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Gasparac et al.

[11] **3,804,342**

[45] **Apr. 16, 1974**

[54] **CRUSHER RELEASE CLEARING SYSTEM**

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[73] Assignee: **Rexnord, Inc.,** Milwaukee, Wis.

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[52] **U.S. Cl.** ..... **241/37,** 241/20 T, 241/290

[51] **Int. Cl.** **B02c 25/00**

[58] **Field of Search** 241/32, 33, 37, 207, 208, 241/214, 215, 286, 290

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Attorney, Agent, or Firm—Parker, Plyer & McEachra

[57] **ABSTRACT**

This is concerned with a pneumatic loading, release and clearance system for cone crushers and is more specifically concerned with a system that can be used with a plurality of crushers, for example two. It is also concerned with a system that, in addition to fully releasing the pneumatic pressure between the main frame and tilting ring of a crusher, also has a hydraulically-operated system for elevating the tilting ring and bowl so that a plugged or jammed crusher can be cleared. It is also concerned with a pneumatic release system which is specifically constructed so that it may be substituted for the conventional spring-release system on machines now in the field with a minimum of time, effort and expense.

3 Claims, 4 Drawing Figures

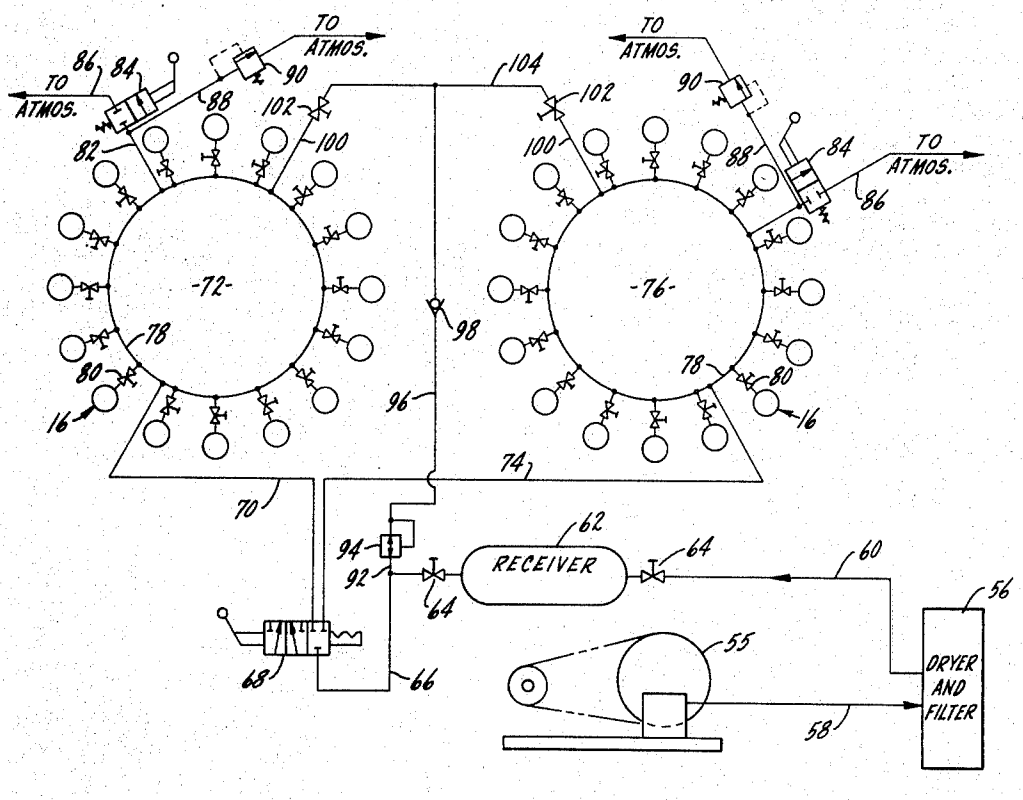
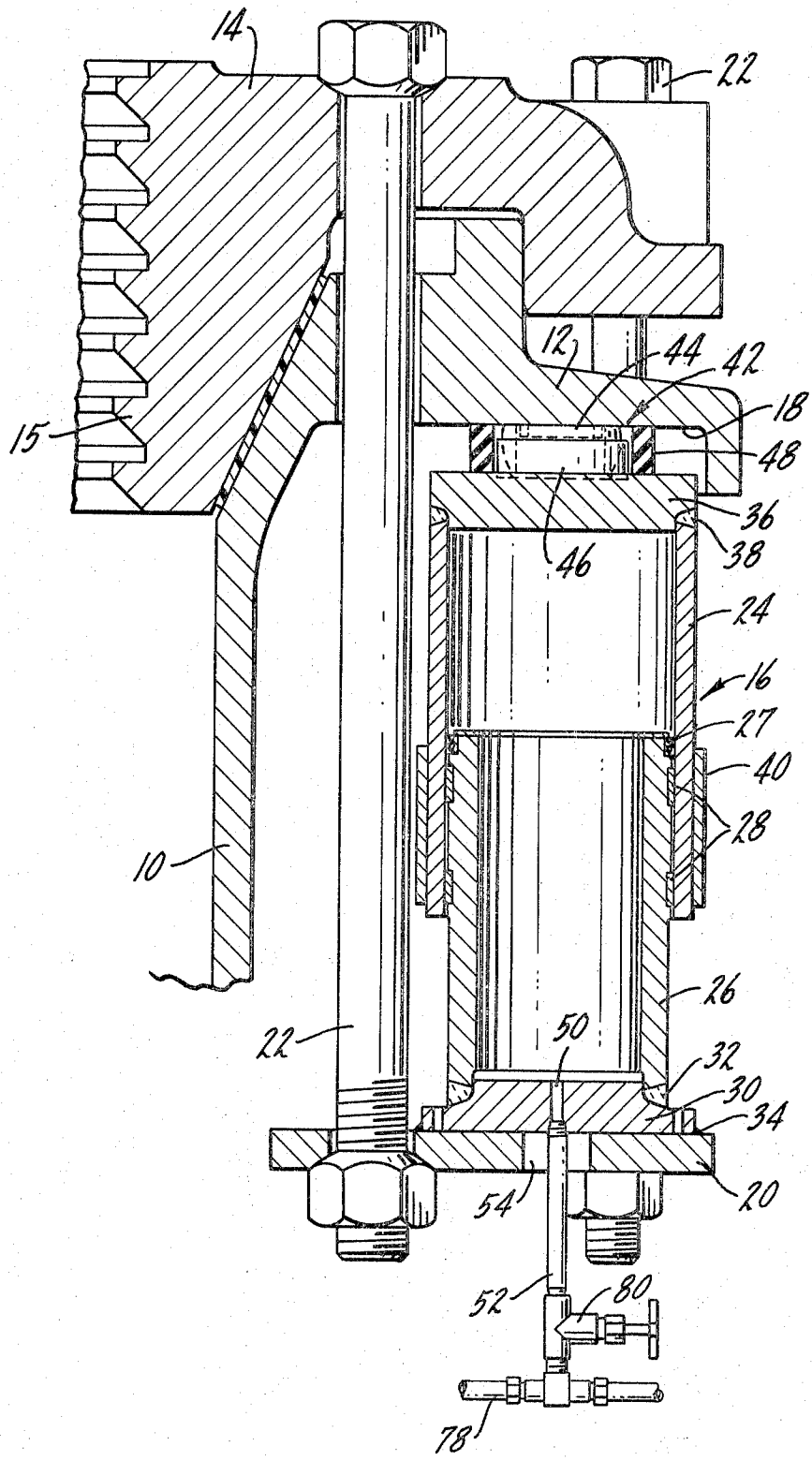


