

March 31, 1931.

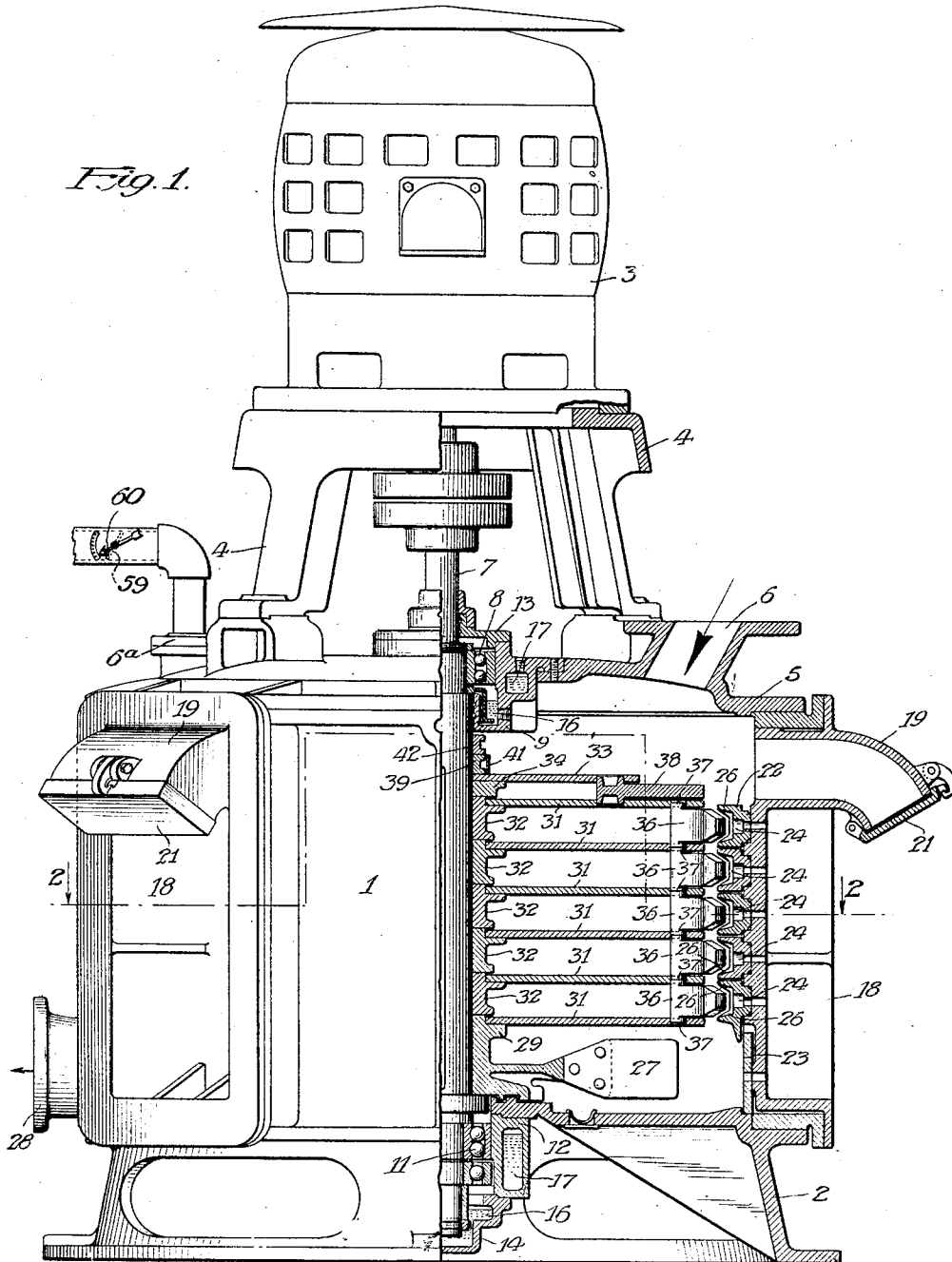
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1,798,465

