Feb. 15, 1938. R. F. O'MARA 2,108,609

WHIZZER SEPARATOR AND MILL

Filed April 15, 1935 3 Sheets-Sheet 1

Fig. 1.

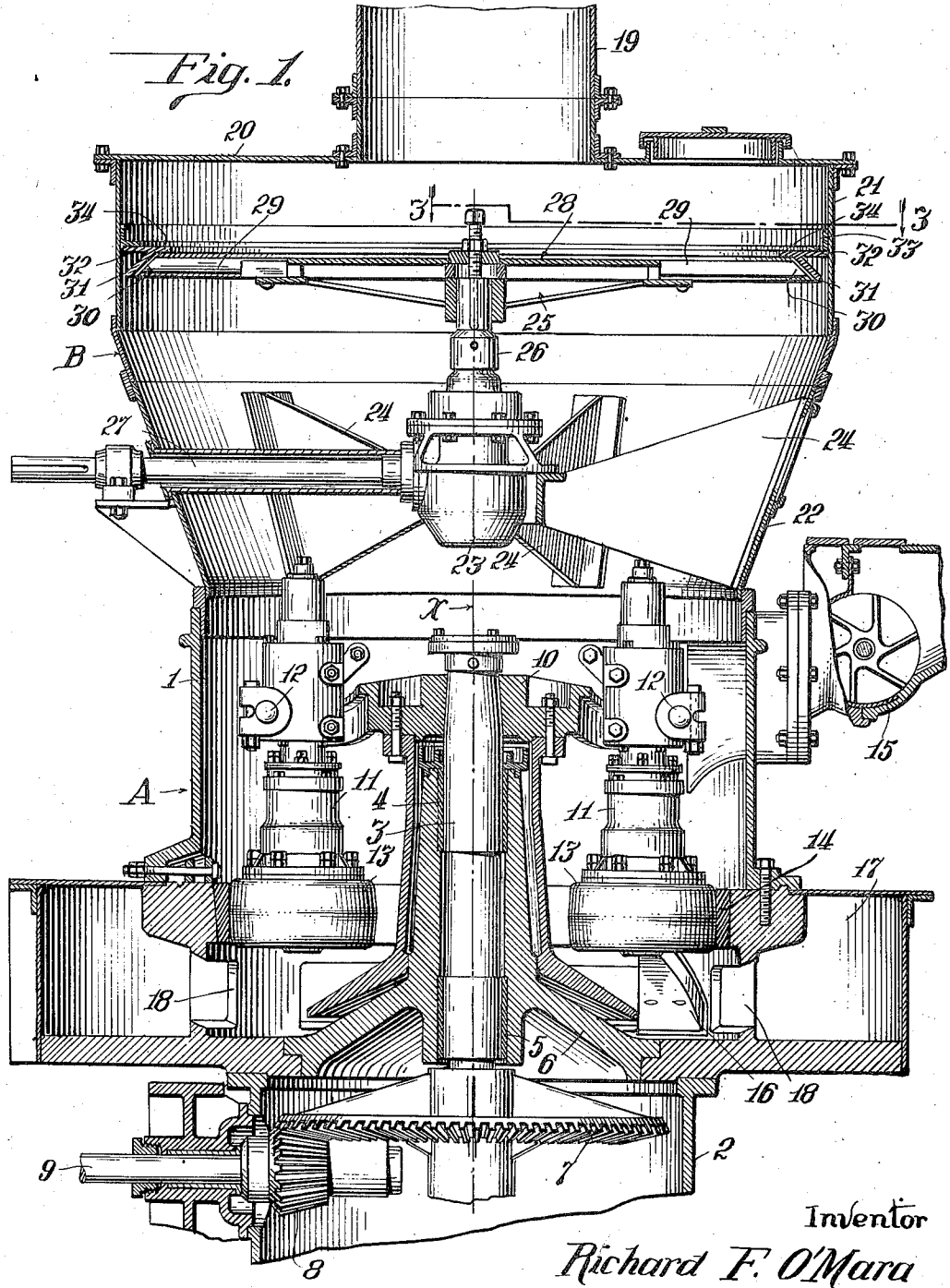

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Fig. 2.

