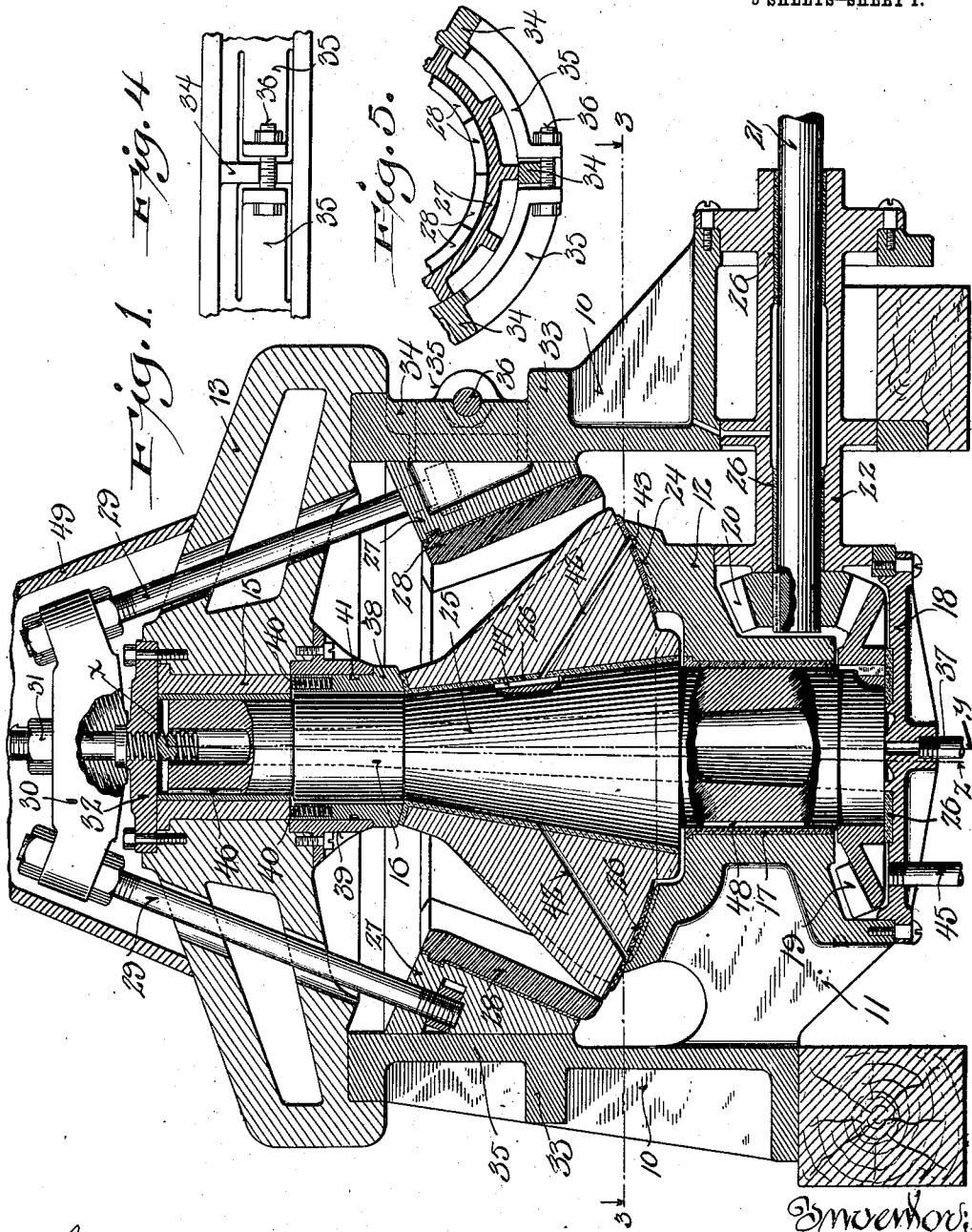


T. L. SMITH.  
 GYRATORY CRUSHER.  
 APPLICATION FILED JULY 22, 1912

1,132,984.

Patented Mar. 23, 1915.

5 SHEETS-SHEET 1.



Witnesses:  
 Casanova Young  
 Katherine Holt

Thomas L. Smith  
 By Morsell Haldwell  
 Attorneys.



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5 SHEETS—SHEET 3.

