G. A. OVERSTROM.

CENTRIFUGAL ORE CRUSHER.

APPLICATION FILED NOV. 26, 1918.

1,405,151.

Patented Jan. 31, 1922.

3 SHEETS—SHEET 1.

Fig. 1.

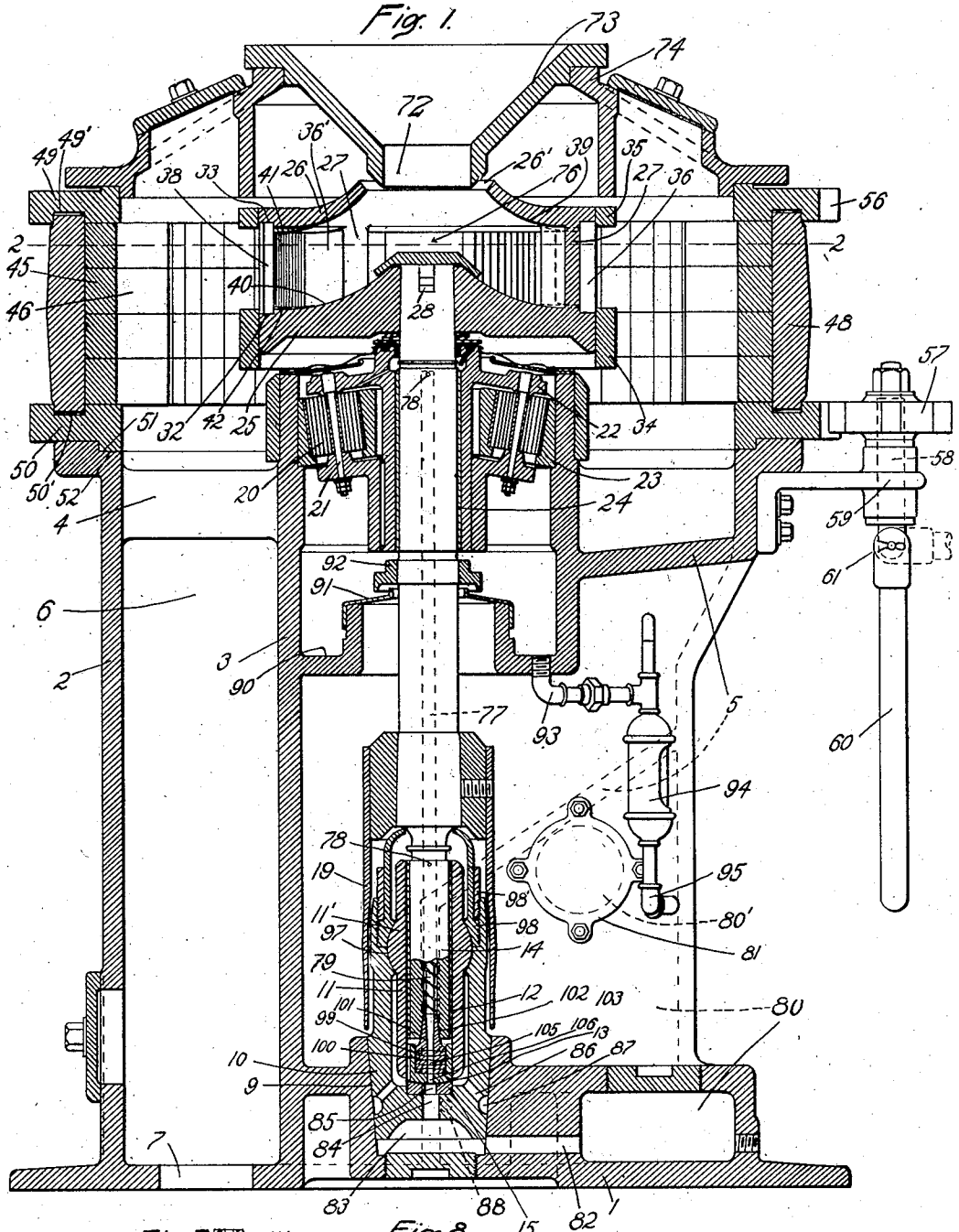


Fig. 7.