COAL MILL

Filed July 29, 1929

4 Sheets-Sheet 1



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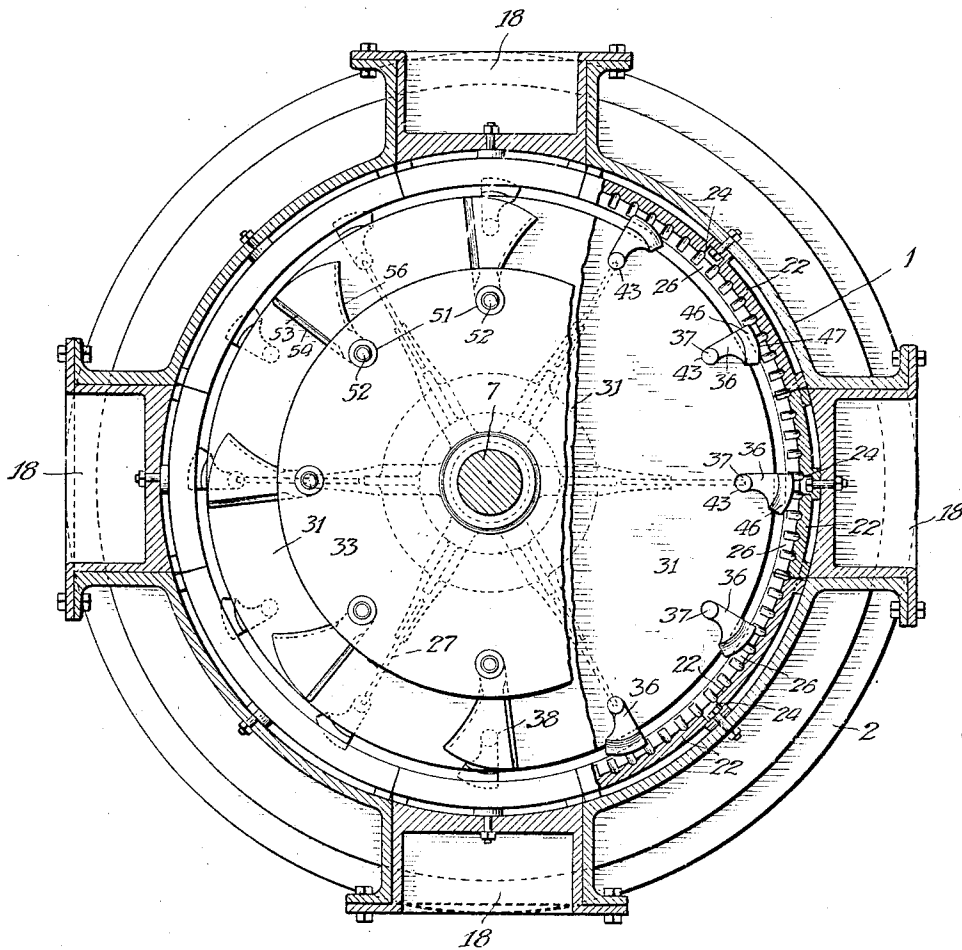
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Fig. 2.



