United States Patent

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[54] **MILL FOR PULVERIZING HARD MATERIAL**
17 Claims, 6 Drawing Figs.

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[51] **Int. Cl.** **B02c 13/18,** B02c 13/288, B02c 31/00
[50] **Field of Search** ..... 241/47, 48, 55, 59, 188, 188(.5), 275, 299, 152, 42–44: 110/(Inquired)

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ABSTRACT: A ventilating mill in which material to be pulverized is fed with a heated transport fluid to crushing plates on a rotor in a housing to be subjected to a first crushing operation. The material is discharged by centrifugal force from the rotor into the housing wherein the material undergoes a second crushing operation and is thereafter discharged to a distributor. The degree of crushing in the second crushing operation is regulated by the period of detention of the material in the housing as controlled by the size of a throttle outlet aperture from the housing to the distributor and the length of the housing between the rotor and the distributor.

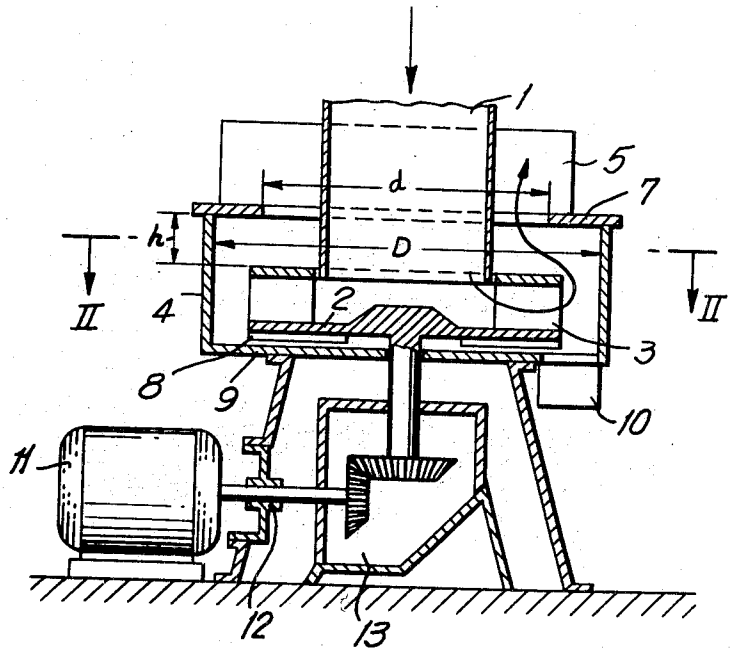
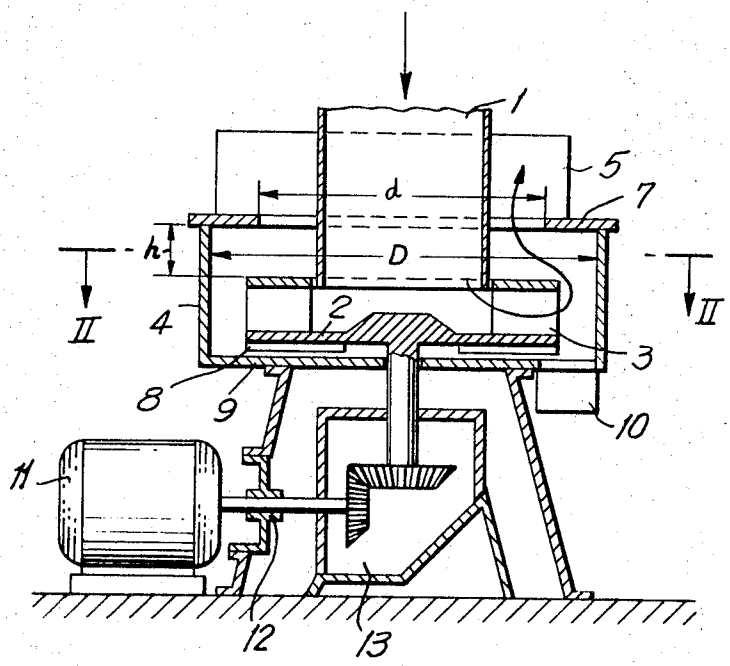


