Nov. 1, 1938. P. B. BROWN 2,135,324

GYRATORY CRUSHING MACHINE

Filed Nov. 11, 1936 3 Sheets-Sheet 1

FIG. 1.

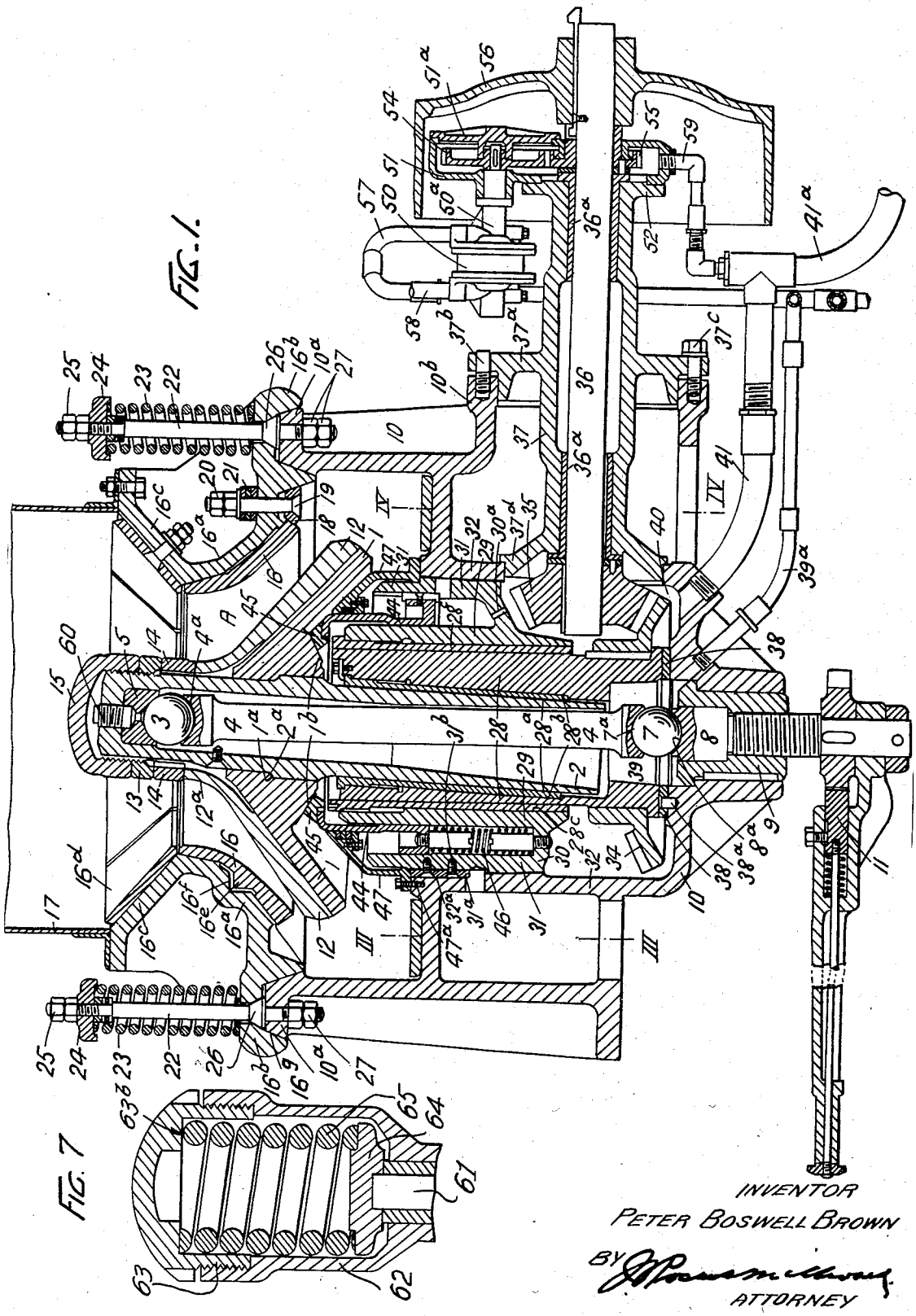


FIG. 7

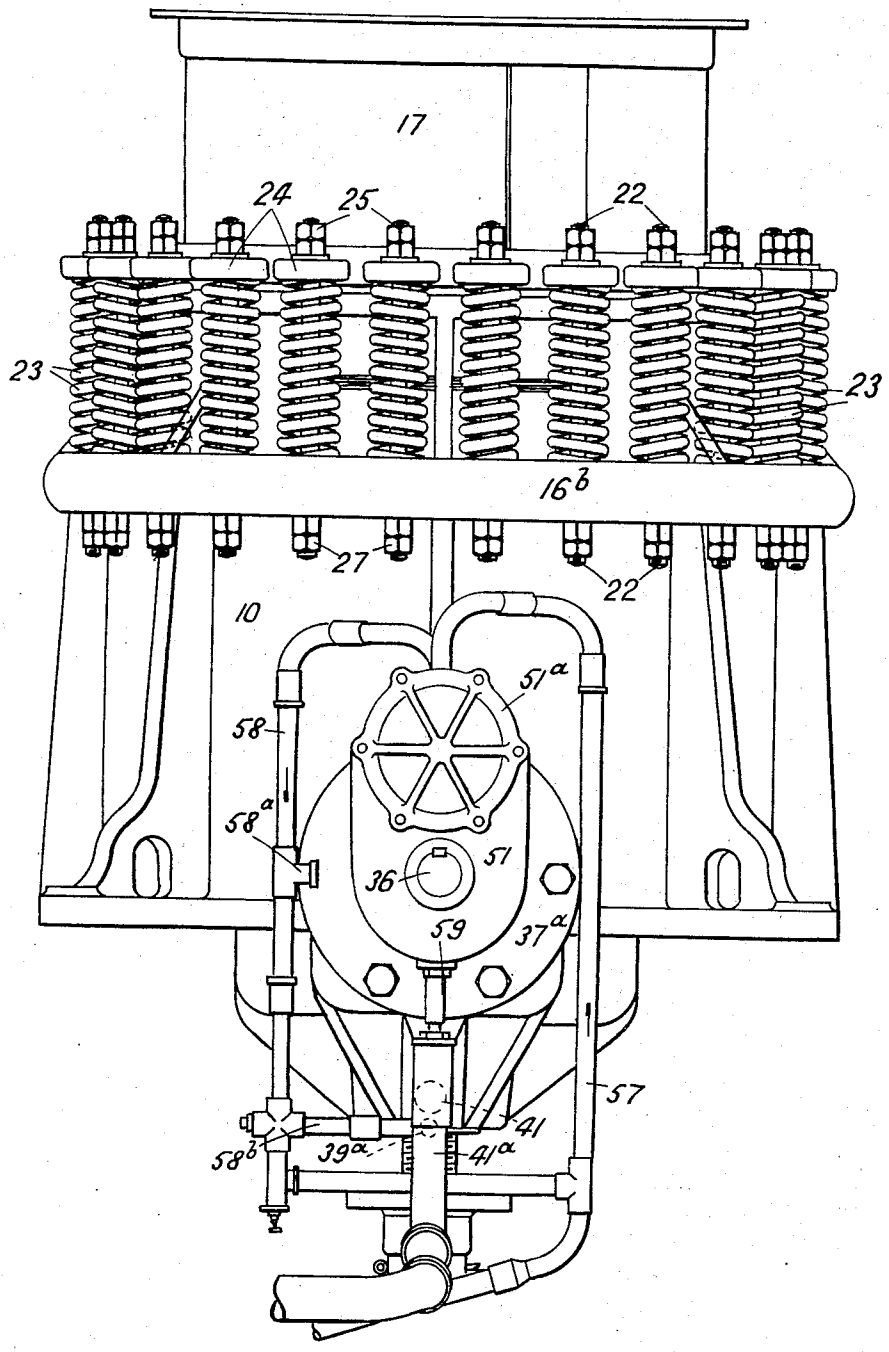
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GYRATORY CRUSHING MACHINE

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FIG. 2.



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FIG. 3.

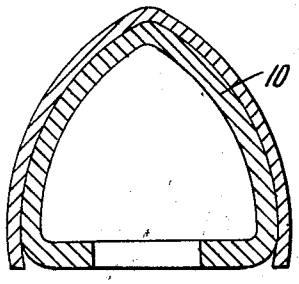


FIG. 4.

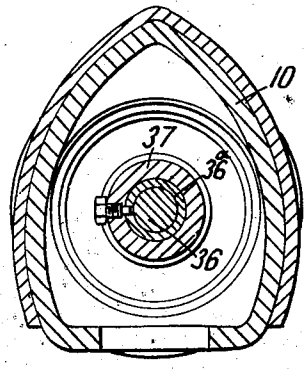


FIG. 5.

