

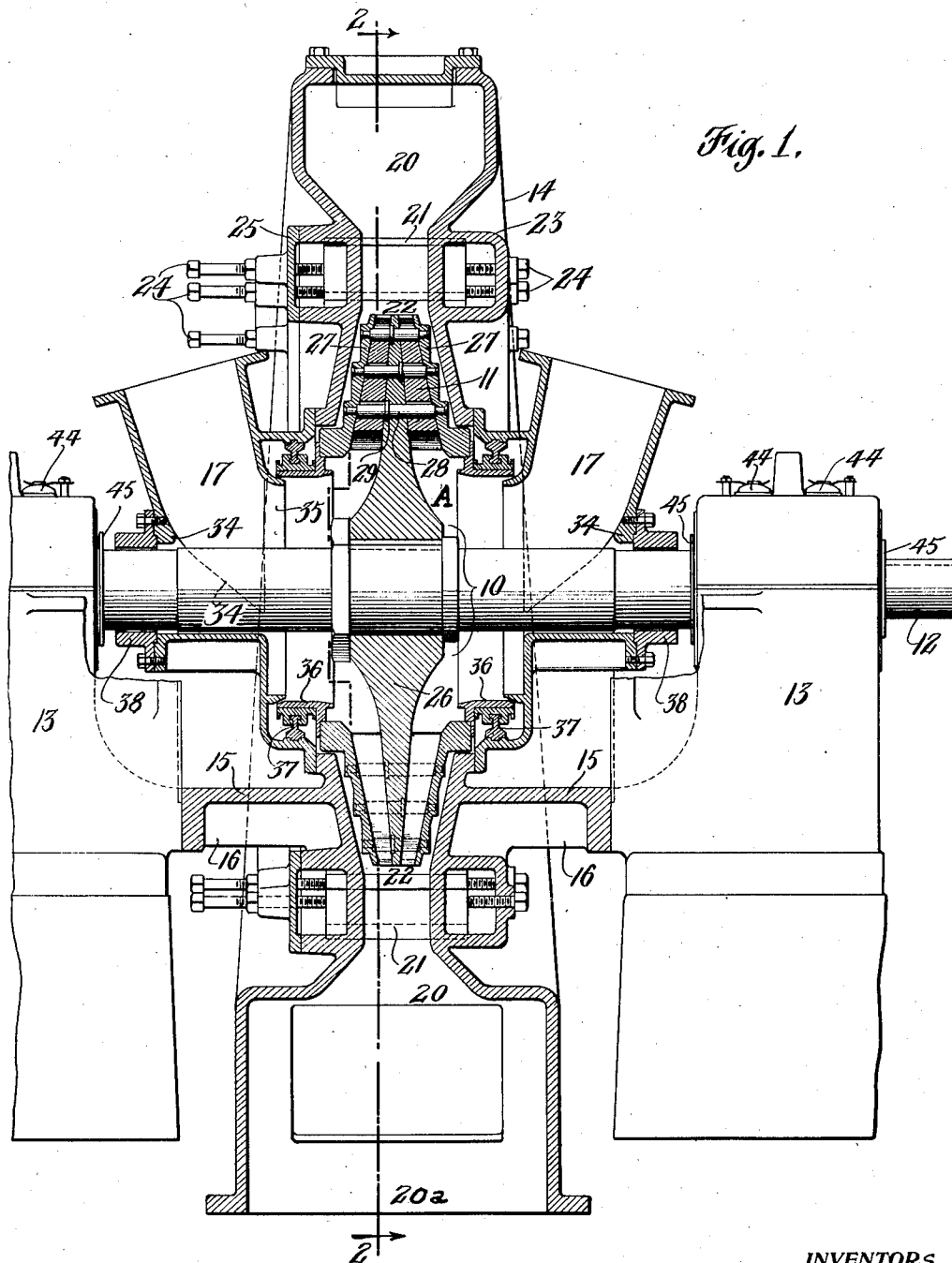
Sept. 7, 1926.

