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Gilbert et al.

[11] **3,887,143**

[45] **June 3, 1975**

[54] **GYRATORY CRUSHER**

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[73] Assignee: **Portec, Inc.**, Oak Brook, Ill.

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[52] **U.S. Cl.** **241/215**

[51] **Int. Cl.** **B02c 2/04**

[58] **Field of Search** 241/32, 37, 267, 208, 214, 241/215, 216, 290

[56] **References Cited**

UNITED STATES PATENTS

3,207,449	9/1965	Johnson	241/214
3,337,143	8/1967	Johnson	241/280 X
3,604,640	9/1971	Webster	241/215
R27,970	4/1974	Johnson	241/290 X

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Attorney, Agent, or Firm—Emory L. Groff, Jr.

[57] **ABSTRACT**

A gyratory crusher includes a bowl assembly adjustably positioned relative an annular support ring mounted atop a fixed peripheral frame. Radial flanges on the bowl are vertically located by shims and retainer brackets containing the flanges which are then interlocked relative the support ring by hydraulically actuated means. A segmented clamp ring intermediate the bowl and support ring is provided with hydraulically energized means for clamping the bowl assembly to the support ring while a plurality of fluid cylinder assemblies carried by the bowl assembly are subsequently operable to break loose the locking action of the clamp ring to permit readjustment of the bowl assembly. During operation of the crusher a plurality of fluid load relief cylinders interconnecting the support ring and peripheral frame yield, in a unique controlled manner, to permit elevation of the bowl assembly, clamp ring and support ring, when non-crushable material is fed into the apparatus.

12 Claims, 9 Drawing Figures

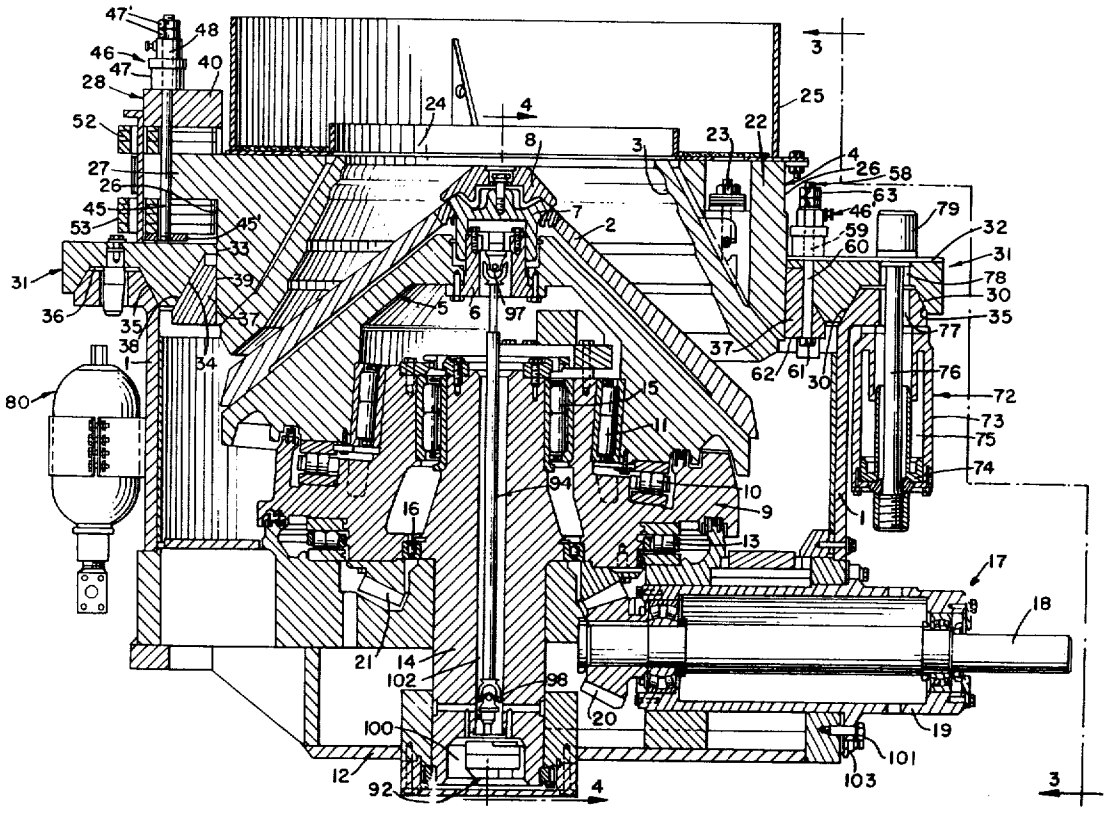


FIG. 1.

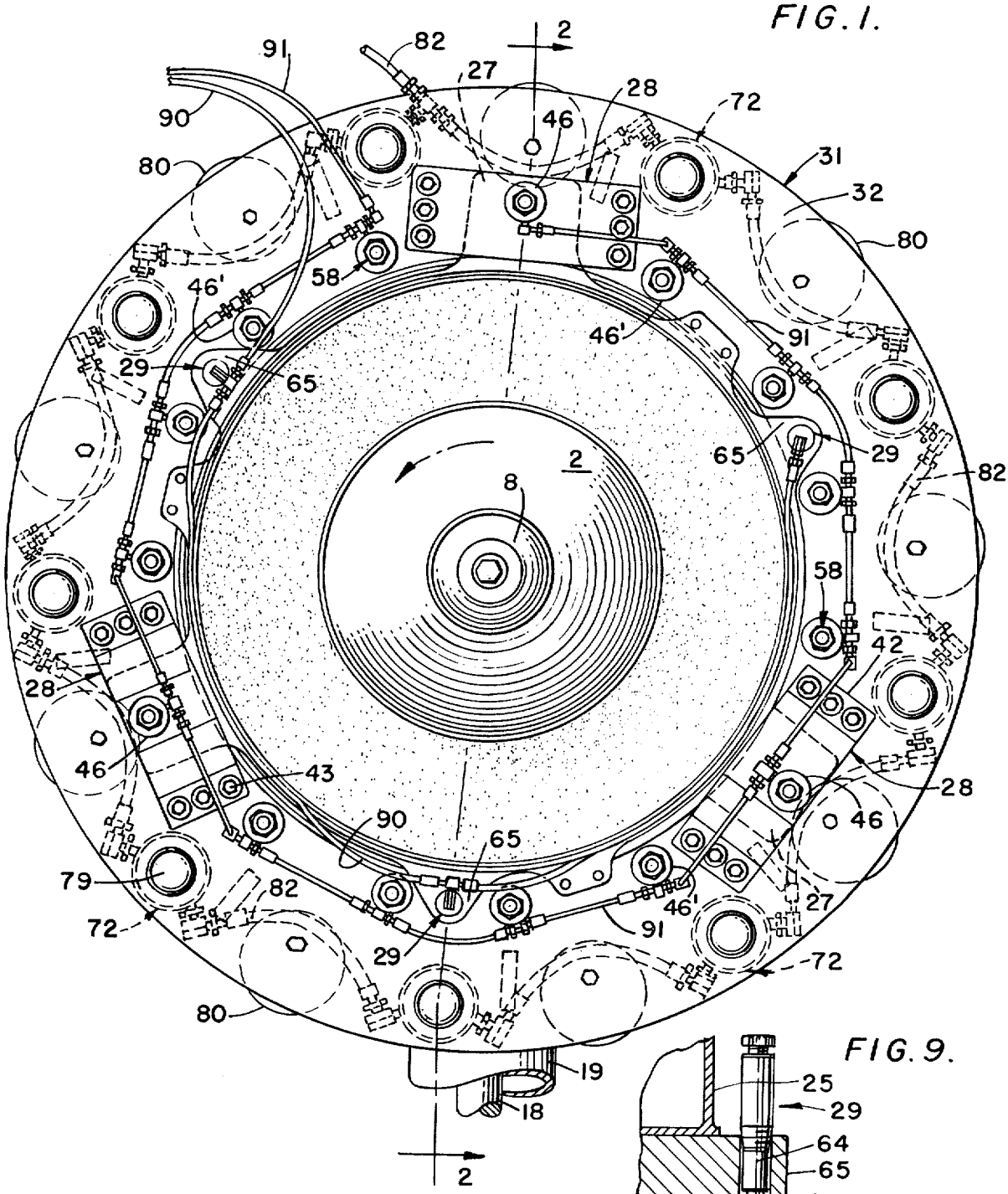

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80
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46'
46'
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46'
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FIG. 9.

