March 17, 1931. C. R. TAYLOR 1,796,545

PULVERIZER

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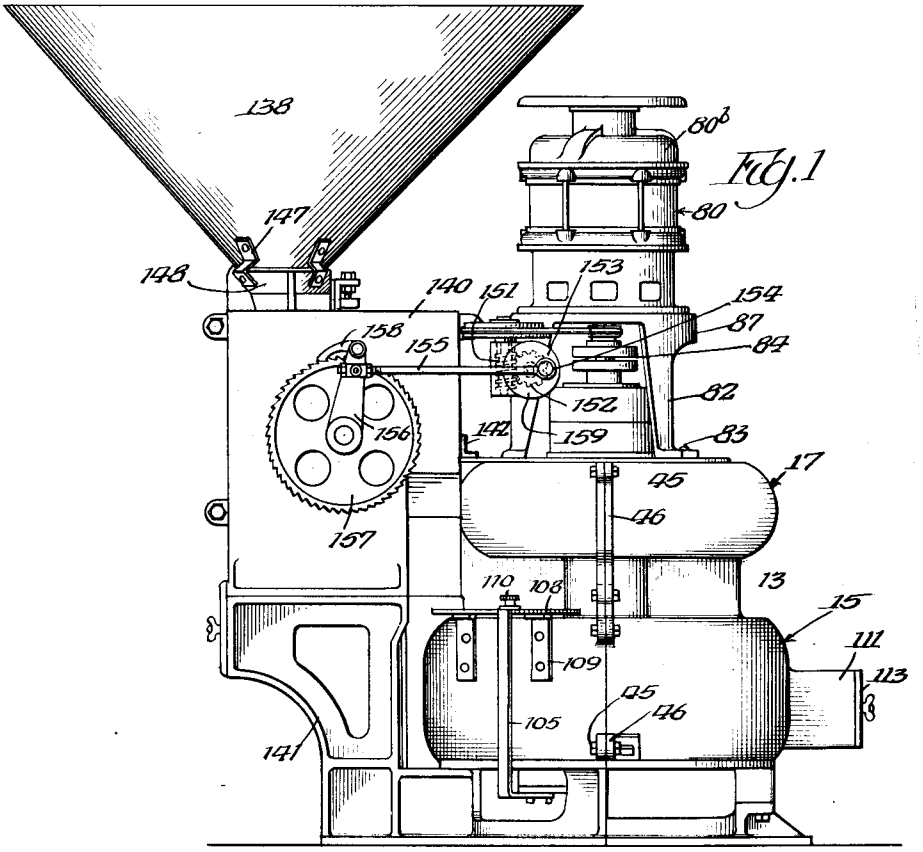


Fig. 1

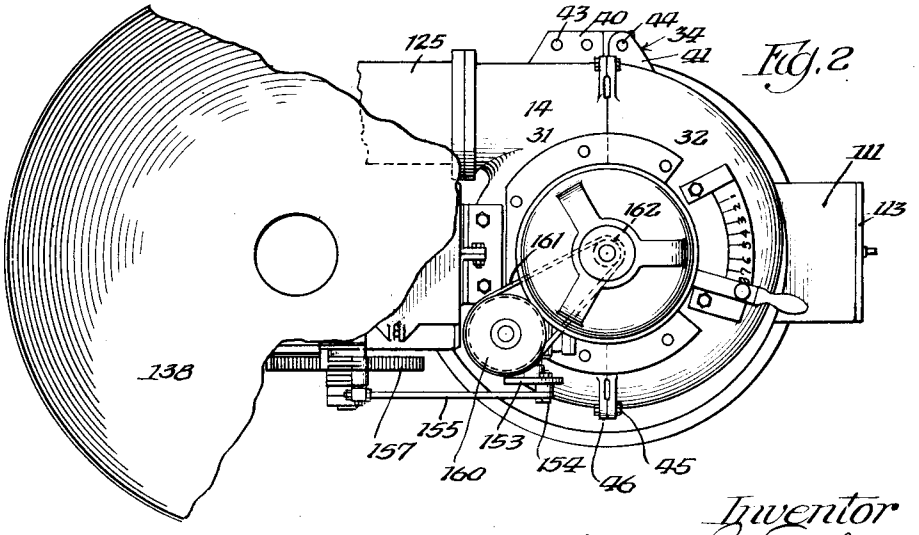


Fig. 2

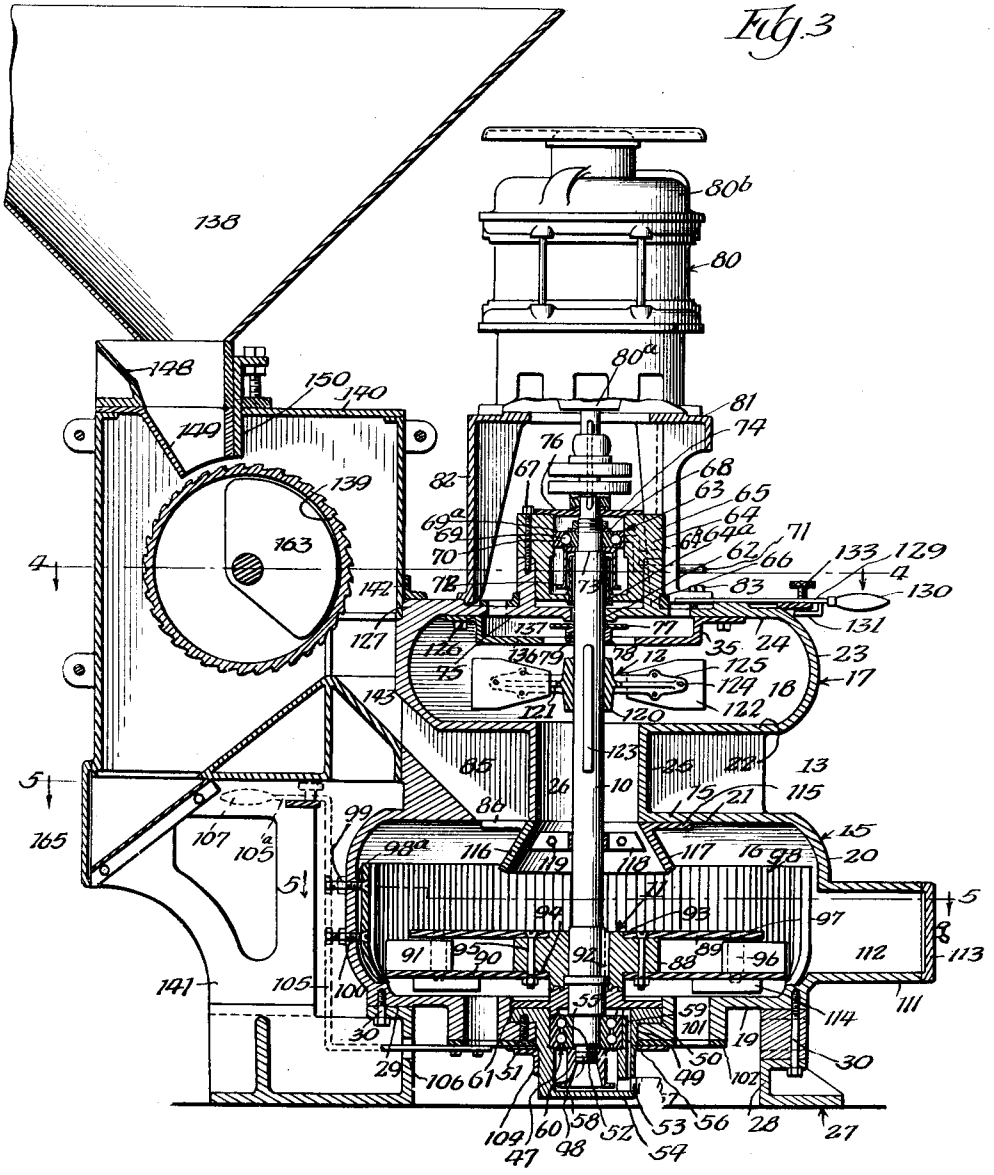
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Fig. 3



