

Oct. 17, 1944.

W. B. MARSHALL

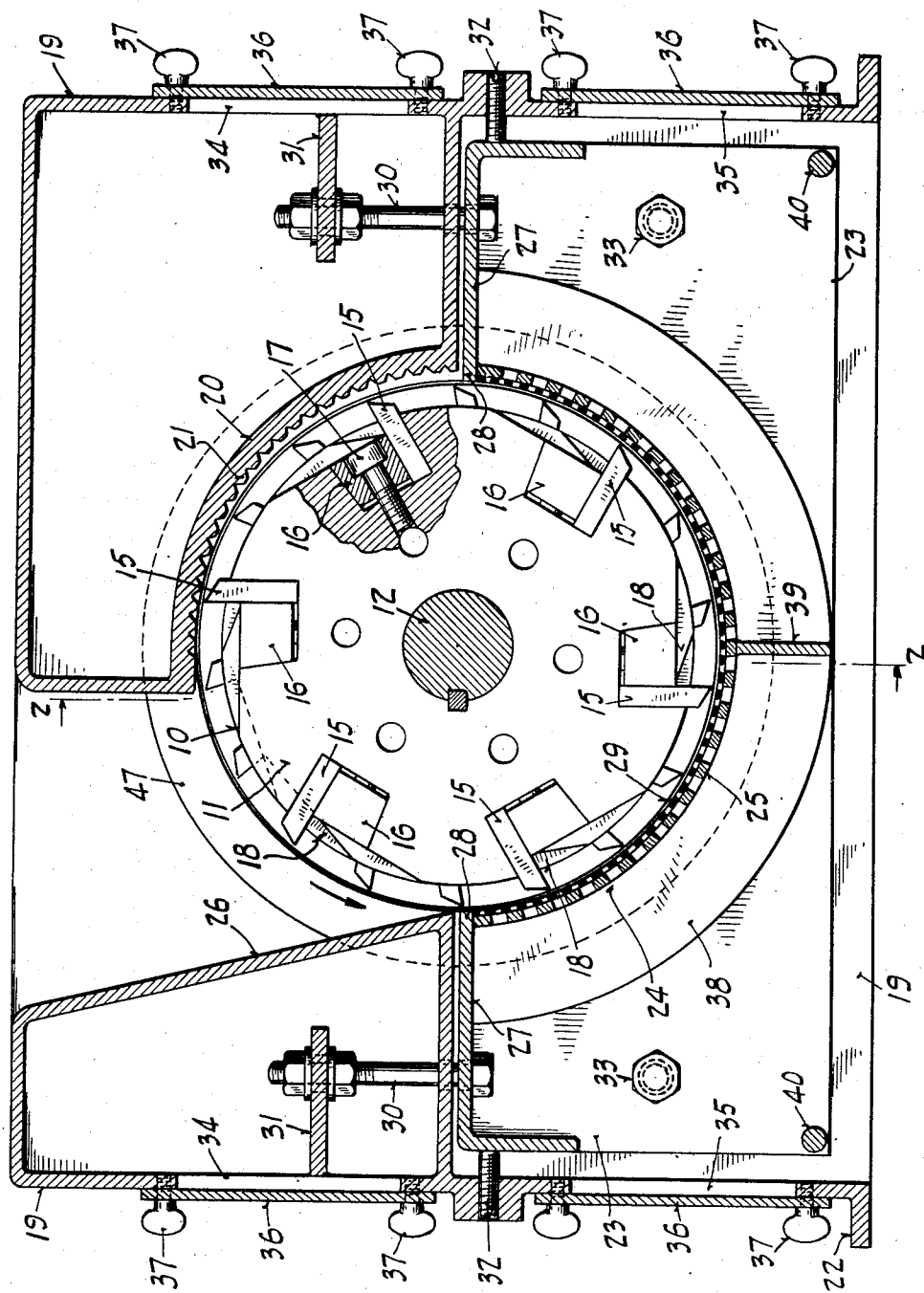
2,360,357

GRINDING MILL

Filed April 25, 1941

2 Sheets-Sheet 1

FIG. 1.



William B. Marshall
INVENTOR.

BY *George A. Evans*
ATTORNEY.