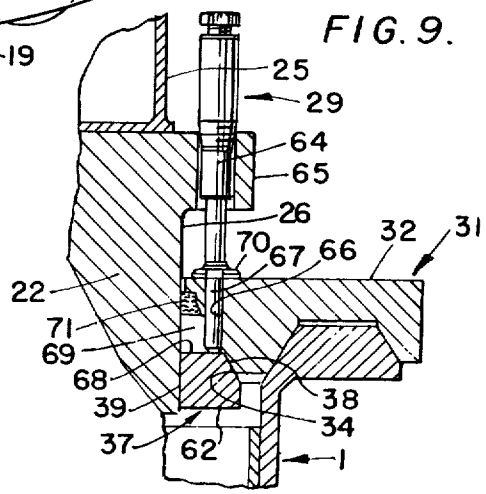

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FIG. 2.

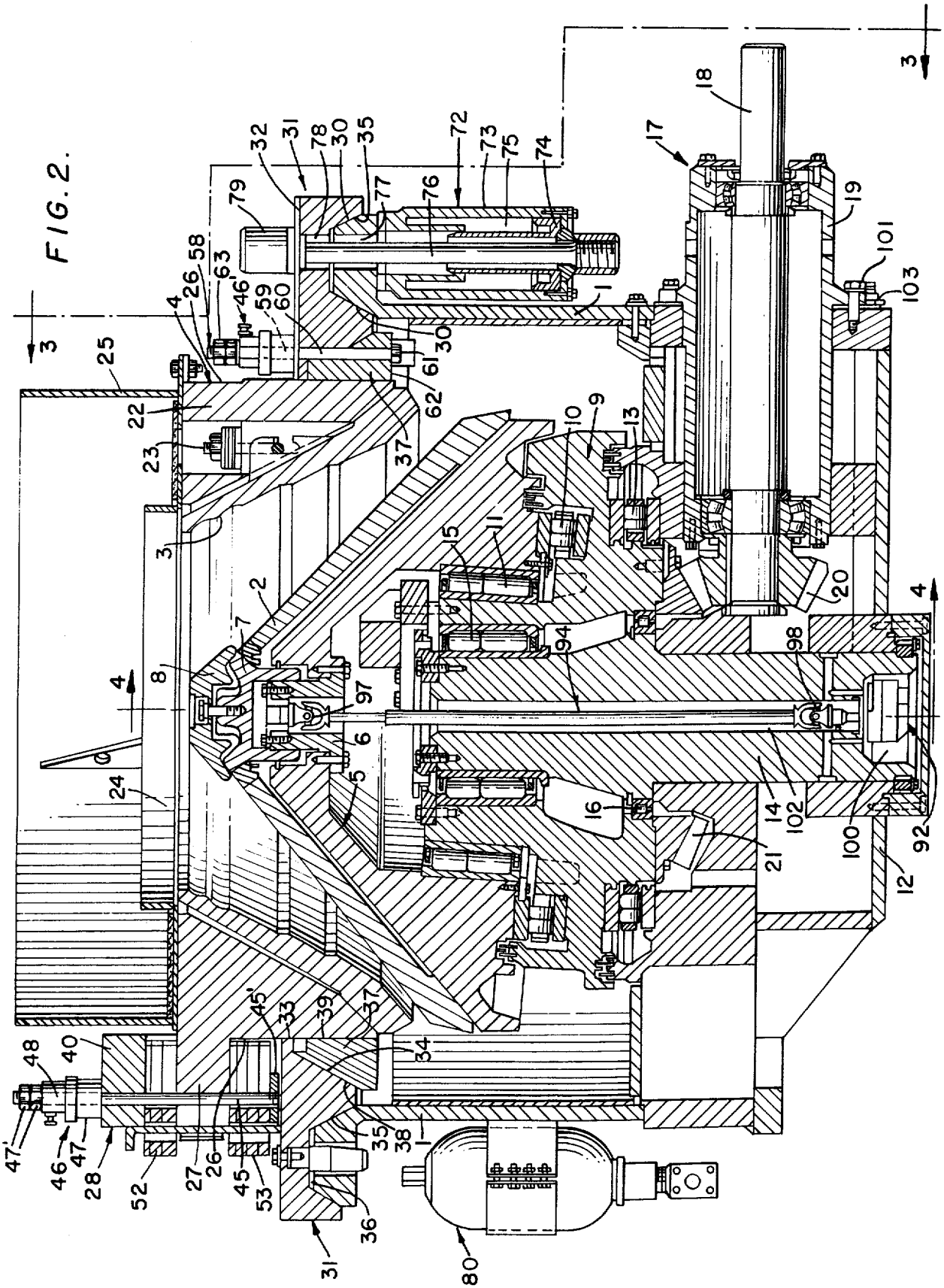

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23
3
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24
97
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45'
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37
34
48
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47'
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28
52
27
26
45
53
36
31
35
38
1
80
16
21
14
102
100
92
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94
98
20
15
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13
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101
103
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46'
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FIG. 3.