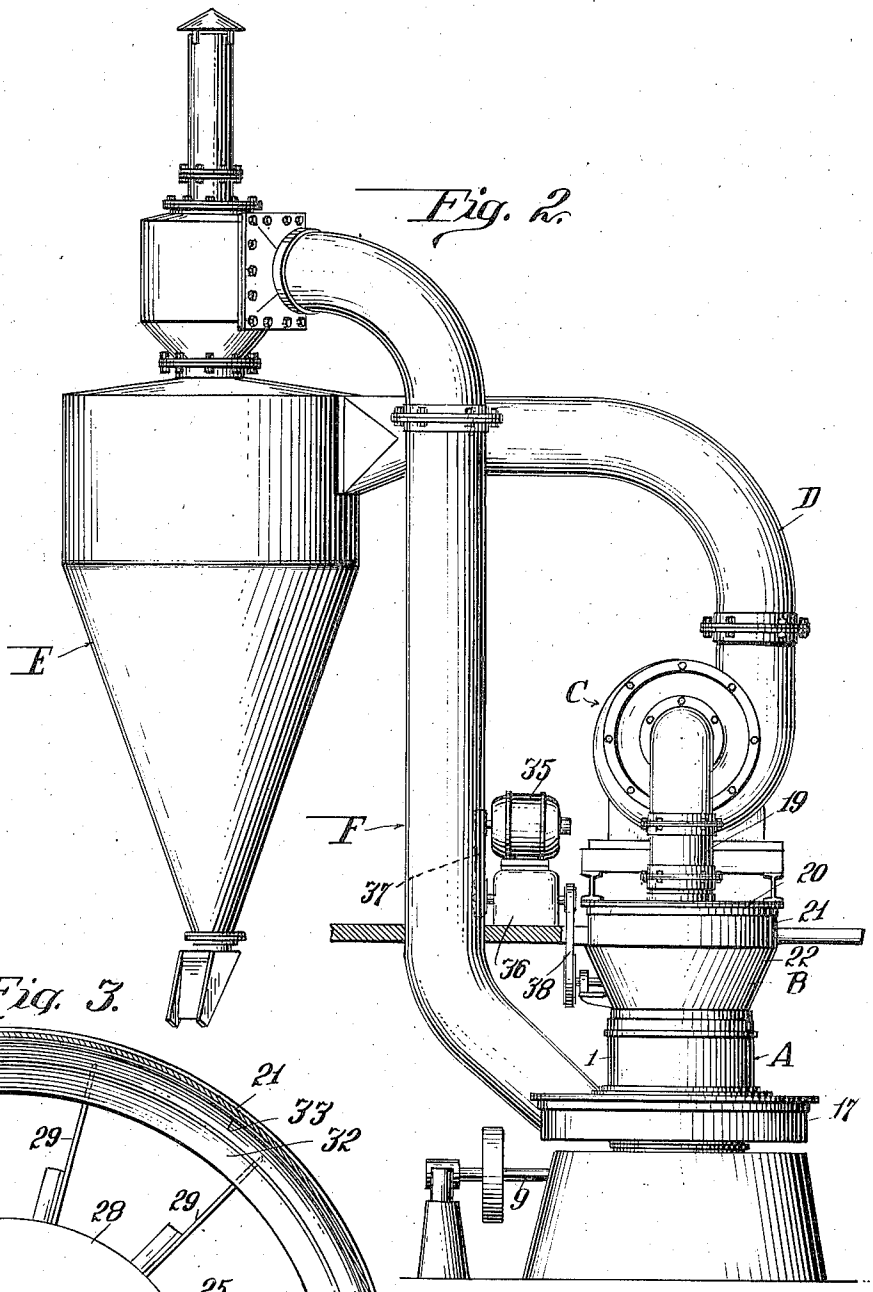

Fig. 3.