FIG. 1



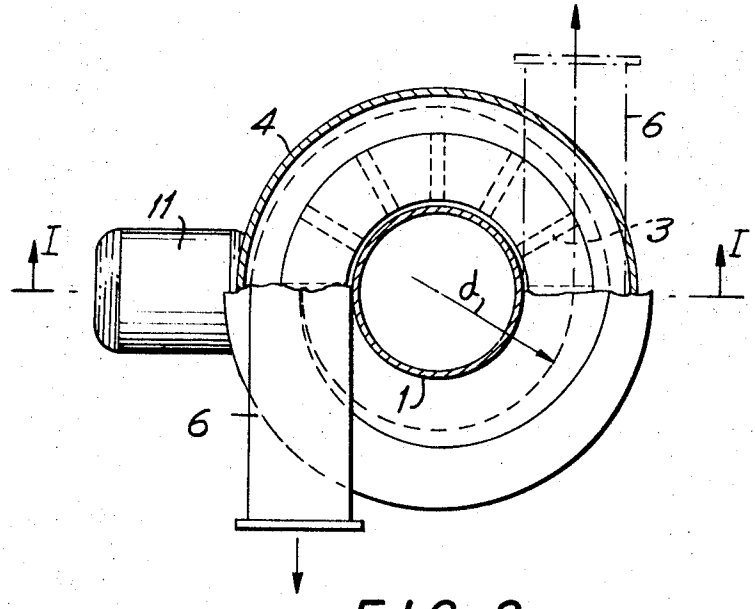
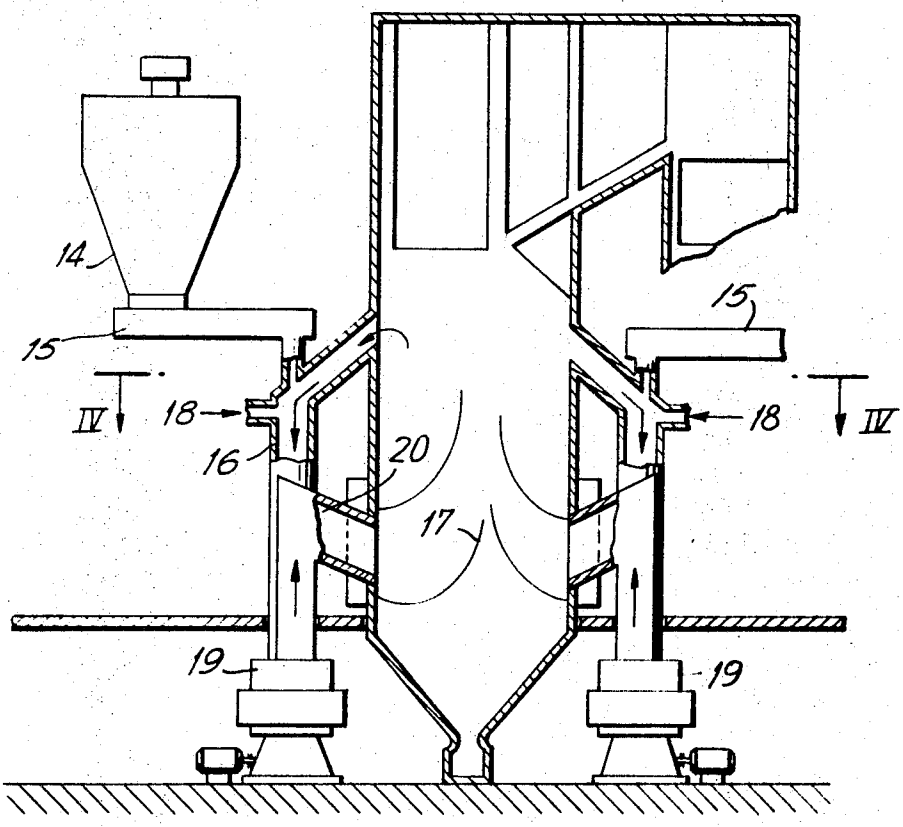