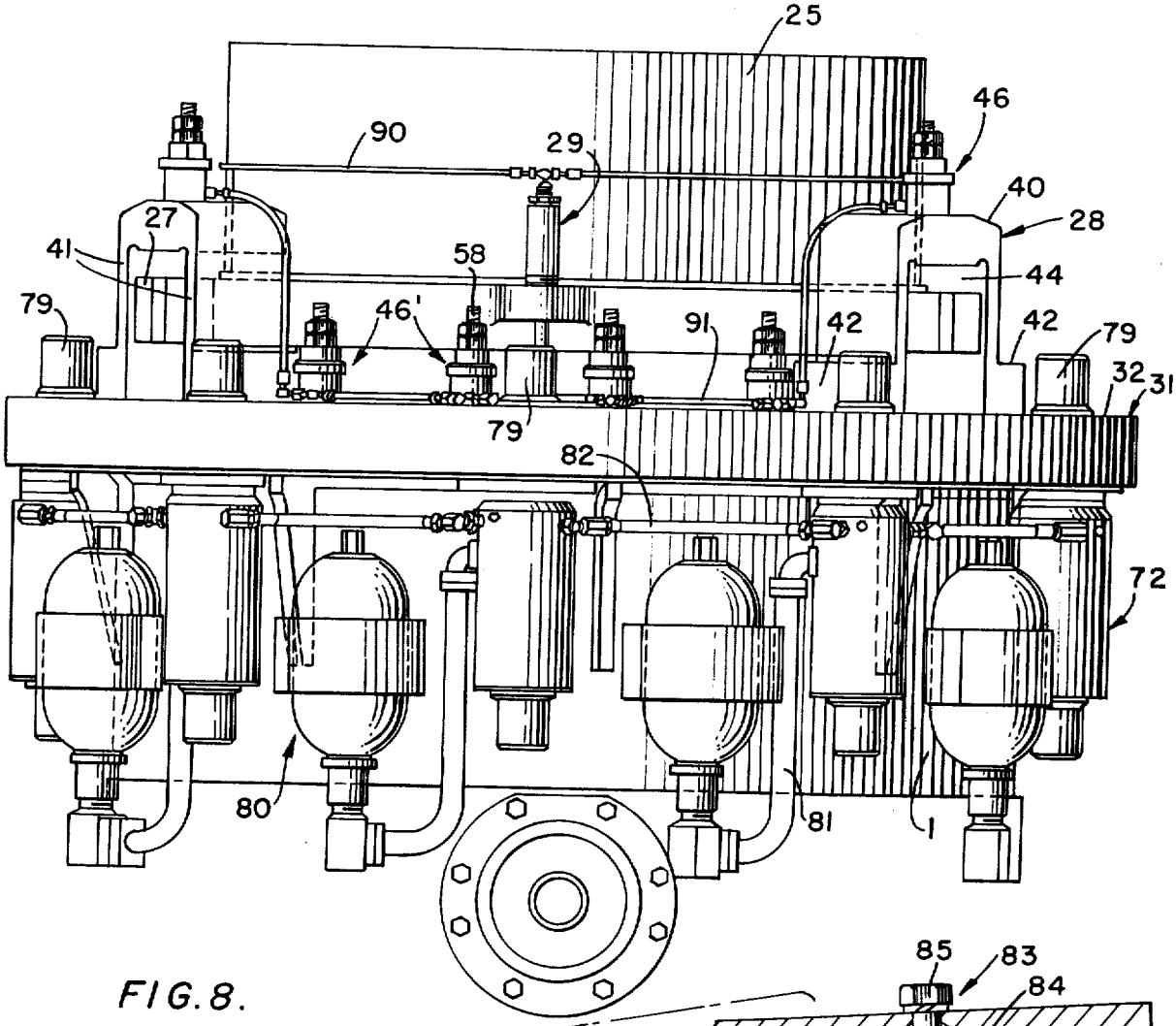

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FIG. 8.

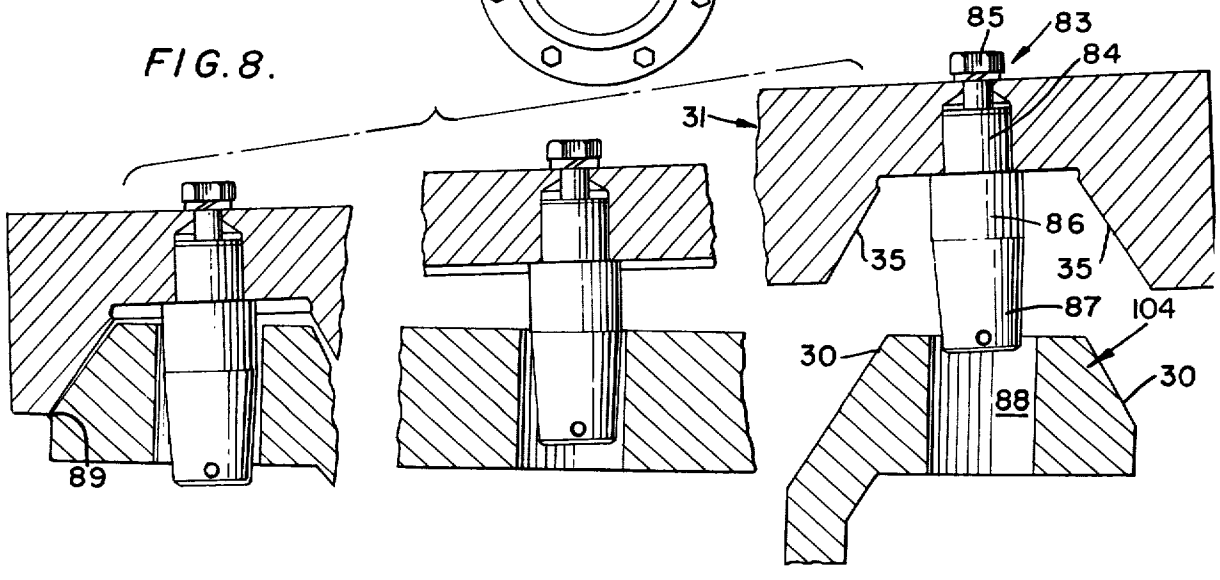

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FIG. 4.

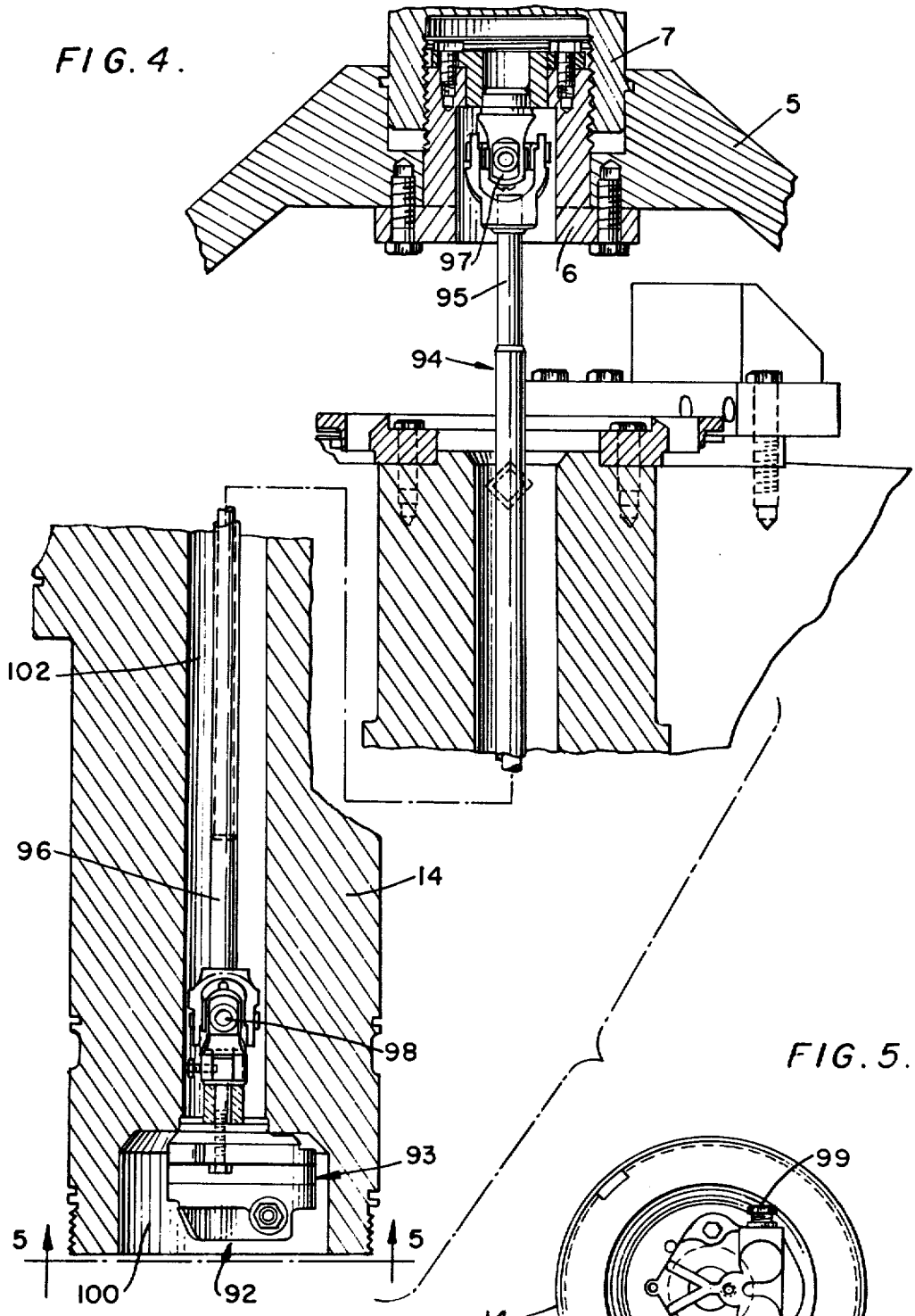


FIG. 5.