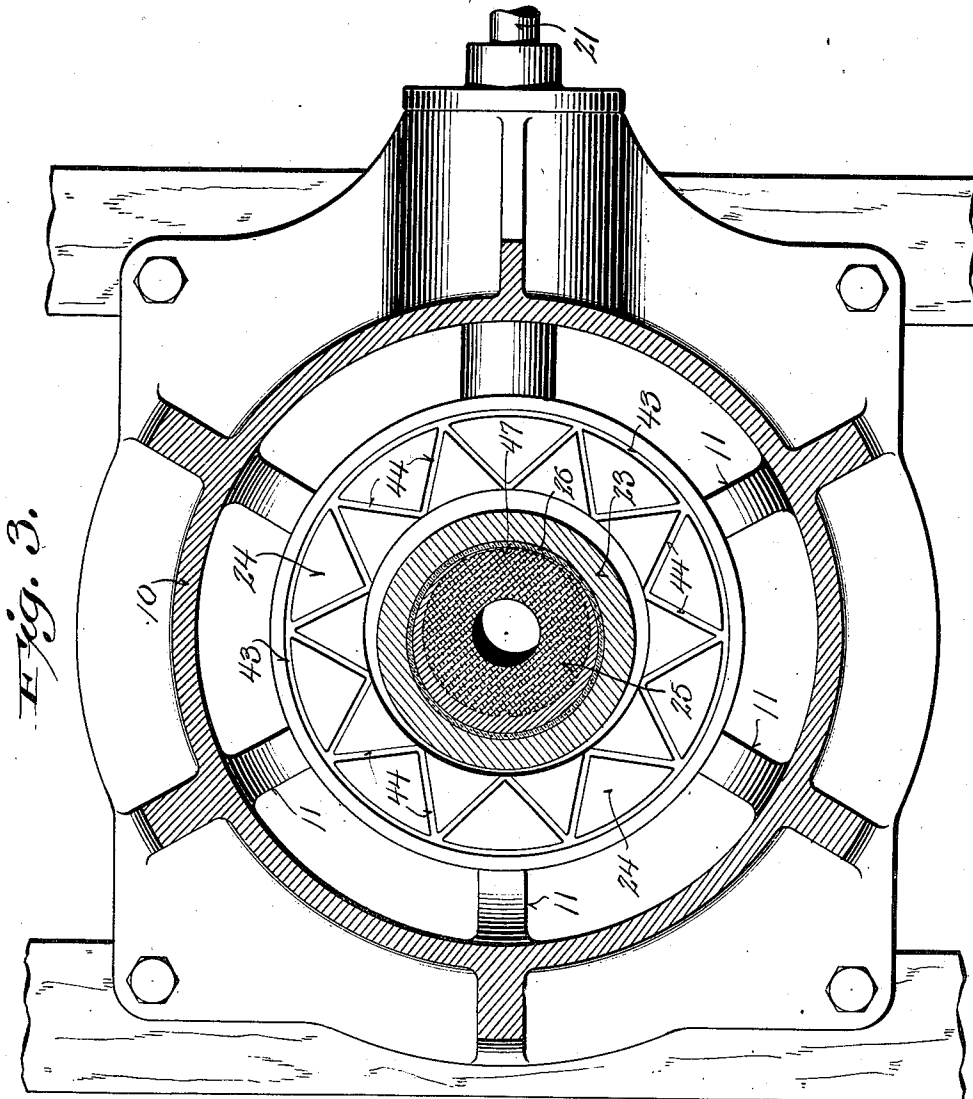


Fig. 3.

