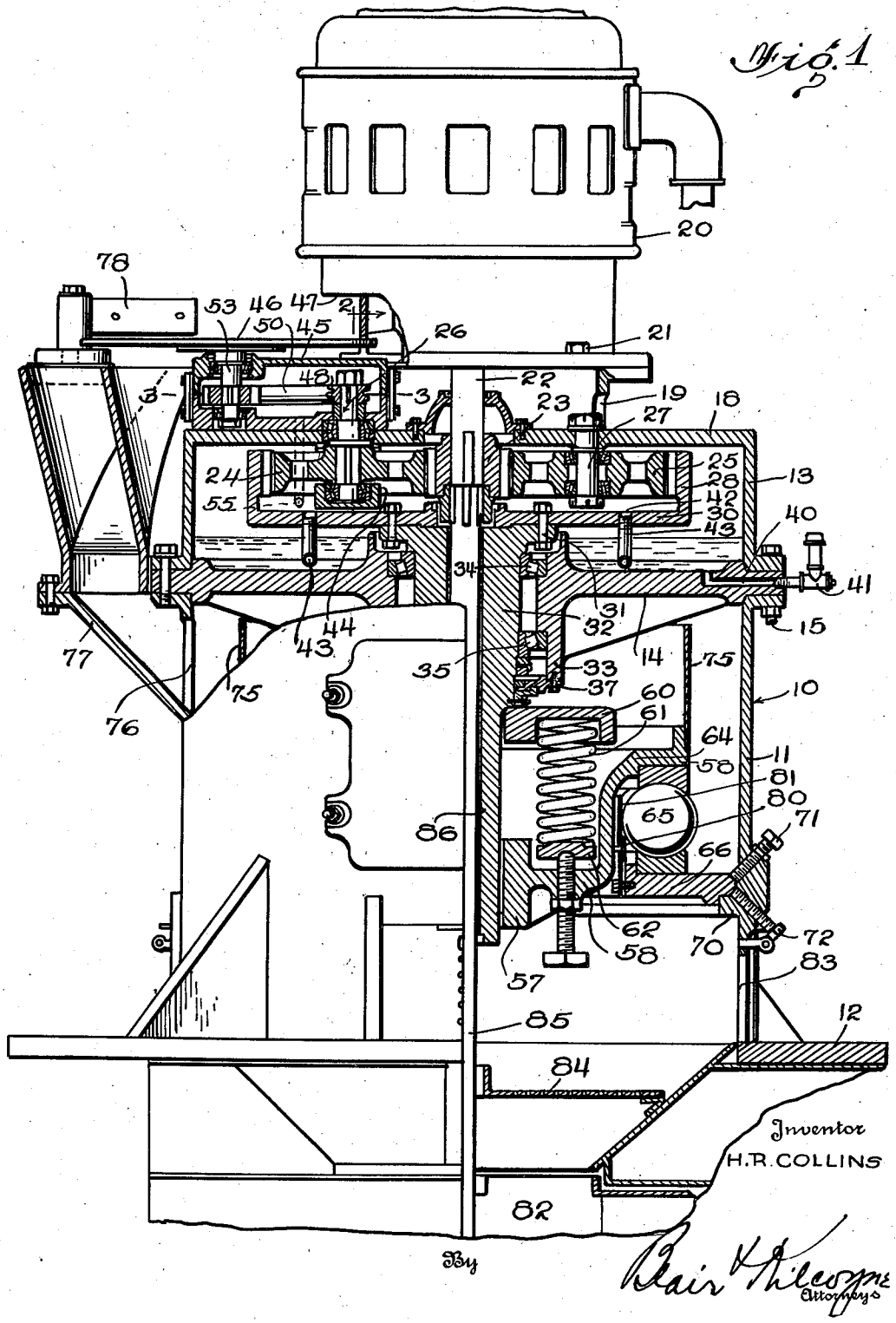
March 7, 1939. H. R. COLLINS 2,149,580

PULVERIZER MILL

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Fig. 1



Inventor
H.R. COLLINS

By Blair & Wilcoxon
Attorneys

March 7, 1939. H. R. COLLINS 2,149,580

PULVERIZER MILL

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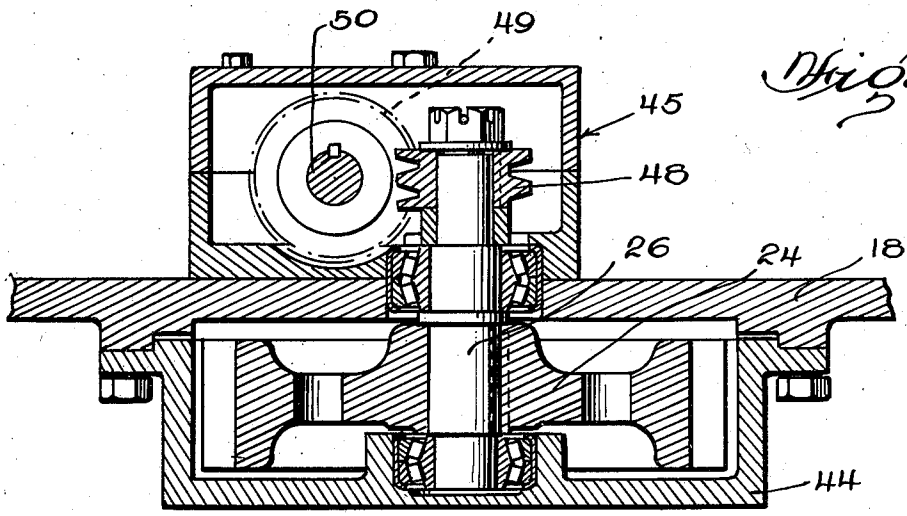