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PULVERIZER

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Fig. 4.

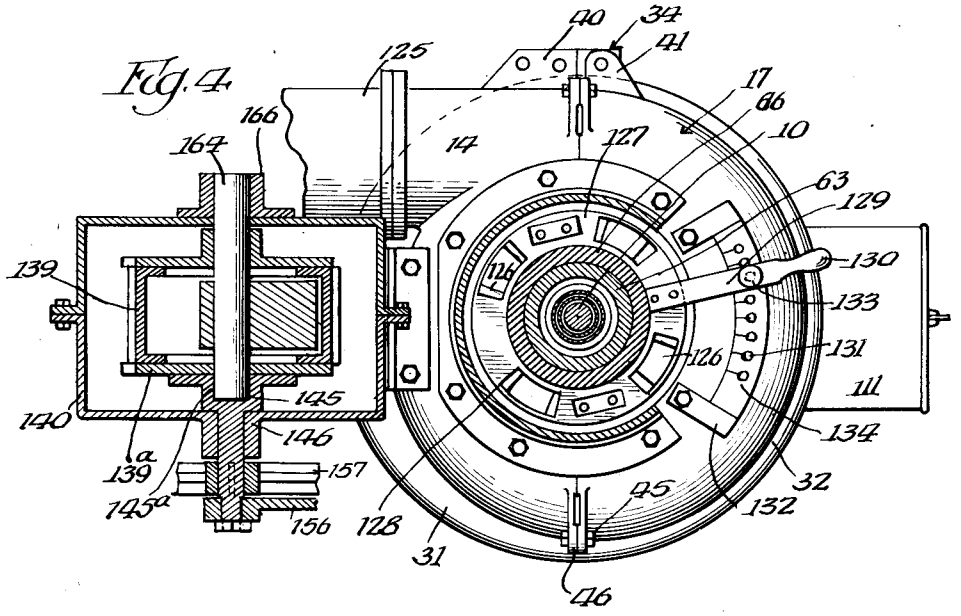
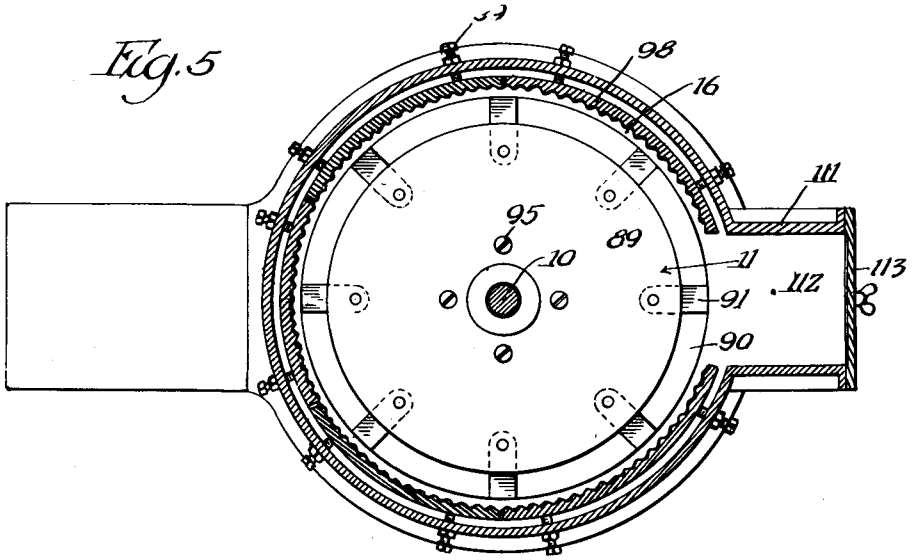


Fig. 5.



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Fig. 6

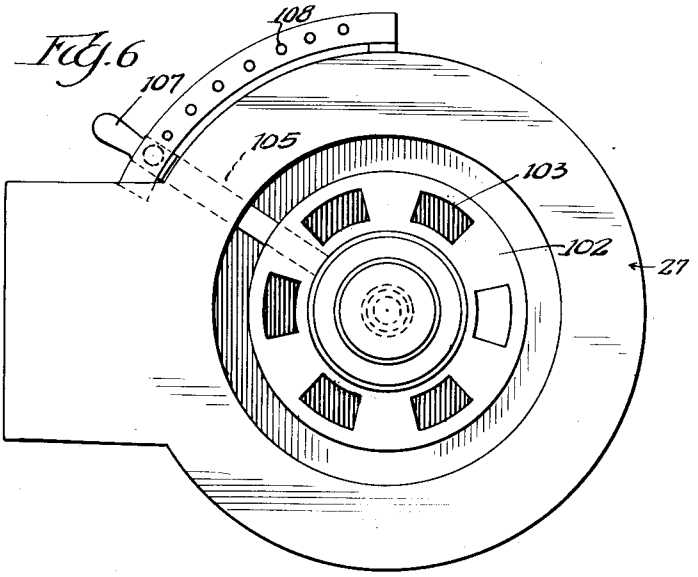


Fig. 8

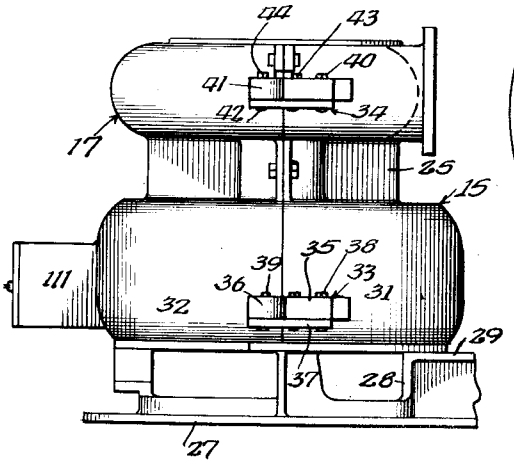
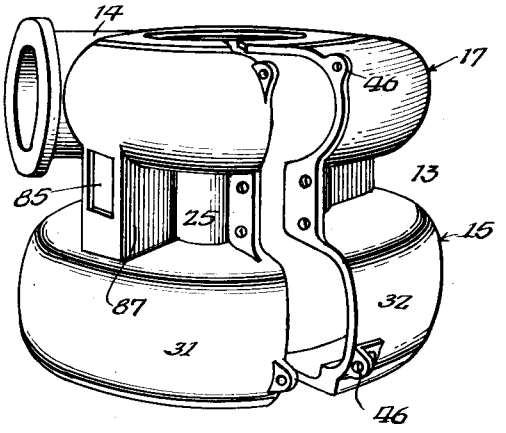


