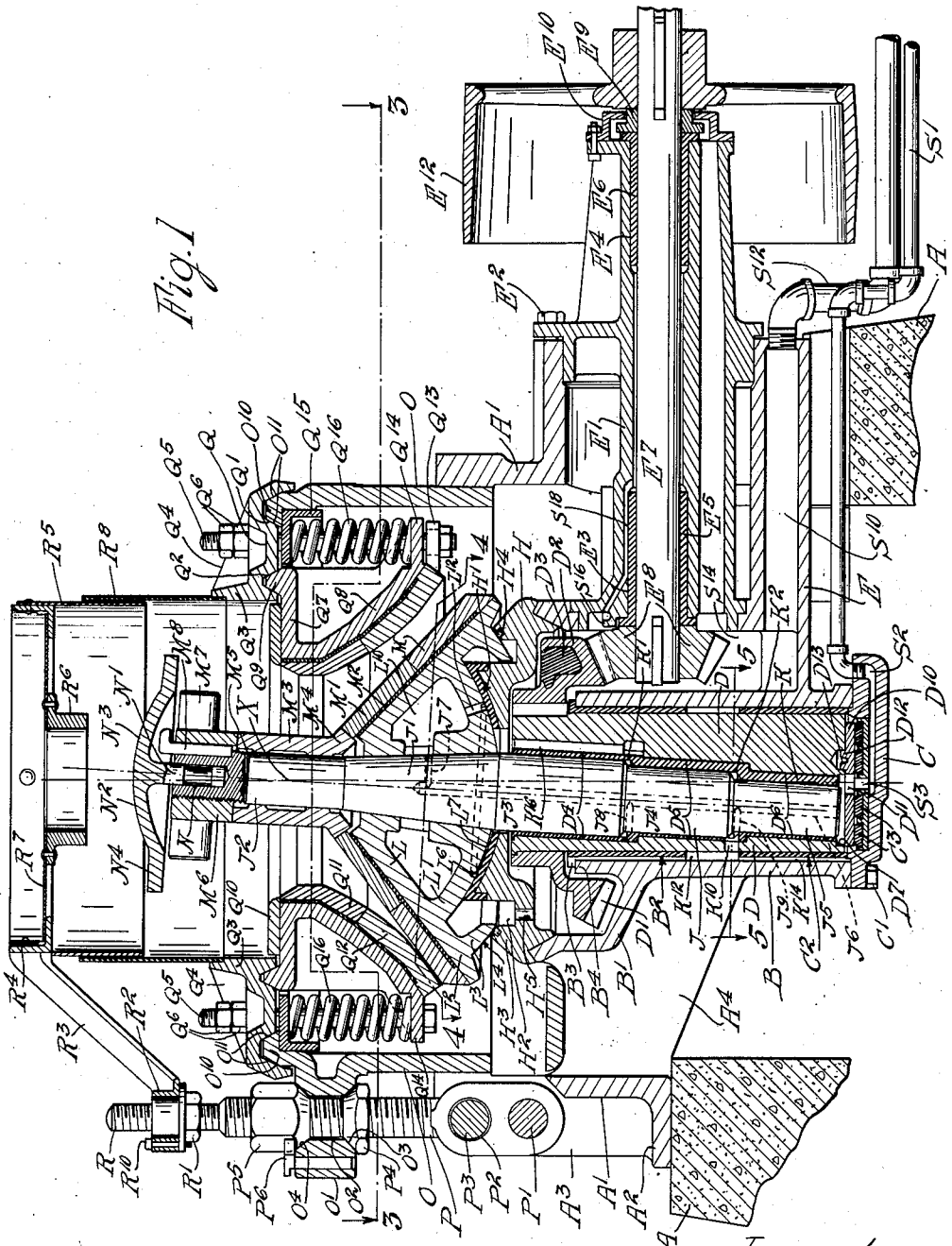
July 13, 1926. 1,592,314

E. B. SYMONS

OILING MEANS FOR GYRATORY CRUSHERS

Filed June 4, 1925 3 Sheets-Sheet 1

Fig. 1



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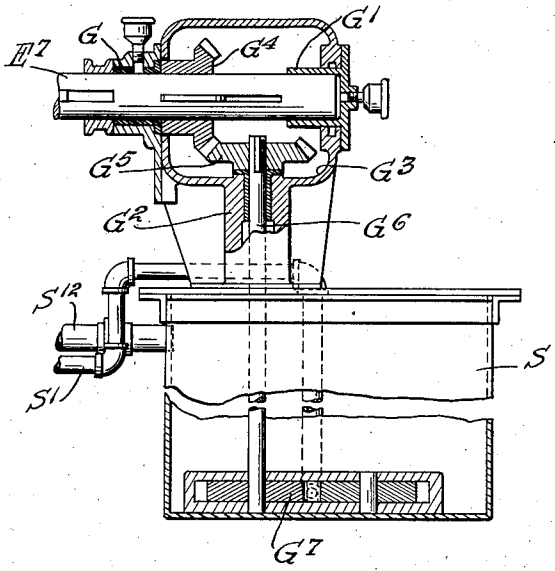


