Jan. 19, 1937. W. J. EHRSAM 2,068,599

HAMMER MILL

Filed Aug. 9, 1933 2 Sheets-Sheet 1

Fig. 1.

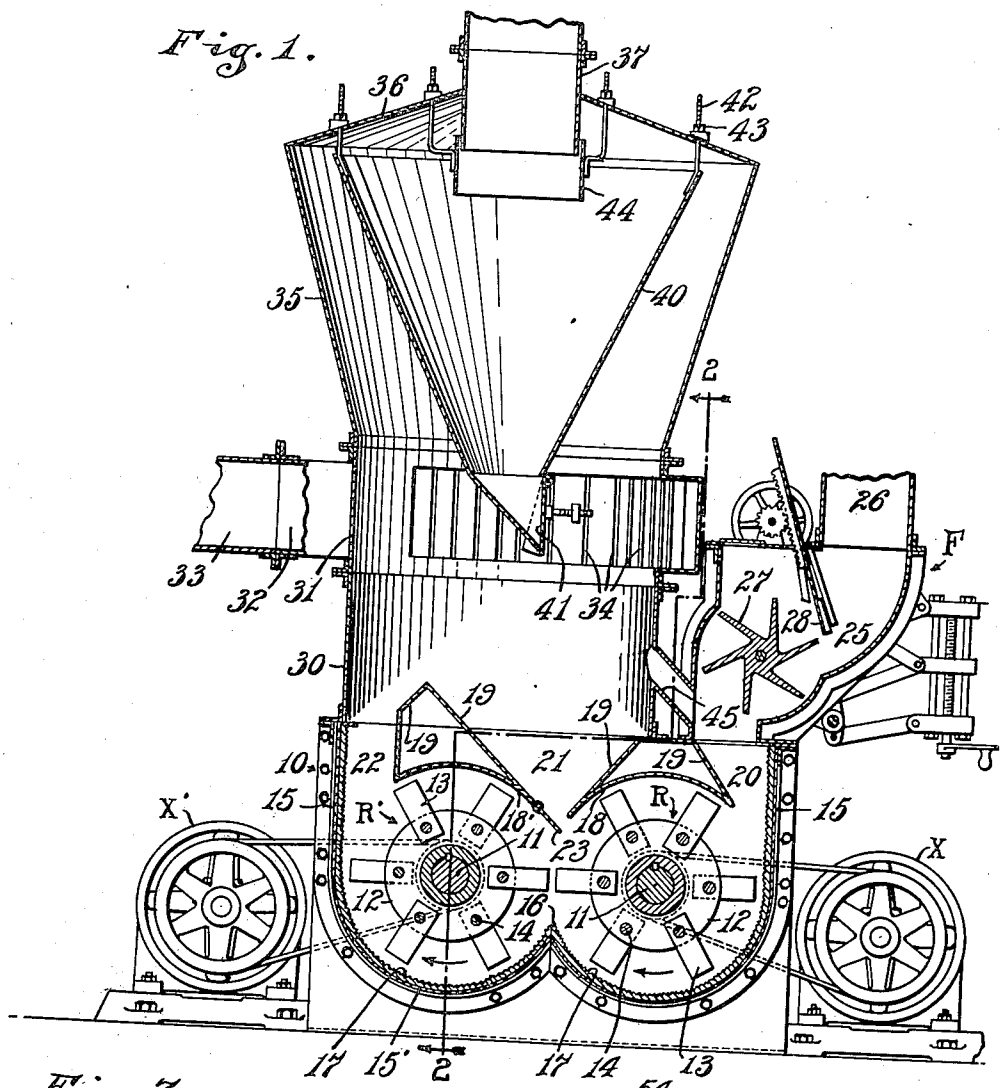
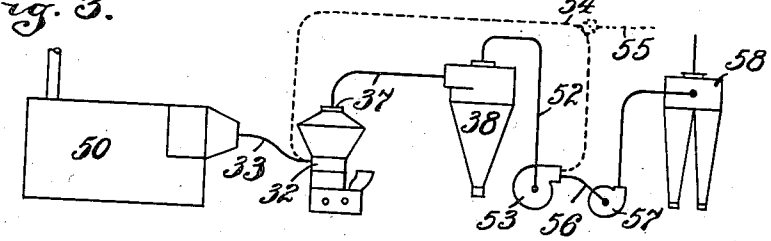


Fig. 3.



