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CRUSHER

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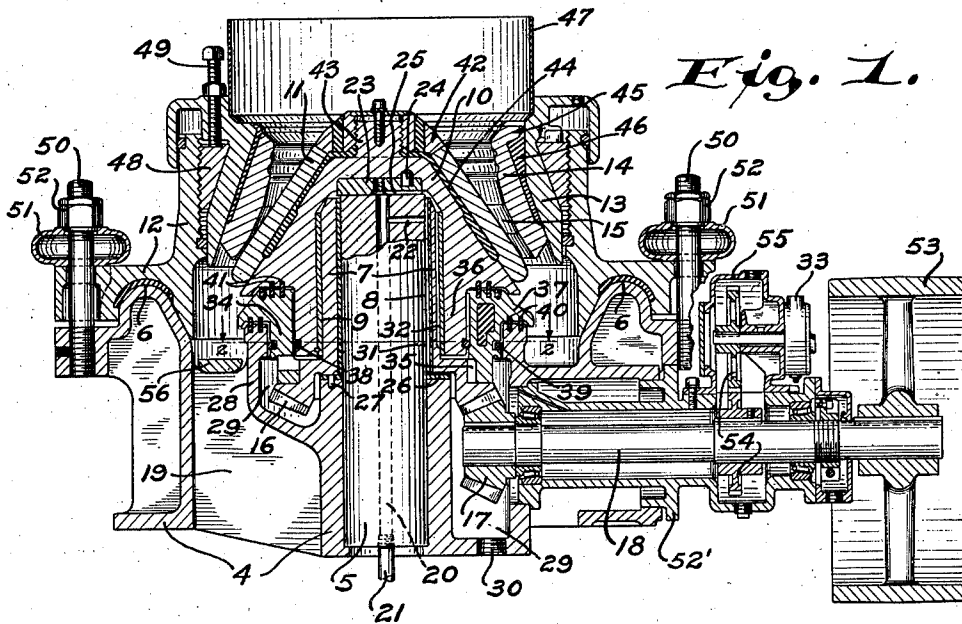
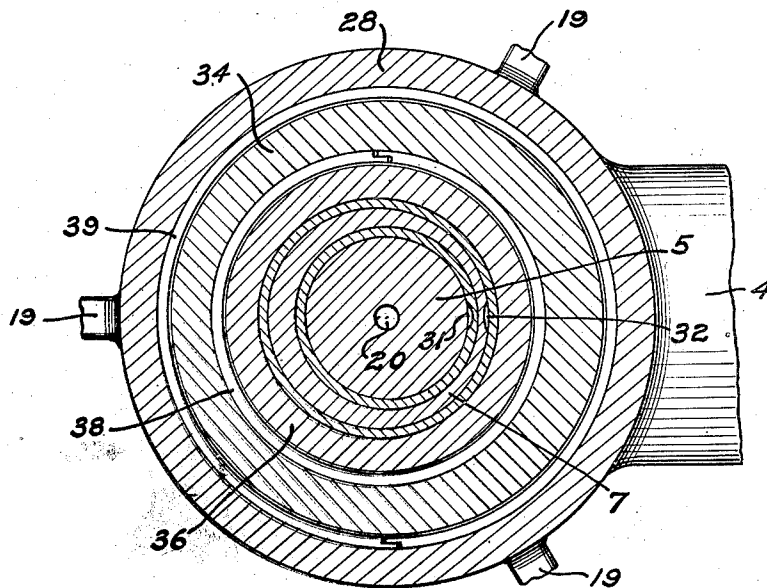


Fig. 2.

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## UNITED STATES PATENT OFFICE

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## CRUSHER

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The present invention relates generally to improvements in the construction and operation of gyratory crushers for rock, ore and the like; and contemplates provision of an improved gyratory crusher assemblage which is simple and compact in construction, and which is moreover highly efficient in operation.

