and is concerned with eliminating wear in the threads between the bowl and adjustment ring or frame.

A primary object is to take care of the thread clearance between the bowl and frame of a crusher thereby eliminating excessive wear.

Another object is to lock the bowl at the same time that thread clearance is eliminated.

Another object is to provide a releasable upthrust to the bowl of a cone crusher.

Another object is a plurality of piston and cylinder assemblies which are effective to provide a releasable upthrust to the bowl at all positions of bowl adjustment on the crusher main frame.

Another object is a structure of the type described which has safety means to prevent rupture of the fluid lines supplying the piston and cylinder assemblies when tramp material or the like passes through the crushing cavity.

Another object is a readily releasable mechanism for providing an even upthrust to the bowl of a crusher to eliminate thread clearance between the bowl and adjustment ring.

Another object is a clamping means of the type described which is arranged to move the bowl up and down with a minimum of work.

Another object is a kit or attachment unit which may be used to convert conventional cone crushers to operate as described herein.

Another object is a thread clearance and adjustment unit for a crusher which automatically locks and releases the bowl when the rams are operated.

Other objects will appear in the ensuing specification, drawings and claims.

The invention is illustrated diagrammatically in the following drawings wherein:

FIGURE 1 is a schematic illustration of the fluid supply system used with the bowl locking arrangement;

FIGURE 2 is a partial vertical section through a cone crusher showing the locking arrangement;

FIGURE 3 is an enlarged vertical section through one form of piston and cylinder assembly;

FIGURE 4 is an enlarged vertical section, similar to FIGURE 3, showing a modified piston and cylinder assembly; and

FIGURE 5 is a partial vertical section through a further modification.

It is conventional in cone crushers, for example gyratory crushers, to have a bowl which forms or defines the upper side of the crushing cavity, adjustably mounted on the crusher frame. It is also conventional to have an adjustment ring on the crusher frame which threadedly mounts the bowl so that the bowl may be rotated and easily moved up and down to compensate for wear of the bowl liner, usually formed of manganese steel or the like. Because of the size of crushers of this type it is not practical to machine or form the threads for the adjustment ring and bowl to a tolerance which eliminates all play or clearance between the threads. Accordingly, it is desirable and has been the practice for some time, to provide a means for applying an upthrust to the bowl so that the bowl threads are firmly held against the adjustment ring threads. It is important to provide such an upthrust which is effective at all positions of bowl adjustment.

Considering FIGURE 2, a crusher, which may be any type of cone crusher, and as shown herein is a gyratory crusher, has a main frame 10 with an outwardly directed flange 12 upon which is mounted an adjustment ring 14. A plurality of spring assemblies 16 may be circumferentially positioned around the crusher frame and yieldingly hold the adjustment ring to the frame. It is necessary to yieldingly hold the adjustment ring and bowl to the frame so that when tramp iron, such as dipper teeth or the like, passes through the crushing cavity, the bowl can move up to pass this material.

The crushing cavity is defined by a head 18, having a mantle 20, and a bowl 22 having a bowl liner 24. The bowl is threaded, as at 26, and the adjustment ring 14 is threaded, as at 28. Rotation of the bowl on the ring 14 moves the bowl up and down on the crusher frame to vary the size of the crushing cavity and to compensate for wear of the bowl liner 24 and mantle 20.

The adjustment ring 14 mounts a rotary cap 29 including an upwardly directed side wall 30 upon which a cover 32 may be welded or otherwise secured. The cover 32 may mount a plurality of piston and cylinder assemblies 34 which are shown in detail in FIGURES 3 and 4. Inside the wall 30 is an upstanding bar 36 positioned between a pair of spaced ears 31*a* extending outward from bowl flange 31. The ears 31*a* and the bar 36 provide a lock between the cap 29 and bowl so that they rotate together.

The arrangement disclosed provides an upthrust to the bowl such that the play or clearance in the threads is always at the bottom of the bowl threads during crushing and so that the threads are always in firm contact.

