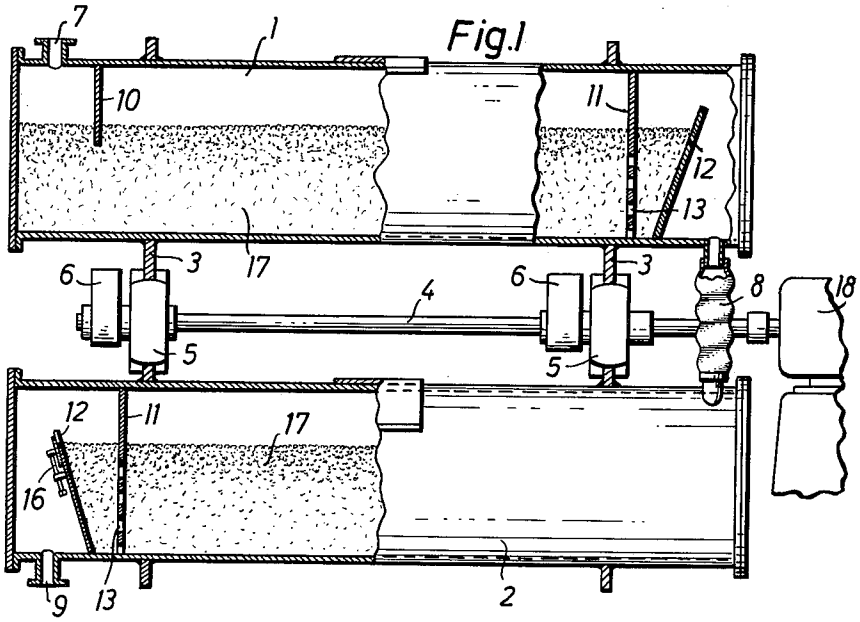
Oct. 19, 1965 HEINZ-JOCHEM MAEDER ETAL 3,212,722

VIBRATORY GRINDING MILL OF THE DRUM TYPE

Filed July 1, 1963

Fig.1



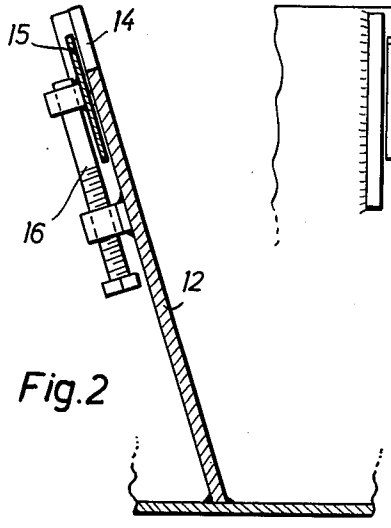




Fig.2

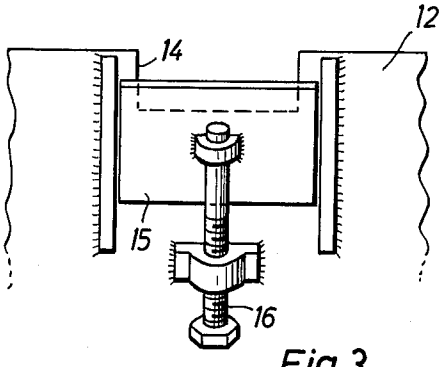



Fig.3

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3,212,722

# VIBRATORY GRINDING MILL OF THE DRUM TYPE

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6 Claims. (Cl. 241—171)

Our invention relates to drum-type continuously operable vibratory mills in which one or more vibrating grinder drums contain a number of balls or other grinder bodies and receive the material to be ground through an inlet near one axial end of each drum and discharge the material near the opposite end. In a more particular aspect, our invention relates to a load discharging device in such vibratory mills and has the general object of reducing the cost of operating such machinery.

Drum-type vibratory mills, as a rule, are provided with discharge devices for the purpose of adjusting the average level of the load contained in the drum and also for limiting the active space within the grinder drum so as to keep the outlet opening unclogged. Such discharge devices consist, for example, of a partitioning wall extending across the drum in its interior closely upstream of the outlet opening and provided with slots through which the material can pass to the outlet opening, while the grinder bodies and the bulk of the material is retained in the grinding space proper. Two problems that are presented in such a device, namely that of adjusting the load level and of limiting the active grinding space, are difficult to resolve simultaneously which makes it difficult in turn to provide the slots in the retaining plate with a size that is most favorable under various operating conditions.

Slotted plates have a further disadvantage in that they must be made very thick in view of the large amount of wear to which they are subjected. Furthermore, it is difficult to provide slots that retain a constant size in vibratory mills of the drum type because narrow slots become rapidly clogged when the material being ground is moist and tends to stick together. When the material is dry and rather fluid, however, an excessive amount of material may pass through the retaining plate even when the slots are very narrow or small so that the load level becomes too low. The fluidity of the material being processed in a mill of this type may also change during operation because of changes in humidity, so that control or regulation of the mill loading by a retaining plate with constant slots is infeasible.