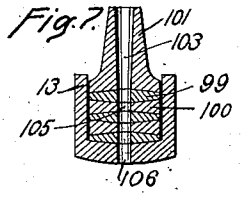
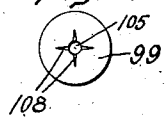


Fig. 8.



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3 SHEETS—SHEET 2.

Fig. 2.

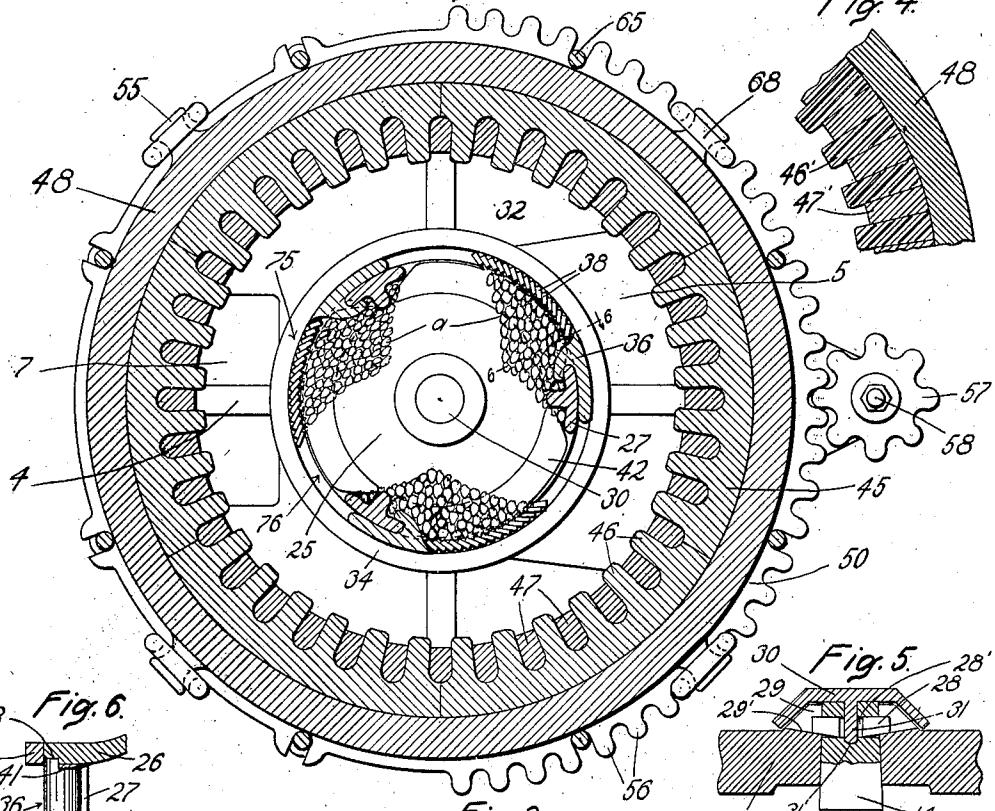


Fig. 4.

Fig. 5.

Fig. 6.

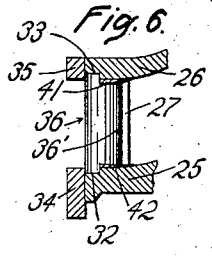
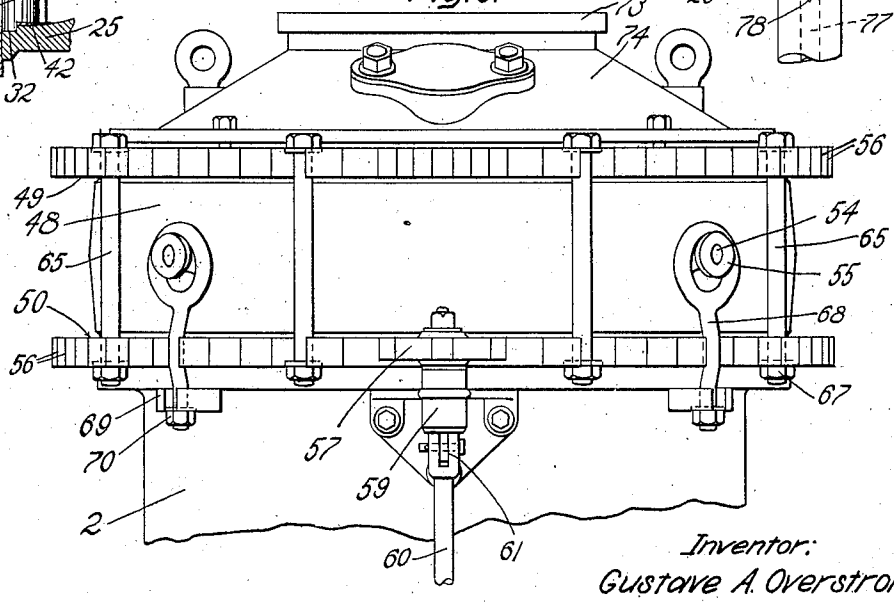


