

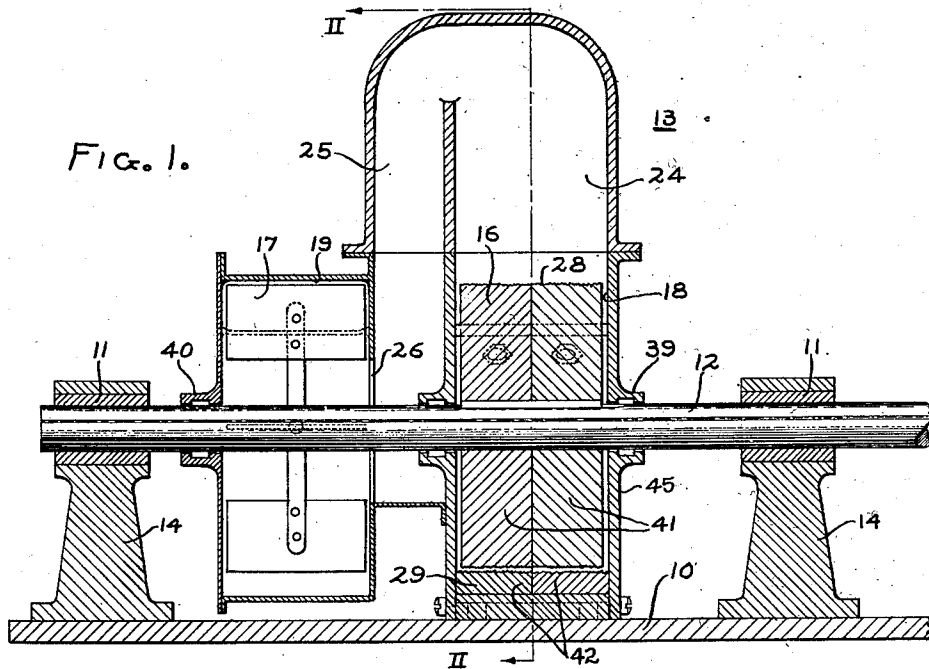
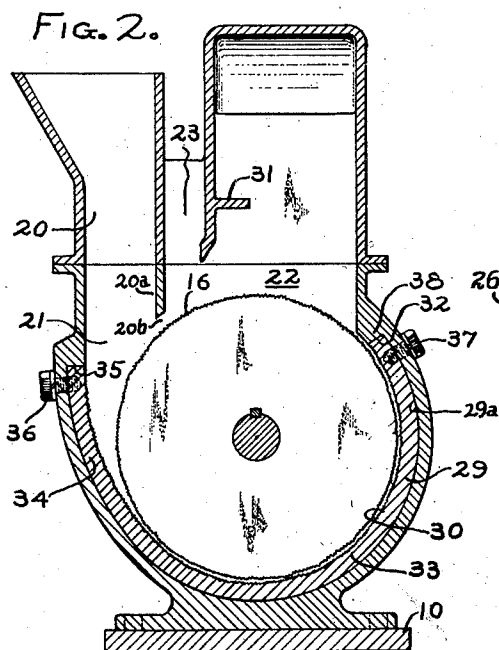
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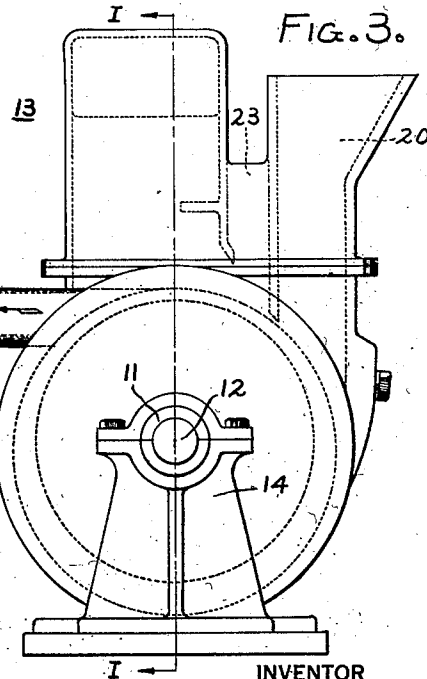
PULVERIZER

