Aug. 2, 1966 C. W. GORDON 3,263,338

FLASH DRYING SYSTEM FOR FINE COAL

Filed Sept. 26, 1963 4 Sheets-Sheet 1

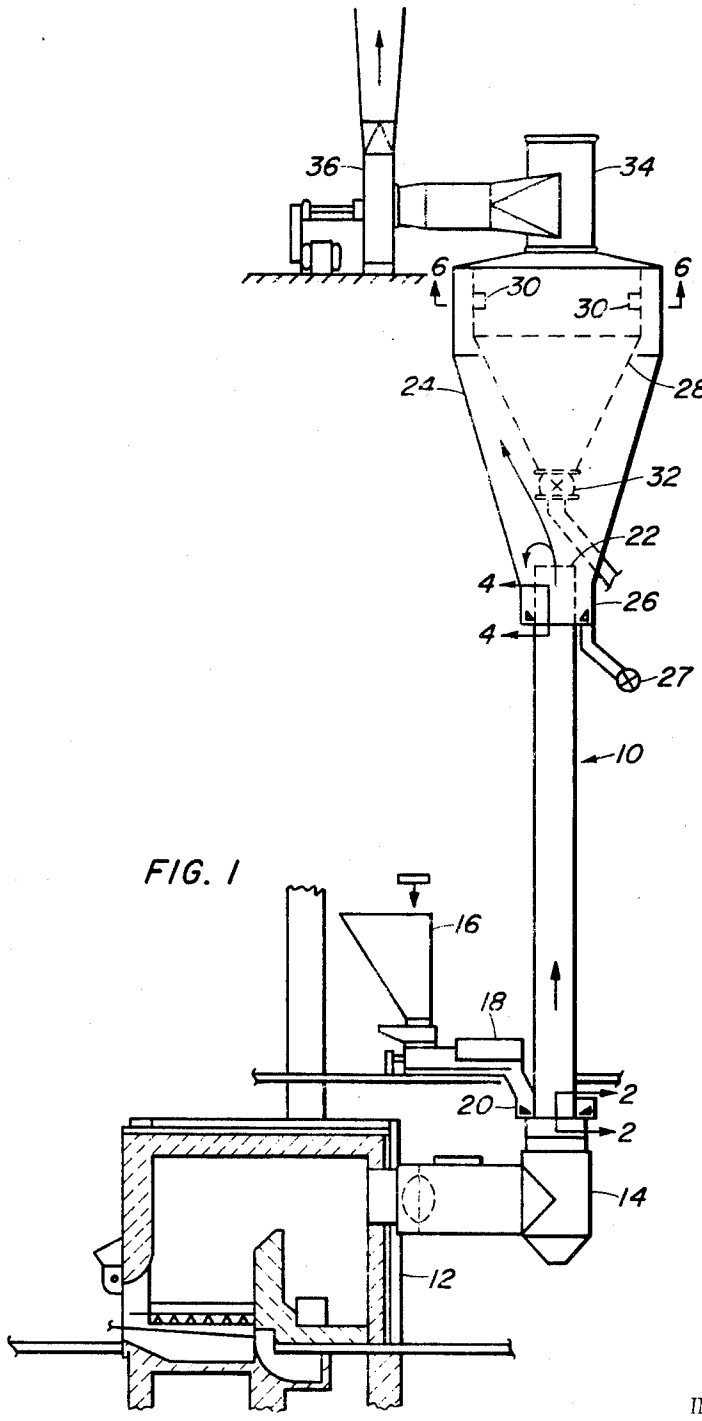

FIG. 1

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Filed Sept. 26, 1963 4 Sheets-Sheet 2