Many different types of gyratory crushers wherein a crushing head and a concave are relatively gyratable by means of an eccentric in order to crush the intervening material, have heretofore been proposed and used for the reduction of hard substances such as coal, rock, and ore. Some of these prior gyratory crushing machines have been provided with the desirable feature whereby the inlet opening leading to the crushing zone is maintained free from obstruction such as shaft supporting spider arms, and others embodied the parallel stroke or throw feature whereby the inner and outer surfaces of the gyratory eccentric could be bored and turned about parallel axes thus simplifying the construction. Still others of the prior crushers of this general type incorporated the idea of low vertical height resulting from disposition of the actuating eccentric within the head, and others introduced the feature of protecting the crusher elements against breakage by permitting the same to separate against resilient restraining means in case uncrushable material entered or accumulated within the crushing chamber. But none of the prior gyratory crushers included all of these desirable features in a simple, compact and durable structure having large capacity considering the space occupied.

My present invention therefore more specifically contemplates provision of a very compact and efficient gyratory crusher assemblage embodying all of the above described desirable features, which may be readily manufactured, assembled and dismantled, and effectively lubricated.

Another specific object of my invention is to provide an improved parallel throw gyratory crusher having an eccentric mounted and effectively journaled within the head, and provided with means for insuring efficient lubrication of the bearing surfaces and for protecting the same against ingress of grit and dirt.

Still another specific object of my present invention is the provision of an extremely simple and effective cone crusher assemblage especially adapted for intermediate crushing service, and having maximum capacity per unit cost of operation.

These and other specific objects and advantages of my invention will be apparent from the following detailed description.

A clear conception of embodiments of the several features constituting my present invention, and of the mode of constructing and of operating gyratory crushers built in accordance with the improvement, may be had by referring to the drawing accompanying and forming a part of this specification wherein like reference numerals designate the same or similar parts in the several views:

Fig. 1 is a central vertical section through a typical gyratory crusher embodying the invention; and

Fig. 2 is an enlarged horizontal transverse section taken through the central portion of the crusher along the line 2—2 of Fig. 1.

While my invention has been shown and described herein as being specifically embodied in a particular type of gyratory crusher having a rather steeply tapered cone head and provided with special means for permitting recession of the concave under abnormal crushing conditions, it is not the intent to thereby unnecessarily restrict the scope.

Referring to the drawing, the improved gyratory crusher illustrated therein comprises in general a main frame 4 having a central upwardly extending cylindrical column shaft 5 rigidly attached thereto and being provided with an integral upper annular seating surface 6 surrounding and spaced from the shaft 5; an eccentric 7 having a cylindrical bore 8 rotatably engaging the shaft 5 and also having a cylindrical outer eccentric surface 9; a substantially conical crushing head 10 having an internal cylindrical bore coacting with the outer eccentric surface 9 and being provided with a frusto-conical mantle 11; a concave support 12 resting upon the annular frame surface 6 and adjustably sustaining an annular internally tapered concave 13, the inner surface of which has a liner 14 cooperating with the head mantle 11 to provide a downwardly and outwardly flaring crushing zone or chamber 15; and a bevel gear 16 secured to the eccentric 7 and meshing with a pinion 17 carried by a horizontal drive shaft 18 journaled in the main frame 4 for rotating the eccentric 7 so as to normally gyrate the head 10 relative to the normally fixed concave 13.

The central and outer surrounding portions of the main frame 4 may be rigidly interconnected by means of integral ribs 19 so as to leave space for discharge of the crushed material by gravity

from the lower portion of the annular crushing chamber 15, and the upright central shaft 5 may be rigidly attached to the frame 4 in any suitable manner as by shrinking the frame onto this shaft. The shaft 5 is provided with a central through passage 20 the lower end of which communicates with an oil inlet pipe 21; and the upper end of which communicates with a lateral duct 22 leading to the bore 8 of the eccentric 7, and with the lower face of a supporting plate 23 for the crusher head 10. The plate 23 may be snugly fitted within a recess in the head 10 and secured therein by means of a dowel pin 24, and has one or more radial oil grooves 25 extending from the upper extremity of the shaft passage 20 to the annular space above the eccentric 7. The eccentric 7 and driving gear 16 may be formed integral, and the lower end of the eccentric rests upon a thrust bearing plate 26 secured to the central portion of the main frame 4 by a dowel pin 27, and embracing the medial portion of the shaft 5. The main frame 4 also has an integral annular wall 28 which forms a chamber 29 within which the gear 16 and thrust bearing plate 26 are housed, and this chamber communicates with the lower end of the eccentric bearing surface 9 and has an oil outlet 30. The eccentric bore 8 is provided with an internal oil groove 31 leading from the space at the top of the eccentric 7 to the bearing plate 26, this groove being communicable with the duct 22 as the eccentric is rotated; and the outer eccentric surface 9 is likewise provided with an external oil groove 32 leading from the top of the eccentric into the chamber 29 above the gear 16. The oil outlet 30 and the inlet pipe 21 communicate with an oil circulating pump 33 to complete the lubricant circulating system, and the operation of this pump will be subsequently described.

