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PULVERIZING MILL

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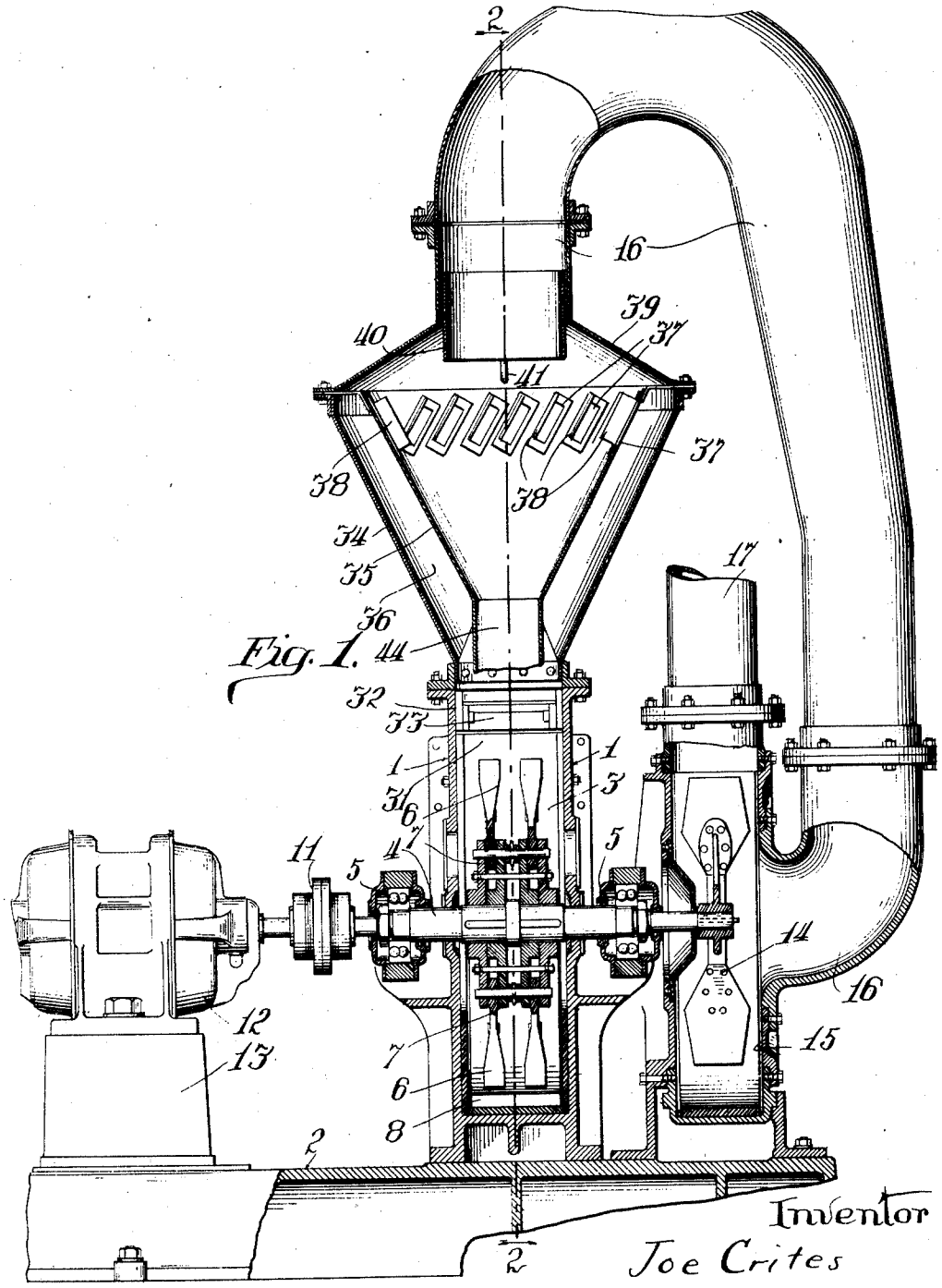

Fig. 1.