Witnesses:  
Carroll Young,  
Katherine Holt

Inventor:  
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By Morsell & Caldwell,  
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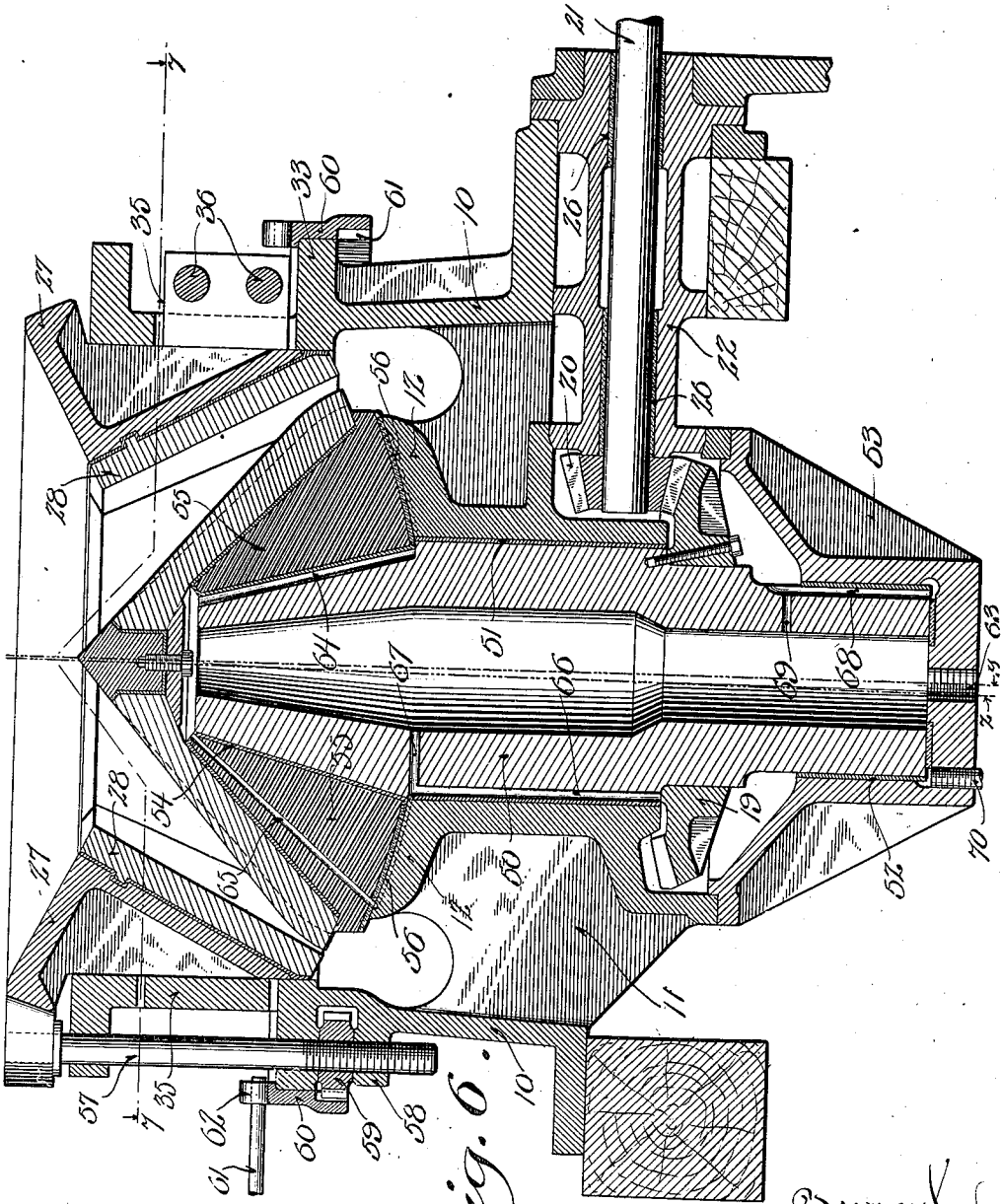


Fig. 6.

Witnesses:  
 Curran & Young  
 Katherine Holt

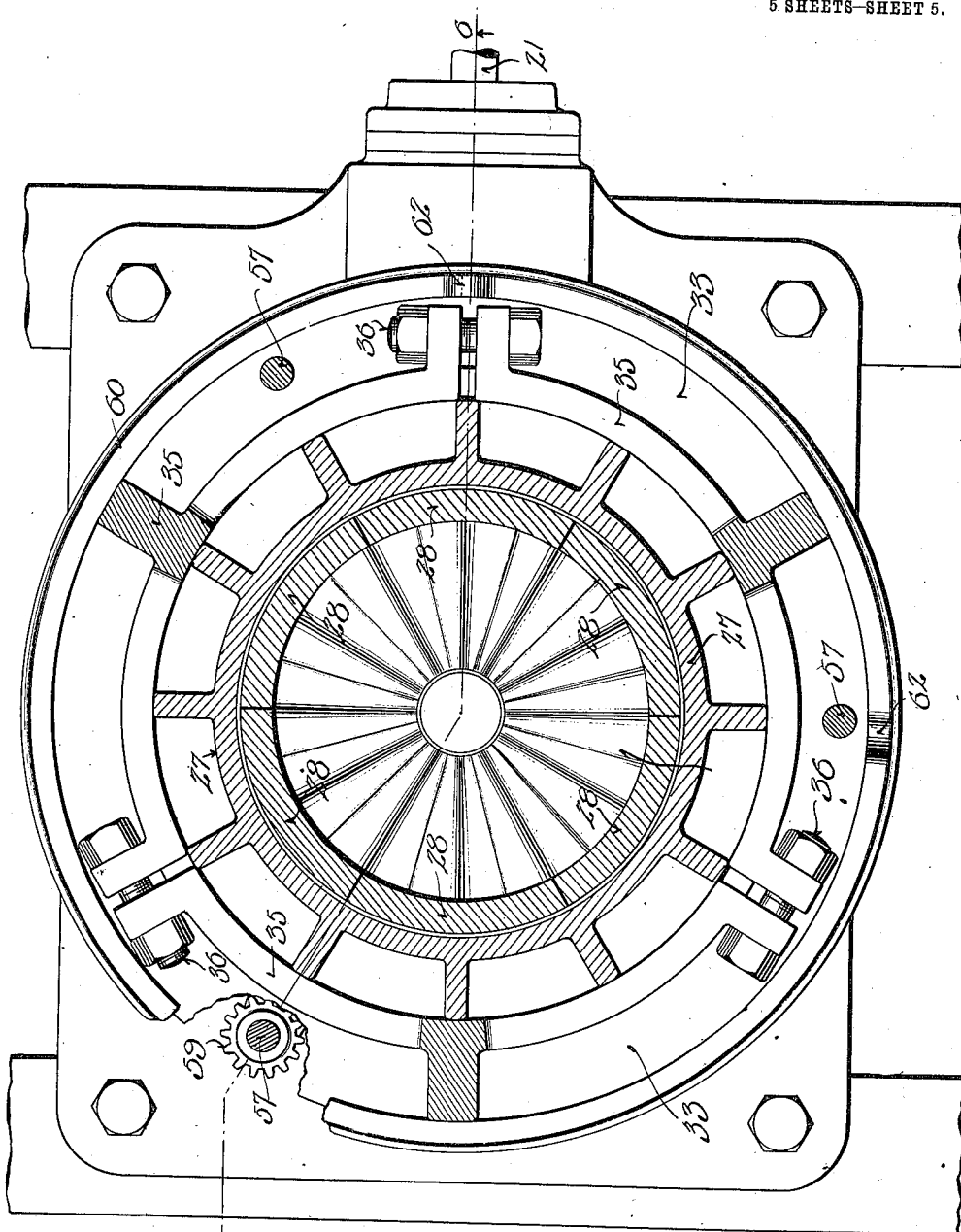
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 Thomas L. Smith.  
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5 SHEETS-SHEET 5.



