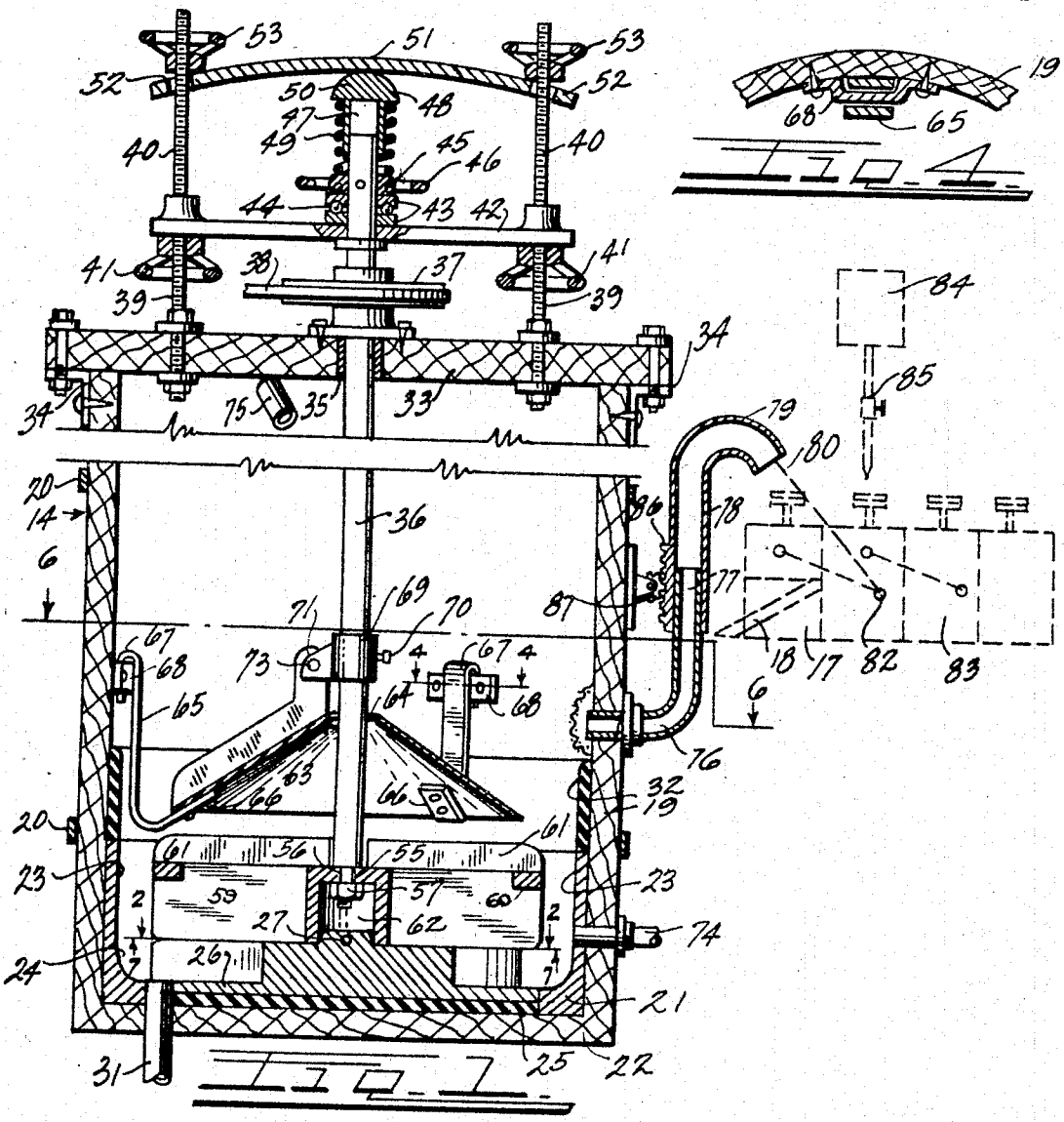
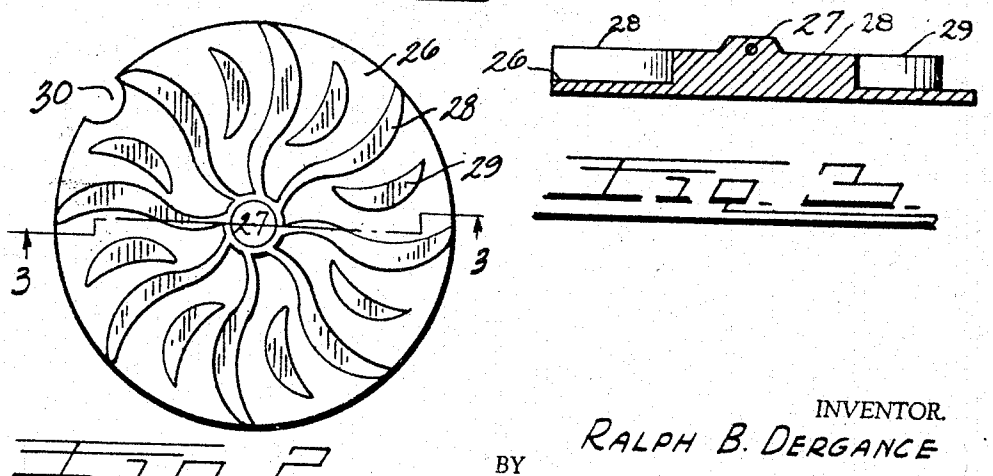
April 29, 1941. R. B. DERGANCE 2,239,952

