

April 2, 1968

R. S. LEASE
METHOD AND SYSTEM FOR REDUCING COAL LOSSES
AT PYRITE TRAPS OF A COAL PULVERIZER

3,375,982

Filed June 17, 1966

3 Sheets-Sheet 1

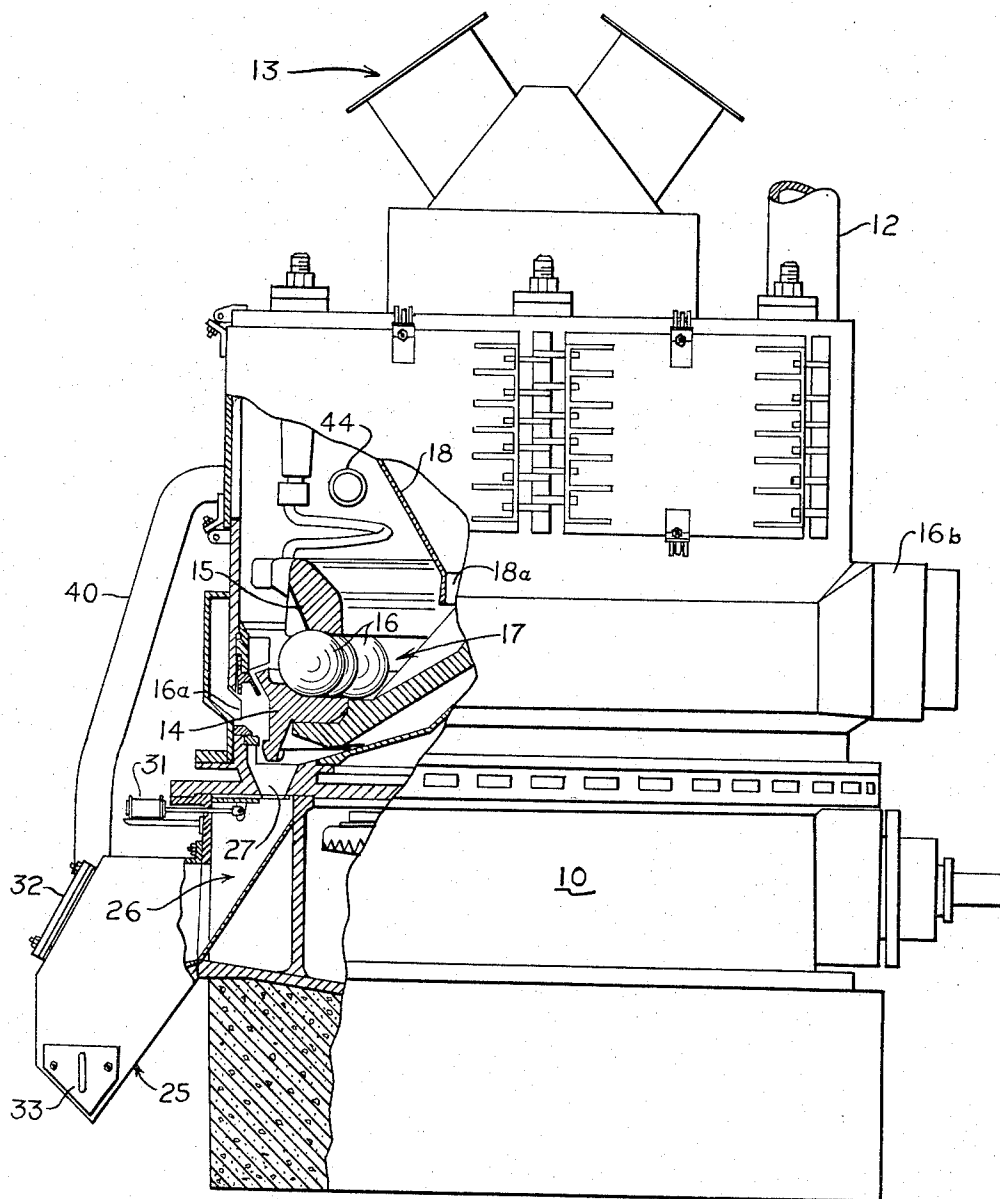