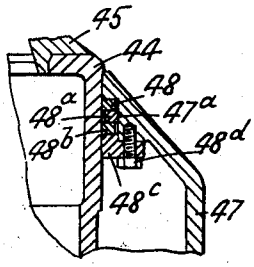
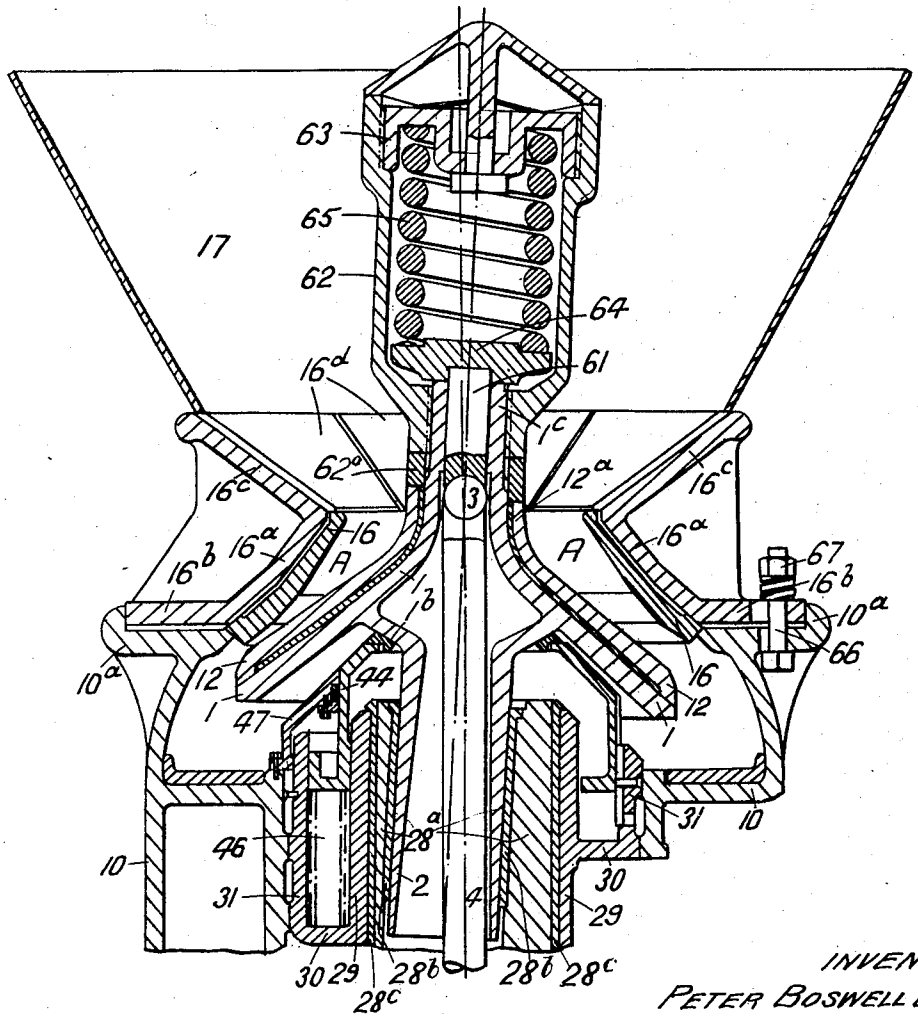


FIG. 6.



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UNITED STATES PATENT OFFICE

2,135,324

GYRATORY CRUSHING MACHINE

Peter Boswell Brown, Sheffield, England

Application November 11, 1936, Serial No. 110,209
In Great Britain January 4, 1936

9 Claims. (Cl. 83—10)

This invention relates to gyratory crushing machines of the type in which a combined conical or conoidal crushing head and downwardly extending hollow shaft are mounted to gyrate by a rotary eccentric device, about a spherical bearing and within a stationary companion concave, conical or conoidal crushing member arranged to overhang the crushing head and form therewith a downwardly and outwardly flaring crushing zone of decreasing cross sectional area in the downward direction and into which material to be crushed is fed, the crushing head and companion crushing member being provided respectively with a removable mantle and a removable liner of hard durable metal, as for instance, manganese steel, and being relatively adjustable to one another, in a vertical direction, by hand operated means to vary the cross sectional area of the crushing zone to suit different requirements, and automatically movable in a lateral or vertical direction, relatively to one another, against the action of spring controlling means, to permit of the release from the crushing zone of material of too hard a nature to be crushed by the available crushing pressure, between the crushing head and overhanging companion crushing member. The latter member is commonly called a concave and, for brevity, it will hereinafter be so called.