FIG. 7.

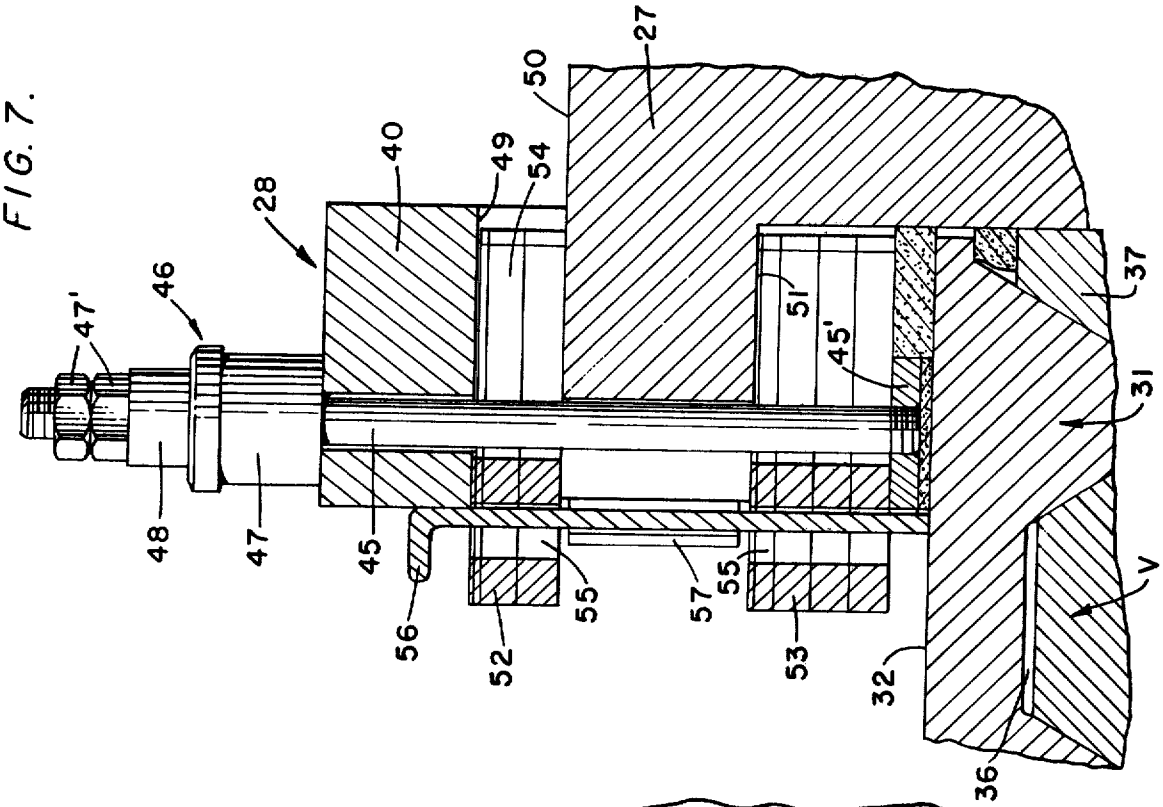
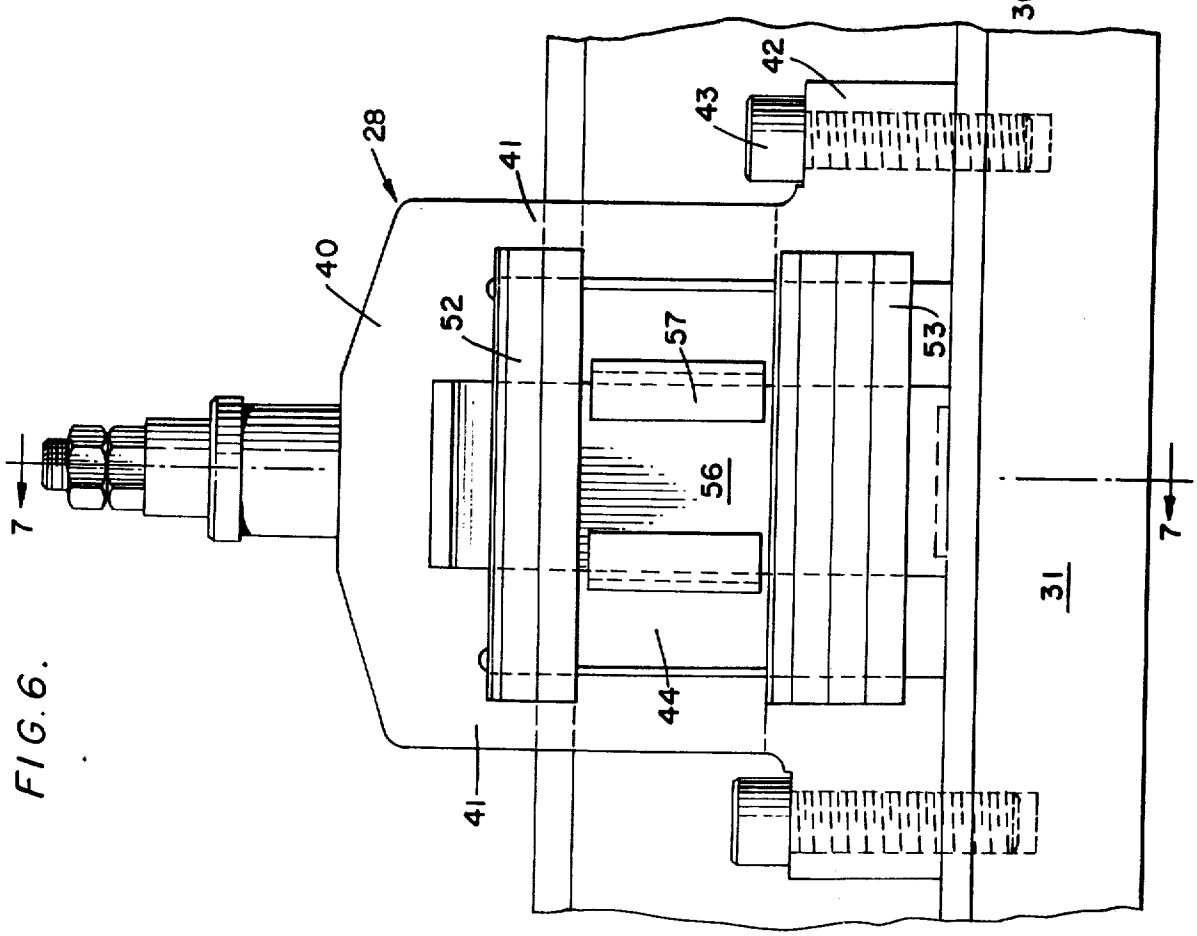

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FIG. 6.


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GYRATORY CRUSHER

This invention relates generally to rock crushing apparatus and more particularly to an improved gyratory or cone crusher.

