Aug. 13, 1968 R. H. KEMNITZ ET AL 3,396,916

FLUID PRESSURE OPERATED ADJUSTMENT AND RELEASE FOR GYRATORY CRUSHERS AND THE LIKE

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2 Sheets-Sheet 1

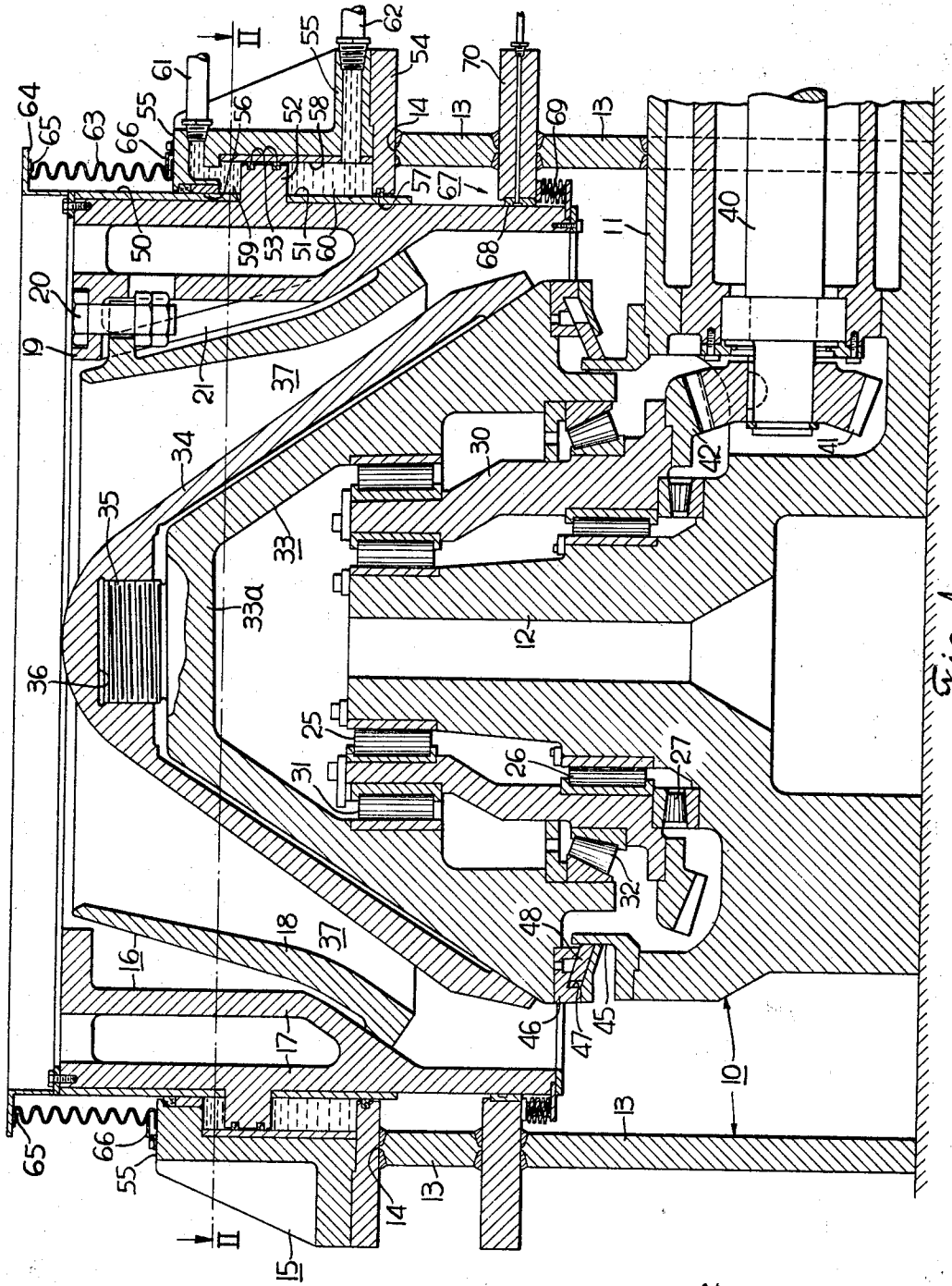

Fig. 1

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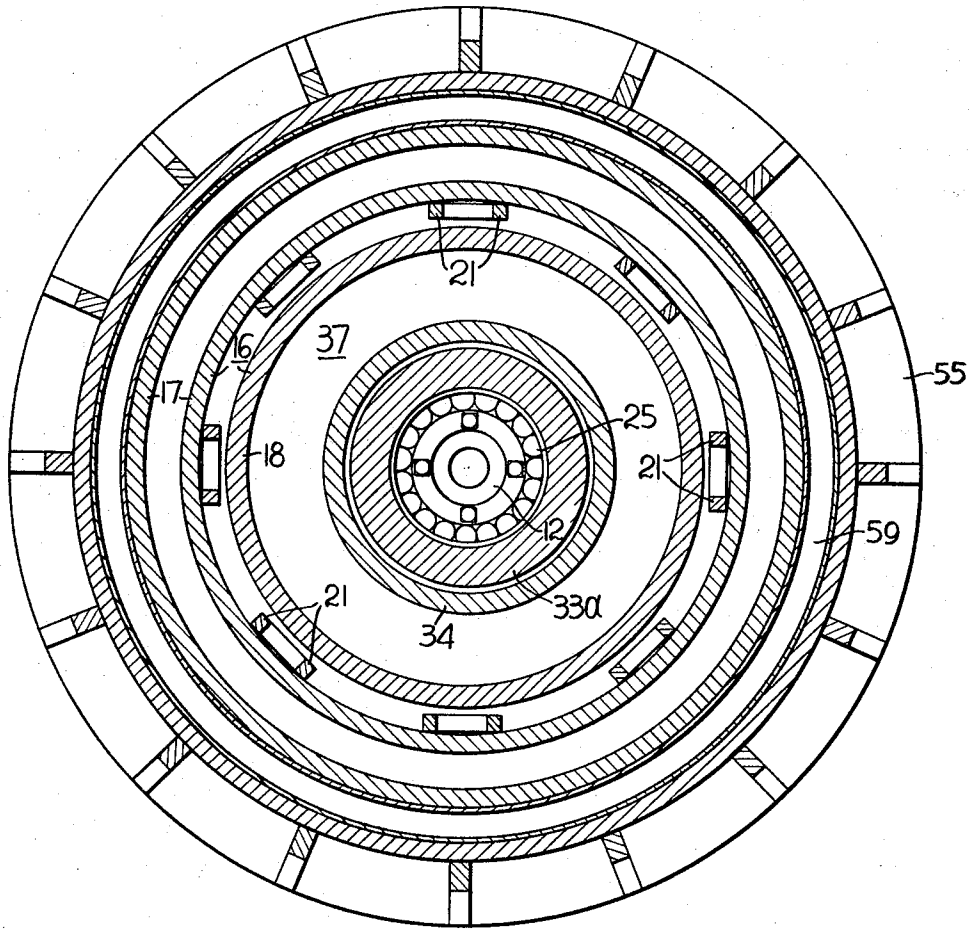

Fig. 2

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FLUID PRESSURE OPERATED ADJUSTMENT AND RELEASE FOR GYRATORY CRUSHERS AND THE LIKE

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7 Claims. (Cl. 241—290)

This invention relates to crushers of the type in which a cone-shaped head rotates or gyrates within an annular bowl to crush material in a chamber defined between the head and the surrounding bowl. In particular, this invention relates to a gyratory crusher having an adjusting mechanism for changing the size of the opening between the head and bowl or adjusting the relative position of the head and bowl to compensate for wear to the crushing surfaces, and a release mechanism for causing the bowl and cone to move apart and pass uncrushable material without damage to the cone or bowl.

U.S. Patents Nos. 2,349,790; 2,448,936 and 2,579,516 disclose an approach to designing crushers of the type referred to, that involve a hydraulic pressure actuated piston beneath the head. The piston operates to raise and lower the head within a bowl mounted in a fixed position. There are, however, installations where it is undesirable or inconvenient to locate such a piston beneath the head for raising or lowering the head and therefore, an alternative approach is to provide for raising and lowering the bowl about a cone supported in fixed vertical position. U.S. Patents Nos. 2,680,571; 2,791,383; 3,038,670 and others show how a plurality of cylinders containing fluid actuated pistons can be arranged around the circumference of the bowl for raising and lowering a bowl about a centrally located cone. A plurality of piston and cylinder assemblies arranged according to the teachings of the prior art resulted in the cone being movable vertically but being held against rotation in a horizontal plane. It is a primary object of the present invention to provide a crusher having a cone-shaped head movable within a bowl, with a new and improved fluid pressure operated adjusting and release mechanism for raising and lowering the bowl about the head, that provides for allowing the bowl to also rotate in a horizontal plane while crushing material between opposing surfaces of the bowl and cone, and thus provide for even wear on these opposing crushing surfaces when there is an uneven distribution of feed material to the crushing chamber.

