This invention relates to a beater wheel mill in which material is pulverized by rotating a beater wheel or rotor within a housing or casing at high speeds. The invention is particularly concerned with the type of mill wherein the ground material entrained in carrier gas is discharged from the mill by centrifugal force by way of an outlet duct adjacent to the mill casing. The invention contemplates the improvements built into the outlet duct and mill outlet casing for separating the coarser particles from the fines and returning the former to the mill for regrinding.

In mills of this type, as commonly practiced, the conveying gas and material mixture is conducted from the mill into a reverse flow separator, cyclone classifier or sifting screen, in which the oversized or coarse particles are separated from the mixture and are returned to the mill for further grinding by being passed again through the beater wheel. These separators, classifiers or screens represent a substantial investment and a significant portion of the original cost of the mill. Furthermore, they contribute to higher operating and maintenance costs by substantially increasing the flow resistance through the mill system. These disadvantages are especially disturbing because, due to the high grinding efficiency of this type of mill, only small quantities of oversized material are carried in the conveying gas leaving the mill, so that in many cases the relatively high outlay for additional separating apparatus cannot be justified.

In accordance with the invention these conditions can be considerably improved by providing the outlet of the mill with a front wall portion inclined for directing the stream of carrier gas and entrained pulverized material transversely of the duct and toward a depression, pocket or niche provided in the duct wall opposite and above the inclined front wall portion. Due to inherent inertia forces, the oversized or coarser particles entrained in the gas stream are thus carried into the pocket or niche, whereas the conveying gases with the finely pulverized material remaining therein is drawn off past the niche and out through the outlet duct to a place of use. The separated coarse particles fall back into the beater wheel for further grinding.

In order to prevent the separated particles to be caught up again in the dust conveying gas stream while returning, an adjustable wall is provided, according to the invention, for shielding these returning particles from the upwardly flowing gas stream. This adjustable wall terminates in close proximity of the beater wheel, extends up to the base of the pocket and is spaced from the rear wall of the outlet gas duct to form a convenient return passage for conducting the coarse particles to the mill housing. By adjusting the position of this wall with respect to the front wall of the gas outlet, the velocity of the gas stream leaving the mill outlet can be altered at will thereby influencing the size of the particles captured in the pocket. If the material to be ground is of extremely friable nature and can readily be pulverized to the desired fineness, or when a coarse mixture is desired, the invention contemplates that the pocket or niche be equipped with a rear wall section acting as a flap or door that is movable inwardly in a direction toward the gas stream. In this manner the pocket can be partially or completely covered or closed by the door to control the degree of particle separation desired or to eliminate separation entirely.

Further, in accordance with the invention, one or more openings are provided at the lower end of the above adjustable pocket door or flap to permit any material accumulated between the pocket door and the rear casing to drop back into the mill housing.

In addition, the invention contemplates the provision of an inward enlargement, extension or thickening of the rear duct casing to fill and occupy the above-mentioned opening or cut-out in the flap door when the door is in the overmost rearward or fully open position. In this manner an unbroken and smooth inside-lined of the duct can be presented to the flow, thereby eliminating depressions which may favor undue wear of the inside wall surface by the formation of eddy current.

Further details and objectives of the invention will become apparent from the drawing and the following description thereof. In the drawing:

FIG. 1 is an elevational section through a beater mill equipped with the herein disclosed improvements, when taken on line 1—1 of FIG. 2;

FIG. 2 is an elevational section taken through the improved beater mill on line 2—2 of FIG. 1;

FIG. 3 is an enlarged view taken along lines 3—3 of FIG. 1 and showing the lower end of the adjustable door or flap of the herein disclosed pocket formation;

FIG. 4 is an enlarged cross section taken on line 4—4 of FIG. 5.

Referring to FIG. 1 the illustrated mill is provided with a beater wheel 10 serving simultaneously as the rotor of a blower. The beater wheel comprises a wheel disc 11, an annular disc 12, spaced therefrom and a plurality of radial beater plates 14 arranged between discs 11 and 12 and equally spaced around the circumference of the beater wheel. An overhung shaft 16 journalled in a bearing 18 serves to support the beater wheel or rotor 10 for horizontal rotation and is connected to a conventional driving means, not shown, by way of a coupling 20. The beater wheel 10 rotates within a housing 22 in direction of arrow 23. The preferred shape of housing 22 is that of a spiral gradually expanding in direction of rotation and terminating in a generally vertical outlet duct 24. This duct, preferably located directly above the rotor 10 has a vertical front wall portion 26 with the lower end thereof being connected to the spiral housing by an inclined wall extension 28. The inclination of this wall with respect to the vertical continuation of duct 24 is toward the axis of rotation, and such as to cause the stream of pulverized material entrained in the carrier gas to be deflected transversely of the duct 24 and in direction toward a pocket or niche 30 provided in the rear wall of duct 24. This pocket 30 is defined by an upper horizontal wall 32 and an adjustable door or flap 34 pivotally supported at a lower end thereof at 36. A positioning device such as notched bar 38 enables the operator to adjust the position of flap 34 from a rearward or open position as shown in solid lines with flap 34 in close proximity of outer rear casing 40, to a forward or closed position as shown in dot and dash lines, with the flap door shutting off the pocket 30 and eliminating the effect thereof. A series of notches in the bar bearing
against a stop plate 31 enable the operator to position flap 34 at other locations intermediate the above two extreme positions, so as to control the effectiveness of pocket 30 in capturing oversized particles entrained in the gas stream.