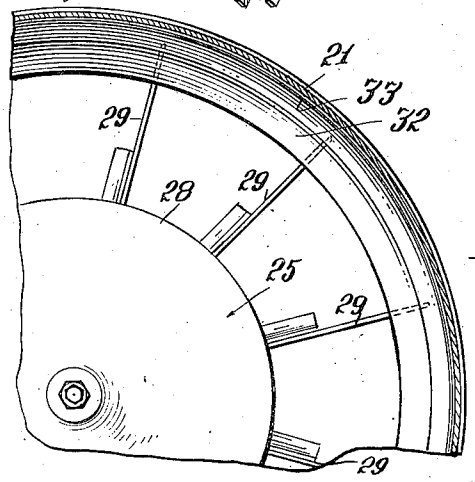

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Fig. 5.

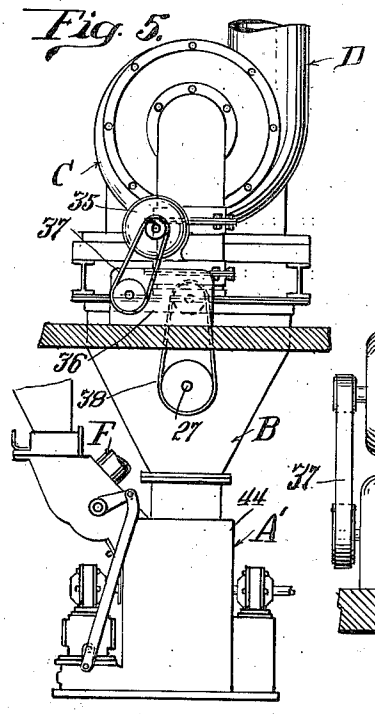

Fig. 4.

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Patented Feb. 15, 1938 2,108,609

UNITED STATES PATENT OFFICE

2,108,609

WHIZZER SEPARATOR AND MILL

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Application April 15, 1935, Serial No. 16,443

11 Claims. (Cl. 83—45)

This invention relates to certain new and useful improvements in a whizzer separator and mill adapted to be used in direct combination with a pulverizing mill, especially a roller mill or similar slow-speed mill, so as to selectively determine the grade of pulverized material that may be withdrawn from the mill in suspension in an air stream.

In a mill of the type to which this improved separating apparatus is applied, the material is ground or pulverized by means of a plurality of rollers or similar devices and sufficiently fine material to be carried in suspension is lifted out in an air stream passing through the mill and afterwards separated from this air stream by means of a cyclone separator or other suitable apparatus. The separating device which forms the particular subject matter of this invention is interposed directly between the outlet of the mill and the conduit through which the material is withdrawn in suspension, and is used to reject the heavier particles from this air stream and selectively determine the fineness or grade of material that may be lifted from the mill. Briefly described, this separator comprises a rotary deflector or "whizzer", closed at its central portion and comprising a plurality of outwardly projecting vanes between which the suspended pulverized material must pass before emerging from the mill housing. This rotary deflector tends to throw the material outwardly by centrifugal force and cooperates with the surrounding casing walls or a stationary deflector carried thereby to reject the heavier particles passed downwardly into the mill for further treatment. The faster the speed of rotation of the rotary deflector the finer the material that will be rejected in this manner, and by suitably controlling the speed of the rotary deflector the grade of material that emerges from the mill in the air stream may be accurately determined within certain limits.

The principal object of this invention is to provide an improved grinding and separating apparatus of the type briefly described hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide an improved form of whizzer separator for use with roller mills.

Another object is to provide an improved separator that may be conveniently regulated to select the grade of material that may pass therethrough.

Another object is to provide an improved apparatus especially adapted for handling sticky materials such as paint pigments.

Other objects and advantages of this invention will be more apparent from the following detail description of one approved form of apparatus constructed and operating according to the principles of this invention.

In the accompanying drawings:

Fig. 1 is a central vertical section through one approved form of the improved grinding and separating apparatus.

Fig. 2 is an elevation showing the complete circulating system of which this improved separating unit forms a part.

Fig. 3 is a partial horizontal section taken substantially on the line 3—3 of Fig. 1.