Fig. 7



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UNITED STATES PATENT OFFICE

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PULVERIZER

Application filed October 11, 1929. Serial No. 398,879.

The present invention relates generally to pulverizers for use in pulverizing coal and supplying the same in comminuted form to a heating apparatus, such as a furnace or boiler. More particularly the invention relates to that type of pulverizer which comprises a casing, a motor-driven shaft, and a beater-equipped rotor, and in which a fan on the motor-driven shaft is utilized to draw air through the pulverizing chamber for the purpose of filtering out and exhausting the comminuted coal particles from said chamber.

One object of the invention is to provide an improved pulverizer of the above mentioned type and in which the motor-driven shaft is positioned vertically and has the fan and the rotor fixed respectively to the upper and lower portions thereof, and the casing is shaped so that it forms a pulverizing chamber around the rotor and a fan chamber which is positioned directly above the pulverizing chamber and is in communication with the latter through a vertical conduit.

Another object of the invention is to provide a pulverizer of the last mentioned character in which the casing has formed in the portion thereof that defines the pulverizing chamber, openings which serve, during drive of the fan, to admit air into the pulverizing chamber for use in separating the fine comminuted coal particles from the coarser particles and lifting the fine particles through the vertical conduit up into the fan chamber.

Another object of the invention is the provision of a gate which operates as a valve to control the volume or amount of air admitted into the pulverizing chamber through the aforementioned openings and thereby determines the velocity of the air through the pulverizing chamber and the conduit and the fineness of the comminuted coal particles.

Another object of the invention is to provide a pulverizer of the character under consideration in which the portion of the casing that defines the fan chamber is provided with openings for supplying air into the fan chamber for use in facilitating delivery of the comminuted particles to the heating apparatus and supporting combustion in said apparatus.

A further object of the invention is to provide a gate for the last mentioned openings which is in the nature of a valve and permits of regulation of the amount of air drawn into the fan chamber for combustion purposes.

A still further object of the invention is the provision of baffle means in the pulverizing chamber for preventing entry of the coarse particles into the conduit.

In addition, the invention contemplates as one of the objects thereof to provide a pulverizer which is generally of new and improved construction and may be produced at a comparatively low cost, and in which facility of replacement of the various operating parts is combined with durability and compactness of construction.

Other objects of the invention and the various advantages and characteristics of the present construction will be apparent to those skilled in the art from a consideration of the following detailed description.

The invention consists in the several novel features hereinafter set forth and more particularly defined by the claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a side view of a pulverizer embodying the invention together with a coal feeding device;

Figure 2 is a plan view;

Figure 3 is a vertical section showing in detail the arrangement and construction of the fan and rotor and the gate-controlled openings for admitting air into the fan and pulverizing chambers;

Figure 4 is a horizontal section taken on the line 4—4 of Figure 3 and illustrating the arrangement of the openings in the portion of the casing that defines the fan chamber and the manner in which the gate which is associated with such openings is operable to control the volume or amount of air admitted into the fan chamber for use in supporting com-

bustion in the heating apparatus with which the pulverizer is associated;

Figure 5 is a horizontal section taken on the line 5—5 of Figure 3 and disclosing the construction of the beater-equipped rotor and the corrugated liner which cooperates with the rotor to effect the desired pulverizing of the coal;

Figure 6 is a bottom view of the pulverizer, illustrating the arrangement of the openings for admitting air into the pulverizing chamber and the manner in which the gate which is associated with said openings operates to control adjustably the volume of air that is admitted into the pulverizing chamber and is used to lift the comminuted coal particles up through the conduit into the fan chamber of the casing;

Figure 7 is a perspective view of the pulverizer casing; and

Figure 8 is a side view of the pulverizer casing.

The pulverizer which forms the subject matter of the present invention is adapted primarily to pulverize coal and to supply the comminuted particles to a brick kiln, furnace, boiler, core oven, or similar heating apparatus for firing purposes. This pulverizer comprises in general a vertically extending rotor shaft 10, a rotor 11 for pulverizing the coal, a fan 12, and a casing 13. The rotor 11 is mounted on the lower end of the shaft 10 and is adapted to effect a gradual reduction of the coal. The fan 12 is mounted on the central portion of the rotor shaft and is adapted to draw upwardly the comminuted coal particles and to discharge the latter through an outlet member 14. The casing 13 comprises a member 15 which houses the rotor 11 and forms an annular pulverizing chamber 16. In addition to the member 15, the casing 13 comprises a member 17 which houses the fan 12 and forms a fan chamber 18. The casing-member 15 is composed of a circular bottom wall 19, a substantially cylindrical side wall 20, and a circular top wall 21. These walls together define or form the pulverizing chamber 16 in which the rotor 11 is disposed. The casing-member 17 is positioned above the member 15 and is composed of a circular bottom wall 22, an outwardly bulged annular side wall 23, and a circular top wall 24. These last mentioned walls together define or form the fan chamber 18 in which is disposed the fan 12. A cylindrical neck or wall 25 supports the casing-member 17 above the casing-member 15 and is connected to the inner portions of the circular walls 21 and 22. This cylindrical wall 25 extends around the rotor shaft 10 and forms a vertically extending conduit 26 between the pulverizing chamber 16 and the fan chamber 18. The casing 13 is supported upon a ring-shaped base structure 27. The latter is adapted to be anchored to the floor of the room or space in which the pulverizer is disposed and embodies an upwardly extending annular wall 28 and an outwardly or radially extending flange 29 which fits against the outer marginal portion of the circular wall 19. The casing is fixedly secured to the base structure by screws 30 which extend through the radially extending flange 28 and the contiguous portion of the wall 19.