Witnessed:  
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Fig. 7.

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Thomas L. Smith,  
By Morrell & Caldwell  
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# UNITED STATES PATENT OFFICE.

THOMAS L. SMITH, OF MILWAUKEE, WISCONSIN.

## GYRATORY CRUSHER.

1,132,984.

Specification of Letters Patent.

Patented Mar. 23, 1915.

Application filed July 22, 1912. Serial No. 710,912.

*To all whom it may concern:*

Be it known that I, THOMAS L. SMITH, a citizen of the United States, and resident of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Gyratory Crushers, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

This invention relates to rock crushers and has for its object to provide the eccentric surface for producing the gyratory motion of the crusher head directly in alinement with the line of stress of the crushing action.

Another object of the invention is to provide an efficient system of lubrication for gyratory crushers which will provide the working parts with lubricant free from dust and grit.

Another object of the invention is to provide novel means for adjusting the crushing ring with relation to the crusher head and also novel means for clamping the crusher ring in its adjustments.

Another object of the invention is to improve upon details of construction of gyratory crushers.

With the above and other objects in view the invention consists in the gyratory crusher as herein claimed and all equivalents.

Referring to the accompanying drawings in which like characters of reference indicate the same parts in the different views: Figure 1 is a central sectional elevation of a gyratory crusher constructed in accordance with this invention; Fig. 2 is a plan view thereof with parts broken away, the line 1—1 indicating a sectional plane of Fig. 1; Fig. 3 is a sectional plan view thereof on the plane of line 3—3 of Fig. 1; Fig. 4 is a detail view of the crusher ring clamping means; Fig. 5 is a sectional plan view thereof; Fig. 6 is a central sectional elevation of a gyratory crusher of a modified form also constructed in accordance with this invention; and, Fig. 7 is a sectional plan view thereof on the plane of line 7—7 of Fig. 6, the lines 6—6 of Fig. 7 indicating the sectional plane of Fig. 6.

In these drawings 10 indicates a frame or casing of a generally cylindrical formation

with internal radial webs 11 uniting it with a centrally located bearing portion 12.

In that form of crusher illustrated in Figs. 1, 2 and 3 a cylindrical frame has an upper bearing frame 13 securely clamped to its upper edge by having its lower portion constituting a split flanged ring fitting the edge of the frame 10 and clamped thereon by bolts 14, as best seen in Fig. 2. This upper bearing frame 13 extends across the cylindrical frame 10 leaving openings on opposite sides thereof through which the material may be fed to the crusher and at its center it has a removable flanged bushing 15 forming the upper bearing for a vertical crusher spindle 16 which has its lower end fitting within a bearing 17 in the bearing member 12 and which is seated on a bottom plate 18 secured to the lower end of the bearing member 12 and closing the opening thereof to render it oil tight. A beveled gear wheel 19 is keyed on the lower end of the crusher shaft 16 and meshes with a beveled pinion 20 on a suitably driven shaft 21 which enters through the frame 10 and the bearing member 12 inclosed within a flanged sleeve 22 which completes the closure of the gear chamber in the bearing member 12. A crusher head 23 of a conical shape with a spherical convex base or bearing portion is seated upon a broad spherical concave bearing 24 on the upper part of bearing member 12, the said spherical surfaces of the crusher head 23 and the bearing 24 having a common center at the point in the line of the axis of rotation of the crusher shaft 16 designated "X Y" in Fig. 1. The crusher shaft 16 has an eccentric conical enlargement 25 which fits within a correspondingly shaped central opening of the crusher head 23 while the axis of the conical eccentric 25 intercepts the axis of rotation of the crusher shaft 16 at the point X and is indicated in Fig. 1 by the line X—Z. In the rotation of the crusher shaft 16 the axis X Z of the conical eccentric 25 travels around the axis X Y of the crusher shaft and the crusher head 23 though independent of the rotary movement of the crusher shaft is given a gyratory movement by the eccentric corresponding with the movement of the axis X Z and because of its spherical bearing center on the