ORE GRINDER

Filed Sept. 23, 1940 2 Sheets-Sheet 1





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ORE GRINDER

Filed Sept. 23, 1940 2 Sheets-Sheet 2

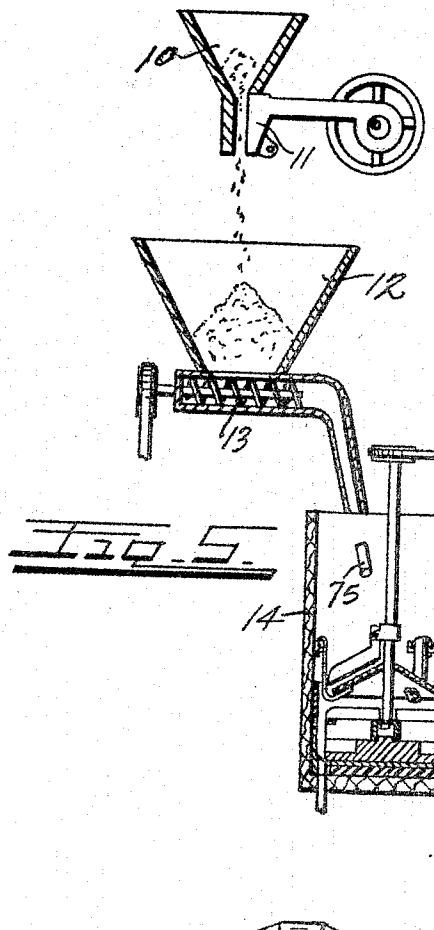


Fig. 5.

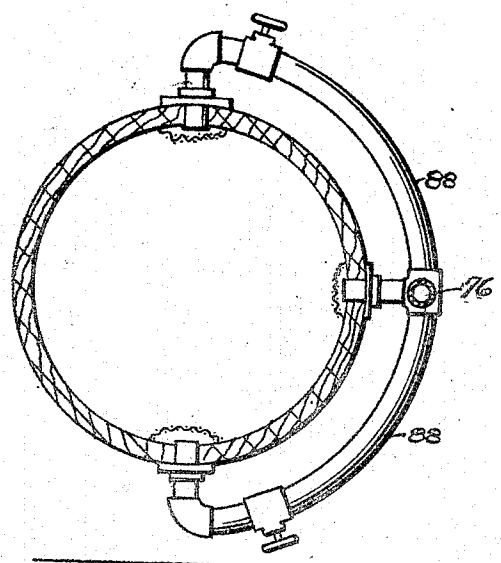


Fig. 6.

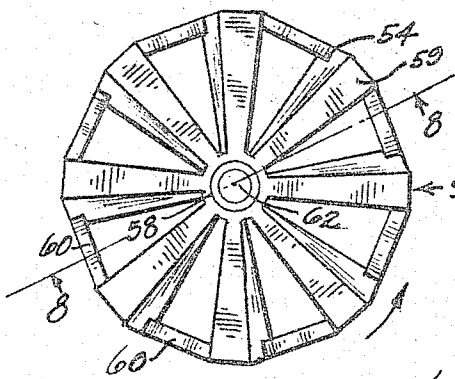


Fig. 7.