To permit of access to the various operating elements, such as the rotor 11 and the fan 12, the casing 13 is formed in two one-piece complementary sections. These sections are designated by the reference numerals 31, 32, and are connected together by a pair of hinges 33 and 34 so that they may be swung laterally relatively to each other. The hinge 33 comprises a pair of lugs 35 and 36 and a link 37. The lug 35 is formed integrally with the part of the cylindrical side wall 20 that is embodied in the casing-section 31, and is rigidly connected to the link 37 by a pair of bolts 38. The lug 36 is formed integrally with the part of the cylindrical side wall 20 that is embodied in the casing-section 32 and is pivotally connected to the link 37 by a pin or pivot bolt 39. The hinge 34 is positioned directly above the hinge 33 and comprises a pair of lugs 40 and 41 and a connecting link 42. The lug 40 is formed integrally with the outlet member 14 and is rigidly connected to the link 42 by a pair of bolts 43. The lug 41 is formed integrally with the part of the annular side wall 23 that is included in the casing-section 32 and is pivotally connected to the link 42 by a pin or bolt 44. A characteristic and an advantage of providing the hinges 33 and 34 and arranging said hinges in the manner set forth, is that the casing-sections 31 and 32 may be readily swung or shifted sidewise into an open position whenever access is desired to the various operating elements or the chambers 16 and 18. The casing-sections are held in their closed position by bolts 45. The latter extend through pairs of lugs 46 which are connected to contiguous parts of the casing-sections. The outlet member 14 is formed integrally with the part of the side wall 17 that is included in the casing-section 31.

The lower end of the vertically extending rotor shaft 10 extends through the pulverizing chamber 16 and is journalled in a ball bearing 47 which is carried and supported by a cup-shaped retaining element 48. This element extends through a circular opening 49 in the central portion of the bottom wall 19 of the casing-member 15 and is provided at the upper end thereof with an outwardly or radially extending flange 50. The latter rests upon the portion of the wall 19 that forms the opening 49 and is rigidly secured to such part by screws 51. The ball bearing 47 comprises an inner race 52, an outer race 53, and two annular series of balls 54.

The inner race 52 is fixed to the extreme lower end of the rotor shaft and abuts against a shoulder 55 on the shaft. The outer race 53 is embedded in an annular recess 56 which is formed in the upper portion of the cup-shaped element 48. By arranging the races 52 and 53 in the manner set forth, the ball bearing 47 operates as a thrust bearing as well as to support rotatably the rotor shaft. A pipe 57 is connected to the lower end of the element 48 and is adapted to supply oil to lubricate the bearing. The oil that is delivered into the lower portion of the cup-shaped element is adapted to be forced by a flinger 58 to the top portion of the ball bearing via a duct 59 in the element 48. This flinger is secured to a threaded stem 60 on the lower end of the rotor shaft and operates upon rotation of said shaft to fling the oil outwardly so that it is thrown upwardly into contact with the lower part of the bearing and passes through the duct 59 to contact with the upper part of the bearing. A dust ring 61 rests upon the radially extending flange 50 and fits around the portion of the rotor shaft that forms the shoulder 55.

The upper end of the rotor shaft projects through a circular opening 62 in the central portion of the circular wall 24 and is journalled in a ball bearing 63 which is carried and supported by a cup-shaped element 64. The latter has formed in the bottom thereof a circular opening 64ª through which extends the rotor shaft. The side wall of the element 64 is provided at the upper end thereof with a radially extending flange 65 and fits in an annular flange 66 which is formed integrally with and projects upwardly from the wall 24 and the casing-member 13. Screws 67 extend through the flange 65 and into the flange 66 and serve to secure the element 64 in connected relation with the casing. The ball bearing 63 comprises an inner race 68, an annular series of balls 69, and an outer race 70. The inner race 68 is fixed to the rotor shaft. The outer race 70 fits against the inner periphery of the cup-shaped element 64. The ball bearing 63 is lubricated by oil which is delivered into the element 64 through a pipe 71. A flinger 72 operates upon rotation of the shaft 10 to throw the oil upwardly into contact or engagement with the lower part of the bearing. The upper part of the bearing receives oil from the flinger via a vertically extending duct 64ᵇ in the element 64. The flinger 72 is interposed between a shoulder 73 on the shaft and the inner race 68 and is clamped in place for rotation with the rotor shaft by a nut 74. Leakage of oil through the opening 64ª is prevented by a sheet metal sleeve 75 which is connected to the bottom of the element 64 adjacent to the opening 64ª and projects upwardly within the flinger 72. The upper part of the ball bearing 70 is protected against dust by a disk-like plate 76 which extends around the rotor shaft and rests upon the upper face of the radially projecting flange 65 of the ball bearing supporting element 64. The lower part of the ball bearing 63 is protected against the entry of dust through the openings 62 and 64ª by a disk-like plate 77. The latter extends around the rotor shaft and is supported opposite to the inner face of the circular wall 24 by a collar 78 which is rigidly connected to the rotor shaft by a set screw 79.

The rotor shaft 10 is driven to effect rotation of the rotor 11 and the fan 12, by means of an electric motor 80. This motor comprises a drive shaft 80ª and a casing 80ᵇ and is supported on top of the casing 10 by a pedestal 81. The latter embodies a plurality of legs 82 which are secured to the circular top wall 24 of the casing member 13 by bolts 83. The motor-casing 80ª is secured directly to the top portion of the pedestal. The pedestal legs 82 are preferably of such length that the motor is supported slightly above the ball bearing 63 and the supporting element 64. The drive shaft 80ª of the motor is arranged so that it is coaxial with the rotor shaft 10 and is connected to said rotor shaft by a flexible coupling 84.

The coal that is to be pulverized by the rotor 11 is delivered into the chamber 16 by a chute 85. This chute is formed integrally with the top wall 21 of the casing member 15 and is adapted to discharge the coal into the pulverizing chamber through an opening 86 in the central portion of the top wall 21. The sides of the chute are closed by vertically extending webs 87 which extend between and are formed integrally with the walls 21 and 22. These webs, in addition to closing the sides of the chute, operate to reinforce the casing and form supports for the member 17. The rotor 11 which operates during rotation of the shaft 10 to pulverize the coal comprises a body 88, a pair of ring-shaped plates 89 and 90, and an annular series of beaters 91. The rotor-body extends around the rotor shaft 10 and is fixedly connected to the latter for rotation therewith by a key 92. The plate 89 is positioned above the plate 90 and is arranged so that the inner marginal portion thereof fits in an annular recess 93 in the upper portion of the rotor-body 88. The rotor plate 90 is arranged so that the inner marginal portion thereof fits in an annular groove 94 in the rotor portion of the body. Bolts 95 extend through the plates and the outer portion of the rotor-body and serve to hold said plates and body in connected relation. The beaters 91 are positioned between the rotor plates 89 and 90 and are pivotally supported by pins 96. The latter extend through the inner ends of the beaters and have the ends thereof disposed in vertically aligned openings 97 in the outer marginal portions of the rotor plates. The outer ends

of the beaters project beyond the outer edge of the upper rotor plate 89 and are adapted to engage the coal and throw it outwardly against a corrugated liner 98 which fits against the inner periphery of the cylindrical side wall 20. The liner 98 is preferably formed in sections so that it may be readily assembled with respect to the casing-member 15. The upper portions of the liner sections are provided with outwardly extending ribs 98ª. The liner sections are held in place by means of bolts 99 which extend through the side wall 20 and the upper portions of said liner sections. The lower portions of the liner sections are provided with screws 100 which project outwardly through the wall 20 and are adapted to be adjusted so as to position the said lower ends of the liner sections with respect to the beaters. By connecting the liner sections to the side wall 20 of the casing-member 15 in the manner set forth, it is possible to adjust the lower portions of the liner sections and to shift such portions inwardly in the event that they become worn. The liner 98 operates, in a measure as an anvil and cooperates with the beaters to effect a gradual diminution of the coal.