Another object of the present invention is to provide a gyratory crusher with a new and improved fluid pressure operated adjusting and release mechanism in which a single piston within a single chamber raises or lowers a bowl about a cone shaped head.

Still another object of the present invention is to provide a gyratory crusher with a new and improved fluid pressure operated adjusting and release mechanism for raising and lowering the bowl about the head with the bowl being provided support to prevent the bowl from tipping relative to the head as the bowl moves up and down.

A gyratory crusher, according to a preferred embodiment of the present invention, is provided with a top shell assembly having an annular bowl with an outer cylindrical surface and a replaceable annular bowl liner suspended within the bowl, to coact with a cone shaped head to define an annular crushing chamber. An annular piston projects radially outward, in a horizontal plane, from the outer cylindrical surface of the bowl and presents a radially outer cylindrical piston wall surface. A collar is mounted in a fixed position on the crusher frame with

three cylindrical surfaces facing radially inward. A first and second of these collar surfaces slidably engage the outer cylindrical surface of the bowl respectively above and below the annular piston. A third of these three collar surfaces, between and having greater diameter than the first and second of these surfaces, slidably engages the radially outer cylindrical surface of the annular piston. Thus, the three radially inward facing surfaces of the collar engage the outward facing surfaces of the bowl and piston to define an annular expansible and contractable chamber above and below the annular piston. The collar assembly defines an internal passage to the upper expansible and contractable chamber and another passage to the lower chamber, for delivering and venting fluid pressure to and from each chamber. The pressures in the upper and lower expansible and contractable chambers can thus be adjusted to move the annular piston, the connected bowl and suspended bowl liner, to adjust the opening of the crushing chamber. Likewise, an excessive pressure build up in the upper expansible chamber, as occurs when an uncrushable object becomes jammed in the crushing chamber, can be relieved and the piston, bowl and liner will move upwardly for the uncrushable object to pass through the crushing chamber.

Other objects and how they are attained will appear from the following description with references to the drawings, in which:

FIG. 1 is a vertical sectional view of a crusher according to the present invention; and

FIG. 2 is a view taken as indicated by line II—II in FIG. 1.

Referring to FIG. 1 of the drawing, a preferred embodiment of the invention comprises a main frame assembly **10** having a drive housing portion **11** and a cylindrical hub portion **12** extending vertically therefrom at a right angle to the drive housing **11**. An annular vertical wall structure **13**, having a horizontal surface **14** at the top thereof, is concentrically disposed around the cylindrical hub **12** and rigidly secured to the drive housing **11**. A pair of concentric members **15**, **16** with the outer member **15** is mounted in a fixed position on the surface **14** of the wall structure **13**, and the inner member **16** is supported by the outer member **15** for vertical movement and rotation about the hub **12**, in a manner and for a purpose that will be described after certain other components of the machine of FIG. 1 are identified and described.

The inner member **16** comprises an annular bowl **17** with an inner replaceable bowl liner **18** suspended from an inwardly projecting bowl flange **19** by a plurality of bolts **20**, one of which is shown in FIG. 1. The radially inner edge of the flange **19** is supported by a plurality of downwardly extending support arms **21**. One of these arms **21** is shown in FIG. 1 and eight of these arms (in cross section) appear in FIG. 2.

With further reference to FIG. 1 and the assembly of which the aforementioned hub **12** is a part, antifriction roller bearing assemblies **25**, **26** and **27** encircle the hub **12** to support an eccentric drive shaft **30** that encircles hub **12**. A second group of antifriction roller bearing assemblies **31**, **32** encircle eccentric shaft **30** and support a head assembly **33**. The head assembly includes a truncated cone **33***a* and a replaceable mantle **34** secured on top of cone **33***a* by a threaded bolt **35** provided on top of the truncated cone **33***a* to engage a threaded cavity **36** in the underside of mantle **34**.

The head assembly **33**, and specifically the mantle **34**, cooperates with liner **18** of the inner concentric member **16**, to define a crushing chamber **37**.

A drive mechanism for this machine includes a drive shaft **40** extending through drive housing **11**. A pinion gear **41** is mounted on the inner end of shaft **40** and meshes with a ring gear **42** attached to the lower end of

the eccentric drive shaft **30**. Thus, a source of rotary power (not shown) can act to rotate pinion gear **41** and in turn rotate ring gear **42** and the eccentric drive shaft **30** about the hub **12**. Rotation of eccentric drive shaft **30** within head assembly **33** will cause the trucated cone **33***a* and mantle **34** to gyrate relative to the bowl liner **18** of the inner concentric member **16** as necessary for the crushing action.