FIG. 2

FIG. 3



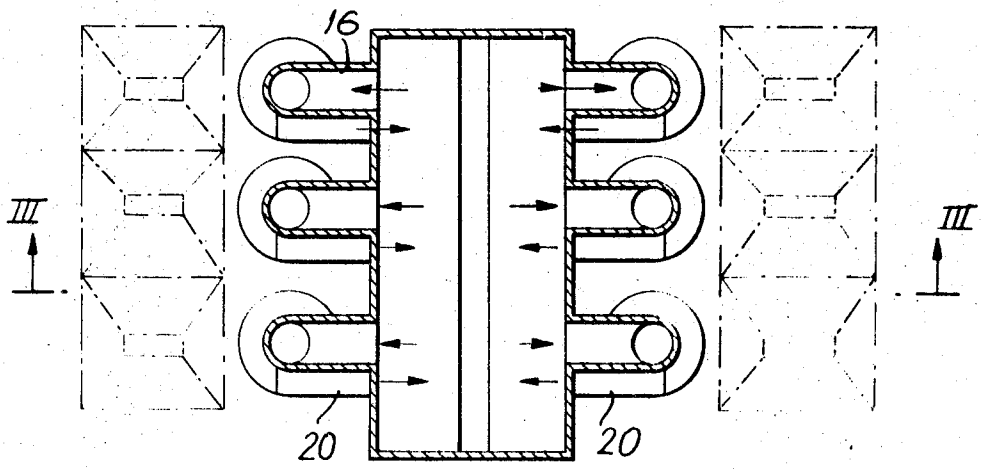


FIG. 4

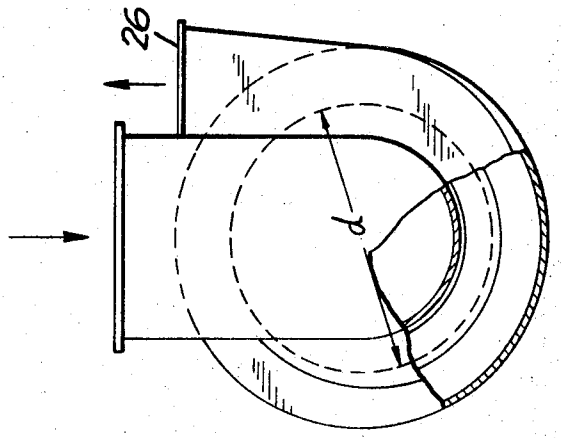


FIG. 6

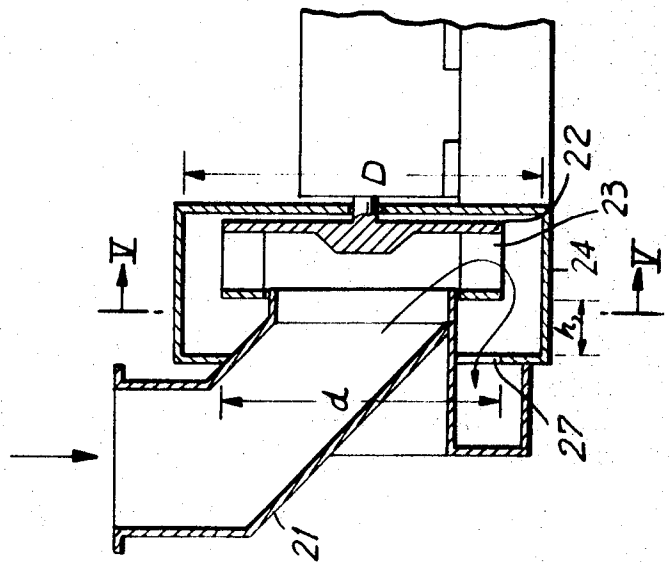


FIG. 5

MILL FOR PULVERIZING HARD MATERIAL

BRIEF SUMMARY OF THE INVENTION

This invention relates to ventilating mills for the pulverizing of coal as well as to the pulverizing of other materials in the milling industry.