1,598,702

J. E. BELL ET AL
PULVERIZING APPARATUS

Filed Jan. 8, 1924

3 Sheets-Sheet 1



WITNESS
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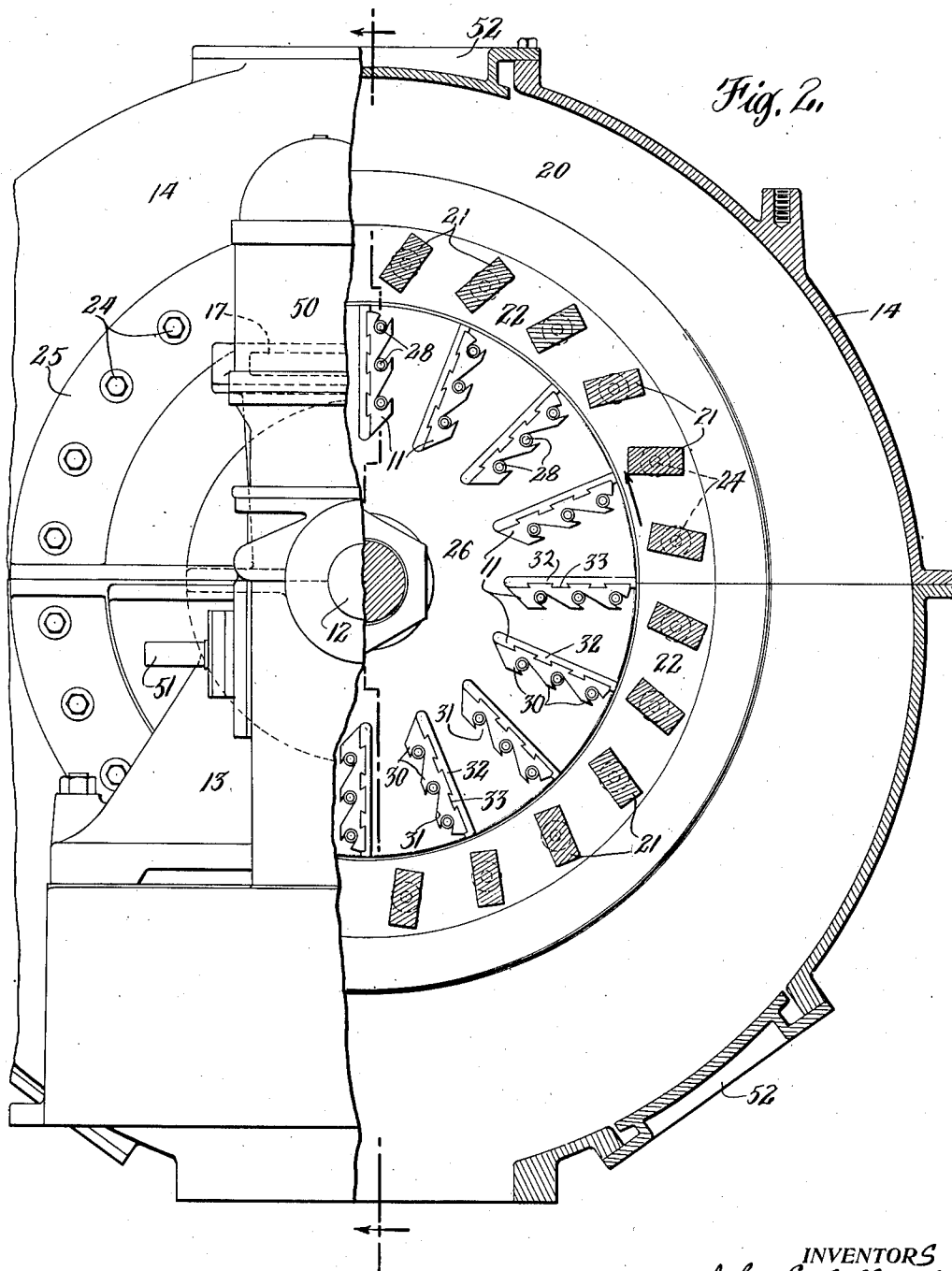