Suitable dust seal means may be provided between the head assembly **33** and the main frame assembly **10**. As shown, the seal may include a vertical cylindrical wall **45** extending upwardly from the main frame assembly **10**. A collar **46**, defining an annular groove **47**, is attached beneath cone **33***a* and a dust ring **48** is slidably fitted in the groove **47** and engages wall **45** to keep crushed material and dust away from the drive mechanism and bearings beneath the head assembly **33**.

The outer concentric member **15** and cooperating portions of inner concentric member **16** that act to support the inner concentric member **16** with its bowl **17** and liner **18** to define crushing chamber **37**, will now be described. Bowl **17** has an outer wall defining an upper cylindrical surface **50** and a lower cylindrical surface **51** of equal diameter. Surfaces **50**, **51** are separated by an annular piston **52** projecting horizontally and radially outward from bowl **17** to present a radially outer cylindrical surface **53** of a diameter greater than the diameter of surfaces **50**, **51**. The outer concentric member **15** is constructed to define a collar around piston **52**. Outer concentric member **15** comprises lower collar piece **54** attached to surface **14** of wall structure **13**, and an upper collar piece **55** attached to collar piece **54**. Collar pieces **54**, **55** of member **15** present three inwardly facing cylindrical collar surfaces **56**, **57**, **58**. Collar surfaces **56**, **57** slidably engage bowl surfaces **50**, **51**, respectively, and collar surface **58** slidably engages piston surface **53** to define within the collar an upper expansible and contractable chamber **59** above piston **52** and a lower expansible and contractable chamber **60** below piston **52**. A conduit **61** communicates with chamber **59** and a conduit **62** communicates with chamber **60** for delivering and venting fluid pressure to the chambers **59**, **60**.

The bowl surface **50** that extends above collar piece **54** is shielded by a cylindrical sleeve **63** that protects surface **50** and prevents dust entering chamber **59**. An annular flange **64** projects horizontally and radially outward of bowl surface **50** at a level space above collar piece **55**. Sleeve **63** is flexible and has a horizontal pleated periphery providing for expanding and compressing the axial length of the sleeve. The top of sleeve **63** is attached to the underside of flange **64** by screws **65** and the bottom of sleeve **63** is held in slidable contact with the top of collar piece **55** by an annular lip defining piece **66** attached to the top of collar piece **55**. Dust is prevented from entering chamber **60** below piston **52** by an annular sealing and bearing assembly **67** which is supported by wall structure **13** to slidably engage the outer circumference of bowl **17**. The sealing assembly **67** includes a bearing **68** and a sleeve **69** (which may be similar to sleeve **63**) arranged beneath a flange **70** that also holds bearing **68**. Sleeve **69** may be secured to the underside of flange **70** and slidably engage the lower portion of bowl **17**.

According to the described invention, crushing chamber **37** can be adjusted to change product size, or adjustments made to compensate for wear on surface bowl liner **18** and mantle **34** to maintain desired product size, by adjusting fluid pressure admitted to conduits **61**, **62** from a source not shown. That is, if it is desired that the crusher crush material to a smaller size or to compensate for wear, the pressure to conduit **62** is reduced and the pressure to conduit **61** increased. Adjusting the crusher to produce larger size pieces, of course, requires the opposite changes in fluid pressure. Further, when uncrushable material enters chamber **37** a sharp increase in pressure in chamber **59** will occur that can initiate pressure releasing action that will permit bowl **17** to raise and permit uncrushable material to pass through without damage to the crusher. Fluid pressure delivery and control systems suitable for such purposes are known to those skilled in the art and are presently supplied with crushers of the general type shown in U.S. Patents Nos. 2,349,790; 2,448,936 and 2,579,516.

Thus, it has been shown how a crusher according to the present invention utilizes a single annular piston **52** to move bowl **17** and bowl liner **18** up and down. Since this action is achieved with a single annular piston, the bowl and bowl liner are free to rotate about the mantle and achieve even wear on the liner **18** and mantle **34**. Contact between the movable bowl **17** and the stationary collar pieces **54**, **55** involves the engagement of two pairs of vertically spaced annular bearing surfaces, i.e., surface **50** with surface **56** and bearing **68** with the lower portion of bowl **17** and therefore, the bowl **17** moves up and down with reduce tendency to tilt.

