May 10, 1927. 1,628,295

A. A. WICKLAND

PULVERIZER

Filed Feb. 20, 1925 3 Sheets-Sheet 1

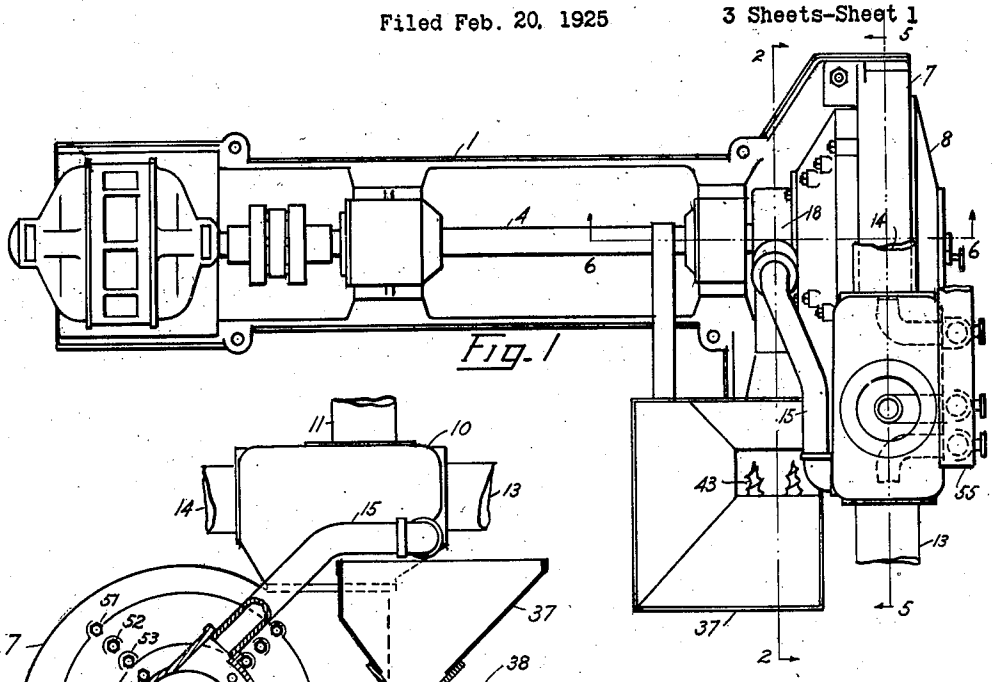


Fig. 1

Fig. 2

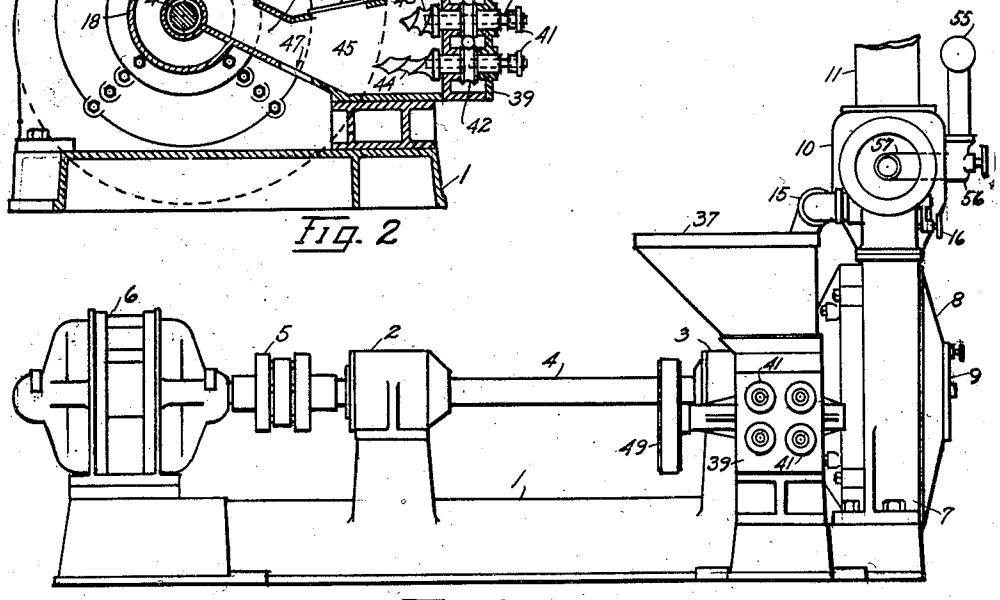


Fig. 3

INVENTOR

Augt. A. Wickland

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A. A. WICKLAND