INVENTOR.
William J. Ehrsam,

BY

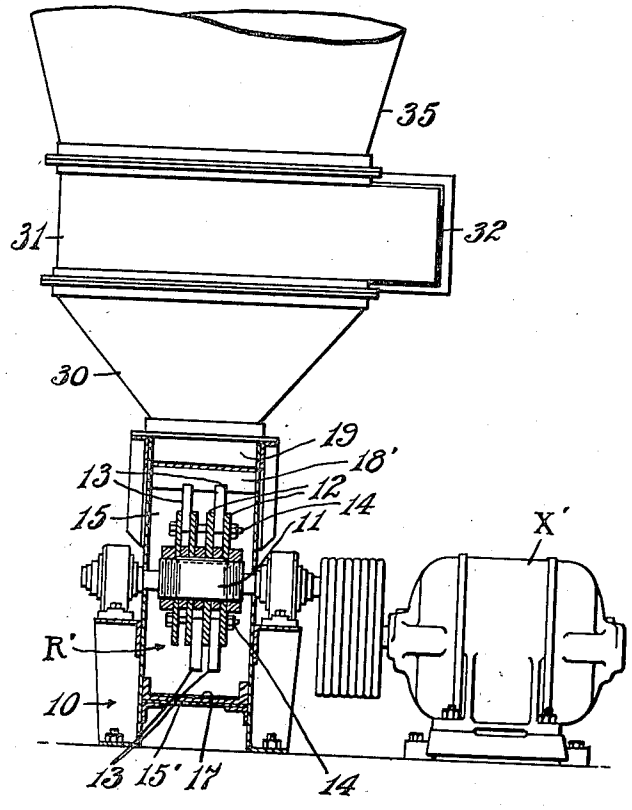
Hood + Hahn.
ATTORNEYS

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Fig. 2.



INVENTOR.
William J. Ehrsam,

BY

Hood + Hahn.
ATTORNEYS

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2,068,599

HAMMER MILL

William J. Ehrsam, Enterprise, Kans., assignor to The J. B. Ehrsam & Sons Mfg. Co., Enterprise, Kans., a corporation of Kansas

Application August 9, 1933, Serial No. 684,353

8 Claims. (Cl. 83—11)

The object of my invention is to produce a highly efficient mill of the rotary hammer type wherein material to be pulverized is subject to successive impacts of hammers of tandem rotary hammers and impacts and attrition against casing walls until broken to the required fineness and wherein a reduced air pressure is maintained in the hammer zone so that power consumption of the apparatus is comparatively low, and wherein the finally reduced material is withdrawn by air currents.

The accompanying drawings illustrate my invention:

Fig. 1 is a medial vertical section of an embodiment of the hammer mill of my invention;

Fig. 2 is a fragmentary section on line 2—2 of Fig. 1, and

Fig. 3 is a flow diagram.

In the drawings 10 indicates a hollow base in which are rotatably mounted, on horizontal axes, two hammer rotors R and R' each comprising a shaft 11, a series of axially-spaced disks 12 keyed or otherwise non-rotatively secured to shaft 11, and a plurality of radially projecting hammers 13 arranged in any desired relation between the several disks in a plurality of circular series and held in place by bolts 14 upon which the hammers may be either pivoted or rigidly secured.

The hammers 13 are of such length and the shafts 11, 11 are so spaced that the outer ends of the hammers of one rotor will traverse a circular path closely adjacent the hammers of the other rotor but will not interefere therewith.