Fig. 1.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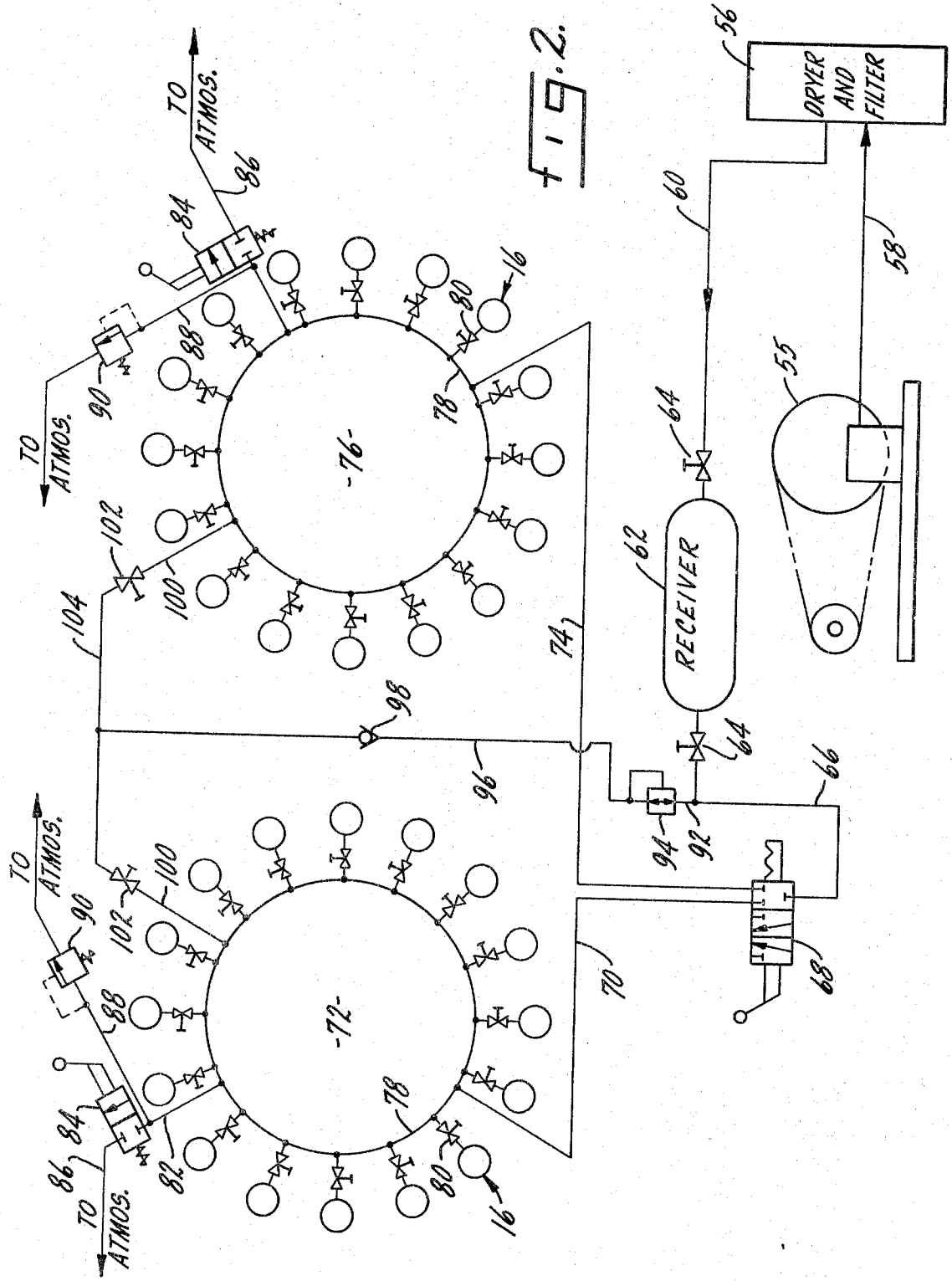
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Fig. 2.

