Jan. 2, 1940. M. VOGEL-JORGENSEN 2,185,960

MILL

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Fig. 1.

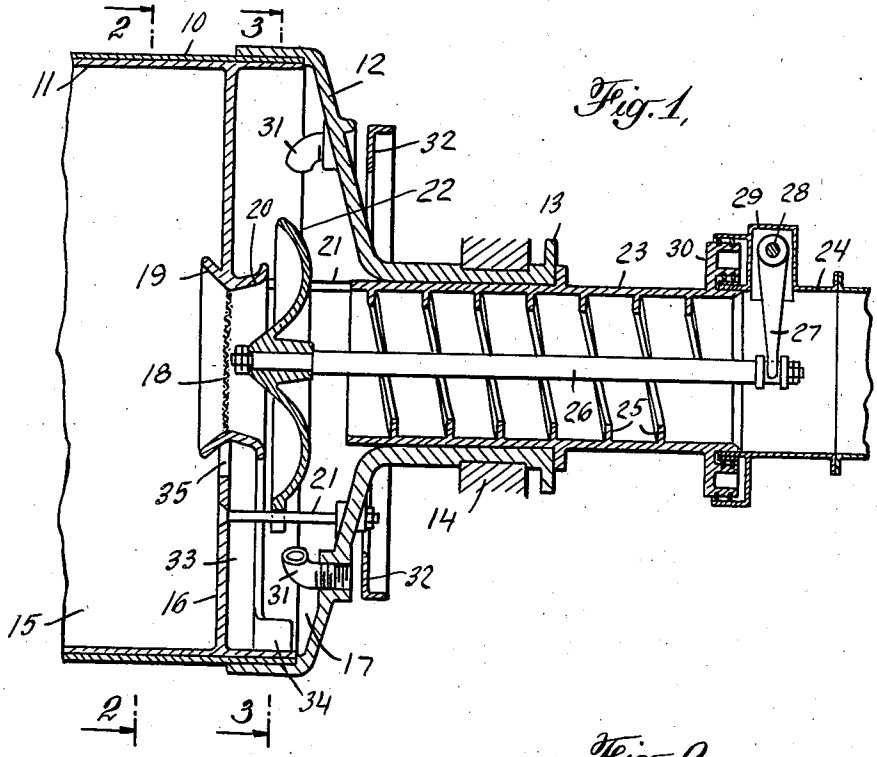

Fig. 2.