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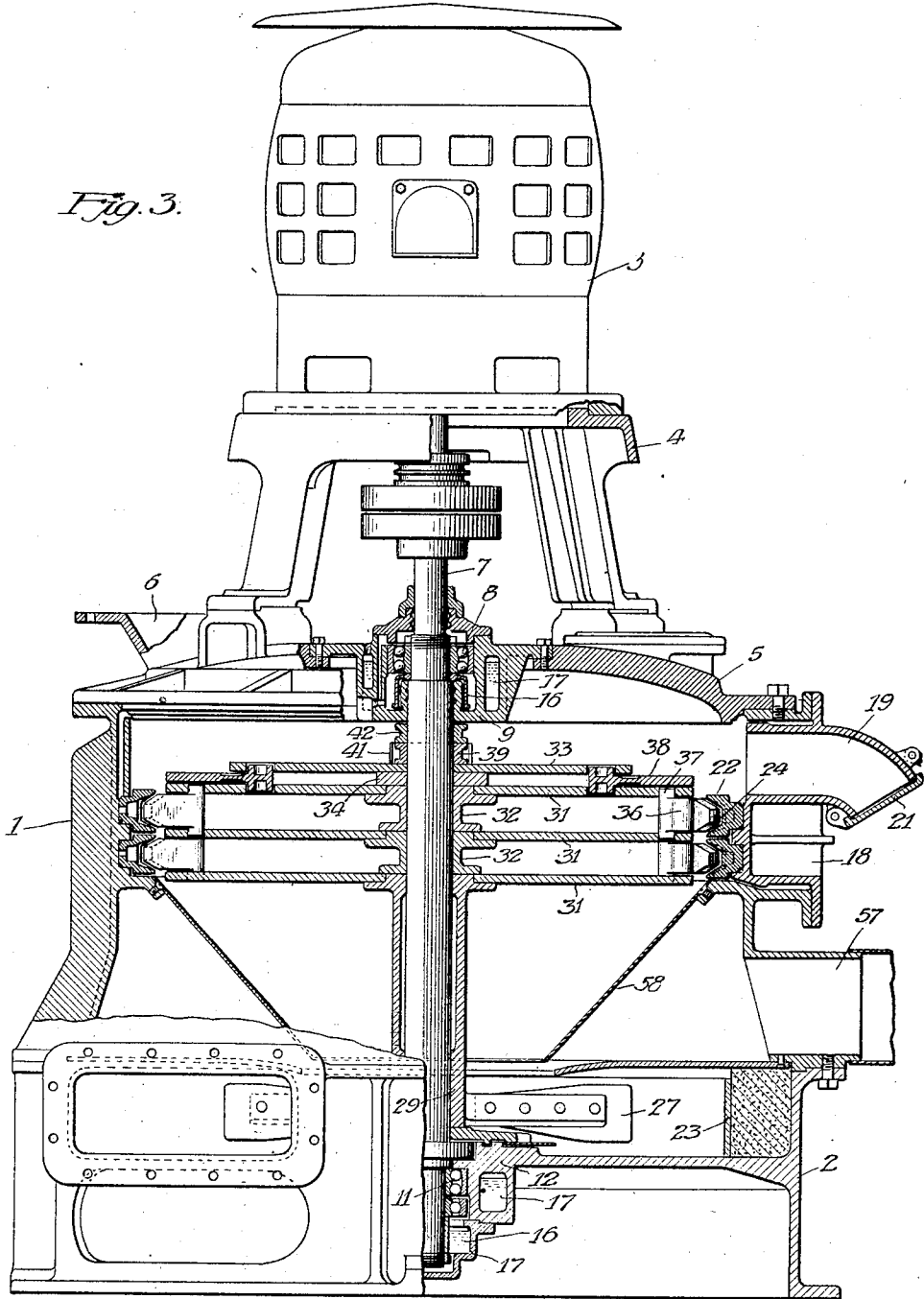
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Fig. 3.



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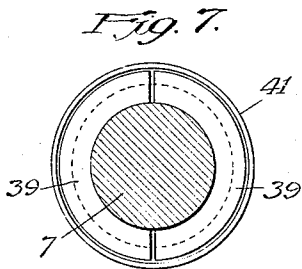
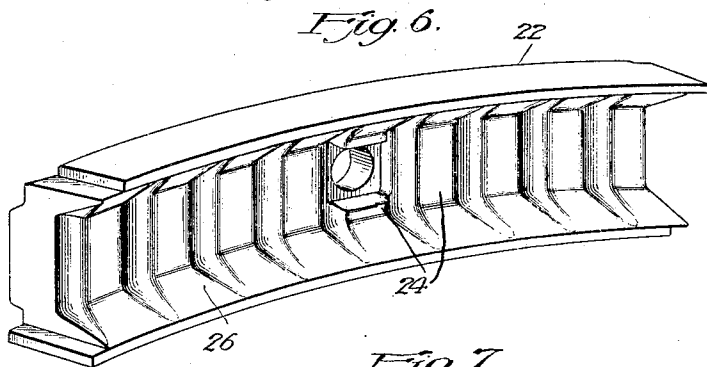
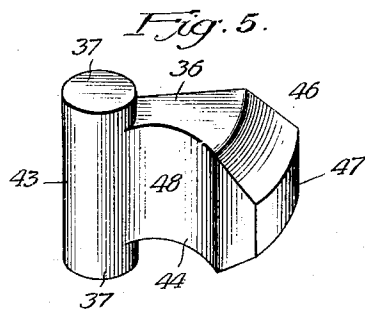
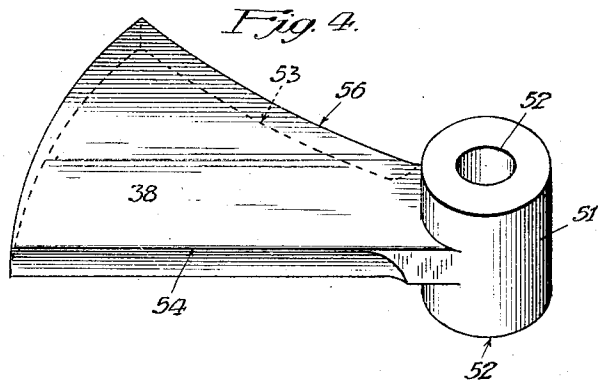
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COAL MILL