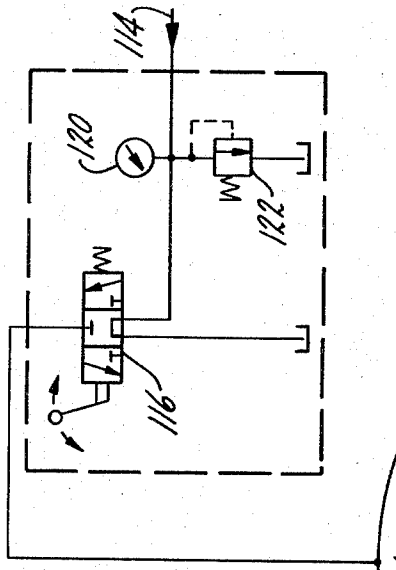
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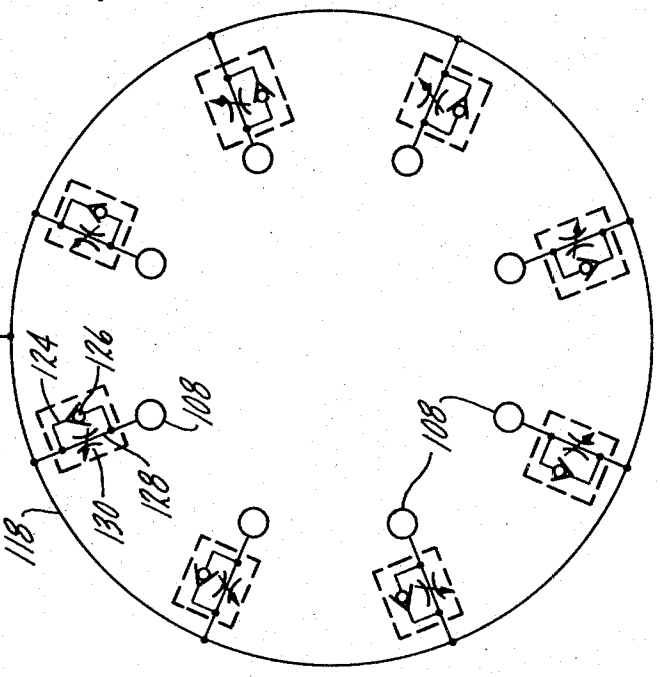
Fig. 4.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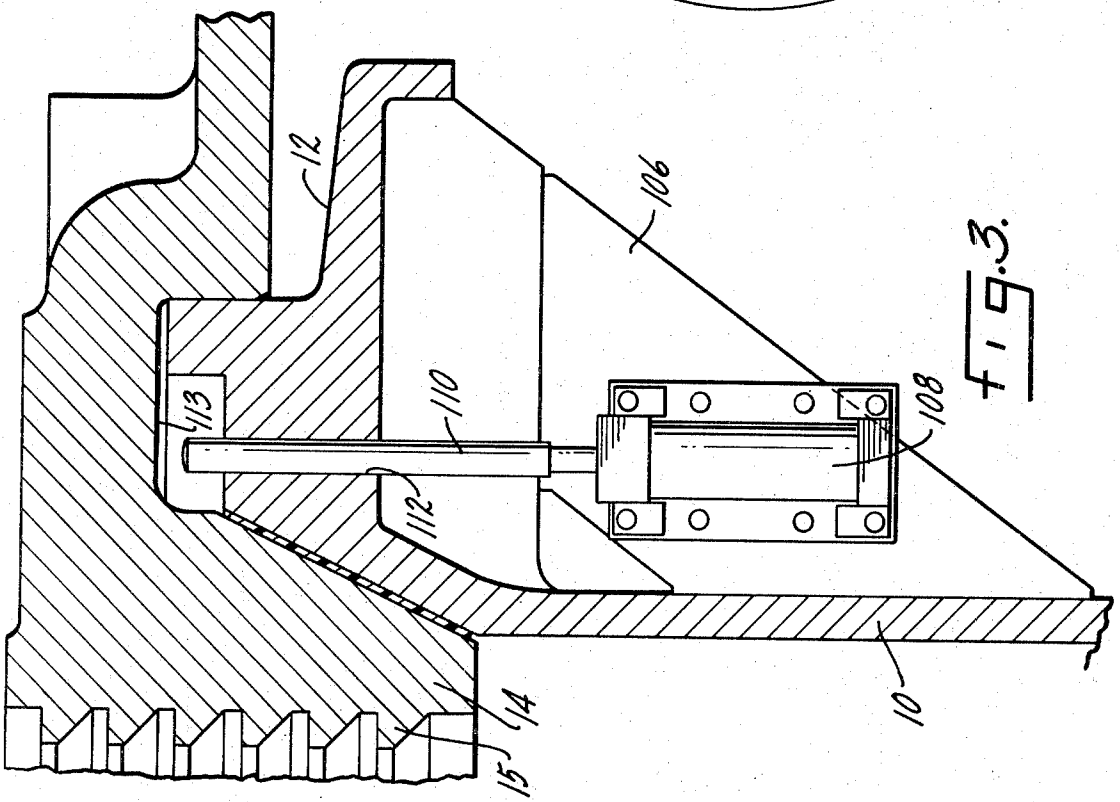
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Fig. 3.