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 9

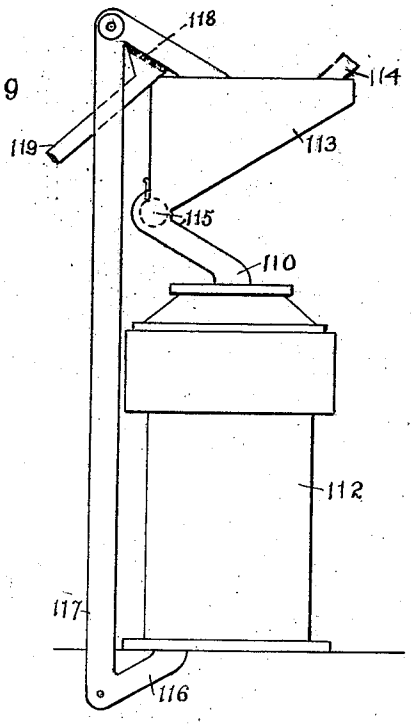
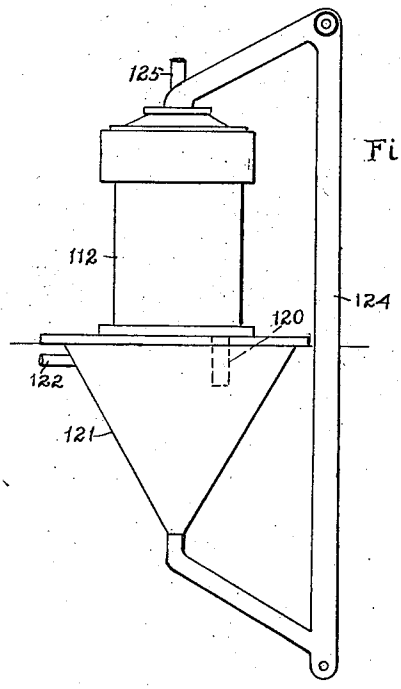


Fig. 10.



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UNITED STATES PATENT OFFICE.

GUSTAVE A. OVERSTROM, OF PASADENA, CALIFORNIA.

CENTRIFUGAL ORE CRUSHER.

1,405,151. Specification of Letters Patent. Patented Jan. 31, 1922.

Application filed November 26, 1918. Serial No. 264,243.

To all whom it may concern:

Be it known that I, GUSTAVE A. OVERSTROM, a citizen of the United States of America, residing at Pasadena, in the county of Los Angeles and State of California, have invented a new and useful Centrifugal Ore Crusher, of which the following is a specification.

This invention relates to apparatus for crushing ore, rock, etc., by causing the material to be crushed to be thrown from an impeller, rotating at high speed, and to strike against a surface at such high velocity as to crush the ore by the force of the impact. It relates more particularly to the type of such apparatus wherein the ore is thrown from the impeller by lateral discharge rather than by top discharge, and the main object of the present invention is to provide for an improved construction of the impeller so that a bed of the ore is retained within the same to take the wear due to the abrasion of the ore or rock passing through the impeller.

Another object of the invention is to provide for convenient and economic removal and renewal of such parts of the impeller as are subject to unavoidable wear.

Another object of the invention is to prevent serious damage to the apparatus due to the sudden breaking off of any large part of the impeller under the action of excessive wear at one point.

A further object of the invention is to provide for an improved construction of the die or impact-receiving means, whereby its resistance against the abrasion due to the impact of the ore is increased, and at the same time it may be conveniently and economically renewed at the points of greatest wear.

Other objects and advantages of my invention will appear hereinafter.

The accompanying drawings illustrate an embodiment of my invention, and referring thereto:

Fig. 1 is a vertical section of the apparatus, the impeller being shown as empty.