The captured coarse particles are returned to the mill housing to the grinding action of the beater wheel by way of a slot formed in the outlet duct 24 directly below pocket 30. Passage 42 is defined by an adjustable division wall 44 separating and shielding the returning coarse particles from being re-captured by the upwardly flowing gas stream. The lower end of division wall 44 can be pivoted at 46, which pivot can be of the fixed type or the position thereof can conveniently be adjusted in a slot 47 provided in each of the side walls of duct 24. Notched bar 48 and stop plate 49 or other suitable device permits adjustment of the angularity of wall 44 with respect to inclined wall 28, so as to increase or decrease the flow area of the outlet duct for the purpose of decreasing or increasing respectively the velocity of the gas stream. In this manner the size of coarse particles captured in pocket 30 can be influenced and with it the fineness of the pulverized material leaving duct 24.

FIGS. 3 and 4 show an opening 50 provided in the housing 20 rotatable about a horizontal axis and adapted for pulverizing material by attrition and impact, means for receiving material to be pulverized and carrier gas into said housing, an outlet duct leading from said housing for expelling by centrifugal force a stream of carrier gas and pulverized material entrained therein, said duct having a wall inclined for directing said stream transversely of the duct, means forming a pocket in the duct wall opposite and above said directing wall for capturing oversized particles contained in said stream, a passage generally parallel to said outlet duct leading from said pocket to said housing, and a deflecting surface included in the uppermost wall portion of said pocket for deflecting said captured oversized particles toward said outlet duct for returning said particles to the mill for further grinding, said passage having an adjustable wall spaced from said inclined wall and common to said outlet duct, means for adjusting the angularity of said division wall with respect to said front wall portion to increase or decrease the velocity of said transversely directed stream.

2. In a beater mill, a housing, a rotor within said housing rotatable about a horizontal axis and adapted for pulverizing material by attrition and impact, means for receiving into said housing material to be pulverized and carrier gas and pulverized material entrained therein, said upright duct including a wall section inclined to the vertical for directing said stream transversely of said upright duct, means forming a triangular pocket in the duct wall opposite and above said directing wall for capturing oversized particles contained in said stream, said pocket having an adjustable door hinged at the lower corner of said triangular pocket, means for moving said adjustable door inwardly in a general direction opposed to said transversely directed stream for the purpose of decreasing or increasing the effective width of said pocket and thereby the reduction thereof in capturing said oversized particles and a passage leading from the hinged corner of said pocket to said housing for returning said oversized particles to the mill for further grinding.

3. The improvement in a beater mill as defined in claim 2, wherein said adjustable hinged door is provided with an opening at the hinged lower end thereof to permit escape of captured particles while the door is in the inward and forward position.

4. The improvement in a beater mill as defined in claim 3, wherein an extension or filter is provided in said opposite duct wall to fill said opening while said adjustable rear wall is in the rearward position.

5. In a beater mill, a casing having an involute outline, a beater wheel within said casing rotatable on a horizontal axis and adapted for pulverizing material that is being fed to the mill in a gas stream, said beater wheel with an upright outlet duct positioned above said horizontal axis for tangentially discharging a stream of pulverized and gas entrained material, the lower front wall portion of said outlet duct directly adjoining said involute casing and being inclined toward said axis for directing said stream transversely of said duct, an adjustable division wall opposite said front wall portion and generally parallel thereto for dividing said duct into a forward passage adjacent said front wall portion and a rearward passage remote therefrom, means for adjusting the angularity of said division wall with respect to said front wall portion for restricting the flow area of said forward passage and enlarging the flow area of said rearward passage at the upper ends thereof, said outlet duct being provided with a pocket above said rearward passage for capturing oversized material entrained in said transversely directed stream, said pocket being defined by a roof surface for deflecting oversized particles downwardly towards said rear wall passage and means for returning oversized particles back into said casing via said rearward passage.

6. In a beater mill, a casing having a curved outline, a beater wheel within said casing rotatable on an axis and adapted for pulverizing material that is being fed to the mill in a gas stream, said beater wheel having an upright outlet duct positioned above said horizontal axis for tangentially discharging a stream of pulverized and gas entrained material, said outlet duct including a lower front wall portion adjoining said curved casing and being inclined toward said axis for directing said stream transversely of said duct, an adjustable division wall opposite said front wall portion and generally parallel thereto for dividing said duct into a forward passage adjacent said front wall portion and a rearward passage remote therefrom, pivoting means for supporting said division wall at the lower end thereof, means for adjusting the angularity of said division wall with respect to said front wall portion for restricting the flow area of said forward passage and enlarging the flow area of said rearward passage at the upper ends thereof, said outlet duct being provided with a pocket above said rearward passage for capturing oversized material entrained in said transversely directed stream, said pocket including an upper deflecting surface for deflecting oversized particles back into said casing, via said rearward passage, said beater wheel having an upright substantially upright door to shield at least a major portion of said deflecting surface, pivoting means supporting said door at the lower end thereof for swinging the upper end of said door forward to decrease the size of said pocket and accordingly the effectiveness thereof in re-
turning oversized particles back into said mill casing for further grinding.

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