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Fig. 2.

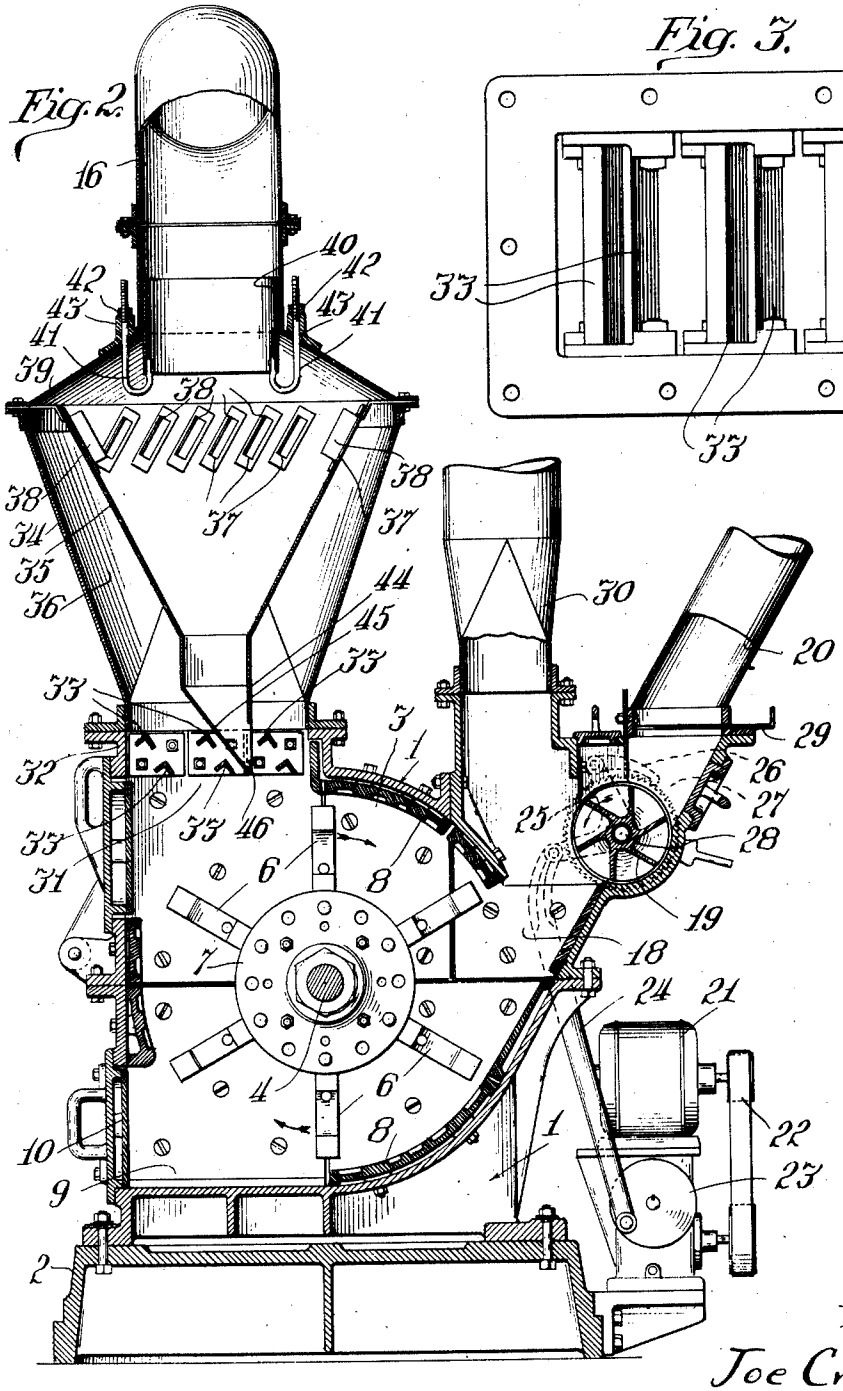

Fig. 3.