point X its movement corresponds with the movement which it would have if it were suspended from the point X. Antifriction bushings 26 are provided at the bearing parts such as the bearings for driving shaft 21, the end thrust bearing for the crusher shaft 16 on the bottom plate 18, the upper bearing 15 and the lower bearing 17 for the crusher shaft, the conical bearing in the crusher head 23 for the conical eccentric 25 and the spherical bearing 24 for the crusher head.

A crusher ring 27 is provided which is conical and is provided with ribs to fit within the cylindrical frame 10 and its conical inner surface forms a converging throatway between it and the conical crusher head 23 which throatway surrounds the crusher head and increases in diameter in the direction of travel of the material therethrough. This crusher ring 27 is provided with a sectional lining of hardened metal plates 28 and is adjustable vertically within the cylindrical frame 10 to vary the size of the throatway between the crusher head and the crusher ring. As shown the crusher ring is provided with upwardly extending rods 29 clamped to a crosspiece 30 which is mounted on a shouldered adjusting screw 31 which is threaded in a cover plate 32 secured to the upper bearing frame 13 and covering the upper bearing 15 of the crusher shaft. By turning the adjusting screw 31 the crosspiece 30 may be raised or lowered and thus through its connections 29 with the crusher ring 27 cause the latter to be raised or lowered within the cylindrical frame 10. When the adjustment of the crusher ring suits the requirements it is rigidly clamped to the frame 10 so that the stress to which the crusher ring is subjected during the crushing operation will be borne by the frame. As shown more particularly in Figs. 4 and 5 the cylindrical frame 10 above its intermediate annular strengthening flange 33 is slit from one radial rib 34 to another to form slightly yielding tongue members 35 with outwardly turned free ends on opposite sides of one of the radial strengthening ribs 34 of the frame. A bolt 36 connects the outwardly turned ends of each pair of tongue members 35 and is seated in a notch in the edge of rib 34 between them. By tightening the bolts 36 the tongue members 35 are sprung inwardly against the flanges of the crusher ring 27 to form a tight clamping connection between the crusher ring and the frame which will avoid the crusher ring being crowded upwardly and will cause the stress of the crushing action against the crusher ring to be borne by the frame.

A lubricant supply pipe 37 delivers lubricant under pressure to an opening in the

center of the bottom plate 18 and as the crusher shaft 16 is hollow and is seated on the anti-friction gasket 26 the lubricant cannot escape at the lower end of the crusher shaft but is forced up through the central opening thereof and runs over the upper end of the crusher shaft into the upper bearing 15 thereof to lubricate it. In order that the lubricant from the upper bearing may run down the outside of the crusher shaft 16 to the conical eccentric 25 thereof without being exposed to the dust rising from the crusher a sleeve 38 surrounds the crusher shaft and being of larger diameter permits the oil to pass between it and the crusher shaft. This sleeve is slidably mounted in a guide bushing 39 which is secured to the bottom of the upper bearing frame 13 and is rounded at its lower end so as to form a spherical bearing against the upper end of the crusher head 23, said spherical bearing having the point X as its center so that the gyratory movements of the crusher head are freely permitted without a movement of the sleeve 38 and without admitting dust to the oil passageway between the sleeve and the crusher shaft. In order that the sleeve 38 may continue its bearing against the crusher head notwithstanding wear of the parts it is made slidable within the guide bushing 39 and is preferably provided with coil springs 40 set in openings at its upper edge and bearing against the flanged bushing which forms the removable upper bearing 15 for the crusher shaft and a packing groove 41 surrounds the sleeve 38 to prevent the leakage of oil between the sleeve 38 and the guide bushing 39. The lubricant which is thus delivered from the upper bearing 15 to the conical eccentric 25 of the crusher shaft serves to lubricate the bearing between said eccentric and the crusher head and at an intermediate point in its travel down the eccentric a portion thereof will be conveyed through inclined oil ducts 42 through the crusher head to the outer edges of the spherical bearing 24 for the bottom of the crusher head. This spherical bearing 24, as seen in Fig. 3, has an annular groove 43 to receive the oil from ducts 42 and has a series of oblique grooves 44 extending from across the surface of the spherical bearing 24 to the interior thereof from which it flows to the lower bearing 17 of the crusher shaft. The oil leaving the lower bearing 17 of the crusher shaft flows over the teeth of the beveled gear 19 to lubricate the driving connection between the driving shaft and the crusher shaft and finally collects in the well formed by the bottom plate 18 and is drawn off by the lubricant pump, not shown, through the oil discharge pipe 45. In its passage down the crusher shaft the oil has passageways provided for it in the surface