In FIGURE 1, each of the assemblies 34, which preferably are generally equally spaced around the periphery of the crusher, are connected together by individual hoses or other suitable fluid connections 38. As shown, the assemblies may be considered to be connected either in parallel or in series. The particular type of fluid connection is not important. The system may be air, hydraulic, or otherwise; however, hydraulic is preferred. A fluid line 40 may run from a control console and fluid source 41 to the group of piston and cylinder assemblies 34. A suitable coupling 42, which is a quick disconnect, may form the connection between line 40 and the hoses 38. If the unit is hydraulic, the console may be connected to a suitable source of power at 43, for example shop air, with a converter in the console to convert air pressure to hydraulic pressure, or an hydraulic pump. When it is desired to rotate the bowl on the adjustment ring to compensate for wear in the manganese or bowl liner, the fluid pressure in the cylinders is first removed so that the bowl can be turned. There may be a plurality of connections 44 spaced around the connection between the piston and cylinder assemblies 34 so that the line 40 can be connected at various points about the crusher.

Also connected to the console 41 are fluid lines 46 and 48 which in turn branch out to lines 50, 52, 54 and 56 for connection to fluid-operated rams 58 and 60. The rams are mounted on the adjustment ring 14 and are effective to rotate the cap 29 and bowl in increments by pushing against the toothed ring 62 mounted on the cap 29. The rams and cylinders for removing thread clearance are shown as part of a single fluid system, but they may be otherwise. When together, a single console may be used to completely control the operation and adjustment of the crusher from a remote location.

FIGURE 3 illustrates the details of one form of piston and cylinder assembly. A cylinder 64 may be suitably mounted on the cover 32 and may have a fluid inlet

65 which is in communication with the interior of the cylinder. The lower end 66 of the cylinder may project into an opening in the top cap 32 and may be provided with suitable seals, as at 67. Mounted for reciprocation within the cylinder is an elongated bolt 68 having a slightly enlarged head portion 70. The bolt 68 may be surrounded by a piston rod in the form of a sleeve 72 which has an outwardly directed flange 74 adjacent the enlarged portion 70. Seated upon the flange 74 and positioned to bear against the head portion 70 is a spring arrangement 76 which may include a plurality of washer springs. Springs of this type provided a large thrust with only a small displacement. Positioned in the cylindrical chamber or area 71 defined by the sleeve 72 and the cylinder 64 is a piston head 78. The piston head 78 is not fixed to the piston rod or sleeve and will move freely in the chamber between the sleeve 72 and the cylinder 64 in accordance with the fluid pressure in the chamber. This is an advantageous arrangement in that as the bowl and hence the bolt and sleeve move up during replacement of the liner or mantle or both, the piston head will not move up against a vacuum. Port 65 is closed when the bowl is being turned up and if the piston head moved with the rod, a vacuum would be pulled below it.

The bolt 68 may be suitably connected to the outwardly directed flange 31 on the bowl 22. For example, a collar 82 may be mounted on the lower end 84 of the bolt to bear against a pin or key 85 through the end of the rod.

FIGURE 4 shows a modified form of piston and cylinder assembly which includes a cylinder 86 in which an elongated piston bolt 88 has an upwardly enlarged portion or head 90. A piston rod or sleeve 92 surrounds the bolt and has a flange 94, preferably integral, at its upper end bearing against the piston rod head 90. A free piston 96 having suitable seals may be positioned around the sleeve below the flange.

There may be an inlet port 98 opening into the bottom of the cylinder below the free piston and the lower end of the piston may be sealed, as at 100, around the sleeve. By a T connection 102 an accumulator 104 is shown as connected to the inlet port.

In this form, the piston and cylinder assembly is similar to FIGURE 3 except that the Belleville or washer springs are not used and an accumulator is substituted. In the FIGURE 4 form, it will be understood that we prefer to have an accumulator connected directly next to each of the piston and cylinder assemblies so that the shock produced in the fluid when tramp iron, or other foreign matter, goes through the crusher will be absorbed almost immediately and directly at each cylinder assembly without having to pass through any appreciable length of lines, hoses, etc., to get to the accumulator. The greater distance shock waves must travel through piping before getting to the accumulator, the less effect the accumulator will have due to friction in the piping. We might also use one accumulator for two cylinders, but one for each is preferred.

