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P. HOLLSTEIN ET AL

2,295,473

GRINDING MILL

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2 Sheets-Sheet 1

Fig. 2

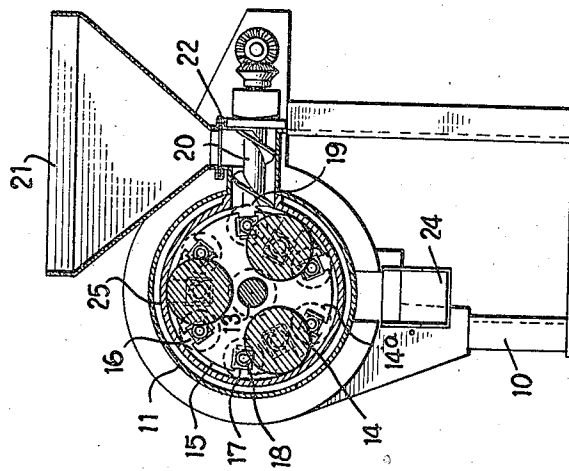
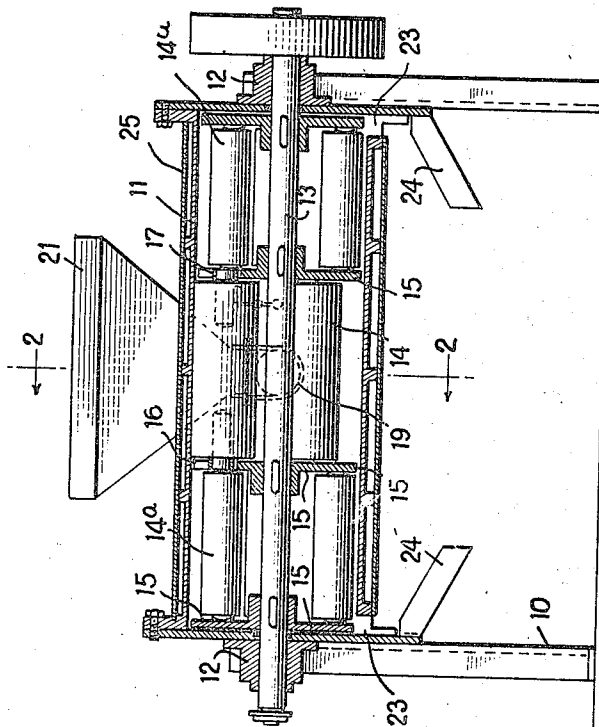


Fig. 1



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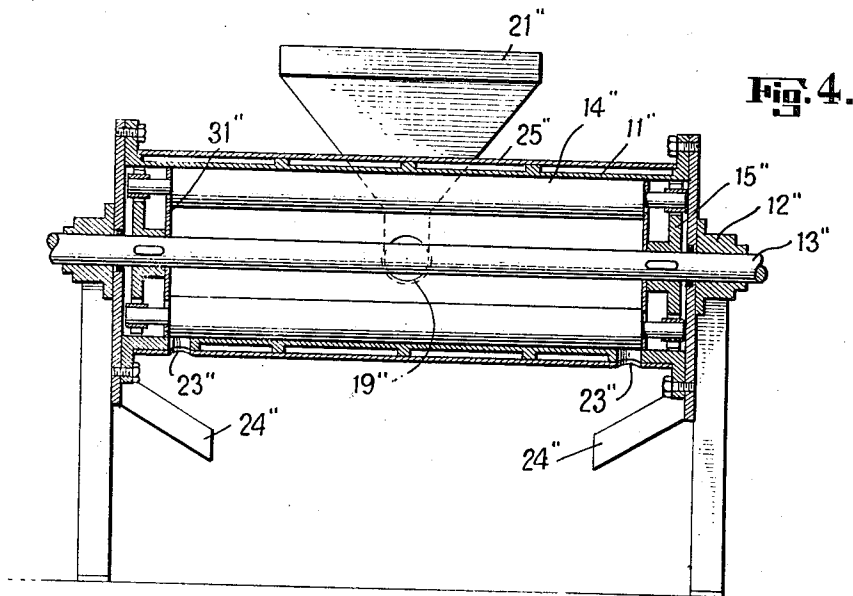
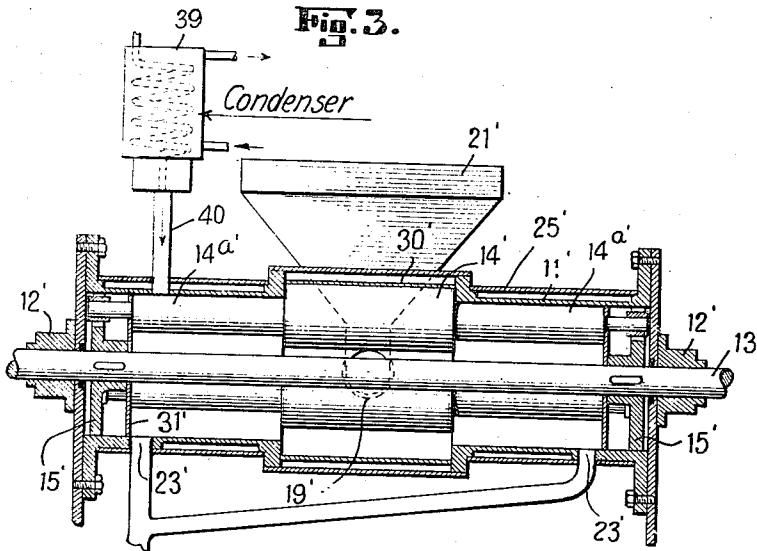
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GRINDING MILL