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W. B. MARSHALL

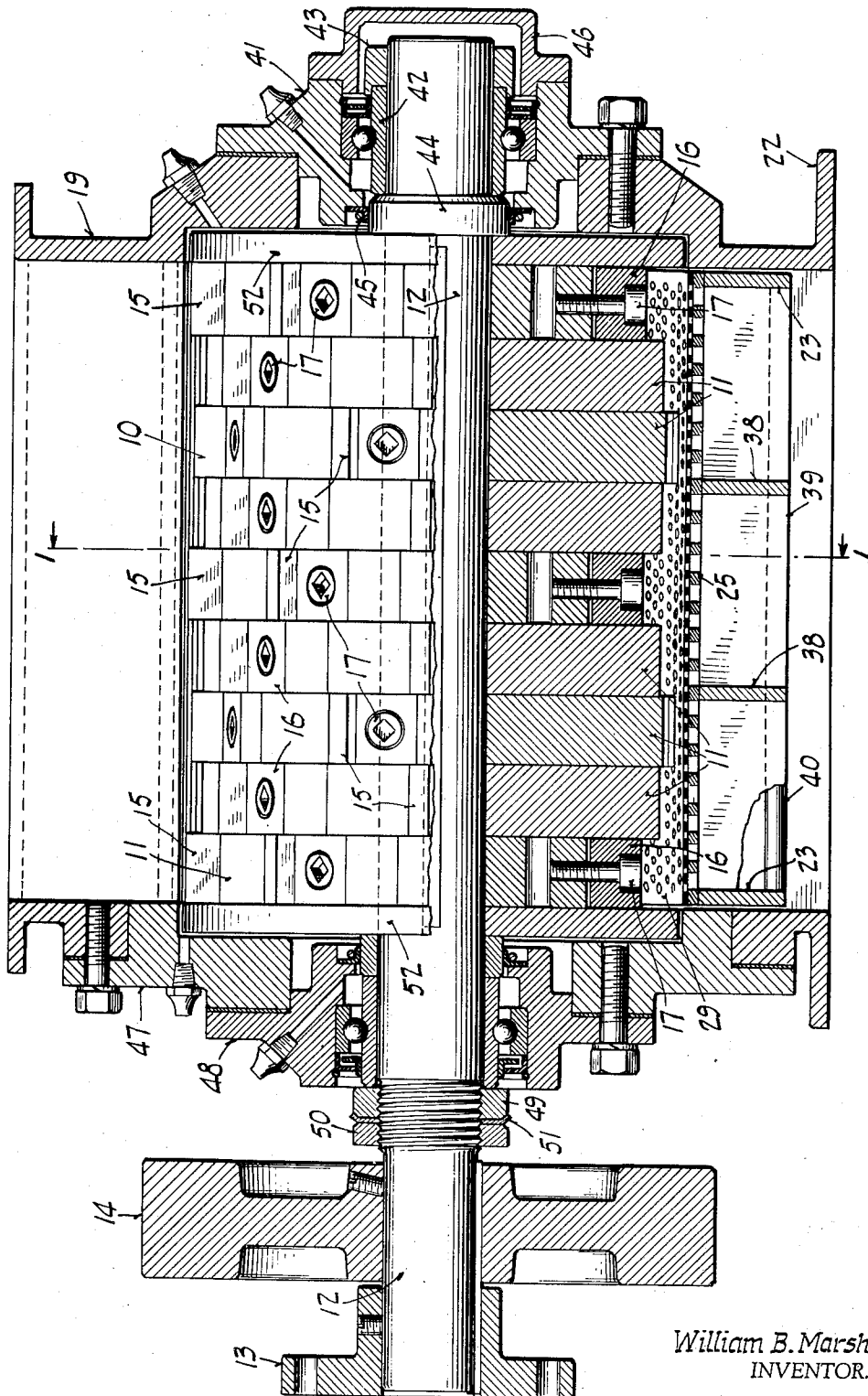
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2 Sheets-Sheet 2

FIG. 2.



William B. Marshall
INVENTOR.

BY

George A. Evans

ATTORNEY.

UNITED STATES PATENT OFFICE

2,360,357

GRINDING MILL

William B. Marshall, Milwaukee, Wis., assignor
to Chain Belt Company, Milwaukee, Wis., a
corporation of Wisconsin

Application April 25, 1941, Serial No. 390,253

3 Claims. (Cl. 83—6)

This invention relates to apparatus for grinding and is primarily intended for fine grinding as in various industrial processing operations.

