HAMMER MILL STRUCTURE

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This invention relates to a new and useful improvement in a grinding mill structure, and more particularly in the type of a grinding mill structure referred to as a hammer mill.

It is an object of this invention to provide for a full circle grinding operation.

It is another object of this invention to provide an improved in a hammer mill screen design and construction such that material to be ground does not recirculate and build up on the screen, but is constantly returned into the hammers.

It is also an object of this invention to provide such efficient and effective air circulation within the grinding chamber that there is no need for an external dust collector.

It is a further object of this invention to provide an improved structure in a screen cover to substantially improve the air circulation within the grinding chamber.

It is also an object of this invention to provide an improved construction of a feed inlet into the grinding chamber for a continuous flow of material, which material flow is aided by the operation of the hammers within the grinding chamber.

These and other objects and advantages of the invention will be fully set forth in the following description made in connection with the accompanying drawings in which like reference characters refer to similar parts throughout the several views and in which:

FIG. 1 is a view of applicant's device in front elevation;

FIG. 2 is a view of applicant's device in side elevation with a portion thereof broken away;

FIG. 3 is a view in longitudinal vertical section on an enlarged scale taken on line 3—3 of FIG. 1 as indicated, and with some portions thereof being broken away and some portions shown in dotted line in alternate position;

FIG. 4 is a view similar to FIG. 1 on a reduced scale with a cover portion thereof being removed;

FIG. 5 is a view in vertical section taken on line 5—5 of FIG. 3 as indicated by the arrows, and with some portions thereof being shown in dotted line;

FIG. 6 is an exploded view in vertical section of a broken away portion of applicant's device; and

FIG. 7 is a view in perspective of a detail of applicant's device.

Referring to the drawings, a preferred embodiment of applicant's apparatus is shown indicated generally by the character 10 and comprising a housing portion 12 substantially parallelepiped in form having side walls 13 and 14 and a top wall 15. Some wall portions are flanged at their bottoms in a conventional manner. The rear side of said portion 12 is open having an angled frame member 16 extending across the upper portion thereof.

Projecting forwardly of said housing portion 12 is a housing portion 20 of substantially reduced height having side walls 22 and 23 forming extensions of said side walls 13 and 14 and having an arcuate top wall 25.

The wall 18 forms a common wall between said housing portions 12 and 20 forming the front wall of the former housing portion and the rear wall of said latter housing portion.

Said housing portion 20 has a front wall 26 of small width which in turn has a forwardly projecting flange portion 28 defining the opening 30 into the chamber 31 formed within said housing portion 20. An inclined strip or plate member 24 having inwardly inclined side wall portions at either end thereof extends across between the bottom ends of said flange portions leading to discharge outlet 27 formed as the bottom of said chamber 31. Said chamber 31 has inclined lower side wall portions 22a and 23a which together with said plate member 24 define the opening of said discharge outlet 27.

Extending rearwardly of said housing portion 12 is a ground supported relatively low base portion 32 supporting a motor 33 of conventional design and having a drive shaft 34 connected by a coupling means 35 to a driven shaft 36 extending within said chamber 31. Said shaft 36 is appropriately journaled in bearing blocks 39 carried on a supporting shelf 40 mounted between the wall 16 and a supporting wall 19 in connection with said housing portion 12. Said shaft has journaled on the forwardly extending portion thereof a rotor assembly 42 having secured about the periphery thereof in a conventional manner a plurality of swing hammers 44. Said rotor assembly equipped with said hammers is of conventional design and is indicated generally by the character 45 as a hammer assembly.

A flange 48 extends forwardly of said wall 18 into said chamber 31 defining a tear drop configuration having its apex portion at the top thereof. Extending forwardly of said wall 18 from within the apex portion of said flange 48 is an arm type of bracket 50 indicated here as being angular in cross section.

Adapted to be carried on said bracket and mounted on said flange is a screen 53. With particular reference to FIG. 7, screen 53 is shown in a preferred embodiment formed of a flat sheet material of suitable mesh which is substantially rectangular in blank and having a width to extend the full width of said hammer assembly.

Said screen is curved to have a tear drop configuration in plan corresponding with the configuration of said flange 48 and the free ends of said screen are angled outwardly and form the apex thereof. An angled bracket 56 comprises a portion overlying said free ends of said screen and a mating portion underlaying said free ends which together with bolts 58 holds the same in locked engagement. Said bracket 56 with said screen depending therefrom in operating position is carried on said bracket 50 with the inner edge portions of said screen overlying said flange 48 and bearing the adjacent surface of said wall 18. The hammer assembly will be contained within said screen and thus formed within said screen is a grinding chamber 60.

