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GRINDING DEVICE

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Fig.1.

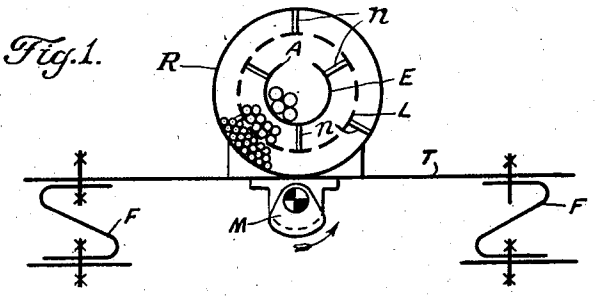


Fig.2.

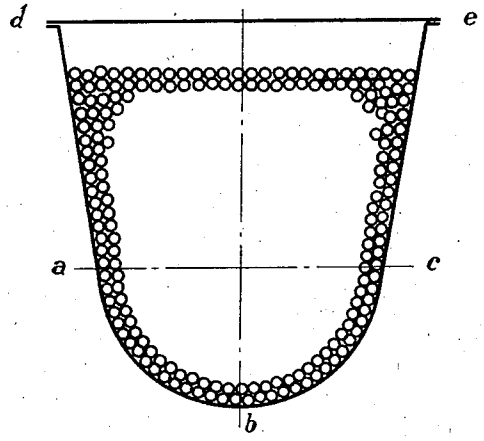
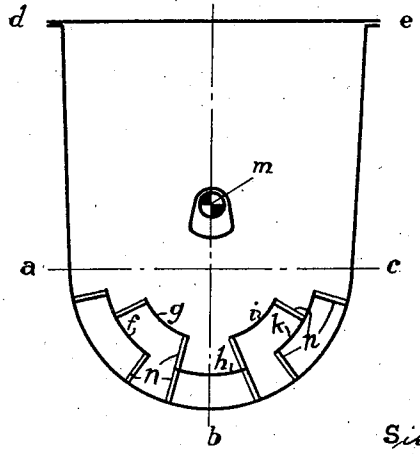


Fig.3



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GRINDING DEVICE

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4 Claims. (Cl. 83—9)

The present invention relates to a grinding device.

In our co-pending U. S. application Serial No. 731,172 filed June 18, 1934, there is described a device for grinding dry substances, suspensions, pastes and the like by means of quartz sand or similar hard, fine-grained grinding elements and with the aid of circular vibrations caused by unbalanced masses. The device comprises a container for the reception of the material to be ground, the said container having a substantially arcuate wall for supporting the mixture of said substances and grinding elements. The container is arranged on an elastic mounting and is connected with means for causing it rapidly to vibrate in such a manner that all parts of it move in closed curved paths of small amplitude and congruent to each other, in parallel vertical planes. The oscillating impulses cause the various particles of the mixture in the container to move in planes at right angles to the axis of symmetry of the container. The movement of the material caused by the oscillations chiefly consists in a mutual displacing, moving and rubbing, whereby the material to be ground is subjected to shearing strains.

The oscillating movements are first transmitted from the walls of the container to the adjacent layer of grinding elements. This movement is transmitted, by friction, to the next layer and so on. It is a characteristic feature of this propagation of oscillation that a decreased amount of energy and a slackening impulse of motion and, in consequence thereof, an inferior comminuting power are transmitted to each consecutive layer. If a container of a comparatively large diameter is used, for instance having a diameter of 300 mm., or more, the disadvantage arises that the particles of the mixture to be pulverized which are to be found near the axis of the container do not take part in the oscillations. In consequence thereof, a dead zone is produced which is ineffective for the grinding process.

Now we have found that this disadvantage can be overcome by subdividing the interior of the container by partitions which are essentially parallel to the arcuate wall of the container and rigidly connected thereto. These particles increase the transmission of the oscillating movement to the mixture to be pulverized. These partitions may be of different shapes and sections. If a tubular container is used, it may be particularly advantageous to make the partitions in the form of cylinders which are mounted in a concentric manner in the interior of the container, the walls of these cylinders being spaced by a distance of, for instance, 100 to 200 mm. from one another or from the outer wall of the container. In order to interchange the material to be pulverized in the different parts of the interior of the subdivided container, the partitions, and especially the cylindrical casings may be provided with openings arranged in line from end to end or arranged in staggered manner. Finally, instead of cylinders, a helical wall may be used.

In the accompanying drawing Fig. 1 is a diagrammatic sectional view of a construction embodying means for increasing the transmission of the oscillatory movement of the container to the material contained therein;

Fig. 2 is a sectional view of a desirable form of container; and

Fig. 3 shows diagrammatically a further arrangement of a container and drive therefor.