It is accordingly a specific object of our invention to eliminate the above-mentioned shortcomings of the load-level controlling and discharge regulating devices in continuously operable drum-type vibratory grinding mills.

To this end, and in accordance with our invention, we separate the fuctions heretofore provided by a single slotted plate, namely the regulation of the load level on the one hand, and the limitation of the grinding space in the drum on the other hand, so as to provide improved controllability and thereby increase the efficiency and economy of operation of the mill.

More specifically, we provide according to our invention a discharge device consisting of two separate members, namely a perforated or slotted partition near the outlet end of the grinder drum but axially spaced therefrom to form an outlet chamber in which the outlet opening of the drum is located, and an overflow gate between the slotted or other screening partition and the outlet opening. This overflow gate extends from the bottom of



the substantially horizontal drum upwardly either in the vertical direction or at an angle inclined to the drum axis.

According to another preferred feature of the invention, the overflow gate is provided with a displaceable gate member that permits adjustment of the effective overflow level.

According to still another feature of the invention, the upper portion of the partition is designed as a closed wall extending downwardly to below the load level formed by the mass of grinding bodies and the material being ground, whereas the lower portion of the partition possesses slot-like openings that permit the grinding material to pass through. It is further preferable to insert in the interior of the dum a baffle wall near the inlet opening for the material to be ground but axially spaced from the opening in the material-flow direction, this wall extending from above to below the load level but remaining spaced from the bottom of the drum, thus promoting the formation of a uniform layer of the material being ground.

According to a further preferred feature of the invention, the partition and the overflow gate, as well as the baffle wall where such a wall is provided, have each a peripheral edge abutting the peripheral wall of the drum, and are permanently joined with the drum along the periphery for example by welding.

The above-mentioned and other objects, advantages and features will be apparent from, and will be described in the following with reference to the embodiment of a drum-type vibratory mill according to the invention illustrated by way of example on the accompanying drawing in which:

FIG. 1 is a side elevational view of a vibratory mill having two grinder drums which embodies the features of our invention;

FIG. 2 is a cross-sectional view on an enlarged scale of the vibratory mill overflow gate shown in FIG. 1; and

FIG. 3 is a front view partly broken away of the top portion of the overflow gate shown in FIG. 2.

The illustrated vibratory mill comprises two cylindrical grinder drums 1 and 2 which are horizontally arranged one above the other in symmetrical relation to the drive shaft 4 of the machine. The two drums are rigidly connected with each other by two bridge members 3 which are vibratorily mounted on a suitable supporting structure (not shown) to permit the rigid drum assembly to perform a swinging motion in transversal planes substantially perpendicular to the plane of illustration in FIG. 1. The vibratory or elastic mounting structure is not further described because it is well known as such and not essential to the present invention proper. If desired, reference may be had in this respect to U.S. Patent 3,082,965 or to our copending application Serial No. 282,962, filed May 24, 1963, for Vibratory Grinding Mill.

The drive shaft 4 is rotatable in bearings 5 which are mounted in the respective bridge members 3. Unbalanced weights 6 are firmly mounted on shaft 4. During operation of the mill, the shaft 4 is driven through a universal linking connection from a stationary electric motor 18. The rotation of the unbalanced weights 6 on shaft 4, places the vibratory system comprising the two grinder drums 1 and 2 into substantially circular swinging motion.

Each drum is provided with a large quantity of grinder balls that occupy only part of the internal drum space and which, together with the amount of material fed into each drum for grinding between the balls, approximately define a load level in each drum. During operation of the mill, the grinder balls are subjected to a haphazard throwing motion, thus imposing a size-reducing action by impact and friction upon the material.

The material to be ground is supplied to the upper grinder drum 1 through an inlet 7. After passing through

the upper drum, the material enters through a corrugated hose **8** into the lower drum **2**, and after travelling through the lower drum the material reaches the outlet **9**.

According to our invention, a partition **11** is mounted in each drum upstream of the outlet opening, this partition being provided with a number of slots **13**, and an overflow gate **12** is mounted in the chamber thus separated by the partition from the active grinding space of the drum.

The overflow gate **12** extends between the partition and the outlet opening of each drum from the drum bottom upwardly and determines by its overflow height the effective height of the load level during operation of the mill. Only the material being ground can pass through the openings **13** of each partition **11** to the overflow gate **12** and past the gate into the drum outlet **9**, whereas the grinder balls are retained by the partition **11** in the active grinder space of the drum.

The overflow gate **12** may extend in a vertical direction in the drum a short distance behind the partition, but is preferably inclined with respect to the partition, preferably so that it extends upwardly away from the partition. The overflow gate is adjustable so that the material is retained up to a variable predetermined level. Thus the quantity passing out of the drum is controlled and regulated so that the mill is more uniformly loaded.