CRUSHER RELEASE CLEARING SYSTEM

SUMMARY OF THE INVENTION

This invention is concerned with a pneumatic loading, release and clearance system for cone crushers of the type in which the crushing cavity is defined between a gyrated head and an overhanging bowl. Cone crushers are normally constructed with a so-called release system so that when uncrushable material, such as tramp iron or large pieces of wood, get stuck in the crushing cavity, the permanent parts of the machine such as the bowl, frame, etc. will be protected as the release system will allow the permanent parts to separate. The release system also is constructed so that a plugged crusher caused by a power failure or the like may be quickly cleared and restored to full operation.

A primary object of the invention is a crusher release and clearance system which may be used for two or more crushers.

Another object is a clearance system which has a hydraulic or pneumatic arrangement for raising the tilting ring and bowl so that a plugged crusher, due to a power failure or the like, can be quickly cleared and restored to full operation.

Another object is a pneumatic release system for a crusher which, at a minimum expense, may be used to replace conventional spring-release systems in the field.

Another object is a pneumatic release system which prevents surges between interconnected crushers.

Another object is a pneumatic release system for crushers which can be quickly recharged, after release, on a selective basis.

Another object is a pneumatic release system for a plurality of crushers which enables one crusher system to be isolated and released without disturbing the release system on other crushers in the system.

Another object is a release system and valving arrangement for a plurality of crushers which provides for selective isolation.

Another object is a pneumatic release system for a crusher in which a plurality of pneumatic cylinders, while interconnected in a manifold-type arrangement, are individually self-contained and effectively isolated from each other in both operation and effect.

Another object is a pneumatic release system for cone crushers in which the cylinders thereof are specially constructed to compensate for and absorb side shifts.

Another object is a pneumatic release system for cone crushers which avoids problems due to misalignment and side shifts upon bowl tilting.

Another object is an off-line pneumatic release system which may be charged and maintained on standby for use in returning a crusher, after clearing, to service.

Other objects will appear from time to time in the ensuing specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a portion of a crusher with a release cylinder in section;

FIG. 2 is a schematic of a release system for two crushers which are shown schematically;

FIG. 3 is a section through a portion of a crusher on a different radial than FIG. 1 with the elevating cylinder shown mounted on the main frame web; and

FIG. 4 is a schematic of the hydraulic elevating system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. 1 and 3, the generally circumferential main frame 10 of the crusher has been indicated with only a portion thereof being illustrated. The main frame has an outstanding flange 12 at or toward the upper end which supports a so-called tilting or adjustment ring 14, all of which is old and well-known. The tilting ring normally supports a bowl by a screw threaded connection 15, so that the bowl may be adjusted up or down in accordance with the desired setting for the machine or to compensate for wear of the removable and replaceable mantle and bowl liner. The frame also encloses the usual crushing head which is mounted for gyration and has not been shown.

Gyratory cone crushers normally have a so-called spring release which holds the bowl and tilting ring 14 down on the main frame flange 12. This spring release is constructed and arranged to give or yield so that when a piece of uncrushable material, such as tramp iron or the like, goes through the crushing cavity, the ring can tilt up compressing the spring release and allowing the object to pass. Springs as the release means have the disadvantage that, on large machines, they occupy a great deal of space and cannot be released easily. It is often desirable to clear a plugged or stuck crusher. The springs as a group provide a tremendous force which create an insuperable obstacle to jacking up the bowl and tilting ring.

In the arrangement shown in FIG. 1 a pneumatic cylinder 16 is interposed between the bottom surface 18 of the main frame flange and a lower plate or retainer 20. While only one cylinder 16 is shown in FIG. 1, it will be understood that a plurality of cylinders is used, in the general arrangement in FIG. 2 and described in detail hereafter. The cylinders are positioned about the crusher so that the yielding force is generally uniform all the way around. Bolts 22 pass through the main frame flange, tilting ring and retainer plate with a semi-spherical head on one end and a semi-spherical nut on the other to provide for some misalignment in assembly and under conditions in which the adjustment ring is lifted during the passage of tramp metal. For each cylinder 16, three such bolts are provided, one on each peripheral side of the cylinder and one inside and aligned with it radially.