The opposite side walls 15 of base 10 are closely tangent to the paths of travel of the adjacent hammers and bottom 15' of the base closely parallels said paths of travel and forms the intermediate ridge 16 somewhat below the plane of the axes of shafts 11. The walls 15 and bottom 15' are lined with an abrasion-resistant lining 17 which may, if desired, be serrated or roughened as indicated in Fig. 1.

Arranged above rotors R and R' are arc-shaped guards 18 and 18', respectively, which are surmounted by hopper-forming plates 19 which contribute to form an inlet throat 20, leading to the outer side of the chamber containing rotor R, a tailings-hopper 21 capable of delivering to the inner side of said chamber, and a discharge throat 22 leading from the outer side of the chamber containing rotor R'. Hopper 21 is provided with an adjustable valve plate 23 which is inclined downwardly toward rotor R, and well known means, not shown, is provided by which said plate may be adjusted to control the rate of flow of material from hopper 21. Rotors R and R' are driven at high speed by suitable motors X and X' respectively.

Surmounting hopper 20, and covering a portion of the upper open end of base 10, is a feeding mechanism F comprising a feeder hopper 25 forming a channel the lower end of which registers with hopper 20, and the upper end of which supports the feed pipe 26. Rotatably mounted in hopper 25 is a winged controller 27 rotated at desired speeds by well known means, not shown, and interposed between this controller and pipe 26 is an adjustable gate 28.

Surmounting, and closing, the rectangular remainder of the open upper end of casing 10 is a conduit 30, rectangular at its lower end and circular at its upper end, which is surmounted by the cylindrical conduit 31 having the tangential air inlet 32 connected to a suitable air conduit 33. Deflector vanes 34 are preferably provided to assist in causing inflow of air tangentially to conduit 31.

Surmounting conduit 31 is a conical separating chamber 35 covered by a cap 36 axially pierced by a conduit 37 the delivering end of which is connected to a suitable dust separator 38 conveniently of the well-known "cyclone" type.

Mounted within chamber 35 is a conical tailings-hopper 40 the upper end of which is vertically spaced below cap 36 and the lower end of which is provided with the gravity gate 41, of well known form, which serves to retain a sufficient amount of material within hopper 40 to substantially air-seal its outlet yet yields to permit outflow of surplus to the tailings-hopper 21.

Hopper 40 is conveniently supported by vertical threaded hangers 42 which pierce cap 36 and receive nuts 43 by means of which hopper 40 may be vertically adjusted. In order that the effective inlet end of conduit 37 may be adjustable relative to the upper end of hopper 40 said hopper carries an axial eye 44 which is sleeved over the lower end of said conduit.

An air conduit 45 connects the lower end of feeder hopper 25 with conduit 30 and this conduit 45 is preferably inclined upwardly toward conduit 30 so as to inhibit flow of solids from hopper 25 directly to conduit 30.

In use, the above-described apparatus is used for further reduction of comparatively finely comminuted material and may be installed with other apparatus as indicated in Fig. 3. Where 50 is a source of hot air delivering to pipe 33; 38 a well known "cyclone" separator having its primary

inlet connected to conduit 37 and its air outlet connected by pipe 52 with a suction fan 53 provided with a branched and valved delivery pipe, one branch 54 returning into pipe 33, one branch 55 discharging to atmosphere, and one branch 56 delivering to the eye of a booster suction fan 57 which, in turn, delivers to a second dust separator 58 which may be of the twin-cone "cyclone" type.

The two rotors R and R' are rotated at high speed, in the directions indicated by arrows, and they and the suction fans act to substantially reduce the air pressure in base 10 so that the hammers are considerably relieved from air resistance.