Fig. 2

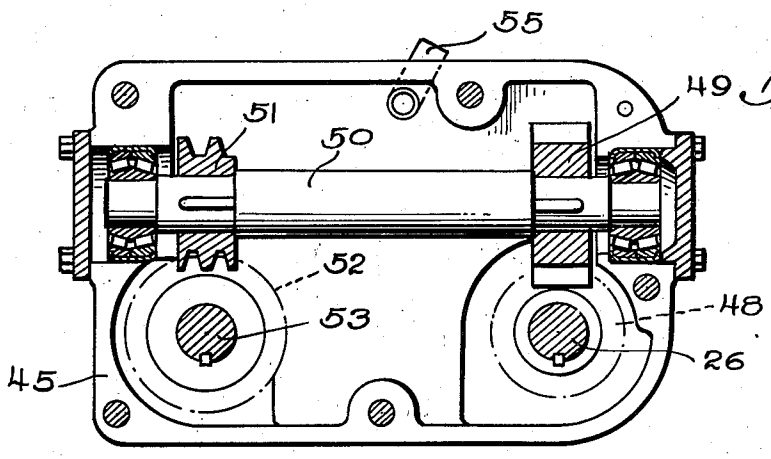


Fig. 3

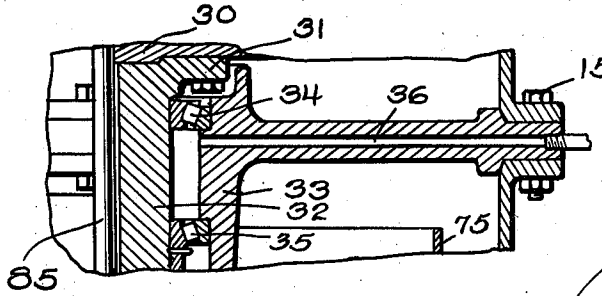


Fig. 5

Inventor
H. R. COLLINS

By Blair & Kilcoyne
Attorneys

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PULVERIZER MILL

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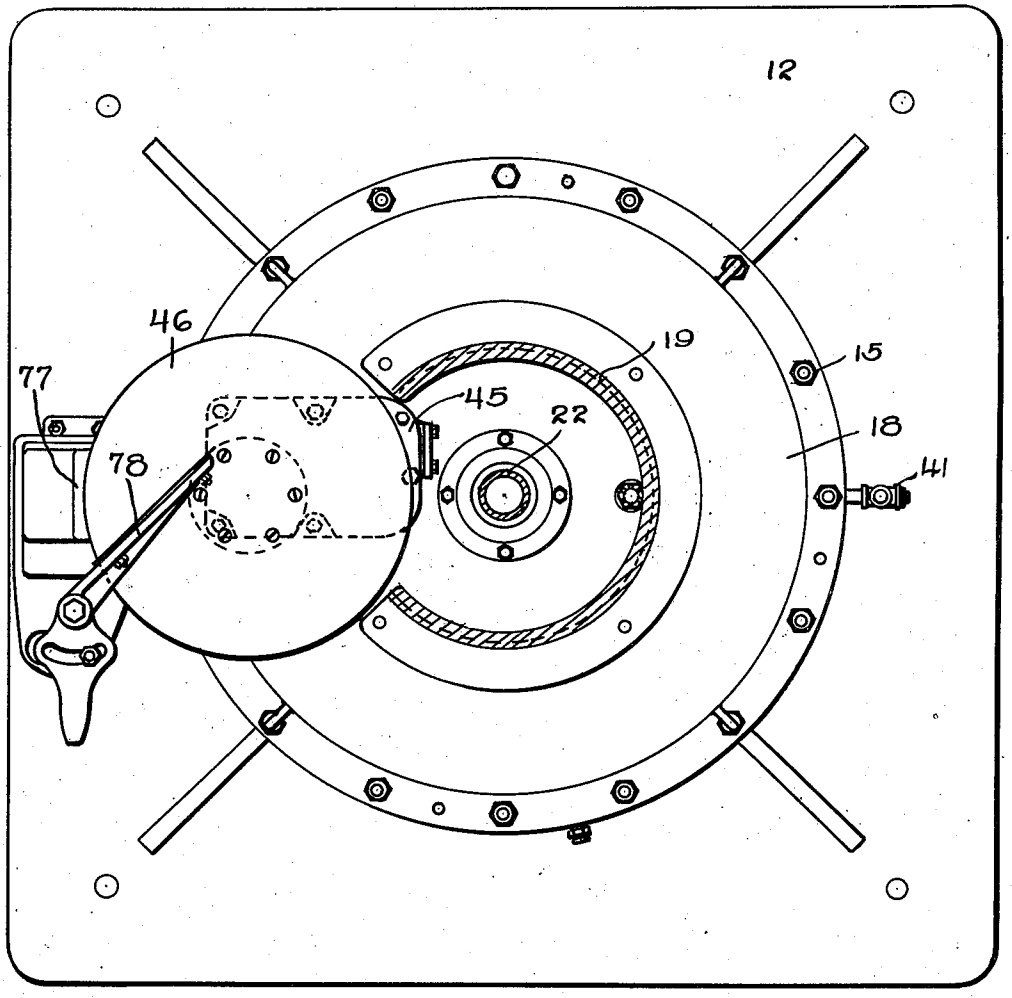


Fig. 4

Inventor
H. R. COLLINS

By Blair & Kilcoyne
Attorneys

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UNITED STATES PATENT OFFICE

2,149,580

PULVERIZER MILL

Harry R. Collins, Allentown, Pa.; May H. Collins administratrix of said Harry R. Collins, deceased

Application August 12, 1936, Serial No. 95,657

7 Claims. (Cl. 83—45)

This invention relates to pulverizing mills, especially intended for the reduction of non-metallic materials such as coal, limestones, and cement clinker, and in its more specific aspects pertains to driving mechanisms for the rotating element and/or elements of the material feeding and grinding assemblies and to a system of lubrication therefor.

Among the objects of the present invention may be noted the provision of improved driving means for a pulverizing mill of the type in which the grinding assembly preferably comprises one or more annular series of grinding elements, such as balls, which cooperate with grinding surfaces, at least one of which is rotatably driven in a horizontal plane. The design contemplates a driving mechanism arranged as a separate unit above the grinding assembly and embodying speed reducing gear driven from a suitable source of power, such as a motor, in driving relation to the rotating grinding surface of the grinding assembly and so arranged as to drive the grinding elements circumferentially of the mill at a speed which corresponds substantially to the gravity fall of the material to be pulverized. Such material enters the casing through an inlet opening or openings in regulated quantity as controlled by a rotary feed table which is driven at a desired speed from a gear forming part of the speed reducing mechanism as aforesaid. Where an exhaust fan or slurry pump is associated with the mill for forwarding pulverized material, such is also driven through a connection with the driving mechanism as aforesaid, preferably at the full load speed of the motor. Among the important mechanical advantages of the above described arrangement may be noted the fact that a common source of power is utilized for driving the grinding assembly, work feed table, and exhaust fan or slurry pump, thus to provide a construction of exceedingly simple design.