Fig. 2

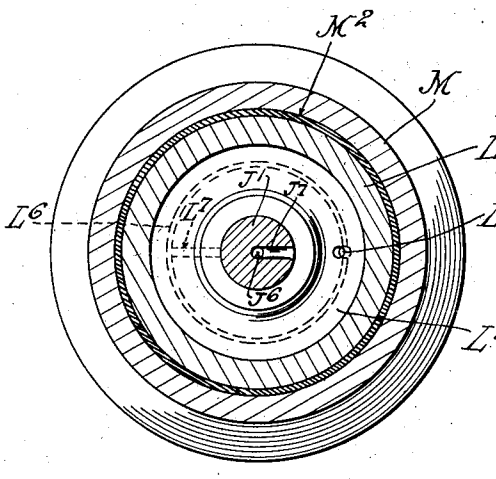


Fig. 4

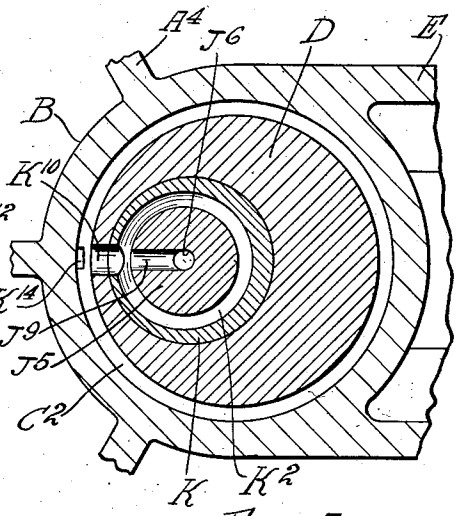


Fig. 5

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Filed June 4, 1925 3 Sheets-Sheet 3

