April 20, 1943. L. A. WILSON 2,316,982

APPARATUS FOR GRINDING AND SEPARATING ORES

Filed April 15, 1938

Fig. 1.

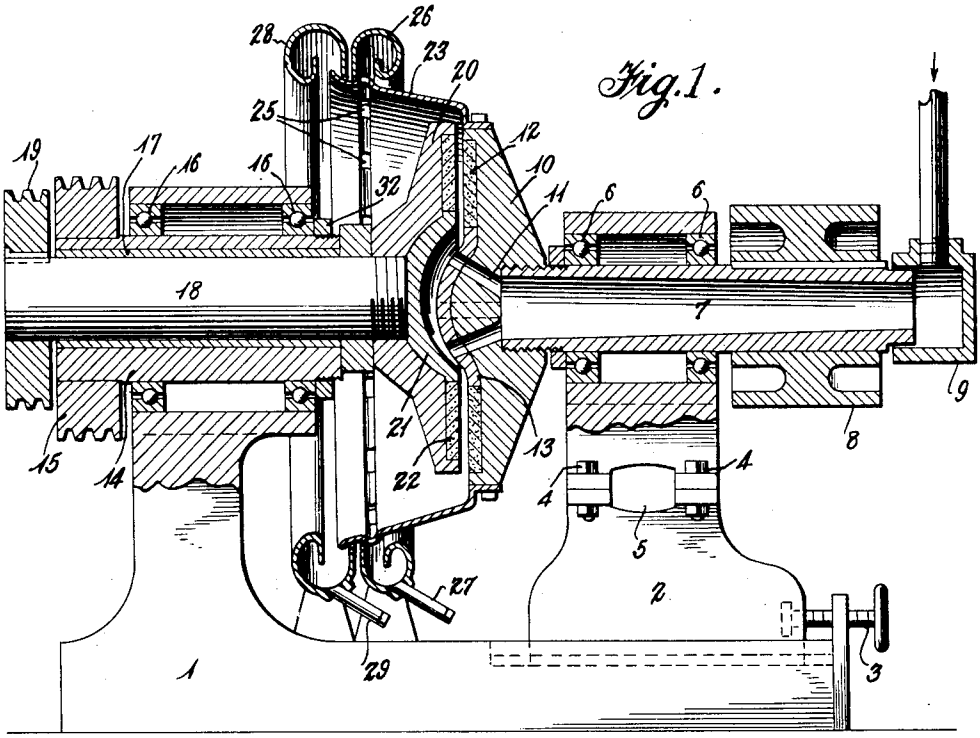
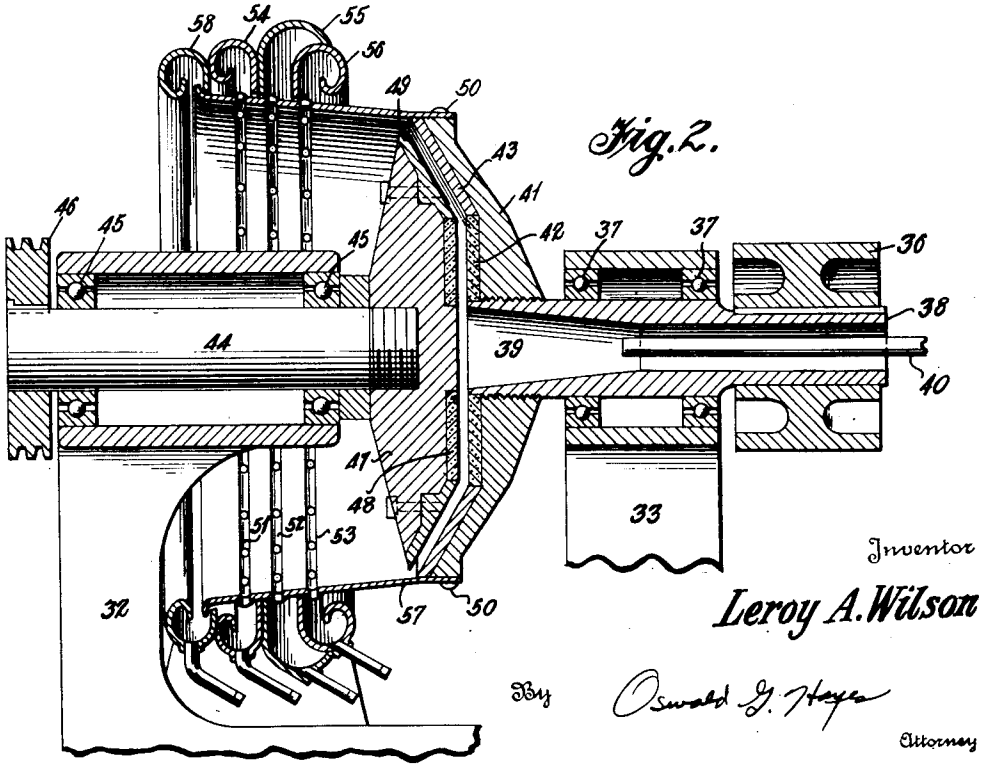


Fig. 2.