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4 Sheets-Sheet 4



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# UNITED STATES PATENT OFFICE

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## COAL MILL

Application filed July 29, 1929. Serial No. 381,733.

This invention relates to mills or pulverizers which are particularly well adapted for grinding coal for use as pulverized fuel and which are known as the beater type.

5 Pulverizers or mills of this type are usually constructed with one or more stages. Each stage comprises a series of hammers or beaters pivotally mounted upon a rotating member in such a manner as to be swung by centrifugal action into extremely close proximity to the inner surface of a cylindrical chamber. The coal or other material is usually fed into the top of the machine where it is acted upon by a hammer or series of hammers and beaters of the first stage after which the powdered material passes down to the next stages successively where it is acted upon by the succeeding set or sets of hammers or beaters. After the coal has been ground to the required degree of fineness by passing it through the requisite number of stages the pulverized material is removed by means of a draft of air produced by a fan external thereto.

25 In mills of this construction which rely upon a beating action to pulverize the fuel, as might be expected, there is considerable wear upon the hammer elements requiring constant repair and replacement. Heretofore this necessitated shutting down the machine for a sufficient period of time to dismantle the entire machine and to rebuild the beater assembly.

35 It is the purpose of this invention to provide a machine of this general type but which does not rely upon a beating action alone but upon attrition and beating to produce the pulverizing action. It is an object of this invention to provide beaters and hammers which will withstand wear to a greater extent than those made heretofore and which in combination with their co-operating inner walls will pulverize the material being treated to a greater fineness and which are secured and assembled in such a manner that they may be readily removed without dismantling the entire machine. In accordance with this invention the contacting surfaces of the beaters are shaped to give added length of life by eliminating wearing at local

spots. The beaters are also constructed with additional material at point opposite to those general portions which are gradually worn away to compensate for the wear usually occurring with use of the machine. Sufficient clearance is also provided in the mill housing which in combination with the specially constructed securing means for the beater carriers to permit the carriers to be separated, thus allowing removal of the beaters without disassembling the entire machine. In order to produce attrition as well as a beating action the inner surface of the mill is provided with channelled or grooved members within which the beaters rotate in close proximity. To permit renewal of the hammers and the grooved members or lining, the interior grooved lining of the mill housing may be constructed in sections removable from the outside of the mill housing. It is also within the contemplation of this invention to remove the pulverized fuel from the base of the machine and control the fineness thereof by means of a fan built integrally into the machine and which serves to agitate the pulverized fuel and to deliver the agitated fuel with a certain amount of preliminary air from the base of the housing to the point of consumption.

A detailed description of the invention will be given in connection with the drawings, in which,

Fig. 1 is a front elevation of a five stage mill partly in section,

Fig. 2 is a section on line 2—2 of Fig. 1 with certain parts broken away to further illustrate the internal construction,

Fig. 3 is a vertical section through a modified two stage mill,

Fig. 4 is a perspective detail of a single hammer,

Fig. 5 is a perspective detail of a single beater,

Fig. 6 is a perspective of a section of the mill lining, and

Fig. 7 is a detail of a split spacing collar and shield used in securing the beaters in place.