Fig. 4 is an elevation partially in section, showing the improved separator applied to a well-known form of impact-mill.

Fig. 5 is an elevation showing a modification of the apparatus shown in Fig. 4.

The complete circulation system of which this improved combination forms a part comprises the mill A and novel separator B (which when assembled forms substantially a single unit); the fan C which lifts pulverized material from the mill through separator B in suspension in an air stream; the conduit D through which the air stream is propelled by fan C into the cyclone separator E wherein the suspended material is deposited; and the conduit F for returning the air stream, or a portion thereof, to the mill A.

As shown in Figs. 1, 2, and 3, the mill A comprises the upright casing 1, usually cylindrical, which is centered about the central vertical axis x and is supported by the frame 2. The central vertical shaft 3 is rotatable in bearings 4 and 5 in the supporting structure 6 and carries at its lower end a beveled gear 7 which meshes with a pinion 8 on the drive shaft 9 projecting horizontally from the supporting frame 2 and driven from any suitable source of power. The spider 10 carried at the upper end of shaft 3 supports a circular series of roller-carriers 11, each pivoted in spider 10 at 12 so that the grinding rollers 13 which are supported by carriers 11 for free rotation may swing radially toward or from the shaft 3. When this assembly is rotated, the rollers 13 will swing outwardly under the influence of centrifugal force against the stationary bull-ring 14. The material to be ground is delivered into the mill housing by any suitable means such as the pocketed feeder shown at 15 and falls down between the grinding rollers 13 and bull-ring 14 so as to be crushed or pulverized. The plows 16, also carried by the rotating assembly, pick up material that falls

through the bottom of the casing and deliver it back up between the grinding elements.

The fan C draws air into the mill housing from the annular manifold 17 through inlet openings 18 and thence upwardly through the mill housing, this air stream picking up in suspension such material as is sufficiently finely pulverized to be carried by the air stream. In the usual system, this air stream passes directly from the mill housing through outlet conduit 19 into the fan C and is then projected through conduit D into the cyclone separator E.

According to the present invention, this suspended material must first pass through the separator B which is interposed between the upper end of the mill and the outlet conduit 19. The separator casing comprises substantially an upward extension of the mill casing 1 and consists of a top or closure plate 20 from the central portion of which the outlet conduit 19 extends, an upper cylindrical shell 21 preferably of somewhat larger diameter than the mill housing 1, and a downwardly and inwardly tapering conical shell 22 which connects the lower portion of shell 21 with the upper edge of mill housing 1. A gear casing 23 is supported centrally within the conical casing 22 by means of a plurality of radially extending plates 24, these plates being positioned vertically so as to present a minimum of obstruction to the air stream flowing upwardly through this casing. The rotary deflector or "whizzer" 25 is carried by the vertical shaft 26 journaled in gear casing 23 about the central vertical axis x. Shaft 26 is rotated, through suitable gearing mounted in the casing 23, from the horizontal drive shaft 27 extending through one side wall of casing 22 and driven by means hereinafter described.

The rotary deflector 25 comprises a closed central disk-like portion 28 from which extend a plurality of radially projecting vanes or blades 29. The outer ends of these vanes are beveled inwardly and upwardly as indicated at 30 and rotate in close proximity to the lower surface of a downwardly and outwardly projecting annular conical deflector 31 carried by the horizontal extending annular top plate 32 which is secured to the inner surface of casing wall 21 in any suitable manner, for example by the angular ring 33. The inner portion of annular plate 32 preferably projects over the adjacent upper and outer surface of the vanes 29 as indicated at 34.

These cooperating rotary and stationary deflectors operate much the same as the corresponding elements as disclosed in the patent to Cook 1,783,357, granted December 2, 1930 for Mechanical separator. The rotary deflector 25 imparts a whirling motion to the air within the separator casing, the heavier particles of material carried by the air stream being thrown out against the casing walls or the stationary deflector 31 and thence rejected downwardly through the separator casings and back into the mill. The only upward path for the air stream is between the rapidly rotating vanes 29, between the central disk or apron 28 and the outer stationary deflector and casing walls, and only finely pulverized material can be lifted in suspension between these vanes. All of the material above a certain size will be thrown outwardly against the stationary deflector 31 and thence thrown downwardly to reenter the mill for further treatment.