FIG. 1

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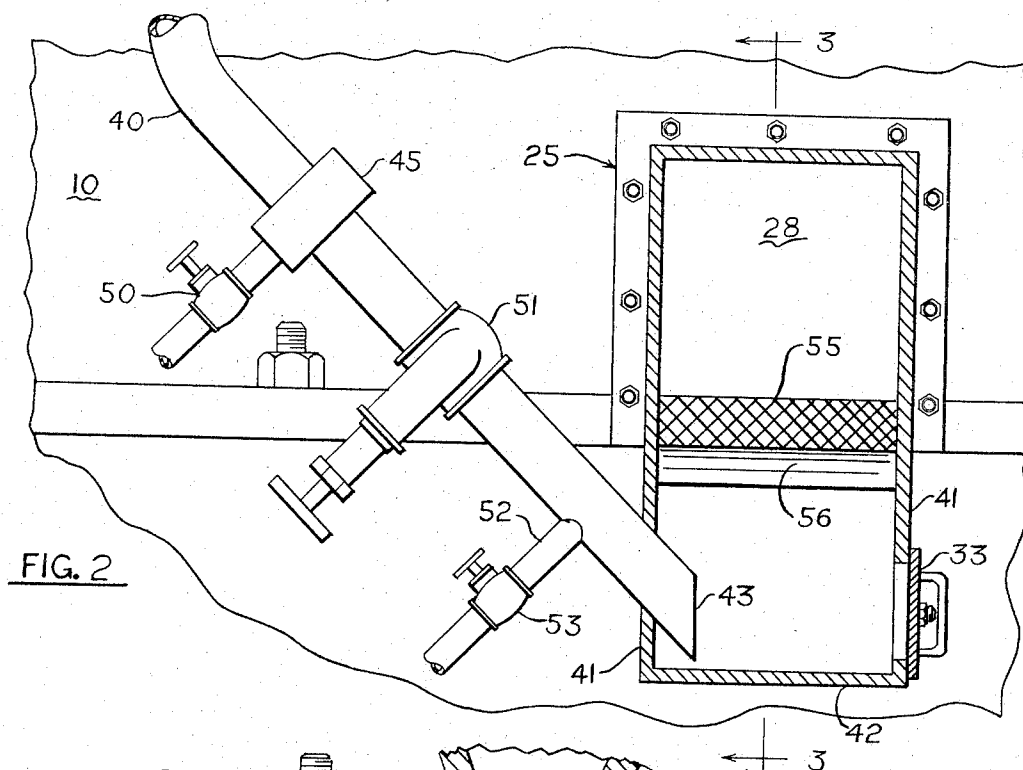
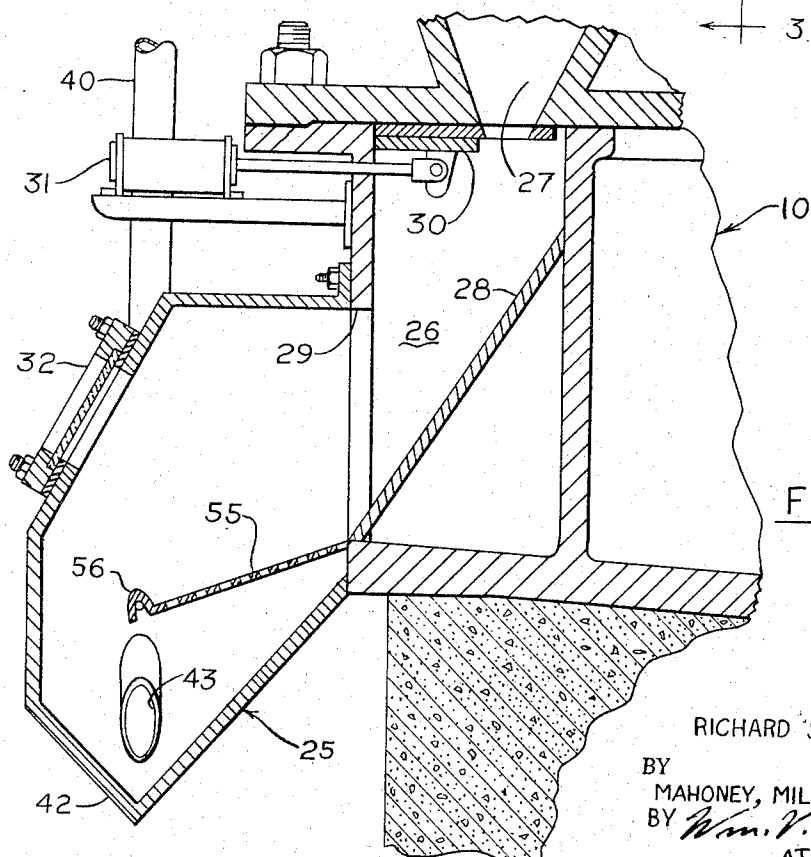
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