The present invention further contemplates improved and simplified means for lubricating elements of the driving mechanism, as aforesaid, with the lubricating medium such as oil being forced into contact with parts to be lubricated by means operated by and driven from the driving mechanism.

Other objects will be in part obvious and in part hereinafter pointed out in connection with the accompanying drawings illustrating an embodiment of my invention.

In the drawings—

Fig. 1 is an elevation, partly in section, of a pulverizer mill embodying the drive and lubrication features in accordance with the invention;

Fig. 2 is a section taken along lines 2—2 of Fig. 1;

Fig. 3 is a section taken along lines 3—3 of Fig. 1;

Fig. 4 is a plan view of the work feed table and the mill casing, with the motor removed for the sake of clearness;

Fig. 5 is a detail view illustrating the main shaft bearing and lubrication means therefor.

Referring to the drawings in detail, wherein like reference characters designate like parts throughout the several views, reference character 10 designates a generally cylindrical casing constituted by a lower casing section 11, provided with an annular flange 12 which may serve as a bed plate for the apparatus, and an upper section 13. Between the casing sections 11 and 13 is arranged a main bearing support or partition 14, with bolts or equivalent securing means 15 removably securing the bearing support 14 to facing flanges of the aforesaid casing sections 11 and 13. The upper casing section 13 is provided with a horizontal top plate 18 which serves to close the top of the casing 10 as formed by the casing sections 11 and 13.

The top plate 18 of casing section 13 has secured thereto an arcuate motor support 19, on which a driving motor 20 for the driving mechanism to be described is secured as by bolts 21, with the motor 20 being thus supported from the casing section 13 and spaced from the top plate 18 thereof. A motor shaft 22 extends through the spacing support 19, and the top plate 18, and extends into the chamber or compartment formed by the casing section 13, its top plate 18, and the main bearing plate 14.

Motor shaft 22 carries a hardened steel pinion 23 which drives oppositely arranged idler gears 24, 25, respectively, carried by bearings on suitable vertical shafts 26, 27 secured in the cover plate 18 of the top casing section. Idler gears 24, 25 mesh with a ring gear 28 carried by a circular supporting plate 30, the latter being secured as by bolts 31 to a flange formed on the upper end of a main driving shaft 32, the upper portion of which is preferably circular in cross section.

The main bearing plate 14 is provided with a central elongated hub 33 which is suitably recessed to receive the outer raceways of spaced tapered roller bearings 34, 35, the inner raceways of which are carried by the main driving shaft 32. The bearings 34, 35 are suitably lubricated as by grease injected through a bore 36 (Fig. 5)

extending horizontally through the main bearing plate 14 and delivering grease into the space between the bearings 34, 35. A packing ring 37 operative between the end of the main bearing plate hub 33 and the driving shaft 32 serves to exclude entry of dust along the shaft and to the bearings 34, 35.

Main bearing plate hub 33 extends upwardly above the top horizontal surface of the main bearing plate 14, and forms with said top horizontal surface and with the inner wall of the top casing section 13 an annular well or main reservoir adapted to contain a quantity of lubricating oil for the elements of the drive mechanism. Oil is supplied to the aforesaid reservoir as through a port 40 formed in the main bearing plate and communicating with an oil supply line indicated at 41.

The bottom plate 30 of the ring gear 28 is provided with one or more apertures as at 42, and threaded into each of said apertures is an L-shaped scoop pipe 43 which extends downwardly into the oil reservoir as aforesaid, and below the level of the oil maintained therein. Upon rotation of the ring gear and its bottom plate, the open-ended scoop pipes 43 pick up oil contained in the reservoir and force it upwardly into the zone of the motor shaft pinion 23, idler gears 24, 25, and gear surfaces of the ring gear 28, thus to lubricate the same. Bottom plate 30 of the ring gear, its upstanding peripheral wall and its central hub form a secondary oil reservoir in which a quantity of oil forced thereto by the scoop pipes 43 is maintained for the purpose to be hereinafter described.