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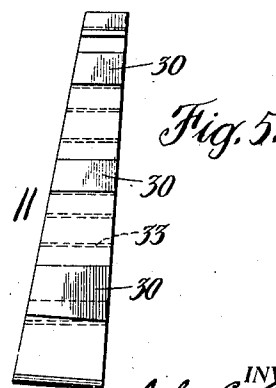
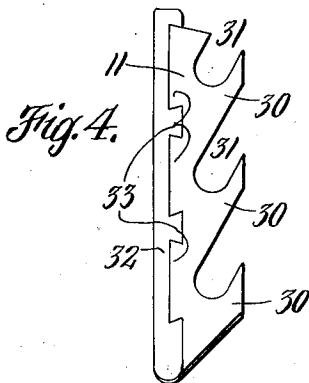
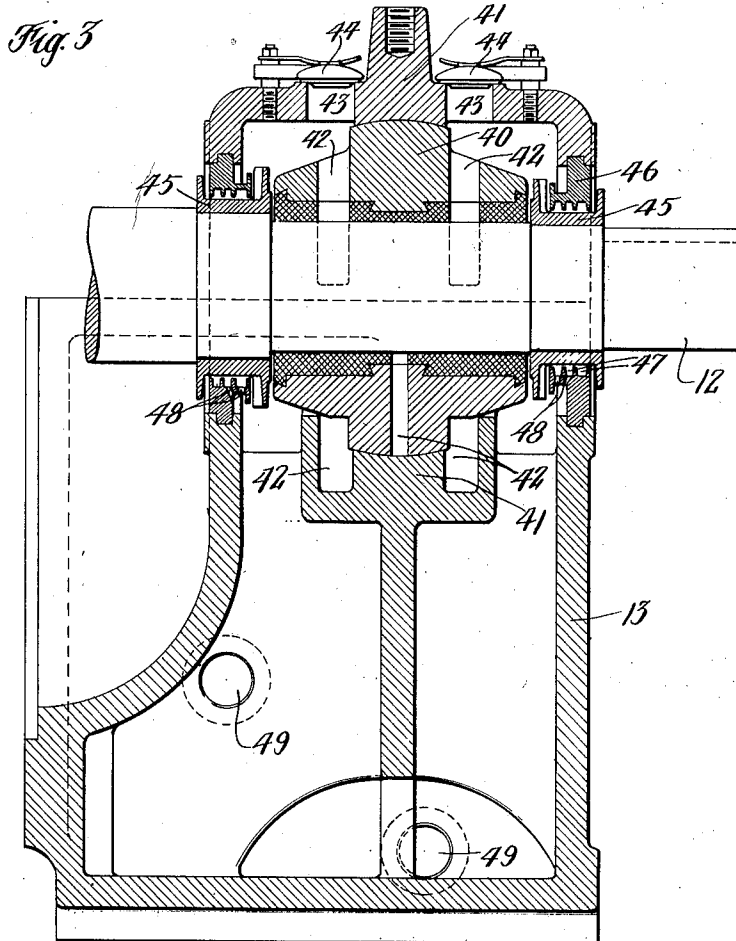
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UNITED STATES PATENT OFFICE.