The cylinder itself is made up of two telescoping sleeves or cylinders, a larger one 24 and a smaller one 26. Suitable seals 27 and guide bearings 28 are provided between the outside of the smaller one and the inside of the larger one. In the arrangement shown, the larger sleeve 24 is on top with the smaller one below but it might be reversed. The bottom of the smaller sleeve is closed by an end plate disc 30 which may be suitably welded thereto, as at 32, with the end plate being welded or otherwise suitably connected at 34 to the retainer or lower plate 20. The top of the upper sleeve is closed by a plate 36 which is suitably welded or otherwise connected thereto as at 38 so that the cylinder itself is otherwise closed. The two sleeves overlap for a substantial distance, as shown in FIG. 1, and a band 40 is shrink fitted around the outside of the overlap to gain rigidity which limits leakage due to cylinder expansion.

The top of the cylinder bears against the lower surface **18** of the main frame flange by a spherical joint **42** which includes a ball **44** contacting the lower surface of the main frame flange and matching a socket **46** mounted on the upper surface of the cylinder. The joint is enclosed by a flexible sleeve **48,** which is slightly larger in diameter than the joint, with the dimensions being such that, with the socket fully engaged, the sleeve **48** will be under a predetermined amount of vertical compression so that a dust-type seal is provided around the joint.

The bottom closure or plate **30** on the cylinder has a suitable passage **50** which is connected by a pipe **52** or the like through a suitable opening **54** in the bottom retainer **20** to a pneumatic system shown schematically in FIG. **2.**

The system itself includes a suitable air compressor **55** or any suitable source of pressure air. Air from the source is supplied to a suitable dryer and filter **56** through a connection **58** and then through connection **60** to a receiver **62** which has valves **64** on each side so it may be isolated. Air from the receiver goes through a branch line, one side **66** of which goes to a selector valve **68** of any suitable type which may selectively supply the air through a line **70** to one crusher **72** or through another line **74** to another crusher **76.** The piping cylinder, valves, etc. for the two crushers may be the same, so only one will be referred to in detail. Considering the crusher **72** on the left in FIG. **2,** the supply line **70** is connected to a pipe ring **78** which, through suitable valves **80,** supplies air to each of the cylinders, designated **16** in FIG. **2.** An exhaust or vent line **82** is connected to the pipe ring and, by a manually operated valve **84,** is adapted to vent to the atmosphere as at **86.** A branch **88,** controlled by pressure release valve **90,** also prevents overload or excessive pressures in the cylinders by automatically venting to the atmosphere when a predetermined pressure is reached in the cylinders.

From the receiver **62,** an other branch **92** is connected to a pressure regulator **94** and then through a line **96** to a check valve **98** leading to a connection **100** with the pipe ring **78** through a manual valve **102.** Line **96** branches so that a separate line **104** leads to the other crusher.

The volume and pressure level of the receiver **62** are such that one of the two crushers may be completely vented, for example, in clearing a jam, and then recharged by pressure air from only the receiver to a pressure in the cylinder that makes the crusher operative again. As an example, the cylinders themselves may operate at 1,000 psi with the receiver at 2,500 psi. The volumes should be related so that when the pressure from the receiver is released through selector valve **68** to a crusher that is down, the pressure will stabilize in the cylinders **16** at something on the order of 1000 psi in accordance with well-known pressure-volume relationships for gases.

Branch **66** and selector valve **68** are used to recharge either crusher that has been vented and released. Branch **96** and pressure reducer **94** make up leakage in either or both crushers at the same time while they are in operation but are not used during recharging. If the crushers are to operate with, say, **1000** psi in the cylinders, the regulator **94** will maintain pressure. To maintain the spatial relationship of the component parts and prevent disengagement of the cylinder and the spherical joint **42** a residual gas pressure may be maintained at all times in the cylinder cavity.