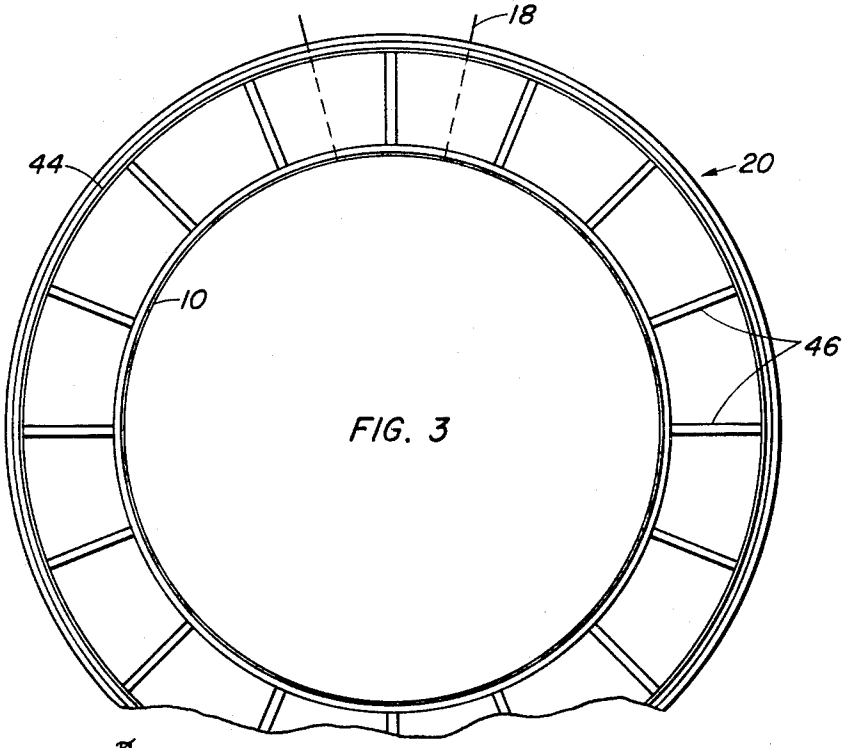

FIG. 3

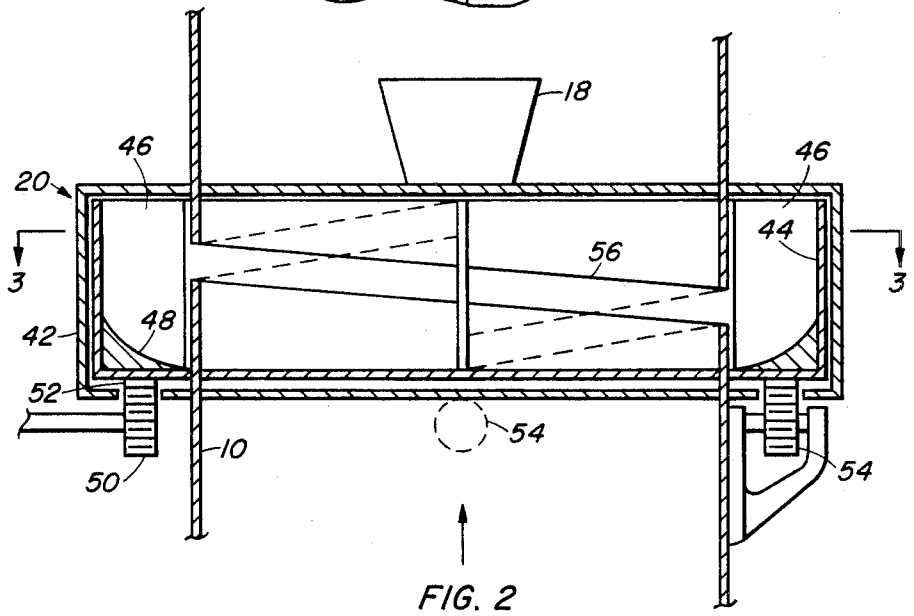

FIG. 2

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FLASH DRYING SYSTEM FOR FINE COAL