In the embodiment of this invention as illustrated in Figs. 1, 2, 4, 5, 6 and 7 there

is shown a five stage vertical type mill comprising generally a housing 1 mounted upon a base 2 and which is driven by an electric motor 3 supported by a motor support 4 rigidly secured to the upper end plate 5, which end plate is formed with a fuel intake 6 and an air intake 6A therein, into the housing 1. A vertical shaft 7 is mounted for rotation in the housing 1 and is supported therefore by means of upper bearing 8 mounted in bearing housing 9 and lower bearing 11 mounted in lower bearing housing 12. The upper bearing housing is provided with a cover 13 whereas the lower bearing housing is provided with a lower cap 14. Both bearings are provided with oil wells 16 and may be water cooled by water chambers 17. The housing 1 is generally of cylindrical shape and is provided with four doors 18 disposed evenly about the periphery and extending the full height of the housing. At the upper end of each door there is provided a tramp iron spout 19 having a hinged and latched cover 21 at the extremity thereof. These spouts are adapted to catch any portions of iron or other material harder and heavier than coal which will be unbroken by the hammers and thrown out by centrifugal action. By unlatching the trap doors 21 the iron so collected may be removed.

The inner surface of the housing 1 is provided with a lining which lining is in sections 22 to permit them being installed and removed without dismantling the entire machine. Those sections removed from the doors 18 are bolted or otherwise secured to the housing 1 whereas those sections overlying the doors are bolted to the doors. Thus as the doors are removed the lining sections will be removed therewith and thus permit access to the interior of the housing whereby the other sections of the lining may be removed. The bottom liner 23 is a sleeve-like member having a smooth interior surface. The upper liners are shaped to form channel-like grooves having ribbed or corrugated bottom surfaces 24 and inclined ribbed side walls 26. The width and depth of the channels are slightly greater than the width and depth of the beaters to be described hereafter.

Upon its lower end just above the base 2 shaft 7 carries a fan 27 which is keyed to the shaft to rotate therewith within the housing in the vertical chamber formed by liner 23. The blades of the fan 27 are shaped to produce a stirring and agitating action as well as a feeding action to agitate the pulverized fuel and discharge it through the outlet 28 provided in housing 1. The upper end of the fan supporting collar 29 carries a beater disc 31. Above the fan supporting collar 29 are mounted successively a series of beater disc supporting collars 32 all of which are keyed

to shaft 7 to rotate therewith. Each of the collars 32 carries for rotation therewith a beater disc 31. In the illustrated embodiment there are shown five collars supporting five beater discs. Adjacent the upper beater disc 31 there is secured a hammer disc 33 carried by a hammer disc collar 34. Each of the beater discs is provided adjacent its periphery with a series of apertures which constitute pivot points for the beaters 36 which are formed with laterally extending bosses 37 which serve as pivot pins and engage the apertures in beater discs 31. The apertures in the discs are staggered in order to support the beaters in staggered relation. Between the disc 33 and the disc 31 there is pivotally secured a series of hammers 38. The hammers and beaters will be described hereafter.

The entire assembly of discs 31, collars 32, disc 33, collar 34, beaters 36 and hammers 38 is held in axial position by means of a split spacing collar 39 surrounded by a shield 41 and a solid collar 42 secured on the shaft 7 against axial displacement by means of set screws or the like. If it is desired to separate discs 31 and 33 to replace any or all of the hammers and beaters it is merely necessary to raise shield 41 and remove collar 39 after which the discs may be raised vertically to permit removal of the hammers or beaters. It is understood, of course, that the doors 18 must be first removed in order to give access to the interior of the casing housing. In order to remove and replace the hammers or beaters it is only necessary to remove one door but to remove and replace the liners it is necessary to remove all doors.

Each of the beaters 36 is composed of a substantially solid block of metal, such as manganese steel, having a hub portion 43 and a head portion 44, the end portions 37 of the hub portion project beyond the sides of the head portion and engage in the apertures in discs 31. The outer end of the head portion is bevelled as at 46 leaving a relatively narrow peripheral surface 47. The taper of the bevelled edges 46 and the width of the surface 47 are of proper dimensions to permit the beater to fit within the channel 24 of the liner sections 22. The peripheral edge 47 is formed as a section of an arc, the radius of which is less than the radius of the inner curvature of the liners. Thus the retreating end of the hammer will clear the bottom of the channel formed in the liners, that is, the peripheral edge of the beater will approach the bottom of the channel of the liner at a tangential point only rather than along the entire peripheral edge as would be the case with a radius of curvature of the outer peripheral edge of the beater substantially the same as the radius of the liners. In this manner wear at local points is substantially eliminated and the entire peripheral edge of the beater receives substan-

tially the same amount of wear. To compensate, however, for any inequalities in the wearing action due to centrifugal action which sometimes causes the retreating end to wear more than the leading end of the hammer the retreating end of the hammer is extended or lengthened thus giving additional material at this portion. To reduce the overall weight of the beater the metal between the hub and the retreating end of the hammer is cut away as indicated at 48.