It is known that a very intensive pulverizing of coal is achieved in ventilating mills, along with simultaneous drying, when moistened coal is pulverized with the addition of hot burning products from a steam boiler furnace and heated air from an air heater.

In known mills, the degree of fineness of the pulverized coal is achieved in that coal particles which were not crushed in the first pass through the crushing rotor to the desired degree of specific fineness, are separated in a centrifugal separator, which is located after the mill, and returned for subsequent milling by the crushing rotor of the ventilating mill.

Such an internal circulation of the insufficiently pulverized particles and burning products enriched with volatile ingredients, adversely affects the mill's operation since it enormously increases the erosion of the crushing plates of the rotor, and it also decreases the drying potential of the burning products which serve for the drying of the pulverized coal and its transport to the burner.

The erosion of the crushing plates due to the circulation of the pulverized material between the centrifugal separator and the crushing rotor increases very intensively, because a great quantity of mineral materials (ashes) will be returned into the crushing rotor, which have been already reduced in size to a very small degree, but are returned to the mill because of their high specific mass. This recirculation of mineral material is especially detrimental because it contains silicon dioxide, pyrites and other heavy and abrasive materials. Moreover, a significant amount of mechanical energy will be wasted for the unnecessary pulverization of the mineral materials, thus decreasing the efficiency of the mill and the steam generator, as well.

The pulverization of the fine particles of coal and other materials returning to the crushing rotor is not efficient due to the small mass of the particle, and therefore their pulverization is conducted by friction between the crushing plates of the rotor and the housing body.

A further deficiency of the known arrangement is that the lateral supply of raw coal to the crushing rotor by gravity, decreases the drying intensity due to insufficient contact of the entire fluid drying mass with the entire coal quantity, thus causing irregular rotor wear, resulting in a state of unbalance of the rotor.

In addition, the centrifugal separators must be larger, causing an increase in the pressure loss in the pressure tubing of the mixture of pulverized coal and carrier or transport fluid thereby raising the level of the fireman's station and making the mill's mounting next to the boiler more difficult, while also increasing the size of the boiler due to asymmetric design.

An object of the present invention is to provide a ventilating mill which does not employ a separator and which is free of the mentioned disadvantages.

According to the invention, the mill includes means for subjecting the material to be pulverized to two stages of crushing, the second stage being controlled in such a way that the particle size of the discharged material corresponds to that desired.

In the mill according to the invention, a rotor with crushing plates thereon is disposed in a housing and the material to be pulverized is fed with a carrier, constituted by a heated drying fluid, to the crushing plates and thereat subjected to the first stage of crushing. The material passes, under the influence of centrifugal force, from the crushing plate into the housing where the material undergoes the second stage of crushing, where after the material passes to a distributor and is fed to a combustion chamber of a steam generator. The period of detention of the material in the housing is controlled by regulating the length of the housing along which the material passes as it flows towards the distributor, and the size of a throttle outlet opening from the housing to the distributor, the latter being achieved with a plate having a diameter of particular size.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical section through a ventilating mill according to the invention along line I–I of FIG. 2;

FIG. 2 is a plan view of the mill of FIG. 1 partially broken away along line II–II in FIG. 1;

FIG. 3 is a side elevation view diagrammatically showing a plurality of mills and a steam generator;

FIG. 4 is a sectional view taken on line IV–IV in FIG. 3;

FIG. 5 is a sectional view of a modified version of the mill of FIG. 1; and

FIG. 6 is an end view of the mill of FIG. 5 partly broken away along line V–V in FIG. 5.

DETAILED DESCRIPTION

As shown in FIG. 1, raw coal with recirculated gases or other transporting fluid fall through a hollow shaft 1 onto a disc 2 of a crushing rotor which serves for the first stage of coal pulverization as well as for increasing the pressure in the milling system. The raw coal will be pulverized by impact with crushing plates 3, and due to the action of centrifugal force will be forcibly discharged against cylindrical frame 4 where a second stage of coal pulverization will be effected due to the friction between each coal particle and the portion of the housing frame opposite the plate 3.