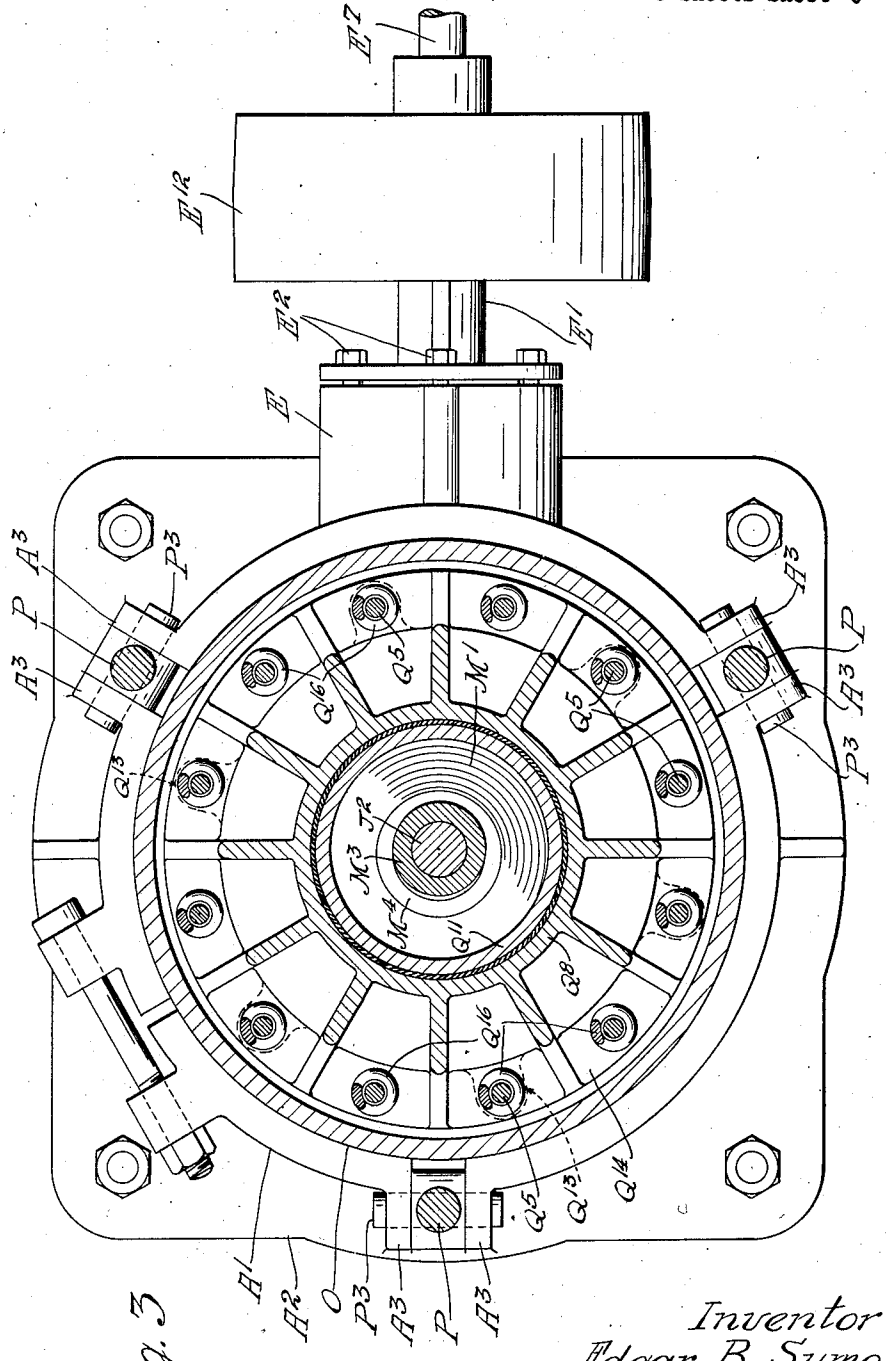


Fig. 3

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UNITED STATES PATENT OFFICE.

EDGAR B. SYMONS, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO SYMONS BROTHERS COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF SOUTH DAKOTA.

OILING MEANS FOR GYRATORY CRUSHERS.

Application filed June 4, 1925. Serial No. 34,796.

My invention relates to improvements in gyratory cone crushing machines of the type in which the material to be crushed is fed, or is allowed to flow by gravity, through a crushing zone between a normally fixed concave and a cone gyrating within the concave.

One object of my invention is to provide a new and improved type of gyratory crusher adapted for fine crushing. Another object is to provide such a crusher wherein means are provided to permit a very fine adjustment of cone and concave. Another object is to provide opposed yieldingly supported crushing elements in such a crusher. Another object is to provide a yieldingly supported crushing concave. Another object is to provide a gyratory crusher for fine reduction, which can be set for small sizes of output without risk of stoppage or breakage upon the passage through the crushing zone of relatively large masses of uncrushable material. Another object is to provide a simple and effective oiling system to prevent the entry of dust, water or other foreign materials into the bearings, and to prevent oil leakage.

Other objects will appear from time to time in the course of the specification and claims.

My invention is illustrated more or less diagrammatically in the accompanying drawings, wherein—

Figure 1 is a vertical axial section with parts broken away;

Figure 2 is a detail section of the portion not shown in Figure 1;

Figure 3 is a sectional plan view section on the line 3—3 of Figure 1;

Figure 4 is a detail section on the line 4—4 of Figure 1.

Figure 5 is an enlarged detail section on the line 5—5 of Figure 1.

Like parts are indicated by like symbols throughout the specification and drawings.

A is a bed or support upon which rests a frame A^1 provided at its base with the horizontal reinforcing flange A^2 and strengthened by the vertical reinforcing flanges A^3. Projecting inwardly from the frame A^1 are the radial flanges or ribs or frame members A^4, which join and support the central cylindrical housing B.

The housing or cylinder B is outwardly expanded adjacent its upper end, as at B^1. A suitable bearing member or sleeve B^2, of suitable anti-friction material, penetrates the upper end of the cylinder, its outwardly projecting flange B^3 resting upon the top B^4 of the cylinder.

The bottom of the cylinder is closed, for example by the cap C, which may be bolted as at C^1, and which supports the lower bearing sleeve or anti-friction member C^2. The top of the cap C is provided with any suitable anti-frictional surfacing, herein illustrated as the inset blocks C^3, of any suitable but preferably highly wear resistant anti-frictional metal.

Penetrating the cylinder B in bearing contact with the sleeves B^2 and C^2 is the eccentric sleeve D. It is provided at its upper end with the outwardly projecting ring gear D^1 inclosed within the space defined by the wall B^1 and projecting outwardly and downwardly beyond the upper edge B^4 of the cylinder. It is provided at one point in its periphery with the upwardly hollow enlargement D^2, adapted to receive a variable quantity of lead or other heavy material D^3.

The sleeve D is eccentrically apertured from the top to the bottom, the aperture comprising, for example, an upper bore D^4 of maximum diameter, an intermediate bore D^5 of intermediate diameter, and a lower bore D^6 of minimum diameter, beneath which is the somewhat enlarged aperture or depression D^7 in the bottom of the shaft. The several bores or stages are co-axial and are aligned along an axis both eccentric to and inclined to the axis of the cylinder B, but intersecting such axis at the point X, the significance of which will appear later.