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3 Claims. (Cl. 83—9)

This invention relates to grinding mills and has for an object the provision of improvements in this art.

According to the invention, material is ground continuously, entering at one point, and is progressively and uniformly ground as it travels to another point where it is discharged. During the grinding action the material may be kept under closely regulated temperature conditions; and may be sealed so as to keep it free from outside contamination and, if desired, to maintain it under selective pressure conditions. For example, when the interior of the grinding space is completely enclosed and sealed it is possible to use the machine for grinding and mixing material containing high volatile vehicles. Some special fast drying inks, such as those used in roto-gravure work, have as an important constituent high volatile material. The "centrifugal dispersion mill," as the one disclosed herein may be termed when applied to such uses, may find a wide and important use in this field. The grinding progresses at a very rapid rate but the wear on the parts is a minimum. As an example, to give an understanding of operation but not as a limitation, a mill having a drum size of approximately 16" inside diameter, 6" diameter center rolls and 3½" end rolls, may have a shaft speed of 275 R. P. M. or more. This will vary with drum and roll size, the kind of material to be treated and other factors. The machine is very simple and may be easily cleaned or repaired.

The invention and its various objects, advantages and features of novelty will best be understood from a consideration of an exemplary embodiment thereof illustrated in the accompanying drawings, wherein:

Fig. 1 is a vertical longitudinal section through a machine embodying the invention;

Fig. 2 is a vertical transverse section taken on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 1 but showing a modified form of drum and rolls; and

Fig. 4 is a view similar to Fig. 1 but showing a modified form of rolls.

The machine was designed principally for wet grinding and particularly for grinding cocoa nibs. As is well known, cocoa nibs contain a large percentage of cocoa butter and when crushed form a material of a pasty or fluid consistency which clings and flows under the rolling action. Other materials such as paints, inks, pigments, chocolate and the like have a similar consistency and are well adapted to be similarly treated. The machine will grind particles of any size and may

be used for thoroughly mixing materials as well as for grinding. The materials may be fed in solid form, or in liquid form, or both in solid and liquid form for mixing and grinding.

In the specific form of apparatus illustrated in Figs. 1 and 2, a frame 10 supports an elongated drum 11 and bearings 12 for a shaft 13 which passes through the drum.

Means are provided for mounting centrifugal grinding rolls 14 on the shaft 13 inside the drum. As shown, the shaft is provided with a plurality of spaced spiders 15 formed with radial slots 16 for receiving roll bearing blocks 17. The rolls may be provided with removable journals 18 mounted in the bearing blocks 17.

The surfaces of both rolls and drum may be made very hard to resist the grinding action but the movement between the drum and rolls is largely a true rolling action so that the grinding is largely a crushing action and the wear between rolls and drum is a minimum.

Material is fed in through an opening 19 in the periphery of the drum by a positive feed device such as a worm 20. The material is fed from a hopper 21 and a regulating plate 22 may be used to control the rate of feed.

The positive feed provided by the worm 20 insures that closely regulated amounts of material will be pushed in to the rolls; also that the liquid material will not be forced out into the feed opening to clog the feed. By providing the feed opening on the side it is possible to feed solid or liquid material properly with the least filling of the interior at the shaft regardless of the speed of rotation of the rolls. By feeding material positively by means extending almost to the rolls, the selective pick-up of material of certain sizes by the rolls, which is characteristic where fluid material is fed to rolls in a large free body, is avoided.

Ground material is discharged at both ends of the drum through openings 23 and flows down chutes 24 to a point of delivery.

The material seals the feed opening and also the discharge opening, when that is made small enough. In cases where grinding is done under pressure or in a partial vacuum, special air locks, such as rotary valves, screws and the like, may be provided at inlets and outlets. Consequently it is possible to maintain any desired atmosphere and any desired pressure within the drum. Even a vacuum may be maintained. This is very important in dealing with some materials and in all cases prevents contamination from outside.