Air is admitted into the bottom of the pulverizing chamber through an annular series of holes 101 in the circular bottom wall 19 of the casing-member 15. The air that is admitted into the pulverizing chamber through these openings passes upwardly around the outer edges of the rotor plates 89 and 90 and is drawn through the conduit 26 into the fan chamber 18 by the fan 12. As the air travels upwardly into the conduit 26, it lifts the fine comminuted coal particles out of the pulverizing chamber. The fineness of the coal particles that are drawn upwardly into the fan chamber 18 is determined by the amount of air that is admitted into the pulverizing chamber 16. When the volume of air admitted into the pulverizing chamber 16 is large, the velocity of the air that travels upwardly through the conduit 26 is comparatively great with the result that the large sized coal particles are drawn into the fan chamber. When the volume of air admitted into the pulverizing chamber 16 is small, the velocity of the air that is sucked upwardly by the fan is comparatively small and consequently only small sized coal particles are lifted up through the conduit 26 into the fan chamber. In order to regulate the amount of air admitted into the pulverizing chamber through the openings 101 so as to control adjustably the fineness of the comminuted coal particles, a ring-shaped gate 102 is provided. This gate fits against the lower face of the bottom wall 19 and is provided with an annular series of openings 103 which correspond to the openings 101. Said gate extends around the cup-shaped element 48 and is rotatably mounted so that the openings 103 therein may be shifted out of alignment with the openings 101 in the wall 19 so as to cause a restriction of the amount of air admitted into the pulverizing chamber through said openings 101. An angle-iron ring 104 is secured to the element 48 and forms a rotatable support for the gate. The gate is rotated for air regulating purposes by an arm 105. The inner end of this arm is suitably attached to the gate and extends outwardly through a slot 106 in the annular wall 28 of the base structure 27. The outer or distal end of the arm extends upwardly alongside of the casing-member 15 and is provided with an outturned portion 105ª. The latter has secured thereto a handle 107 and is movable over an arcuate strip 108. This strip is supported by brackets 109 which are attached to the side wall 20 of the casing-member 15. When the arm 105 is shifted in one direction, the gate 102 is caused to be rotated so as to bring the openings 103 into registry with the openings 101. When the arm 105 is shifted in the opposite direction, the gate 102 is caused to be rotated so as to limit or restrict the amount of air admitted into the pulverizing chamber through the openings 101. The gate 102 is locked in an assigned position by a screw 110 which extends through the portion 105ª of the arm 105 and cooperates with a series of holes in the arcuate strip 108. The gate 102 exemplifies means for regulating the volume of air admitted into the pulverizing chamber. By extending and arranging the arm 105 in the manner set forth, rotation of the gate for air regulating purposes may be readily effected.

A tubular element 111 is formed integrally with and projects laterally from the portion of the side wall 20 that is formed in the casing-section 32. This element forms a pocket 112 at one side of the pulverizing chamber, into which are projected or thrown the various non-breakable pieces (slag, scrap-iron, etc.) that are sometimes included with the coal that is delivered into the pulverizing chamber. The sections of the corrugated liner 98 are arranged so that the entrance to the pocket is free and there is a direct communication between the pocket and the pulverizing chamber. During operation of the rotor the various non-breakable pieces are rotated around the pulverizing chamber by the beater until they are eventually thrown into the pocket 112. The outer end of the element 111 is closed by a door 113. When this door is removed or swung into its open position, access may be had to the pocket 112 for removal of the various non-breakable pieces that are disposed therein. To prevent pieces of coal from dropping into the space between the lower rotor plate 90 and the top surface of the circular bottom wall 19, an annular series of radially extending blades 114 is provided. These blades are preferably formed of angle-iron and are secured

to the outer marginal portion of the plate 90. During rotation of the rotor, the blades 114 operate to draw aid through the openings 101 and prevent pieces of coal from working down around the outer parts of the beaters and the rotor plates.

A ring-shaped baffle 115 is disposed in the pulverizing chamber and is fixedly secured to the bottom face of the circular top wall 21. This baffle is provided with an annular flange 116 which extends downwardly and outwardly and forms a conoidal entrance 117 to the conduit 26. By having the flange 16 extend downwardly and outwardly, the coarse comminuted particles that are in suspension in the pulverizing chamber are deflected downwardly towards the rotor so that they are not drawn upwardly through the conduit 26. To assist the baffle 115 in preventing the coarse comminuted coal particles from entering the fan chamber 18 through the circuit 26, vanes 118 are provided. These vanes are disposed in the conoidal entrance 117 and are held in clamped relation around the rotor shaft 10 by bolts 119. During operation of the pulverizer, the vanes are rotated with the shaft 10 and serve to throw outwardly against the baffle flange 116, the coarse comminuted particles that are sometimes carried upwardly by the air passing into the conduit 26. The comminuted coal particles of the desired fineness that are separated or filtered out by the flow of air through the pulverizing chamber are not subjected to the action of the baffle 115 and the vanes 118 by virtue of the fact that the velocity of the air passing upwardly into the conduit 26 is sufficient to carry upwardly such particles. The baffle and the vanes exemplify means for preventing coarse coal particles from being drawn upwardly through the conduit 26 with the comminuted particles of the desired fineness.

The fan 12, which operates as previously pointed out to lift the coal particles from the pulverizing chamber 16 and to force said particles through the outlet member 14, consists of a hub 120, radially extending arms 121, and fan blades 122. The hub 120 is fixed for conjoint rotation with the rotor shaft 10 by a key 123. The radially extending arms 121 are preferably formed integrally with the hub 120. The blades 122 are formed of sheet metal and are secured to the outer or distal ends of the arms 121 by rivets or studs 124. During operation of the pulverizer the fan 12 produces suction and thereby causes air to enter the pulverizing chamber 16 through the openings 101 and together with the comminuted coal particles, to flow upwardly through the conduit 26 into the fan chamber 18. The blades 122 of the fan, besides creating suction for use in lifting the comminuted coal particles from the pulverizing chamber, operate to throw such particles outwardly with sufficient force to carry them through the outlet member 14. The latter is adapted to be connected by means of a pipe or similar connecting instrumentality 125 to discharge into the combustion chamber of the heating apparatus with which the pulverizer is used or associated.

