J. B. RHODES.

GYRATORY CRUSHER.

APPLICATION FILED FEB. 18, 1907.

945,806.

Patented Jan. 11, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

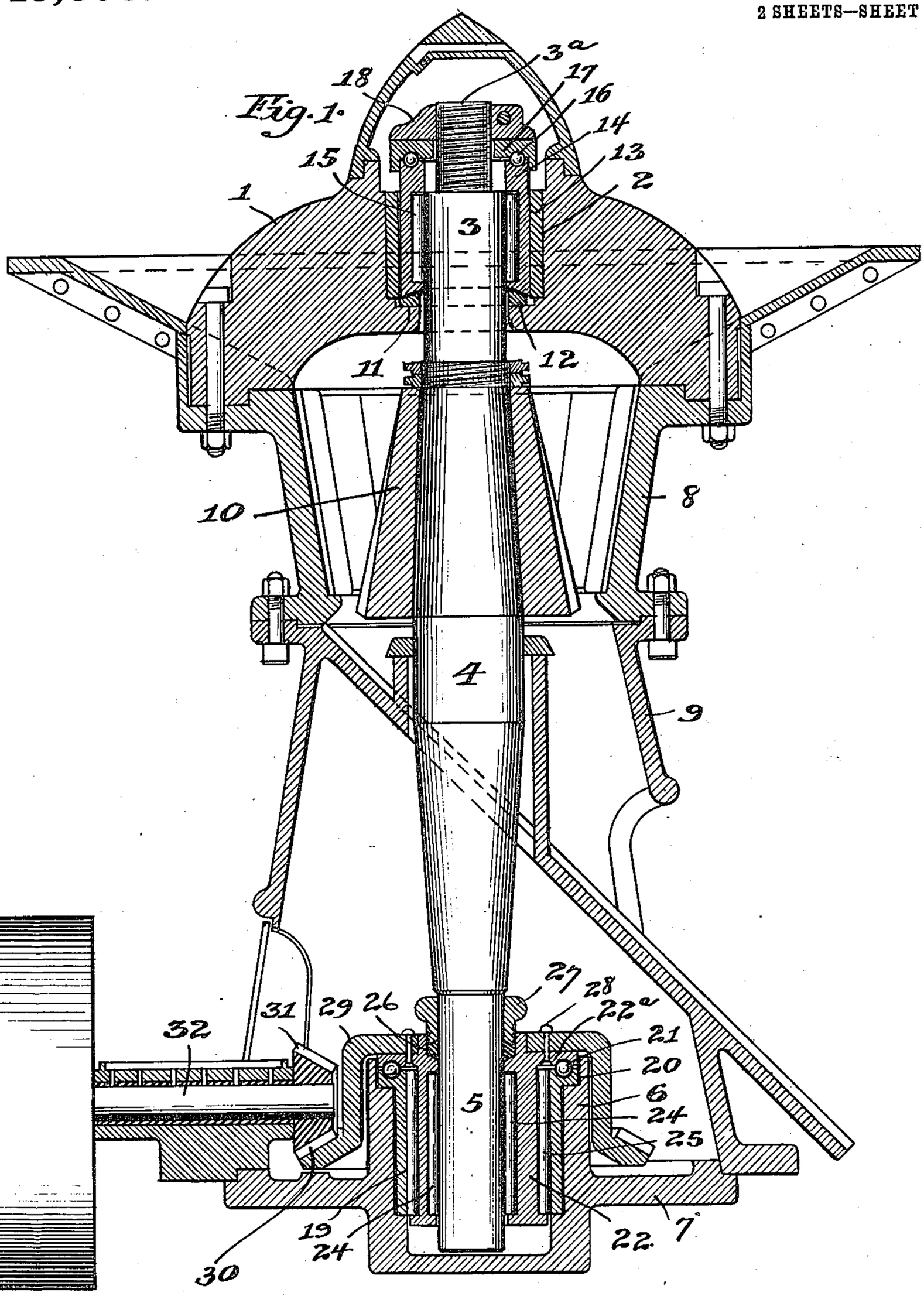
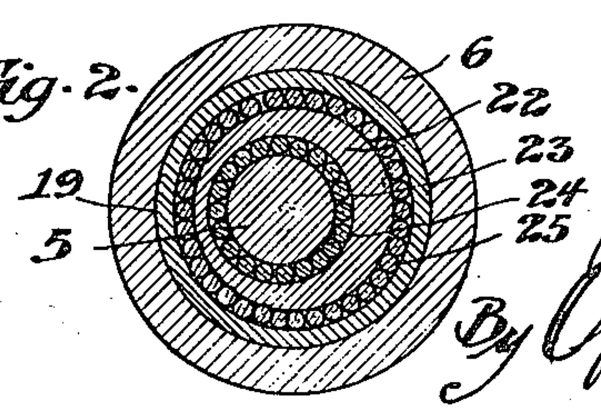