JOHN E. BELL, OF BROOKLYN, NEW YORK, AND WILLIAM J. A. LONDON, OF HARTFORD, CONNECTICUT, ASSIGNORS TO INTERNATIONAL COMBUSTION ENGINEERING CORPORATION, A CORPORATION OF DELAWARE.

PULVERIZING APPARATUS.

Application filed January 8, 1924. Serial No. 684,950.

Our invention relates to pulverizing apparatus, and is especially useful in connection with the pulverization of coal for burning in powdered form. Our apparatus is of what may be termed the "centrifugal impact" type, since it depends on imparting velocity to the coal centrifugally, and shattering it by impingement on a suitable surface or structure. We aim to provide a practically efficient and convenient apparatus, of high capacity in proportion to its size; and relatively simple in construction, durable in service, and inexpensive to manufacture. We also aim to minimize wear of the more active parts, and to provide for relatively easy replacement or renewal of such parts and their acting surfaces.

How these and other advantages can be realized in novel fashion through our invention will appear from our description hereinafter of a selected and preferred embodiment.

In the drawings, Fig. 1 shows a vertical axial section through a "double" type of pulverizer, taken as indicated by the line 1-1 in Fig. 2.

Fig. 2 is in part an end view of the machine from the left of Fig. 1, and in part a transverse sectional view taken as indicated by the line 2-2 in Fig. 1.

Fig. 3 shows a vertical axial section through one of the shaft bearings which appears in elevation in Fig. 1, on a larger scale.

Figs. 4 and 5 are side views of one of the centrifugal impeller blades shown in Figs. 1 and 2, also on a larger scale than in those figures.

The apparatus here illustrated is adapted to form part of a pulverizing system such as set forth in the U. S. application of John E. Bell, Serial No. 625,193, filed March 15, 1923, and assigned to the assignee of this application. In order to obviate excessive expenditure of power, air is admitted to the pulverizing apparatus only in limited amounts, preferably not exceeding materially the minimum required for the handling of the pulverized product. When the pulverizer is operated as herein-after indicated, the air may be limited to from 50 to 100 percent of the fuel by weight. For this purpose, a sufficient depth of coal to act as a partial seal may be main-

tained in the supply bin, and the area of the supply conduit or feeder casing may also be appropriately limited.

As shown in Figs. 1 and 2, the apparatus comprises a centrifugal rotary impeller 10 with blades 11 for acting on the coal. The impeller 10 is mounted on a shaft 12 that revolves in suitably mounted bearing structures or pedestals 13, and is driven by any suitable means (not shown). The impeller 10 is enclosed in a casing or housing 14, preferably cast in horizontally divided halves, for convenience in assembling the machine or opening it up. To afford a rigid longitudinal "frame" structure (so to term it) for keeping the bearings 13 and the casing 14 fixed in reference to one another, and to obviate vibration, the bearing structures 13 may be bolted to integral braces 15 projecting from either side of the casing 14. As shown, these casing projections 15 are concave upward, and are reinforced with longitudinal flanges 16 on their lower sides, so as to be absolutely rigid.

Crushed coal to be pulverized is supplied to the impeller 10 from either side, through lateral intakes 17 on the casing 14, and is discharged from the impeller peripherally, into a surrounding annular receiving chamber 20 in the outer portion of the casing 14. This chamber 20 has a discharge outlet 20^a at its bottom, and increases in cross section (by gradual enlargement both laterally and radially) either way around from top to bottom: i. e., the impeller axis is substantially above the centers of casing 14 and chamber 20. In the path of the discharge from the impeller 10 outward into the chamber 20 are impact surfaces for shattering the coal, afforded by members 21 mounted in the casing 14. In the present instance, the members 21 extend across a relatively narrow annular throat 22 around the impeller periphery, between the central region of the casing 14 and the laterally flaring enlargement that forms the chamber 20. These members 21 have a massive brick-like form, and their ends are socketed in the openings of correspondingly shaped boxes or pockets 23 cast on the casing wall. They are held in proper position endwise by adjusting screws 24 threaded through the outer walls or covers of the boxes 23. The covers 25 at one side may be made remov-

able, to permit the members 21 to be removed and replaced endwise through the casing wall. For this purpose, the screws 24 at the other side may be employed to start the members 21 and push them loose from accumulations of coal dust packed around them in their sockets.