Vertical shaft 26 on which idler gear 24 rotates has its lower end carried by bearings in a U-shaped saddle 44 (Fig. 2) bolted to the under side of the casing top plate 18, and its upper end extends through the top plate 18 of casing section 13 and into a two-part housing 45 suitably secured to the casing top plate 18 and relatively laterally of the axis of motor shaft 22. By reference to Fig. 4, the housing 45 extends between the ends of arcuate motor support 19 and contains driving elements for a rotating feed table 46 rotating on a vertical axis. The peripheral edge of the feed table, which due to the relatively large diameter thereof, may extend into a cut-away recess 47 formed in the casing of motor 20, as indicated in Figs. 1 and 4.

The feed table drive as aforesaid (Figs. 2 and 3) preferably consists of a worm pinion 48 keyed or otherwise secured to the upper end of the vertical shaft 26, the pinion driving a gear 49 secured to a horizontal shaft 50 journaled in bearings in the vertical walls of the housing 45. The other end of shaft 50 carries a worm pinion 51 meshing with a pinion 52 carried by the vertical feed table shaft 53, which latter is mounted for rotation in bearings set into the top and bottom walls of the housing 45 (Fig. 1).

By the aforesaid arrangement the feed table 46 is driven from motor shaft 22 by a gear train including drive pinion 23, idler gear 24, its shaft 26, worm pinion 48, gearing 49 and 51 arranged on shaft 50, and pinion 52 carried directly by the feed table shaft 53.

To lubricate the drive parts contained in housing 45, casing top plate 18 and the bottom wall of housing 45 are provided with a set of aligned apertures, and threaded into said apertures is an L-shaped scoop pipe 55, the lower open end of which extends into the secondary oil reservoir formed by the ring gear 28 and its bottom plate 30, and below the level of the idler gear 24 rotating therein on the fixed vertical axis of shaft 26. Hence, oil contained in the secondary reservoir as aforesaid is, upon rotation of the ring gear, forced upwardly through the scoop pipe 55 and into the housing 45, thus to lubricate the drive parts therein contained.

The lower end of main drive shaft 32 is of square or other angular section and extends through a central opening in the hub 57 of a rotary grinding ring 58 of a grinding assembly which, as illustrated, is of a type effecting reduction of the material to be pulverized in a single stage. It will be understood, however that the drive and lubricating features as above described are equally adapted to drive the rotary element or elements of grinding assemblies in which reduction is effected in a plurality of stages and, further, that forms of single stage grinding assemblies other than that to be particularly described herein may be associated with the drive mechanism and lubricating means therefor, as aforesaid.

The grinding assembly illustrated embodies a spring seating disc 60 disposed above the hub 57 of the rotary ring, the disc being driven by the lower half or square driving portion of shaft 32 and located vertically with respect thereto as by a shoulder formed on the shaft between the circular upper portion and the square lower portion thereof. The disc 60 is provided with a plurality of downwardly opening pockets, in each of which seats the end of a compression spring 61. The lower ends of the springs engage against spring heads 62 which are disposed in upwardly opening pockets formed in the rotary ring intermediate the hub 57 and a generally cylindrical portion thereof, which latter merges outwardly to form a horizontally disposed rim portion 64. The rim portion is recessed on its under face to provide a seat for a circumferentially grooved or channeled raceway welded or otherwise secured to the rim, and which engages the top portions of an annular series of grinding balls 65 which are supported in a circumferentially grooved or channeled raceway welded or otherwise secured to the upper face of a fixed grinding ring 66. The curvature of the channels of the raceways of the rotary grinding ring 58 and the fixed grinding ring 66 corresponds substantially to the curvature of the grinding balls 65, with the channel of the rotary grinding ring being disposed directly above the channel of the fixed grinding ring.

The fixed grinding ring 66 is supported on an inwardly directed shelf 70 carried by the casing section 11, the fixed ring being maintained seated on said shelf by holding bolts 71 which engage against the upper surface of the fixed ring. Fixed ring raising bolts 72 are also provided and are operative, upon unthreading of bolts 71, to engage the under surface of the fixed ring and unseat it as when it is desired to remove the fixed ring from the casing.