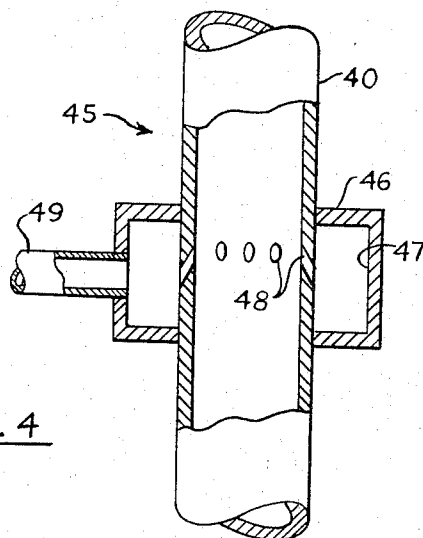


FIG. 4

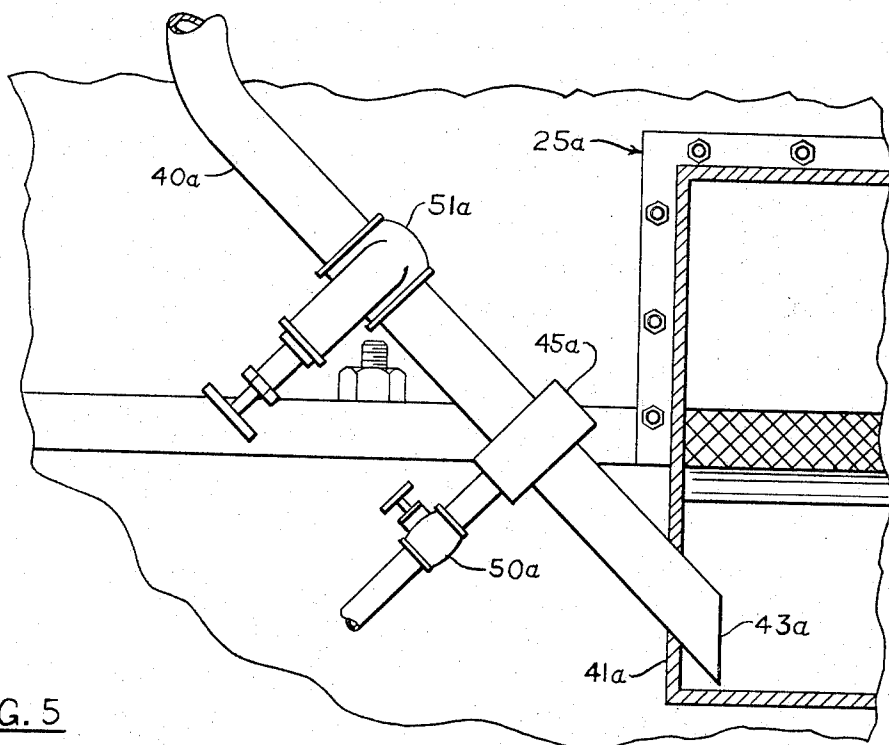


FIG. 5

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METHOD AND SYSTEM FOR REDUCING COAL LOSSES AT PYRITE TRAPS OF A COAL PULVERIZER