Fig. 2.



Witnesses,
F. S. Mann,
S. N. Pond

Inventor,
Jay B. Rhodes,
By Offield Towle
& Linthicum
Attys.

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2 SHEETS—SHEET 2.

Fig. 3.

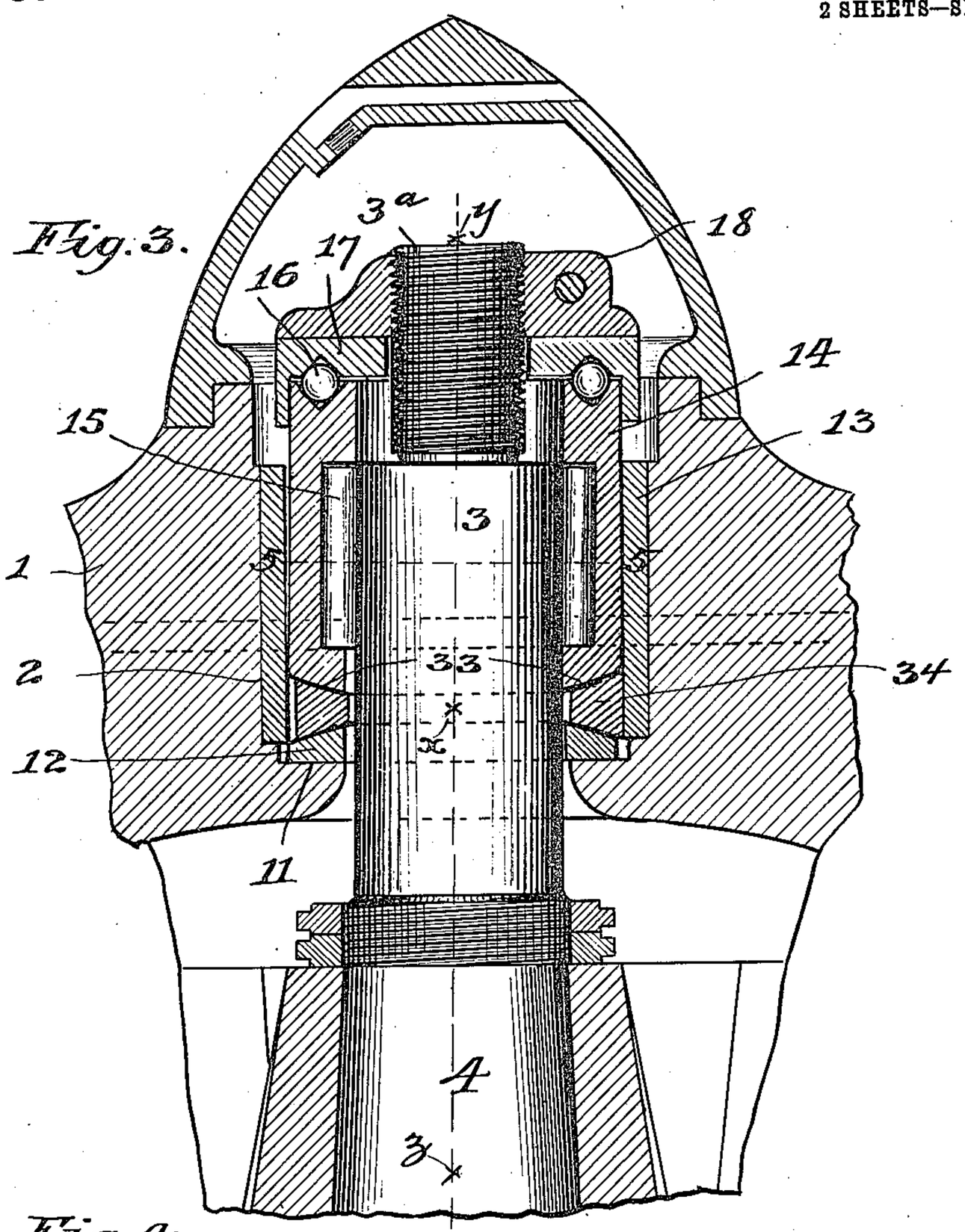


Fig. 4.

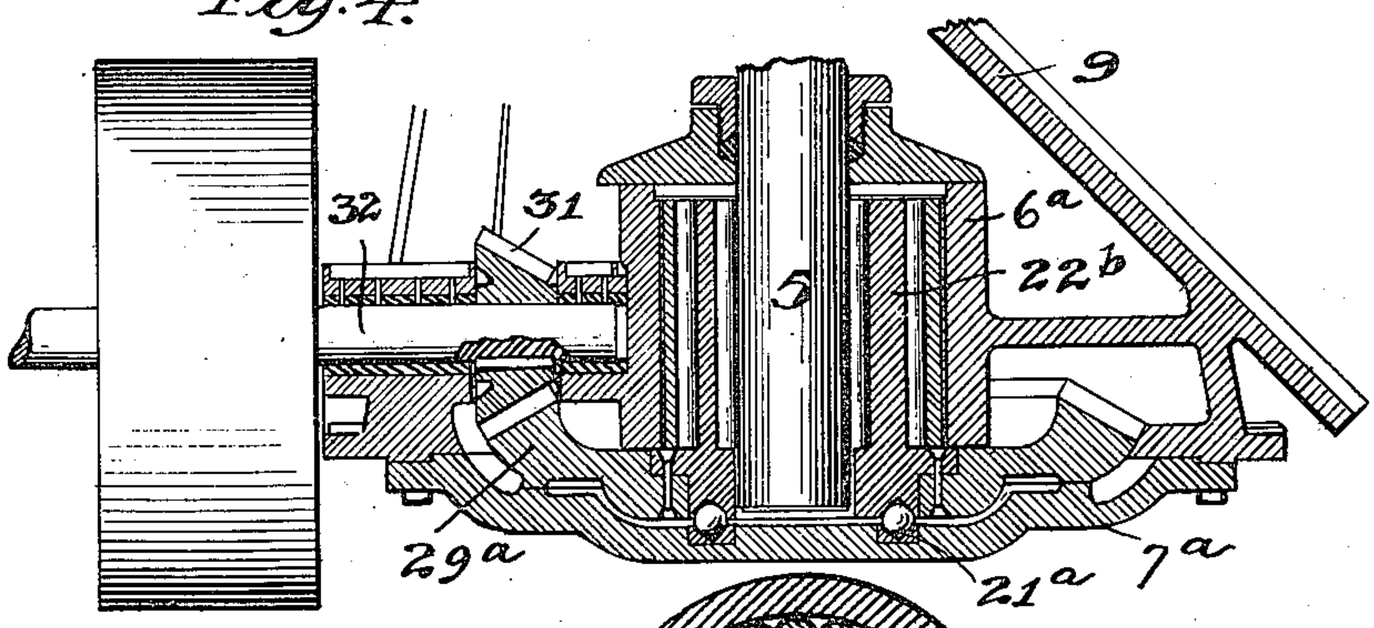
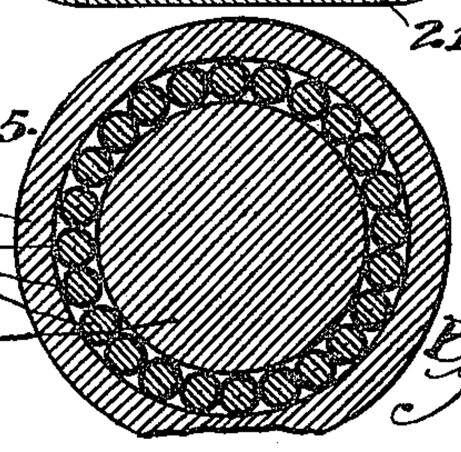


Fig. 5.