Fig. 2 is a horizontal section on line 2—2 in Fig. 1, the impeller being shown as containing beds of ore as in operation.

Fig. 3 is a side elevation of the upper portion of the apparatus.

Fig. 4 is a cross-section of a modified form of the die means for receiving the impact of the ore.

Fig. 5 is a cross-section of the means for securing the impeller to its spindle.

Fig. 6 is a detail view of a portion of the impeller taken on line 6—6 in Fig. 2, the ore being removed.

Fig. 7 is a detail view of the lower bearing.

Fig. 8 is a plan view of one of the members thereof.

Figs. 9 and 10 are elevations showing the feed and outlet connections for the material being crushed.

The general construction of the apparatus, with the exception of the impelling member, may be substantially the same as set forth in my application filed August 21, 1916, Ser. No. 115,947, for "Centrifugal ore crusher", comprising a frame, a vertically extending spindle mounted in said frame, an impeller carried by said spindle, means carried by said frame for receiving the impact of the material discharged from the impeller, and means for feeding material to the impeller. The frame may comprise a base 1, and a casing 2 thereon. An interior frame member 3 is mounted within the casing 2, for example, by means of arms 4 and web 5, members 2 and 3 being substantially cylindrical in shape and coaxially mounted, so as to form an annular space 6 between the inner member 3 and the outer member 2, and web 5 is inclined downward toward the center of the frame so as to form an inclined chute at the bottom of said space 6, whereby the crushed material is conducted by gravity to a discharge opening 7 in the base 1.

Base 1 is provided with a taper seat 9 for a bearing support 10, which is tapered to fit said seat. Said support 10 supports a bearing sleeve 11, which is formed with a bearing surface 12 for engaging the spindle 14 for the impeller, said bearing member 10 being provided with a ball and socket bearing for sleeve 11. A lower bearing plate 15 engages a member 13 on the lower end of said sleeve, the engaging faces of said plate and sleeve being rounded concentrically with the center of the ball and socket bearing, so that the spindle may gyrate on this center. A driving pulley 19 is mounted on the spindle 14 around the bearing portion thereof, so that the lateral stress of the belt running on said pulley is substantially balanced with respect to the center of support of the spindle, and the spindle is therefore

free to rock on said support. Such rocking or gyrating motion of the spindle on its support is resisted and controlled by resilient supporting means consisting, for example, of spiral springs 20 arranged in an annular series around the spindle and having their inner portions connected by bolts 21 to a spider 22 provided with a bearing 24 for the spindle, and said springs having their outer portions connected to a ring 23 secured to the stationary member 3. The construction of this yielding support for the spindle may be substantially as shown in my application filed May 9, 1916, Serial No. 96,275, for "Flexible bearing for high speed spindles".

An impeller is mounted on the upper end of spindle 14, said impeller preferably comprising a lower member or base 25 and an upper member or cover 26, said upper and lower members being connected by vertical bars or members 27, and all of the members 25, 26 and 27 being preferably cast in one piece. The lower member 25 is formed as a disk, having its upper face curved upward toward the center, and is secured to the upper end of spindle 14 by a taper fit and held in position by wedge keys 28 in a recess 28′ in said spindle, said keys 28 extending out into keyways 29 in the member 25, said keyways having inclines 29′ for engaging said keys so that centrifugal action in the keys will hold the parts fast. A circular cap 30 covers the top of spindle 14 and the adjacent portions of the member 25, a lug 31 on the bottom of said cap resting in a recess 31′ in the top of the spindle. The upper member 26 of the impeller is formed as a disk curved upward toward the center and having a circular opening 26′ at its center adapted to receive the material to be crushed from the feeding means hereinafter described. Annular rabbets are provided at the rims of members 25 and 26, and rings 34 and 35 are shrunk onto said members so as to form grooves 32 and 33 outside of the bars 27.