The particles will remain on the aforesaid portion of the housing 4 until they are pulverized to the degree of intended fineness, after which they will be conveyed by the transporting gases into a distributor shown schematically as 5. The distributor may be of a type provided with an optional number of discharge outlets 6, see FIG. 2, depending on how many burners will be supplied from the mill with gaseous mixture.

The size of the pulverized coal can be increased by reducing the height h and/or increasing the exit diameter d leading to the distributor 5. By varying the above parameters in the opposite direction, the size of the pulverized coal can be decreased.

When there is no necessity for a very fine pulverization, the plate 7 with the reduced exit diameter d, placed between the housing 4 and the distributor 5, may be omitted, thus reducing the mill height and increasing the useful ventilating mill action.

On the undersurface of disc 2 of the rotor, there are mounted blades 8 which prevent penetration of the coal dust into the space between the rotor and the bottom 9 of the housing.

All metal and other particles of great specific mass, which cannot be pulverized, drop into a collecting box shown schematically as 10 for foreign particles and from which the particles are periodically removed.

The mill is driven by an electromotor 11 which is coupled by a fluid coupling or torque converter 12 to a bevel gear transmission 13. Such a driving mechanism enables the use of low-price electromotors with a smaller number of poles. The mill according to this invention can also employ a directly coupled electromotor, which is vertically installed.

FIGS. 3 and 4 show an assembly of six mills coupled to one greater steam generator. Coal is supplied to each mill 19 from a coal bunker 14 via a supplying device 15 and vertical shaft 16. Through the shafts 16 are passed the recirculated combustion products from the furnace 17, together with heated air 18 from an external air heater (not shown).

The pulverized and dried coal is conducted to the burners through air mixture conduit 20 where it is mixed with secondary air and burned. The heated combustion products serve to generate steam as they flow past the boilers.

A mill with a horizontally installed drive axle is represented in FIGS. 5 and 6 and is constructed in a manner similar to the mill, according to this invention, with the vertical drive axle, as shown in FIGS. 1 and 2.

However, in the mill in FIGS. 5 and 6, raw coal is supplied through shaft 21 and fed to rotor 22, so that the coal is crushed by plates 23 in the first milling stage. The crushed coal particles are then discharged against cylindrical frame 24 where a secondary milling stage will be achieved by friction between the coal particles and the housing body. A plate 27 with reduced passageway enables the pulverized coal to remain in the cylindrical frame, as in the previously described embodiment with the vertical driving axle. The pulverized coal is supplied to distributor 25 and thence past a connection flange 26 to the burners.

The mill according to the present invention has the following basic advantages with regard to known ventilating mills:

- intensive wear of crushing plates 3 by abrasive mineral materials contained in coal is prevented;
- a second pulverization stage by friction is achieved through longer detention of coarse-grained particles in housing body 4;
- the required degree of fineness of the milling may be obtained by proper sizing of the height of housing 4 and the diameter *d* of plate 7;
- the vertical position of the rotor axis enables smooth operation of the mill with less loading of radial bearings;
- the absence of a separator permits the construction of lower and lighter mills, since the distributor shape enables simple distribution of the air mixture and uniform concentration in one or more supply channels;
- the compact design of the mill enables it to be located close to the boiler resulting in a smaller overall size of the assembly; and the single support of the rotor enables operation of the mill with very high temperature of drying fluid, thus resulting in a high drying intensity.

We claim:

1. A ventilating mill for the pulverization of a hard product, said mill comprising a housing, a rotor in said housing, means for supplying material to be pulverized to said rotor, means peripherally located on said rotor for subjecting said material to a first crushing operation and for discharging the thus crushed material radially outwards thereof into the housing under the influence of centrifugal force, said means on said rotor being spaced from and cooperating with said housing for subjecting all of the crushed material interposed therebetween to a second crushing operation while said crushed material is under the influence of centrifugal force, a distributor connected to said housing for receiving the crushed material from said housing, means for controlling the period of detention of the crushed material in the housing before the crushed material is fed to the distributor thereby to control the degree of crushing of the material in the second crushing operation, and means for preventing recirculation of the crushed material in the housing to impinge against the means for subjecting the material to the first crushing operation after the crushed material has been subjected to the second crushing operation.