Overlying the open end of said screen 53 is a cover member 63 of flat sheet material having a somewhat inset inwardly extending flange 64 to be received within the adjacent edge portion of said screen. Said cover member is provided with a pair of transversely spaced handles 65. Substantially centrally of said cover member 63 and
axially aligned with said hammer assembly 45 is an aperture shown as a circular opening 66 which forms an air inlet. It is noted with reference to FIG. 5 that there is ample space about said screen 53 within the chamber 31 for the circulation of air whereby said chamber 31 forms an air circulation chamber. Overlying said screen cover member 63 to hold the same in operating position is an outer cover member 68 having a configuration in plan of the flange portion 28 and having a forwardly extending rim portion 69 adapted to be carried within said flange 28 and to bear against a stop rib 28b formed within said flange. Said cover member 68 has spaced projecting legs 70 integral with the rim portion 69 which are shown reinforced by connecting ribs 70a. Carried on said cover are handles 71. Spaced about the outer side of said flange in alignment with said legs are toggle clamps 72 of conventional design adapted to embrace said legs and bear against the same with hand screws 73 carried thereby.

Carried by said cover member 68 are spaced hold-down thumb screws 74 threaded through bosses 75 integral with the inner side of said cover. Said screws are adapted to bear against said screen cover 63 to hold the same secure in operating position.

Referring now to FIGS. 3 and 5, the housing portion 12 has disposed therein a hopper 80 having in common with said housing portion its front wall 18. Said hopper has side walls 81 and 82 and a rear wall 83. Said rear wall is forwardly or forwardly inclined lower portion 83a. The side walls 81 and 82 respectively are a radius in width to correspond to the configuration of said rear wall. Said hopper terminates in connection with a slot 112 as will be described.

The inclined portion 83a of said rear wall 83 has an opening therein overlaid by a magnet loaded plate member 86 secured by a hinge 87 at its contact with housing portion 12 and secured by a clamping bar or handle 88 at its upper end portion. This is a conventional cleanout door and the magnet therein collects metallic articles from the material fed into the hopper. Said bar or handle 88 will be appropriately pivoted to said plate member 86.

Inclined downwardly from front to back of said hopper to feed material onto said inclined wall portion 83a is a baffle plate member 90.

Secured to either inner side of said side walls 81 and 82 at either side of said front wall 18 substantially centrally vertically thereof with side washing 90 is a combination of ways 93 within which is vertically disposed a plate door member 94 having in connection therewith linkage 95 comprising a stub or lug portion 96 extending outwardly thereof having a connecting link 97 pivoted thereto and having an elongated crank 98 pivoted to the other end thereof with the free end 98a of said crank being secured to a bar 100 extending therefrom and rigid therewith. Said bar will have its inner end journaled in a boss 102 carried on the wall 81. Said bar will extend through the wall 82 to be journaled through a boss 103 carried on the wall 14 and has secured to the outwardly extending free end thereof a hand lever 105 by which said bar will be rotated to operate said linkage in raising and lowering the door 94.

Said handle 105 has pivoted thereto the inner end of a hand screw 107 threaded through a boss 108 riding on the outer side of an actuating bracket 109 having therein an arcuate slot 110 through which slot is disposed the Shank of said hand screw. Hence said handle 105 in being swung upwardly or downwardly will be secured in any given position within the extent of the arcuate slot 110 by tightening the hand screw 107.

Forced by the slot 112 in the wall 18 is the wall 112a having substantially parallel upper and lower walls providing an inlet into the grinding chamber 60, as illustrated in FIG. 5. Said slot is arcuate curved having for its greater extent a radius which substantially coincides with the radius of the path described by the hammers 44. It will be noted that the upper portion of said slot tends away from the curvature of the lower portion thereof having a radius of greater extent and thereby straightening out somewhat the curvature of said slot to provide an increase in the pitch or slope thereof.

With respect to said slot 112, said side wall 82 has its lower portion 82a angled inwardly and extend transversely of said wall 18 forming longitudinally to the curvature of the lower side or wall of said slot 112 being integral therewith and lath therewith. Said lower portion 82b inclines downwardly somewhat transversely in the direction of said slot and tapers in width as it extends along said slot to merge into the wall thereof in the plane thereof at the point 112a of said slot. The rear wall 83a at its lower end will conform to the taper and longitudinal curvature of said wall portion 82b and merges into wall 18 in the plane thereof at the point 112a of said slot. Thus there is formed a discharge passage 112b between said hopper and said slot 112 which provides a free and unobstructed passage to and through said slot 112 whereby there will be no shelf portion or plateau to permit any buildup or accumulation of material feeding through. The bottom curvature 94a of the door 94 conforms to that of said slot 112.