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UNITED STATES PATENT OFFICE.

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PULVERIZING MILL.

Application filed December 31, 1926. Serial No. 158,206.

This invention relates to means for pulverizing materials, and more particularly to improvements in a pulverizing mill of the impact type, in which a plurality of rotary hammers or beaters operate within a substantially cylindrical beater chamber. This apparatus is especially designed for pulverizing coal for feeding directly to a furnace. The apparatus is designed to remove the fine materials as rapidly as they are formed, thus avoiding unnecessary pulverization, and the consequent loss of power that would be consumed by useless work done on this material if left in the pulverizer longer than necessary. At the same time means is provided to throw directly back into the pulverizer chamber particles insufficiently pulverized.

The pulverizer comprises a substantially closed beater chamber in which a plurality of swing hammers or beaters rotate about a horizontal axis. Substantially tangential inlet and outlet openings are arranged at opposite sides of the upper portion of the chamber, and so positioned with relation to the direction of rotation of the hammers that there will be a tendency for the material to be ground to be drawn into the chamber, and for material that has been acted upon by the hammers to be thrown out centrifugally through the outlet opening. A conduit for the material to be ground leads to the inlet opening, and a rotary feeder is positioned in the discharge end of this conduit to feed measured quantities of material to the pulverizer as desired. An inlet for heated air communicates with the discharge end of the first conduit in such a way that this air, which is drawn into the pulverizer with the solid materials, first acts to heat the rotary feeder and the material carried thereby to prevent moist materials from sticking in the feeder.

A separator, of substantially the modified cyclone type disclosed in the patent to Pool 870,383, granted November 5, 1907, has its inlet in direct communication with the outlet opening of the pulverizing chamber, and the tailings collected in the separator are discharged directly back into the pulverizing chamber. This separator involves certain improvements whereby the fineness of the pulverized material may be regulated, as set forth in detail hereinafter.

Improved means is positioned in the outlet opening of the pulverizer chamber for preventing large particles and insufficiently pulverized material from being drawn into the separator, or thrown from the chamber by the centrifugal action of the hammers. Preferably this means consists of a plurality of baffle bars, arranged in staggered relation within the opening, and having concaved lower faces opposed to the direct path in which materials will be thrown from the pulverizing chamber, so that such material will be deflected back into the chamber. The finer, properly pulverized material carried in suspension in the air will be drawn in circuitous paths between these baffle members, into the separator.

One of the main objects of this invention is to provide improved means for separating the properly pulverized material from the unpulverized material, and for returning such unpulverized material directly back into the pulverizing chamber.

Another object is to provide improved concaved baffle bars for preventing the throwing of large particles from the pulverizing chamber through the outlet opening by the centrifugal force of the beater hammers.

Another object is to provide improved means for discharging tailings from the separator directly back into the pulverizing chamber, between these baffle bars.

Another object is to provide improved means for feeding heated air to the pulverizer so as to prevent sticking of moist materials in the feeding apparatus.

Another object is to provide a compact pulverizing apparatus of the type briefly described hereinabove, designed to economically produce pulverized fuel and deliver same direct to a furnace.

Other objects and advantages of this invention will be apparent from the following detailed description of one approved form of the apparatus.

In the accompanying drawings:

Fig. 1 is an elevation of the assembled apparatus, the pulverizing chamber, fan chamber, and separator being shown in central vertical section.

Fig. 2 is a central vertical section taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a plan view, on an enlarged scale, of the frame member carrying the baffle bars.