In Fig. 1 T is an oscillating table which is elastically suspended by means of bent leaf springs F. On the underside of this table, there is mounted in known manner a rapidly rotating shaft carrying an unbalanced mass M which causes the entire system including the tubular oscillating device R to oscillate. The oscillating path of the oscillating device R is in a plane perpendicular to the rotating shaft and consequently to the axis of the oscillating container. In order vigorously to cause the auxiliary grinding bodies, consisting in this case of globules, to undergo useful oscillating movements, cylindrical partitions are inserted into the tubular containers. The interior cylinder E is formed with a solid jacket plate which at the top part is provided with one or several openings A in order to make it possible for the material to be pulverized to be interchanged and mixed.

The effect of the inserted cylinder E in increasing the transmission of the oscillations may be augmented by providing an intermediate cylindrical partition L formed as a perforated plate, the perforations being smaller than the diameter of the grinding bodies to be used. When the material to be ground is moved, the pulverizing globules will stop in these openings and cause the neighbouring globules or grains of the auxiliary grinding bodies to oscillate more vigorously than would occur merely on account of friction with the walls of the cylinder. In some cases it may also be advisable to insert a lattice of bars of any desired shape instead of the cylindrical casings as illustrated in Fig. 1.

Trough-shaped containers may be used with advantage. As illustrated in Fig. 2 of the accom-

panying drawing it is advisable to give to the bottom part *a*—*b*—*c* of the horizontal trough a substantially semi-circular curvature, while the two side plates of the trough are connected to this semi-circular bottom in a parallel or upwardly slightly diverging manner. The trough may be closed by a lid *d*—*e*.

A particularly intensive oscillating motion which radiates uniformly to all parts, may be attained by mounting the shaft with the unbalanced masses which, by its rotation, produces the oscillating motion, in the longitudinal axis of the tubular container. In this case it is advisable to surround the rotating shaft with a protective casing whereby it is prevented from coming in contact with the material to be pulverized.

It has been found suitable to fill the trough with grinding bodies such as globules, porcelain fragments or the like to nine-tenths of its height. In contrast with the known pulverizing devices containing filling material it is possible and even advisable to fill the grinding containers to far more than half their capacity. The usefulness of the particular shape and the extent of filling is evident from the fact that the oscillations are transmitted to the pulverizing bodies chiefly from the semi-circularly bent bottom of the trough.

It may, again, be advantageous to insert into the device guide plates which augment the transmission of the oscillations to the auxiliary pulverizing bodies and to mount the shaft producing the oscillations together with so-called free-swinging drive in the heavy axle of the trough-shaped container. In Fig. 3 of the accompanying drawing is illustrated an arrangement of these guide plates *f*, *g*, *h*, *i* and *k* and the exciting rotor *m* inserted in the heavy axle of the trough. As hereinbefore indicated, the partitions E and L (Fig. 1) and the guide plates *f*, *g*, *h*, *i* and *k* (Fig. 3) are rigidly connected to the wall of the vessel as for example, by the supporting members *n* by means of which the oscillating movement of the container wall is transmitted to the material to be subdivided. If it is desired to produce circular oscillations, it is, of course, also possible to employ known means for providing the desired oscillatory movements, for instance so-called Schieferstein drives, which are machines with elastically coupled masses, described in Schieferstein Patent 1,797,840, issued March 24, 1931.

We claim:

1. A device for grinding dry substances, suspensions, pastes and the like mixed with hard fine-grained grinding elements comprising a substantially horizontally disposed vessel having a substantially arcuate bottom wall adapted to provide vertical support to the mixture of the substance to be ground and the grinding elements, at least one partition within said vessel disposed essentially parallel to said arcuate bottom wall and rigidly connected thereto, means yieldingly and resiliently supporting said vessel and permitting each point thereof to vibrate in a closed curved path of relatively small amplitude in a vertical plane perpendicular to said arcuate wall and means for imparting vibratory movement to said vessel so that all points thereof vibrate in closed curved congruent paths in vertical planes perpendicular to said arcuate wall, said perpendicularity being such that the intersections of said planes with the arcuate wall are curves similar to the curvature of said arcuate wall.

2. A device as defined in claim 1 in which the vessel and the partition are tubular.

3. A device for grinding dry substances, suspensions, pastes and the like mixed with hard fine-grained grinding elements, comprising a vessel for supporting the mixture of said substance and grinding elements, said vessel having the shape of a trough the bottom of which is substantially semi-circular in cross-section and the side walls of which are plane and substantially parallel, at least one partition wall within said vessel essentially parallel to said bottom and rigidly connected thereto, an elastic mounting for said vessel and means for causing said vessel rapidly to vibrate in such a manner that all parts of it move in closed curved paths of small amplitude congruent to each other, in parallel vertical planes.

4. A device as defined in claim 3 in which the side walls of the vessel slightly diverge upwardly.

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