In FIG. **3** a section through the main frame, main frame flange and tilting ring is shown but on a different radial than that of FIG. **1.** At suitable intervals around the main frame are positioned flanges or web **106,** on which are mounted hydraulic jacks **108.** A plurality of such jacks are used about the crusher and are shown schematically in FIG. **4.** The piston extension **110** of each jack extends upwardly through a channel or hole **112** in the main frame flange to a position opposite the lower surface **113** of the tilting ring. Any suitable source **114** supplies pressure oil through a selector valve **116** to a manifold **118** about the crusher to which each of the individual jacks **108** is connected. The hydraulic system may be provided with a suitable gauge **120** and pressure release valve **122** set to prevent the hydraulic pressure from becoming excessive. Each of the jacks **108** has one line **124** with a check valve **126** for supplying oil to the jack as it extends and another line **128** with a restriction or throttling orifice **130** through which the oil returns on a controlled basis as the jack comes down.

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

A pneumatic release system is provided that is especially constructed and adapted as a conversion unit for machines in the field, meaning that the springs which are normally used on cone crushers may be removed in the field and the pneumatic cylinders shown and described here take their place. The arrangement requires a minimum of time, effort and trouble in altering and adapting a crusher in the field. All that is required is that the springs be removed, a few holes drilled and the present unit installed. This is not to say that the release system shown and described herein cannot or should not be used on original equipment since it is equally applicable to either new or field units.

The arrangement is specifically constructed to operate at what may be considered a relatively low pneumatic pressure. One thousand psi has been mentioned as an example and although this is not critical, a pressure of this low magnitude is desired.

The pneumatic cylinders themselves are constructed to be flat, or relatively so, on each end so that they will fit between the lower surfaces of the main frame flange and the upper surface of the metal plate or retainer. The upper surface is provided with a sealed ball joint so that the attitude of the assembly can change, as the unit tilts, without kicking out.

The system is also specifically designed to be attached to more than one crusher. Two have been shown, but it should be understood that, by suitable connection, more than that could be used. The arrangement shown in FIG. **2** has the advantage that either crusher can be vented and then restored to full-line operation in a very short time. In the FIG. **2** arrangement assume that the crusher on the left, designated **72,** is stuck or plugged. First, valve **102** for crusher **72** will be closed. Then the selector **84** will be opened to vent all of the cylinders to the atmosphere. This relieves all pressure between the main frame and tilting ring, other than gravity. Then selector valve **116** in the hydraulic system is actuated so that the jacks are energized to raise the bowl and tilting ring.

The amount of raise is that necessary to clear the crusher. The jacks in this case, as a group, are only re-

quired to have just sufficient thrust to raise the dead weight of the bowl and tilting ring with their various appurtenances as well as to overcome the residual gas pressure in the cylinders. The source of pressure oil, indicated at **114** in FIG. **4**, is optional and a suitable pump may be used. If the crusher is of the type that has a source of pressure oil already on it, for example for clamping or unclamping and/or rotating the bowl, such as shown in U.S. Pat. No. 3,133,708, issued May 19, 1964 or U.S. Pat. No. 3,140,835, issued July 14, 1964, the same source of hydraulic pressure may be used. After the crusher is cleared, the oil pressure is released to lower the tilting ring and bowl. The rate of descent will be controlled by the throttling orifices **130** to avoid any freefall and accidents. With the bowl and tilting ring back down, the air cylinders will be repressurized by operating selector valve **68** so that the supply of pressure air from the receiver would go to the cylinders on crusher **72.** All of this would be done without affecting the cylinders on the other crusher **76** since the first crusher **72** would, in effect, be isolated. The air system would stabilize at a pressure in the cylinders permitting the crusher to be started up immediately. Selector valve **68** would then be returned to the blocking position, shown in FIG. **2** and the compressor **55,** when it sensed the reduced pressure in the receiver, would start up and bring the receiver back to its higher reserve pressure level. All the time the auxiliary connection **96–104** to the other crusher **76** would be compensating for leakage, if any was occuring. With both crushers back on the line and the valve **102** for crusher **72** opened again, normal operation would resume.

It is not thought necessary to make the receiver large enough and/or to raise the pressure therein high enough so that sufficient pressure air is available to completely recharge more than one crusher at a time. It might also be arranged so that each crusher has its own receiver with one compressor supplying a group of receivers. In either such arrangement, if any one of the crushers tied into a common system leaks, the regulator **94** will sense it and will automatically bring the pressure in the cylinders on all connected crushers back to the operating level. Or two regulators could be used, one for each crusher.