Operation

One of the improvement elements of construction embodied in the applicant's device is the particular tear drop design of the screen 53. The screen is easily handled. By removing the angle plate 56 the screen is readily nested for storage purposes. In use this screen permits a full circle grinding operation without any buildup of material on the inner surface of the screen. As the material is brought upwardly by the action of the hammers it is thrown into the free space area at the apex of the screen out of contact with the grinding media, and from there to drop downwardly directly into the blades for continuous grinding action until reduced to the size to permit it to pass through the mesh of the screen and to drop into the discharge outlet.

The screen is readily mounted in operating position supported on the arm bracket 50 and the flange 48. Overlying the open side of said screen is a cover member 63 having the substantial aperture 66 therein in axial alignment with the hammer assembly 45. Thus within the screen is formed the grinding chamber 60. About the screen and within the housing portion 20 is the chamber 51 in which is disposed by the door or cover member 66 with said cover member carrying hold down screws 74 to secureche screen cover 63 in position:

Chamber 31 forms the air circulation chamber about the grinding chamber 60. A requirement for a good grinding operation is a good circulation of air throughout the grinding chamber. Absent a good circulation of air there is a tendency for the material therein to clog the mesh of the screen and to have a tendency to build up therein. Thus the applicant combines two improved features to bring about a more efficient grinding operation. These features are the tear drop screen design and the air circulation chamber in cooperation therewith. The direction of air flow is indicated by arrows in FIG. 3. The action of the hammers creates an area of low pressure at the inner side of the apertured portion of the cover plate 63 which results in a steady stream of air being drawn inwardly through the aperture 66, said hammers moving the material through the screen as a part of the grinding operation. Thus there is a steady recirculation of air of such an efficient nature that it has been found that there is very little if any need for the use of a dust collector in connection with the device.

A third element of improved construction in applicant's device is the design of the inlet slot 112 through which material is fed into the grinding chamber. The particular design of the slot and the passage directly in connection therewith avoids any buildup of material which might otherwise clog the inlet. One of the problems faced with
a slot of usual rectangular configuration is that the action of the hammers and the air pressures created thereby tend to block the opening of the slot and prevent the free movement of material into the grinding chamber. It is noted here that the passage 112b in connection with said slot has a downward curvature terminating by merging into the wall 18 and thereby into the plane of the slot. The curvature of the slot 112 follows generally the path described by the hammers in action. Thus during a grinding operation the hammers in moving air across the face of said slot 112 tend to create a low pressure area thus encouraging a free flow of material, and the action of said hammer tends to withdraw material from the passage feeding through the slot 112. The arrangement set forth provides a very efficient flow of material into the grinding chamber.

Thus the applicant in a simply constructed and efficiently designed hammer mill grinding device provides a substantial improvement in the grinding operation thereof. This device has been very successful in commercial use and represents a substantial improvement in the grinding art.

It will of course be understood that various changes may be made in the form, details, arrangement and proportions of the parts, without departing from the scope of applicant's invention which, generally stated, consists in a device capable of carrying out the objects above set forth, in the parts and combinations of parts disclosed and defined in the appended claims.

What is claimed is:

1. In a grinding apparatus having in combination, a housing, said housing having a grinding chamber formed therein, a hopper in connection with said housing, said grinding chamber and said housing having a common wall, said grinding chamber comprising a screen, said screen being formed of sheet screen material substantially rectangular in blank and formed into an endless collar-like member having a tear drop configuration in plan with the apex thereof being uppermost, means mounting said screen to have one open side thereof bearing against said common wall, a cover overlying the other open side of said screen, said cover having an aperture therein, a plurality of hammers within said grinding chamber, means rotatably supporting said hammers about an axis in alignment with said aperture in said screen cover, an inlet into said grinding chamber formed as an arcuate slot in said common wall, a passage connecting said hopper and said inlet, said passage having a depth tapering in width longitudinally of said inlet and merging therewith to become flush with the face portion of said inlet at one end portion thereof, said inlet defining an arc having a radius substantially equivalent to the radius of the path described by said hammers and being parallel to said path and closely adjacent the hammers nearest thereto, said inlet discharging in the direction of rotation of said hammers, an outlet in said housing receiving material from said grinding chamber and discharging the same, and said housing having an air circulation chamber about said grinding chamber.

2. In a grinding apparatus having in combination, a housing, an endless belt-like screen of some width having a tear drop configuration in plan with the apex thereof being uppermost, means in connection with an upstanding wall of said housing supporting said screen thereon, said wall overlying one open side of said screen and said screen forming grinding chamber therein,
adjustable holding means carried by said second cover securing said first mentioned cover,
said wall having an inlet into said grinding chamber,  
a hopper in connection with said housing,  
a passage connecting said hopper and said inlet,  
said passage having a bottom wall integral with the lower wall of said inlet, said bottom wall merging into the plane of said inlet, said passage having a side wall portion coextensive with said bottom wall being inclined in the direction thereof and merging into the plane of said inlet.