Filed Sept. 26, 1963 4 Sheets-Sheet 3

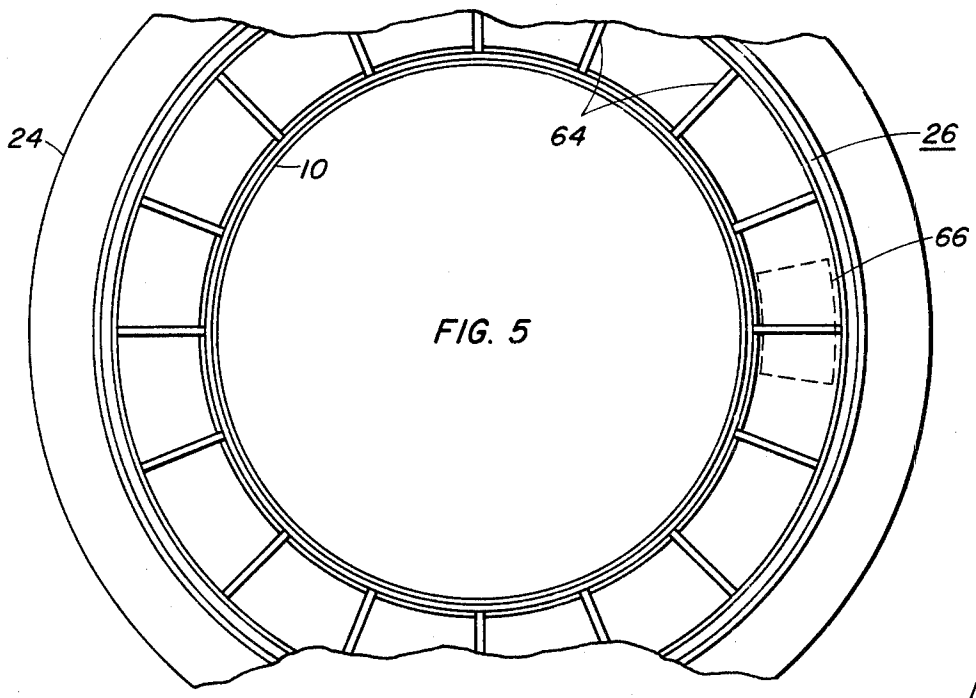

FIG. 5

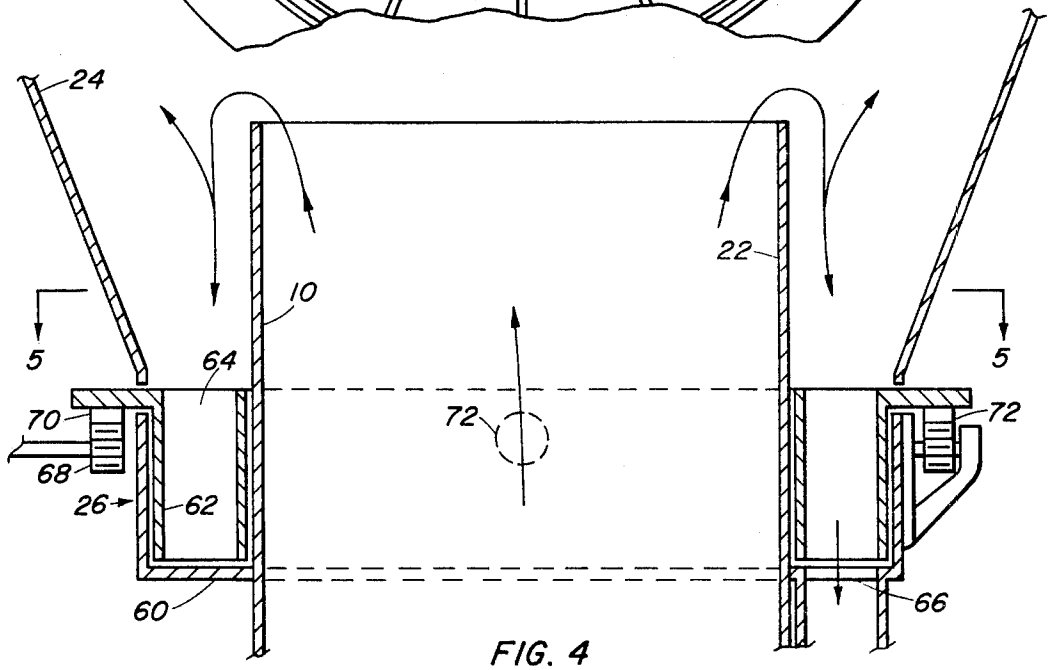

FIG. 4

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Aug. 2, 1966 C. W. GORDON 3,263,338