The present invention has reference to various improvements in gyratory crushing machines of the type referred to, having for their object to improve the construction, working, adjustment, durability and efficiency of such machines.

In a gyratory crushing machine of the type referred to, constructed according to the present invention, the combined gyratory crushing head and hollow shaft are mounted to gyrate upon and about a spherical bearing carried by the upper end of a vertical or substantially vertical shaft located within the crushing head and hollow shaft and the lower end of which is mounted upon a spherical bearing carried by a normally stationary but vertically adjustable spindle carried by the lower portion of the frame of the machine, the arrangement being such that the inner supporting shaft is free to gyrate with the crushing head and hollow shaft about its lower spherical bearing and thus be relieved of lateral stress, and can, with the crushing head and hollow shaft, be adjusted vertically in relation to the concave, to vary the cross sectional area of the crushing zone between the crushing head and concave, when such variation is desired. The lower portion of the gyratory hollow shaft is made of cylindrical shape externally and fitted within an eccentrically arranged hole that is inclined to the vertical and formed in a cylindrical vertical block arranged to rotate within a cylindrical bearing fixed within a gear box formed in the frame of the machine, the eccentricity and inclination of the hole in the block being such as to suit crushing requirements. The eccentric block is rotated by gearing located within the said gear box and actuated by a horizontal driving shaft extending through a bearing or bearings in a horizontal sleeve extending through and fixed to one side of the frame of the machine. Means are provided for excluding dust from the gear box and the bearing surfaces therein.

A gyratory crushing machine embodying the invention can be constructed in various ways.

In the accompanying illustrative drawings, Fig. 1 shows in vertical section and Fig. 2 in side elevation, with part of the right hand end of Fig. 1 removed, one construction of gyratory crushing machine embodying the present invention. Figs. 3 and 4 are respectively sections on the lines III—III and IV—IV of Fig. 1. Fig. 5 is an enenlarged view of a detail shown in Fig. 1. Fig. 6 is a similar view to part of Fig. 1, showing a modified construction. Fig. 7 is a detail view showing, in central vertical section, a further modification.

Referring to the construction shown in Figs. 1 to 5 inclusive in which the crushing head is made separate from and mounted upon the hollow gyratory shaft which extends through it, the combined crushing head 1 and hollow shaft 2 are mounted upon and supported by a spherical bearing consisting of a ball 3 arranged between a concave seat 4a in the upper end of an inner vertical shaft 4 and a concave seat in a ball socket 5 arranged within the closed end of the hollow shaft 2. The spherical bearing for the lower end of the inner supporting shaft 4 also consists of a ball 7 fitting in a concave seat 7a in the said shaft and a concave seat 8a in a vertical supporting spindle 8 which is screw-threaded and extends through a correspondingly screw-threaded bush 9 fixed in the bottom of the frame 10 of the machine. The lower end of the spindle 8 is adapted to be rotated by hand operated means, as for example ratchet mechanism 11 as shown.

The crushing head 1 is fitted to cylindrical portions of the hollow shaft 2 of different diameters with an intervening annular shoulder 2a against which a corresponding annular shoulder 1a within the crushing head is arranged to bear. The mantle 12 for the crushing head 1 is caused to bear upon the head by a nut 13 screwed upon

the upper end of the hollow shaft 2 and acting through a packing ring or sleeve 14, upon an upper tubular extension 12a of the mantle so that by screwing down the nut 13, the mantle will be securely fixed to the crushing head 1. The head 1 may be fixed to the shaft 2 by shrinking it thereon. The lower face of the packing ring or sleeve 14 and the upper edge or face of the tubular extensions 12a of the mantle 12 are provided with a series of co-acting inclined surfaces so as to form, in known way, a self-tightening device should the mantle turn in relation to the head. A cap 15 may, as shown, be screwed on to the upper portion of the hollow shaft 2 to act as a lock nut for the nut 13 and also to form a protective covering for the top of the hollow shaft and to exclude dust therefrom. 16a is a normally stationary concave casing provided with a liner 16 formed of hard durable metal such as manganese steel, and constituting the concave. The concave casing 16a forms part of a cap or cover having a lower outer annular flange 16b seated upon the hanged upper end 10a of the frame 10 of the machine, and of an upwardly extending outwardly flaring portion 16c forming an inverted conical receptacle, that may be lined with hard durable metal 16d, for directing material to be crushed, into the crushing zone A between the crushing head and concave 16. To the upper end of the portion 16c of the concave casing 16a may be fixed a feed hopper 17 of cylindrical or other shape. The concave 16 can be fixed in position in the concave casing 16a in any known or convenient manner, as by wedge devices 18 forced against its lower end by bolts 19 extending upward through the flange 16b of the concave casing 16a, and nuts 20 screwed upon their upper ends and bearing upon washers 21 of resilient material interposed between them and the said flange. Rotation of the concave 16 within the concave casing 16a is prevented by any known or suitable means, as by forming the one with projections 16e extending into corresponding recesses 16f in the other. The mantle 12 upon the crushing head 1 may be of a plain conical or conoidal shape. The concave 16 within the concave casing 16a, may be of concave or conoidal shape.