In order to prevent dirt and grit from entering the bearings through the chamber 29, the joint between the frame wall 28 and the lower face of the head 10 must be effectively sealed at all times. This sealing is accomplished by providing an annular member 34 which is secured to and is rotatable with the eccentric 7 and gear 16 by virtue of a driving key 35, and which embraces the lower annular end 36 of the head 10 and is located within the annular upper portion of the frame wall 28. The member 34 also has an outwardly projecting upper flange 37 which is disposed between the lower horizontal face of the head and the upper horizontal end surface of the wall 28, and the bore and external cylindrical surface of the member 34 are formed concentric respectively with the outer cylindrical surface 9 and bore 8 of the eccentric 7. A circular resilient metal inner sealing ring 38 which is slightly compressible and rotatably confined within an annular groove in the head end 36, snugly engages the cylindrical bore in and rotates with the sealing member 34. Another circular resilient metal outer sealing ring 39 which is likewise slightly compressible and slidably confined within an annular groove in the depending portion of the member 34, snugly engages the cylindrical bore of and is normally held stationary by the frame wall 28. The top of the frame wall 28 and the lower portion of the sealing member flange 37 are provided with concentric vertically aligned recesses within which flexible leather or similar sealing bands 40 are disposed; and the top of the member 34 and the lower face of the head 10 are likewise provided with concentric vertically aligned recesses within which

other flexible leather sealing bands 41 are confined. The bands 40, 41 may be formed of any material such as leather; and the bands 40 are concentric with the eccentric bore 8, while the bands 41 are concentric with the outer eccentric surface 9, thereby permitting free gyration of the head 10 relative to the frame 4 and rotation of the head relative to the eccentric 7 and member 34.

The frustro-conical head mantle 11 may be secured to the tapered head 10 in any suitable manner as by means of a clamping nut 42 coacting with a threaded upper projection 43 formed integral with the head, and molten metal 44 poured into passages in the nut and spaces between the head and mantle. The concave liner 14 which cooperates with the mantle 11 to form the crushing chamber 15, may likewise be secured to the interior of the annular concave 13 by means of a gun-lock 45, and molten metal 46 poured into spaces adjacent the gun-lock and between the concave and liner. The concave 13 supports an annular hopper wall 47, and is adjustably mounted upon its support 12 by means of wedges 48 having external threads coacting with internal screw threads formed in the upper annular end of the concave support 12, the wedges 48 normally being locked in fixed position by jack screws 49. As previously indicated, the outwardly projecting lower portion of the concave support 12 rests upon the upper annular surface 6 of the frame 4, and the concave 13 and its support 12 are normally held in fixed position by a series of studs 50 secured to the frame 4 and coacting with the support 12 through resilient breaking washers 51 and nuts 52 adjustably engaging the studs 50. The assemblage is obviously such that the studs 50 will positively prevent the concave 13 and support 12 from rotating during normal crushing; and in the event that uncrushable material such as a shovel tooth enters the crushing chamber 15 the washers 51 are adapted to break and thereby permit the obstructive material to pass through the discharge opening without damaging other elements of the machine.