The impeller is provided with wall portions 75 equally spaced and near the outer rim thereof so as to leave ore discharge openings 76 between said wall portions for the discharge of the ore from the impeller, said wall portions comprising the supporting bars 27 aforesaid, supporting plates 36, and vertically extending strips 38, each of said plates 36 acting as a support for the corresponding series of strips 38. The supporting bars 27 are preferably T-shaped as best shown in Fig. 2, the supporting plates 36 being provided with lips 36′ engaging said bars 27 to prevent circumferential movement of said plates 36. The supporting plates 36 and the strips 38 are fitted between the grooves 32 and 33 so as to prevent radial motion thereof. The wall portions 75 thus formed cause the ore within the impeller to pile up behind them under the action of centrifugal force due to the rapid rotation of the impeller and to form bodies of ore as indicated at *a*, thereby providing wearing surfaces composed almost entirely of the ore or rock itself and reducing to a minimum the wear upon the parts of the impeller. The only parts of the impeller to receive the abrasive action of the ore in passing through it are the top and bottom faces 39 and 40 and the end strip of each series of strips 38. Segmental wearing plates 41 and 42 of extra hard material are provided for the portions of the top and bottom surfaces 39 and 40, which receive the greatest wear and are held in position by being wedged between the lips 36′ of members 36 and said surfaces. By forming the sides of the impeller by means of the plurality of strips 38, as above described, it is possible to easily renew them as they wear out. In continued operation of this apparatus the abrasive action of the ore on the sides of the impeller is not uniform at all levels and deep cuts tend to form where the wear is greatest. Such a cut having been once formed all the wear tends to follow in that same line and a solid plate would soon be cut clear through and break off. This would not only cause a great waste of the material of which the plate was made but the breaking off of such a large piece of metal would be liable to cause serious damage to the machine. By providing a series of strips of comparatively small size each strip breaks off as it is worn through and presents an entirely new wearing surface to the abrasive action of the ore, causing the wear to be more evenly distributed over that surface, and thereby effecting a great saving in the material of which the sides of the impeller are made and preventing damage to the apparatus.

A die or impact receiving member is provided on top of the frame member 2 opposite the impeller and extending some distance below the lower member 25 of the same, said die member preferably comprising a plurality of annular members arranged one above another, each annular member being preferably built up of a plurality of sections or segments 45 of chilled steel, white iron or other suitable material. Each of these segments is preferably formed with teeth or projections 46 extending inwardly toward the center of the machine, the spaces between said teeth 46 being partially filled by strips 47 which may be of softer material, thereby giving added strength to the teeth without destroying the desired crushing effect of the same. In order that the material striking the die may be effectively arrested by the die and broken by the impact, it is desirable to provide the die with teeth or projections, and the described construction provides for this, and

at the same time supports each tooth of hard material by the soft material lying back of same, and in the operation of the machine, the abrasion of the material on the surface of the die wears away the softer material more readily than the harder material so that the parts of harder material are always left projecting beyond the parts of softer material to form teeth. The same effect may be obtained by forming the hard and soft teeth as alternately placed segments, 46′ and 47′ as shown in Fig. 4.

All of the said series of segments 45 are maintained within a frame or retaining ring 48, and for convenience in construction and operation this ring is preferably provided with upper and lower flange rings 49 and 50, secured to ring 48 as hereinafter described, each of which flange rings is provided with means for engaging the top of the frame member 2 so that the ring may be reversed as a whole if desired. For this purpose each of the flange rings 49 and 50 may be provided with an annular rib 51 adapted to engage in an annular rabbet 52 on the top of frame 2, the construction being such that the entire member, consisting of ring 48 and flange rings 49 and 50, together with the segments 45 carried thereby, can be turned around the axis of the machine to shift the point of greatest wear on the segments 45, as may be found necessary. This rotative movement of the parts aforesaid may be effected by a capstan bar inserted in holes 54 in studs 55 on ring 48, or, in the case of a large machine, by the aid of gearing, the flange rings 49 and 50 being provided in that case with gear teeth 56 and a pinion 57 being mounted on a shaft 58 journaled in a bearing 59 on the frame member 2 and provided with an operating handle 60, said pinion being adapted to engage the gear teeth on the lower flange ring aforesaid to rotate the said parts. Said handle 60 is preferably mounted on its shaft 58 by a hinge connection 61 to enable it to be swung to one side or the other, or to hang vertically as shown in Fig. 1.

The flange rings 49 and 50 may be formed with annular grooves 49′ and 50′ to fit the upper and lower edges of ring 48, these members 49, 48 and 50 being clamped together to form a rigid body, by means of bolts 65 secured by nuts 67. Said rigid body, consisting of members 37, 36 and 38 may be held securely in position on the frame member 2 by eye bolts 68 having eyes engaging studs 55 aforesaid, said bolts extending between lugs 69 on frame member 2 and being secured by nuts 70 on said bolts and engaging said lugs.

