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METHODS AND APPARATUS FOR COMMINUTING ORES OR THE LIKE

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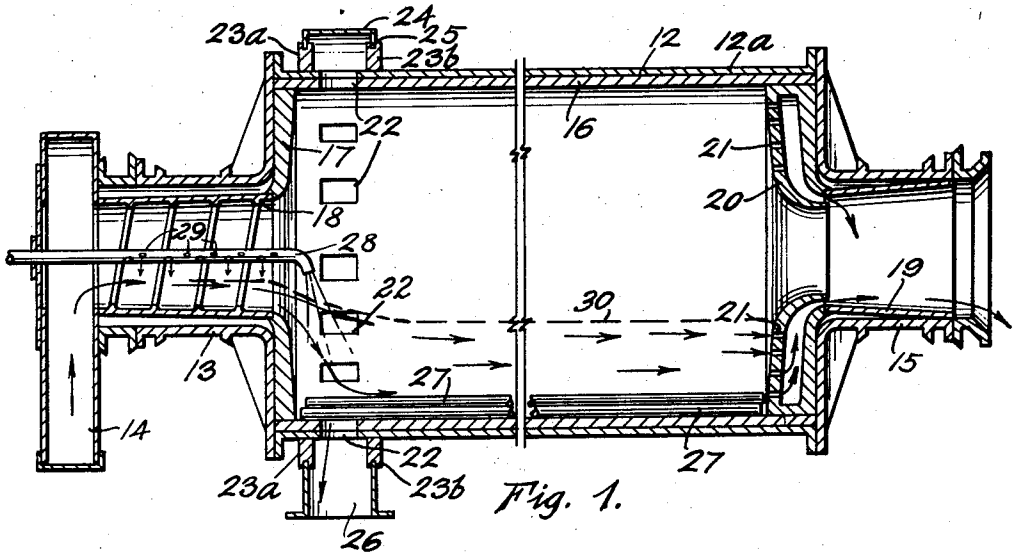

Fig. 1.

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METHODS AND APPARATUS FOR COMMINUTING ORES OR THE LIKE

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This invention relates to apparatus for comminuting ores or the like and more particularly to circuits involving rod mill operation.

Many ores will contain native inclusions of waste materials such as clays, gypsum, and the like which are of extremely fine size and tend to form colloidal dispersions in the pulp in grinding operations. Such materials, as for example the clays and other gangue constituents of the sylvinite ores of the Carlsbad, New Mexico field, will be referred to herein as primary slimes. Other material reduced to relatively fine size in the grinding operation employed to unlock the valuable constituent from associated matter will be referred to as secondary slimes.

The primary slimes in a liquid carrier usually are of a slimy or gummy consistency which impedes the efficiency of equipment throughout the milling circuit and performs no useful function in the treatment. Some operations provide a desliming treatment before a flotation separation for example, but are only effective in removing a portion of the primary slimes, leaving another portion as a nuisance factor in the subsequent treatment stages.

It is an object of the present invention to provide simple, efficient and economical apparatus for elimination of a major portion of the primary slimes of an ore at the commencement of the pulp-forming stage of a beneficiation treatment so as to prevent intermingling of such portion with other solids of the pulp in the grinding and subsequent stages of the circuit.

Another object of this invention is to provide simple, durable and efficient equipment, such as rod mills or ball mills, capable of removing a substantial portion of the primary slimes of an ore pulp before or at the commencement of a size reduction operation.

A further object of the invention is the provision of a grinding adjunct for cylindrical grinding mills rotating about a horizontal axis involving the application of vibratory influences applied directly to the surface of the pulp body contained in the mill.

Other objects reside in novel details of construction and novel combinations and arrangements of parts, all of which will be explained in the course of the following description.

The practice of the present invention will be best understood by reference to the accompanying drawings illustrating typical arrangements for attaining the aforesaid objects. In the drawings, in the several views of which like parts bear similar reference numerals, Fig. 1 is a vertical central section through a rod mill assembly representing one structural embodiment of this invention.

One of the novel features of my invention is the provision of a discharge outlet for slimes at the feed end of the mill and screening structure arranged in covering relation to said outlet to pass slimes and reject coarser sizes in order that the primary slimes may be separated and removed before being subjected to any substantial

impact or attrition influences within the mill. As shown in Fig. 1, this structure may comprise a charge of rods of sufficient length to at all times cover the peripheral passage to the outlet and the spacing between the adjoining rods of the charge provides the restricted passages for the desired screening action.

Preferably, but not necessarily, a perforated spray unit is disposed in the feed trunnion to accelerate the separation of primary slimes from the other ore constituents and thereby assist their entrainment in the flow to the slimes discharge outlet.