FLASH DRYING SYSTEM FOR FINE COAL

Filed Sept. 26, 1963 4 Sheets-Sheet 4

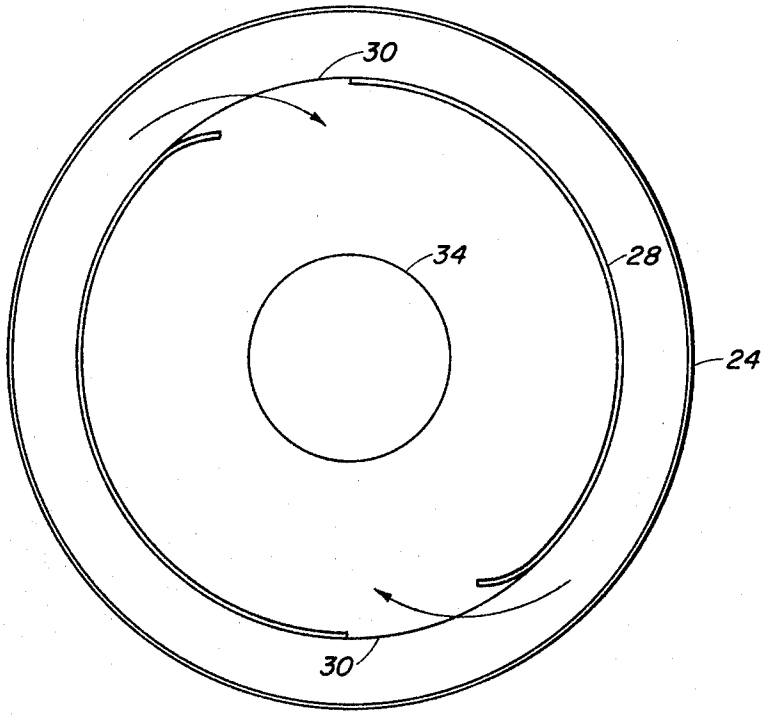

FIG. 6

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FLASH DRYING SYSTEM FOR FINE COAL

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3 Claims. (Cl. 34—57)

This invention relates to comminuted coal drying and separating systems in which wet crushed coal is delivered into a stream of high velocity hot gases in which the coal particles are substantially instantaneously dried and the gases and coal particles carried thereby are delivered into a separator, such as a cyclone, wherein the now moisture-laden gases are separated from the dried coal.

In present day conventional drying systems, problems are encountered in that the crushed coal in passing through the drying system causes undue wear at certain points within the system, thus resulting in increased maintenance, and more frequent shutdown periods of the system for replacement and repair of worn parts. Also, degradation in coal particle size results from impingement of the coal at various points in the drying system, which degradation decreases the value of the dried coal.

It is an object of this invention to provide a drying system incorporating a straight vertical drying column, containing no bends or turns therein, and means for introducing wet crushed coal thereinto around the entire periphery of such drying column, so that no portion of the drying system will become unduly worn, and little or no degradation in coal particle size results.

Other objects and advantages of the present system will become more apparent from the following specification when taken in consideration with the accompanying drawings wherein:

FIG. 1 is a cross sectional side view of drying system embodying my invention;

FIG. 2 is an enlarged view of the wet coal feeding apparatus taken on line 2—2 of FIG. 1;

FIG. 3 is a cross sectional plan view taken on line 3—3 of FIG. 2;

FIG. 4 is an enlarged view of the coarse coal discharge apparatus taken on line 4—4 of FIG. 1;

FIG. 5 is a cross sectional plan view taken on line 5—5 of FIG. 4; and

FIG. 6 is an enlarged plan view of the inner cyclone taken on line 6—6 of FIG. 1.