To facilitate the travel of the comminuted coal particles into the outlet member 14 and through the pipe 125, and to support combustion in the heating apparatus with which the pulverizer is associated, air is admitted into the top of the fan chamber 18 through an annular series of openings 126 in the circular top wall 24 of the casing-member 13. The openings 126 are positioned outwardly of the annular flange 66. The volume of air introduced into the fan chamber through the openings 126 is regulated by a ring-shaped gate 127. This gate is rotatable around the flange 66 and has formed therein openings 128 which correspond in number and size with the openings 126. Rotation of the gate 127 is effected by an arm 129. This arm projects outwardly and has the inner end thereof fixedly secured to the top face of the gate. The outer or distal end of the arm is provided with a handle 130 and rests upon an arcuate strip 131. The latter is supported upon brackets 132 which are secured to the side wall 23 of the casing-member 13. The arm 129 is adapted to be locked in any of its assigned positions by means of a screw 133. This screw extends through the outer end of the arm and cooperates with a series of holes 134 in the arcuate strip 131. When the arm 129 is shifted in one direction, the openings 128 in the gate 127 are moved out of registry with the openings 126 and consequently the admission of air into the fan chamber 18 is cut off. When the arm 129 is shifted in the opposite direction, the openings 128 are brought into registry with the openings 126 in the top wall 24 with the result that air is admitted into the fan chamber 18 through said openings 126. By adjusting the gate 127, the volume of air that is used to support combustion in the heating apparatus which is fired by the pulverized coal may be regulated. By admitting the air for combustion into the fan-casing 18 through the openings 126, but a single fan is necessary to force such air into the heating apparatus and to lift the comminuted coal particles out of the pulverizing chamber. A plate 135 is secured to the bottom face of the circular top wall 25 and is provided with an inwardly extending flange 136. The latter is spaced from the top wall 24 and operates to form a restricted air-outlet 137 adjacent to the rotor shaft 10. This outlet 137 causes the air passing into the fan chamber 18 through the openings 126 to be delivered to the central or inner portion of the fan.

The coal that is to be pulverized is pref-

erably delivered to the chute 85 by a continuous feed device, such, for example, as the one herein disclosed which comprises a coal hopper 138, a feed drum 139, and a sectional housing 140. The housing is supported at one side of the casing 13 by a pair of brackets 141 and an angle-iron bar 142, and embodies an outlet chute 143 which is arranged so that it forms a continuation of the pulverizer chute 85. The brackets 141 are secured to the bottom of the housing and rest upon the base structure 27 of the pulverizer. The angle-iron bar 142 is secured to the inner side of the housing and is anchored to the circular top wall 24 of the casing-member 13. The drum 139 is disposed in the housing 140. It is provided at the ends thereof with heads 139ª and is mounted for rotation by means of a shaft 145. The latter is rigidly secured to one of the heads 139ª and projects through a bearing 146 in one side of the housing 140. The hopper 138 is secured by brackets 147 to a funnel-shaped member 148 at the top of the housing and is arranged so as to discharge the coal therein through the funnel-shaped member and onto a trough 149. The latter is formed integrally with the housing and discharges the coal directly onto the top of the drum 139. The periphery of the drum is preferably fluted longitudinally in order to cause the coal to be drawn from the trough 149. The quantity of coal that is drawn by the drum from the trough is controlled or regulated by a vertically adjustable plate 150 which is carried by the top of the housing 140. The drum 139 is rotated step by step to cause a continuous discharge of the coal into the casing chute 85, by means of gearing comprising a vertically extending worm 151; a worm-wheel 152 which meshes with the worm 151 and is fixedly secured to a horizontally extending shaft 153; a crank pin 154 which is driven by rotation of the shaft 153 and is connected to one end of a link 155; a rocker arm 156 which is loosely mounted on the outer end of the drum-shaft 145 and is connected to the other end of the link 155; and a ratchet wheel 157 which is fixedly secured to the shaft 145 and is rotated step by step by a dog or pawl 158 on the distal end of the rocker arm 156. The worm-wheel 152 and the horizontally extending drive shaft 153 are mounted in a gear box 159 which is supported on the top wall 24 of the casing-member 13. The worm 151 is connected to a pulley 160. The latter is connected by a belt 161 to a pulley 162 on the drive shaft 80ª of the electric motor 80 in order that the hereinbefore described gearing operates to drive the drum 139 of the feed device synchronously with the rotor shaft 10. An electro-magnetic separator 163 is disposed in the drum and is adapted to cause articles that are subject to magnetic influence to be held on the drum so that they are not discharged with the coal onto the chute 143. Said separator is mounted on a non-rotatable shaft 164 and is positioned adjacent the operative portion of the drum, that is, the portion on which the coal is carried from the trough 149 to the chute 143. By arranging the separator in this manner, the various articles that are separated from the coal are caused to adhere to the drum until they pass beyond the chute 143. As soon as the articles pass beyond the range of the separator, they fall to the bottom of the housing 140 from which they may be removed by way of a doorway 165. The shaft 164 has one end thereof disposed in an open-ended socket 145ª in the inner end of the shaft 145 and its other end held in a hub 166.

The operation of the pulverizer is as follows: When the electric motor 80 is started, the rotor shaft 10 is caused to be driven by the flexible coupling 84 and the feed device is caused to be simultaneously actuated by means of the gearing which is driven from the motor by the belt and pulley connection between the motor shaft 80ª and the worm 151. Drive of the gearing in the gear box 159 causes a reciprocatory movement to be imparted to the rocker arm 156 and results in the drum being rotated step by step through the medium of the pawl and ratchet. This step by step movement of the drum causes the coal to be drawn from the hopper 138 and projected in a continuous stream onto the chute 143. The coal, after leaving the drum, passes downwardly from the chute 143 onto the casing chute 85 and enters the pulverizing chamber 16 through the opening 86. As soon as the coal enters the pulverizing chamber, it is subjected to the action of the rotor and is caused to be impacted or thrust against the corrugated liner 98. During rotation of the rotor, the beaters 91 which are pivotally connected to the plates 89 and 90, successively strike against the coal particles and together with the corrugated liner effect a gradual reduction of the coal. While the pulverization of the coal is taking place in the chamber 16, air enters the chamber through the openings 101 and flows upwardly in a continuous stream through the conduit 26 in response to the action of the fan 12. Before entering the fan chamber, the air filters out the fine coal particles and directs them into the conoidal entrance 117. From said entrance the fine particles are drawn upwardly through the conduit 26 into the chamber 18 from which they are ejected by the fan blades 122 into the laterally extending outlet member 14. The fan, besides lifting the comminuted coal particles from the pulverizing chamber, draws air for combustion purposes through the openings 126 in the top wall 24 and forces such air, together with the coal particles, through the pipe 125 to the heating