As shown in Fig. 1, a cylindrical mill 12 has a shell 12*a* connected with a feed trunnion 13 adapted to be journaled for rotation in conventional manner and provided with a feed scoop 14. A discharge trunnion 15 is connected with the shell at the opposite end of the mill and also is adapted to be journaled for rotation in conventional manner. The mill has the usual shell liners 16, an end liner 17 of standard type cooperating with a spiral-flight trunnion liner 18 for the feed end, and for tumbling the feed and directing it inwardly of the mill a conventional trunnion liner 19 and grate-type end liner 20 for the discharge end. The liner 20 screens solids passing to discharge and has pulp-elevating means for moving such discharge into the interior of trunnion liner 19.

Peripheral discharge passages 22 comprising a series of alined slots extends through the shell 12*a* and liners 16 at the feed end of the mill, and two external flanges 23*a* and 23*b* on shell 12*a* are grooved for admission of the flanged ends of a stationary annular cover member 24 as shown at 25, which has the slimes discharge outlet 26 formed in its bottom surface. A group of rods 27 of only slightly less length than the distance between the end liner 17 and grate 20 at the periphery of the mill covers the portion of any slotted passage 22 which overhangs outlet 26 during rotation of the mill and functions as a screening structure to pass slimes and reject coarser solids in the flow of material through the spaces between said rods and into the outlet 26.

In this assembly a spray pipe 28 extends into the mill 12 through feed trunnion 13 from a suitable source of supply (not shown) and has a series of fine orifices 29 arranged to spray the feed entering trunnion 13. Conventional features of mill construction such as fastening of heads, bolting of liner sections, location of manhole, etc. have not been shown in order to more effectively illustrate the novel features of the assembly.

In operation, a pulp comprising crushed ore and a suspension medium such as water is delivered into scoop 14 from which it flows through the hollow portion of trunnion 13 assisted by the impelling influence of the spiral flights of liner 18 and enters the mill 12 as the feed of the grinding operation. The pulp level in a typical operation is indicated by the dash line 30 in Fig. 1. During its progress through trunnion 13, this feed is subjected to a washing or scrubbing action by the perforated spray pipe 28 in conjunction with the attrition resulting from its tumbling movements. As a consequence, much of the primary slimes present as surface contaminant on the particles of the pulp is loosened or separated and suspended in the liquid medium.

The head of liquid above outlet 26 induces a substantial flow of liquid thereto and most of the released slimes content is entrained in such flow and passes directly to the outlet. While the mill provides a continuous flow from feed end to discharge end, a substantial retention interval is provided, and such portion of the primary slimes as separate from the ore before substantial progression through the mill remain within the range of the slimes discharge flow and sooner or later are entrained therein and removed from the mill.

Consequently, the major portion of the grinding action involves substantially slime-free material and while secondary slimes are produced in such action, the slimes content of the final mill discharge is not of a character to impede the efficiency of the subsequent treatments as now occurs in conventional grinding treatments.

A hollow end grate **20** screens the pulp at the discharge end of the mill and the grate openings **21** are of a size to reject oversize and pass solids of desired fineness. The pulp passing said openings is directed through the hollow portion of the grate structure by a plurality of radial lifter bars which lift the pulp which passes the grate into the interior of trunnion **19** from which it discharges by gravity as the finished product of the operation. In the event of blinding of openings **21**, the discharge may enter directly into trunnion **19** until they are cleared.

Some ores will not contain enough primary slimes to require separate elimination and the mills of this invention such as mill **12**, improve the reduction of such ores. The discharge through outlet **26** will remove the finer sizes which require no further grinding, leaving the full capacity of the mill for sizes requiring further reduction. The fines not entraining in the flow through outlet **26** travel to the openings **21** of grate **20**, which because of the reduced quantity of such sizes in the mill discharges the finished product at a faster rate than otherwise would be possible. Consequently, less slimes are formed in grinding to a given size range than is usual in such operations.

From the foregoing, it will be apparent that the novel features of the present invention are applicable to a great variety of grinding mills and the structural embodiments shown and described herein are intended merely to teach the practice of my invention but not to limit same.

I claim:

1. The combination with a rotary, drum-type grinding mill mounted for rotation about a substantially horizontal axis and having at least one end feed trunnion and a discharge outlet for ground product remote from the point of feed introduction into the mill, of means in the feed trunnion for directing a spiralling component of movement to entering pulp feed inwardly of the mill, means for spraying said pulp during the spiralling movement, and means internally of the mill and adjacent the feed end of the mill for separating and discharging primary slimes of the entering feed before it is subjected to any substantial comminuting action of the mill.

2. The combination with a rotary, drum-type grinding mill mounted for rotation about a substantially horizontal axis and having at least one end feed trunnion and a discharge outlet for ground product remote from the point of feed introduction into the mill, of means in the feed trunnion for tumbling and directing the entering pulp inwardly of the mill, means for washing said pulp during its tumbling movement in the feed trunnion and immediately thereafter, and means internally of the mill and adjacent the feed end of the mill for separating and discharging primary slimes of the entering feed before the pulp is subjected to any substantial comminuting action of the mill.

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