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Filed June 17, 1966, Ser. No. 558,321

11 Claims. (Cl. 241—19)

My invention relates to a Method and System for Reducing Coal Losses at Pyrite Traps of a Coal Pulverizer. It has to do, more particularly, with a system for use with a coal pulverizer of the mill type for preventing the removal of uneconomical amounts of pulverized coal with the pyrite traps used for removing tramp iron and other pyrite materials from the coal as it passes through the mill. More specifically, the invention relates to a system for recirculating the coal dribbles which reach the pyrite trap, after passing through the pulverizer, back to the pulverizer just ahead of the pulverizer grinding zone.

With coal pulverizers of the type now commonly in use, a considerable money loss occurs through the pyrite discharge from the mill. This discharge is expected to be pyrites and metal but actual analysis shows it to be a high percentage of coal. The ideal approach to this problem would be to eliminate the coal dribble rather than to reclaim it but it has been found to be economically impossible to provide a coal pulverizer that can reject foreign material without also passing some coal. The coal dribble problem is an old one and attempts have been made to overcome it by initial design of the pulverizer with the proper clearances on throats, seals and relief gates and rigid maintenance of such clearances but it has been found impossible even with such extreme practices to prevent coal dribble at the pyrite traps. The present invention provides a system in conjunction with such coal pulverizers for reclaiming the coal dribbles which do occur in spite of all original design and maintenance precautions.

The present invention not only provides for recirculating the coal from the pyrite trap, which dribbles thereinto from the pulverizing grinding zone and otherwise is discarded at considerable loss, but which accomplishes this in a simple and economical way without any substantial decrease in the pulverizer capacity and without any substantial increase in the pyrite content of the pulverized coal injected into the furnaces with a consequent increase in sulfur content. Also, the present invention provides an improved and more efficient pyrites trap so that the pyrites are not likely to be recirculated with the coal but are more effectively separated therefrom.

Various other objects and advantages will be apparent.

In the accompanying drawings, I have illustrated the preferred apparatus in which my invention is embodied but it is to be understood that specific details may be varied without departing from basic principles.

In these drawings:

FIGURE 1 is a schematic vertical sectional view through a coal pulverizer of a type to which my coal reclaiming system can be applied and showing the manner of applying this system thereto.

FIGURE 2 is a sectional view through the pyrite collecting box or trap showing the coal recirculating conduit or pipe connected thereto, the recirculating pipe also having an air jet means incorporated therein.

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 2.

FIGURE 4 is an enlarged, axial sectional view of the air jet means.

FIGURE 5 is a schematic sectional view showing a different form of air jet means as compared to FIGURE 2.

With reference to the drawings and particularly to FIG-

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URE 1, I have illustrated a coal pulverizer of a well-known type to which my invention has been applied, but my invention is not necessarily limited to this specific structure of pulverizer. The pulverizer shown comprises a lower gear housing 10 which contains driving mechanism, which itself is stationary and which has an upper, housing unit 11 mounted thereon and upstanding therefrom. Leading into the upper end of the housing unit 11, adjacent its periphery, is a feeder discharge pipe 12 for supplying the coal to be pulverized. Leading axially upwardly from the housing unit is a discharge outlet fitting which includes the burner pipe connections 13 that lead the pulverized coal to the furnaces.

The lower part of the housing unit 11 contains the pulverizer mill which comprises a bottom grinding ring 14, a top grinding ring 15 and intermediate grinding balls 16 which elements form a milling zone 17. The rings 14 and 15 are driven relatively and this rotates the balls 16 therebetween and, as the coal is fed thereto, it is subjected to a milling action by these cooperating parts in a well-known manner. The feed of coal to be pulverized is from the pipe 12 downwardly through the housing 11 into the interior of the top grinding ring 15. As the coal is pulverized, it circulates outwardly between the balls and is picked up by high velocity air currents. These air currents are produced by a primary air blower (not shown) connected to the air distribution ring 16b and entering by air ports 16a directed radially inwardly into the lower portion of the housing 11 and these currents carry the pulverized coal upwardly through an annular space at the milling zone 17 and into a classifier zone around a suitable classifier 18 in the upper end of the housing directly below the discharge fitting and from which zone some of the coarser particles are returned to the milling zone 17 adjacent the axis of the mill. This classifier 18 may be of the cyclone type and further accomplishes separation of the coarser particles from the air stream and returns these coarser particles axially downwardly through the annular discharge passageway 18a to the milling zone 17 of the pulverizer mill for further milling. From the classifier 18, the pulverized coal is discharged through the discharge outlet fitting into the burner pipe connections 13. The burner pipe connections 13 may have a suction force applied thereto to draw the pulverized coal into the furnaces.