In the present instance, the impeller 10 is built double, with a set of the blades 11 at either side of a central radially tapering disc 26 that is fast on the shaft 12, and a conically dished annular cover disc or shrouding 27 over each set of blades. The spaces or throats between the disc 26 and the shrouding discs 27, 27 converge somewhat, so that the streams of coal discharging from the impeller periphery converge in the circumjacent casing throat 22. As shown, the discs 27 are secured to the disc 26 and spaced therefrom independently of the blades 11, by means of shouldered members 28 that extend through the disc and have their reduced outer ends riveted over in conical countersinks in the annularly stepped outer sides of the discs 27. The members 28 have flanges 29 on their intermediate portions, and these flanges 29 are seated in countersinks around the holes in the disc 26, at opposite sides thereof alternately. Thus the discs 27 are both held to the disc 26 and spaced therefrom by the connecting members 28. The blades 11 are removably mounted between discs 26, 27. As shown in Figs. 1 and 2, there is a more or less nearly radial row of the members 28 for each blade 11, and the blade has at one side lateral engagement means for taking hold of these members 28, in the form of fingers 30 (Fig. 4) formed by slots or notches open diagonally outward, toward the impeller periphery. Moreover, the blades 11 and the annular interspaces or throats between discs 26, 27 taper outward, so that said throats afford tapering spaces in which the blades wedge tightly between the discs about as the members 28 are nearly "home" in the slots at 31. As shown in Figs. 2, 4 and 5, each of the blades 11 has a readily renewable wear facing 32. (preferably of wear-resistant material such as manganese steel) at its active front side. This facing 32 may be detachably secured to the body member of the blade by a transverse dovetail tongue and groove attachment 33, so that when the blade is in place between discs 26, 27, accidental detachment of the facing will be effectually prevented.

It will be seen, therefore, that while the blades 11 can be detached and removed inward, through the central openings of the shrouds 27, they will be firmly wedged, and held securely to the cross connections 28 between the discs 26, 27, when the impeller is in operation,—by the effect of centrifugal force.

As already mentioned, the coal to be pul-

verized is supplied laterally through the sloping casing intakes 17, 17. In the present instance, each of these intakes 17 is a separate part (divided horizontally like the casing 14 itself) secured over a corresponding opening in the side of the casing 14 proper, around the shouldered inner edge of the shrouding 27. The lower intake wall has a "bell-shaped" downward extension 34, over and to either side of the shaft 12. Between the inner lip or flange 35 of each intake 17 and the corresponding shrouding 27 is a flanged annular part 36, preferably fastened to the shrouding. The lip 35 of each intake 17 overhangs the corresponding ring 36, in order to minimize leakage of coal delivered to the ring 36 out around its edge. A dovetail joint or packing 37 may be interposed between ring 36 and the circumjacent portion of the intake structure 17, to prevent the draft naturally created by the impeller 10 from sucking coal dust around between the parts 35, 36. At the outer end of each intake structure 17 is a flanged collar 38 whose internal surface just clears the shaft 12.

As shown in Fig. 3, each of the pedestals 13 carries a babbitted bearing box 40 for the shaft 12, mounted in a spherical seat 41 in the interior of the pedestal. As shown, the box 40 and its seat 41 have lubricating slots or openings 42, and there are oil holes 43 with spring-pressed swinging covers 44 at the top of each pedestal, over corresponding openings 42. Leakage of oil along the shaft 12 may be prevented by joints or packings at either side of the pedestal, comprising doubly flanged collars 45 fast to the shaft, and cooperating collars 46 on the pedestal that fit between the revolving collar flanges and have grooves 47 to afford a "labyrinth" effect. Holes 48 may be provided for draining the inner grooves 47 back into the interior of the pedestal 13. If desired, connections 49, 49 may be provided for circulation of a cooling medium through the pedestal 13. As shown in Fig. 2, a governor casing or housing 50 may be associated with one of the pedestals 13, to accommodate a governor (not shown) driven from the shaft 12 in any suitable way, and controlling the speed of the shaft in any desired manner,—for which purpose it has a connection 51.

Preferably, the casing 14 may be provided with one or more peripheral manholes or other openings affording convenient access thereto via the chamber 20. These openings may normally be closed by covers 52, with their inner surfaces curved in conformity to the interior of the casing 14.

In the operation of the pulverizer, the impeller 10 may be rotated at a uniform peripheral speed as high as 25,000 to 35,000 ft. per minute.