The hammers or the first stage of beaters are constructed in a similar manner, that is, with a hub portion 51 which is hollowed out as at 52 to reduce the overall weight and a head portion 53. As in the case of the beaters the edge of the hammer is arcuate with a radius less than that of the radius of the liners. Here again the retreating edge of the hammer head is extended to give additional wearing qualities. The leading edge of the hammer is inclined as at 54 while the retreating end is reversely inclined as at 56. It has been found that the bevelled or inclined edge 54 substantially eliminates wear upon the disc immediately below the hammer. Without the bevel there is appreciable wear upon the disc at the edge of the hammer. Generally speaking, the hammer is relatively thinner and longer than the beaters and operates to break up the incoming lumps of coal rather than grind the coal between two surfaces. The fineness of the fuel may to some extent be controlled by the rapidity with which the fuel is forced through the mill. This of course is determined by the amount of air passed through the mill. In the type mill shown in Fig. 1 the air may be controlled by a valve 59 having an indicator 60. By means of this latter control the flow of air may be reduced after the beaters and liners have become partially worn and the fineness maintained the same.

In Fig. 3 there is shown a slightly modified form of mill in which there are two stages of beaters preceded by a set of hammers and in which the air for feeding the pulverized material through the mill is derived from some external source through an air inlet 57 which may be controlled by any suitable valve (not shown) and the blades of fan 27 serve only to agitate the pulverized fuel in the lower region of the housing. The lower portion of the housing is provided with a conical member 58 which directs the powdered fuel from the beaters downwardly toward the center of the base 2 where it passes through an aperture therein and is picked up by the fan and draft of air passing therethrough to be delivered to the point of consumption. The construction of this modification in other respects is substantially the same as the form shown in Figs. 1, 2, 4, 5, 6 and 7 and will not be described in greater detail.

The operation of the mill is believed to be

apparent from the foregoing description and will therefore only briefly be summarized. Lump fuel is fed in through inlet 6 in top cover 5 from which it passes downwardly by gravity into the interior of the housing 1. The lump coal is thus first struck by the pivoted hammers 38 and broken up into smaller particle size. Any lumps of harder or heavier material than coal will be thrown outwardly by centrifugal force into the tramp iron spouts which may be emptied at will. The coal thus broken up by the hammers will then pass downwardly and successively through the channels formed in the inner surfaces of liners 22 where it will be successively ground by a cooperating action of the beaters 36, and channels 24 by a combined beating and attrition action until the coal finally reaches the chamber in the bottom of the housing 1 where it will be thoroughly agitated and mixed by means of a fan 27. In the modification illustrated in Fig. 1 the fan will also serve to propel the mixture of pulverized fuel and air outwardly from the bottom of the housing through outlet 28 and the fineness thereof may be controlled to some extent by regulating the amount of air flowing through the mill by means of valve 59.

It is obvious that minor changes may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. In a grinding mill a substantially closed housing having spaced inlet and outlets therein, a shaft, bearing for supporting said shaft for rotation within said housing, a plurality of beater discs mounted on said shaft for rotation therewith within said housing, beaters pivotally secured to said discs, and means on said shaft within said housing for securing said discs against axial movement on said shaft, said latter means being movable to permit separation of said discs while said shaft is supported in said bearings.

2. In a grinding mill a substantially closed housing having spaced inlet and outlets therein, a shaft jouralled for rotation within said housing, a plurality of beater discs mounted on said shaft for rotation therewith within said housing, beaters pivotally secured to said discs, and a removable spacing collar on said shaft within said housing for securing said discs against axial movement on said shaft, said collar being removable from said shaft while said shaft is in place.