It should be noted that the piston and cylinder assemblies are quite long. In order to provide an upthrust in all positions of the bowl on the adjustment ring, it is necessary to have a piston with sufficient stroke. The bowl 22 will initially be positioned such that its bottom threads are engaged with the top threads of the adjustment ring. This is the condition when new manganese steel has been applied to the head and bowl. In the extreme up position, but the piston will be adjacent the top of the cylinder and will be in the position shown in FIGURES 3 and 4. As the bowl is gradually moved down to compensate for wear in the manganese, the piston will be stationed at gradually lower positions within the cylinder. The bowl is in the furthest down position when the manganese liner and mantle are almost worn out.

In FIGURE 5 an alternative is shown in which the adjustment ring 106 carries a locking unit, designated generally 108. One or more such units may be used. The locking unit may include a housing 110 supporting a pivoted lever 112 carrying a fluid cylinder 114 connected to the hydraulic system at 116. The piston on the cylinder engages a plate 118 in the housing and, when energized, pivots the lever out so that its upper end does not fit in one of the notches in the torque ring 120. The lever is biased inwardly by a suitable spring 122.

When the locking unit is connected into the hydraulic circuit with the rams, it will be automatically energized to unlock the bowl when the rams are energized. The spring 122 normally keeps the unit locked but when supplied with fluid, the piston pivots the lever out, compresses spring 122 and unlocks the bowl.

The use, operation and function of the invention are as follows:

It is necessary in cone crushers, for example gyratory crushers, in which the bowl is adjustably mounted on the frame, to provide a means for holding the bowl in position. In particular, when the bowl is threaded to an adjustment ring which, in turn, is yieldingly mounted on the frame, it is necessary to remove the play or clearance between the bowl and the adjustment ring threads. Preferably, this play or clearance is removed by an upthrust on the bowl which holds it against the bottom of the adjustment ring threads.

It is also desirable to provide a locking arrangement which needs a minimum of manual effort and attention by operating personnel. It is preferred to have a locking arrangement which can be completely automatic. By providing a plurality of piston and cylinder assemblies around the crusher, it is possible to apply an upthrust to the bowl. In order to supply this upthrust at all positions of the bowl, the piston should have a stroke slightly more than the liner length.

While we may get sufficient additional upthrust from the assemblies 34 to also lock the bowl against rotation during crushing, in certain applications we prefer to use just sufficient upthrust to exceed the weight of the bowl assembly with locking being taken care of by a separate lock. Where a separate lock is used, it may be manually operated or hydraulic. If hydraulic, we prefer to tie it into the hydraulic system so that the lock will automatically be released when the rams are energized.

An advantage of the form of piston and cylinder shown in FIGURE 3 is that the piston head moves freely within the chamber 71. When the port 65 is closed during upward rotation of the bowl, the piston rod will be moving in the cylinder 64. If the piston head were firmly attached to the piston rod, a vacuum would be created behind the head and it would take additional work to move the piston, and hence the bowl. By utilizing a free piston head, no vacuum is created, as the piston head remains down until fluid pressure is introduced into the cylinder.

In addition to use on new crushing units, the particular clamping or locking means disclosed may be attached, in the form of a kit, to existing machines to convert them to the type of operation described. As machinery of this type is quite expensive, a kit arrangement is very advantageous. For example, the piston and cylinder assemblies and the various hose connections along with the control console may constitute a unit which is sold for attachment to an existing machine. In addition, the fluid or hydraulic rams for incrementally turning the bowl on the adjustment ring may constitute a part of the attachment unit. By using the control console shown with both the piston and cylinder assemblies and the rams, movement of the bowl to compensate for wear of the liners and removing thread clearance may all be controlled from a single remote unit.

Before turning the bowl on the adjustment ring, the upthrust on the bowl is removed. The fluid system is then detached at intervals from the piston and cylinder assemblies to allow the bowl to move freely. In this connection, there are a plurality of connecting points for

attaching the fluid line 40 to the group of piston and cylinder assemblies. The rams may then be operated to incrementally turn the bowl.