Carried by the outer peripheral edge of the rotary grinding ring 58 is a circular material guard 75 which extends upwardly within the casing to about the upper level of casing inlet opening 76. Material enters said opening 76 from a feed spout 77, the upper open end of which is disposed below an edge portion of the rotary feed table 46. Material fed to the feed table is upon rotation thereof directed against an adjustable scraper element 78 which functions to direct material from the table into the spout 77 and thence into the mill casing through inlet

opening 76 thereof. The guard 75 functions to prevent flow of the material in an inward direction and, instead, causes it to drop directly on to the top surface of the fixed grinding ring 66, where it builds up on the outer side of the grinding balls 65 and thence flows inwardly through the series of grinding balls.

The inner edge of the fixed grinding ring 66 is provided with an adjustable height dam 80, the dam carrying a screen 81. The dam and screen extend upwardly into the annular space between the inner side of the grinding balls 65 and the substantially cylindrical portion of the rotary grinding ring 58, with the dam controlling the degree of fineness of the product which subsequently passes through the openings of the screen 81.

Pulverized material then drops downwardly and is picked up by inlet air to an exhaust fan 82 secured to the bottom portion of the casing or bed plate 12 thereof, air inlet openings 83 being provided in the lower part of the casing section 11. Prior to entering the fan the pulverized material passes through a grating 84 and is thence operated on by the fan which functions to forward the pulverized material as desired.

The fan 82 is driven by a shaft 85 which passes upwardly through a bore 86 in the main drive shaft 32 and is secured at its upper end to the hub of the driving pinion 23. The lower end of the shaft 85 is supported for rotation in a bearing carried in the lower fan section (not shown). It will thus be seen that the motor 20 drives the fan 82 at full load speed, whereas the grinding balls 65 are driven circumferentially of the mill at a speed which preferably corresponds to the gravity fall of the material through the reducing effect of the driving mechanism, as aforesaid.

It will be understood that a slurry pump may be substituted for the exhaust fan 82 when wet grinding is contemplated.

In a pulverizer mill according to the foregoing, the driving mechanism is suitably lubricated by a simple arrangement of parts, with the feed of the oil from a suitable reservoir or reservoirs being derived from rotation of parts to be lubricated. Further, all of the rotating parts of the mill are driven from a common power source and in such manner that the various driven units, such as the rotary grinding ring of the grinding assembly, the work feed table, and the exhaust fan or slurry pump, are driven at appropriate speeds, all within a mill of simple and practical construction, in which the parts are compactly arranged and positioned with a view to ready assembly and convenient access.

It will be further seen that the driving mechanism as aforesaid is arranged as a separate unit above the grinding assembly. Thus, by removing the holding bolts 15, the driving mechanism including the feed table and its drive may be lifted bodily from the main casing, with provision being made for independent removal of the feed table and its drive from the casing section 13, and also separate removal of the casing section 13 and parts carried thereby for access to the drive mechanism and/or parts thereof as carried by the main bearing plate 14.

The particular arrangement of the grinding mechanism shown herein is claimed in my copending application, Serial No. 95,659, filed of even date herewith.

As many changes could be made in carrying out the above constructions, without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A pulverizer mill comprising, in combination, a casing including upper and lower sections, a main bearing plate arranged between the sections and forming with the upper section a compartment, a grinding assembly including a rotating grinding ring contained within the lower section, a drive shaft extending through and supported for rotation in the bearing plate, a driving motor, speed reduction means contained in the compartment and arranged between the driving motor and the drive shaft, the speed reduction means including a ring gear, means including the bearing plate providing in the compartment an oil reservoir below the ring gear, and scoop pipes rotating with the ring gear adapted to extend into oil contained in the reservoir to raise oil to the speed reduction means.

2. A pulverizer mill comprising, in combination, a casing, a grinding assembly arranged therein, the grinding assembly including a rotating grinding ring, a driving motor carried by the casing, speed reduction means within the casing and operative between the motor and the rotating ring, the speed reduction means including an idler gear shaft, said casing having a material inlet opening therein, a housing carried by the casing into which the idler shaft extends, a feed table shaft journaled for rotation in the housing, a feed table carried by the shaft and operatively related to the inlet opening, and drive connections in the compartment operative between the idler gear and the feed table shaft.