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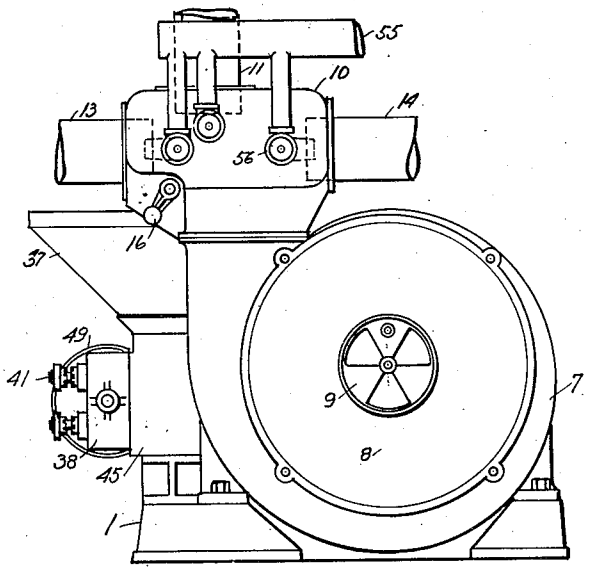


Fig. 4

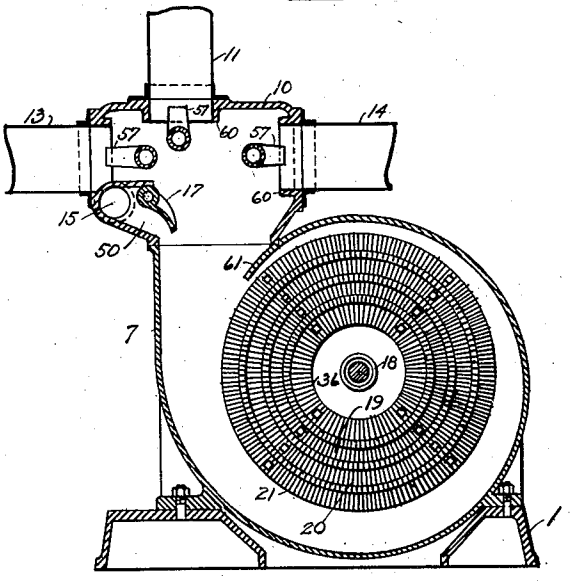


Fig. 5

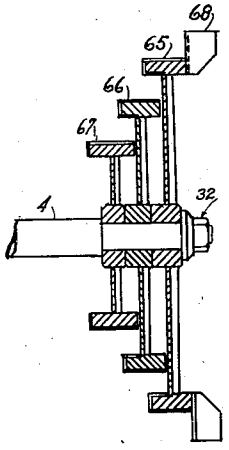


Fig. 10

INVENTOR

Albert A. Wickland

May 10, 1927. 1,628,295

A. A. WICKLAND

PULVERIZER

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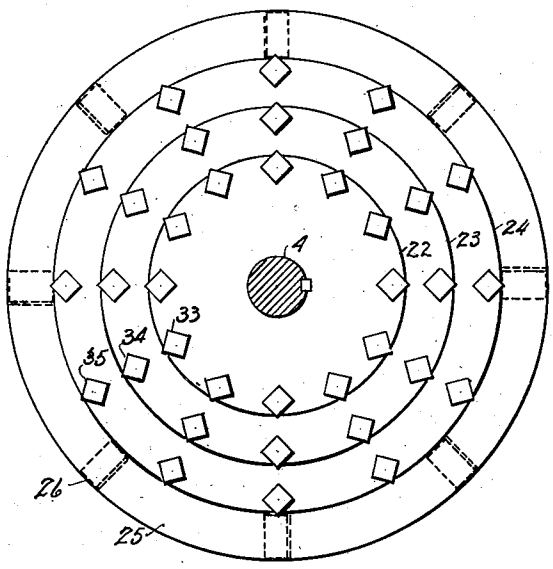