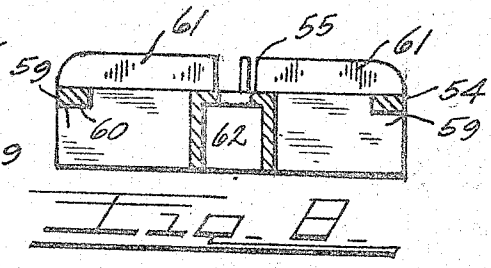


Fig. 8.

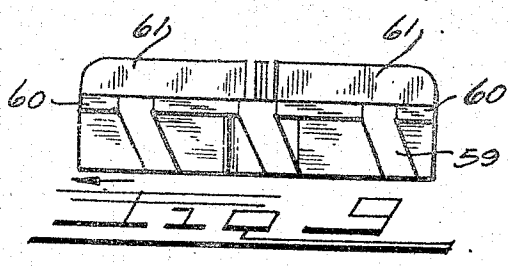


Fig. 9.

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ORE GRINDER

Ralph B. Dergance, Denver, Colo.

Application September 23, 1940, Serial No. 357,910

7 Claims. (Cl. 83—93)

This invention relates to improvements in mining machines and has reference more particularly to an improved ore grinder and classifier.

In the mining of gold and its recovery from ore in which it is found in metallic form, it is necessary to crush the ore and then grind it to such fineness that the gold is unlocked after which the ground ore is subjected to a concentrating operation for the purpose of separating the gold from the gangue.

In the usual mill operations, the ore is first crushed to a suitable fineness, usually to one quarter mesh and the crushed ore is then sent to a ball or rod mill where it is reduced to the required fineness. The pulp from the ball mill is subjected to a proper conditioning after which it is mixed with a small quantity of frother and subjected to treatment in a series of flotation cells. Ball and rod mills are large and require much power to operate and are therefore suitable for large installations only.

There are many small mines so located that it is difficult and highly expensive to transport the ore as such to a customs mill and these mines are too small to warrant the installation of the usual type of mill and as a result such mines must be abandoned.

It is the object of this invention to produce a mill for the treatment of ore which shall be of such small size and weight that it can be transported to any mine and which can be operated by means of power from any available source. Instead of the usual ball or rod mills in common use, a specially constructed and designed mill is employed which is of light weight, requires a comparatively small amount of power to operate and which can be disassembled for transportation and readily reassembled at the mine.

Since the machine can be operated by an internal combustion engine of the type employed with automobiles and trucks, it is apparent that the transportation of the gasoline involves no serious difficulty.

Another object of this invention is to produce a grinder having incorporated in its construction means for classifying the ore in a simple and efficient manner so as to obviate the necessity of employing a separate classifier or screening mechanism.

Another object is to produce a grinder in which the ore particles will be subjected to impact and shearing and in addition to attrition between relatively movable grinding surfaces.

The above and other objects that may become apparent as this description proceeds are attained by means of a construction and an arrangement of parts that will now be described in detail and for this purpose reference will be had to the accompanying drawings in which the preferred embodiment of the invention has been illustrated, and in which:

Figure 1 is a vertical diametrical section through the improved grinding and classifying device;

Figure 2 is a top plan view of the bottom grinding disk looking in the direction of arrows 2—2, Figure 1;

Figure 3 is a section taken on line 3—3, Figure 2;

Figure 4 is a section taken on line 4—4, Figure 1;

Figure 5 is a diagrammatic view showing the different steps of the method to which ore is subjected in connection with the improved grinder;

Figure 6 is a section taken on line 6—6, Figure 1, and shows a slightly modified form of construction;

Figure 7 is a bottom plan view of the upper grinding disk looking in the direction of arrows 7—7, Figure 1;

Figure 8 is a section taken on line 8—8, Figure 7; and

Figure 9 is a side elevation looking in the direction of arrow 9, Figure 7.

In order to facilitate the description, reference will now be had to Figure 5, which is a diagrammatic representation or flow sheet showing the several steps in the method of treating ore. The ore is first deposited in the hopper 10 of a crusher having a movable jaw 11 and this, in turn, may be further reduced by other crushers until the ore has been reduced to quarter mesh particles. The crushed ore is then fed into a hopper 12, from which it is fed by means of a screw conveyor 13 to the interior of the grinder, which has been indicated in its entirety by reference numeral 14. From the grinder the ore passes through conduits 15 to a group of flotation cells which have been designated in a general way by reference numeral 16. The concentrate is deposited by the cleaner cells 17 into a launder 18 that transports it to a vessel or bin where the pulp is dewatered.