A critical area in the operation of gyratory crushers is the system employed to permit adjustment of the bowl assembly relative the gyrating crusher head and mantle. In view of the significant size and weight of the structure involved, many existing crushers of this type have utilized a large number of peripherally disposed bolts, each provided with suitable lock nuts which must be individually manipulated whenever it is desired to alter the adjustment of the bowl assembly to vary the product size. Even then, additional means must be used in order to break loose the rigid connection between the bowl assembly, its annular support ring and the upper portion of the crusher frame before any adjustment of the bowl assembly may be made. Additionally, structure should be provided in the form of shock absorbing means designed to serve as a load relief to protect the bowl liner, mantle and associated structure of the gyrating mantle should tramp iron or other non-crushable material be introduced between the liner and mantle.

By the present invention an improved structure is provided to facilitate the adjustment and clamping of the bowl assembly as well as to break loose the clamping assembly prior to any subsequent adjustment. Cooperating with the means supporting the bowl assembly upon the crusher frame are a plurality of hydraulic load relief cylinders, each of which is provided with a fluid accumulator to regulate the actuation of the cylinders. All of the aforementioned structure is controlled by a plurality of hydraulic systems which are connected in series and are directly related to one another whereby a unique cooperation is achieved to provide a practically automatic adjustment of the bowl liner with the only manual operation involved being the addition of or removal of one or more shims at each of three bowl support flanges radially extending from the bowl assembly at equi-distant points overlying a bowl support ring.

Cooperating with the above referenced structure is an impoved anti-spin assembly connecting between the base of the crusher frame and the top of the crusher head and which is likewise regulated by means of a fluid system to inhibit undesirable rotation of the crusher head relative the bowl liner during the absence of any feed material between the bowl liner and mantle.

Accordingly, one of the primary objects of the present invention is to provide a gyratory crusher having an improved means for adjustably positioning the bowl assembly relative the crusher head by means of a plurality of removable shims which are automatically clamped and released by means of hydraulically operable elements.

Another object of the present invention is to provide a gyratory crusher including improved bolt means for retaining the crusher bowl support ring in locking engagement with a segmented bowl clamp ring in order to retain the bowl assembly in its adjusted position and which is regulated by means of hydraulically operable elements.

Still another object of the present invention is to provide a gyratory crusher having an improved system for breaking loose the wedge clamping fit between a bowl clamp ring and bowl support ring by means of a plurality of lift cylinders between the bowl assembly and bowl clamp ring, which cylinders are hydraulically actuated.

A further object of the present invention is to provide a gyratory crusher having a plurality of load relief cylinders peripherally disposed about the frame of the crusher and joining the bowl support ring and upper support surface of the frame with each relief cylinder hydraulically connected to an individual fluid accumulator and at the same time hydraulically connected in series with each adjacent relief cylinder and a pressure regulated source of fluid.

With these and other objects in view which will be more readily apparent as the nature of the invention is better understood, the invention consists in the novel construction, combination and arrangement of parts hereinafter more fully described, illustrated and claimed.

A preferred and practical embodiment of the invention is illustrated in the accompanying drawings in which:

FIG. **1** is a top plan view of the improved gyratory crusher of the present invention and most clearly illustrates the hydraulic aspect of the apparatus.

FIG. **2** is a vertical sectional view taken along the line **2—2** of FIG. **1.**

FIG. **3** is a side elevation of the present invention taken along the line **3—3** of FIG. **2.**

FIG. **4** is an enlarged vertical sectional view taken along the line **4—4** of FIG. **2** more clearly illustrating the anti-spin structure of the present invention.

FIG. **5** is a bottom plan view taken along the line **5—5** of FIG. **4.**

FIG. **6** is an enlarged side elevation illustrating the bowl retainer bracket and adjustment shims associated therewith.

FIG. **7** is a vertical sectional view taken along the line **7—7** of FIG. **6.**

FIG. **8** is a vertical sectional view, greatly enlarged, and illustrates a plurality of the guide pins carried by the bowl support ring in the various relative positions they would appeare were a piece of non-crushable material to be caught within the crusher.

FIG. **9** is a fragmentary vertical sectional view illustrating one of the hydraulic lift cylinder assemblies.

Similar reference characters designate corresponding parts throughout the several figures of the drawings.

Referring now to the drawings, particularly FIGS. **1–3**, the present invention will be seen to comprise a gyratory crusher including a peripheral frame **1** having disposed therewithin a crushing mantle **2** adapted to cooperate with a relatively stationary liner **3** carried by a normally stationary bowl assembly generally designated **4**, and which is mounted atop the peripheral frame **1.** As shown most clearly in FIG. **2** of the drawings, the conical mantle **2** is removably attached to a conical crusher head, generally designated **5**, by means of a mantle bolt **6** which cooperates with a mantle nut **7**, which fastener assembly is protected by means of a removable mantle cap **8.** The crusher head **5** is supported upon an eccentric, generally designated **9**, by means of a plurality of upper thrust bearings **10** and upper outer radial bearings **11.** The eccentric in turn is supported upon the base frame **12** by means of lower thrust bearings **13** and retained for rotary movement by means of a fixed vertical bearing shaft **14**, the upper portion of which radially supports the eccentric by

means of upper interior radial bearings **15** and lower radial bearings **16.**

Gyratory motion is imparted to the crusher head and its mantle by means of a drive shaft assembly, generally designated **17,** which contains a drive shaft **18** disposed within the drive housing **19** and provided with a drive pinion **20** constantly meshing with the ring gear **21** affixed to the lower portion of the eccentric intermediate the lower thrust bearings **13** and lower radial bearings **16.** The aforementioned bowl assembly **4** includes a cylindrical body **22** containing suitable attaching means **23** for rigidly connecting the bowl liner **3** thereto with its upper portion adjacent a feed opening **24** within the feed hopper **25** mounted atop the cylindrical body **22.** The outer periphery **26** of the bowl assembly cylindrical body **22** is provided with a plurality of radially extending bowl adjustment flanges **27** extending from the upper plane of the cylindrical body **22** and adapted to cooperate with a corresponding number of bowl retainer brackets **28** in a manner to be described hereinafter.

Also extending radially from the outer periphery **26** of the cylindrical body of the bowl assembly are a corresponding number of lift cylinder assemblies, generally designated **29,** and shown in FIGS. **3** and **9.** Preferably there are three lift cylinder assemblies **29** and three bowl adjustment flanges **27** equi-spaced about the periphery of the bowl assembly. The most efficient operation of the invention has been found when utilizing three bowl retainer brackets **28** and three lift cylinder assemblies **29** and accordingly it will be understood that each one of these elements willa be disposed 120° from the remaining two similar elements.

To support the entire bowl assembly **4,** the upper portion of the peripheral frame **1** is formed with an inverted V-way **104** comprising a pair of upwardly and inwardly inclined or tapered support surfaces **30—30** extending in a circular manner about the apparatus frame and each of which describes a circumference the diameter of which is substantially greater than that of the bowl assembly outer periphery **26.** Overlying the frame inverted V-way **104** is an annular bowl support ring, generally designated **31,** having a top surface **32** extending inwardly to describe circular inner periphery **33** forming a close sliding fit with the outer periphery **26** of the bowl assembly cylindrical body **22.** The undersurface of the bowl support ring **31** adjacent the bowl assembly is provided with a bowl wedge surface **34** which is inclined downwardly and outwardly from a point spaced well outwardly from the inner periphery **33** and also includes a pair of female tapered surfaces **35–35** forming a downwardly facing cavity **36,** the cross section of which is frusto-conical and is adapted to mate with the similarly tapered male support surfaces **30—30** of the frame V-way **104.**

The afore-mentioned bowl support ring wedge surface **34** cooperates with a segmented bowl clamp ring **37** which is substantially triangular in cross sectional configuration and includes a bowl wedge surface **38** mating with the bowl support ring wedge surface **34** while its inner periphery **39** engages the outer periphery **26** of the cylindrical body **22** as shown most clearly in the left hand portion of FIG. **2** of the drawings.