Fig. 7

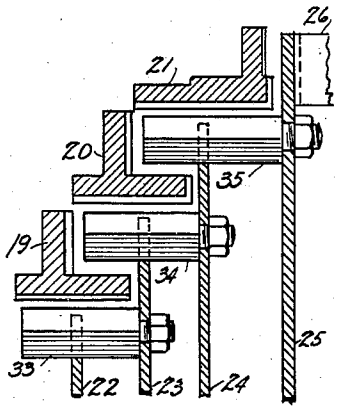


Fig. 8

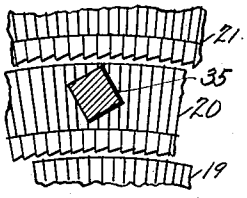


Fig. 9

Fig. 6

INVENTOR

Algot A. Wickland

Patented May 10, 1927. 1,628,295

UNITED STATES PATENT OFFICE.

ALGOT A. WICKLAND, OF CHICAGO, ILLINOIS.

PULVERIZER.

Application filed February 20, 1925. Serial No. 10,458.

This invention relates to coal pulverizers and particularly of the type adapted to be located adjacent to the furnace.

It has been found in practice that the method of pulverizing solid fuel at or near the furnace is economical and in many instances a vast improvement over the central system where the powdered coal is conveyed long distances before entering the furnaces.

Another feature is that the user of this machine may obtain all the advantages of powdered coal without investing a large amount of money in expensive equipment.

Another feature of the invention is that ordinary bituminous screenings or slack can be pulverized without previous drying, and such foreign material as slate, stone, and metal, is automatically rejected, as will be described in detail in the specification.

Another object sought, is to provide a mechanical device of simple and rugged construction for pulverizing coal, so designed that replacement of wearing parts can be made at minimum expense and labor.

A further object of the invention is to provide means whereby one machine can supply powdered coal to one or more burners simultaneously. This feature is of particular advantage in operating a battery of annealing or heat-treating furnaces.

A still further object is to provide a semi-portable machine, the grinding element and the driving motor being mounted on a heavy bed plate, thereby maintaining a perfect alignment of the revolving parts.

A still further object is to provide means for pulverizing the coal in three separate and distinct stages, thereby securing a uniformly fine product, which is necessary in order to obtain uniform results and secure complete combustion of the powdered fuel.

Other features and advantages of the invention will appear from time to time, as the description of the invention progresses.

Referring now to the drawings:

Figure 1 is a plan view.

Figure 2 is a vertical cross section on line 2—2.

Figure 3 is a side view.

Figure 4 is a front view.

Figure 5 is a transverse section on line 5—5.

Figure 6 is a vertical longitudinal section on line 6—6.

Figure 7 is a rear view of the revolving grinding element.

Figure 8 is an enlarged view of the stationary and revolving grinding elements.

Figure 9 is a cross section of the grinding pins, also showing the serrated surfaces of the stationary parts and the approximate position of the grinding pins with respect to the stationary members.

Figure 10 is a modification of the revolving member, showing the construction employing continuous rings in place of separate grinding pins.

The novel features of the present invention will be best understood from a detailed description thereof, taken in connection with the drawings in which like reference characters indicate corresponding parts in the several views.

Referring to Fig. 1, casing 7 is rigidly mounted on bed plate 1. This plate also supports an electric motor 6, having a flexible connection 5 to shaft 4, which is mounted on bearings 2 and 3, Fig. 3. Cover plate 8, having shutter 9, is part of casing 7. Fig. 6. Feed housing 45 and coal hopper 37 are also mounted on bed plate 1.

A cylindrical chamber 18, having an intake duct 48, constitutes the connection between the coal feed and the grinding chamber.

Casing 7 has a tangential discharge opening connecting with the distributing chamber 10. This chamber has a plurality of openings 11, 13, and 14, with suitable connections for the discharge pipes leading to the burners.

The main driving shaft 4, being suitably supported on bearings 2 and 3, has an overhang on one end to receive a plurality of circular discs having removable grinding pins located near the periphery, see Fig. 6.

Stationary grinding rings 19, 20, 21, are mounted on the inside of casing 7, as clearly indicated in Fig. 6.