Comminuted material in the hopper 25 above valve 28 effectively prevents inflow of substantial currents of air at this point and the material, controlled by element 27, is delivered into hopper 20 from which it falls, by gravity, into the path of movement of the hammers of rotor R. The impact of these hammers upon the particles of material, and the impact of the material on liner 17 serves to rupture the particles and the hammers sweep said particles downwardly and forwardly and project them, at high velocity, upwardly and forwardly into the path of movement of the hammers of rotor R' which hammers impact the particles to rupture them and sweep them downwardly and then upwardly, expelling them upwardly through throat 22 into conduit 30 the converging walls of which inwardly deflect the particles so that the larger particles fall into the tailings-hopper 21 while the smaller particles are carried into the whirlpool, created by the air entering through conduit 32, and pass upwardly through cone 35 into cone 40, the larger particles dropping to the bottom of the tailings-hopper 40 while the particles which have been reduced to the desired size, or less, are carried by the air current into eye 44 and thence out through conduit 37 to suitable means, such as separator 38, where they are separated from the carrying air.

Air arising at hopper 20 is withdrawn through passage 45 so that, if the comminuted material fed to the machine is hot a considerable quantity of heat is diverted from the bearings which support the two rotors.

Heretofore, in the use of hammer mills, it has been found necessary to provide means for cooling the rotor bearings. In my present device, I have found in actual practice that even though calcining temperatures of from 480 to 500 F. be established within cone 35, it has not been necessary to artificially cool the rotor bearings.

This result is apparently due to maintenance of a substantial minus air pressure in the region of the rapidly revolving hammers and the establishment of an upwardly moving air current between the rotors and the hot air inlet at 32.

I have found in practice that materials may be very finely reduced at a much lower power expenditure than has heretofore been found possible in the use of hammer mills.

I claim as my invention:

1. In a hammer mill, a receiving rotor and a discharging rotor each having a circumferential series of radiating hammers, means for rotatably supporting said rotors upon laterally spaced axes with the paths of travel of the ends of said hammers approximating tangency, an enclosing casing for said rotors formed to provide two substantially cylindrical chambers, the axes of said chambers being parallel and being spaced apart a distance less than the sum of the radii of said chambers but greater than one-half such sum, said casing having a down flow feed inlet outside the vertical axial plane of the receiving rotor, an upflow discharge passage outside the vertical axial plane of the discharging rotor, and means for sealing said inlet against substantial air flow into the region of said hammers.

2. In a hammer mill, a receiving rotor and a discharging rotor each having a circumferential series of radiating hammers, means for rotatably supporting said rotors upon laterally spaced axes with the paths of travel of the ends of said hammers approximating tangency, an enclosing substantially air tight casing for said rotors with arc-shaped imperforate bottoms merging along a ridge intermediate said axes and spaced below the axial plane, and with arc-shaped cover elements medially overlying said rotors, said casing having a down flow feed inlet outside the vertical axial plane of the receiving rotor, sealing means in said inlet substantially preventing air flow therethrough, and an upflow discharge passage outside the vertical axial plane of the discharging rotor, and a tailings hopper arranged above the rotors in position to receive tailings from said discharge passage and discharge the same to the receiving rotor at a point adjacent the discharging rotor and above the horizontal axial plane of said receiving rotor and within the path of travel of the ends of the hammers thereof.

3. In a hammer mill, a receiving rotor and a discharging rotor each having a circumferential series of radiating hammers, means for rotatably supporting said rotors upon laterally spaced axes with the paths of travel of the ends of said hammers approximating tangency, an enclosing casing for said rotors with arc-shaped imperforate bottoms merging along a ridge intermediate said axes and spaced below the axial plane, and with arc-shaped cover elements medially overlying said rotors, said casing having a down flow feed inlet outside the vertical axial plane of the receiving rotor, and an upflow discharge passage outside the vertical axial plane of the discharging rotor, and a tailings hopper arranged above the rotors in position to receive tailings from said discharge passage and discharge the same to the receiving rotor at a point above the horizontal axial plane of said receiving rotor and within the path of travel of the ends of the hammers thereof, air suction means having a capacity to maintain sub-atmospheric pressure above the rotors, a conduit enveloping the tailings hopper and forming a communication between said discharge passage and suction means and an air inlet leading into said conduit between said hopper and suction means of such character as to enable the establishment of a particle-sustaining air current from said air inlet toward the suction means.