Witnesses,

F. D. Mann,

S. N. Pond

Inventor,

Jay B. Rhodes,

By Auld, Towle & Lothrop,

Attys.

UNITED STATES PATENT OFFICE.

JAY B. RHODES, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUSTIN MANUFACTURING COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

GYRATORY CRUSHER.

945,806. Specification of Letters Patent. Patented Jan. 11, 1910.

Application filed February 18, 1907. Serial No. 358,096.

To all whom it may concern:

Be it known that I, JAY B. RHODES, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gyratory Crushers, of which the following is a specification.

This invention relates to improvements in gyratory crushers, and has reference more particularly to that type of crushers employing a suspension shaft, although my improvements are in part applicable to crushers wherein the shaft is otherwise supported.

Among the principal objects of the invention are to provide a construction in which the friction of the shaft in its bearings, and consequently the power required to drive the same, is materially reduced as compared with present practice; to provide a construction wherein the gyratory motion is accompanied by a minimum of surface rubbing and wear in the end bearings of the shaft; to provide a construction which may be easily assembled and wherein the shaft may be readily adjusted longitudinally; to provide a construction wherein the lower or foot bearing of the shaft can be packed and work in a lubricant; and generally, to improve upon the construction of gyratory crushers of this type.

To the above ends the invention consists in the matters hereinafter described and more particularly pointed out in the appended claims.

The invention will be readily understood from the following description, reference being had to the accompanying drawings showing approved mechanical embodiments of the same, wherein—

Figure 1 is a vertical axial section through a gyratory crusher embodying several of my improved features of construction; Fig. 2 is a cross-sectional detail through the lower bearing of the shaft; Fig. 3 is a vertical section on an enlarged scale illustrating a modified form of upper shaft bearing as compared with Fig. 1, and showing additional features of improvement; Fig. 4 is a vertical section through the lower bearing of the shaft and its supporting and carrying parts illustrating a modification wherein the driving means is applied at the lower end of the bearing instead of at the upper end, as in Fig. 1; and Fig. 5 is a cross-sectional view on the line 5—5 of Fig. 3 through the upper bearing of the shaft.

Referring first to Figs. 1 and 2, 1 designates as an entirety the upper spider-head of the crusher, which is provided with an axial bore 2 to accommodate the upper end portion 3 of the usual heavy gyratory shaft, the intermediate portion 4 of which is reversely tapered, as shown, and the lower end portion 5 of which enters a lower bearing member 6 formed integral with a base-plate 7. 8 designates the usual tapered wall or casing of the crusher mounted upon and bolted to the usual hollow standard 9 and surrounding the usual tapered crushing cone 10 fitted to the intermediate portion 4 of the shaft.

Referring now more particularly to the upper bearing of the shaft, 11 designates an internal annular shoulder at the lower end of the bore 2, on which rests a wearing ring 12, this wearing ring having an upper convex face and being of an internal diameter slightly exceeding the diameter of the end 3 of the shaft which extends therethrough. The bore 2 is preferably provided with a hardened bushing 13 snugly fitting the same, within which and surrounding the shaft is a wearing sleeve 14 that is of slightly tapered form externally, being slightly narrower at its upper than at its lower end to accommodate the gyratory movement of the portion of the shaft surrounded thereby in the bushing 13. This wearing sleeve 14 has an internal annular race-way of considerable width designed to accommodate a series of vertical rollers 15 forming antifriction bearings between said wearing sleeve and shaft to resist the lateral thrust of the latter. The extreme upper end portion of the shaft is reduced and threaded as shown at 3^a, and the upper end of the wearing sleeve 14 is provided with an annular race-way receiving a series of balls 16. A cap 17 centrally apertured to have a sliding fit over the threaded end 3^a of the shaft is provided on its under side with a registering race-way resting upon the balls 16, and an internally threaded split clamp 18 engages the threaded end of the shaft above the cap 17 and thereby suspends the shaft upon the underlying parts of the bearing.