Coal fed drops by gravity, supplemented by the outward flow of air set up, from the

intakes 17—17 into the annular spaces or chambers A, and travels downward and outward toward the inner edges of the radial blades 11 and is also carried annularly around the periphery of the spaces under some conditions but at less speed than that of the rotor 26. There are sixteen of the blades 11 and, at the speed mentioned, an incredibly large number of the blades pass a given point in a second. What appears to and probably does happen in operation is that the coal, under the action of gravity, possibly centrifugal force, and the radially outward air flow, is brought in position to be acted upon by the blades with the apparent result (if a single piece of coal be considered) that it has infinitesimally thin layers shaved off by the edges of the blades. These layers are so thin that the product is finely pulverized coal, which is carried out between the blades by the outward air flow and centrifugal force. If any particles of larger size than desired enter the spaces between the blades, these are shattered by a single impact on the plates 21, the line of flight being such that the shattered particles pass into the annular chamber beyond the plates. Quickly losing much of their velocity in the slower moving air of the larger chamber 20, the shattered particles pass around to the outlet 21,—being effectually prevented from entering the impeller on rebound from the chamber walls by the higher velocity of the air issuing through the throat 22. However, the air in the chamber 20 still retains sufficient velocity to carry off the particles to a cyclone classifier or separator (not shown), or other point of use or storage. Any particles not fine enough may, of course, be returned through the intakes 17 to be further reduced.

As shown in Fig. 2, the impact surfaces of the members 21 above the impeller are inclined at a greater angle relative to corresponding radii drawn from the impeller axis, in order to compensate for the opposite effects of gravity above and below the impeller. This greater inclination, in other words, tends to make the particles take a slightly more direct initial outward course, so that gravity cannot possibly pull them back into the throat 22.

This mill will deliver pulverized coal of the same fineness from zero to full capacity. In other words the product of the mill is the same at all rates of feed within the range of feed the machine is designed for. To decrease or increase the output, all that is required is to correspondingly change the rate of lump coal feed.

We claim:

1. A centrifugal pulverizer comprising an impeller disc and impeller blades therefor detachably carried thereby, together with an annular receiving chamber and impact

blades interposed between the disc and chamber.

2. A centrifugal pulverizer comprising an impeller disc and impeller blades therefor detachably carried thereby together with an annular receiving chamber and impact blades interposed between the disc and chamber, said impact blades being removable.

3. A pulverizer comprising an impeller casing having a peripheral receiving chamber with outlet at its bottom; a centrifugal impeller in said casing rotating about a horizontal axis substantially above the center of the chamber, so that the radial width of the chamber space beyond the impeller increases either way around toward the outlet; and a series of deflecting impact surfaces around the impeller periphery, in the path of the discharge therefrom outward into said chamber.

4. A pulverizer comprising a centrifugal impeller rotating about a horizontal axis; a receiving chamber around the impeller; and a series of deflecting impact surfaces around the impeller periphery in the path of the discharge therefrom outward into said receiving chamber; the inclination of such surfaces being greater above than below the impeller, so as to compensate for the opposite effect of gravity on the discharge.

5. A pulverizer comprising a centrifugal impeller rotating about a horizontal axis; a receiving chamber around the impeller increasing in cross-section from top to bottom, and discharging at the bottom; and deflecting impact surfaces around the impeller periphery in the path of the discharge therefrom outward into said receiving chamber; the inclination of such surfaces being greater above than below the impeller.

6. A pulverizer comprising a centrifugal impeller; a casing for the impeller, with an annular throat and a receiving chamber therebeyond around its periphery; and a series of impact members in said throat, in the path of the discharge therefrom outward into said receiving chamber, with their ends socketed in the opposite casing walls.

7. A pulverizer comprising a centrifugal impeller; a casing for the impeller, with an annular throat and a receiving chamber therebeyond around its periphery; and a series of impact members in said throat, in the path of the discharge therefrom outward into said receiving chamber, removable endwise through lateral openings in the chamber wall.

8. A pulverizer comprising radially extending rotary impeller blades, with central intake and peripheral discharge, discs at either side of said blades secured together and spaced apart independently of them, and inclined impact members around the impeller periphery, with intervals between them, deflecting the discharge therefrom

outward through said intervals past themselves.