A suitable number of connected metallic frame members 1 are mounted on a supporting base 2, and enclose a pulverizing chamber or beater chamber 3. Extending centrally through this chamber is a horizontal shaft 4, preferably supported adjacent its ends in roller bearings 5 positioned outside of the pulverizing chamber. A plurality of swing hammers or beaters 6 are pivoted at their inner ends to a spider assembly 7 mounted on shaft 4. When the shaft 4 is rotated, these hammers are adapted to swing freely, within certain limits, and their outer ends revolve in proximity to a series of breaker plates or liners 8 mounted around the inner circumference of the pulverizing chamber 3. The solid material which is fed into the chamber is pulverized by direct impact of the hammers 6, or by being thrown by these hammers against the liners 8, or by being ground between the hammers and the liners. In order to trap heavy bodies, not readily crushed, such as pieces of metal, a pocket 9 is provided in the lower portion of the pulverizing chamber, the trapped material being accessible through the removable door 10.

One end of shaft 4 is driven through flexible connection 11 from the motor 12 mounted on pedestal 13 supported by base 2. The fan 14, by means of which suction is created for withdrawing the pulverized material suspended in air from the mill, may conveniently be secured on the other projecting end of shaft 4, the fan 14 being enclosed in a fan chamber 15 also supported by the base 2. Opening centrally into this fan chamber is the conduit 16 through which the pulverized material is drawn from the mill through the separator, hereinafter described. The pulverized material suspended in air is projected from the fan chamber 15 through conduit 17 to the furnace, or to a storage receptacle, if desired.

A substantially tangential inlet opening 18, for air and the solid materials to be pulverized, is provided in one side of the pulverizing chamber, preferably so positioned that the materials will be drawn down into the chamber by the whirling action of the hammers, which rotate in the direction indicated by the arrows, Fig. 2. Mounted in the casing approximately above the inlet opening 18, is a feeder 19, adapted to deliver measured quantities of the material to be pulverized from the conduit 20 into the pulverizing chamber. The feed roll 19 is rotated intermittently, in the direction of the arrow, by means of motor 21, reduction gearing 22, disc 23, pitman 24, bell crank 25, pawl 26, and ratchet 27 mounted on the shaft 28 of feed roll 19. The slidable gate or valve 29 is adapted to limit the flow of material from conduit 20 to the feed roll 19.

A conduit 30 is provided for directing air, preferably heated air, into the pulverizing chamber. Instead of leading this air directly into the chamber 3, as is usual in such mills, the conduits 20 and 30 are arranged to converge above the inlet opening 18, so that the heated air from conduit 30 will be directed against the feed roll 19 and the material carried thereby. In case the coal or other material, fed in by the pocketed feed roll 19 is moist, the heated air from conduit 30 will tend to dry this material and the feed roll, so that the material will not stick to the roll and clog or retard the mechanism. The heated air passes into the pulverizing chamber through inlet opening 18 along with the material to be pulverized. The air fed in through conduit 30 may be preheated in any approved manner, or may consist wholly or in part of flue gases withdrawn from the furnace.

The outlet opening 31 leads tangentially from the opposite upper side of the pulverizing chamber 3, being so located that the rotating hammers 6 tend to cause a current of the material upwardly through the said opening. The air and pulverized material suspended therein are also drawn upwardly through this opening by the suction created in conduit 16 by fan 14. Mounted in any approved manner on the frame member 32 which surrounds the outlet opening 31, is a plurality of baffle members or deflecting bars 33. These bars are preferably mounted parallel with one another transversely of the opening 31, and in two or more rows, the bars being staggered with relation to one another so that the air and pulverized material suspended therein must follow a circuitous path in passing upwardly through the outlet 31. The lower face of each bar or baffle is concave, preferably by forming these bars of angular cross section, as shown, the concave face of each bar being directly opposed to the paths along which solid materials will be thrown up centrifugally from the hammers 6. In this way, all large solids or insufficiently pulverized materials thrown up against these baffles 33 will be deflected downwardly into the pulverizing chamber 3 to receive further treatment. Materials which have been sufficiently pulverized to be carried in suspension in the air currents will pass along the circuitous paths between the bars or baffles 33 upwardly through the outlet opening 31.