Prior to operation of the instant crusher apparatus, the bowl assembly **4** must be initially vertically oriented within the confines of the inner periphery **33** of the bowl support ring **31** at the proper elevation to locate the bowl liner **3** in a spaced relationship to the crusher mantle **2** so that the desired product size will be achieved during operation of the apparatus. Inasmuch as the bowl support ring **31,** which is an integral circular member, will be fixedly supported upon the upper portion of the peripheral frame **1** during normal operation of the crusher it will follow that means must be provided to interlock the bowl assembly **4** and the bowl support ring **31** in various selected positions of vertical relationship. From a review of FIG. **2** of the drawings, it will be seen that before the locking and adjusting means are actuated the bowl assembly **4** is free to be vertically displaced a substantial distance with the bowl adjustment flanges **27** moving within the confines of the bowl retainer brackets **28.**

The details of the brackets **28** are shown more clearly in FIGS. **3, 6** and **7** of the drawings, wherein it will be seen that a plurality of the brackets **28,** preferably three, are equi-spaced about the periphery of the bowl assembly and each bracket comprises a cross-head **40** having a pair of depending side walls **41—41** each having a laterally extending foot **42** disposed upon the top surface **32** of the bowl support ring **31** and suitably secured thereto such as by means of the attaching bolts **43.** During the initial assembly of the apparatus, the bowl assembly **4** is lowered into position with each of the bowl adjustment flanges **27** disposed above the support ring top surface **32** and thereafter the plurality of retainer brackets **28** are dropped over the flanges **27** and the bolts **43** installed so that the bowl assembly will thereafter be limited to vertical displacement as defined by the limits of the opening **44** within the brackets **28.** A shim stud **45** extends through each bracket cross-head **40** down through the opening **44** and is secured to a base plate **45'** disposed above the upper portion **32** of the support ring **31** and is provided with a hydraulic washer, generally designatd **46,** on the upper portion of its shank immediately above the top of the cross-head **40.** Suitable adjustable limit means such as the nuts **47'** are carried by the uppermost distal portion of the shim stud **45.** Hydraulic washers as such are well known in the art and the example as shown in the drawings attached hereto includes a cylinder unit **47** and a vertically displaceable piston unit **48.** The specific operation of the hydraulic washers **46** will be described hereinafter.

When the bowl assembly **4** has been lowered to the proper elevation according to the desired crusher product size one or more shims are inserted between the bottom surface **49** of the cross-head **40** and top surface **50** of the bowl flange **27** as well as between the bottom surface **51** of the flange and the top surface of the stud base plate **45'** resting upon the support ring **31** so as to occupy all free space within the bracket opening **44** both above and below the bowl flange **27** as shown in FIGS. **2** and **7.** The upper shims **52** and lower shims **53** are preferably of the same construction although, of course, various thicknesses may be employed and each includes a central longitudinal slot **54** through one end thereof adapted to straddle the shank of the shim stud **45,** as well as a separate enclosed opening **55** adjacent the outer edge for the reception of a guide key **56,** which key will be seen to extend through all of the stacked openings of both the upper and lower shims **52** and **53** respectivley. In order to prevent the key **56** and all of the upper and lower shims from shifting from the fully inserted position as shown in FIG. **7** before the

shim stud **45** is clamped or locked, a pair of hooks **57** extend outwardly from either side of each bowl adjustment flange **27** to overlie the outer face of the guide key **56.**

When the bowl assembly has thus been vertically positioned and the proper sizes and numbers of shims have been inserted both above and below the bowl adjustment flange **27** to fill all free space within the opening **44,** each of the associated hydraulic washers **46** are actuated, as will be described hereinafter, to extend the piston unit **48** upwardly against the stationary nuts **47'** and urge the cylinder unit **47** downwardly against the bracket **28** whereby a positive upward force is applied to the stud **45** and the base plate **45'** attached to the lower distal portion so that the shims **52** and **53** and the sandwiched bowl flange are tightly clamped with respect to the surrounding bracket and thus also relative to the bowl support ring **31** inasmuch as each bracket is bolted to the support ring.

It will be understood that the above-described selection and installation of the shims **52** and **53** merely serve the purpose of properly locating the bowl liner **3** at the desired elevation relative to the crusher mantle **2** according to the desired product size by positioning the bowl assembly relative its surrounding support ring **31** and thus it is necessary to thereafter employ more positive and stronger clamping means to rigidly retain the entire periphery of the bowl assembly **4** at this elevation relative to the top of the peripheral frame **1.**

Quite obviously the shims could never withstand the tremendous shock generated by the pounding of stone within the crushing zone and accordingly a segmented bowl clamp ring **37** is utilized in combination with the outer periphery **26** of the bowl assembly cylindrical body **22** and the bowl support ring **31** in order to rigidly clamp the entire periphery of the bowl assembly to the normally stationary bowl support ring. The clamp ring **37** actually comprises six separate arcuate segments substantially describing an arc of 60° each and wherein the arcuate configuration of the inner surface **39** thereof is congruent with the outer periphery **26** of the bowl assembly cylindrical body while the bowl clamp ring wedge surface **38** is likewise congruent with the bowl support ring wedge surface **34** so that vertical displacement of each clamp ring segment **37** will provide an ever tightening or clamping action resulting in an interlocking of the bowl assembly and bowl support ring by means of the clamp ring **37.**

The above mentioned clamping action is achieved by means of a plurality of clamp ring bolts **58,** preferably two such bolts serving each one of the ring segments **37.** Each bolt **58** includes an upper portion **59** disposed well above the top surface **32** of the bowl support ring **31** and a shank portion **60** extending downwardly through the bowl support ring and bowl clamp ring **37** and terminating in a head **61** engaging the bottom surface **62** of the clamp ring. The clamp ring bolts **58** are provided with hydraulic washers **46'** of a construction similar to the hydraulic washers **46** heretobefore described, and which engage the top surface **32** of the bowl support ring **31** on the one hand and are retained about the bolt upper portions **59** by means of a plurality of adjustment nuts **63** engaging the threaded area of the upper portions **59.** It will now be apparent that upon the application of hydraulic fluid to the hydraulic washers **46',** the piston units **48** and cylinder units **47** will be expanded relative to one another whereby an upward force is applied to the undersurface of the nuts **63** and a simultaneous downward force directed upon the top surface **32** of the bowl support ring **31** so that the segmented bowl clamp rings **37** will be drawn upwardly to provide a positive wedging or clamping action rigidly interlocking the entire periphery of the bowl assembly **4** relative to the bowl support ring **31.**

The hydraulic washers **46** and **46'** are of the single action type; that is, fluid pressure is applied through a single fitting in order to expand relatively the piston and cylinder units thereof and when this fluid pressure is relieved the expansion force is terminated and an outside force must be applied in order to collapse the piston relative to the cylinder. Keeping the foregoing in mind it will be appreciated that in order to subsequently readjust the elevation of the bowl assembly **4** it is necessary to break loose the clamping or wedging action of the bowl clamp rings **37** before it is possible to readjust the bowl assembly since the mere relaxation of positive fluid pressure to the hydraulic washers **46'** will not cause the bowl clamp ring segments **37** to drop from their elevated clamping relationship with the outer periphery **26** of the bowl assembly and the wedge surface **38** of the bowl support ring **31.** This breaking action of the wedged clamp ring **37** is achieved by means of a single lift cylinder assembly **29** associated with each pair of segments of the bowl clamp ring **37** as shown most clearly in FIG. **9** of the drawings.