Looking now to FIG. 1, numeral 10 designates a vertical drying column, the inlet end of which is connected to a source of hot gases such as furnace 12. Wet crushed coal contained in bin or hopper 16 is discharged by way of screw feeder 18 and rotating table feeder 20 into the drying column 10. Any overly large coal particles which are not picked up by the high velocity flow of hot gases will drop down into chamber 14, and these particles can be periodically removed from the bottom thereof, so that they may be again reduced in size.

The wet coal entering drying column 10 is instantaneously substantially dried by the hot gases, and is carried along with the high velocity flow upwardly through the drying column 10 and is discharged through the outlet 22 into the outer cyclone or chamber 24. The stream of gases upon entering chamber 24 expands outwardly, causing a reduction in velocity of such gases, and the heavier coarse coal particles are thus gravity separated and fall down upon table feeder 26. This coarse coal is continuously discharged through a duct and a suitable conventional rotary air lock 27 to its ultimate point of use.

The hot gas along with the fines, or smaller particles of coal, flows upwardly through the chamber 24 and enters the inner cyclone 28 through tangential inlets 30.

The tangential inlets 30 cause the gases to flow in a rotating manner within cyclone 28, and thus the fines are centrifugally separated therefrom, and fall to the bottom of the cyclone. These fines are removed through rotary air lock 32 and its associated duct. The now moisture-laden gases pass upwardly out of cyclone 28 through exhaust duct 34, fan 36, and is discharged to the atmosphere. Fan 36 must be of such capacity that it maintains a high enough velocity flow of gases through the drying column 10 so as to enable the wet crushed coal to be carried upwardly therethrough. This wet crushed coal is generally on the order of ⅜ inch x 0 inch particle size. In other words, the largest particle size is ⅜ inch and the smallest particle size may be ultra-fines.

FIGS. 2 and 3 show the details of the wet coal feeding apparatus 20. Positioned within fixed or stationary housing 42 is a rotating annular table 44. The rotating annular table contains partitions or side walls 46 which form cavities or pockets into which wet crushed coal is introduced from the feeder 18. The table 44 contains an angled or inclined bottom 48. Table 44 is rotated by means of a motor driven drive pinion 50, and rack 52. A plurality of pinions 54 also help support the rotating table 44. A helical inlet opening 56 is formed in drying column 10, with one end of the opening 56 being at approximately the same height as the highest portion of the pockets of the table feeder, and the lower portion of the opening corresponding in height to the lowest portion of the pockets. Thus as the table feeder rotates, the pockets are continuously filled by feeder 18, and continuously discharge wet crushed coal into the drying column 10 evenly around the entire periphery thereof through the helical inlet opening 56.

FIGS. 4 and 5 show the details of the coarse coal discharge apparatus. As shown in FIG. 4, the coal and hot gases expand outwardly through outlet opening 22 into chamber 24, there being a decrease in flow velocity because of the increased flow area in the chamber. The heaviest or coarse coal particles fall by gravity downwardly onto the rotating table feeder 62 contained within fixed or stationary housing 60. Table feeder 62 contains a plurality of partitions 64, which form open bottomed pockets for continuoulsy rotating the coarse coal particles around to discharge outlet 66. The table feeder is rotated by means of a motor driven drive pinion 68, and rack 70. Support pinions 72 help support the table feeder. The outer separating chamber 24 would not necessarily have to be of the illustrated configuration, but from a practical standpoint this is the most economical.

As best seen in FIG. 6, the hot gases along with the fine particles of coal pass upwardly through chamber 24 and enter the inner cyclone 28 by means of openings 30. The gases enter the cyclone 28 tangentially, and thus rotate or spin within the cyclone. This results in centrifugal separation of the fine particles of coal, which drop to the bottom of the cyclone. The moisture-laden gases flow upwardly out of the cyclone through duct 34.