To enable the combined concave 16 and concave casing 16a to yield in a lateral direction relatively to the combined crushing head 1 and mantle 12 when necessary to release uncrushable material from the crushing zone A, the outer flange 16b of the concave casing 16a is, according to the arrangement shown in Fig. 1, formed on its underside with an annular groove 16g of truncated conical shape in cross section and held down upon a corresponding conical annular seat on the flanged upper end 10a of the frame 10 of the machine by spring pressure, so that it can tilt upward about any part of the flanged top of the machine in known manner. According to the present invention, the flange 16b is held down on the flanged top 10a of the machine by an annular series of vertical bolts 22 and upwardly extending coiled compression springs 23 (Figs. 1 and 2), the bolts 22 extending upward through the flanges 10a and 16b on the frame 10 and concave casing 16a respectively, and the springs 23 bearing upon the flange 16b and surrounding the corresponding bolts 22, the upper end of each bolt being provided with a cap piece 24 held against the top of the corresponding spring 23 by nuts 25. Each bolt 22 is formed intermediate of its length with a conical collar 26 seated in a correspondingly shaped recess in the underside of the flange 16b of the concave casing 16a and held against the flange 10a on the frame 10 by nuts 27 screwed on the lower portion of the bolt 22 that extends through the said flange 10a. The arrangement is such that the combined concave casing 16a and concave 16 is normally held down in position for use, by the springs 23 but in the event of uncrushable material being present in any part of the crushing zone A, it can tilt upward upon an opposite portion of the flanged upper end 10a of the frame, against the action of the springs 23, to release the uncrushable material from the said zone, after which it will be returned to its proper position by the springs.

The lower cylindrical portion of the hollow gyratory shaft 2 extends downward into an inclined eccentrically arranged hole 28a in a cylindrical eccentric block 28, as hereinbefore mentioned, the interior of the said shaft 2 being of conical shape to afford ample clearance for the inner vertical supporting shaft 4. The bearing 29 for the eccentric block 28 is connected by an annular external web 30 to an outer cylindrical wall 31 fixed within the upper portion of the gear box 32. For this purpose, the wall 31 may be made externally of slightly tapering shape in a downward direction and the inner surface of the gear box 32 be made of corresponding slightly tapered shape to suit, rotation of the wall 31 and attached parts 30 and 29 of the bearing being prevented by a vertical key 31a fixed to the wall 31 by screws 31b and arranged within a vertical keyway 32a in the wall of the gear box 32. The hole in the eccentric block 28, and the bearing 29 for the said block, may be provided with linings 28b and 28c respectively, of anti-friction metal. The gear box 32 is cast integral with the frame 10 of the machine, and openings are provided in the bottom of the frame through which the crushed material can fall.

The lower end of the eccentric block 28 has fixed to it a horizontal tootned bevel wheel 34 that is in gear with a vertical bevel wheel 35 fixed to a horizontal driving shaft 36 mounted in bearings 36a within a horizontal sleeve 37 that extends through a lateral tubular portion 10b of the frame 10 of the machine. The sleeve 37 is provided with an external annular flange 37a that is located in position by means of a dowel pin 37b and is secured by screws 37c to the outer end of the said tubular portion 10b of the frame in such manner that the inner end 37d of the sleeve is held firmly against a seat surrounding an opening in one side of the frame 10 through which the driving shaft 36 extends. The lower end of the eccentric block 28 is arranged to bear against an annular bearing 38 carried by the bottom of the gear box 32 and formed, it may be of anti-friction metal. 38a is a dowel pin to hold the bearing 38 in position. The lower end of the eccentric block 28 is formed at the bottom of the inclined eccentrically arranged hole therein, with an aperture or chamber 39 to accommodate the lower end of the supporting shaft 4 and the ball bearing 7 between that shaft and the lower vertically adjustable spindle 8. The said chamber 39 also forms a lubricant chamber into which lubricant can be forced through a supply pipe 39a from an oil circulating pump and thence flow into the lower end of the eccentrically arranged hole in the eccentric block 28. From the said hole the lubricant will flow upward between the hollow gyratory shaft 2 and eccentric block 28, thence