When tramp iron passes through the machine, the adjustment ring and bowl will be tipped up. When the head recesses, bringing the adjustment ring and bowl back down on the frame, they will hit the frame at a high velocity. With the weight of the bowl and spring thrust behind it, the bowl will continue down through the thread clearance. This additional movement, even though small, will force the pistons down sufficiently in the cylinders to compress the fluid such that quite high pressures can be developed. This is particularly true when the manganese steel is almost worn out, since the pistons will be near the bottom and the volume of fluid available to be compressed will be small. Under these conditions, the pressures developed can be tremendous.

To prevent these high pressures which will result in a break in the hydraulic line, the springs, such as in FIGURE 3, will absorb this movement. The same is true of the accumulators, such as in FIGURE 4.

Whereas the preferred form of the invention has been shown and described herein, it should be realized that there are many modifications, substitutions and alterations thereto, within the scope of the following claims.

We claim:

1. In a gyratory crusher, a main circumferential frame, an adjustment ring releasably mounted on the main frame, a bowl screw-threaded into the adjustment ring, a head mounted in the frame for gyratory movement defining a crushing cavity with the bowl, a release between the main frame and adjustment ring for allowing the bowl to release when uncrushable material passes through the crushing cavity, a plurality of fluid piston and cylinder assemblies spaced about the bowl and effective between the adjustment ring and bowl to apply an upthrust to the bowl to remove thread clearance between the bowl and adjustment ring, each piston having a stroke sufficient to apply an upthrust to the bowl at all positions of adjustment of the bowl, a fluid system for supplying fluid under pressure to the assemblies, as a group, to provide an upthrust to the bowl, a top cap rotatably mounted on the adjustment ring rising above the bowl, and a key connection between the top cap and bowl such that the bowl may move vertically relative to the top cap but is interlocked rotatably to it, the piston and cylinder assemblies being mounted on the top cap, the piston rod of each cylinder extending down through the top cap and being connected to the bowl.

2. The structure of claim 1 further characterized by a plurality of fluid actuated rams mounted on the adjustment ring equidistant from each other about the main frame and effective to apply a peripheral thrust to the top cap thereby rotating the top cap, cylinders, and bowl relative to the adjustment ring.

3. For use with a remotely controlled clamping unit to be applied to a cone crusher having a circumferential main frame with an adjustment ring releasably mounted on the main frame and a bowl screw-threaded in the adjustment ring with a top cap mounted on the adjustment ring with a head mounted for gyration in the main frame defining a crushing cavity with the bowl, the improvement comprising a plurality of piston and cylinder assemblies to be mounted with the cylinder of each assembly on the top cap and the piston rod extending through the top cap and connected to the bowl, each of the assemblies having sufficient stroke such that, as a group, they will apply an upward thrust to the bowl to remove thread clearance between the bowl and adjustment ring in all positions of adjustment between and including the highest position of the bowl when new manganese steel wearing parts have been applied to the bowl and head and the lowest position of the bowl when the wearing parts require replacement, and a fluid control system connected to the assemblies for controlling the supply of fluid under pressure to the assemblies.

4. The structure of claim 3 further characterized by and including at least two fluid rams adapted to be mounted on the adjustment ring, equally spaced from each other, to apply a peripheral thrust to the top cap thereby rotating the bowl for adjustment.

5. The structure of claim 3 further characterized by and including yielding means providing a yielding bottoming of each piston with its cylinder.

6. The structure of claim 5 further characterized in that said yielding means includes a fluid accumulator connected to each cylinder.

7. The structure of claim 5 further characterized in that said yielding means includes a plurality of washer-like springs mounted within each cylinder and about each piston.

8. The structure of claim 5 further characterized by and including at least two fluid operated rams adapted to be mounted on the adjustment ring to apply a peripheral thrust to the top cap, a locking structure adapted to apply a positive lock between the adjustment ring and top cap, and a fluid connection between the rams and lock structure such that when the rams are energized the lock structure will release the top cap.

