

July 3, 1934.

R. M. HARDGROVE

1,965,186

GRINDING MILL WITH AIR SEALING DEVICE

Filed Sept. 15, 1930

2 Sheets-Sheet 1

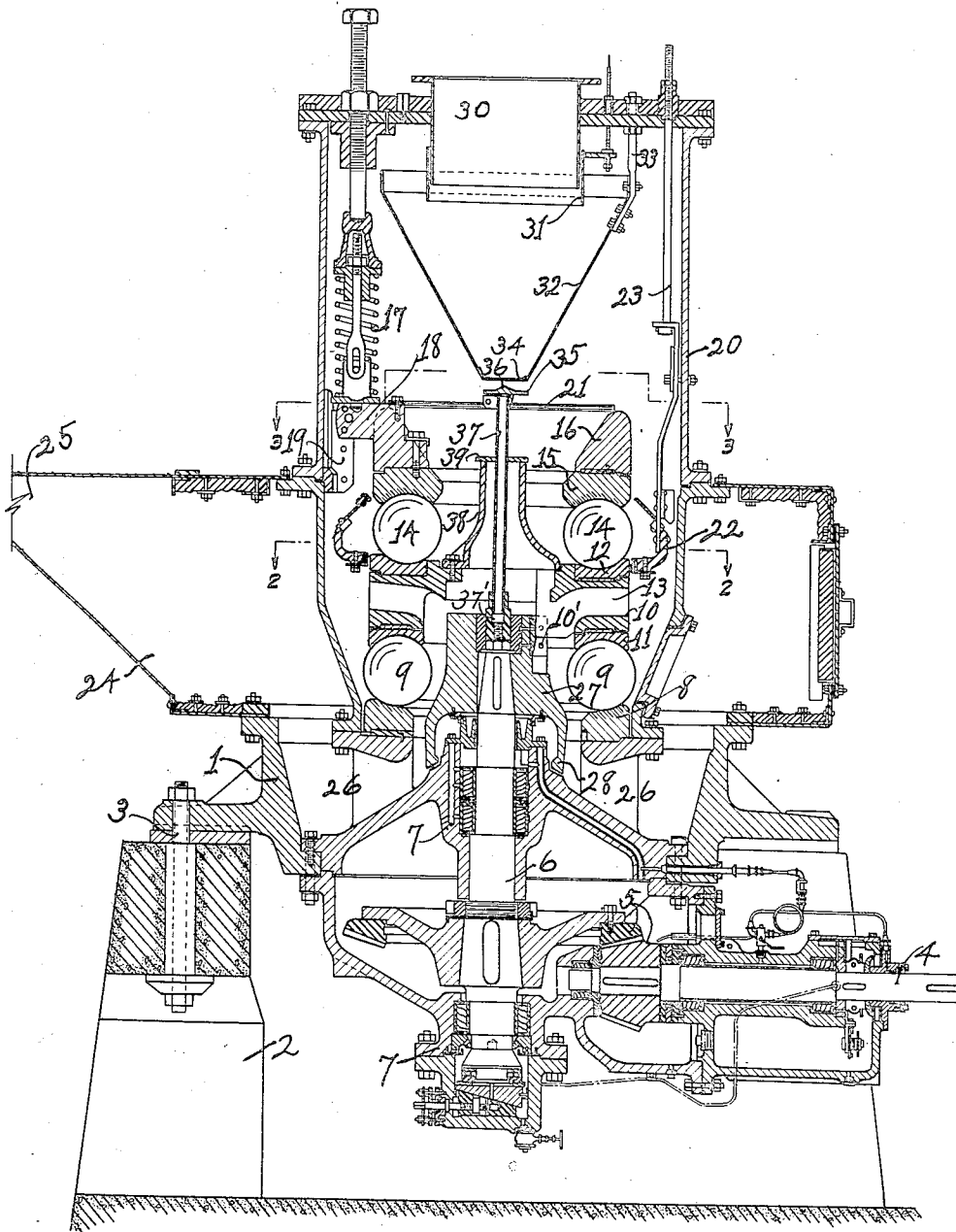


FIG. 1 *Ralph M. Hardgrove*
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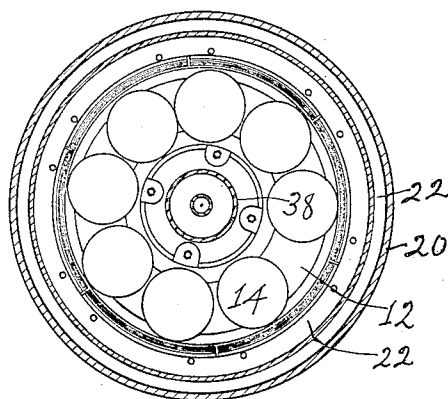