The positive coal feed, which is situated directly below the coal hopper 37, Fig. 2, consists of two or more power-driven screws 43, 44. These screws are driven by worm wheels 42, actuated by a worm shaft which is in turn driven by pulley 49, belted to the main driving shaft 4. The worm wheels inside of gear casing 38 revolve continuously when the machine is in operation. The feed screws proper are mounted on a shaft 40, which passes through the worm wheels. At the free end of this shaft a keyed dental clutch is provided so that when

the feed screws are to be engaged, clutch 41 is moved forward to engage the exposed hub or sleeve of the worm wheel. By this means the feed screws are connected or disconnected at will.

The feed screws all run at the same speed, but in opposite direction. To secure a variable feed the screws are made with a different pitch and it follows that with this arrangement it is possible to obtain a constant and graduated feed. The worm gear casing 38 is provided with a cover 39. This casing is oil-tight, thereby insuring ample lubrication of the revolving parts.

In operation the coal is fed by gravity to the feed chamber just described, and is acted upon by the feed screws to move forward. At some distance from the feed screws an opening 47 is provided, and it is obvious that the coal in moving forward must reach this opening and fall out. This is prevented by means of a strong current of air and suction, the purpose of which will be described in the succeeding paragraph.

Coal contains considerable foreign material, such as stone, slate, metal, etc. This material has no fuel value and would lower the quality of the finished product if reduced to a fine powder. Iron and stone would be extremely injurious to the grinding parts, and I have found that these materials can be separated in a satisfactory manner by suction. Referring to Fig. 2, it will be seen that an opening or air port 47 is provided for at the bottom between the feed chamber 45 and rectangular intake duct 48. The feed chamber 45 has a shutter 46 which serves the purpose of admitting air above the coal, thereby regulating the velocity and suction of the air entering opening 47. The volume and velocity of the air entering the intake duct is sufficient to lift the coal and convey it over an incline. Before it reaches the intake leading to the grinding chamber, it meets with a semi-circular wall or obstruction, consisting of a sleeve around shaft 4. It should also be noted that the intake duct is of enlarged section at the terminal, the object of this being to reduce the velocity so that should a piece of iron accidentally be carried along with the coal, it would meet the obstruction, and since the air velocity is reduced at this point the likelihood of metal being carried over into the grinding compartment is very remote. A cross section of intake 18 is clearly shown in Fig. 6.

Mounted on a shaft 4 are discs 22, 23, 24, 25, held in position by collars 27, 28, 29, 30, 31, which are keyed to the shaft and held in place by nut 32. At or near the periphery of these discs I have arranged a plurality of grinding pins of square cross section. Referring to Fig. 7 and Fig. 8, it will be seen that these pins are held in position at one end by a stem passing through one disc. This stem is threaded to receive a nut which is kept from turning by a special lock washer. Discs 22, 23, and 24 further serve the purpose of dividing the grinding chamber into three distinct compartments, and also form a rigid support for the grinding pins. It should be noted that the free end of the pins enter square holes in the discs, and by these means the pins are prevented from turning, and are also held in position to resist the centrifugal force. Opposite stresses are set up in the pins when material is ground, due to impact and resistance, and such compression stresses are transferred to discs 22, 23, 24, which form a rigid support for the pins to prevent displacement.

I have also found that the angularity of the faces of the pins with respect to the center of the shaft is of considerable importance in producing the fine product and preventing the machine from clogging when grinding moist coal.

The stationary grinding rings 36, 19, 20, 21 are preferably made of white iron or manganese steel, cast with serrated surfaces on all sides, as shown in Fig. 8 and Fig. 9. These rings are mounted inside of casing 7 and are held in position by bolts 51, 52, 53, and 54, Fig. 2. These parts are subject to considerable wear on account of the abrasive nature of the material pulverized, and to replace same it is only necessary to take off nut 32 and remove disc 25. The remaining discs 24, 23, and 22, may be removed in the same manner, thereby exposing the interior of the machine for convenient replacement. The grinding pins are replaced in the same manner. In actual operation I find that the greatest wear comes on ring 21 and grinding pins 35, and as just described, the work involved in renewing these parts is small. I have also found that the greatest wear on the grinding pins occurs at the corners which pass in close proximity to the serrated surfaces of the stationary rings. Being square, these pins can be turned four times, thereby prolonging the lift and reducing the cost of replacement very materially.