9. In a gyratory crusher, a main circumferential frame, an adjustment ring releasably mounted on the main frame, a bowl screw-threaded into the adjustment ring, a head mounted in the frame for gyratory movement defining a crushing cavity with the bowl, a release between the main frame and adjustment ring for allowing the bowl to release when uncrushable material passes through the crushing cavity, a plurality of fluid piston and cylinder assemblies spaced about the bowl and effective between the adjustment ring and bowl to apply an upthrust to the bowl to remove thread clearance between the bowl and adjustment ring, each piston having a stroke sufficient to apply an upthrust to the bowl at all positions of adjustment of the bowl, a fluid system for supplying fluid under pressure to the assemblies, as a group, to provide an upthrust to the bowl, and a compressible element for each piston and cylinder assembly, such that when the bowl returns to crushing position after tramp iron has passed through the cavity, the compressible elements may yield to protect the fluid system against excessively high pressures.

10. The structure of claim 9 further characterized by and including a releasable connection between the group of assemblies and the source of fluid pressure such that when the assemblies are rotated with the bowl, the source of fluid pressure may remain stationary and may be reconnected after an adjustment has been made.

11. The structure of claim 9 further characterized in that each piston includes a piston rod and a piston head freely movable thereon, and further characterized in that the compressible element includes a spring arrangement positioned between the piston rod and the piston head.

12. The structure of claim 11 further characterized in that the spring arrangement includes a plurality of washer springs positioned between the piston rod and piston head.

13. The structure of claim 9 further characterized by and including an accumulator directly adjacent and in communication with the inside of each cylinder so that a minimum of resistance is offered to the flow of pressure waves from the cylinder to the accumulator.

14. The structure of claim 9 further characterized in that each of said pistons includes a piston rod having an enlarged upper portion which loosely mounts a piston head, the piston rod and piston head being reciprocal together within the cylinder.

15. In a system of bowl adjustment for a crusher and the like, a main frame, a bowl mounted on the main frame for rotary adjustment relative thereto, and means for rotating the bowl relative to the main frame to effect adjustment thereof, including at least one fluid operated

ram adapted to apply a tangential thrust to the bowl to rotate it relative to the main frame, a fluid control system connected to the ram for controlling the supply of fluid thereto, a locking structure adapted to apply a positive lock between the bowl and main frame, and means for automatically releasing the lock structure when the ram is energized so that the bowl is automatically released to be rotated for adjustment by the ram.

16. The structure of claim 15 further characterized by and including a plurality of fluid piston and cylinder assemblies spaced about the bowl and effective between the bowl and main frame to apply an upthrust to the bowl to remove thread clearance, and a fluid connection between the piston and cylinder assemblies connected to the fluid control system such that when the control system energizes the ram, the piston and cylinder assemblies will be released so that the upthrust will be removed from the bowl.

17. The structure of claim 16 further characterized by and including a compressible element for each piston and cylinder assembly such that when the bowl returns to crushing position after tramp iron has passed through the machine, the compressible elements may yield to protect the control system against excessively high pressures.

18. The structure of claim 17 further characterized in that the compressible elements include a plurality of washer springs in each of the piston and cylinder assemblies.

19. In a gyratory crusher, a main circumferential frame, an adjustment ring releasably mounted on the main frame, a bowl screw-threaded into the adjustment ring,

a head mounted in the frame for gyratory movement defining a crushing cavity with the bowl, a release between the main frame and adjustment ring for allowing the bowl to release when uncrushable material passes through the crushing cavity, a top enclosure connected to the bowl to be rotated therewith, a plurality of piston and cylinder assemblies mounted on the top enclosure, the cylinder of each assembly being mounted on the top enclosure and the piston rod extending through the top enclosure and being connected to the bowl, each of the assemblies having sufficient stroke such that, as a group, they will apply an upward thrust to the bowl to remove thread clearance between the bowl and adjustment ring in all positions of adjustment between and including the highest position of the bowl when new manganese steel wearing parts have been applied to the bowl and head and the lowest position of the bowl when the wearing parts require replacement, and a fluid control system connected to the assemblies for controlling the supply of fluid under pressure to the assemblies.

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