Suitable feed means may be provided for the machine, comprising, for example, a hopper or funnel 73 carried by a top member 74 resting on top of the upper annular flange 49, the discharge opening 72 of said funnel extending centrally within the central opening 26′ in the upper member 26 of the impeller, so as to conduct the material to be crushed, into the impeller below the discharge lip of said funnel.

Any suitable means may be provided for oiling the spindle and its bearings. For example: As shown in Fig. 1, the spindle 14 may be provided with an axial bore 77, extending from its lower end to near the upper end of the spindle and provided with openings 78, through which oil may be discharged to the outside of the shaft within the upper and lower bearings therefor, and a screw 79 is provided within this bore for forcing oil upwardly by the rotation of the spindle. An oil well or reservoir 80 is formed in the frame or casing member 2, suitable means, such as openings 80′ closed by caps 81, being provided within the wall of said casing for supplying such reservoir with oil. A duct 82 leads from a portion of such reservoir to a chamber 83 in the base 1 directly underneath the bearing support 10 aforesaid, said bearing support being provided with a passage 84 communicating with a passage 85 which extends through the bottom bearing plate 15 aforesaid, so as to communicate with an opening in the bottom of the spindle. A duct 86 in the side of the bearing support 10 for the lower bearing opens into an annular passage 87 communicating through a passage 88 with the oil well or reservoir aforesaid. The inner casing 3 is provided with an annular trough 90 and with an inclined annular apron 91 extending inwardly from the upper edge of said trough, and spindle 14 is provided with an oil shedding collar 92 above said apron so that any oil running down from the upper bearing into said trough will pass through a pipe 93, a sight-feed device 94 and a pipe 95 to the oil well or reservoir aforesaid.

The lower bearing for spindle 14 is preferably constructed as shown in Fig. 1, the bearing sleeve 11 having a rounded portion 11′ formed as a zone of a sphere and fitting within a concave spherical bearing 97 formed in the supporting member 10, and on a screw sleeve 98 screwed on said supporting member and extending upwardly therefrom. Sleeve 98 serves to hold the bearing sleeve in place, and is itself locked in position by a locking screw ring 98′. The lower bearing further comprises a bottom member 13 formed as a cup, resting on the lower bearing plate 15 aforesaid and enclosing a series of superposed disks 99 and 100, said disks being alternately convexly and concavely faced, so as to centralize themselves under the pressure of the spindle. A foot or step member 101, formed as a hollow taper plug, fits in a corresponding socket 102 in the lower end of spindle 14,

and engages by a concave face at its lower end, with the top of the uppermost disk 99, said member 101 having a vertical passage 103 communicating at its upper end with the bore 77 in the spindle, and at its lower end, through passages 105 in the disks 99 and 100, and through passage 106 in the bottom member 13 with the opening 85 aforesaid, in the bottom plate 15. Disks 99 are preferably provided with radial notches 108 for facilitating flow of oil from the passages 105 to the bearing faces of said disks.

In the operation of the machine, the spindle 14 is rotated rapidly by power applied to pulley 19, and ore is fed to the impeller through hopper 73, the mouthpiece of which delivers the ore or rock into the impeller. The material such as ore or rock accumulates against the wall portions 75 of the impeller to form beds of ore of the shape indicated at *a*, see Fig. 1, the remainder of the material being discharged from the impeller through the ore discharge openings 75 between said wall portions. The material thus discharged from the impeller moves tangentially with substantially the full peripheral velocity of the impeller, and strikes the die means 45, so as to be crushed or broken by impact. The crushed pieces descend by gravity through the space 6 between the inner and outer casings 2 and 3 and are deflected by the inclined web 5 so as to pass through the opening 7 to any suitable receiving means. It will be understood that the bed or body of material in the impeller is in general being continually worn or carried away and continually built up or renewed in the operation of the machine, but its general shape and effect will be maintained at all times. The greatest part of the wear of the material passing through the impeller will therefore be received by these protective bodies of ore, the end strip of each series of strips 38 being the only part of the walls of the impeller to receive an appreciable amount of wear. As heretofore explained, the wear upon the exposed surface of this strip is not evenly distributed and after a certain time of operation deep cuts tend to form at the point or points of greatest wear, and when such cuts have been once started the wear at these points becomes even greater. If the wall portions of the impeller were made of solid pieces of metal the wear would soon be practically all concentrated at the deepest cut and the wall portion would be worn through rapidly at this point and break off, thus causing a great waste of metal. By providing a series of thin strips, however, an entirely new surface is presented to the abrasion of the ore each time one of the strips is worn through, thus causing the wear to be more evenly distributed and effecting a material saving in the amount of metal used for this purpose. The strips thus worn away may be easily replaced by new ones when the wall has receded so far that it no longer serves to hold a large enough bed of ore to protect bar 27 and supporting plate 36, this renewal being accomplished by stopping the machine and inserting new strips between the grooves 32 and 33 until the wall is again built up to the desired size.