Each lift cylinder assembly **29** comprises a cylinder unit **64** fixedly attached to a bowl lift flange **65** and extending downwardly therethrough to a point adjacent the top surface **32** of the bowl support ring **31.** A vertical aperture **66** is provided through the bowl support ring beneath the cylinder unit **64** for the reception of a clamp release pin **67** which is actually an extension of a piston within the cylinder unit **64** and which extends downwardly through the aperture **66** to engage a horizontal platform **68** forming the bottom of a cut-out **69** provided in the bowl clamp ring **37.** It will now be appreciated that upon the application of a positive hydraulic pressure to the lift cylinder assembly **29** the clamp release pin **67** will be extending downwardly to apply a force upon the platform **68** of the bowl clamp ring **37,** thus driving this ring downwardly to break its clamping or wedging action between the bowl assembly and bowl support ring **31.** Each clamp release pin **67** carries a pin seal **70** surrounding the pin adjacent the juncture between the cylinder unit **64** and the pin to preclude the entrance of foreign material into the bowl support ring aperture **66,** while a separate ring seal **71** is carried by the upper portion of the bowl clamp ring **37** and constantly wipes or engages the outer periphery **26** of the bowl assembly cylindrical body to prevent the entrance of any dirt or foreign material between the inner surface **39** of the clamp ring **37** and bowl assembly outer periphery **26,** it being readily appreciated that any foreign material admitted between the clamping surfaces of the clamp ring **37** would be detrimental to the accomplishment of a positive tight interlocking of the involved components.

The massive weight of the entire bowl assembly **4** and the associated clamping means comprising the segmented ring **37** and bowl support ring **31** and the attendant structure previously described herein is supported upon the upper portion or V-way V of the peripheral frame **1** by means of the male tapered support surfaces **30—30** engaging the female tapered support surfaces

35—35 of the bowl support ring 31. Means must be provided to prevent jamming or damage to the crusher parts upon the introduction of tramp iron or other non-crushable material into the apparatus. Such means comprise a plurality of shock load relief cylinders, generally designated 72, fixedly attached to the frame of the crusher immediately beneath the bowl support ring 31 in an equi-distant manner. A total of nine such cylinders has been found to be most desirable. Each load relief cylinder amounts to a hydraulic shock absorber and includes a fixed cylinder unit 73 containing a vertically displaceable piston unit 74 between which is defined a fluid chamber 75. As will be seen in FIG. 2, the piston unit 74 is spherically seated on and containend by the lower end of a tie bolt 76, the upper portion of which freely passes through an aperture 77 in the upper portion of the peripheral frame 1 as well as an overlying aperture 78 through the bowl support ring 31. The upper end of the tie bolt 76 terminates in a tie bolt nut 79 adapted to overlie and engage the top surface 32 of the bowl support ring 31.

Associated with each load relief cylinder 72 is a hydraulic accumulator 80 shown most clearly in FIGS. 1 and 3 and which is connected by a hydraulic relief tube 81 which communicates with the upper portion of the fluid chamber 75 of its associated relief cylinder 72. The upper portion of each fluid chamber 75 is additionally connected by means of a separate relief cylinder series line 82 to the upper portion of each adjacent fluid chamber 75 such that it will be seen that all of the plurality of load relief cylinders 72 have the upper portion of their fluid chambers 75 communicating with one another in series while each load relief cylinder directly communicates with its own separate fluid accumulator 80. The above structure will be understood to provide an improved shock load relief system whereupon when tramp iron or other mon-crushable material is trapped between one point of the bowl liner 3 and an adjacent point on the gyrating mantle 2 the radially adjacent portion of the bowl support ring 31 will be urged upwardly with the result that the support ring top surface 32 will elevate the tie bolt nuts 79 thereby causing a corresponding elevation of its attached piston unit 74. This vertical displacement of the load relief piston will, of course, meet the resistance of the hydraulic fluid contained within the respective fluid chambers 75. During this displacement a small portion of the displaced fluid will be ejected from the respective fluid chamber 75 through the two series lines 82—82 leading from this cylinder to the next two adjacent load relief cylinders 72—72 and at the same time a significant portion of the displaced fluid will be ejected through the single hydraulic relief tube 81 leading from the load relief cylinder to its associated accumulator 80. Quite obviously, the resistance offered by the above action of the load relief cylinder 72 will be controlled by the pressure setting of the related accumulators 80.

The above description relates to the displacement action attendant to only a single load relief cylinder 72 during the entrapment of tramp iron within the crusher, yet it will be appreciated that at any time when one point of the bowl support ring 31 is elevated, other circumferentially spaced points of the support ring will likewise be elevated, to various degrees. The greatest vertical displacement of the bowl support ring 31, of course, occurs directly radially outward of the point of entrapment of non-crushable material with a lesser degree of vertical displacement thereof occurring as one circumferentially follows this point about the remainder of the bowl support ring so that the least amount of displacement of the bowl support ring 31 occurs at a point diametrically opposed the maximum degree of displacement.

Reference may be made to FIG. 8 for an illustration of this variance in displacement of the bowl support ring 31. In this figure the right hand portion thereof illustrates a typical example of the relative position between the bowl support ring 31 and top portion of the peripheral frame 1 at a point substantially adjacent the greatest degree of bowl support ring vertical displacement while the left hand portion of this figure illustrates the relative position of the crusher components at a point 180° from the point of maximum displacement. The center illustration in FIG. 8 represents the relative positioning of the bowl support and peripheral frame at a point intermediate to the points of maximum and minimum displacement. Also shown in this figure is the provision of a guide or alignment pin generally designated 83. A plurality of these pins 83 are provided about the circumference of the bowl support ring 31 equi-spaced thereabout and intermediate the load relief cylinders 72. Each guide pin 83 includes a mounting shank 84 disposed within the bowl support ring 31 intermediate the female tapered support surfaces 35—35 thereof and secured to the support ring by means of an attaching bolt 85. A cylindrical body section 86 depends from the shank 84 and terminates in a tapered body section 87. The normal disposition of the guide pins 83 closely approximates the relationship as is shown in the left hand portion of FIG. 2 wherein it will be appreciated that during normal operation of the crusher all of the plurality of guide pins 83 are disposed with the central body sections 86 and tapered body sections 87 centrally located within the confines of vertical apertures 88 formed in the upper portion of the peripheral frame 1 intermediate the male tapered support surfaces 30—30 thereof. The inclination of the tapered body section 87 of the guide pins 83 is selected to ensure that whenever the relief cylinders 72 are actuated by vertical displacement of the support ring 31, the tapered body sections 87 will not engage or bind with the side of the vertical apertures 88 through the peripheral frame 1. This is shown most clearly in FIG. 8 wherein it will be seen that the periphery of the tapered body sections 87 of the three guide pins 83 are disposed substantially parallel to the vertical apertures 88 when the bowl is tilted. This relationship is achieved due to the combined elevation and tilting of the vertical axes of the various guide pins during tilting of the bowl assembly 4 and as shown in the left hand portion of FIG. 8 the lowermost portion of the outer female tapered support surface 35 serves as a fulcrurm 89 in the area which is substantially 180° from the point of maximum vertical displacement of the bowl support ring 31.

The hydraulic interaction between all of the load relief cylinders 72 as well as each individual accumulator 80 associated with each load relief cylinder has been described hereinabove. As previously mentioned, the three lift cylinder assemblies 29 are adapted to be supplied with hydraulic fluid under pressure as are the three shim stud hydraulic washers 46 and twelve clamp ring hydraulic washers 46'. As shown most clearly in FIGs. 1 and 3, a lift cylinder assembly conduit 90 supplies hydraulic fluid to all of the three lift cylinder

assemblies **29** in a series manner from a suitable regulateable hydraulic supply means (not shown). A separate hydraulic washer conduit **91** similarly leads to all of the hydraulic washers **46** and **46'** in a series manner and is likewise connected to a suitable hydraulic supply source (not shown).