3. A pulverizer mill comprising, in combination, a casing including upper and lower sections, a main bearing plate arranged between the sections and forming with the upper section a compartment, a grinding assembly including a rotating grinding ring contained within the lower section, a drive shaft extending through and supported for rotation in the bearing plate, driving mechanism for the rotating ring contained within the compartment, a driving motor for the driving mechanism, the casing having a material inlet opening, a rotating feed table operatively related thereto, driving connections between the driving mechanism and the feed table, means including the bearing plate providing a main oil reservoir within the compartment, a secondary oil reservoir above the main reservoir, and means including the driving mechanism for supplying oil from the main reservoir to the secondary reservoir, and from said secondary reservoir to the driving connections.

4. A pulverizer mill comprising, in combination, a casing including upper and lower sections, a main bearing plate arranged between the sections and forming with the upper section a compartment, a grinding assembly including a rotating grinding ring contained within the lower section, a driving motor carried by the upper section, speed reduction means arranged in the compartment and operative between the driving motor and the rotating grinding ring, the speed reduction means including a ring gear having a bottom plate, and a gear shaft, the casing having an inlet opening, a rotating feed table operatively related thereto, driving connections between the gear shaft and the rotating feed table, the upper casing and the main bearing plate forming a main oil reservoir, the ring gear and

its bottom plate forming a secondary rotating oil reservoir, means adapted to supply oil from the main reservoir to the secondary oil reservoir, to lubricate the driving mechanism parts, and means adapted to supply oil from the secondary reservoir to the drive connections between the gear shaft and the rotating feed table.

5. A pulverizer mill comprising, in combination, a casing including upper and lower sections, a main bearing plate arranged between the sections and forming with the upper section a compartment, a grinding assembly including a rotating grinding ring contained within the lower section, a driving motor carried by the upper section, speed reduction means arranged in the compartment and operative between the driving motor and the rotating grinding ring, the speed reduction means including a ring gear having a bottom plate, and an idler gear shaft, the casing having an inlet opening, a rotating feed table operatively related thereto, driving connections between the idler gear shaft and the rotating feed table, the upper casing and the main bearing plate forming a main oil reservoir, the ring gear and its bottom plate forming a secondary rotating oil reservoir, the ring gear carrying scoop pipes adapted to extend into the oil contained in the main reservoir to supply oil to the secondary reservoir, thus to lubricate the speed reduction means, and the upper section of the casing carrying scoop pipes adapted to extend into the secondary oil reservoir to supply oil to the drive connections between the idler gear shaft and the rotating feed table.

6. A pulverizer mill comprising, in combination, a casing having in its upper portion a compartment, a grinding assembly contained in the lower portion of the casing and including a rotating grinding ring, a drive shaft therefor, a motor carried by the casing, a motor shaft extending into the compartment, speed reduction means disposed in the compartment and arranged symmetrically about the vertical axis of the casing, the speed reduction means being operative between the motor shaft and the drive shaft and including a gear shaft, the casing having a material inlet opening, a rotating feed table operatively related thereto, drive connections between the gear shaft and the feed table to drive the latter, an exhaust fan related to the lower portion of the casing for forwarding material pulverized by the grinding assembly, and a drive connection between the motor shaft and the fan, said drive connection extending through the drive shaft.

7. A pulverizer mill comprising, in combination, a casing including upper and lower sections, a main bearing plate arranged between said sections, the bearing plate having a central opening and a hub portion about said opening, a grinding assembly including a rotating ring contained within the lower section, a driving shaft for the rotating grinding ring extending through the opening of the main bearing plate, a motor carried by the top section, speed reduction means arranged in the upper section and operative between the motor and the drive shaft, spaced bearings operative between the drive shaft and the hub of the main bearing plate for supporting the drive shaft for rotation thereon, and a bore extending through said bearing plate and opening at one end into the space between said bearings, said bore at its other end being adapted for connection with a source of lubricant.

HARRY R. COLLINS.