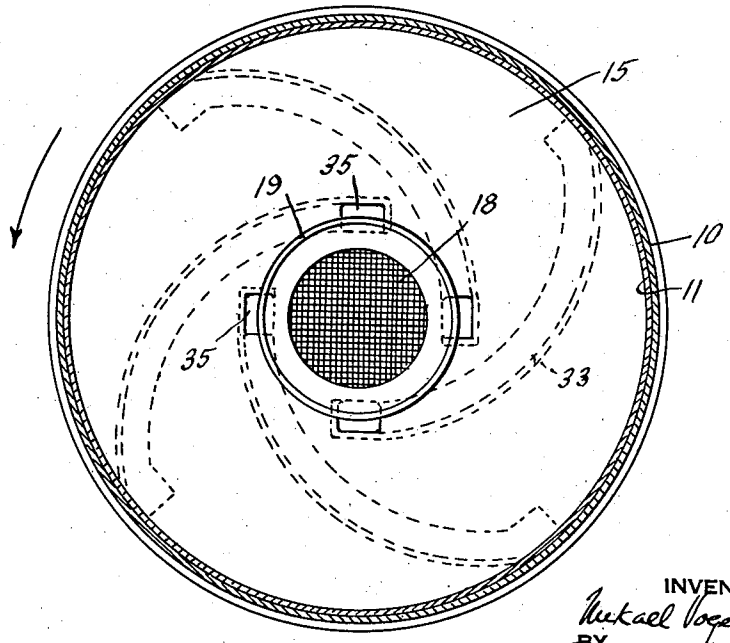

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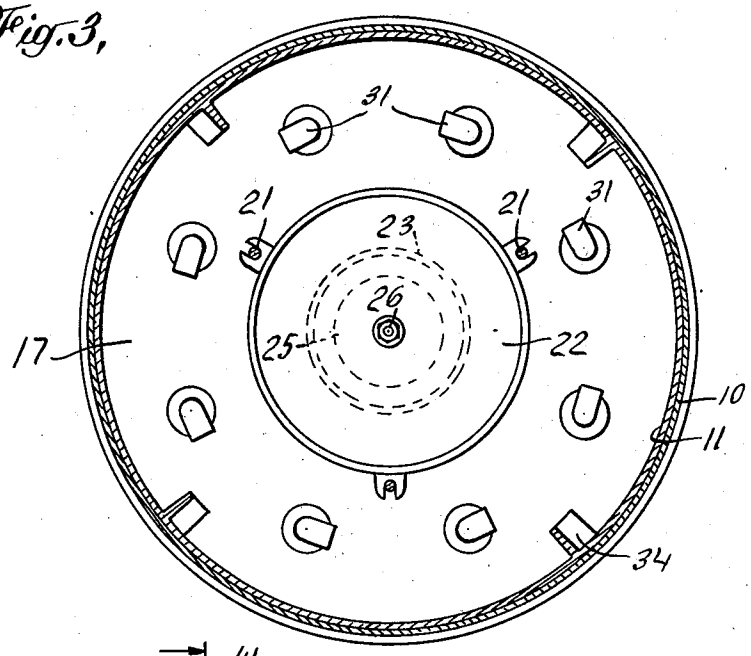
Fig. 3,