The sleeve D is supported by the rotating plate D^{10}, which rests upon the pads or blocks C^3. It is centrally apertured as at D^{11}, and is provided with an eccentric stud or upward projection D^{12} adapted to engage the opposed aperture D^{13} in the bottom of the sleeve D.

The cylindrical housing B is at one side provided with the outwardly projecting shaft housing E, herein shown as integral with it. Mounted therewithin is the shaft supporting sleeve E^1 bolted to the main frame, for example, as at E^2. The sleeve E^1 is enlarged or socketed at either end, as at E^3, E^4, to receive the anti-frictional bear-

ings or bushings E^5, E^6. Mounted in said bearings is the drive shaft E^7, to the inner end of which is keyed the beveled pinion E^8 in mesh with the gear D^1. The outer bushing E^6 is contacted by the ring E^9, of angular cross-section, which in turn is surrounded by the flanged plate E^{10} bolted to the outer end of the sleeve E^1. E^{12} is a pulley keyed to the shaft E^7.

The shaft continues beyond the bearing E^6 and the pulley E^{12}, being received in the bearings G, G^1, suitably mounted upon the support G^2. G^3 is a housing or casing integral with such support and housing the beveled pinion G^4 keyed to the shaft E^7. In mesh with it is the beveled pinion G^5 keyed to the vertical shaft G^6 housed within the support G^2. At the lower end of said shaft G^6 is any suitable rotary oil pump, herein diagrammatically illustrated as at G^7

The top of the housing B is closed by the cover plate H, which is provided with the spherical bearing portion H^1, herein shown as of some suitable anti-friction material, which may be removed and renewed. Surrounding the bearing portion H^1 is the circumferential well or sump H^2, beyond which is the spherical bearing portion H^3 provided with any suitable washer or oil wiping member H^4. H^5 is a passage from the sump H^2 adapted to deliver the oil contained therein to the parts inclosed by the housing B^1.

Mounted in the eccentric D is the shaft J, comprising an intermediate tapered portion J^1, an upper cylindrical portion J^2 of minimum cross-section, a central cylindrical portion J^3 of maximum diameter, and the cylindrical sections of progressively reduced diameter, J^4 and J^5. The portions J^3, J^4 and J^5 of the shaft are contained within the portions D^4, D^5 and D^6, respectively, of the aperture of the eccentric D. The shaft is axially apertured as at J^6, the aperture extending from the bottom of the shaft to a point within the inclined portion J^1. J^7 is an oil passage extending laterally from it to the outside of the shaft adjacent its top. J^8 and J^9 are similar lateral oil ducts positioned, respectively, just beneath the termination of the cylindrical sections J^3 and J^4.

The shaft axially engages the sleeve K of suitable anti-friction material. The cross-section of its interior aperture conforms to the cross-section of the various portions of the shaft, but the aperture of corresponding bore in each case continues below the termination of the corresponding cylindrical shaft section, as at K^1 and K^2. The open spaces so formed are aligned with the oiling ducts J^8 and J^9, respectively. K^{10} is an oiling passage in the eccentric D aligned with the oiling duct J^9 and the annular space K^2 and communicating with the interval or space K^{12} between the upper and lower anti-friction members B^2 and C^2. K^{14} is a vertical key extending from top to bottom of said sleeves. K^{16} is a vertical key let in the inside surface D^4 of the eccentric D, and adapted to prevent relative rotation of the sleeve K and the eccentric D.

L is a crushing cone seated upon the tapered portion J^1 of the shaft. It is provided with an integral spherical bearing portion L^1, adapted to conform to and to engage the opposed spherical bearing surface H^1 on the cap H. It is provided with an integral downwardly and outwardly projecting skirt L^2, inwardly projecting from which is the annular flange L^3 provided with the spherical bearing surface L^4 concentric with the surface L^1 and adapted to engage the packing H^4 of the member H^3. The surface L^1 is broken by a circumferential oil duct L^6, which is connected by means of the radial duct L^7 with the central aperture of the cap H. The hollow interior L^{10} of the head communicates with the oil duct J^7 and is provided with an oil duct L^{12} leading to the circumferential oil channel or duct L^6, at an angle of 180° from the duct L^7.

M, M^1 are mantle members mounted on the head L and directly contacting, for example, the zinc layer M^2. M^3 is a securing sleeve slidable along the upper cylindrical portion J^2 of the shaft and provided with a downwardly and outwardly flaring or conic portion M^4, adapted to engage the upper edge of the mantle section M^1, but normally out of engagement with the head L. The upper end of the shaft is screw-threaded as at M^5, and is surrounded by the locking sleeve or nut M^6, screw-threaded in conformity with it. M^7 are handles or turning studs whereby the nut M^6 may be rotated to exert a downward thrust against the sleeve M^3, and thus against the mantle section M^1 and the head L. M^8 is any suitable key member adapted to be inserted between the nut M^6 and the screwthreaded portion of the shaft, to prevent their further relative movement.