The horizontal drive shaft 18 may be journaled in a bearing member 52' which is firmly but detachably secured to the main frame 4, and the pinion 17 which meshes with the eccentric driving gear 16 is also housed within the chamber 29 and is secured to the inner end of the shaft 18. The outer end of the shaft 18 may be provided with a driving pulley 53 or with any other suitable drive means, and the medial portion of this shaft cooperates with gearing 54 for driving the oil circulating pump 33. The pump 33 may be of any desired type and is supported upon the bearing member 52 by means of a gear casing 55 which is located midway between the two adjacent studs 50 so as to avoid interfering with the tilting or raising motion of the concave support 12 relative to the frame 4. The interior of the frame 4 adjacent the ribs 19 and above the driving mechanism may also be provided with the usual protecting plates 56 for preventing excessive wear by the crused material discharged from the crushing chamber 15.

During normal operation of the improved gyratory crusher, the drive shaft 18 is being rotated by application of power to the pulley 53, thereby imparting relatively rapid rotation to the eccentric 7 through the pinion 17 and gear 16. This rotation of the eccentric produces gyration of the head 10 and mantle 11 relative to the concave 13 and liner 14, while at the same time permitting rotation of

of the head about the outer concave surface 9. Material admitted to the crushing chamber 15 through the hopper wall 47, is then subjected to successive crushing impulses and passes downwardly through the chamber 15, being eventually sufficiently reduced and discharged from the lower end of this chamber. While the crusher is operating, the pump 33 is also being driven through the gearing 54 to withdraw oil from the chamber 29 through the outlet 30, and to force oil under pressure through the inlet pipe 21 and central passage 20 in the shaft 5, to the bearing surfaces. The oil under pressure is delivered from the upper end of the passage 20 to the recesses 25 of the head supporting plate 23, and is discharged from these recesses 25 and through the duct 22 into the vertical oil grooves 31, 32 of the eccentric. The oil then flows through these vertical grooves 31, 32 and thereby effectively lubricates the bore 8 and the outer cylindrical surface 9 of the eccentric, whereupon the oil discharged from the lower end of the groove 31 also effectively lubricates the thrust plate 26 and eventually returns to the chamber 29. The oil flowing downwardly through the oil groove 32 flows outwardly over the gear 16 and thus effectively lubricates this gear and the pinion 17, and after having thus lubricated all of the bearings, the oil is eventually returned to the pump through the outlet 30.

While abundant lubrication of all of the bearings is essential, it is also important that dust and grit be prevented from entering the lubrication zones. The sealing bands 40, 41 will obviously prevent ingress of dust and dirt to the chamber 29, since these bands are of considerable width and extend well into the adjacent annular grooves of the head 10, member 34, and frame wall 28. The resilient metal sealing rings 38, 39 carried by the head 10 and member 34 respectively, further aid in preventing ingress of dust and grit to the lubrication zone. The bands 40, 41 and the rings 38, 39, however, permit free upward removal of the head 10 from the eccentric 7, and also perform their function without interfering with the gyration or the rotation of the head 10. Removal of the head 10 may obviously be effected upon removal of the concave 13 and its support 12, and when the head has been removed, the member 34 and the eccentric 7 are also freely vertically removable.

The wedges 48 provide means for effectively and conveniently adjusting the concave 13 relative to the head 10 so as to vary the size of the discharge opening, and if uncrushable material such as a piece of tramp iron should enter the chamber 15, one or more of the safety washers 51 will break to thus permit passage of the obstruction without breaking more intricate and expensive parts of the machine.

From the foregoing description it will be apparent that the improved gyratory crusher has an unobstructed inlet, is of relatively low and compact construction, and is effectively protected against damage by the admission of uncrushable material to the crushing chamber 15. The provision of the central vertical shaft 5 and of the parallel throw eccentric 7 coacting with this first shaft 5 and with the interior of the head 10, obviously facilitates production of a crusher having extremely low height, but also possessing great strength. The cylindrical formation of the bearing surfaces of the eccentric permits construction of the head and of the eccentric as well as of the member 34, at minimum cost because all of the cooperating bores and surfaces of these elements

are either plane surfaces or cylindrical surfaces generated about the same on parallel axes. The internal surface of the frame wall 28 is concentric with the bore in the frame within which the shaft 5 is fitted, and the internal bore and the external surfaces of the bores 36 of the head 10 are also concentric cylindrical surfaces. While the bore 8 and external surface 9 of the eccentric 7, and the internal and external surfaces of the member 34 are not concentric, they may be bored on parallel axes, thus enabling most convenient machining of these bearing surfaces. The sealing member 34 obviously effectively prevents entry of foreign substances to the lubricating zone, and all of the bearings of the structure are abundantly and effectively lubricated during normal operation of the machine. The improved structure has proven highly satisfactory in actual crushing use, and has enormous capacity considering the space occupied and the power consumed in driving the crusher.