When the segmental wearing plates 41 and 42 become worn so that it is desired to replace them, it is only necessary to remove strips 38, when said wearing plates may be easily removed and replaced by new ones. The rings 34 and 35, being shrunk on, may also be easily renewed when worn out.

In general, the material fed to the machine, for example, from an overlying feeder, will tend to fall into a more or less definite part of the impeller, and will consequently be discharged therefrom so as to strike a more or less definite part of the die. This results in excessive wear at such part of the die, and in order to obviate this without the necessity of stopping the machine for replacement or shifting of the die parts, the die may be rotated from time to time, by means of a capstan bar placed in one of the holes 54 in the studs 55 on the retaining ring 48 for the die means, or by operation of gear means 56 by pinion 57 operated by handle 60, said handle being swung about hinge connection 61 to a horizontal position so as to form a crank for said pinion. Such rotation of the die members as a whole brings a different portion of the die means into position to receive the greatest wearing action. Eventually the die means will be worn unevenly at different levels, and this condition may be corrected by removing the upper clamping member 49 and rearranging the die sections 45, so that sections which have received the greatest wear will be replaced by sections which have received the least wear, and vice versa. The die members may also be reversed or inverted as a whole, when desired on account of unequal wear on the upper and lower parts thereof or of any of the die sections, both clamp members 49 and 50 being provided with gear teeth 56 so as to be interchangeable.

It will be understood that the resilient bearing support for the upper bearing of the spindle permits the spindle to rotate at the required high speed, and to gyrate as may be required for proper spinning action under varying conditions of load.

Owing to the high velocity of the impeller and the construction thereof with blades in the manner described, there is a considerable air pressure developed at the periphery thereof, and in case this is found to be objectionable in blowing material through or from the machine too rapidly, it may be desirable to seal the machine at the inlet,

or outlet, or both. Fig. 9 shows one way of doing this, the inlet 110 of the crusher 112, being sealed by connection to a closed bin 113, with an ore or rock supply means 114 and with means 115 for feeding material from the bin to the crusher 112; and the outlet 116 of the crusher being connected to an elevator 117 which lifts the crushed material to a screen 118, the oversize passing back from the screen to the bin 113, and the properly sized material passing out at 119. Or, as shown in Fig. 10, the seal may be provided at the outlet of the crusher 112 by means of an outlet pipe 120 dipping in a body of liquid in a classifying cone tank 121, from which fines run off through pipe 122 and oversize is lifted by the elevator 124 to the supply pipe or launder 125 for the crusher, this form of the invention being especially adapted for wet crushing.

What I claim is:

1. In a centrifugal crusher an impeller provided with a disk shaped bottom and with wall portions extending upwardly from the periphery of said bottom and with lateral openings between such wall portions, said wall portions extending circumferentially of the impeller and forming pockets and being thereby adapted to retain a body of material in the impeller in contact therewith.

2. An impeller for centrifugal crushers, comprising lateral wall portions each formed with a vertically extending support and with an edge member removably mounted thereon.

3. An impeller for centrifugal crushers, provided with a lateral wall portion formed with a vertically extending support, lower and upper, horizontally extending supports below and above the first named support, and a plurality of edge members mounted in said lower and upper supports in advance of the vertically extending members, to take the wear due to passage of material over the forward edge of the wall portion.

In testimony whereof I have hereunto subscribed my name this 16th day of November 1918.

GUSTAVE A. OVERSTROM.