Since the invention resides, primarily, in the construction of the grinder, reference will now be had to Figure 1 where a vertical diametrical section of the grinder has been shown. In Figure 1, reference numeral 19 designates the side wall of the vessel which may be in the form of a

cylindrical tank constructed from wood staves and held in assembled relation by means of bands 20. The construction of the vessel is immaterial, however, and instead of being made of wood, it may be made from metal. In the form illustrated, a cast iron ring 21 is positioned in the vessel and rests on the bottom 22. This ring has an upwardly extending side 23 and the inner wall is curved as designated by reference numeral 24. Within the opening in the ring, a rubber sheet 25 is positioned and resting on this sheet is a grinding disk 26. The upper surface of this disk is provided with a conical projection 27 and a plurality of curved ribs 28 that radiate from the central projection. In between adjacent curved ribs are the short ribs 29 having a somewhat crescent shape. This disk is provided with a notch 30, which engages the discharge pipe 31 for the purpose of holding it against rotation. It will be observed that the upper surface of the grinding disk 26 is at a level with the lower curved surface of ring 21 so that material discharged from this disk will be turned upwardly in a smooth and uniform manner. Above the upwardly extending side 23 a rubber ring 32 is positioned and secured to the inner surface of the vessel by suitable means. The rubber ring forms a wear resisting surface which is an extension of the part designated by reference numeral 23. Secured to the top of the vessel is a transverse bar 33 whose ends are attached to the vessel by brackets 34. A bearing 35 is secured to the bar 33 and mounted for rotation in this bearing is a shaft 36. One or more pulleys 37 are nonrotatably connected with shaft 36 at a point above the bearing 35 and power for rotating the shaft is transmitted to the pulley by means of a belt 38. Secured to the transverse bar 33 are upwardly extending bolts 39 that are threaded as indicated by reference numeral 40. Hand wheels 41 are threadedly connected with the bolts 39 and supported on these hand wheels is a transverse bar 42 through which the shaft 36 extends. Two ball races 43 separated by balls 44 are supported on the bar 42 and resting on the upper ball race is the lower end of a hub 45 on hand wheel 46 that is attached to the shaft by a pin, one end of which is indicated by the small circle. The handwheel serves as a thrust collar and also as a means for turning the shaft manually while effecting adjustments of the parts. A tubular member 47 is slidably connected with the upper end of the shaft 36 and provided with an outwardly extending shoulder 48 which forms the upper abutment for a helical compression spring 49. The upper end of member 47 is preferably spherical as designated by reference numeral 50 and this engages the under surface of the steel spring 51 which is provided at its ends with openings 52 for the reception of the bolts 39. Hand wheels 53 are threadedly connected with the upper ends of the bolts and positioned to exert pressure on the spring 51 which, in the embodiment illustrated, has been shown as longitudinally curved due to the forces acting on the same. Secured to the lower end of shaft 36 is a grinding disk 54 which has been shown in greater detail in Figures 7, 8 and 9 and which is provided with a central opening 55 for the reception of the lower reduced end 56 of the shaft. A nut 57 is threadedly connected with the bolt and holds the grinding disk 54 firmly attached to the shaft.

Referring now more particularly to Figures 7, 8 and 9 it will be observed that the grinding disk 54 comprises a central hub 58 from which a plurality of ribs 59 radiate. The outer ends of the ribs 59 are joined by integral bars 60 and the ribs are inclined with respect to the axis of the impeller in the manner indicated in Figure 9. This grinding disk is intended to rotate in a counterclockwise direction when viewed as in Figure 7, which corresponds to the direction indicated by the arrow in Figure 9.