9. A pulverizer impeller comprising discs spaced apart and secured together independently of blades, and blades with separate renewable acting faces, removably mounted between said discs.

10. A pulverizer impeller comprising discs spaced apart and secured together independently of blades, and outward tapering blades wedge in the space between said discs.

11. A pulverizer impeller comprising spaced discs with cross connections across their interspace securing them together, and blades between said discs with lateral engagement means open substantially radially outward to take said connections; so that the blades may be detached and removed radially inward, but will be held securely when the impeller is in operation.

12. A pulverizer impeller comprising discs with outward tapering interspace and cross connections thereacross securing them together, and radially outward tapering blades between said discs with lateral engagement means open substantially radially outward to take said connections; so that the blades may be detached and removed radially inward, but will be wedged between the discs and held securely to said connections when the impeller is in operation.

13. A pulverizer impeller blade with lateral engagement means open substantially radially outward and a separate detachable wearing face.

14. An outward-tapering pulverizer impeller blade with lateral engagement means open substantially radially outward to take a securing member associated with an impeller disc.

15. A pulverizer impeller blade member with lateral engagement means open substantially radially outward to take a securing member associated with an impeller disc, and lateral dovetails for holding a renewable wearing face.

16. A pulverizer comprising a centrifugal impeller receiving material to be pulverized at either side, and discharging peripherally, a receiving chamber around the impeller, and a series of deflecting impact surfaces beyond the impeller periphery, in the path of the discharge therefrom outward into said receiving chamber.

17. A pulverizer comprising a centrifugal impeller receiving material at either side, and discharging such material peripherally in convergent streams, a casing for the impeller, with an annular throat beyond the propeller periphery and a receiving chamber therebeyond enlarged to either side, and a series of deflecting impact members in said throat, in the path of the discharge therefrom outward into said receiving chamber.

18. A pulverizer comprising an impeller disc with blades and annular shroudings secured thereto at either side, means for supplying material to be pulverized through the central openings of the lateral impeller shroudings, and inclined impact members beyond and around the impeller deflecting the discharge from the impeller periphery outward past themselves.

19. A pulverizer comprising an impeller disc with blades and annular shroudings at either side, a casing with intake for material to be pulverized at either side of said impeller, a delivery ring around each of said intakes mounted on each of said shroudings, and a packing between each delivery ring and said casing.

20. In a pulverizer, a casing, a rotor having blades spaced well away from the axis of rotation to provide an annular raw coal receiving space or chamber, means for delivering the coal to be pulverized into such space, and means for rotating the rotor at high speed, substantially as described, the casing having a receiving chamber for the pulverized coal beyond the rotor.

21. In a pulverizer, a casing, a rotor having blades spaced well away from the axis of rotation to provide an annular raw coal receiving space or chamber, means for delivering the coal to be pulverized into such space, and means for rotating the rotor at high speed, substantially as described, the casing having a receiving chamber for the pulverized coal beyond the rotor, together with intermediate spaced impact members.

22. The herein described process of pulverizing coal in a rotary mill having a rotor with spaced blades peripherally arranged, which consists in delivering the coal to be pulverized to the space within the blades, and rotating the rotor so rapidly that the lumps of coal are shaved away substantially without entrance of lumps into the spaces between the adjacent blades.

23. The herein described process of pulverizing coal in a rotary mill having a rotor with spaced blades peripherally arranged, which consists in delivering the coal to be pulverized to the space within the blades, and in rotating the rotor so rapidly that the lump coal cannot pass in lump form between adjacent blades.

24. In combination in a mill, a casing and a rotor provided with peripheral spaced blades, cooperating to provide a substantially central feed chamber and a peripheral receiving chamber, and means for operating the rotor at a speed so high that lumps of coal cannot pass thru the spaces between blades outwardly to the receiving chamber.

In testimony whereof, we have hereunto signed our names.

JOHN E. BELL.
W. J. A. LONDON,