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WITNESSES:

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PULVERIZER

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Substitute for abandoned application Serial No.
689,513, September 15, 1933. This application
March 14, 1935, Serial No. 11,179

6 Claims. (Cl. 83—14)

My invention relates to pulverizing apparatus and it has for an object to provide means of this character wherein pulverant material acted upon is torn apart between relatively movable grinding surfaces of the granular abrading type, and the present application is for the same subject-matter as my prior application, Serial No. 689,513, filed September 15, 1933, and now abandoned.

Pulverizing apparatus for processing pulverant materials, such as coal, are of various types. There is the impact type, which depends upon lumps or particles being hit by movable members and being cast against stationary members. The effectiveness of impact apparatus diminishes with the particle size. The ball or roller type depends upon a crushing action exerted by balls or rollers on the material. Both of these types involve losses because particles acted on are not sufficiently restrained—in the impact type, the particles are free and the impact action becomes less and less effective as the particle size is reduced; and, in the roller type, there is only limited particle restraint. On the other hand, my improved pulverizer greatly extends the use of the principle of particle restraint by the use of a stationary member having a roughened or granular abrading internal arcuate surface arranged relatively close to the roughened or granular abrading peripheral surface of a wheel, the stationary surface serving to hold or to restrain material conveyed between the surfaces by the wheel so that the wheel is highly effective as a hammer-like element in crushing particles held or restrained by the anvil-like stationary surface, this action also being accompanied by attrition due to rubbing between particles. In this way, effective pulverization may be had with a minimum expenditure of energy. Side plates fit closely with respect to the wheel and the stationary member to provide an arcuate pulverizing passage, material being supplied to the inlet end of the passage and pulverized material being discharged from the outlet end of the latter. A further object of my invention is to provide apparatus of this character and having this mode of operation.

A further object of my invention is to provide apparatus including members defining an arcuate pulverizing passage with a feed chamber or hopper supplying material to the inlet end of the passage and a separation chamber into which pulverized material is discharged from the outlet end of the passage, lighter particles being conveyed away from the separation chamber and

heavier particles being returned to the inlet end of the passage.

A further object of my invention is to provide a wheel having a peripheral, granular abrading surface and a member having an arcuate surface cooperating with the peripheral surface to define an arcuate pulverizing passage, the arcuate surface including a first part which converges with respect to the periphery of the wheel in the direction of movement of the latter to provide a first section of the passage wherein pulverization occurs largely by crushing and a second part which is of granular abrading character and is closely spaced with respect to the wheel periphery to define a second section receiving material from the first section and subjecting it to impact and attrition actions to effect pulverization.

A further object of my invention is to provide a pulverizer including a wheel having a peripheral, granular abrading surface and a member having an arcuate granular abrading surface cooperating with the peripheral surface to define an arcuate pulverizing passage together with a supply chamber or hopper for supplying material to the inlet of the passage and a separation chamber transversely of which material leaving the passage outlet is thrown tangentially by the wheel periphery, air entering the separation chamber between the wheel periphery and the stream of material and flowing across the latter to effect separation of lighter from heavier particles, the heavier particles dropping onto the wheel periphery and being conveyed by the latter to the passage inlet.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a vertical longitudinal sectional view taken along the line I—I of Fig. 3;

Fig. 2 is a transverse sectional view taken along the line II—II of Fig. 1; and,

Fig. 3 is an end elevational view of the apparatus.

Referring to the drawing more in detail, I show a frame or bed plate 10 having bearings 11 for the drive shaft 12 and carrying the housing at 13. As shown, the bearings 11 are carried by pedestals 14 disposed at either side of the housing, it being understood that the bearings may be supported in any suitable manner.

The drive shaft 12 carries a high-speed grinding wheel 16 and a fan or blower runner 17, and the housing, at 13, is formed with a chamber 18

for the grinding wheel and with a chamber 19 for the fan or blower runner.