The upper end of the shaft is axially apertured as at N, to receive the stub N^1 of the deflector plate N^2. The plate consists of the central spherical portion N^3 concentric with the bearing surfaces L^1 and L^3, their common center being the point indicated as X. N^4 is a relatively flattened rim outwardly projecting from the spherical portion N^3. The deflector plate is preferably but not necessarily a casting.

Slidably mounted within the lower fixed frame portion A^1 is the upper axially movable frame member O. It is provided with a plurality of outwardly projecting ears O^1, preferably three in number, apertured as at O^2, the upper and lower portions of such apertures being beveled as at O^3, O^4. P are

securing bolts pivoted as at P^1 to the fixed frame member A^1. The base portion is apertured as at P^2, to permit the passage therethrough of the transverse securing member P^3, which passes, for example, also through adjacent flanges A^3 of the frame A^1. Mounted on the bolt P are the upper and lower securing nuts P^4, P^5, beveled to conform to the beveled surfaces O^3 and O^4. It will be understood that the bolt P is of smaller cross-section than the aperture O^2. P^6 is any suitable key or locking member adapted to prevent rotation of the nut P^5. The member O terminates in an inwardly turned flange O^{10}, upwardly beveled as at O^{11}.

Resting upon the upper edge of the member O is the ring Q, provided with the concentric beveled-walled grooves Q^1, Q^2, the outer of which conforms generally to the shape of the upper edge of the frame member O. The ring Q is centrally flanged as at Q^3 about its interior aperture, and is provided with the strengthening ribs Q^4. It is apertured at a number of properly spaced points to permit the passage therethrough of the bolts Q^5, supported in position, for example by the nuts Q^6. Supported by said bolts within the member O is the ring Q^7, supporting the concave Q^8, and provided with the circumferential ridge Q^9 conforming generally to the shape of the groove Q^2 of the ring Q. Q^{10} is any suitable cover plate for the ring Q^7 and Q^{11}, Q^{12} are separate mantle sections supported in position, for example by the outwardly projecting ears Q^{13} mounted upon the bolts Q^5. The mantle section Q^8 terminates in a circumferential flange Q^{14}, through which pass the bolts Q^5. Q^{15} is a stop ring of angular cross-section, adapted to be seated against the flange O^{10} of the frame or housing portion O. Q^{16} are spiral springs adapted to be compressed between the flange Q^{14} and said ring Q^{15}. The bolts P are upwardly reduced as at R, and are provided with supporting nuts R^1, upon the upper surfaces of which seat the terminal portions R^2 of the arms R^3 which support the ring R^4 of the apron R^5. The apron is preferably, although not necessarily, formed of flexible material, such as belting. R^6 is the centrally positioned feed spout connected to the ring R^4 in any suitable manner, and R^7 is any suitable cover plate. R^8 is a housing, for example of sheet iron, seated upon the flange Q^3 of the ring Q and upwardly projecting about the flexible apron R^5. R^{10} is any suitable key adapted to prevent rotation of the nut R^1.

S is any suitable oil tank, from which extends the oil feed line S^1, through which oil may be passed, for example by the rotary pump G^7 earlier described. The oil line S^1 extends to the cap C and through the passage S^2 therein and through the central aperture S^3 and the aperture D^{11} through the plate D^{10}. S^{10} is the return line passing through the shaft housing E, through the pipe section S^{12}, and thereby back to the oil tank S. It communicates with the space S^{14}, in which is positioned the beveled pinion E^8. S^{16} is a ledge formed in the upper part of the same chamber and communicating by an oil duct S^{18} with the bearings of the shaft E^7.

It will be realized that whereas I have described and shown an operative device nevertheless many changes may be made in the size, shape, number and disposition of parts wtihout departing from the spirit of my invention, and that I therefore wish my drawings and description to be taken as in a broad sense illustrative, rather than as limiting me to my specific showing.

The use and operation of my invention are as follows:

When the machine is set up as shown in the drawings the drive shaft is rotated and causes the eccentric sleeve to rotate in its bearing. As the eccentric rotates it gyrates the shaft, and through the shaft it gyrates the cone or crushing head about its large spherical bearing. Upon the cone is mounted the mantle which actually engages the material being crushed. The mantle portions are seated upon the cone and the cone is seated upon the shaft by means of the clamping sleeve and the screwthreaded nut.