As previously mentioned, I employ suction to lift and convey the coal from the coal feed to the grinding chamber. For this reason greater suction is required than if I employed gravity feed. To create the required flow of air I have provided a series of blades or veins at the periphery on disc 25. These veins also serve the purpose of discharging the coal to the distributing chamber. Under certain conditions it is desirable to admit air through shutter 9, Fig. 4 and Fig. 6, in the event a large volume of air is required to convey the coal from the distributing chamber to the burner.

Pipe 15, Fig. 2, serves as a connection between the intake duct and a small pocket which is provided within the distributing chamber. This pocket 50 has a hinged cover plate 17 which may be set in any position by the outside lever 16. The object of the hinged plate 17 and pocket 50 is to arrest coarse particles of material which follow the inside surface of casing 7. These particles are returned to the grinding chamber through pipe connection 15.

The distributing chamber 10 has considerable volume and the velocity of the air currents entering is therefore reduced, permitting coarser particles to separate from the fine dust.

Rims or extensions 60 are provided within the distributing chamber to form a separating wall so that large particles which adhere to the sides of the distributing chamber can not enter the discharge pipe openings. Eddy currents are produced within this chamber and the coarser particles are carried downward only to be picked up by the fan and discharged toward pocket 50. This circulation is maintained constantly.

It has been found in practice that under certain conditions it is difficult to convey powdered coal for some distance without clogging the ducts. And to overcome this I have provided forced blast which enters the discharge pipe through nozzles 57. The blast required is conducted through pipe 55 and the valves and dampers 56 control the flow to each discharge pipe. The supply of air for forced blast is received from an independent source. I have also found that the amount of powdered coal delivered to each burner can be regulated by the suction produced by nozzle 57. The arrangement of the auxiliary air nozzles 57 here described may be seen in Fig. 4 and Fig. 5.

Fig. 10 shows a modification of the grinding discs and pins previously described. In this case the separate grinding pins are substituted for a cast ring having serrated surfaces on three sides. This ring may be cast integral with a hub having spokes, or a plate web, the hubs to fit over shaft 4, and to be held in position by nut 32. A circular plate 68, having a plurality of fan blades may be located at the periphery of the larger diameter ring 65. Stationary grinding rings of similar cross section and arrangement, as 19, 20, and 21, may be used in combination with the design shown by Fig. 10.

The machine is operated as follows: Coal is shoveled into coal hopper 37, thence fed by gravity to feed chamber 45. At this point the coal is moved forward by feed screws 43, 44, and is carried by suction through the intake duct 48 and chamber 18, and enters the grinding chamber through the circular opening in casing 7. From this point the coal is forced in contact with the revolving discs and grinding pins and passes through separate grinding compartments before it is discharged into the distributing chamber.

The amount of coal is controlled by the feed screws, and in the event one or more burners are supplied by one machine, a variation of the feed to each burner can be made by adjusting the blast gate or valves 56. When the wearing parts become worn, a larger percentage of coarse particles will pass through the grinding compartments, and a large percentage of such coarse material may be returned to the intake for regrinding by adjustment of the damper 17.

Occasionally a greater volume of air is required to support combustion, and the volume passing through the machine may be regulated by shutter 9. It has been found that if too much air enters through 9, the intake suction is reduced to a point below that which is required to lift the coal and maintain a constant feed.

Although in the drawings and in the above description I have confined myself to what I consider the preferred embodiment of my invention, it is to be understood that various modifications are contemplated, and the invention should therefore not be limited merely by the scope of the appended claims.

Having now described my invention, what I consider as new and desire to secure by Letters Patent of the United States is:

1. In a pulverizer, a pulverizing chamber, a coal receiving chamber mounted adjacent to said pulverizer chamber, a coal deflecting and distributing sleeve formed in said receiving chamber; a coal receiving well, an upwardly inclined chute joining the said well to the said coal receiving chamber, said well being adapted to be supplied with un-pulverized coal from a hopper mounted thereabove; and means in said well to agitate the coal in the well, forward toward said inclined chute.