The housing, at 13, is provided with an inlet conduit or hopper 20 for material to be ground, such conduit being disposed somewhat tangential with respect to the wheel to provide the cusp feed chamber 21, one wall of which is formed by the periphery of the grinding wheel.

Ground material cast tangentially from the periphery of the wheel 16 passes upwardly and transversely of the outlet chamber 22 and air from the atmosphere entering the inlet 23 at the side of the said chamber opposite to the region of tangential entry of ground material passes upwardly underneath the discharging sheet of material and carries in suspension the finer particles of the latter up through the outlet conduit 24 and thence through the down-comer 25 to the eye 26 of the fan or blower 17 having a discharge outlet 26a.

The grinding wheel 16 has a granular abrasive peripheral surface 28 preferably cylindrical and a stationary arcuate grinding member 29 is arranged interiorly of the housing and it has an internal curved granular abrasive surface 30 for cooperation with the surface 28.

The stationary grinding member extends part way around the wheel 16, the ends being separated by the inlet and outlet conduits 20 and 24. As already pointed out, the inlet conduit is disposed somewhat tangentially with respect to the down-moving side of the wheel to provide the cusp feed chamber 21. The outlet chamber 22 extends sufficiently toward the up-moving side of the wheel that the curtain of material cast off tangentially from the wheel has sufficient upward trajectory to provide for air entering the inlet 23 to pass underneath and through the curtain to carry in suspension the lighter ground particles. The heavier particles drop back on top of the wheel and are carried around and are re-ground. A deflector 31 is disposed so as to prevent the reflection of heavier particles up the outlet conduit.

The wall 20a between the inlet conduit 20 and air inlet 23 is spaced sufficiently from the wheel periphery, as indicated at 20b to provide for the ready passage of heavier particles from the separating chamber 22 to the feed chamber 21.

The space 20b serves the additional purpose of preventing arching in the feed conduit or hopper. If the wall 20a extended down adjacent to the wheel periphery, the angle therebetween would provide an abutment for an arch and arching would readily occur on that account; however, due to the space, there is considerable motion of material in such space and agitation adjacent to the lower end of the wall 20a that arching is prevented.

As shown, the grinding wheel chamber 18 has a removable side 45, which, when removed, exposes the seat 29a at one side to permit removal or insertion of the member 29 when the screws 36 and 37 are withdrawn.

One end 32 of the stationary pulverizing member is disposed, referring to the direction of rotation of the wheel 16, adjacent to the near side of the outlet chamber 22; the major portion 33 of the member 29 is of substantially uniform radius of curvature to provide concentric pulverizing faces 28 and 30; and the portion 34 of the member 29 adjacent to end 35 thereof is formed of larger radius of curvature taken about a center eccentric to the wheel axis and located above the latter so that such portion may provide

a wall of the cusp chamber 21 opposite to the moving wall thereof constituted by the wheel periphery, the portion 34, with the wheel periphery, defining a convergent crushing zone or section supplying material to the impact and attrition zone or section.

The housing is formed with an arcuate seat 29a for the member 29 and the latter is held in place by screws 36 and 37 and by abutments at the ends of the seat, which takes the peripheral thrust, thereby relieving the screws of shearing stress.

The granular abrading or pulverizing surfaces 28 and 30 are preferably provided incident to casting of the metallic wheel and arcuate member parts 16 and 29, respectively. For example, silicon carbide material of sufficient fineness may be so embedded. To carry out this operation, the desired mold surfaces are coated with the abrasive material carried by a suitable vehicle or binder so that, when filled with molten metal, the abrasive particles will become firmly rooted in the metal.

The wheel 16 may be made of any suitable width, this being facilitated by building up the wheel of laminae 41 of suitable thickness. Likewise, the arcuate member 29 is preferably comprised by one or more adjacent sections 42.

The glands or seals 39 and 40 are obviously subjected internally to slight sub-atmospheric pressure, due to the impeller 17, with the result that atmospheric pressure acting externally is effective to prevent leakage of dust at the ends of the housing.