over the top of the said eccentric block and downward between the said block and its bearing 29, and also over the bearing and descend through one or more openings 30a in the connecting web 30 between such bearing 29 and its outer wall 31, into a chamber 40 that is outside and below the bearing, and contains the toothed gearing 34, 35. From the chamber 40 it passes into connected return pipes 41, 41a, and after passing through a filter, is returned to the suction inlet of the oil circulating pump for re-use.

For excluding dust from the gear box 32 and bearing surfaces therein, there is interposed between the gear box and crushing head 1 and in dust-tight connection with each of these parts, a dust guard adapted to permit of the gyratory motion of the crushing head. For this purpose, according to the arrangement shown in Figs. 1 and 5, the dust guard comprises a metal tube or sleeve 44 arranged to fit and slide vertically against the upper portion of the inner wall of the cylindrical bearing 29, the upper end of the said sleeve being provided with a packing ring 45 that is pressed into close contact with a spherical surface 1b on the lower side of the crushing head 1 by coiled springs 46. For this purpose, the springs 46 are arranged between the inner and outer walls 29 and 31 of the eccentric block bearing and act against the lower end of the sleeve 44 which, for this purpose, is made of channel section, as shown, and arranged to slide between and against the two walls. Also, there is arranged around the outer wall 31 of the eccentric block bearing and the sleeve 44, a metal tube or sleeve 47 the lower end of which is flanged and secured in a dust-tight manner, as by screws 47a, to the top of the gear box 32. The upper portion of the said sleeve 47 is of conical shape and surrounds the upper portion of the sleeve 44 and means are provided for effecting a dust tight closure between the two sleeves. Such dust tight closing means comprises floating split packing rings, three of which are shown at 48, 48a and 48b in Figs. 1 and 5, and of which the upper and lower ones 48 and 48b are sprung on to the sleeve 44 and the intermediate one is sprung into the sleeve 47. The three rings are confined within an annular recess 47a in the sleeve 47, by a ring 48c fixed to the said sleeve by screws 48d. The spherical surface 1b on the crushing head 1 has its centre of curvature coincident with the centre of the ball bearing 3 for the hollow shaft and crushing head. By the arrangement described, an effective dust seal is obtained without in any way interfering with the gyratory motion of the crushing head 1 and gyratory shaft 2, or with the raising and lowering of the crushing head and hollow shaft when this is desired.

For supplying lubricant to the eccentric block 28 and adjacent parts, there may advantageously be employed a rotary oil circulating pump 50 the casing of which is provided at one side with a tubular extension 50a that is secured to one side of a casing 51 fixed to an annular flange 52 on the aforesaid sleeve 37 for the driving shaft 36 of the machine. The said casing 51 surrounds the said shaft and is provided at its opposite side with a removable cover plate 51a. The pump shaft, which is horizontal, extends through the tubular extension 50a of the pump casing, which forms a bearing for it, and into the said casing 51 and has fixed to it a toothed wheel 54 that is in gear with a toothed wheel or pinion 55 fixed to the said driving shaft 36. The casing 51 with gearing may, as shown in Fig. 1, advantageously be located within a driving pulley 56 fixed to the said driving shaft 36 and open at one side, the pump 50 being arranged outside the pulley. Lubricant is supplied through a pipe 57 (Fig. 2) to the pump 50 and is delivered therefrom to an outlet pipe 58 and thence through a branch pipe 58a to the sleeve 37 and bearings 36a for the shaft 36, and also through another branch pipe 58b to the pipe 39a connected to the chamber 39 in the lower end of the eccentric block 28. The used lubricant is, as heretofore stated, led back from the chamber 40 and the pipes 41 and 41a to an oil filtering apparatus from which it is again supplied through the aforesaid inlet pipe 57 to the pump 50 for re-use. Lubricant that passes along the driving shaft 36 and through the bearings 36a therefor, escapes in part into the aforesaid chamber 40 and in part into the casing 51 and thence through a pipe 59 into the return pipe 41a. Lubricant can be supplied to the aforesaid upper ball bearing 3 for the combined crushing head 1 and gyratory hollow shaft 2 by a grease tube 60 or like lubricating device, for instance an ordinary Stauffer lubricator, screwed into a hole in the closed upper end of the hollow gyratory shaft 2. By removing the aforesaid dust cap 15 from the said shaft 2 and replacing the lubricating device 60 by a screw threaded eye bolt, the combined crusher head 1 and shaft 2 can be placed in position and be removed from the machine, when the concave casing 16a and attached parts are removed from the machine.