This type of pulverizer is equipped with means for removing tramp iron or pyrites. This takes the form of a pyrites trap which is located below the milling zone 17 and at the periphery of the housing and into which the heavier pyrites tend to fall. It includes a pyrite collecting box 25 which is connected at its upper end to the milling zone of the housing 11 by a pyrites trap chute 26 which has an inlet 27 at its upper end and a downwardly and outwardly inclined directing baffle or wall 28 which directs the material into the box through a communicating outlet 29. The inlet 27 is controlled by a normally open sliding gate 30 which can be closed by an operatively connected fluid cylinder 31. The throat or outlet 27 for the pyrites is provided at the usual location directly below the lower grinding ring 14. An access and observation door or gate 32 is usually provided in the outer side of the box 25 and a bottom discharge gate is usually provided in the bottom of the box. Waste material discharged through the bottom gate is usually flushed by a suitable pipe and valve system to the ash hopper of the furnaces. When either of the box gates is opened, the valve or gate 30 is closed.

The parts so far described are the parts usually included in a pulverizer of this type. Normally, there is a pressure differential between the level of the air inlets 16a which is just below the milling zone 17 and the upper classification zone 18 of about eight to ten inches water

column differential, the pressure gradually decreasing upwardly or in the direction of flow of the pulverized coal.

I have found in actual operation of a classifier of this type that considerable pulverized coal dribbles down through the pyrites trap inlet 27 along with the heavier pyrites and tramp iron even though theoretically the lighter coal particles should travel upwardly with the air currents, created in the housing 11, from the lower milling zone 17 to the upper classifying zone. This coal is normally discarded with the waste material and obviously this is uneconomical. To recover this normally wasted coal dribble material, I have devised a novel and effective reclaiming system by collecting and reinjecting the coal dribbles into the grinding zone.

The reclaiming system of my invention comprises, generally, a connecting passage or conduit between the pyrites collecting zone and a zone of lesser pressure beyond the milling zone in the direction of the classifying and discharge zone of the pulverizer. The basic principle of the reclaiming system is that there is a differential of air pressure between these two zones in a normally operating pulverizer, the pressure decreasing in the direction of flow of the pulverized coal, and air will flow through the reclaiming passage or conduit with sufficient pressure and velocity to carry the coal discharge or dribble, that passes into the pyrites trap, back to the milling zone of the pulverizer.

According to my invention, a reclaiming line or conduit 40 (FIGURES 1 to 3) is provided between the pyrites collecting box 25 and the housing 11 at the classifying and discharge zone which is above the milling zone 17. The lower end of the line extends angularly downwardly and inwardly into the box through the side wall 41, but terminates at an angular end 43 spaced above the bottom 42 of the box. The bottom 42 is of V-shape or trough shape with the pipe end 43 at one end of the trough and a clean-out gate or door 33 at the other end in the other side wall 41. The upper end of the line 40 is connected to the housing 11 through the peripheral wall thereof at a radially inwardly directed inlet 44 which is located just below the classifier 18. Close to the box 25, the reclaiming line 40 is equipped with an air jet 45, which is shown in detail in FIGURE 4. This air jet comprises an annular casing surrounding the line 40 and providing an annular chamber 47 communicating through a series of inlet openings 48 with the interior of the line. An air inlet 49 leads into the chamber 47 from a suitable source of air under pressure, for example, 100 p.s.i., and this inlet is controlled by a shut-off valve 50. Ordinarily, the normal pressure differential in the pulverizer will be sufficient to cause the coal dribbles to be removed from the pyrites box 25 and travel through the line 40. However, to aid this flow, if necessary, especially at starting, the valve 50 may be opened to create a jet action in the line 40 and draw the particles of coal more effectively into the end 43 of the line 40 at the interior of the box 25. A shut-off valve 51 is provided between the air jet means 45 and the end 43 of the line and at this time this jet will be opened. Another air inlet connection 52 is provided between the valve 51 and the end of the line. At the start, the valve 51 may be closed and the valve 53 opened, to blow away any accumulation of material around the pipe end 43 and thereby expose that end. When it is desired to clean out the pyrites or other waste material from the box, the gate 30 is closed and the material is removed through the opened gate 32 or 33 and at this time the valve 51 is also closed.