of the crusher shaft, such passageways being in the form of grooves 46, 47 and 48 in the upper bearing surface, the conical eccentric bearing surface and the lower bearing surface thereof, respectively. The groove 47 in the conical eccentric bearing surface of the crusher shaft is at the portion thereof which is closest to the axis of rotation while the grooves 46 and 48 are on the opposite side of the crusher shaft and thus in each instance the groove is positioned where the wear is least and the interruption in the bearing surface can best be afforded. A hood or cap 49 rests upon the upper bearing frame 13 and protects the crusher ring adjusting parts from the material fed to the crusher.

In operation the coarse material is fed through the openings on opposite sides of the upper bearing frame 13 and it falls into the annular flaring crushing space between the crusher head 23 and the crusher ring 27. Here it is subjected to the crushing action due to the gyratory movements of the crusher head as produced by the turning of the conical eccentric 25 therein and its spherical bearing support. The upper part of the crusher head being nearer the theoretical center of pivotal suspension has less lateral movement than the lower edge of the crusher head and consequently the crushing stress exerted thereby upon the larger particles of material lodged at this point in the throatway of the machine is greater than at the more contracted portion of the throatway. Also, because of the flaring shape of the annular contracting throatway provision is made for accommodating the particles of material in increasing numbers as their disintegration progresses and they become small. The adjustability of the crusher ring permits of the product being varied so that the machine may deliver a coarse product or a fine product as desired and the operation of effecting such adjustment is simply the releasing of the clamping action on the crusher ring by loosening the bolts 36 and then turning the screw 31 to raise or lower the crusher ring as desired and reclamping it in its new position by again tightening the bolts 36. The bolts 36 being embedded in the notches of flanges 34 of the frame prevent an upward yielding of the crusher ring and the pressure of the crushing action.

The lubricating system by which oil is conducted through the hollow crusher shaft to the upper end thereof and flows by gravity over the several bearings of the crusher shaft and is conveyed to and distributed over the spherical bearing for the crusher head and finally lubricates the driving connection amply provides for the lubrication of all parts and the oil passageway being at all parts inclosed is protected from dust and grit.

In that form of the invention illustrated in Figs. 6 and 7, the crusher shaft is not provided with a bearing above the crusher head, but still has a conical eccentric turning within the crusher head and the crusher head is still mounted upon a spherical bearing so as to have an oscillating movement from a theoretical point of pivotal suspension. In this construction the cylindrical frame 10 has webs 11 supporting a central bearing member 12 substantially as before and a tubular vertical crusher shaft 50 is journaled at its enlarged central portion within a bearing 51 in the bearing member with its reduced lower end fitting in a bearing 52 of bottom plate 53 which is secured to the bottom of the bearing member 12. The beveled gear 19 keyed on the crusher shaft meshes with the beveled pinion 20 on the driving shaft 21 within the flanged sleeve 22 as before and constitutes the means for turning the crusher shaft in its bearing. At its upper end the crusher shaft 50 has a conical eccentric 54 and as before the point, not shown, at which the axis of the conical eccentric intercepts the axis of rotation of the crusher shaft constitutes the theoretical center of pivotal suspension of a conical crusher head 55 which has a conical opening within it fitting upon the eccentric 54 and which has a spherical bottom portion resting upon a spherical bearing 56 of the bearing member 12, such spherical bearing for the crusher head having this point of interception of the axis of the eccentric and the axis of rotation of the crusher shaft as its center. The clamping of the crusher ring 27 within the cylindrical frame 10 is substantially as before by means of bolts 36 connecting the outturned ends of yielding tongue members 35, but the means for adjusting the crusher ring is somewhat different, consisting of downwardly extending screw rods 57 on the edge of the crusher ring passing through guide lugs 58 on the side of the frame 10 with pinions 50 threaded on them between the guide lugs. These pinions 59 form nuts for lifting or lowering the crusher ring and are turned simultaneously by means of a flanged ring 60 mounted to turn on the annular flange 33 of the frame and having internal rack teeth 61 meshing with the several pinions 59. A pin 61 may be inserted in any one of several ears 62 projecting from the ring 60 and by means thereof the said ring may be turned so as to simultaneously turn the pinions 59 and raise or lower the crusher ring. With this construction the lubricant system is substantially like that of the other construction, a supply pipe, not shown, connecting with an opening 63 in the bottom plate 53 and the lubricant therefrom filling the interior of the crusher shaft 50 and overflowing the up-