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APPARATUS FOR GRINDING AND SEPARATING ORES

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2 Claims. (Cl. 83—10)

This invention relates to a process of preparing concentrates and extracting valuable minerals from ores thereof and more particularly it relates to a process in which gold, silver, platinum metals and the like are extracted from their ores by amalgamation, and apparatus for the practice of such processes.

The nature and scope of my process will be readily apparent upon consideration of the accompanying drawing, wherein:

Fig. 1 is a cross-section through my combined gyratory pulverizer and amalgamator;

Fig. 2 is a cross-section through my combined attrition disc, colloid mill, amalgamator, and centrifuge.

Crushed ore is fed to a combined gyratory pulverizer and amalgamator. This stage reduces the ore to the finely divided condition required for most efficient operation of the process and at the same time agitates the mass of rock with mercury to amalgamate noble metals present in a form readily removed by that means. The pulp is passed then to a mill in which is further processed by a combined attrition disc assembly, colloid mill, amalgamator and centrifuge. In addition to removal of noble metals in amalgam, this stage further reduces the size of the particles, achieves an intimate mixture of ore particles with mercury and separates a plurality of mineral fractions in accordance with relative specific gravity.

The invention further contemplates the separation of undissolved solids from the reaction mass flowing from a chemical digestion stage. When the ore contains large quantities of silica, silicates and the like which are not affected by treatment with ordinary reagents, or any substance not affected by the special or selective reagents used, I prefer to separate these before subjecting the digested liquor to precipitation. Since finely ground silica, silicates, and the like are merchantable commodities, I pass the material flowing from the reaction chamber to an amalgamating centrifuge of the type herein described and withdraw therefrom amalgam and non-metallic insoluble matter, which last constitutes a valuable by-product of the process. The liquors are then passed to the precipitation stage in the manner described.

The device represented in partial section by Fig. 1 is a combined gyratory attrition mill and amalgamator. The parts of this device are supported on base 1 which may be bolted to a foundation (not shown) or otherwise secured in a desired position. A support 2 is slidably mounted on base 1 and caused to remain in proper alignment by tracks or guide rods (not shown) and an adjusting screw 3 is provided to control the position of support 2 in such guide means. The support is preferably composed of two parts joined by bolts 4 through flanges 5 on each portion of the said support. Shims between the flanges 5 provide a ready means of making such adjustments as are necessary to maintain the moving parts in the desired relationship. Bearings 6 mounted in the support 2 carry a hollow shaft 7 on which is mounted a pulley 8, through which power is supplied to rotate the said hollow shaft. The hollow interior of the shaft 7 is tapered so as to provide a bore of constantly varying diameter from one end to the other in the manner shown. The end of shaft 7 having the smaller bore is fitted into a packed joint feeding device 9 connected to a supply of crushed ore in water.

The end of shaft 7 having the larger bore carries a head 10 pierced by ports 11 communicating with the bore of shaft 7 and extending through the head 10 at an angle to the axis thereof. The head is preferably formed, as by casting, in the shape shown, it being necessary that a recess be formed therein for holding abrasive material 12 which may be molded in place or performed and fitted to the head. The convex portion 13 of the head is preferably formed of an abrasion resistant alloy such as manganese steel or the like.

Referring now to that portion of the device opposed to head 10, I mount a shaft 14 carrying pulley 15 in bearings 16 on the base 1. The cylindrical bore in the shaft 14, lined with antifriction metal 17, is eccentric with respect to the said shaft and a shaft 18 is fitted into said lined bore. The contacting surfaces may be lubricated by any suitable force feed lubricating system. It will be seen that gyratory motion is imparted to the shaft 18 while the same is positively rotated about its axis through the pulley 19. Head 20 mounted upon the end of shaft 18 is formed to correspond in configuration to the face of head 10 and like that member is equipped with abrasion resistant surface 21 and abrading surface 22. The convex area 21 is, of course, so formed that it will not come into actual contact with surface 13 by reason of the eccentric motion imparted by rotation of shaft 14.

A centrifugal bowl 23 is connected to the periphery of head 10 by welding, bolted flanges or other suitable manner in order that it may be rotated thereby and cause the material contained in the bowl 23 to be propelled toward its free edge. A circular depression catches the heavier fraction of the material passing from between the opposing heads 10 and 20 to pass said fraction through the openings 25 into collecting vessel 26 from which it passes through outlet 27. The lighter fraction passes over the free edge of bowl 23 into collecting vessel 28 from which it is withdrawn through outlet 29. The collecting vessels are preferably formed with curled lips of the form

shown to inhibit loss of material from the system. Supporting pedestals mounted on base 1 or other suitable means may be used to maintain vessels 26 and 28 in operative position. A collar type bearing 32, in effect a thrust bearing, is found to reduce the wear resulting from the friction between head 20 and shaft 14.