It has been discovered that, within certain rather wide limits, the faster the rotation of the deflector 25 the finer the material that will be rejected and returned to the mill. Consequently, by suitably varying the speed of rotation of this deflector or "whizzer", the grade or fineness of the material that is withdrawn in suspension from the separator can be selected and regulated quite accurately. In the form here shown, a constant speed electric motor 35 (see Fig. 2) suitably supported outside of the separator housing drives the shaft 27 through a suitable change speed mechanism. As here shown, a Reeves variable speed transmission 36 is driven from motor 35 through the belt gearing 37 and drives shaft 27 through belt gearing 38. By means of this variable speed gearing, or any other suitable device, the deflector 25 may be rotated at any one of a multiplicity of selected speeds, and a corresponding grade of ground or pulverized material will be delivered from the mill and separator combination hereinabove described.

By means of this apparatus, pulverized material of greater and more uniform fineness may be obtained, and simple and accurate control of the degree of this fineness is possible by simply adjusting the speed of rotation of the whizzer. This rotary deflector is self-cleaning and is especially adapted for handling sticky substances such as paint materials, especially when used in direct combination with the mill, as herein disclosed. The finely divided particles of certain paint pigments, such as lithopone, or white lead, have a strong tendency to adhere to one another and to the exposed surfaces of a separator, even though the materials are quite dry. As a consequence the ordinary type of separator having closely spaced parts and relatively small passages, such for example as the double-cone type of separator with small inlet and outlet openings, will soon clog up and become ineffective. The same is true with the type of separator disclosed in the Cook patent hereinabove referred to, from which certain elements of the present separator have been adapted, when this Cook separator is used apart from the mill and in the form disclosed in the patent. It will be noted that in the present combination certain of the cones of this Cook separator have been eliminated, and the single conical shell now used has a large lower inlet and return opening corresponding to the full diameter of the mill housing and in fact forming a continuation thereof. Furthermore, the vibration imparted to the assembly by the rotating elements of the mill and separator serves to agitate the sticky materials and minimize the adherence of the material particles to the separator structure. As a result these materials can be very effectively handled and classified, the larger and heavier particles falling freely back into the mill while the finer materials are carried out in suspension in the air stream, without clogging the apparatus. For these reasons the mill-separator combination will operate efficiently for long periods of time without requiring attention or cleaning.

While this improved separating mechanism is hereinabove disclosed in combination with a roller mill of the well known Raymond type, it will be apparent that it could be combined in similar manner with other forms of mills. In Fig. 4 is shown an impact mill A' of well known type comprising a plurality of swing-hammers 39 carried by horizontal shaft 40 driven by motor 41. The material to be pulverized and dried is introduced from hopper 42 by means of rotary feeder 43 into the mill housing 44 wherein it is pulver-

ized by the impact of the rotary hammers 39 and by being thrown against the peripheral liners 45 of the housing. The heated air introduced through conduit F carries out the pulverized material in suspension through outlet 46 and thence into separator B. The remainder of the circulating system may be the same as shown in Fig. 2.

The modification shown in Fig. 5 is much the same except for the fact that the inlet to separator B is connected with the top or peripheral portion of the mill-housing 44, the mill being of the same type shown in Fig. 4.

This improved grinding and separating unit is quite simple and compact, and in most instances will eliminate the necessity of subjecting the pulverized material to a separating process after it has been delivered from the mill and collected from the air stream.

I claim:

1. In combination with a roller-mill comprising an upright casing having an open upper end, grinding mechanism in the casing comprising rotary members and means for rotating the same, means for feeding material into the mill, and means comprising an outlet conduit for lifting pulverized material from the mill in suspension in an air stream, a separator interposed between the mill and outlet conduit and comprising a laterally closed separator casing forming substantially an upward extension of the mill casing, a rotary deflector mounted for rotation about a central vertical axis within the separator casing, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes extending into proximity to the casing walls, an annular stationary deflector carried by the casing wall and closely overlapping the outer end portions of the vanes so that the only path for the upwardly flowing air stream is between the rotating vanes, and means for rotating the rotary deflector.