Since I use my crusher for fine reduction and wish to set the cone very close to the mantle, I provide a yielding release which will permit the passage through the crushing zone of uncrushable material, when by any chance it passes therethrough, without either stopping the machine or causing breakage. I obtain this result by providing a spring release for the crushing concave. I suspend the concave by means of a set of bolts passing through the plate or ring Q and depending from it and passing through the circumferential flange Q^{14} about the bottom of the concave. The mantle is locked in position by the same bolts by means of the ears Q^{13}, through which the bolts also pass. The strength of the spiral springs Q^{16} is such that, under all normal conditions, the concave is fixed in position and will not be moved at all by the pressures incident to normal crushing operation. However, the springs are sufficiently yielding to permit movement of the concave when unbreakable material passes through, and they will yield sufficiently rapidly to prevent breakage of any of the parts or stoppage of the machine. The spring Q^7 is normally drawn up by the bolts into such position that the beveled flange Q^9 is seated within the beveled-walled groove Q^2, and the ring Q^7 or concave and the grooved ring Q will from that time on act as one piece. If a non-crushable

substance is introduced between the cone and the concave, causing the concave to be lifted on one side, the flange Q^{14} will raise and compress the springs, because the angle ring Q^{15} is held rigidly to place by the holding bolts Q^5 and the flange O^{10}. The concave and the ring Q lift as a unit and pivot about a point diametrically opposed to the location of the interfering object, the beveled upper edge of the ring O serving as the pivot. Thus, if a piece of iron passes through the crushing zone, the concave, instead of cracking, will tilt, and it will tilt before the machine can be stopped by the obstruction. If the material being crushed is damp and compresses into an uncrushable mass, the machine will not tend to stop, as is the case with unrelieved crushing members, but the only unfavorable result will be that a little over-size and a few flakes of compressed material will pass through the crushing zone.

The material to be crushed is fed in from above, falling freely under gravity into the crushing space between the concave and the cone. As the cone gyrates, the material being crushed will be wedged or pinched between it and the concave and each particle, as soon as it has been crushed, will commence to fall freely away from the concave, the distance of its fall depending on the relation between the acceleration due to gravity, the rate and length of gyration of the cone, and the size of the particle. The particles will fall vertically until they strike the cone and will then be deflected outwardly and downwardly until they reach a point at which the distance between the cone and concave, at the distance the particles arrive, is equal to the diameter of the particular particles. At this point the downward movement of the particles ceases until they have been crushed and released, and the process is repeated in a sequence of similar successive drops, lateral conveying excursions, and actual crushing excursions.

Vertical adjustment of the concave is provided by means of a plurality of adjusting screws, preferably three in number. These screws are pivoted upon a fixed base A^1 but are held normally in vertical position. They loosely engage the apertures of the flanges of the vertically movable frame member O. The said frame member is adjusted for height in the following manner: The lower nuts P^4 are positioned at the desired height and the frame member O is lowered into contact therewith. The upper nuts P^5 are then rotated into proper position and locked against further movement, for example by the keys P^6. When it is desired to make an adjustment of the frame member O, it can be done by successively adjusting its relation with each of the holding bolts. In such case the upper nut P^5 is released and moved upwardly along the bolt to the desired height, and the ear O^1 is raised to contact the bottom of the nut P^5, and the nut P^4 is then screwed up to the proper position. Since there is something of a play between the apertures of said ears and the supporting bolts, it is possible to make the adjustments one at a time, without even stopping the operation of the crusher.

The material to be crushed may, if desired, be permitted to accumulate in any suitable species of hopper or container above the cover plate R^7. In any case the material flows through the central aperture and forms a column resting on the feed or deflector plate N^2. This column is of generally conic form and material from its base is continuously fed outwardly by the rotation and gyration of the plate. The cover plate may be vertically adjusted along the reduced portions R of the supporting bolts P, as shown, in order to regulate the flow of material to the feed plate. When so adjusted the feed plate will feed a substantially constant volume of material to the crushing zone, the material being delivered substantially uniformly about the annular entrance into the crushing zone, the point of maximum feed being the lowest point of the edge of the plate, and moving around the plate as the plate is gyrated.

By making the apron R^5 flexible, I prevent any tendency of binding or wear between said apron and the housing R^8, which is preferably fixed in relation to the ring Q and, of course, moves with it when the ring Q is tilted in response to the passage of uncrushable material through the crushing zone.

The oiling system is simple and is entirely concealed and internal, the oil being supplied to all bearings from a single oil reservoir. Oil may be pumped in any suitable manner from the oil tank G^6. I have illustrated a rotary pump driven from the shaft E^7 but any other suitable pumping means may be employed. The oil is pumped along the inlet line S^1 to the plate C wherein is formed the passage S^2 aligned with the central aperture S^3. The oil passes therethrough and through the central aperture D^{11} of the rotating bearing plate D^{10}. It passes thence to the space D^7 formed in the bottom of the eccentric sleeve D in line with the shaft receiving aperture. The members C^3 being raised above the level of the surface in which they are set the oil penetrates freely thereabout and lubricates the bearing between them and the rotating plate. The pumping means serve to force the oil up the longitudinal main oil duct J^1 of the shaft. Some of the oil so pumped passes to the top of the duct and outwardly through the oil passage J^7 into the hollow of the crushing head. It flows thence downwardly through the passage L^{12} to the cir-