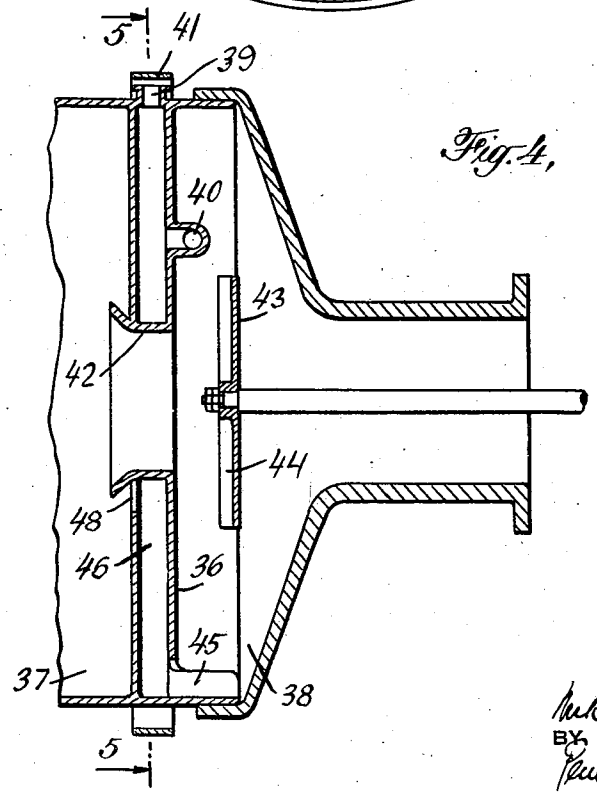


Fig. 4,

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Fig. 5,

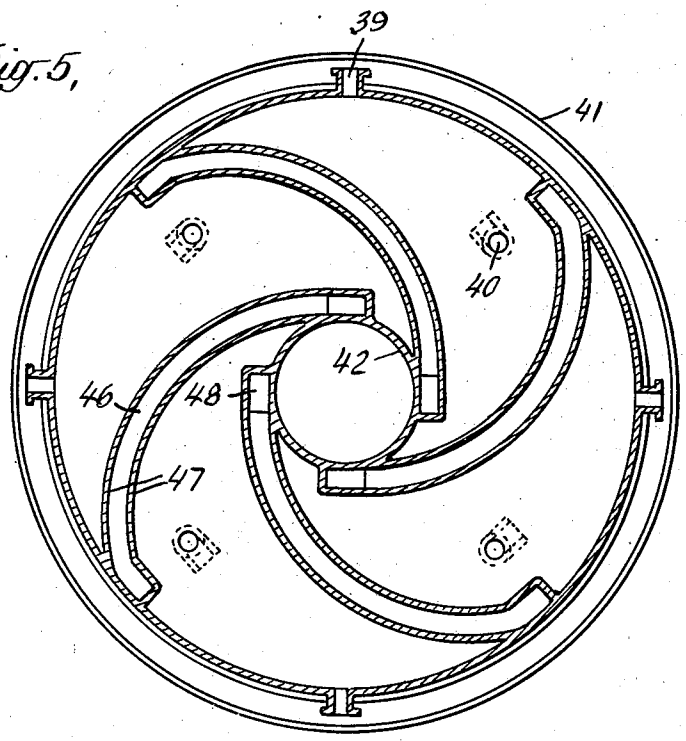
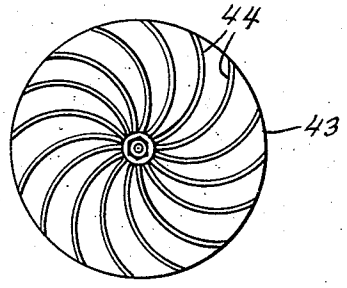


Fig. 6.



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Patented Jan. 2, 1940 2,185,960

UNITED STATES PATENT OFFICE

2,185,960

MILL

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Application September 1, 1937, Serial No. 161,885
In Great Britain September 7, 1936

7 Claims. (Cl. 83—9)

This invention relates to grinding mills of the type in which the pulverized or ground material is discharged from the mill by means of a current of air drawn or forced through the rotating drum containing the grinding compartments. More specifically, the invention is concerned with an air-swept tube mill provided with novel means for separating the fine ground materials from those of coarser size, so that the latter are prevented from being discharged and may be returned to the grinding compartments for further grinding.

In air-swept tube mills as commonly constructed, there are several grinding compartments from the last of which the fine ground material is carried away by a current of air, and, since in practice, the air may also carry away some coarse material, provision must be made for separating the latter from the air current and returning it to the mill for further treatment. In the mill of the present invention, one of the grinding compartments, preferably the last in the series, is provided with a central outlet opening leading to a separating chamber within which is a deflector which is mounted in line with the opening and acts to cause the air and material passing through the opening to flow outwardly and radially in the chamber. Means are also provided to cause the deflected air current in which the material is suspended to flow rotationally, with the result that the centrifugal action to which the suspended material is subjected causes the coarser heavier particles to be thrown out of the air current and to be collected at a point where they can be returned to the grinding compartment. In the new mill, rotational movement can be imparted to the deflected current in several ways, as, for example, in a mill in which air is drawn through the drum by suction, the desired effect can be accomplished by admitting additional air into the separating chamber adjacent the deflector through nozzles so arranged as to cause the admitted air to have a whirling motion. In a mill operating under forced draft, the stream of air impinging upon the deflector and containing the suspended particles may be given the whirling motion by forming the deflector with ribs or vanes of appropriate shape, by rotating the deflector, or by a combination of these expedients.

For a better understanding of the invention, reference may be made to the accompanying drawings in which

Figure 1 is a longitudinal sectional view through the discharge end of one type of mill constructed in accordance with the invention;

Figures 2 and 3 are sectional views on the lines 2—2 and 3—3, respectively, of Figure 1;

Figure 4 is a view similar to Figure 1 of a mill of modified construction;

Figure 5 is a sectional view on the line 5—5 of Figure 4; and

Figure 6 is a front elevational view of the deflector employed in the mill shown in Figure 4.