The general object of the invention is to provide novel apparatus for rapid and continuous grinding whereby a uniformly ground product may be obtained with a minimum of dust or undersized particles, all at lowered cost in time and power expenditure, and with maintenance of quiet and balanced operation at all speeds.

According to one aspect of the invention, the grinding is accomplished by crowding particles against a smooth surface provided with perforations located at close and contiguous spots, said particles penetrating said perforations, and while so penetrating, being sheared by the action of the cutting members. In order to accomplish fine grinding, extremely close adjustment must be made between the cutting edges and the perforated surface, the provision for which constitutes a further object of this invention.

While I am aware that screens and other perforate means have been employed to restrain the passages of material through rotary mills until the material is reduced to the desired size, such screens have not been used, as far as I am aware, to cooperate with the cutting means to shear the material as herein disclosed.

The use of foraminous cages with hammer mills is not analogous in that the blades or beaters there employed pulverize the material by beating it against either breaker plates or perforated surfaces. This results in the formation of dust and lack of uniformity in the ground material which, in some of the uses here contemplated, makes the resulting product quite unsatisfactory.

The grinding action provided by this invention is further distinguished by the fact that the blades operate in very close contact with a smooth surface which is broken only by the perforated discharge passages. There are no grooves for shredding the material or raised, breaker teeth for crushing. Instead, the action includes a crowding effect caused by the rotor body which occupies nearly all the space within the casing, followed by the shaving of particles which are crowded into the perforations. The remarkable feature of the invention is that the size of grindings appear to have little, if any relation to the size of the perforations, said grindings being uniformly fine and very much smaller than the perforations.

With the above and other objects in view which will be more apparent as the description proceeds, the invention resides in the novel arrangements

of elements more fully described herein and particularly pointed out in the appended claims.

Referring to the drawings, wherein like parts will be designated by like characters throughout:

Figure 1 is a vertical sectional view through the grinder on the line 1—1 of Fig. 2; and

Figure 2 is a transverse sectional view through the grinder on the line 2—2 of Fig. 1, the upper portion of the rotor being shown in elevation.

The rotor 10 is made up of a number of cylindrical discs 11 splined to a shaft 12, driven by any suitable source of power. For convenience in assembly and disassembly, a coupling 13 may be secured to the end of shaft 12 for cooperation with a mating coupling secured to the power input shaft (not shown), a flywheel 14 being mounted on the rotor shaft in this instance for absorbing load fluctuations.

Each disc 11 has mounted therein at its periphery a plurality of angularly spaced and axially disposed cutter blades 15, which are the same width as the discs in which they are mounted. Blades 15 are held securely in the rotor discs 11 by means of wedge blocks 16, which in turn are retained by cap screws 17 threaded into the respective discs. Ahead of each blade is a flat portion 18 formed on the rotor disc, providing a pocket for accumulation of material, which is pushed ahead by the cutter blade following in its path. The blades 15 on respective discs are staggered so as to arrange the foremost blade in the center of the rotor, with blades in adjacent discs set back in general inverted V shape. There are preferably provided a plurality of such rows, forming blade surfaces in herringbone fashion, the disposition of which promotes the spreading of material axially of the rotor over all parts of the cutting surface.

Rotor 10 is contained in a housing 19 which is open at the top for receiving materials. The feed inlet thus provided extends for some distance above the highest point of the rotor in order that a column of material may be maintained for uniformity in feeding and the inlet extends axially a distance equal to the sum of the widths of the rotor discs 11. Preferably the feed inlet is disposed over only approximately one quadrant of the rotor, the other upper quadrant being enclosed by an arcuate plate 20 provided with serrations 21. Plate 20 serves the purpose of directing material revolving with the rotor (direction of rotation indicated by the arrow in Figure 1) back into the feed inlet, while the serrations afford a breaker surface for any material which might have revolved with the rotor through the

grinding zone without having been crowded into the perforations.