2. In a coal pulverizer, a coal pulverizing chamber, a tangential outlet therefrom, a powdered coal selecting and distributing chamber in immediate communication with the tangential outlet leading from said pulverizing chamber, and means in said distributing chamber for the ultimate selection and distribution of the particles of coal from said pulverizing chamber.

3. A coal pulverizer, comprising a coal receiving well in direct communication with a coal hopper mounted thereabove, and means in said well to agitate the coal therein toward an upwardly inclined chute in direct communication with the centrally located coal receiving chamber, substantially as shown; and means to operate the said coal agitating mechanism.

4. A coal pulverizer, comprising a coal pulverizing chamber having a spiral wall terminating tangentially to form a tangential outlet, immediately communicating with a powdered coal selecting and distributing chamber; an enlarging series of co-axial steps formed in one of the side walls of said pulverizing chamber, and an enlarging series of demountable flanged serrated, or corrugated rings, secured in said co-axial steps, a series of numerically increasing beaters, or crushers, revolvably mounted in co-operative relation to the serrated or corrugated, surface of said rings; and a series of enlarging lateral baffle plates carrying said beaters and crushers, detachably secured on the end of a rotatably mounted beater carrying shaft.

5. In a coal pulverizer, a pulverizing chamber, a coal receiving chamber mounted adjacent to and communicating with the coal pulverizing chamber; a coal receiving well positioned at a level below said receiving chamber, an upwardly inclined chute connecting said coal receiving well with the coal receiving chamber, an air inlet in the bottom of said chute, an air inlet in the top of said chute, slightly behind that of said bottom air inlet, and means for controlling the size of said top inlet.

6. A coal pulverizer, comprising a coal pulverizing chamber having a spiral wall terminating tangentially to form a tangential outlet therefrom, a series of co-axial steps formed in one side of said chamber, an enlarging series of co-axial flanged serrated, or corrugated rings, detachably secured in said steps; an upwardly inclined chute connecting the coal receiving well with the centrally mounted coal receiving and distributing chamber, and means in said chute to separate the heavier material, such as stone, metal, or the like, from the coal, or vice versa.

7. A coal pulverizer, comprising a centrally mounted coal receiving and distributing chamber detachably secured to one side of the coal pulverizing chamber; an upwardly inclined chute connecting the coal receiving well with said centrally mounted chamber, and means for admitting air through the bottom and top of said chute, for the purpose of lifting the coal from heavier foreign material, such as stone, metal, or the like, and delivering said coal up to and through the said centrally mounted distributing chamber to said pulverizing chamber.

8. A pulverizer having a pulverizing chamber comprising a spiral wall terminating tangentially to form a tangential outlet communicating immediately with a powdered material selecting and distributing chamber; said pulverizing chamber having side walls containing central openings therein, one serving as an un-pulverized material inlet, and the other as an auxiliary air inlet, a controlling damper in said air inlet; a series of enlarging lateral baffle plates detachably secured within said pulverizing chamber to the end of a rotatably mounted shaft, and a series of numerically increasing lugs or beater segments arranged at the periphery of said plates and co-operating with a series of co-axial serrated, or corrugated, flanged rings arranged in steps in said chamber.

9. A pulverizer having a pulverizing chamber comprising a spiral wall terminating tangentially to form a tangential outlet communicating immediately with a powdered material selecting and distributing chamber; said pulverizing chamber comprising said walls having central openings therein, one serving as an un-pulverized material inlet, and the other as an auxiliary air inlet, a controlling damper in said air inlet; a centrally mounted coal receiving and distributing chamber detachably secured to the side wall opposite said air inlet; an upwardly inclined chute connecting said receiving and distributing chamber with a material receiving well, means in said well to agitate the material toward said chute, other means by which the oncoming material from said well is drawn up and through said chute to the said material receiving and distributing chamber, and means to control the supply of material to the pulverizing chamber, substantially as described.

10. In a pulverizer, substantially of the class set forth, having means for converting unpulverized material, such as coal, into finely powdered dust, of means, in conjunction with said pulverizer, for selecting the material to be powdered while same is being lifted and delivered through an inclined chute connecting the material receiving well with the centrally mounted material receiving and distributing chamber.