The upper surface of the grinding disk 54 is provided with four or more radial vanes 61. It will be observed that the under surface of the grinding disk 54 is provided with a central opening 62 in which the nut 57 and the lower end of the shaft are positioned. The opening 62 is designed to receive the upper end of the central projection 27 on the lower grinding disk and cooperate with the latter to keep the two grinding disks in concentric relation when the shaft 36 is rotating. Positioned above the upper grinding disk 54 is a conical deflector 63 that is provided at its apex with an opening 64 through which the shaft passes. This deflector is supported by means of straps 65 that are connected with the inner surface of the deflector as indicated at 66. The upper ends of straps 65 are reversely bent so as to form hooks 67 that engage the loops 68 that are secured to the inner surface of the wall 19 of vessel 14. Secured to the shaft is a tubular member 69 that is held in place by means of a set screw 70 or other suitable clamping means. Member 69 is provided on one side with two outwardly extended ends 71 between which a blade 72 is pivoted and held in position by means of a pivot pin 73. This blade rotates with the shaft and normally rests on the upper surface of the conical deflector and serves to move from the surface any pulp that may lodge thereon. Water is supplied to the vessel through a pipe 74 which may be connected with a suitable source of water under pressure and controlled by a valve which has not been shown. The ore is fed to the vessel through a pipe 75 and drops onto the deflector 63 from which it is scraped by means of the blade 72. The ore as it passes from the deflector is drawn downwardly and due to the powerful centrifugal force produced by the rotation of ribs 59 it passes between the ribs 59 of the upper grinding disk onto the upper surface of the lower grinding disk and as the two disks rotate, the ore is subjected to a grinding action consisting partly of impact blows delivered to the particles as the ribs 59 approach ribs 28. Any particles between the adjacent surfaces of the grinding ribs is submitted to a grinding action and as a result of these two actions, the ore is quickly reduced to fine particles which, when mixed with the water, produce a pulp. Owing to the construction of the grinding device, there occurs a recirculation of the pulp which carries the larger particles into position to be acted upon successively until they are reduced to such a size that they will be suspended in the water, whereupon the finely ground particles will rise and finally reach the level of the outlet conduit 76 through which the pulp flows and from which it enters the vertical portions 77 and 78 of the outlet conduit. At the top of this outlet conduit a connection 79 is provided which directs the pulp into the downwardly extending conduit that has been designated by a broken line 80 and which is connected with the L 79 by means of a suitable fitting. The conduit 80 which may be a rubber hose, if desired, extends to the intake 82 of one of a group of flotation cells, which have

been designated by reference numeral 83. The construction and mode of operation of the flotation cells involves nothing new and they have been indicated by broken lines merely to facilitate the description and to make the operation more readily apparent.

The cell designated by reference character 17 is the cleaning cell which delivers froth to the launder 18. Frothing chemical is supplied from a container 84 which is supported at a suitable height above the flotation cells and the flow of frother is controlled by means of a valve 85.

It will be observed from Figure 1 that pipe 78 is provided with a rack 86 which is engaged by means of a pinion 87 that is secured to the outer wall of the vessel. The pinion 87 can be rotated by suitable means whereupon the pipe 78 can be raised and lowered, thereby varying the distance from the outlet conduit 76 to the point of overflow. The friction of the parts is sufficient to maintain them in adjusted position. The purpose of this adjustment is to effect a classifying action and the size of the particles that will flow upwardly in a pipe through which the pulp is being discharged at a given rate varies in fineness with the distance it must travel in an upward direction, and it is therefore possible by the simple expedient of raising and lowering the point of overflow to control the fineness of the grind and in this manner the operation of a separate classifier is dispensed with.

I desire to call particular attention to the shape and relation of the two grinding disks and more particularly to the fact that the lower grinding disk is provided with curved ribs, whereas, the upper grinding disk is provided with straight ribs. As these two disks rotate relative to each other, the point of intersection of the leading edges of ribs 59 with the opposed edges of the curved ribs 28 move radially and therefore subjects any particles to a shearing action, as well as impact blows and as a result of this the efficiency of the grinder is increased.

The mechanism comprising the feeder, the grinder and the flotation cells can be readily mounted on the chassis of a truck or automobile and operated by power derived from the engine of such a vehicle and therefore such a mechanism can readily be transported to any place where a truck can go and in case there is no road suitable, the several parts can be disassembled and transported to the mine by any suitable means where they will then be reassembled and put into operation. This crusher which, of necessity must be quite massive, can be transported to any suitable place, especially since such crushers can be taken apart and separated into pieces of reasonable weight.

Attention is called to the helical inclination of the ribs 59 which gives a propeller action when the grinding disk is rotated, which action serves to force the pulp downwardly against the upper surface of the lower grinding disk.

Where the capacity of the mill is larger than that illustrated in Figure 1, a plurality of outlets are provided at spaced points around the vessel and connected to the vertical conduit 76 by pipes or tubes 88, the size of conduit 76 being increased in proportion.