cumferential duct L^6 formed in the lower spherical bearing face of the crushing head. As the head is gyrated on the spherical bearing the oil is wiped across the opposed bearing surfaces. The surplus oil flows inwardly toward the shaft along the radial oil passage L^7 which is positioned at an angle of 180° to the outlet of the oil passage L^{12}. Thus the oil passes in a double stream about the passage L^6, the two streams converging on the passage L^7. Some of the oil passes outwardly over the edge of the spherical bearing H^1 into the sump H^2 whence it flows by the passage H^5 into the space enclosed by the housing B^1. The rest of it flows inwardly along the passage L^7 and downwardly along the shaft, flowing outwardly across the gear D^1 or to some extent penetrating between the shaft and its bearing.

The lubrication of the shaft proper however is obtained through the radial oiling passages J^8 J^9. These passages reach the surface of the shaft which is beneath the ledges formed between the generally cylindrical sections J^3 and J^4 and J^4 and J^5 respectively. At these points there are the clearances K^1 and K^2 which permit the oil to flow about the shaft and to work into the adjacent opposed bearing surfaces between the shaft and the sleeve K.

The outer bearing of the sleeve K is lubricated for example by the flow of oil through the passage K^{10} which is generally aligned with the oil passage J^9. K^{14} is a vertical duct which permits the oil flowing through the passage K^{10} to reach the bearing surfaces above and below it.

The oil all flows back into the space S^{14} and thence along the return passage S^{10} and the return pipe S^{12} to the tank. In order to lubricate the bearings of the shaft E^7 I provide the oil gathering inlet S^{16} which receives the oil as it is splashed by the gear D^1 and the pinion E^8. It passes downwardly along the passage S^{18} to the rest of the shaft between the bearing sleeves E^5 and E^6 and works along said bearing sleeves sufficiently to provide such lubrication as is necessary.

I claim:

1. In a gyratory crusher, a crusher shaft, an eccentric sleeve thereabout and means for rotating it, a bearing member for said eccentric sleeve, a crushing head mounted on said shaft above said eccentric and a bearing support therefor, said shaft being longitudinally penetrated by an oil duct and by a plurality of oil passages extending outwardly from said duct to the surface of said shaft, one of said passages extending to the bearing surface of the shaft, and an oiling connection between another of said passages and the bearing surface of the head.

2. In a gyratory crusher, a crusher shaft, an eccentric sleeve thereabout and means for rotating it, a bearing member for said eccentric sleeve, a conic crushing head mounted on said shaft and having a spherical lower bearing portion, a spherical surfaced support in bearing contact therewith, the shaft being penetrated by a longitudinal oil duct and by oil passages outwardly extending therefrom to the surface of the shaft, one of said passages extending to the bearing surface of the shaft and an oiling connection between another of said passages and the spherical bearing surface of the head.

3. In a gyratory crusher, a crusher shaft, and means for rotating it, a crusher head mounted thereon and provided with a spherical lower bearing surface, a spherical surfaced supporting member adapted to support said head, said shaft being penetrated by a longitudinal oil duct and by an oil passage extending thence to the interior of said head, said head being penetrated by an oil passage in connection therewith and extending to said spherical bearing surface.

4. In a gyratory crusher, a crusher shaft, and means for rotating it, a crusher head mounted thereon and provided with a spherical lower bearing surface, a spherical surfaced supporting member adapted to support said head, said shaft being penetrated by a longitudinal oil duct and by an oil passage extending thence to the interior of said head, said head being penetrated by an oil passage in connection therewith and extending to said spherical bearing surface, the spherical bearing surface having formed in it an open annular oiling duct in communication with said above mentioned oiling passage.

5. In a gyratory crusher, a crusher shaft, and means for rotating it, a crusher head mounted thereon and provided with a spherical lower bearing surface, a spherical surfaced supporting member adapted to support said head, said shaft being penetrated by a longitudinal oil duct and by an oil passage extending thence to the interior of said head, said head being penetrated by an oil passage in connection therewith and extending to said spherical bearing surface, the spherical bearing surface having formed in it an open annular oiling duct in communication with said above mentioned oiling passage, and a radial oiling slot extending inwardly from said annular duct.

6. In a gyratory crusher, a crusher shaft, and means for rotating it, a crusher head mounted thereon and provided with a spherical lower bearing surface, a spherical surfaced supporting member adapted to support said head, said shaft being penetrated by a longitudinal oil duct and by an oil passage extending thence to the interior of said head, said head being penetrated by an oil passage in connection therewith and extending to said spherical bearing surface, the

spherical bearing surface having formed in it an open annular oiling duct in communication with said above mentioned oiling passage, and a radial oiling slot extending inwardly from said annular duct at an angle of about 180° from the connection between said annular duct and said oiling passage.