11. The combination with a pulverizer, of means for converting unpulverized material, such as coal, into a desired finely powdered dust, through the medium of a reverse zig-zag and radial action of the material through and between, around, and against a series of numerically increasing revolving beaters, or crushers, and normally stationary co-acting serrated, or corrugated, impinging ring walls or surfaces, detachably secured in the pulverizing chamber.

12. The combination with a pulverizer, of means for converting unpulverized material, such as coal, into a desired finely powdered dust, through the medium of a reverse zig-zag and radial motion of the material through and between, around and against a series of numerically increasing revolving beaters, or crushers, and an enlarging series of normally stationary co-acting serrated,

or corrugated, flanged rings, detachably secured in the pulverizing chamber.

13. In a pulverizer, a pulverizing chamber, an enlarging series of demountable flanged serrate surfaced rings, a series of revolvably mounted numerically increasing beaters, or crushers, in co-operative relation with said rings, contained in said pulverizing chamber, said pulverizing chamber having a spiral wall terminating tangentially to form a tangential outlet therefrom an enlarging series of co-axial steps formed in one of the side walls of said chamber adapted to receive said flanged rings, a removable cover plate forming one side of the said pulverizer chamber, said cover plate having an inlet, and means for admitting selected un-pulverized material to the pulverizing mechanism through an opening in the wall opposite said cover plate.

14. The combination with a pulverizer, of means for converting un-pulverized material, such as coal, into finely powdered dust through reverse zig-zag and radial movement of the material spirally against a series of enlarging and numerically increasing co-operating beaters.

15. The combination with a pulverizer, substantially of the class set forth, of means for converting un-pulverized material, such as coal, into finely powdered dust through reverse zig-zag, radial and an enlarging spiral movement of the material through and against a series of enlarging and numerically increasing co-operating beaters, or crushers.

16. A coal pulverizer, comprising a housing having a conical grinding chamber with an inlet and an outlet, said outlet being tangential with the spiral compartment enclosing the revolving and stationary grinding members, said grinding chamber having a plurality of co-axial, concentrically advancing steps of varying diameters adapted to receive and partially enclose a series of stationary rings or linings of corresponding diameters, said rings being serrated on their outer surfaces and said surfaces in co-operative relation with the revolving beaters, and radial flanges at the outer circumference of said rings to form a series of annular, co-axial grooves or channels of varying diameters advancing in progressive steps from the inlet to the outlet of said grinding chamber.

17. A coal pulverizer comprising a housing having a conical grinding chamber with a series of annular, co-axial serrated grooves or channels of varying internal diameters advancing in progressive steps from the inlet to the outlet; a plurality of driving discs of varying diameters, having at their periphery a series of numerically increasing beaters arranged in co-operative relation with said grooves, said discs carried by a rotatably mounted driving shaft having its free end projecting through and concentric with, the inlet to the said grinding chamber.

18. In a coal pulverizer, a housing inclosing a pulverizing chamber having an inlet for the untreated material said inlet consisting of a closed compartment with a suction duct communicating with the coal feed mechanism, said suction duct having an opening on its under side over which the untreated material must pass to enter the pulverizing chamber, said duct having a second opening above said first mentioned opening, and a shutter controlling said second opening, whereby the suction is regulated to lift the material and convey same from the feed chamber through the duct to the grinding chamber.

19. In a coal pulverizer, a housing enclosing a grinding chamber, an inlet for untreated materials and communicating with said chamber, said inlet consisting of a cylindrical compartment with a closed end and having an air and material duct directly connected to the coal feed chamber, said duct having an opening on the under side forming a gap or break over which the material must pass, and means in said chamber for producing a suction for lifting the desired material over said gap and conveying same through the duct to the grinding chamber.

20. In a coal pulverizer, a housing enclosing a grinding chamber, with an inlet and an outlet for the pulverized materials, a driving shaft therein carrying a series of discs with beaters in co-operative relation with stationary grinding rings forming annular grooves or channels of varying diameters advancing co-axially in progressive steps within the grinding chamber, from the inlet to the outlet, a coal feed hopper with a closed feed chamber below said grinding chamber, a plurality of feed screws in said feed chamber, driving means for said screws, independent clutches for driving the feed screws to said driving means whereby any one of the feed screws may be engaged or disengaged, a duct or passageway for the materials connecting the feed chamber with the grinding chamber, and means for separating and discharging the heavy unpulverized material and conveying the lighter materials through said duct into the grinding chamber.