The upper portion of the partition **11** is closed, i.e. not perforated, whereas the lower portion is provided with the openings or slots **13**. These are located below the level of the load which consists of the mass of grinding bodies and the material being ground. This feature assures uniform flowthrough of the comminuted material. Any pieces of material that have not been sufficiently broken up and are floating on the surface of the finer material are kept back, however, by the partition and are further subjected to the beating action of the grinding bodies until these pieces of material are also reduced to such a grain size that the material can pass through the slots **13** and thus become discharged from the drum. It is also desirable to provide a short baffle wall **10** near the drum inlet side which extends from the top wall of the drum into the load material **17** for a short distance, thus also forcing the insufficiently broken pieces to become further subjected to the grinding action of the balls.

In accordance with our invention, the partition located in front of the overflow gate is provided with perforations or slots of sufficiently large cross section so that the necessary quantities of material can pass through even under unfavorable flowing conditions of the material being processed. As a result, a smearing and clogging of the heretofore conventional narrow slots by the grinding bodies and material is eliminated, thus also eliminating the heretofore encountered reduction in throughput and efficiency of drum-type vibratory mills. Furthermore, formation of a uniform layer of the material being processed is promoted because the relatively large and incompletely broken up pieces are forced back into engagement with the grinding balls thereby becoming further reduced in size until they can pass through the slots.

A slide plate **15** is upwardly and downwardly displaceable on the gate **12** for the purpose of varying the retaining height and hence the effective level of the grinder load. In the illustrated embodiment the slide plate **15** is guided between lateral bars and adjustable in height by means of a screw spindle **16** so that a passage **14** in gate **12** can be opened to a greater or lesser extent. The height of the overflow gate can thus be adjusted as desired in accordance with the particular operating conditions of the mill in order to obtain uniform passage of the material through the mill. Instead of providing a linearly displaceable slide plate, a rotatably adjustable slide plate may also be used for the aforementioned purpose.

All of the transverse wall structures **10**, **11**, as well as the gate **12**, extend to the periphery of the drum wall.



Preferably the circular or arcuate peripheral edges of these wall or gate structures are joined with the interior wall of the drum by welding so that the individual subdivisions and their contents in the interior of the drum are well separated and cut off from each other.

Our invention accordingly provides well balanced operation of the drum-type vibratory mill as well as satisfactory control and regulation of the throughput thereof while achieving more uniform quality of the output material than heretofore reliably obtainable.

To those skilled in the art, it will be obvious upon a study of this disclosure that vibratory grinding mills according to our invention can be given embodiments other than particularly illustrated and described herein, without departing from the essential features of our invention and within the scope of the claims annexed hereto.

We claim:

**1.** A continuously operable vibratory grinding mill comprising at least one vibratory grinder drum whose axis extends substantially horizontally, said drum having a material inlet opening near one drum end, a screening partition fastened in said drum near the other end but axially spaced therefrom to form an outlet chamber, said drum having a bottom outlet in said chamber, and an overflow gate extending upwardly from the bottom in said chamber between said partition and said outlet.

**2.** A continuously operable vibratory grinding mill comprising at least one vibratory grinder drum whose axis extends substantially horizontally, said drum having a material inlet opening near one drum end, a screening partition fastened in said drum near the other end but axially spaced therefrom to form an outlet chamber, said drum having a bottom outlet in said chamber, and an overflow gate extending from the drum bottom upwardly in said chamber between said partition and said outlet in spaced relation to both, said overflow gate being inclined upwardly away from said partition.

**3.** A continuously operable vibratory grinding mill comprising at least one vibratory grinder drum whose axis extends substantially horizontally, said drum having a material inlet opening near one drum end, a screening partition fastened in said drum near the other end but axially spaced therefrom to form an outlet chamber, said drum having a bottom outlet in said chamber, and an overflow gate extending upwardly from the bottom in said chamber between said partition and said outlet and having displaceable gate means for adjusting the overflow height.

**4.** In a vibratory grinding mill according to claim **1**, said drum containing a mass of grinder bodies which, together with the material being ground, defines an approximate load level when the mill is in operation, said partition being a closed structure from the top down to below said level and having therebelow a number of openings passable by the material but smaller than said grinder bodies.

**5.** In a vibratory grinding mill according to claim **1**, said drum containing a mass of grinder bodies which, together with the material being ground, defines an approximate load level when the mill is in operation, and a baffle wall mounted in said said drum near said one end but axially spaced in the material-flow direction from said inlet opening, said wall extending from the top downwardly to below said level but being spaced from the drum bottom.

**6.** In a vibratory grinding mill according to claim **1**, said drum containing a mass of grinder bodies which, together with the material being ground, defines an approximate load level when the mill is in operation, said partition being a closed structure from the top down to below said level and having therebelow a number of openings passable by the material but smaller than said grinder bodies, a baffle wall mounted in said drum near said one end but axially spaced in the material-flow direction from

said inlet opening, said wall extending from the top downwardly to below said level but being spaced from the drum bottom, said partition and said wall and said overflow gate consisting each of sheet metal and having each a peripheral edge along the peripheral wall of said drum and permanently joined therewith.



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