It, therefore, has been shown how the objects of the present invention have been attained in a preferred manner. However, modifications and equivalents of the disclosed concepts such as readily occur to those skilled in the art are intended to be included in the scope of this invention. Thus, the scope of this invention is intended to be limited only by the scope of the claims such as are, or may hereafter be, appended hereto.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A crusher comprising: a main frame including vertical wall structure enclosing a central space; a cone shaped head supported by said frame and projecting upwardly within said central space; a pair of concentric members with the outer member supported by said frame in fixed position and the inner member being supported by said outer member for vertical movement and rotation about a central vertical axis; and inner member comprising an annular bowl arranged about said head and cooperating therewith to define a crushing chamber therebetween, said outer member comprising an annular collar around said bowl; one of said concentric members having a wall defining upper and lower vertical cylindrical surfaces separated by an annular piston projecting horizontally and radially from said surfaces to present a vertical cylindrical piston surface of a diameter different than said upper and lower cylindrical surfaces; the other of said concentric members having three vertical cylindrical surfaces facing and slidably engaging with said upper and lower and piston surfaces of the said one of the concentric members to define between said pair of concentric members an upper expansible and contractable chamber above said piston and a lower expansible and contractable chamber below said piston; and a means communicating with each of said expansible chambers for delivering and venting fluid pressure thereto.

2. In a crusher according to claim **1**: a flexible cylindrical sleeve having a horizontally pleated periphery providing for expanding and compressing the axial length of said sleeve; a portion of said inner concentric member projecting upwardly from said outer concentric member; and an annular flange projecting horizontally and radially outward from the inner concentric member at a level spaced vertically above the outer concentric member, said sleeve being arranged about said inner concentric member between said flange and said outer concentric member and in contact with said flange and said outer concentric member in all vertical positions of said inner concentric member relative to said outer concentric member and said frame.

3. In a crusher according to claim **2**: a top portion of said sleeve being removably secured to said flange and means attached to said outer concentric member and slidably engaging a bottom portion of said sleeve to enclose the space between said flange and said outer concentric member as said inner concentric member moves

up and down and turns about its central axis relative to said spacially fixed outer concentric member and said frame.

4. A crusher comprising: a main frame including vertical wall structure enclosing a central space; a cone shaped head supported by said frame and projecting upwardly within said central space; an annular bowl arranged about said head and cooperating therewith to define a crushing chamber therebetween, said bowl having an outer wall defining an upper and lower cylindrical surface of equal diameter, said upper and lower surfaces being separated by an annular piston projecting horizontally and radially outward from said bowl to present a radially outer cylindrical surface of a diameter greater than said upper and lower cylindrical surfaces; a collar mounted in a fixed position on said crusher frame and having three cylindrical surfaces facing radially inward, a first and second of said collar surfaces slidably engaging with said upper and lower outer bowl surfaces and the third of said collar surfaces slidably engaging with said outer surface of said annular piston to define an upper expansible and contractable chamber within said collar above said piston and a lower expansible and contractable chamber within said collar below said piston; and a means communicating with each of said expansible chambers for delivering and venting fluid pressure to move said piston within said collar and thereby raise and lower said bowl about said head.

5. In a crusher according to claim 4: a flexible cylindrical sleeve having a horizontally pleated periphery providing for expanding and compressing the axial length of said sleeve; and an annular flange projecting horizontally and radially outward from said bowl at a level spaced vertically above said piston and said collar, said sleeve being arranged about said bowl between said flange and said collar and in contact with said flange and said collar in all vertical positions of said bowl relative to said collar and said frame.

6. In a crusher according to claim 5: a top portion of said sleeve being removably secured to said bowl flange and means attached to said collar and slidably engaging a bottom portion of said sleeve to enclose the space between said bowl flange and said collar as said bowl moves up and down and turns about its central axis relative to said collar and said frame.

7. In a crusher according to claim 1: a flexible cylindrical sleeve having a horizontally pleated periphery providing for expanding and compressing the axial length of said sleeve; a portion of said inner concentric member projecting downwardly from said outer concentric member; and an annular flange projecting horizontally and radially inward from the wall structure concentric at a level spaced vertically below the outer concentric member, said sleeve being arranged about said inner concentric member with the bottom end of said sleeve slidably connected to an adjacent portion of said inner concentric member and the top end of said sleeve connected to the underside of said flange in all vertical positions of said inner concentric member relative to said outer concentric member and said frame.

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