2. In combination with a mill comprising a casing having an outlet, grinding mechanism in the casing comprising rotary members and means for rotating the same, means for feeding material into the mill, and means comprising an outlet conduit for lifting pulverized material from the mill in suspension in an air stream, a separator interposed between the mill and outlet conduit and comprising a laterally closed separator casing forming substantially an extension of the mill casing, a rotary deflector mounted for rotation about a central axis within the separator casing, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes extending into proximity to the casing walls, an annular stationary deflector carried by the casing wall and closely overlapping the outer end portions of the vanes so that the only path for the upwardly flowing air stream is between the rotating vanes, a motor for rotating the rotary deflector, and variable speed gearing interposed between the motor and deflector without affecting the speed of the grinding mechanism.

3. In combination with a mill comprising an upright casing having an outlet, grinding mechanism in the casing comprising rotary members and means for rotating the same, means for feeding material into the mill, and means comprising an outlet conduit for lifting pulverized material from the mill in suspension in an air stream, a separator interposed between the mill and outlet conduit and comprising a separator casing forming substantially an upward extension of the mill casing, a rotary deflector mounted for rotation about a central vertical axis within the separator casing, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes having upwardly and inwardly beveled outer ends, and an annular stationary conical deflector carried by the separator wall and closely overlapping the outer end portions of the vanes, and means for rotating the rotary deflector.

4. A grinding and separating apparatus comprising a vertical casing substantially symmetrical about a central vertical axis, a grinding mechanism in the lower portion of the casing rotatable about the vertical axis, means for rotating the grinding mechanism, an air inlet to the lower portion of the casing, means for feeding material to the grinding mechanism, an outlet conduit leading from the upper end of the casing through which pulverized material is lifted in suspension in an air stream, a deflector mounted in the upper portion of the casing for rotation about the central vertical axis, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes extending into proximity to the casing wall, an annular stationary deflector carried by the casing wall and closely overlapping the outer end portions of the vanes so that the only path for the upwardly flowing air stream is between the rotating vanes, and means for rotating the rotary deflector.

5. A grinding and separating apparatus comprising a vertical casing substantially symmetrical about a central vertical axis, a grinding mechanism in the lower portion of the casing rotatable about the vertical axis, means for rotating the grinding mechanism, an air inlet to the lower portion of the casing, means for feeding material to the grinding mechanism, an outlet conduit leading from the upper end of the casing through which pulverized material is lifted in suspension in an air stream, a deflector mounted in the upper portion of the casing for rotation about the central vertical axis, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes extending into proximity to the casing wall, an annular stationary deflector carried by the casing wall and closely overlapping the outer end portions of the vanes, and means for rotating the rotary deflector at various selected speeds without affecting the speed of the grinding mechanism.

6. A grinding and separating apparatus comprising a vertical casing substantially symmetrical about a central vertical axis, a grinding mechanism in the lower portion of the casing rotatable about the vertical axis, means for rotating the grinding mechanism, an air inlet to the lower portion of the casing, means for feeding material to the grinding mechanism, an outlet conduit leading from the upper end of the casing through which pulverized material is lifted in suspension in an air stream, a deflector mounted in the upper portion of the casing for rotation about the central vertical axis, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes having upwardly and inwardly beveled end portions, an annular conical deflector overlapping the outer end portions of the vanes, and means for rotating the rotary deflector at various selected speeds without affecting the speed of the grinding mechanism.

7. A grinding and separating apparatus comprising a vertical casing substantially symmetrical about a central vertical axis, a grinding mechanism in the lower portion of the casing rotatable about the vertical axis, means for rotating the grinding mechanism, an air inlet to the lower portion of the casing, means for feeding material to the grinding mechanism, an outlet conduit leading from the upper end of the casing through which pulverized material is lifted in suspension in an air stream, a deflector mounted in the upper portion of the casing for rotation about the central vertical axis, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes having upwardly and inwardly beveled end portions, an annular stationary conical deflector carried by the casing wall and overlapping the outer end portions of the vanes, a motor for rotating the rotary deflector, and variable speed gearing interposed between the motor and deflector.