Referring to the drawings, the mill illustrated in Figures 1 to 3, inclusive, includes a shell 10 of tubular form having the usual lining 11 and closed at one end by a head 12 provided with a trunnion 13 rotating in a bearing 14. The mill contains a plurality of grinding compartments containing grinding bodies in accordance with the usual practice, a portion of the last compartment 15 only being illustrated. This compartment is defined at one end by a partition 16 which forms one wall of a separating chamber 17 lying within the mill, and the partition 16 has a central outlet opening containing a screen 18. The opening is defined by flanges 19 and 20 flaring outwardly and lying, respectively, in the grinding and separating compartments, and the flange 19 serves to keep the grinding bodies in the compartment 15 from coming in contact with the screen 18, while the flange 20 in the separating chamber serves as a guide for the air current passing through the screen.

Mounted on rods 21 extending from the head 12 to the partition 16 is a deflector plate 22, the forward face of which is of dish shape, and the current of air, in which ground material is suspended, passing through the screen 18, impinges upon the front face of the deflector and is deflected outwardly and radially thereby, so that the coarser particles are thrown toward the periphery of the chamber. The finer particles are then carried with the current of air through the chamber and pass out through a sleeve 23 which extends through the trunnion 13 to a stationary duct 24 and is provided with helical conveying flights 25 which serve to return to the separating chamber any particles of material precipitated out of the air current flowing through the sleeve. The deflector 20 is movable on the rods 21 toward and away from the opening in the partition 16 by means of a rod 26, one end of which passes through the deflector, the other end of the rod being engaged by a fork 27 mounted on a shaft 28 in a housing 29 on the stationary duct 24. By rocking the shaft, the rod 26 can be moved endwise to alter the position of the

deflector relative to the opening. In order to prevent leakage between the sleeve 23 and the stationary duct, a seal 30 of any suitable construction may be employed.

In order to accelerate the separation of the coarse material, the deflected air current containing the particles of material is caused to move rotationally within the separating chamber, and for this purpose, in the mill illustrated in Figures 1 to 3, air is admitted into that chamber through a plurality of nozzles 31 adjustably mounted in openings in the head 12. These nozzles are so positioned that air entering through them into the separating chamber flows with a rotational movement and the admitted air imparts a similar movement to the deflected current, so that the centrifugal action to which the suspended particles are subjected, is intensified.

The fineness of the finished material at various capacities of the mill can be controlled by varying the position of the deflector relative to the discharge opening, and the separation can also be controlled by varying the whirling motion imparted to the air within the separating chamber. For this latter purpose, the nozzles 31 may be adjusted to different positions as may be desired, and the amount of air that enters through the nozzles may be controlled by means of a ring 32 mounted outside the head 12 in any convenient way and movable toward and away from the inlet ends of the nozzles.

The coarse material that is precipitated in the separating chamber is returned to the grinding compartment by means of a plurality of curved conveying channels 33 mounted on the partition 16 and connected to conveyor flights 34 within the separator chamber. The material picked up by the flights and entering the channels is discharged therefrom into the grinding compartment 15 through openings 35 through the partition 16 to which the channels respectively lead. The openings 35 are disposed close to the flange 19 and are overhung thereby so that the material entering chamber 15 through the openings will not immediately be picked up by the current of outgoing air.

In the construction illustrated in Figures 4 to 6, inclusive, a double walled partition 36 separates the final grinding compartment 37 from the separating chamber 38 and air is admitted into the separating chamber through the space between the two walls of the partition. Openings 39 through the shell of the mill are provided to armit air into the space referred to, and the air passes through the space and enters the separating chamber through nozzles 40 arranged to impart a whirling motion to the air issuing therefrom. The amount of air thus introduced can be controlled by a ring 41 encircling the mill and lying close to the inlet openings 39, and the whirling effect can be controlled by adjustment of the position of the nozzles.