In previous drying systems, the wet crushed coal was introduced into the drying column from one side of the column only. Because of the high gas velocity and extreme turbulence, the wet coal was immediately picked up but not extensively distributed across the drying column. This resulted in a concentration of impingement of the coal particles on the side of the column opposite the feed entrance point, causing undue wear and also degradation in coal particle size. By introducing the wet coal evenly around the entire periphery of the drying column this problem is overcome. Also, since there are no bends or turns in the drying column, no undue wear of the drying column is caused by impingement of coal particles thereon in passing through such bend or turn.

The uniform distribution of the coal across the cross-section of the hot gas drying column achieved by utilizing my invention not only results in less wear of the drying column and less degradation in coal particle size, but also achieves a more efficient mixing of the hot gases and the wet feed, permitting heavier solids loading per pound of drying gas and therefore increased capacity of a given drying column. This also eliminates overloading surges of wet material and drop out at the bottom of the column.

The double cyclone arrangement results in first, the separation of the larger coarse coal particles from the hot gases and the coal fines; and secondly, the separation of the fine coal particles from the then moisture-laden gases. This dual separation is desirable from the standpoint of sale of such coal.

While I have illustrated and described a preferred embodiment of my novel drying system it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. For example, the system may be useful in drying other solid fuel materials in addition to crushed coal. I therefore do not wish to be limited to the precise details set forth but desired to avail myself of such changes and alterations as fall within the purview of my invention.

What I claim is:

1. A drying system for coal comprising a substantially vertical duct, having a lower inlet end and an upper outlet end, a source of hot gases connected to the inlet end, means for maintaining a high velocity flow of the hot gases through said duct, means for introducing crushed wet coal into said duct evenly about the entire periphery thereof at a location above the inlet end, and means for separating the dried coal particles leaving the outlet end from the gases, said means for introducing wet crushed coal into the duct around the entire periphery thereof comprises a table feeder which completely surrounds the duct, the table feeder being made up of wall means forming a series of pockets, and a helical discharge opening in the duct adjacent such pockets, said helical opening extending through a 360° arc, the upper portions of the pockets being at the same height as the highest portion of the helical opening, and the lowest portion of the pockets being at the same height as the lower portion of the helical opening, and means for continuously rotating the table feeder.

2. The drying system set forth in claim 1, whereby the pockets of the table feeder have an inclined bottom, the lowest portion of the inclined bottom being closest to the duct.

3. A drying system for coal comprising a vertical duct, having a lower inlet end and an upper outlet end, a source of hot gases connected to the inlet end, means for maintaining a high velocity flow of the hot gases through said duct, means for introducing crushed wet coal into said duct evenly about the entire periphery thereof at a location above the inlet end, means for separating the dried coal particles leaving the outlet end, said separating means comprising an outer chamber to which the outlet end of the duct is connected, the cross-sectional area of the chamber adjacent said outlet end being larger than the cross-sectional area of said duct, so that the gases carrying the coal particles are reduced in velocity upon entering said chamber, resulting in a gravity separation of the larger dried coal particles, conveying means located in the bottom of said chamber to continuously remove such separated larger coal particles, and a cyclone separator positioned within said chamber, the inlet of said cyclone separator being in communication with said chamber, said cyclone separator having an upper cylindrical portion and a lower frusto-conical shaped portion, said cyclone separator having an outlet at the bottom thereof through which the fine coal particles which are centrifugally separated from the hot gases are discharged, and a centrally located outlet positioned in the top of said cyclone separator through which the gases can be exhausted, said means for introducing crushed wet coal into the duct around the entire periphery thereof comprises a table feeder which completely surrounds the duct, the table feeder being made up of wall means forming a series of pockets, and a helical discharge opening in the duct adjacent such pockets, said helical opening extending through a 360° arc, the upper portions of the pockets being at the same height as the highest portion of the helical opening, and the lowest portion of the pockets being at the same height as the lower portion of the helical opening, and means for continuously rotating the table feeder.

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