Having described the invention what is claimed as new is:

1. An ore grinder comprising, in combination, a vessel having a bottom, a grinding disk supported on the bottom, a bearing at the top of the vessel, a shaft journaled in the bearing for rotation about a vertical axis, a grinding disk on the lower end of the shaft, positioned above the first mentioned grinding disk, means for supporting the shaft comprising a bar having an opening for the reception of the shaft, a collar on the shaft at a point above the bar, means for raising and lowering the bar to adjust the vertical position of the shaft, resilient means for urging the shaft downwardly, and means comprising a threaded member and a handwheel, one of which is attached to the vessel and the other in engagement with the resilient means, for adjusting the force exerted by the latter.

2. An ore grinder comprising in combination, a vessel having a bottom, a grinding disk supported on the bottom, a bearing supported on the vessel adjacent its top, a shaft journaled in the bearing for rotation about a vertical axis, means for rotating the shaft, a grinding disk secured to the lower end of the shaft and normally supported on the lower grinding disk, means for varying the pressure exerted by the upper grinding disk on the lower one comprising, a spring having one portion in engagement with the shaft through a force transmitting means, and another portion connected with the vessel, means comprising a threaded member attached at its lower end to the vessel and a nut operatively associated with both the threaded member and the spring for varying the tension of the spring, and an abrading resisting ring surrounding the grinding disks.

3. An ore grinder comprising in combination, a vessel having a bottom, a grinding disk supported on the bottom, a bearing at the upper end of the vessel, attached to the latter, a shaft mounted in the bearing for rotation about a vertical axis, a grinding disk attached to the lower end of the shaft and positioned above this first mentioned grinding disk, two vertical rods having their lower ends rigidly connected with the vessel, the rods being threaded, a nut on each rod, a bar having three spaced openings, the outer openings receiving the rods, the central opening receiving the shaft, a collar secured to the shaft above the bar whereby the shaft can be raised when the bar is shifted in an upward direction by the nuts, and means comprising a spring having a portion thereof positioned above the upper end of the shaft, means for transmitting force from the spring to the shaft, other portions of the spring being provided with openings for the reception of the rods, and nuts operatively connected with the rods above the spring for moving the latter downwardly to increase the pressure of the shaft.

4. An ore grinder comprising in combination, a vessel having a bottom, an annular lining having its lower end resting on the bottom, a resilient rubber pad positioned in the lower end of the lining and resting on the bottom, a grinding disk supported on the pad, the upper surface of said disk having radiating ribs, an upper grinding disk resting on the under one, a shaft attached to the last mentioned disk, the shaft being mounted for rotation about a vertical axis, cooperating means on the adjacent surfaces of the disks for centering them, the under surface of the upper disk having radial ribs, and means for exerting a yieldable downward pressure on the shaft.

5. An ore grinder comprising, a vessel having a bottom, a grinding disk supported on the bottom, an abrasion shield surrounding the disk,

the upper surface of the disk having a plurality of radial ribs, a bearing supported by the vessel near the top thereof, a shaft journaled in the bearing for rotation about a vertical axis, a grinding disk nonrotatably attached to the lower end of the shaft, the under surface of the upper disk having radial ribs positioned for cooperative engagement with the ribs on the lower disk, means for raising and lowering the shaft, a conical deflector element positioned above the upper disk, the apex of the cone pointing upwardly, and means for supporting the cone from the wall of the vessel.

6. An ore grinder comprising, a vessel having a bottom, a grinding disk supported on the bottom, an abrasion shield surrounding the disk, the upper surface of the disk having a plurality of radial ribs, a bearing supported by the vessel near the top thereof, a shaft journaled in the bearing for rotation about a vertical axis, a grinding disk nonrotatably attached to the lower end of the shaft, means for raising and lowering the shaft, the under surface of the upper disk having radial ribs positioned for cooperative engagement with the ribs on the lower disk, a conical deflector element positioned above the upper disk, the apex of the cone having an opening for the reception of the shaft, means for supporting the cone from the wall of the vessel, and a wiper blade nonrotatably attached to the shaft for rotary engagement with the upper surface of the cone.

7. An ore grinder comprising in combination, a vessel having a bottom, a grinding disk supported on the bottom, an abrasion shield surrounding the disk, the upper surface of the disk having a plurality of ribs, a bearing supported above the vessel, near the top thereof, a shaft journaled in the bearing for rotation about a vertical axis, a grinding disk non-rotatably attached to the lower end of the shaft, the under surface of the disk having ribs positioned for cooperating engagement with the ribs on the lower disk, means for raising and lowering the shaft, a deflector shield positioned above the upper disk, means for supporting the deflector shield from the wall of the vessel, and a wiper carried by the shaft in engagement with the deflector shield for removing material from the upper surface thereof.

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