According to my invention, there is also provided a screen 55 at a level in the box 25 spaced above the end 43 of the line 40. This will receive and support particles of waste material which can be removed readily at the gate 32 frequently. This screen is at the lower side of the opening 29 and is angled downwardly and outwardly having a restraining lip 56 on its outer end. Normally,

the coal dribble material will pass through the screen and be drawn into the pick-up end 43 of the line 40. Any waste material that does pass over the lip 56 will accumulate in the V-shaped bottom 42 of the box 25 and can be removed at less frequent intervals through the gate 33. Because the bottom is V-shaped, the heavier waste material will tend to accumulate and remain therein at the lowest level until it is removed and will not usually interfere with pick-up of the lighter coal dribbles which will be at a higher level.

In FIGURE 5, I have illustrated an arrangement similar to that shown in FIGURE 2 but in this instance, the jet 45a is located between the shut-off valve 51a and the end 43a of the line 40a. If the valve 51a is closed, the jet may be controlled by the valve 50a to force air pressure back into the box 25a to blow material away from and expose the pipe end 43a. The jet 45a may be used, with the valve 51a open, only to start the flow upwardly through the line 40a or may be used to augment the flow continuously during operation of the pulverizer. To clean out the box 25, the gate 30 is closed and the valve 51a is also closed so that the waste material can be removed through gates like 32 or 33.

In the operation of the coal pulverizer, normally there will be sufficient air flow through the line 40 or 40a due to the inlet air pressure supplied to the pulverizer. I have found that the differential across the reclaiming line of a normally operating pulverizer is from eight to ten inches of water column and this differential creates a velocity sufficient to carry normal coal dribble through the reclaiming line and back to the pulverizer grinding zone. However, the jet arrangement may be used to start the reclaiming line in its function or the jet may be used to continuously augment the pressure in that line. Thus, the jet is used when the coal dribble exceeds the capacity of the reclaiming line under normal pressure differential conditions of the pulverizer. Recirculation of the coal dribble back to the grinding zone of the pulverizer will be accomplished without injecting the recirculated material into the housing in opposition to the feed of material to be ground to the milling zone 17. In fact, it will be added to the material to be ground in the normal direction of flow of that material, and it will be noted from FIGURE 1 that it is added at a point where it will drop into the interior of the ring 15 and join the coal being returned to the mill from the classifier 18. The reclaiming system has a tendency not to recirculate material heavier than the coal because the reclaiming air stream is not of sufficient velocity to pick up the heavy material and carry it. Nearly all metal and other heavy material will collect on the screen 55 from which it can be removed readily. The vibration of the pulverizer helps to shake the coal dribbles downwardly through the screen into association with the pick-up point of the reclaiming line. Any pluggage of material at the pick-up point 43 or 43a of the reclaiming line can be cleared by closing the shut-off valve 51 or 51a and using the air pressure supply to blow the material back into the pyrites box 25 away from the pick-up opening.