2. A mill as claimed in claim 1 wherein said means which controls the period of detention of the particles comprises a plate between the distributor and the housing, said plate having an outlet of determinable size for influencing the detention of the particles in the housing and opening into said distributor.

3. A mill as claimed in claim 2 comprising means for supplying a heated carrier fluid to the rotor with the material to be pulverized whereby the material is transported through the housing and distributor by said carrier fluid.

4. A mill as claimed in claim 3 wherein the size of said opening in said plate is less than the size of the housing whereby a throttle effect is produced on the fluid and material upon passing from the housing to the distributor.

5. A mill as claimed in claim 4 wherein said rotor is mounted for rotation about a vertical axis and the distributor is located above the housing, the carrier fluid and crushed material passing upwardly from the rotor to the distributor via said housing.

6. A mill as claimed in claim 5 wherein said means for supplying material to the rotor comprises a hollow shaft concentric with the rotor and having a discharge aperture above the rotor.

7. A mill as claimed in claim 6 wherein said means on said rotor for crushing the material comprises a plurality of spaced vertical crushing plates arranged radially on the rotor in a region encircling the discharge aperture of said hollow shaft, said housing extending a determinable distance above the crushing plates thereby also serving to control the period of detention of the particles in the housing.

8. A mill as claimed in claim 7 wherein said housing is circular and is concentric with the rotor.

9. A mill as claimed in claim 8 wherein said heated carrier fluid is a recirculated portion of the product of combustion of previously crushed material and secondary air.

10. A mill as claimed in claim 4 wherein said rotor is mounted for rotation about a horizontal axis and the distributor is located adjacent the housing in alinement therewith along a horizontal line.

11. A mill as claimed in claim 10 wherein said means for supplying material to the rotor comprises a hollow shaft with a vertical inlet portion and a horizontal outlet portion from which the material is fed to the crushing means on said rotor.

12. A mill as claimed in claim 11 wherein said crushing means comprises a plurality of crushing plates arranged radially on the rotor in a region encircling the discharge aperture of said outlet portion, said housing extending a determinable distance beyond the crushing plates towards the distributor thereby also serving to control the period of detention of the particles in the housing.

13. A mill as claimed in claim 1 wherein said rotor has opposed plates in spaced relation, said means peripherally located on the rotor comprising spaced, radial blades connecting said plates and defining therewith open passageways for outflow of material, said housing encircling said rotor in spaced relation with said passageways, said means for supplying material to be pulverized by said rotor comprising a hollow shaft which opens into one of said plates of said rotor, said means for controlling the period of detention of the crushed material in the housing being positioned relative to said plates to discharge the crushed material from the housing after the second crushing operation in a direction away from said rotor.

14. A mill as claimed in claim 13 wherein said means for controlling the period of detention of the crushed material comprises a plate parallel to the opposed plates of the rotor and encircling said hollow shaft.

15. A mill as claimed in claim 14 wherein said rotor is rotatable about a vertical axis and said opposed plates are horizontal, said hollow shaft being vertical, said one plates of the rotor being above the other plate thereof.

16. A mill as claimed in claim 15 wherein said plate of the means which controls the period of detention is horizontal and disposed in spaced relation above the upper plate of the rotor, and said plate of the means which controls the period of detention has an aperture in which the vertical shaft is positioned whereby the crushed material is constrained to flow from the rotor and upwardly through the housing for discharge through said aperture and around the vertical shaft.

17. A mill as claimed in claim 16 wherein said distributor is supported on said plate of the means which controls the period of detention, said upper plate of the rotor facing said aperture in said plate of the means which controls the period of detention to constitute at least in part said means for preventing recirculation of the crushed material in the housing to impinge against the radial blades.