The material leaving the grinding compartment through the central outlet opening 42 in the double wall partition 36 impinges upon a deflector 43, the face of which may be provided with curved ribs 44 which assist in imparting a rotational movement to the deflected current of air. The deflector is supported in position in any desired way, as, for example, by the means illustrated in Figure 1, and is adjusted toward and away from the central outlet opening.

The coarser material separated in the chamber 38 is introduced by conveyor flights 45 into passages 46 defined by partitions 47 lying in the space between the two walls of partition 36, and the material leaves the channels 46 through openings 48 through which the material is discharged into the grinding compartment 37.

When the mill is of the type in which air is drawn through the grinding compartments and separating chamber by suction applied through the pipe 24, acceleration of the separation by the admission of additional air through the nozzles as described may be advantageously employed, but in mills working with forced draft, it is preferable to supply no air to the separator, but to impart a whirling motion to the deflected air current by the formation of ribs, such as those designated 44, on the face of the deflector opposed to the outlet opening. If desired, the whirling action may also be accomplished by rotating the deflector by appropriate means, or by a combination of these expedients.

A mill constructed in accordance with the present invention is more efficient than those of prior constructions by reason of the better separation of the coarse particles from the current of air issuing from the discharge opening. The whirling motion imparted to the air within the separating chamber accelerates the separation and thus insures that the coarse particles will be thrown out of the air current so that the particles may be returned for further grinding. Also, the new mill is well adapted to use in direct firing, for example, of cement kilns, in which case the ground material is the fuel which is led with air through a fan direct to the supply pipe of the burner of the mill.

I claim:

1. In an air-swept rotary tube mill, the combination of a rotary grinding chamber and a rotary separation chamber separated by a partition having a central opening through it for the passage of air and material from the grinding chamber to the separation chamber, a deflector in the separation chamber in line with said opening for deflecting in generally outward directions the entire stream of air and material entering the separation chamber through the opening, means arranged to act on the deflected stream of air and material for causing such deflected stream to move rotationally in the separation chamber, and means for returning to the grinding chamber the coarser material thrown outwardly by such rotational movement.

2. A tube mill in accordance with claim 1 in which the deflector is axially adjustable relative to said opening.

3. In an air-swept rotary tube mill the combination of a rotary grinding chamber and a rotary separation chamber separated by a partition having an opening for the passage of air and material from the grinding chamber to the separation chamber, a deflector in the separation chamber for producing outward radial movement of the stream of air and material entering the separation chamber through the opening, means for admitting air into the separation chamber and in a direction to produce rotational movement of the deflected stream of air and material, and means for returning to the grinding chamber the coarser material thrown outwardly by such rotational movement.

4. In an air-swept rotary tube mill the combination of a rotary grinding chamber and a rotary separation chamber separated by a partition having an opening for the passage of air and material from the grinding chamber to the separation chamber, a deflector in the separation

chamber for producing outward radial movement of the air entering the separation chamber through said opening, a plurality of air nozzles for directing air into the separation chamber in the vicinity of the deflector and in a direction circumferentially of the mill to produce rotational movement of the deflected stream of air and material, and means for returning to the grinding chamber the coarser material thrown outwardly by such rotational movement.

5. A tube mill in accordance with claim 4 in which the air nozzles are adjustably mounted.

6. In an air-swept tube mill the combination of a grinding chamber and a separation chamber separated by a double walled partition having an opening through it for the passage of air and ground material from the grinding chamber to the separation chamber, a deflector in the separation chamber in line with said opening for directing outwardly the air and material entering the separation chamber, means for admitting air into the space between the walls of the partition, and means for directing air from said space against the deflected stream of material in the separation chamber and in a direction circumferentially of the mill to produce rotational movement of the deflected stream in the separation chamber.

7. A tube mill in accordance with claim 6 provided with means for returning to the grinding chamber through the space between the walls of the partition the coarser material thrown outwardly in the separation chamber by the rotational movement therein of the stream of material.

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