apparatus with which the pulverizer is associated. In the event that coarse particles are desired, the gate 102 is positioned so that the openings 103 are in registry with the openings 101. In this position of the gate, a maximum amount of air is admitted into the pulverizing chamber with the result that the air travels upwardly through the conduit 26 with an increased velocity and thereby causes the coarse comminuted particles to be discharged into the fan chamber. In the event that the heating apparatus requires more air for combustion purposes, the gate 127 is positioned so that the openings 128 therein are in registry with the openings 126 in the top wall 24. When the gate is positioned in this manner, a maximum quantity or amount of air will be admitted into the fan chamber 18 and a greater supply of air will be forced into the heating apparatus by the fan. During operation of the pulverizer, the baffle 115 and the vanes 118 operate to insure a uniform fineness of the comminuted coal particles by deflecting the coarse particles back into contact with the rotor 11. During the pulverizing action, the blades 114 serve to draw air into the chamber 16 through the openings 101 and prevent small particles of coal from lodging in the space between the lower rotor plate 90 and the top surface of the bottom wall 19.

In the event that it becomes necessary to replace the beaters 91 or to repair any of the other operating parts, the bolts 45 are withdrawn and the casing-section 32 is swung away from the section 31 so that access may be had to the interior of the casing. When the lower portions of the liner sections become worn, due to impingement of the coal, it is only necessary to adjust the screws 100 in order to shift inwardly the liner sections to compensate for the wear.

The pulverizer herein disclosed consists of but a comparatively small number of parts and therefore may be produced at a low and reasonable cost. By having the rotor shaft extend vertically and arranging the fan chamber above the pulverizing chamber, the action of gravity is made use of in retaining the comminuted coal particles in the pulverizing chamber until such particles are of the desired fineness.

Although the pulverizer has been described as being designed primarily for use in connection with the pulverizing of coal, it is to be understood that such pulverizer may be used equally as well in connection with other frangible materials. It is also to be understood that the invention is not to be restricted to the details set forth, since these may be modified within the scope of the appended claims, without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a pulverizer, the combination of a casing comprising a top wall, a side wall and a bottom wall, said top wall having a central opening formed therein and forming with the side and bottom walls a pulverzing chamber, means for delivering into the chamber the material to be pulverized, a motor driven shaft extending vertically through the central portion of the chamber, a flat circular plate disposed in the chamber in close proximity to the bottom wall and fixed to the shaft for rotation therewith, beaters connected pivotally to and projecting outwardly from the outer marginal part of the plate and operative, during rotation of the shaft, to fling the material towards the side wall, the bottom wall of the casing having an opening formed therein beneath and inwardly of the marginal part of the plate for delivering air into the pulverizing chamber, and a fan for drawing the air from under the plate upwardly around the beaters and through the central opening in the top wall to lift the comminuted particles of material out of the pulverizing chamber and prevent the material from accumulating on the bottom wall under the plate.

2. In a pulverizer, the combination of a casing comprising a top wall, a side wall and a bottom wall, said top wall having a central opening formed therein and forming with the side and bottom walls a pulverizing chamber, means for delivering into the chamber the material to be pulverized, a motor driven shaft extending vertically through the central portion of the chamber, a flat circular plate disposed in the chamber in close proximity to the bottom wall and fixed to the shaft for rotation therewith, beaters connected to and projecting from the outer marginal part of the plate and operative, during rotation of the shaft, to fling the material towards the side wall, the bottom wall of the casing having an opening formed therein beneath and inwardly of the marginal part of the plate for delivering air into the pulverizing chamber, a fan for drawing the air from under the plate upwardly around the beaters and through the central opening in the top wall to lift the comminuted particles of material out of the pulverizing chamber and prevent the material from accumulating on the bottom wall under the plate, and a valve associated with said opening and arranged to control the quantity of air admitted into the chamber through said opening in order to regulate the fineness of the particles lifted out of the pulverizing chamber by the fan.

3. In a pulverizer, the combination of a casing comprising a top wall, a side wall and a bottom wall, said top wall having a central opening formed therein and forming with the side and bottom walls a pulverizing chamber, means for delivering into the chamber

the material to be pulverized, a motor driven shaft extending vertically through the central portion of the chamber, a flat circular plate disposed in the chamber in close proximity to the bottom wall and fixed to the shaft for rotation therewith, beaters connected to and projecting from the outer marginal part of the plate and operative, during rotation of the shaft, to fling the material towards the side wall, the bottom wall of the casing having an annular series of openings therein beneath and inwardly of the outer marginal part of the plate for delivering air into the pulverizing chamber, a fan for drawing the air from under the plate upwardly around the beaters and through the central opening in the top wall to lift the comminuted particles of material out of the pulverizing chamber and prevent the material from accumulating on the bottom wall under the plate, and a ring-shaped gate valve positioned against the bottom wall and adapted in connection with said annular series of openings to control the quantity of air admitted into the pulverizing chamber through said openings in order to regulate the fineness of the particles lifted out of the pulverizing chamber by the fan.

4. In a pulverizer, the combination of a casing comprising a top wall, a side wall and a bottom wall, said top wall having a central opening formed therein and forming with the side and bottom walls a pulverizing chamber, a motor-driven shaft extending vertically through the central portion of the chamber, a beater-equipped rotor disposed in the chamber and fixed to the shaft for rotation therewith, means for delivering into the chamber the material to be pulverized, the bottom wall having openings formed therein for delivering air into the pulverizing chamber, a fan for drawing the air upwardly through the central opening in the top wall to lift the comminuted particles of material out of the pulverizing chamber, and radially extending blades on the bottom of the rotor for drawing the air into the pulverizing chamber through the openings in the bottom wall and preventing the material from accumulating on said bottom wall.

5. In a pulverizer, the combination of a casing comprising a top wall, a side wall and a bottom wall, said top wall having a central opening formed therein and forming with the side and bottom walls a pulverizing chamber, means for delivering into the chamber the material to be pulverized, a motor driven shaft extending vertically through the central portion of the chamber, a flat circular plate disposed in the chamber in close proximity to the bottom wall and fixed to the shaft for rotation therewith, beaters connected pivotally to and projecting outwardly from the outer marginal part of the plate and operative, during rotation of the shaft, to fling the material towards the side wall, the bottom wall having an opening formed therein beneath and inwardly of the marginal part of the plate for delivering air into the pulverizing chamber, a fan for drawing the air from under the plate upwardly around the beaters and through the central opening in the top wall to lift the comminuted particles of material out of the pulverizing chamber, and an annular series of separately formed angle iron blades secured to the bottom face of the plate for assisting the fan in drawing the air into the pulverizing chamber through the opening in the bottom wall and preventing the material from accumulating on the bottom wall beneath the plate.