8. In combination with a mill comprising an upright casing having an outlet, grinding mechanism in the casing comprising rotary members and means for rotating the same, means for feeding material into the mill, and means comprising an outlet conduit for lifting pulverized material from the mill in suspension in an air stream, a separator interposed between the mill and outlet conduit and comprising a laterally closed separator casing forming substantially an upward extension of the mill casing, a rotary deflector mounted for rotation about a central vertical axis within the separator casing, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes, and an annular conical outwardly and downwardly projecting stationary deflector carried by the casing wall in substantially lateral alignment with the vanes and having an inwardly projecting upper extension closely overlapping the outer end portions of the vanes, said stationary deflector closing the space beyond the ends of the vanes so that the upwardly flowing air stream must pass between the rotating vanes, and means for rotating the deflector.

9. In combination with a mill comprising an upright casing having an outlet, grinding mechanism in the casing comprising rotary members and means for rotating the same, means for feeding material into the mill, and means comprising an outlet conduit for lifting pulverized material from the mill in suspension in an air stream, a separator interposed between the mill and outlet conduit and comprising a laterally closed separator casing forming substantially an upward extension of the mill casing, a rotary deflector mounted for rotation about a central vertical axis within the separator casing, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes, and an annular conical outwardly and downwardly projecting stationary deflector carried by the casing wall in substantially lateral alignment with the vanes and having an inwardly projecting upper extension closely overlapping the outer end portions of the vanes, said stationary deflector closing the space beyond the ends of the vanes so that the upwardly flowing air stream must pass between the rotating vanes, and means for rotating the deflector at various selected speeds independently of the speed of the grinding mechanism.

10. A grinding and separating apparatus comprising a laterally closed vertical casing substantially symmetrical about a central vertical axis, a grinding mechanism in the lower portion of the casing rotatable about the vertical axis, means for rotating the grinding mechanism, an air inlet in the lower portion of the casing, means for feeding material to the grinding mechanism, an outlet conduit leading from the upper portion of the casing through which pulverized material is lifted in suspension in an air stream, a deflector mounted in the upper portion of the casing for rotation about the central vertical axis, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes, and an annular conical outwardly and downwardly projecting stationary deflector carried by the casing wall in substantial lateral alignment with the vanes and having an inwardly projecting upper extension closely overlapping the outer end portions of the vanes, said stationary deflector closing the space beyond the ends of the vanes so that the upwardly flowing air stream must pass between the rotating vanes, and means for rotating the rotary deflector.

11. A grinding and separating apparatus comprising a laterally closed vertical casing substantially symmetrical about a central vertical axis, a grinding mechanism in the lower portion of the casing rotatable about the vertical axis, means for rotating the grinding mechanism, an air inlet in the lower portion of the casing, means for feeding material to the grinding mechanism, an outlet conduit leading from the upper portion of the casing through which pulverized material is lifted in suspension in an air stream, a deflector mounted in the upper portion of the casing for rotation about the central vertical axis, said deflector comprising a closed central portion and a plurality of spaced apart outwardly projecting vanes, and an annular conical outwardly and downwardly projecting stationary deflector carried by the casing wall in substantial lateral alignment with the vanes and having an inwardly projecting upper extension closely overlapping the outer end portions of the vanes, said stationary deflector closing the space beyond the ends of the vanes so that the upwardly flowing air stream must pass between the rotating vanes, and means for rotating the rotary deflector at various selected speeds independently of the speed of the grinding mechanism.

RICHARD F. O'MARA.

CERTIFICATE OF CORRECTION.

Patent No.2,108,609. February 15, 1938.

RICHARD F. O'MARA.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, lines 64, 65, and 66, claim 2, strike out the words "without affecting the speed of the grinding mechanism"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 29th day of March, A. D. 1938.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.