Where the material supplied is in large par-

ticles the central rolls or the central portion of the rolls may be made of large diameter in order that the angle of entry of material may be deeper and also more effective for seizing and crushing the particles. The end rolls 14a may be made of smaller diameter because the particles are much smaller by the time they advance to these points. To give an idea of the work done by one of these mills, it may crush cocoa nibs of from $\frac{1}{8}$ to $\frac{1}{16}$ inch size and deliver material of such fineness that only a fraction of 1% fails to pass a 150 mesh screen. The grinding is very uniform and it is not necessary to throw material back or hold it in the grinding zone as is usual with many previous grinding mills because the progressive grinding action precludes the possibility of material not being subjected to sufficient grinding.

The long grinding zone or long grinding rolls and the continuous progressive grinding action are very important from the standpoint of uniformity of product as well as from the standpoint of large production.

The feature of feeding material to the center of long rolls or at the center of long grinding zones is also important because it permits a balanced grinding action and longer life of the machine. The action is improved by providing a few large rolls in the center, three being shown in Fig. 2, and a larger number of small rolls at the ends, six being shown in Fig. 2.

The drum may be provided with a jacket for heating or cooling fluid to supplement or counteract the heat produced by grinding. By suitable controls a uniform heat best suited to the material under treatment may be maintained.

In the modification shown in Fig. 3, the central portion of the drum 11' may be enlarged or recessed as at 30 for the large grinding rolls 14' when it is desired to accentuate the coarse grinding action. The steps at the ends of the enlarged portion retard the movement of large particles to the fine grinding zone. It will also be noted that in the embodiment shown in Fig. 3 the large rolls and the small rolls are formed integrally. This permits the shaft bearings in the spiders 15' to be located at the ends of the drum outside the zone in which material is disposed. This is important when dealing with materials having abrasive characteristics. In order further to protect the bearings, shields 31' may be provided at each end of the drum. These shields have a close fit with the shaft and drum and provide a sliding seal for the roll shafts. Also if desired they may be suitably shaped to urge material back toward the rolls and away from the bearings.

When large rolls and small rolls are mounted integrally one of them may not have a true rolling action but the variation will not be great enough to cause any difficulties in operation.

In Fig. 3 the parts which correspond to those shown in Figs. 1 and 2 are designated by the same reference characters with a prime (') added.

The mill shown in the Fig. 4 modification is similar to that of Fig. 3 except that the rolls 14'' are approximately the same diameter throughout their length and the recessed portion of the drum is not present. This like the Fig. 3 form, places the roll bearings in protected zones.

Other parts which correspond to those shown in Figs. 1 to 3 are designated by the same refer-

ence characters with a double prime (') added.

When employed for grinding and emulsifying or dispersing high volatile materials, the mill may be provided with a condenser for automatically condensing and continuously returning to the mill volatile constituents which may be evaporated during the operation of the mill. Such a condenser might be of the open coil type so that a pressure could not build up in the grinding chamber due to the grinding temperatures and corresponding vapor pressures of the volatile vehicle. Also, if desired, the product may be discharged through a jacketed and trapped delivery tube which chills the product to such a temperature below the temperature of the grinder as may be required by the nature of the volatile product. The loss of volatile material, which is usually expensive and hazardous is thus avoided. In Fig. 3 there is shown suitable apparatus for liquefying the volatile constituents as by a condenser 39; and for returning the condensate to the grinder. The recovery system is shown only in the Fig. 3 embodiment but it may be used with any embodiment.

While certain embodiments of the invention have been specifically described it is to be understood that the invention may have various embodiments within the limits of the prior art and the scope of the subjoined claims.

We claim:

1. A grinding mill comprising in combination, an elongated horizontal stationary drum, a rotary shaft passing through said drum along its axis, three sets of elongated par-axial radially movable centrifugal rolls rotatably carried by said shaft for rolling against the interior of said drum, the sets being disposed in order along the axis of the drum, the central set of rolls being of large diameter and the end sets of rolls being of smaller diameter, means for forcing material through the wall of said drum near its mid-height and mid-length, and outlets for the ground material at each end of the drum.

2. A grinding mill comprising in combination, an elongated horizontal stationary drum, means for feeding material into the drum through its outer wall intermediate its ends and substantially not above mid-height, a par-axial rotary centrifugal cylindrical roll of large diameter spanning the feeding zone, discharge means at the ends of the drum, and a par-axial rotary centrifugal cylindrical roll of smaller diameter near each end of the drum.

3. A grinding mill comprising in combination, a horizontal stationary drum having a feed opening and an axially spaced discharge opening, the drum being provided with an annular recess of enlarged diameter spanning the zone of the feed opening, a par-axial centrifugal roll operating in said annular recess, and a centrifugal roll operating in the smaller portion of the drum beyond the annular enlarged recess in the zone of the discharge opening, whereby material is required to flow upward over the offset between the enlarged annular recess portion and the portion of smaller diameter under the influence of the rolls in moving from the feed opening to the discharge opening.

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