FIG. 2

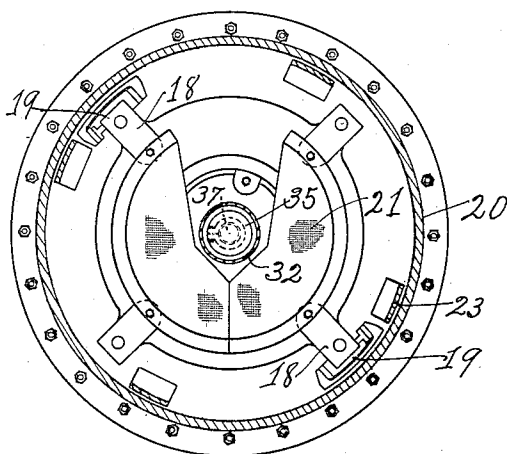


FIG. 3

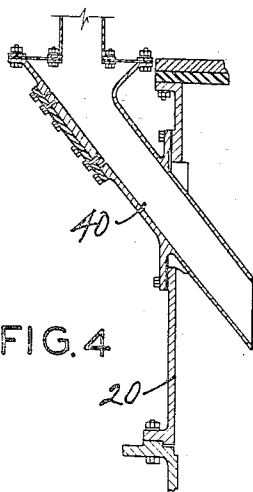


FIG. 4

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UNITED STATES PATENT OFFICE

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GRINDING MILL WITH AIR SEALING DEVICE

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3 Claims. (Cl. 83—45)

This invention relates to a grinding mill of the type in which grinding balls grind the material and a current of air is passed through the mill to pick up the fine particles of ground material.

The invention is especially applicable to a mill for grinding or pulverizing coal, but is not restricted to this particular material.

A separator is located near the outlet of the mill for separating the coarse particles of material from the fine particles that are being carried along in the air and returning the coarse particles to be reground. A rotating air seal is provided near the lower end of the separator to prevent air from passing upwardly through the separator instead of passing over the upper edge and downwardly into the separator.

The invention will be understood from the description in connection with the accompanying drawings, in which Fig. 1 is a vertical section through an illustrative embodiment of the invention; Fig. 2 is a section along the line 2—2 of Fig. 1; Fig. 3 is a section along the line 3—3 of Fig. 1, and Fig. 4 is a section through the spout for the mill.

In the drawings, reference character 1 indicates the base of the grinding mill that is connected to the supports 2 by means of the bolts 3. A driving shaft 4 that may be driven from any convenient source of power is connected by means of the gears 5 to the vertical shaft 6 of the mill. Bearings 7 for the shaft 6 are connected to the base 1.

A stationary grinding ring 8 is located in the lower portion of the mill and a row of grinding balls 9 is rotated circumferentially on the grinding ring 8. A rotatable table 10 is driven by the shaft 6 and is provided along its lower side with a grinding ring 11 located above the balls 9. The table 10 is also provided along its upper side with a grinding ring 12 upon which the row of grinding balls 14 rotates. Radially extending ports 13 are provided through the table 10 and the table 10 is driven by the shaft 6 with a slidable connection between the two, as indicated at 10', so that the table 10 can move vertically with respect to the shaft 6 to compensate for wear and for different amounts of grinding material that may be present in the mill. A non-rotatable grinding ring 15 is located upon the balls 14 and rest thereupon. A pressure ring 16 is provided along the upper side of the grinding ring 15 and is attached thereto. Adjustable springs 17 are provided for the pressure ring 16 to regulate the amount of pressure upon the grinding balls 9 and 14. Lugs 18 are provided on the ring 16 ex-

tending into holding devices 19 that are located along the inside of the casing 20 to prevent the rings 15 and 16 from rotating. A screen 21 may be provided along the upper edge of the ring 16.

An annular baffle 22 is provided along the outside of the row of balls 14 and is supported by means of adjustable supports 23 by means of which it can be adjusted into different vertical positions.

An air casing 24 surrounds the lower portion of the casing 20 and is provided with an air inlet 25 from a source of compressed air, such as a fan, for example. Ports 26 are provided from the lower portion of the air casing 24 into the space within the row of balls 9.

A casting 27 is connected to the upper portion of the shaft 6 in the space within the row of balls 9 and is provided with a flange 28 to prevent dust from reaching the bearings 7.

An outlet 30 is provided at the top of the casing 20 and an adjustable extension 31 is located around the lower end of the outlet 30.