From the foregoing, it will be apparent that I have provided pulverizing apparatus which effectively and efficiently utilizes the applied energy in pulverizing by crushing and by impact and attrition, the apparatus including a wheel having a peripheral granular abrading surface and a stationary member having an internal arcuate, granular abrading surface cooperating with and so spaced with respect to the wheel periphery as to define a pulverizing passage comprising a first section in which pulverization occurs largely due to crushing and a second section in which pulverization is due to impact and attrition. The crushing zone or section provides particles which are small enough to enter the impact and attrition zone or section; and, as the latter section occupies substantial arcuate extent, the material, in being traversed there-through, has the opportunity of being crushed time and time again between the surfaces. Not only is the wheel or disc the active element in the two pulverizing zones or sections, but it conveys material progressively through the zones or sections and discharges the latter tangentially and upwardly from the outlet of the pulverizing passage over the top of the wheel so that a current of air entering below the material, not only sweeps the wheel, but it passes upwardly through the discharging curtain of material and carries along in suspension lighter particles, heavier particles, incapable of being carried in suspension, dropping back on top of the wheel to be conveyed by the latter to the inlet of the pulverizing passage. Preferably, the outlet conduit is provided with a deflector to prevent heavier particles from being thrown up the conduit. Also, the wall of the feed conduit is spaced from the wheel a sufficient distance to provide for the free conveyance of heavier particles into the feed chamber, the space so provided preventing arching of material in the feed conduit. Stated in an-

other way, the single rotary element of my pulverizer, during each revolution, is responsible for the following functions in sequence: feeding, crushing, grinding by impact and attrition, separation of particle sizes, and return of coarse or heavier particles to the inlet end of the pulverizing passage.

In operation, pulverization takes place in two different ways, first, by a crushing or crowding action occurring in the converging portion of the pulverizing passage, and, second, by impact or attrition in the portion of the passage of approximately uniform section. The term "pulverize" is used herein to designate any or all of the modes of particle size reduction described herein, and the term "pulverizing passage" includes either a crushing section followed by an impact and attrition section or the latter alone.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a pulverizer for pulverant materials, a wheel having a cylindrical and granular peripheral abrading surface; a member having an internal arcuate and granular abrading surface closely spaced with respect to the wheel surface; side plates fitting closely with respect to the wheel and the member and cooperating with said surfaces to define an arcuate pulverizing passage; means for supplying material to be ground to the inlet end of said passage; material being ground and moved along the passage due to movement of the wheel; a separation chamber at the discharge end of said passage and transversely of which material discharged from the passage is thrown by the wheel surface, the bottom of said separation chamber being constituted by the wheel surface; means providing for a current of air entering the separation chamber between the wheel surface and the tangential stream of discharging material and flowing across the latter to effect separation of lighter from heavier particles and to carry away the lighter particles in suspension, the heavier particles dropping onto the wheel surface; and means utilizing the wheel surface to convey heavier particles from the separation chamber to the inlet end of said passage.

2. In a pulverizer, a rotary disc having a roughened cylindrical periphery, a member having an internal roughened arcuate portion which is closely spaced with respect to the disc periphery and cooperates with the latter to define an arcuate pulverizing passage, means including a feed chamber for supplying material to be pulverized to the inlet end of the passage, said feed chamber having the wall thereof which extends transversely of the disc periphery spaced from the latter to provide a first opening, a separation chamber open to the periphery of the disc and disposed at the discharge end of the passage so that material leaving the latter is discharged tangentially by the disc transversely of the separation chamber, said separation chamber having its wall opposite to the passage outlet and extending transversely of the wheel periphery spaced from the latter to provide a second opening, and means for inducing a current of air to

enter said second opening underneath the sheet of material discharged tangentially from the passage outlet to pass upwardly across said sheet to effect separation of lighter from heavier particles, the lighter particles being conveyed away by the air current and the heavier particles dropping on the disc periphery, said separation chamber being relatively so arranged with respect to the disc periphery that the latter is effective to convey heavier particles dropping thereon through said second and first openings and into the feed chamber.