3. In a grinding mill a substantially closed housing having spaced inlet and outlets therein, a shaft jouralled for rotation within said housing, a plurality of beater discs mounted on said shaft for rotation therewith within said housing, beaters pivotally secured to said discs, a split spacing collar on said shaft, and removable means for securing said collar on said shaft within said housing for se-

curing said discs against axial movement on said shaft, said collar being removable while said shaft is in place.

4. In a grinding mill a substantially closed housing having spaced inlet and outlets therein, removable doors in said housing permitting access therinto, a shaft extending into said housing and mounted for rotation therein, a plurality of beater discs mounted on said shaft for rotation therewith and having a plurality of apertures around their peripheries, beaters pivotally secured between said discs and having portions extending in said apertures whereby axial separation of said discs will permit removal of said beaters, and means for preventing axial movement of said discs on said shaft.

5. In a grinding mill a substantially closed housing having spaced inlet and outlets therein, a sectional lining for said housing, removable doors in said housing permitting access therinto, certain of said sections of said lining being secured to said doors, a shaft extending into said housing and mounted for rotation therein, a plurality of beater discs mounted on said shaft for rotation therewith and having a plurality of apertures around their peripheries, beaters pivotally secured between said discs and having portions extending in said apertures whereby axial separation of said discs will permit removal of said beaters, and means for preventing axial movement of said discs on said shaft.

6. In a grinding mill a substantially closed housing having spaced inlet and outlets therein, removable doors in said housing permitting access therinto, a shaft extending into said housing and mounted for rotation therein, a plurality of beater discs mounted on said shaft for rotation therewith and having a plurality of apertures around their peripheries, beaters pivotally secured between said discs and having portions extending in said apertures whereby axial separation of said discs will permit removal of said beaters, a spacing collar on said shaft for securing said discs against axial movement on said shaft, and means for permitting withdrawal of said collar through said doors.

7. In a grinding mill a substantially closed housing having spaced inlet and outlets therein, removable doors in said housing permitting access therinto, a shaft extending into said housing and mounted for rotation therein, a plurality of heater discs mounted on said shaft for rotation therewith and having a plurality of apertures around their peripheries, beaters pivotally secured between said discs and having portions extending in said apertures whereby axial separation of said discs will permit removal of said beaters, a spacing collar on said shaft for securing said discs against axial movement on said shaft, means preventing axial movement of said

collar, and means preventing lateral movement of said collar, said latter means being removable.

8. In a grinding mill a substantially closed housing having spaced inlet and outlets therein, said housing being formed with a plurality of grooves around a portion of its inner periphery, a shaft extending into said housing, a plurality of beater discs mounted on said shaft for rotation therewith within said housing, hammers pivotally secured to said discs for rotation within said housing adjacent the ungrooved portion thereof and beaters pivotally secured to said discs for rotation within said grooved portion.

9. A hammer for use in a grinding mill comprising a hub portion and a head portion extending laterally from said hub portion, the peripheral edge of said head portion being arcuate and the leading edge of said head portion being inclined inwardly from the bottom toward the top.

10. A beater for use in a grinding mill comprising a hub portion and the head portion extending laterally from said head portion, the peripheral edge of said head portion being arcuate and the retreating edge of the hubbed portion being extended rearwardly beyond the rest of the head portion to increase the material thereof at the retreating edge.

11. In a grinding mill a substantially closed housing having spaced inlet and outlets therein for receiving the material to be ground and for discharging the ground material, said housing being formed with a plurality of grooves around its inner periphery, said grooves having inclined side walls, a shaft extending into said housing, a plurality of beater discs mounted on said shaft for rotation therewith within said housing and beaters pivotally secured to said discs, said beaters having head portions with inclined sides arranged for rotation within said grooves.

12. In a grinding mill a substantially closed housing having spaced inlet and outlets therein for receiving the material to be ground and for discharging the ground material, a removable sectional lining for the interior of said housing, said lining being formed to present a plurality of interior annular peripheral grooves when assembled within said housing, said grooves having inclined side walls, a shaft extending into said housing, a plurality of beater discs mounted on said shaft for rotation therewith within said housing and beaters pivotally secured to said discs, said beaters having head portions with inclined sides arranged for rotation within said grooves.

In witness of the foregoing I affix my signature.

AUBREY J. GRINDLE.

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