Housing 19 also extends somewhat below the rotor 10, the lower extremities being flanged outwardly as at 22 to provide a base. Disposed within the housing and on the underside of rotor 10 is a grate frame 23 with an approximately semi-cylindrical saddle 24 for supporting a grate member 25 which rests thereon. Grate 25 is concentric with rotor 10 and is slightly spaced therefrom. It forms an approximately continuous surface with the left wall 26 of the feed inlet and with the breaker plate 20 which are disposed above the rotor axis and form a part of the outer housing 19. It should be noted that the inner edges of the horizontal top plate 27 of the grate frame 23 extend over the saddle 24 a short distance to form a ledge 28 at each end of the saddle. Each ledge is equal to the width of the grate 25 and the shear plate 29 which is nested into the grate and securely attached thereto. Shear plate 29 and grate 25 need not be welded or riveted to frame 23 but when slid into the saddle and under the ledges 28 are held firmly in place.

Grate frame 23 is adjustably supported on housing 19 by vertically disposed bolts 30 which extend through plate 27 and are hung from ledges 31 formed on the inside of housing 19. Horizontal adjustment may be made by set screws 32 threaded through the sides of housing 19, advancing of screws on one side, of course, requiring the retracting of screws on the opposing side. To permit this horizontal adjustment, holes for bolts 30 are slightly enlarged. The grate saddle is secured in adjusted position by cap screws 33 which extend through enlarged holes in the end walls of the saddle frame and are threaded into housing 19. Accessibility to bolts 30 and screws 33 is provided by apertures 34 and 35 respectively in the side walls of housing 19, which apertures are normally covered by plates 36 retained by thumb screws 37 threaded into the sides of the housing.

Grate 25 is supported intermediate the ends of the adjustable grate frame 23 by vertical, arcuate shaped plates 38 connected to each other and to the end walls of the grate frame by central, vertical webs 39, thus completing the cradle 24. Still further stiffening of the frame 23 is afforded by struts 40 connecting the lower outer extremities of the end plates of the grate support.

From the foregoing description, it will be understood that the grate frame may be removed vertically from beneath the rotor and rotor housing by merely removing bolts 30 and screws 33 and releasing screws 32. When the frame is so removed, the shear plate and backing grate may be slid out horizontally from nesting engagement with the grate frame 23 and either replaced or turned end for end to promote more even wear across its entire exposed surface. When assembled beneath the rotor, the grate saddle may be adjusted either vertically with respect to the rotor by bolts 30, or it may be adjusted horizontally and transversely with regard to the rotor axis by set screws 32 and locked in position by cap screws 33.

For supporting the rotor in the housing, suitable bearings must be provided in the end sides of the housing, and the rotor should be capable of removal from the housing with a minimum of trouble. In Figure 2 there is disclosed a bearing housing 41 which is bolted to one face of the housing 19 and is provided with an anti-friction bearing having an inner race 42 which is retained

for rotation with shaft 12 by collar 43. Race 42 abuts against a shoulder 44 on shaft 12 and suitable sealing means 45 may be employed between shoulder 44 and housing 41. The end of shaft 12 is enclosed by a cap 46 which may be fastened over the end of bearing housing 41.

To the opposite end of the housing 19 a removable, flanged cover 47 is bolted, closing an aperture in the wall of the housing. The aperture is larger in diameter than that of the cutting rotor to permit its endwise assembly and removal. The housing has bolted to it, a bearing housing 48 in which is journaled shaft 12. Bearing housing 48 and its bearing assembly are identical to bearing housing 41 and its bearing assembly at the opposite end of the shaft. All members mounted on shaft 12 within the housing are clamped together by nut 49 and lock nut 50 threaded on shaft 12 outside the open end bearing housing 48, said nuts cooperating with shoulder 44 on the opposite end of the shaft to maintain assembled relation of said members. A lock washer 51 may be interposed between the nuts to further prevent their accidental unscrewing.

At each end of the assembly of rotor discs 11 is a sealing plate 52 preferably of slightly larger diameter than that of the discs, and also splined to shaft 12, which plates 52 are received in circular recesses formed respectively in the end wall of housing 19 and the cover 47. With this construction, when cap 46 and collar 43 are removed, it is only necessary to remove flanged cover 47 to withdraw the entire rotor from the housing. Of course, to remove the discs from shaft 12, the bearing assembly of the housing 48 must be removed prior to sliding the discs off the shaft.

The machine having been described in detail, the operation may now be summarized, as well as the method which is carried out thereby.