Instead of mounting the concave to yield in a lateral direction as hereinbefore described, for releasing uncrushable material from the crushing zone, the crushing head 1 with hollow gyratory shaft 2, may be mounted to yield in a vertical direction for a like purpose. In one arrangement for this purpose, shown in Fig. 6, the crushing head 1 is provided with an upper tubular extension 1c that is arranged to slide vertically along a spindle 61 bearing upon the upper ball bearing 3 carried by the inner supporting shaft 4. To it is screwed an upwardly extending box 62 provided at its upper end with a screw-threaded cap 63 between which and a lower plate 64 bearing on the top of the spindle 59 is interposed a strong coiled spring 65, or, it may be, a nest of springs. The arrangement is such that normally the combined crushing head 1 and hollow gyratory shaft 2 are supported upon the upper ball bearing 3 in normal working position, by the spindle 61, lower bearing plate 64 thereon, the spring 65, the spring box 62 and its cap 63, but the crushing head and its shaft can, when necessary, slide downwards along the spindle 61 against the action of the said spring 65, to release uncrushable material from the crushing zone A, after which the spring will return the crushing head with its shaft to its normal working position. In this arrangement, the mantle 12 is fixed to the crushing head by screwing the spring box 62 downward on the upper extension 1c of the crushing head 1. A sleeve 62a may, as shown, be arranged between the mantle 12 and spring box 62. The lower face of the sleeve 62a and the upper face or end of the tubular extension 12a of the mantle 12 is as in the arrangement shown in Fig. 1 provided with a series of co-acting inclined surfaces to form a self-tightening device should the mantle turn relatively to the head.

In this modified construction of the crushing machine, the lower outer flange 16b of the concave casing 16a is held in position above the flanged upper end 10a of the frame 10 of the ma-

chine by bolts **66** passing through the adjacent flanges **10a** and **16b** and nuts **67**. Also, the hollow gyratory shaft **2** is made integrally with the crushing head and does not extend upwardly therethrough. Instead of making the cover **63** of channel shape at its underside, as shown in Fig. 6, to accommodate the upper end of the spring **65**, it may be made of the shape shown in Fig. 7 in which it is provided at its underside with an annular shoulder **63b** against which the upper end of the spring **65** bears.

In other respects, the other portions of the modified construction of the crushing machine are or may be similar to those of the construction of crushing machine herein described with reference to Figs. 1 to 5 inclusive.

What I claim is:—

1. In a gyratory crushing machine, a gyratory crushing head, a hollow gyratory shaft connected to and depending from said crushing head, a concave arranged to form a downwardly and outwardly flaring crushing zone with said crushing head, a supporting shaft located within said crushing head and hollow shaft, a spherical bearing at or near to the centre of gyration carried by the upper end of said supporting shaft and upon which said crushing head and hollow shaft are mounted to gyrate, a lower spherical bearing carried by the lower portion of the frame of the machine and upon which the lower end of said supporting shaft is mounted, and means for gyrating said crushing head and hollow shaft.

2. In a gyratory crushing machine, a gyratory crushing head, a hollow gyratory shaft connected to and depending from said crushing head, a concave arranged to form a downwardly and outwardly flaring crushing zone with said crushing head, a supporting shaft located within said crushing head and hollow shaft, a sperical bearing at or near to the centre of gyration carried by the upper end of said supporting shaft and upon which said crushing head and hollow shaft are mounted to gyrate, a lower spherical bearing carried by the lower portion of the frame of the machine and upon which the lower end of said supporting shaft is mounted, a vertically adjustable support for said lower spherical bearing, and means for gyrating said crushing head and hollow shaft.

3. A gyratory crushing machine comprising a gyratory crushing head, a hollow gyratory shaft connected to and depending from said crushing head, a concave overhanging said crushing head and forming therewith a downwardly and outwardly flaring crushing zone, a supporting shaft within said crushing head and hollow shaft, a spherical bearing at or near to the centre of gyration at the upper end of said supporting shaft upon and about which said crushing head and hollow shaft can gyrate, a second sperical bearing upon which the lower end of said supporting shaft is mounted so that said supporting shaft is free to gyrate with said crushing head and hollow shaft, a rotary eccentric device for gyrating said crushing head and hollow shaft about said upper spherical bearing and a stationary cylindrical bearing for said eccentric device.