The outlet passage 31 leads directly into a separator of substantially the type disclosed in the Pool patent, hereinabove referred to, although the present separator involves some improvements designed especially for this present mill. The separator comprises an outer casing 34 in the form of an inverted truncated cone, having its smaller end connected directly with the outlet opening 31. A smaller inner conical drum 35 is suspended centrally within the outer drum 34 by having its larger upper end supported by the upper end of drum 34. The air and suspend-

ed materials are drawn up between the baffles 33 into the annular space 36 between the drums 34 and 35. In the upper portion of the inner drum 35 is an annular series of elongated openings 37, each provided with an inwardly projecting vane 38. Preferably the openings 37 are inclined at an angle to the vertical, as shown, and the vanes 38 are inclined downwardly and at acute angles to the circumference of the drum so that the suspended materials drawn through the openings 37 are given a somewhat downwardly projected whirling motion within the inner drum 35. The heavier materials or tailings will be deposited within the inner cone 35, while the air carrying the properly pulverized material will be drawn upwardly into the conduit 16, which communicates with the upper end of the separator through the conical closure 39. A cylindrical sleeve 40, open at both ends, is slidably suspended within the lower end of conduit 16, and is supported for vertical adjustment by means of the rods 41, the threaded ends of which extend through nuts 42 supported on brackets 43 on the cover plate 39. By adjusting the sleeve 40 up or down, the fineness of the material which will find its way out from drum 35 into the conduit 16 may be regulated. The lower the adjustment of the sleeve the finer the material that finds its way into the conduit 16.

The inner drum 35 terminates at its lower end in a spout 44, which extends downwardly between certain of the baffle bars 33 so as to direct the tailings collected by the separator directly back into the pulverizing chamber 3. It will be noted that one face 45 of this spout is almost directly opposed to the path of materials thrown up by the revolving hammers, and the opening 46 at the lower end of the spout is so directed that the tailings delivered from the spout will be drawn into the chamber 3 by the current of rotating material therein.

In operation, the material to be pulverized is fed in at the proper rate by the revolving feed roll 19, is heated by the incoming current of air from conduit 30, and drawn in along with this air to the pulverizing chamber 3 where it is subjected to the continued impact of the hammers 6. As soon as this material is pulverized sufficiently to become suspended in the air, it is drawn up by the air current passing between the baffles 33 into the separator. Any insufficiently pulverized material which is thrown up into this outlet passage by the revolving hammers is deflected back into the pulverizing chamber by the baffles 33, as already described. The suspended material is drawn with a whirling motion into the inner drum 35 where the heavier materials or tailings are deposited, and the properly pulverized material is drawn up into the conduit 16, passing downwardly through fan chamber 15 and being thence propelled through conduit 17 to the furnace. The tailings collected in the spout or chute 44 are drawn by gravity, augmented by the suction effect of the revolving hammers, through opening 46 into the pulverizing chamber. The materials which will not pulverize are collected in the trap 9 and taken out at suitable intervals by removing the door 10.

The arrangement above described permits the use of a relatively small separator with a relatively large pulverizer, and the various connections are compactly and economically arranged, so that the apparatus has a comparatively large output in proportion to its initial and operating costs, all as compared with similar mills heretofore in use.

I claim:

1. In a pulverizing apparatus, a pulverizing chamber, a pulverizing element therein, the chamber having an outlet, means for withdrawing air and suspended pulverized material through the outlet, and a plurality of baffle members positioned in staggered relation at the outlet, the members having concave faces opposed to the direct path of the materials to prevent unpulverized materials being thrown from the chamber by the pulverizing element.

2. In a pulverizing apparatus, a pulverizing chamber, a pulverizing element therein, a separator in communication with said chamber, means for drawing air and suspended pulverized material from said chamber into the separator, and a plurality of baffle members positioned between the chamber and separator and having concaved faces opposed to the direct path of the materials to prevent unpulverized materials being thrown from the chamber by the pulverizing element.