21. In a coal pulverizer of the class set forth, a housing enclosing a grinding chamber, an outlet from said chamber for the pulverized material, said outlet terminating into a chamber or box, a pipe or conduit communicating with said box and means independent of the pulverizer beater mechanism for directing fluid under pressure into said pipe to increase the flow of pulverized material through said pipes to the point of delivery.

22. In a coal pulverizer of the class set forth, a housing having an inlet and an outlet, a driving shaft extending through said inlet and terminating within the forward or outlet compartment of said housing, a removable cover plate giving full access to the interior of said housing, a plurality of movable grinding rings arranged coaxially with the driving shaft and opposite to the said removable cover plate, said rings forming annular continuous grooves or channels with serrated surfaces of varying diameters advancing in progressive steps, the smallest ring being at the inlet, the largest near the outlet.

23. A coal pulverizer, comprising a housing having an inlet and an outlet, a driving shaft extending through said inlet, said driving shaft carrying a plurality of longitudinally spaced discs of varying diameters having a series of detachable beaters in co-operative relation with a plurality of co-axial continuous grooves or channels within the grinding chamber, and said discs arranged on the shaft so as to form a series of co-axial steps increasing outwardly from the fuel inlet.

24. A coal pulverizer, comprising a housing having an inlet for material to be pulverized and an outlet for pulverized materials, a driving shaft extending through said inlet, said shaft being adapted to carry a series of demountable, longitudinally spaced grinder discs of varying diameters, said discs having numerically increasing beaters at their periphery in co-operative relation respectively with co-axial continuous grooves or channels having serrated working surfaces, succeeding discs being of larger diameters and overlapping the preceding groove thereby forming a partial enclosure, confining the material within said grooves to the action of the beaters.

25. In a pulverizer, a pulverizing chamber, a coal receiving well, an upwardly inclined chute joining the said well to said chamber, said well being adapted to be supplied with unpulverized material, said chute having an opening in the underside thereof, means for drawing air through said opening and said chute into said chamber, and means in the said well to agitate the material in the well forward into said chute and over the said opening.

26. In a pulverizer, a pulverizing chamber, a coal receiving well, an upwardly inclined chute joining the said well to said chamber, said well being adapted to be supplied with unpulverized material, said chute having an opening in the underside thereof, means for drawing air through said opening and said chute into said chamber, means at the end of said chute having a second opening above the bottom thereof for controlling the flow of air through said first mentioned opening, and means for regulating the size of the second mentioned opening.

27. In a coal pulverizer, a coal pulverizing chamber, an outlet therefrom, a powdered coal selecting and distributing chamber, nozzles, one extending into each of said discharge pipes, and means for forcing fluid under pressure through said nozzles to accelerate and control the passage of powdered material through said pipes.

28. In a pulverizer, a pulverizing chamber, an enlarging series of demountable flanged serrate surfaced rings in said chambers arranged to form annular grooves or channels therebetween and series of revolvably mounted beater pins in cooperative relation to said rings, the ends of said beater pins extending into the said channels.

29. In a pulverizer, a pulverizing chamber, an enlarging series of concentric flanged serrate surfaced rings in said chambers arranged to form annular grooves or channels therebetween and series of revolvably mounted beater pins in cooperative relation to said rings, the ends of said beater pins extending into the said channels.

30. In a coal pulverizer, a coal pulverizing chamber, an outlet therefrom, a powdered coal selecting and distributing chamber in which said outlet terminates, a powdered coal discharge pipe communicating with said distributing chamber, the said pipe extending inwardly beyond the inner surface of said distributing chamber, means in the said distributing chamber for selecting the coarser particles and means for directing the coarser particles back to the pulverizing chamber.

31. In a pulverizer, a pulverizing chamber, a series of concentric flanged serrated rings in said chamber, a rotatable shaft in said chamber, a series of discs of increasing diameters on said shaft and series of rectangular pins carried by said discs transversely thereto in operative relation to said rings, each of said pins being mounted on a plurality of said discs and rotatably adjustable thereon.

In testimony whereof, I have hereunto signed my name.

ALGOT A. WICKLAND.