3. The combination as claimed in claim 2 with a deflector springing from said transverse wall of the separation chamber for preventing reflection of heavier particles outwardly of the latter.

4. In a pulverizer, a rotary disc having a roughened cylindrical periphery, a member having first and second arcuate portions cooperating with the disc periphery to define an arcuate pulverizing passage, the first arcuate portion converging with respect to the wheel periphery and in the direction of movement of the latter to provide a crushing section and the second arcuate portion being rough and closely spaced with respect to the wheel periphery to provide an impact and attrition section wherein material received from the crushing section is pulverized, means providing a feed chamber for feeding material to the passage inlet, said feed chamber having the wall thereof which extends transversely of the disc periphery spaced from the latter to provide a first opening, means providing a separation chamber open to the periphery of the disc and disposed at the outlet of the pulverizing passage so that material leaving the latter is discharged tangentially by the disc transversely of the separation chamber, said separation chamber having its wall opposite to the passage outlet and extending transversely of the disc periphery spaced from the latter to provide a second opening, means for inducing a current of air to enter the second opening underneath the sheet of material discharged tangentially from the passage outlet and to pass upwardly across the sheet to effect separation of lighter from heavier particles, the lighter particles being conveyed away by the air current and the heavier particles dropping back on the disc periphery, said separation chamber being relatively so arranged with respect to the disc periphery that the latter is effective to convey heavier particles dropping thereon through said second and first openings to the passage inlet, and a deflector springing from said transverse wall of the separation chamber and serving to prevent the reflection of heavier particles outwardly of the latter.

5. In a pulverizer for pulverant materials, a wheel having a cylindrical and granular abrading surface, a stationary member having an internal arcuate and granular abrading surface, side plates fitting closely the sides of said wheel and of said member and said surfaces of the wheel and of the member being closely spaced to provide an arcuate pulverizing passage through which material is traversed by the granular abrading surface of the wheel, a hopper for feeding material to the inlet of said passage, a separation chamber arranged between the outlet of said passage and the hopper, said separation chamber having its bottom formed by the wheel periphery and being so disposed with respect to the wheel periphery that the latter is effective to throw material leaving the passage outlet tangentially therefrom

and upwardly and transversely of the separation chamber, means providing for a current of air entering the separation chamber between the wheel periphery and the tangentially discharging stream of material for passage across the latter to effect the separation of lighter from heavier particles and to conduct the lighter particles to a desired point of discharge, the heavier particles dropping onto the wheel periphery, and means utilizing the wheel periphery to convey heavier particles dropping thereon in the separation chamber from the latter to the inlet of the pulverizing passage.

6. In a pulverizer for pulverent materials, a wheel having a cylindrical and granular peripheral abrading surface; a fixed member having first and second internal arcuate surfaces and at least the second surface being of a granular abrading character; the second surface having a substantially uniform radius of curvature whose center is concentric with the wheel and the first surface having a radius of curvature larger than that of the second surface and whose center is eccentric to and above the wheel axis and both surfaces having a common tangent where they join, whereby the first surface converges with re-

spect to the surface of the wheel in the direction of movement of the latter to provide a first pulverizing section wherein pulverization is due largely to crushing and said second surface is closely spaced with respect to the wheel surface to provide a second pulverizing section wherein pulverization takes place both by impact and by attrition; side plates fitting closely with respect to the wheel and the member to define an arcuate pulverizing passage including said first and second sections; means for supplying material to be ground to the inlet end of said passage; material being ground and moved along the passage due to movement of the wheel; a separation chamber at the discharge end of said passage and transversely of which material is discharged tangentially by and from the peripheral surface of the wheel; means providing for a current of air entering the separation chamber between the peripheral surface of the wheel and the tangential stream of material and flowing across the latter to carry away lighter particles in suspension; and means for conveying heavier particles from the separation chamber to the inlet of said passage.

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