A conically-shaped separator 32 is supported below the outlet 30 by means of supports 33, so that the separator can be adjusted into different vertical positions. An opening 34 is provided at the lower end of the separator 32 and a rotatable disc-shaped air seal 35 is provided near the opening 34. A cone-shaped extension 36 is provided along the upper side of the air seal 35 and is aligned with the center line of the opening 34. A rod 37 to which the air seal 35 is clamped extends to the upper end of the shaft 6 and is fixedly secured thereto as, for example, by welding it to a nut 37' which is screwed on the end of the shaft, so that the air seal 35 will be rotated when the shaft 6 rotates.

A hollow casting 38 is attached to the table 10 and extends through the space within the row of balls 14. A cover plate 39 is provided for the casting 38 and has a hole therein through which the rod 37 passes.

A feed inlet 40 (Fig. 4) for the material to be ground passes through the casing 20 for feeding the material into the space within the row of balls 14.

The operation is as follows: The material to be ground is fed into the space within the row of balls 14 and passes radially outwardly. The particles which have been ground to a certain degree of fineness pass radially outwardly and then downwardly, thence radially inwardly through the spaces between the balls 9, where they are further ground. The air entering through the ports 26 picks up the ground material and car-

ries it outwardly through the ports 13, thence upwardly and over the upper edge of the separator 32, from which the air carrying the fine particles passes out through the outlet 30, while the coarse particles pass downwardly and out through the outlet 34.

The air seal 35 is located below the opening 34 so that the coarse particles fall upon this disc-shaped air seal 35 and as it rotates, these particles are carried over the edges of this air seal and fall into the space between the row of balls 14 with the incoming fresh material, and thus becomes reground. The presence of the air seal 35, together with the coarse particles resting thereon prevents the air carrying the ground particles from passing upwardly through the opening 34, and interfering with the separation of coarse and fine particles in the separator 32. The separator can be adjusted into different positions to vary the distance from the air seal 35 to the opening 34, so that a sufficient amount of coarse particles of the material that is being ground can be maintained on the air seal 35 to prevent air from entering the opening 34 and still permit the particles to pass over the edge of the air seal 35 as they collect in the lower portion of the separator 32.

I claim:—

1. An air-swept pulverizing mill having a casing, an annular grinding ring in said casing, a circular row of rolling grinding elements in said casing cooperating with said grinding ring to form a material grinding stage, a drive shaft extending upwardly within said row of grinding elements and operating to effect relative movement between said elements and ring, an outlet for pulverized material in the top of said casing, a separator cone suspended in said casing and surrounding said material outlet and having its lower smaller end opening to said casing above said grinding stage for the return of coarse material thereto, means for causing a stream of air to sweep up fine material from said grinding stage and to pass inwardly over the upper edge of said separator cone to said outlet, and a rotary sealing disc mounted on said drive shaft and positioned in spaced relation below and in axial alignment with the lower end of said separator cone and cooperating with the coarse material discharging therebetween to minimize the passage of air upwardly through the lower end of said separator cone and to centrifugally discharge said coarse material throughout said grinding stage.

2. An air-swept pulverizing mill having a casing, an annular grinding ring in said casing, a

circular row of rolling grinding elements in said casing cooperating with said grinding ring to form a material grinding stage, a drive shaft extending upwardly within said row of grinding elements and operating to effect relative movement between said elements and ring, an outlet for pulverized material in the top of said casing, a separator cone suspended in said casing and surrounding said material outlet and having its lower smaller end opening to said casing above said grinding stage for the return of coarse material thereto, means for causing a stream of air to sweep up fine material from said grinding stage and to pass inwardly over the upper edge of said separator cone to said outlet, and a rotary sealing disc mounted on said drive shaft and positioned in spaced relation below and in axial alignment with the lower end of said separator cone and cooperating with the coarse material discharging therebetween to minimize the passage of air upwardly through the lower end of said separator cone and to centrifugally discharge said coarse material throughout said grinding stage, the upper surface of said sealing disc being formed so as to facilitate the discharge of material therefrom.

3. An air-swept pulverizing mill having a casing, an annular grinding ring in said casing, a circular row of rolling grinding elements in said casing cooperating with said grinding ring to form a material grinding stage, a drive shaft extending upwardly within said row of grinding elements and operating to effect relative movement between said elements and ring, an outlet for pulverized material in the top of said casing, a separator cone suspended in said casing and surrounding said material outlet and having its lower smaller end opening to said casing above said grinding stage for the return of coarse material thereto, means for causing a stream of air to sweep up fine material from said grinding stage and to pass inwardly over the upper edge of said separator cone to said outlet, a rotary sealing disc mounted on said drive shaft and positioned in spaced relation below and in axial alignment with the lower end of said separator cone and cooperating with the coarse material discharging therebetween to minimize the passage of air upwardly through the lower end of said separator cone and to centrifugally discharge said coarse material throughout said grinding stage, and means for vertically adjusting said separator cone relative to said sealing disc to vary the size of the annular opening therebetween.

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