3. In a pulverizing apparatus, a pulverizing chamber, a pulverizing element therein, a separator in communication with said chamber, means for drawing air and suspended pulverized material from said chamber into the separator, and a plurality of deflecting bars positioned in staggered relation between the chamber and separator and having concave faces opposed to the direct path of the materials to prevent unpulverized materials being thrown from the chamber by the pulverizing element.

4. In a pulverizing apparatus, a pulverizing chamber, a pulverizing element therein, a separator in communication with said chamber, means for drawing air and suspended pulverized material from said chamber into the separator, and a plurality of baffle bars positioned in staggered relation in superposed rows between the chamber and separator so as to throw unpulverized material back into the chamber, the separator comprising a discharge chute directed between the baffle bars

for delivering tailings directly back into the pulverizing chamber.

5. In a pulverizing apparatus, a pulverizing chamber, a pulverizing element therein, a separator in communication with said chamber, means for drawing air and suspended pulverized material from said chamber into the separator, and a plurality of deflecting bars positioned in staggered relation between the chamber and separator and having concave faces opposed to the direct path of the materials to prevent unpulverized materials being thrown from the chamber by the pulverizing element, the separator comprising a discharge chute directed between the baffle bars for delivering tailings directly back into the pulverizing chamber.

6. In a pulverizing apparatus, a pulverizing chamber, a pulverizing element therein, the chamber having an inlet opening, a pair of converging conduits leading to said opening, one conduit carrying solid material to be pulverized and the other heated air, and a feeder positioned in the discharge end of the first conduit, the discharge end of the second conduit being so inclined as to direct the heated air against said feeder and the material carried thereby.

7. In a pulverizing apparatus, a pulverizing chamber, a pulverizing element therein, the chamber having an inlet opening, a pair of converging conduits leading to said opening, one conduit carrying solid material to be pulverized and the other heated air, and a rotary feeder positioned in the discharge end of the first conduit, the discharge end of the second conduit being so inclined as to direct the heated air against said feeder and the material carried thereby.

8. In a pulverizing apparatus, a pulverizing chamber, a pulverizing element therein, a conduit for material to be pulverized leading into said chamber, a movable feeder positioned in the discharge end of this conduit, and a conduit for heated air which is so formed at its discharge end as to direct the air against said feeder before the air passes along with the material into the pulverizing chamber.

9. In a pulverizing apparatus, a pulverizing chamber, a pulverizing element therein, a conduit for material to be pulverized leading into said chamber, a rotary feeder positioned in the discharge end of this conduit, and a conduit for heated air which is so formed at its discharge end as to direct the air against said feeder before the air passes along with the material into the pulverizing chamber.

10. In combination with a pulverizing apparatus including a pulverizing chamber, a pulverizing element rotating therein on a horizontal axis, the chamber having an upper outlet opening positioned substantially tangentially to the rotating element so that the element will tend to project pulverized material through the opening, a separator comprising an outer conical casing and an inner conical drum positioned over the outlet opening, the smaller lower end of the casing fitting the outlet opening, a plurality of baffle bars having concaved lower faces positioned in the outlet opening to prevent the projection of unpulverized material from the chamber, and a discharge spout leading from the smaller lower end of the drum between the baffle bars, means for feeding material and air to the chamber, and means for drawing air and suspended pulverizing material through the outlet opening and the separator.

11. In combination with a pulverizing apparatus including a pulverizing chamber, a pulverizing element rotating therein on a horizontal axis, the chamber having an upper outlet opening positioned substantially tangentially to the rotating element so that the element will tend to project pulverized material through the opening, a separator comprising an outer conical casing and an inner conical drum positioned over the outlet opening, the smaller lower end of the casing fitting the outlet opening, a plurality of baffle bars having concaved lower faces positioned in staggered relation in superposed rows in the outlet opening to prevent the projection of unpulverized material from the chamber, and a discharge spout leading from the smaller lower end of the drum between the baffle bars, the lower portion of the spout being inclined so that one side wall will oppose the material being thrown up by the rotating element, means for feeding material and air to the chamber, and means for drawing air and suspended pulverized material through the outlet opening and the separator.

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