4. In a hammer mill, a receiving rotor and a discharging rotor each having a circumferential series of radiating hammers, means for rotatably supporting said rotors upon laterally spaced axes with the paths of travel of the ends of said hammers approximating tangency, an enclosing casing for said rotors with arc-shaped imperforate bottoms merging along a ridge intermediate said axes and spaced below the axial plane, and with arc-shaped cover elements medially overlying said rotors, said casing having a down flow feed inlet outside the vertical axial plane of the receiving rotor, and an upflow discharge passage outside the vertical axial plane of the discharging rotor, and a tailings hopper arranged above

the rotors in position to receive tailings from said discharge passage and discharge the same to the receiving rotor at a point above the horizontal axial plane of said receiving rotor and within the path of travel of the ends of the hammers thereof, air suction means having a capacity to maintain sub-atmospheric pressure above the rotors, a conduit enveloping the tailings hopper and forming a communication between said discharge passage and suction means and an air inlet leading into said conduit between said hopper and suction means of such character as to enable the establishment of a particle-sustaining air current from said air inlet toward the suction means, and a second tailings-hopper interposed between said air inlet and suction means.

5. In a hammer mill, a receiving rotor and a discharging rotor each having a circumferential series of radiating hammers, means for rotatably supporting said rotors upon laterally spaced axes with the paths of travel of the ends of said hammers approximating tangency, an enclosing substantially air-tight casing for said rotors with arc-shaped imperforate bottoms merging along a ridge intermediate said axes and spaced below the axial plane, and with arc-shaped cover elements medially overlying said rotors, said casing having a down flow feed inlet outside the vertical axial plane of the receiving rotor, and an upflow discharge passage outside the vertical axial plane of the discharging rotor, means for supplying a substantially horizontal gaseous current to said casing in a plane above said cover elements, and a tailings hopper arranged above the rotors but below said horizontal plane in a region of substantially zero air current and in position to receive tailings, through a substantially dead air passage, from the discharge passage and discharge the same into said enclosing casing.

6. In a hammer mill, a casing providing a chamber, at least one rotor mounted in said chamber and having a circumferential series of radiating hammers, a down flow inlet to said chamber, an upflow outlet from said chamber, said hammers being arranged to throw material introduced into said chamber outwardly through said outlet, means for supplying a substantially horizontal blanket of gas in said casing above said rotors, and a tailings hopper arranged above the rotor in position to receive tailings from said outlet and to discharge the same into said chamber, the outlet of said hopper being disposed below said blanket, whereby the path of said tailings, after leaving said outlet, lies substantially entirely in a region of zero air currents.

7. In a hammer mill, two rotors mounted for rotation on parallel axes, a series of hammers carried by each rotor, a substantially air-tight casing enclosing said rotors, said casing providing arc-shaped cover elements, one for each rotor, overlying said rotors, a down-flow feed inlet leading to one of said rotors an upflow discharge passage leading from the other of said rotors and separated from said inlet by said cover elements, and upwardly diverging plane members overlying said cover elements and creating a dead air space thereabove, said plane members having their lower spaced ends disposed above the axial plane of said rotors and between the axes thereof, and serving as a means for returning oversize material to said rotors.

8. In a hammer mill, two rotors mounted for rotation on parallel axes, a series of hammers carried by each rotor, a substantially air-tight casing enclosing said rotors, said casing provided arc-shaped cover elements, one for each rotor, overlying said rotors, a down-flow feed inlet leading to one of said rotors, and upflow discharge passage leading from the other of said rotors separated from said inlet by said cover elements, and upwardly diverging plane members overlying said cover elements and creating a dead air space thereabove, and a tailings hopper disposed above said plane members and adapted to discharge through said dead air space to said plane members, said plane members having their lower spaced ends disposed above the axial plane of said rotors and between the axes thereof, and serving as a means for returning oversized material to said rotors.

WILLIAM J. EHRSAM.