per end thereof into the space between the end of the crusher shaft and the crusher head 55 and then passing down through the conical bearing of the crusher head on the eccentric 54 principally by way of oil groove 64 in the face of the eccentric and also passing through an oil duct 65 in the crusher head to the grooves in the spherical bearing 56 as before and then through the large central bearing 51 of the crusher shaft and principally through the oil groove 66 in the face of this portion of the crusher shaft which is also supplied with oil directly from the interior of the crusher shaft by oil duct 67 at its upper end and then passing over the teeth of the beveled gear 19 as before and then passing to the bearing 52 at the lower end of the crusher shaft and principally through an oil groove 68 in the face of this portion of the crusher shaft which is also supplied direct from the interior of the crusher shaft by an oil duct 69 and finally collecting in the bottom of the bottom plate 53 from which it is drawn off by the oil discharge pipe 70. With this form of construction the gyratory movement of the crusher head is produced by an eccentric within the crusher head as before and the crusher head is given the same gyratory movement as before, owing to its spherical bearing, but the avoidance of a bearing for the crusher shaft above the crusher head leaves the crushing space free and unobstructed so that the material may more readily be fed thereto. The action of the crushing head is the same as before and the large central bearing 51 with its supplemental bearing 52 and the spherical bearing 56 amply withstand the stress of the crushing operation and are thoroughly lubricated without exposing the lubricant to dust and grit.

What I claim as new and desire to secure by Letters Patent is:

1. A crusher, comprising a suitably journaled rotary crusher shaft, an eccentric on the crusher shaft, a crusher head surrounding the eccentric and fitting thereon, a bearing on which the crusher head is seated and supporting the weight and the downward stress thereof, and a crusher ring surrounding the crusher head.
2. A crusher, comprising a suitably journaled rotary crusher shaft, a conical eccentric thereon, a crusher head surrounding and fitting upon the eccentric, a bearing on which the crusher head is seated and supporting the weight and the downward stress thereof, and a crusher ring surrounding the crusher head.
3. A crusher, comprising a suitably journaled rotary crusher shaft, a conical eccentric thereon, a crusher head surrounding and fitting upon the eccentric, a spherical bearing support for the crusher head on which the crusher head is seated and supporting the weight and the downward stress thereof having as its center the point of intersection of the axis of the eccentric with the axis of rotation of the crusher shaft, and a crusher ring surrounding the crusher head.
4. A crusher, comprising a suitably journaled rotary crusher shaft, a conical eccentric thereon, a conical crusher head surrounding and fitting upon the eccentric, a spherical bearing support on which the bottom of the crusher head is seated and supporting the weight and the downward stress thereof, the gyratory motion of the crusher head due to the turning of the eccentric within it resembling the motion of a pivotally suspended crusher head, and a crusher ring surrounding the crusher head and having its inner crushing surface conical to form with the crushing surface of the crushing head an annular crushing space of gradually diminishing width and increasing diameter.
5. A crusher, comprising a suitably journaled vertical rotary crusher shaft having a central opening therethrough, an eccentric on the crusher shaft, a crusher head surrounding and fitting upon the eccentric, a bearing support for the crusher head, a crusher ring surrounding the crusher head, and means for supplying lubricant under pressure through the interior of the crusher shaft and out of the upper end of the same to flow over the bearings of the crusher shaft and the bearings of the crusher head.
6. A crusher, comprising a suitably journaled vertical rotary crusher shaft having a central opening therethrough, an eccentric on the shaft, a crusher head surrounding and fitting upon the eccentric, a bearing support for the crusher head, and means for supplying lubricant under pressure through the central opening of the crusher shaft whereby it will overflow the upper end thereof, there being grooves in the crusher shaft at its bearings and in its eccentric and there being oil passageways through the crusher head and grooves in the bearing support for the crusher head whereby the lubricant overflowing from the upper end of the crusher shaft is provided with a closed conduit supplying lubricant to the bearings for the crusher shaft and the bearings for the crusher head.
7. A crusher, comprising a frame, a suitably driven crusher shaft having an upper and a lower bearing in the frame, an eccentric on the crusher shaft between the bearings, a crusher head surrounding the eccentric and fitting thereon, a bearing support on the frame for the crusher head on which the crusher head is directly seated and sup-

porting the weight and downward stress of the crusher head, and a crusher ring mounted on the frame and surrounding the crusher head.