4. A gyratory crushing machine comprising a gyratory crushing head, a hollow gyratory shaft connected to and depending from said crushing head, a concave overhanging said crushing head and forming therewith a downwardly and outwardly flaring crushing zone, a supporting shaft within said crushing head and hollow shaft, a spherical bearing at or near to the centre of gyration at the upper end of said supporting shaft upon and about which said crushing head and hollow shaft can gyrate, a second spherical bearing upon which the lower end of said supporting shaft is mounted, the lower portion of said rotary eccentric device being mounted to rotate in a fluid tight manner upon the lower portion of said machine to form a chamber housing said lower spherical bearing and provided with an inlet for lubricant and from which lubricant can flow upward between said hollow shaft and rotary eccentric device and over the top of said bearing.

5. In a gyratory crushing machine, a gyratory crushing head having an upwardly extending tubular extension, a hollow shaft connected to and depending from said crushing head, a non-rotatable concave overhanging said crushing head and arranged to form therewith a downwardly extending outwardly flaring crushing zone, a concave casing seated upon a stationary part of the machine and to which said concave is fixed, a supporting shaft located within said crushing head and hollow shaft, an upper spherical bearing at or near to the centre of gyration carried by the upper end of said supporting shaft and about the centre of which said crushing head and hollow shaft can gyrate, a lower spherical bearing for said supporting shaft, means for gyrating said crushing head and hollow shaft, a vertical spindle carried by said upper bearing and along which the tubular extension of said crushing head can slide, an abutment device carried by the upper end of said spindle, one or more compression springs carried by said abutment device and a spring box secured to the tubular extension of the crushing head and supported at its upper end by said spring or springs.

6. A gyratory crushing machine according to claim 5, wherein a mantle of hard durable metal is seated on the crushing head and the spring box is screwed to the tubular extension of said head and a ring arranged between said mantle and spring box and which is forced downward against said mantle by screwing said spring box downward on the tubular extension of said crushing head.

7. In a gyratory crushing machine, a gyratory crushing head, a hollow shaft connected to and depending from said crushing head, a concave arranged to form with said crushing head a downwardly and outwardly flaring crushing zone, a supporting shaft located within said crushing head and hollow shaft, a vertically adjustable spindle carried by the lower portion of the frame of the machine, a ball bearing at or near to the centre of gyration carried by the upper end of said shaft and upon which said crushing head and hollow shaft are mounted to gyrate, a ball bearing located between the lower end of said supporting shaft and said spindle, an eccentric into which said hollow shaft extends and which is adapted to impart a gyratory motion to said shaft and crushing head and a stationary bearing for said eccentric.

8. In a gyratory crushing machine, a gyratory crushing head, a hollow shaft connected to and depending from said crushing head, a concave arranged to form with said crushing head a downwardly and outwardly flaring crushing zone, a supporting shaft located within said crushing head and hollow shaft, a vertically adjustable spindle carried by the lower portion of the frame of the machine, a ball bearing at or near to the centre of gyration carried by the upper end of

said shaft and upon which said crushing head and hollow shaft are mounted to gyrate, a ball bearing located between the lower end of said supporting shaft and said spindle, an eccentric into which said hollow shaft extends and which is adapted to impart a gyratory motion to said hollow shaft and crushing head, a stationary bearing for said eccentric, means for admitting lubricant to the working surfaces of the lower ball bearing and eccentric and means for excluding dust from said working surfaces.

9. In a gyratory crushing machine, a gyratory crushing head, a hollow shaft connected to and depending from said crushing head, a concave arranged to form with said crushing head a downwardly and outwardly flaring crushing zone, a supporting shaft located within said crushing head and hollow shaft, a vertically adjustable spindle carried by the lower portion of the frame of the machine, a ball bearing at or near to the centre of gyration carried by the upper end of said shaft and upon which said crushing head and hollow shaft are mounted to gyrate, a ball bearing located between the lower end of said supporting shaft and said spindle, an eccentric into which said hollow shaft extends and which is adapted to impart a gyratory motion to said shaft and crushing head, and a stationary bearing for said eccentric, said eccentric being arranged to bear in a light tight manner upon the bottom of the said frame and to form therewith and said spindle, a chamber in which the lower ball bearing is located, which is in communication with the working surfaces of the hollow shaft and eccentric and which has an inlet for lubricant.

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