Referring next to the foot bearing of the shaft, 19 designates a substantially cylin-

drical bushing loosely fitted in the bearing member 6 and provided with an annular flange 20 at its upper end, in the upper face of which flange is an annular race-way for a series of balls 21. Within the bushing 19 is a sleeve 22 that is provided with an eccentric bore 23 designed to receive the lower end of the shaft 5. The internal wall of the sleeve 22 has a race-way extending approximately the entire length of the sleeve designed to accommodate a series of vertical rollers 24 between said sleeve and shaft, while a similar series of rollers 25 is preferably provided between the exterior of said sleeve and the bushing 19. The eccentrically bored sleeve 22 has at its upper end a flange 22^a that is provided on its under side with a race-way engaging the balls 21; and said sleeve is also preferably supplied at its upper end with an annular recess for packing 26 maintained tight by a gland 27. Secured to the upper end of the eccentrically bored sleeve 22 as by means of bolts or rivets 28 passed through the flange 22^a is an inverted cup-shaped driving member 29 provided on its lower edge with a bevel gear 30 engaged and driven by a bevel pinion 31 on a driving shaft 32.

Fig. 3 of the drawings illustrates a slight modification of the upper bearing of the gyratory shaft designed to facilitate the gyratory movement of the latter, and more especially to improve the action and wearing qualities of those parts of the bearing that support the weight of the shaft and receive its down thrust. This construction embodies the bushing 13, the wearing sleeve 14, and its superposed parts, the lateral roller bearings 15, the annular ledge or shoulder 11, and the wearing ring 12 of Fig. 1; but differs from the latter figure in respect to the specific means for supporting the lower end of the wearing sleeve 14 through which the weight of the shaft is supported. As herein shown, the lower end of the wearing sleeve 14 is provided with a spherical or convex surface 33 that is formed on the same radius of curvature as the upper spherical or convex surface of the wearing ring 12; and between these parts I interpose what I term an accommodation ring 34, this latter having an internal diameter slightly greater than the diameter of that part of the shaft embraced thereby, and also having upper and lower concave faces conforming to and fitting the convex faces of the wearing sleeve and wearing ring. The accommodation ring 34 is so located as to be concentric with the center of gyration located in the axis of the gyratory shaft, such center being indicated by the point marked *x*; and the convex faces of the wearing sleeve 14 and wearing ring 12 are struck from centers indicated at *y* and *z*, respectively, on opposite sides of the center of gyration on radii of equal length, which radii are preferably substantially twice the diameter of the shaft at the point *x*.

The modification of the lower or foot bearing of the shaft as represented in Fig. 4 consists principally in applying the drive to the lower end of the eccentrically bored sleeve 22^b instead of to its upper end, as in Fig. 1; this modification requiring the carrying of the outer bearing member or casing 6^a by the hollow standard 9 instead of by the base-plate 7^a; and the ball bearings 21^a are located between the eccentrically bored sleeve 22^b and the upper side of the base-plate 7^a, and support the weight of the eccentric shaft-driving member and its driving gear 29^a.

Briefly describing the operation and advantages of the several improvements hereinabove described, it may be noted at the outset that the extended lateral roller bearings between the relatively rotatable parts at the upper and lower ends of the shaft receive and oppose the lateral thrust of the latter and largely reduce the friction and wear that otherwise would arise between said parts; while the ball bearings at both the upper and lower ends similarly reduce the friction and wear between those parts which support the weight of the shaft and parts carried thereby. These improvements conduce both to the longevity of the parts and to an economy in the power required to operate the crusher. The action of the accommodation ring 34 shown and described in connection with Fig. 3 is somewhat peculiar; the said ring having a slight bodily oscillatory movement in a horizontal plane coincident with the center of gyration at *x*, this movement being in the direction of inclination of the upper portion of the shaft above the point *x* and, consequently, opposite to the direction of movement or inclination of that portion of the shaft lying below the point *x*, this movement being due to the squeezing action, as it were, upon the accommodation ring presented by the opposed convex surfaces of the wearing sleeve and wearing ring at the constantly progressing points at which they are approaching each other under the gyrations of the shaft. The employment of this ring 34 located as described and bearing the described relation to the parts engaged thereby substantially prevents any relative rotary or turning movement between the coöperating convex and concave surfaces, and limits such relative movement to a slight movement in radial directions, whereby the extent of rubbing contact is greatly decreased and the longevity of the engaging parts correspondingly increased.