It will be apparent from the above that I have provided a system in cooperation with a coal pulverizer which will reclaim substantially all dribble coal that reaches the pyrite trap of the pulverizer without any substantial decrease in the coal pulverizing capacity of the mill. Furthermore, it does this substantially without aggravating the pyrite problem by reintroducing the pyrites into the pulverizer. Also, the separated pyrites may be kept away from the bottom ash of the boilers so that the ash is substantially pyrite-free and is, therefore, more suitable for sale as cinder block material or other uses requiring substantially pyrite-free ash which is a great advantage over the prior art systems that flush the pyrites to the ash hopper. This system of reclaiming the coal dribbles and the more efficient pyrites trap design greatly reduces the needed capacity of the pyrites trap. It also

eliminates the need of a pyrites flushing pipe and valve system, which in the prior art flushed the pyrites into the ash hopper, and some of the water and dust pumping requirements of present coal pulverizers. Furthermore, it does not significantly increase necessary capital investment expenditures and, in fact, the overall capital investment will be reduced considerably by eliminating the need for a pyrites flushing system. Fewer man-hours of labor will be necessary in operating and maintaining the pulverizer as compared with one not equipped with my system. More efficient feeder calibrations can be performed without being inhibited by substantial amounts of coal dribble.

Many advantages of my coal dribble recirculation system for a coal pulverizer have been discussed above and others will be apparent.

Having thus described my invention, what I claim is:

1. In combination with a pulverizer for solid materials, a housing having a milling zone, means for feeding a supply of material to be pulverized toward said milling zone, a classifying and discharge zone leading from said milling zone where the lighter milled particles are discharged and the heavier particles are returned to said milling zone, means for setting up a pressure differential to conduct the milled particles to the classifying and discharge zone but permitting passage of the heavier particles to a trapping and retaining means, and reclaiming passage means extending from said trapping and retaining means to said classifying and discharge zone for removing lighter particles which enter said trapping and retaining means and conducting them to the classifying and discharge zone from which they are returned, toward said milling zone with the supply of material to be pulverized.

2. The combination of claim 1 in which said pressure differential is created by the use of air inlets adjacent the milling zone and said reclaiming passage means is normally subjected to the pressure differential between said milling zone and said classifying and discharge zone to draw the lighter particles from said trapping and retaining means.

3. The combination of claim 2 in which said reclaiming passage means is provided with a jet means connected therein for augmenting the action of the pressure differential therein.

4. The combination of claim 2 in which said pulverizer has an upright housing with milling means providing the milling zone in the lower portion thereof, said means for feeding the supply of material to be pulverized feeding it downwardly to the milling means, a classifier and discharge means above the milling means providing said classifying and discharge zone and serving to separate and classify the milled material to discharge the lighter particles and return the heavier particles downwardly to said milling means, said means for setting up the pres-

sure differential comprising air inlets leading radially into the housing at the milling zone for creating a pressure differential between the adjacent milling zone and the upper classifying and discharge zone adjacent the classifying and discharge means, said trapping and retaining means being located below the milling means, and a reclaiming passage extending from said trapping and retaining means to said classifying and discharge zone at a level between said classifying and discharge means and said milling means.

5. The combination of claim 4 in which said passage has a jet means connected therein.

6. The combination of claim 5 including a shut-off valve in said passage beyond said jet means in the direction of flow towards said classifying and discharge means.

7. The combination of claim 5 including a shut-off valve in said passage between said jet means and said trapping and retaining means.

8. The combination of claim 7 including additional means for supplying air under pressure in said passage between said trapping and retaining means and said shut-off valve.

9. The combination of claim 4 in which said trapping and retaining means comprises a compartment communicating with said housing below said milling means and having a V-shaped bottom, said passage means comprising a conduit line extending into said compartment with a pick-up end above and in cooperation with said bottom.

10. The combination of claim 9 including a screen spaced above said pick-up end but having a downward passage which permits material to drop from the screen onto said bottom.

11. The method of pulverizing material such as coal or the like which comprises subjecting it to a milling means under the influence of an air stream which carries the lighter particles toward a discharge zone of lesser pressure and permits the heavier particles to drop with some lighter particles in a zone of higher pressure, and recirculating the last-named lighter particles from the zone of higher pressure to the zone of lower pressure and returning them to the milling means.

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GERALD A. DOST, *Primary Examiner*.