7. In a gyratory crusher, a stepped crusher shaft, an eccentric sleeve thereabout, and means for rotating it, the interior of said sleeve being stepped to conform to the steps of said shaft, the ledges intermediate the steps of shaft and bearing receptacle being spaced apart, the shaft being penetrated by a longitudinal oiling duct and by oiling passages extending outwardly from said duct to the surface of said shaft, said passages being aligned with the open space provided by the interval between the opposed ledges on said shaft and bearing.

8. In a gyratory crusher, a crusher shaft having a plurality of sections of differing diameter, an eccentric sleeve thereabout and means for rotating it, the interior of said sleeve conforming generally to the shape of said shaft, the opposed walls of shaft and sleeve being spaced apart at a plurality of points along said shaft, the shaft being penetrated by a longitudinal oiling duct and by oiling passages extending outwardly from said duct to the surface of said shaft at points adjacent the zones of clearance between the opposed surfaces of shaft and sleeve.

9. In a gyratory crusher, a stepped crusher shaft, comprising a plurality of sections of different diameter, the diameter of said sections being generally uniform, an eccentric sleeve thereabout and means for rotating it, the interior of said sleeve being stepped to conform to the steps of said shaft, the opposed surfaces of shaft and sleeve being spaced apart adjacent each change of diameter of the shaft, the shaft being penetrated by a longitudinal oiling duct and by oiling passages extending to the surface of said shaft adjacent the zones of clearance between shaft and sleeve.

10. In a gyratory crusher, a crusher shaft, an eccentric sleeve thereabout and means for rotating it, a housing member surrounding said central sleeve and in bearing relation therewith, said shaft being penetrated by a longitudinal interior oil duct and by an oiling passage extending outwardly from said duct to the surface of said shaft, said eccentric being penetrated by an oiling passage extending to its exterior bearing surface, the surface of said bearing housing being broken by a vertical oiling duct and an oil connection between said vertical duct and the oiling passage extending through the eccentric.

11. In a gyratory crusher, a crusher shaft, an eccentric sleeve thereabout and means for rotating it, a bearing housing surrounding said eccentric sleeve, a closure for the bottom thereof, said closure being adapted to support the weight of said eccentric, an oil line extending to and through said closure and means for moving oil therealong, a centrally apertured anti-friction bearing supported in said closure, a centrally apertured disc rotating thereupon in unison with the eccentric, the bottom of the eccentric being apertured to permit the access of oil to the bottom of the shaft, the shaft being penetrated by a longitudinal oiling duct and oiling passages outwardly extending therefrom to the surface of the shaft.

12. A gyratory crusher, comprising a gyratory shaft and means for rotating it, and a crushing head mounted on said shaft and a supporting bearing member therefor, the shaft being longitudinally penetrated by an oiling duct and by oiling passages extending outwardly from said duct to the bearing surface of said shaft and by another oiling passage extending through the head to the supporting bearing surface of said head.

13. In a gyratory crusher, a crusher shaft, an eccentric sleeve thereabout and means for rotating it, a bearing housing for said eccentric sleeve, a bottom closure therefor adapted to support said eccentric, an anti-friction member mounted on said closure, a plurality of pads of anti-frictional material projecting upwardly from the surface of said member, and means for supplying oil across the surface of said anti-friction member.

14. In a gyratory crusher, a conic head, the lower portion of said head being spherically formed, a support for said head having a bearing surface shaped to conform to the lower spherical bearing portion of said head, a shaft upon which said head is mounted said shaft being penetrated by an interior oil duct, and by an oil passage extending thence to the surface of the shaft within the head, said head being penetrated by an oiling passage extending to the lower spherical bearing surface thereof.

15. In a gyratory crusher, a conic head, the lower portion of said head being spherically formed, a support for said head having a bearing surface shaped to conform to the lower spherical bearing portion of said head, a shaft upon which said head is mounted said shaft being penetrated by an interior oil duct, and by an oil passage extending thence to the surface of the shaft within the head, said head being penetrated by an oiling passage extending to the lower spherical bearing surface thereof, said spherical surface having formed in it a circumferential oil passage in communication with the oil passage through the head.

16. A gyratory crusher comprising a gyra-

tory shaft and means for rotating it, a crushing head positively secured to said shaft and a supporting bearing member therefor, the shaft being longitudinally penetrated by an oiling duct, by an oiling passage extending outwardly from said duct, to the outer surface of the shaft, and by an oiling passage extending through the shaft and head to the supporting bearing surface of the head.

Signed at Chicago, county of Cook and State of Illinois, this 22nd day of May 1925.

EDGAR B. SYMONS.