Also, the system is interconnected by small lines or pipes so that when tramp iron goes through either one crusher and the pressure builds up in its cylinders, a pressure wave will not surge through the system to the other crusher or back to the supply. The lines are also small enough so that each cylinder on a crusher is, for practical purposes, effectively isolated from all the others during surge. If desired, the cylinders may be interconnected with properly sized connections to reduce peak surges by utilizing the volume of air or gas in the entire system.

A pneumatic release system of this nature will greatly soften or reduce the shock load imposed on the crusher head and main shaft as well as the main frame and adjustment ring assembly caused by the passage of tramp iron through the crushing cavity.

Although the details of the particular crusher on which the invention is to be used has not been shown, it should be understood that any crusher or bowl structure needs to be released in response to excess crushing stresses is a proper crusher for the application of this release. In the particular embodiment of the invention shown herein, a plurality of pneumatic cylinders, be they filled with air, nitrogen, or otherwise, are adapted to exert an upward thrust against the underside of the main frame flange and a downward thrust to the bowl and tilting ring. While a separate air compressor has been shown, where a pneumatic supply is maintained in the plant, plant pressure air may be used in the cylinder, or a combination of the two. While examples have been given of the various pressure levels involved, these are merely by way of suggestion or illustration. The pressure maintained in the cylinder is sufficient to sustain normal crushing loads.

One of the advantages of the present system is that for an individual crusher, venting the pressure in the cylinders is done through a separate line from the leakage makeup connection. The advantage of this is that leakage can be taken care of through a quite small connection, whereas discharging and emptying may be done through large piping to insure a rapid operation.

We claim:

1. In a pneumatic release system for at least two gyratory crushers and the like, each crusher having a circumferential main frame with a circumferential flange on an upper portion of the main frame and a bowl-supporting ring tiltably mounted on and above the main frame flange with a bowl supported on the ring opposite a crushing head mounted for gyration within the main frame, the release system being constructed to hold the ring normally fixed in relation to the main frame while permitting it to tilt upwardly in relation to the main frame in response to excessive crushing forces at any point about the main frame, the system including a group of pneumatic release cylinder assemblies disposed about the frame of each crusher with means for causing each cylinder to bear against both the main frame flange and the bowl-supporting ring so that they pneumatically oppose the crushing stresses as a group, manifold piping interconnecting all such cylinder assemblies on a crusher, a source of pneumatic pressure, a receiver connected thereto, a supply line from the receiver to each crusher for refilling the crusher's release sytem after venting and clearing, a second line from the receiver to each crusher to compensate for leakage, and valving in the supply pipe, second line and manifold piping constructed and arranged so that any selected crusher may be isolated from the other crushers and its cylinder assemblies vented so that the selected crusher may be cleared without releasing the pneumatic release pressure or affecting the leakage-compensating line on the other crushers in the system.

2. The structure of claim **1** further characterized in that the capacity of the receiver is such and the valving is arranged so that any one selected crusher may be vented and recharged from the receiver without disturbing the pressure level in any other crusher in the system and the resulting equalization pressure between the receiver and the selected one crusher is adequate for normal operation of the selected one crusher.

3. In a pneumatic release system for a cone crusher and the like, the crusher having a circumferential main frame with a circumferential flange on an upper portion of the main frame and a bowl supporting ring tiltably mounted on and above the main frame flange with a bowl supported on the ring opposite a crushing head mounted for gyration within the main frame, the release system being constructed to hold the ring nor-

mally fixed in relation to the main frame while permitting it to tilt upwardly in relation to the main frame in response to excessive crushing forces at any point about the main frame, the system including a group of pneumatic release cylinder assemblies disposed about the frame of the crusher with means for causing each cylinder to bear against both the main frame flange and the bowl-supporting ring so that they pneumatically oppose the crushing stresses as a group, manifold piping interconnecting all of the cylinder assemblies on the crusher, a source of pneumatic pressure, a receiver connected thereto, a supply line from the receiver to the crusher for refilling the crusher release system after venting and clearing, a second line from the receiver to the crusher to compensate for leakage, and valving in the supply line, the second line and the manifold piping constructed and arranged so that the cylinder assemblies may be vented and the crusher cleared without affecting the leakage compensating line to the crusher.

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