6. In a pulverizer, the combination of a casing comprising a top wall, a side wall and a bottom wall, said top wall having a central opening formed therein and forming with the side and bottom walls a pulverizing chamber, a motor-driven shaft extending vertically through the central portion of the chamber, a beater-equipped rotor disposed in the chamber and fixed to the shaft for rotation therewith, means for delivering into the chamber the material to be pulverized, means forming openings for delivering air into the pulverizing chamber, a fan for drawing the air upwardly through the central opening in the top wall to lift the fine comminuted particles of material out of the pulverizing chamber, and vanes on the shaft above the rotor and adjacent to the central opening for preventing the coarse particles from being lifted out of the pulverizing chamber by said fan.

7. In a pulverizer, the combination of a casing comprising a top wall, a side wall and a bottom wall, said top wall having a central opening formed therein and forming with the side and bottom walls a pulverizing chamber, a motor-driven shaft extending vertically through the central portion of the chamber, a beater-equipped rotor disposed in the chamber and fixed to the shaft for rotation therewith, means for delivering into the chamber the material to be pulverized, means forming openings for delivering air into the pulverizing chamber, a fan for drawing the air upwardly through the central opening in the top wall to lift the fine comminuted particles of material out of the pulverizing chamber, and a ring-shaped baffle around the central opening for preventing the coarse particles from being lifted out of the chamber by the fan.

8. In a pulverizer, the combination of a casing comprising a top wall, a side wall and a bottom wall, said top wall having a central opening formed therein and forming with the side and bottom walls a pulverizing chamber, a motor-driven shaft extending vertically through the central portion of the chamber, a beater-equipped rotor disposed in the chamber

and fixed to the shaft for rotation therewith, means for delivering into the chamber the material to be pulverized, means forming openings for delivering air into the pulverizing chamber, a fan for drawing the air upwardly through the central opening in the top wall to lift the fine comminuted particles of material out of the pulverizing chamber, and a ring-shaped baffle ring secured to the top wall around the central opening and provided with a downwardly and outwardly flared flange for deflecting the coarse particles towards the rotor and thereby preventing such particles from being lifted out of the pulverizing chamber by the fan.

9. In a pulverizer, the combination of a casing consisting of a member forming a pulverizing chamber and a second member forming a fan chamber above the pulverizing chamber and in communication therewith, a motor-driven shaft extending vertically through the central portions of the two chambers, an outlet member for the fan chamber adapted for connection to a heating apparatus, a beater-equipped rotor disposed in the pulverizing chamber and fixed to the shaft for rotation therewith, means for delivering coal to the pulverizing chamber, a fan disposed in the fan chamber and secured fixedly to said shaft, said fan being adapted, upon drive thereof, to lift the comminuted coal particles out of the pulverizing chamber and to force said particles through the outlet member to the heating apparatus, said second member being provided in the top thereof with an annular series of openings around the shaft for admitting air downwardly into the top of the fan chamber for passage to said heating apparatus to support combustion, and a ring-shaped gate valve positioned around the shaft and adapted in connection with said annular series of openings to control the amount of air admitted into the fan chamber through said openings.

10. In a pulverizer, the combination of a casing consisting of a member forming a pulverizing chamber and a second member forming a fan chamber above and in communication with the pulverizing chamber, a motor driven shaft extending vertically through the central portions of the two chambers, an outlet member for the fan chamber adapted for connection to a heating apparatus, a beater-equipped rotor disposed in the pulverizing chamber and fixed to the shaft for rotation therewith, means for delivering coal to the pulverizing chamber, a fan in the fan chamber comprising blades secured fixedly to and extending radially from the shaft and adapted, upon drive thereof, to lift the comminuted coal particles out of the pulverizing chamber and force them through the outlet member to the heating apparatus, said second member being provided in the top wall thereof with an annular series of openings around the shaft for admitting air downwardly into the top of the fan chamber for passage to the heating apparatus to support combustion, and a ring-shaped plate secured to the underface of said top wall and arranged to direct the air from the openings toward the shaft and the inner parts of the fan blades.

11. In a pulverizer, the combination of a casing shaped to form a pulverizing chamber, a motor-driven shaft extending through the chamber, a beater-equipped rotor disposed in the pulverizing chamber and fixed to the shaft for rotation therewith, means for delivering into the pulverizing chamber the material to be pulverized, a sectional liner positioned around the rotor and adapted to have the material impacted thereagainst by the beaters during operation of the rotor, means whereby the sections of the liner may be adjusted to and from the rotor, and means for exhausting the comminuted particles of material from the pulverizing chamber.

12. In a pulverizer, the combination of a casing consisting of a lower member forming a pulverizing chamber, an upper member forming a fan chamber and a comparatively small neck extending between and spacing apart the two members and forming a conduit between the fan and pulverizing chambers, a motor driven shaft extending vertically through the central portions of said chambers, a beater-equipped rotor disposed in the pulverizing chamber and fixed to the lower part of the shaft for rotation therewith, means extending between the two members and positioned adjacent the neck forming a chute for introducing the material to be pulverized into the top central part of the pulverizing chamber, and a fan in the fan chamber secured fixedly to the upper end of the shaft and adapted, upon drive thereof, to lift the comminuted particles from the pulverizing chamber upwardly through the conduit.

13. In a pulverizer, the combination of a cast metal casing consisting of a lower member forming a pulverizing chamber, an upper member forming a fan chamber and a comparatively small neck extending between and spacing apart the two members and forming a conduit between the fan and pulverizing chambers, a motor driven shaft extending vertically through the central portions of said chambers, a beater-equipped rotor disposed in the pulverizing chamber and fixed to the lower part of the shaft for rotation therewith, means extending between and formed integrally with the two chambers and positioned adjacent the neck for forming a chute for introducing the material to be pulverized into the top central part of the pulverizing chamber, and a fan in the fan chamber secured fixedly to the upper end of the shaft and adapted, upon drive thereof, to

lift the comminuted particles from the pulverizing chamber upwardly through the conduit.

14. In a pulverizer, the combination of a cast metal casing consisting of a lower member forming a pulverizing chamber, an upper member forming a fan chamber and a neck extending between and spacing apart the two members and forming a conduit between the fan and pulverizing chambers, said casing being split longitudinally to form two complementary sections and embodying hinges on the upper and lower members whereby the sections may be swung laterally apart when access is desired to the casing interior, a motor driven shaft extending vertically through the central portions of the two chambers, a rotor disposed in the pulverizing chamber and fixed to the lower part of the shaft for rotation therewith, means for supplying into said pulverizing chamber the material to be pulverized, and a fan in the fan chamber secured fixedly to the upper end of the shaft and adapted, during rotation thereof, to exhaust the comminuted particles from the pulverizing chamber upwardly through the conduit.

Signed at Harvey, Illinois, this 27th day of September, 1929.

CLARENCE R. TAYLOR.