5 8. A crusher, comprising a frame, a suitably driven crusher shaft having an upper and a lower bearing in the frame, a conical eccentric on the crusher shaft between the bearings, a crusher head surrounding the  
10 eccentric and fitting thereon, a spherical bearing on the frame for the crusher head on which the crusher head is seated and supporting the weight and downward stress of the crusher head, said bearing having as its  
15 center the point of intersection of the axis of the eccentric with the axis of rotation of the crusher shaft, and a crusher ring on the frame surrounding the crusher head.

20 9. A crusher, comprising a frame, a crusher shaft having an upper and a lower bearing therein, a conical eccentric on the crusher shaft between the bearings, a crusher head surrounding the eccentric and fitting thereon, a spherical bearing support  
25 on the frame for the crusher head having the crusher head directly seated thereon and supporting the weight and downward stress of the crusher head having as its center the point of intersection of the axis of the eccentric with the axis of rotation of the crusher  
30 shaft, a crusher ring on the frame surrounding the crusher head, means for supplying lubricant to the upper bearing, and a sleeve loosely surrounding the crusher shaft and  
35 having a spherical bearing on the crusher head forming a closed oil communication from the upper bearing to the eccentric.

40 10. A crusher, comprising a frame, a crusher shaft having an upper and a lower bearing therein, a conical eccentric on the crusher shaft between the bearings, a crusher head surrounding the eccentric and fitting thereon, a spherical bearing support  
45 on the frame for the crusher head having as its center the point of intersection of the axis of the eccentric with the axis of rotation of the crusher shaft, a crusher ring on the frame surrounding the crusher head,  
50 means for supplying lubricant to the upper bearing, a guide bushing secured to the upper bearing, a sleeve loosely surrounding the crusher shaft and having a sliding lubricant tight fit within the guide bushing, and a  
55 spherical bearing on the crusher head, and springs for holding the sleeve against its bearing on the crusher head whereby the sleeve constitutes a closed conduit for lubricant from the upper bearing to the eccentric.

60 11. A crusher, comprising a frame, a hollow crusher shaft having an upper and a lower bearing therein, a conical eccentric on the crusher shaft between the bearings, a crusher head surrounding the eccentric

and fitting thereon, a spherical bearing support on the frame for the crusher head having as its center the point of intersection of the axis of the eccentric with the axis of rotation of the crusher shaft, a crusher ring on the frame surrounding the crusher head, 70  
means for delivering lubricant under pressure through the lower end of the opening in the crusher shaft, said lubricant overflowing the upper end of the crusher shaft to lubricate the upper bearing, and a closed  
75 conduit from the upper bearing to the eccentric, there being inclined passageways through the crusher head leading from the eccentric bearing thereof to the supporting bearing. 80

12. A crusher, comprising a frame, a crusher shaft journaled in the frame, a crusher head on the crusher shaft, an upper bearing frame removably mounted on the first mentioned frame and in which upper  
85 bearing frame the crusher shaft is also journaled, a crusher ring within the first mentioned frame surrounding the crusher head, a jackscrew on the upper bearing frame, and means connecting the jackscrew with  
90 the crusher ring for adjusting the crusher ring with relation to the crusher head.

13. A crusher, comprising a frame, a crusher shaft suitably mounted in the frame, a crusher head on the crusher shaft, a  
95 crusher ring within the frame surrounding the crusher head, jackscrews connected with the crusher ring, pinions threaded on the jackscrews, lugs on the frame between which the pinions are confined, and a rack ring  
100 mounted to turn on the frame and meshing with the pinions for adjusting the position of the crusher ring with relation to the crusher head.

14. A crusher, comprising a frame having  
105 U-shaped slits in its walls to form yielding tongue members with outturned ends, clamping bolts connecting the outturned ends of adjacent tongue members, a crusher ring within the frame clamped in position  
110 by the engagement of the yielding tongue members therewith, and a suitably mounted crusher head within the crusher ring.

15. A crusher, comprising a suitably journaled rotary crusher shaft, an eccentric  
115 thereon, a crusher head surrounding and fitting upon the eccentric, a spherical bearing support for the crusher head on which the crusher head is seated and supporting the weight and the downward stress thereof,  
120 and a crusher ring surrounding the crusher head.

16. A crusher, comprising a suitably journaled rotary crusher shaft, an eccentric thereon, a crusher head surrounding and fitting upon the eccentric, a spherical bearing support on which the bottom of the crusher head is seated and supporting the weight. 125

and the downward stress of the crusher head, the gyratory motion of the crusher head due to the turning of the eccentric within it resembling the motion of a pivotally suspended crusher head, and a crusher ring surrounding the crusher head and having its inner crushing surface conical to form with the crushing surface of the crusher head an annular crushing space of

gradually diminishing width and increasing diameter. 10

In testimony whereof, I affix my signature, in presence of two witnesses.

THOMAS L. SMITH.

Witnesses:

C. H. KEENEY,  
L. G. THEURER.