As regards the foot bearing of the shaft and its driving means, the action and operation of the devices shown in Figs. 1 and 4,

respectively, is substantially the same, but the construction of Fig. 1 has one advantage over that of Fig. 4 in that the outer bearing member or casing 6, being cast integrally with the base-plate 7, forms in effect an integral cup receiving the antifriction and wearing members of the bearing and permits the said parts to be packed in a lubricant substantially for the full height of the bearing without danger of leakage of such lubricant.

It will be evident to those skilled in the art that other variations and modifications in respect to the details of construction and relative arrangement and organization of the working parts may be made without involving any substantial or material modification of the substance of the invention and without sacrificing any of the advantages obtained thereby. Hence I do not limit the invention to the particular constructions disclosed except to the extent indicated in specific claims.

I claim:

1. In a gyratory crusher, the combination with an axially bored spider-head and a shaft having its upper end lying in said bore, of a cylindrical bushing fitted to said bore, a slightly tapered wearing sleeve having an internal annular race-way surrounding said shaft within said bushing, a series of roller bearings in said race-way, and means for imparting a gyratory movement to said shaft, substantially as described.

2. In a gyratory crusher, the combination with an axially bored spider-head, a gyratory shaft, and a bearing-member for the lower end of said shaft, of a cylindrical bushing loosely fitted within said bearing-member and provided with an annular race-way in its upper end, a sleeve having an eccentric bore mounted in said bushing and provided with an annular flange having in its lower face an annular race-way overlying and registering with the race-way of said bushing, a series of balls in said race-ways, a series of rollers between said sleeve and said bushing, another series of rollers between said shaft and said sleeve, and means for rotating said sleeve, substantially as described.

3. In a gyratory crusher, the combination with an axially bored spider-head having an internal annular shoulder near the lower end of said bore, of a gyratory shaft having its upper end lying in the bore of said spider-head, a wearing ring of slightly greater internal diameter than the end of said shaft seated on said shoulder, a wearing sleeve surrounding the upper end of said shaft within said bore, the proximate ends of said wearing ring and wearing sleeve having convexed surfaces of equal radii of curvature, means whereby said shaft is suspended from said wearing sleeve, and an accommodation ring between said wearing sleeve and wearing ring, said accommodation ring being concentric with the center of gyration and having an internal diameter exceeding the diameter of the end of said shaft and further having concave upper and lower surfaces fitting the convex surfaces of said wearing sleeve and wearing ring, substantially as described.

4. In a gyratory crusher, the combination with an axially bored spider-head having an internal annular shoulder near the lower end of said bore, of a gyratory shaft having its upper end lying in the bore of said spider-head, a wearing ring of slightly greater internal diameter than the end of said shaft seated on said shoulder, a wearing sleeve surrounding the upper end of said shaft within said bore, the proximate ends of said wearing ring and wearing sleeve having convexed surfaces formed on equal radii of curvature struck from points equally distant from the center of gyration on opposite sides of the latter and each approximately equal to twice the diameter of the shaft at said center of gyration, means for suspending said shaft adjustably from the upper end of said wearing sleeve, and an accommodation ring between said wearing sleeve and wearing ring, said accommodation ring being concentric with the center of gyration and having an internal diameter exceeding the diameter of the end of said shaft and further having concave upper and lower surfaces fitting the convex surfaces of said wearing sleeve and wearing ring, substantially as described.

In testimony that I claim the foregoing as my invention, I have hereunto subscribed my name in the presence of two witnesses.

JAY B. RHODES.

Witnesses:

SAMUEL N. POND,

L. F. MCCREA.