The rotor is designed to operate at high speeds, which may be of the order of 1750 R. P. M. and when so rotated it drags material with it from the feed inlet to the enclosed lower portion where the perforated shear plate 29 is disposed. It is difficult to give exact dimensions of shear plate openings because they vary for optimum results with different materials.

In grinding soft, whole kernel corn, oval perforations $\frac{1}{8}$ " axially of the rotor by $\frac{1}{4}$ " circumferentially appeared to give desirable results. In this instance the shear plate was about $\frac{1}{8}$ " thick and the perforations were spaced as closely together as the strength of the material would safely permit. The perforations in the supporting grate 25 were many times larger in order to afford as little restriction as possible to the passage of material through shear plate 29, consistent with strengthening requirements. With the shear plate closely adjusted for small clearance with the rotating blades, and with the apertures mentioned, it was possible to shear the skins of the kernels, so they would ultimately pass through the perforations along with the rest of the material, a result which could not be satisfactorily obtained with other machines heretofore employed.

In grinding dry fish scrap, it was found that round apertures in the shear plate of approximately $\frac{1}{8}$ " diameter, and with centers staggered and spaced approximately $\frac{3}{2}$ " apart, gave good results, the material, which included bones, being ground to a uniform fine powder without appreciable dust.

These results are given by means of illustration and are not intended as limitations of the

scope of the invention. They indicate the necessity of experimentation with different materials and adjustment necessary to give optimum results.

For continuous operation a column of material should be maintained in the feed inlet above the rotor. With each passage of the rotor a layer will be swept off the bottom of this column and due to the space occupancy of the rotor, will be spread out and crowded against the cutting surface. This surface is entirely smooth except for the perforations before described, yet this is apparently sufficient to retard the movement of materials and enable the blades to perform their shearing or shaving function. Should material revolve with the rotor past the shear plate, it is directed back into the feed by plate 20, which plate is preferably serrated to break up any larger pieces in the material being ground.

The provision of the pocket 18 ahead of the cutter is considered a factor in securing improved results, as is the herringbone disposition of the cutting members, the latter facilitating the spreading of material axially of the rotor and into the cutting perforations.

Since different processes and/or materials may require difference in the fineness of the grinding, it is highly desirable that the shear plate be replaceable so that the same machine may be utilized for different operations. The present invention is believed to afford an efficient and convenient manner of accomplishing this.

What I claim is:

1. In a rotary grinder having an internal casing which is generally cylindrical in shape with an opening in its upper portion for receiving material and a lower surface of smooth curved contour having apertures therein for discharge of ground material, a rotor comprising a plurality of disc members mounted side by side and arranged to rotate within said casing, and cutting members disposed in the peripheries of each of the discs, each cutting member having an axial cutting edge extending for substantially the full width of the disc in which it is retained, cutting members on adjacent discs being circumferen-

tially spaced in herringbone fashion, whereby material may be spread laterally across the lower surface of the casing and sheared by the cutting members before passing through said apertures.

2. A rotary grinder comprising a casing with an opening in its upper portion for receiving material and a grinding cage enclosing its lower portion, said grinding cage consisting of a smooth curved surface having apertures therein for discharge of ground material, a rotor mounted in said casing occupying substantially the entire volume thereof and adapted upon rotation to crowd material against said surface, said rotor comprising a plurality of disc members mounted side by side, each disc member having a cutting edge in its periphery extending for substantially the full width of the disc, the cutting edges in adjacent discs being circumferentially spaced, each cutting edge making shearing contact with the edges of the apertures in said surface and the portions of the discs ahead of the cutting edges being depressed below the peripheral surface of an adjacent disc whereby material which is not discharged through perforations in the path of one of said cutting edges may be laterally moved into the depressed portion ahead of an adjacent cutting edge.

3. In a rotary grinder comprising a casing which is generally cylindrical in shape with an opening in its upper portion for receiving material and a lower surface of smooth curved contour having apertures therein for discharge of ground material, a rotor mounted in said casing of substantially cylindrical contour having cutting edges disposed on its periphery, each cutting edge extending generally longitudinally of the rotor and in close cutting proximity for the full length of the edge to the curved lower surface of the casing when rotated in juxtaposed position thereto, each said edge extending for only a portion of the length of said rotor, and longitudinally adjacent edges being spaced circumferentially in staggered relationship and rotating in substantially contiguous paths.

WILLIAM B. MARSHALL.