Reference will now be made to the anti-spin assembly generally designated **92** and which is illustrated in FIGS. **2, 4** and **5.** As is well known to those skilled in the operation of gyratory crushers, when there is no feed material being delivered to the crushing chamber and the drive shaft **18** is running, the head **5** spins during gyration thereof. This action is due to friction in the bearings located between the head **5** and eccentric **9,** and is detrimental to the efficient operation of the crusher when feed material is again admitted to the crushing chamber since a high degree of scuffing and wear of the crushing elements will occur. Anti-friction means for precluding this spinning of the crusher head in the same direction as the eccentric are generally well known in this type of crusher and the present anti-spin assembly **92** has been constructed to provide an improved operation.

A hydraulic fluid pump, generally designatd **93,** is fixedly mounted in the lower portion of the stationary vertical bearing shaft **14** and extending upwardly therefrom is a telescoping propeller shaft **94** comprising upper section **95** and lower section **96.** An upper universal joint **97** connects the top of the upper section **95** to the mantle bolt **6** while a lower U-joint **98** connects the bottom of the lower section **96** to the internal rotary gear mechanism of the fluid pump **93.** The pump **93** contains a check valve **99** opening into an oil chamber **100** completely surrounding the pump **93** and which is constantly supplied with oil under pressure by means of a suitable pump (not shown) located outside the crusher and which supplies oil to the chamber by means of a fluid inlet **101** in the crusher frame. The one-way check valve **99** serves as an inlet port when the shaft **94** rotates in one direction during the normal crushing operation and all fluid drawn into the pump by the gear therein (not shown) is ejected through another port **99'** and into the chamber **100.** On the other hand, during a no-feed condition when the head **5** and shaft **94** tend to rotate in the opposite direction, along with the connected gear of the pump **93,** fluid is drawn into the pump through the port **99'** and meets the resistance of the check valve **99** and bypasses the pump gear to allow very slow rotation of the shaft **94** and head **5.** Thus, by means of the pump **93,** opposite or no-feed spinning motion is restrained, not 100 percent, but significantly, so that there will be no damage to the bowl liner **3** and mantle **2** when feed material is again introduced into the crushing zone therebetween.

The inlet **101** serves to provide oil not only to surround and supply the pump **93** within the chamber **100,** but also to provide oil for lubrication of all relatively moving components of the crusher. From a review of FIG. **2** it will be apparent that oil admitted to the central bore **102** of the vertical bearing shaft **14** will be pumped upwardly therethrough and thence cascade downwardly through the radial and thrust bearings before returning to the sump as formed by the bottom of the base frame **12** and oil outlet **103** connected to a suitable pump (not shown).

We claim:

1. A crusher including, a peripheral frame provided with an uppermost annular V-way, a conical crusher mantle mounted within said frame, a bowl assembly disposed above said mantle and including a cylindrical body having an outer cylindrical periphery of lesser diameter than said peripheral frame, an annular support ring surrounding said bowl body and vertically displaceable relative thereto, said support ring provided with a downwardly facing annular cavity mating with said frame V-way and adapted to be supported thereupon, said support ring having an inwardly facing wedge surface radially spaced from said bowl body outer periphery, a segmented bowl clamp ring surrounding said bowl assembly intermediate said outer periphery and said support ring wedge surface, said segmented clamp ring having an outwardly facing wedge surface juxtaposed said support ring wedge surface, a plurality of bolts carried by each segment of said clamp ring and passing upwardly through said support ring, stop means on the upper distal portion of said bolts, fluid-actuated expansible means surrounding said bolts intermediate said stop means and said supporting ring whereby, actuation of said expansible means urges said clamp ring segments upwardly against said support ring as said two juxtaposed wedge surfaces force said segmented clamp ring radially inwardly to clamp said bowl assembly to said support ring.

2. A crusher according to claim **1** including, breaking means carried by said bowl assembly and engageable with said clamp ring to vertically separate said juxtaposed wedge surfaces from one another.

3. A crusher according to claim **1** wherein, said frame V-way and support ring cavity each include a pair of tapered surfaces defining mating trapezoidal configurations.

4. A crusher according to claim **1** including, yieldable tie means clamping said support ring downwardly toward said frame V-way.

5. A crusher according to claim **1** including, fluid-actuated locking means operable to clamp said bowl assembly to said support ring in selected vertical relationship thereto.

6. A crusher according to claim **1** including, a plurality of adjustment flanges projecting radially and outwardly from said bowl body and overlying said support ring, a retainer bracket overlying each said flange and secured to said support ring, each said bracket having an interior opening surrounding one said flange and permitting of substantial vertical displacement of said flange within the confines of said opening, shim means insertable within each said opening above and below said flange to fill all free vertical space within said opening, and shim lock means carried by each said bracket operable to clamp said bowl flanges in fixed relationship to said brackets and support ring.

7. A crusher according to claim **1** including, a fixed vertical bearing shaft within said frame having a central vertical bore, an eccentric journalled about said vertical shaft, a crusher head supporting said mantle bearing-mounted upon said eccentric, drive means engaging said eccentric for rotation thereof and for imparting gyratory motion to said mantle, an anti-spin assembly within said frame for limiting free spinning of said mantle during operation of said drive means when no feed material is present between said mantle and bowl assembly, said anti-spin assembly provided with a stationary fluid pump having a drive shaft extending upwardly

through said bore and connected to said head, a pair of fluid ports in said pump, means constantly supplying fluid to the exterior of said pump in the area of said ports, one said port including a check valve whereby during normal crushing operation said drive shaft and pump rotates in one direction as fluid is drawn into said pump through said check valve and during no-feed operation the tendency of said shaft and pump to rotate in the opposite direction is substantially restricted as said check valve precludes exit of fluid from said pump.

8. A crusher according to claim **2** wherein, said clamp ring includes a plurality of circumferentially adjacent segments, and said breaking means includes a fluid-actuated lift cylinder, said support ring provided with an aperture beneath said cylinder, a release pin extending from said cylinder and through said aperture to abut two said clamp ring segments.

9. A crusher according to claim **4** wherein, said tie means includes a plurality of load relief cylindners attached to said frame beneath said V-way, each said cylinder having a tie bolt therein provided with a piston adjacent its lower end, the upper end of each said tie bolt projecting upwardly through said V-way and overlying support ring and having a nut affixed to its upper distal portion, a conduit supplying fluid to each said cylinder in series, a fluid accumulator mounted adjacent each said cylinder and provided with a separate conduit whereby, vertical displacement of said bowl assembly and the concurrent displacement of said support ring and tie bolt pistons displaces fluid from at least one said cylinder both toward its respective accumulator and toward said cylinder adjacent thereto.

10. A crusher according to claim **5** wherein, said fluid-actuated expansible means and fluid-actuated locking means comprise hydraulic washers, and a conduit connecting all said hydraulic washers in series for supplying fluid under pressure thereto simultaneously.

11. A crusher according to claim **6** whereiin, each said bracket includes a top cross head and a pair of depending side walls, said shim lock means including a stud passing downwardly through said cross head, a base plate attached to the bottom distal portion of said stud adjacent said support ring, and a hydraulic washer carried by the upper distal portion of said stud above said cross head to elevate said base plate and lock said shims and bowl flange relative said support ring.

12. A crusher according to claim **8** including, at least one lift cylinder medially disposed over each pair of said clamp ring segments, and a conduit supplying fluid to all said lift cylinders in series for simultaneous actuation of said release pins.

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