In operation of the device, power is applied to pulleys 8, 15, and 19 by belts from any suitable source of power (not shown). For most purposes I prefer that heads 10 and 20 be caused to rotate in the same direction, although advantageous results may be obtained in particular cases by having them rotate in opposite directions. I prefer to rotate the discs at different speeds, it being generally true that best results are obtained by causing head 10 to rotate in the same direction but at higher velocity than head 20, since this method of operation gives a more satisfactory combination of attrition and centrifugal action in the manner to be specifically described below.

When the parts of the apparatus have been set in motion a slurry of crushed ore mixed with mercury is supplied to feeding device 9 from which it passes into the small end of the bore in shaft 7. The taper in said bore coupled with the centrifugal force applied by the revolution of shaft 7 causes the mixture to pass toward head 10 and pass through sloped ports 11 into the space between heads 10 and 20. The gyratory motion of head 20 with respect to head 10 results in a crushing of large particles while the centrifugal force applied causes the mass to be moved toward the periphery of the heads between the abrasive surfaces 12 and 22. The clearance between the said surfaces being small, the particles are subjected to a lapping action which grinds the particles to still smaller size. During the period of passage of the pulp from feeding device 9 to the periphery of heads 10 and 20, and to a lesser extent during the time the mass is in bowl 23, the mixture is subjected to an agitation which results in amalgamation of a large proportion of the values which are in amalgamable form. As the mass passes along the sloping side of bowl 23, the heavy amalgam tends to separate from the lighter pulp to form a layer between the pulp and the bowl which layer is allowed to separate at depression 24 and pass out through collecting device 25 and outlet 27 for recovery of the values contained therein. The pulp passes over the free edge of the bowl into collecting vessel 28 and is withdrawn through outlet 29.

The faces of heads 10 and 20 are brought into suitable parallel relationship by adjustment of nuts 4 in conjunction with the shims between flanges 5.

It will be seen that this device accomplishes in ore treatment amalgamation and removal of values readily recovered in that manner, and fine grinding of the pulp to prepare it for further treatment.

In Fig. 2 there is shown a mechanism suitable for the second stage of my process in its preferred embodiment. Basically, its construction is quite similar to that of the device illustrated in Fig. 1, and it may be regarded as a modification of that apparatus for a different operation. The base 32 and adjustable support 33 are equipped with means similar to the screw 3, bolts 4 and flanges 5 for securing proper alignment of the parts. Bearings 37 support a hollow shaf 38 having a tapered bore 39 and driven by mean of pulley 36. The feeding device 40 for pulp i also for use with the apparatus of Fig. 1 and it will be readily understood that the two feeding mechanisms are equally useful with either machine described. Shaft 38 carries a shaped head 41 on which is mounted an abrasive surface 42 and a wear resistant metallic face 43.

A shaft 44 mounted in suitable bearings 45 and driven by pulley 46 carries a head 47 opposed in position and configuration to head 41. The head 47 is equipped with surfaces 48 and 49 similar in nature to the corresponding surfaces of head 41. A centrifugal bowl 57 operatively connected to head 41, as by bolts 58 is constructed with perforated channels 51, 52 and 53 feeding into collecting vessels 54, 55 and 56. Matter passing over the edge of bowl 57 is collected in vessel 56. The fractions of varying specific gravity are withdrawn from the respective vessels through outlet 59, 60, 61 and 62.

The operation of this treating device varies but little from that of the mechanism of Fig. 1 except that there is no provision for subdivision of relatively large particles by crushing. Between the abrasive discs 42 and 43 the pulp is subjected to attrition and when the pulp has progressed to the space between surfaces 43 and 49, the heavy semi-fluid mass receives a treatment which is essentially a shearing operation; that is the fluid film is subjected to the friction of the opposing surfaces moving preferably in the same direction but at different speeds.

In both the devices described above, the centrifugal bowls are preferably lined with amalgamation promoting surfaces by plating with silver and I find that the amalgamation is materially aided in some cases by forming a coating of amalgam. Such plating also provides a surface over which the pulp mixtures flow readily and accumulation of solids in the bowl is substantially inhibited by this expedient. I have also found that good results may be obtained in particular cases by supplying a stream of mercury between the pulp and the surface of the bowl. Means for supplying such streams may be readily incorporated in the structures I have shown.

I claim:

1. An ore treating device comprising a pair of opposed grinding faces mounted for rotation on substantially parallel shafts, a centrifuge bowl affixed to one of said faces and enclosing the peripheries of said faces, one of said shafts being hollow with the bore thereof tapering outwardly toward the treating face mounted on said shaft throughout at least a portion of the length thereof, a conduit for admitting ore to the tapered portion of said bore, and means to independently rotate said faces.

2. An ore treating device comprising a pair of opposed grinding faces mounted for rotation on substantially parallel shafts, one of said shafts being mounted eccentrically within a rotatable bearing, a centrifuge bowl affixed to the face on the other of said shafts, means to rotate said rotatable bearing, means to independently rotate said shafts, and means extending through one of said shafts for introducing material to be treated between said faces.

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