It should be understood that it is not desired to limit this invention to the exact details of construction or to the precise mode of operation herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

#### I claim:

1. In a crusher, a frame having a fixed column surrounded near its base by a thrust bearing, a concave carried by said frame and having an internal tapered crushing surface surrounding and spaced from the upper portion of said column, an eccentric journaled on said column within said concave surface and having its weight supported solely by said bearing, and a head having an external tapered crushing surface cooperating with said concave surface to form a downwardly and outwardly flaring crushing chamber, said head being gyratable by and freely rotatable about said eccentric and also being spaced from the upper end of said eccentric and having its weight supported solely by the top of said fixed column.

2. In a crusher, a frame having a fixed column surrounded near its base by a lower thrust bearing and provided at its top with an approximately plane thrust surface perpendicular to the column axis, a concave carried by said frame and having an internal tapered crushing surface surrounding and spaced from the upper portion of said column, an eccentric journaled on said column within said concave surface and adjacent to said top thrust surface, said eccentric having its weight supported solely by said lower thrust bearing, and a head having an external tapered crushing surface cooperating with said concave surface to form a downwardly and outwardly flaring crushing chamber, said head being gyratable by and freely rotatable about said eccentric and also being spaced from the upper end of said eccentric and having its weight supported solely by said top column surface.

3. In a crusher, a frame, a column secured to said frame and having an external cylindrical surface surrounded near its lower portion by a plane thrust bearing and being provided at its top with a plane thrust surface perpendicular to the column axis and parallel to said lower thrust bearing, a concave carried by said frame and having an internal tapered crushing surface surrounding and spaced from the upper portion of said cylindrical column surface, an eccentric journaled on said cylindrical column surface adjacent to said plane top thrust surface, said eccentric having its weight supported solely by said

lower thrust bearing and being provided with a cylindrical outer surface, and a head having an external tapered crushing surface cooperating with said concave surface to form a downwardly and outwardly flaring crushing chamber, said head being gyratable by said eccentric and freely rotatable about said cylindrical outer eccentric surface and also being spaced from the upper end of said eccentric and having its weight supported solely by said top column surface.

4. In a crusher, a frame, a column secured to said frame and having an external cylindrical surface surrounded near its lower portion by a plane thrust bearing and being provided at its top with a plane thrust surface perpendicular to the column axis and parallel to said lower thrust bearing, a concave carried by said frame and having an internal tapered crushing surface surrounding and spaced from the upper portion of said cylindrical column surface, an eccentric journaled on said cylindrical column surface adjacent to said plane top thrust surface, said eccentric having its weight supported solely by said lower thrust bearing and being provided with a cylindrical outer surface, a head having an external tapered crushing surface cooperating with said concave surface to form a downwardly and outwardly

flaring crushing chamber, said head being gyratable by said eccentric and freely rotatable about said cylindrical outer eccentric surface and also being spaced from the upper end of said eccentric and having its weight supported solely by said top column surface, and means for circulating lubricant through said column and outwardly across said top column surface and in parallel along the inner and outer cylindrical surfaces of said eccentric.

5. In a crusher, a frame having a fixed column surrounded beneath its top by a thrust bearing, a concave carried by said frame and having an internal tapered crushing surface surrounding and spaced from the upper portion of said column, an eccentric journaled on said column within said concave surface and having its weight supported solely by said bearing, and a head having an external tapered crushing surface cooperating with said concave surface to form a downwardly and outwardly flaring crushing chamber, said head being gyratable by and freely rotatable about said eccentric and also being spaced from the upper end of said eccentric and having its weight supported solely by said top of said fixed column.

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