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MACHINERY FOR GRINDING, MIXING, AND LIKE OPERATIONS

Filed May 24, 1928

2 Sheets-Sheet 1

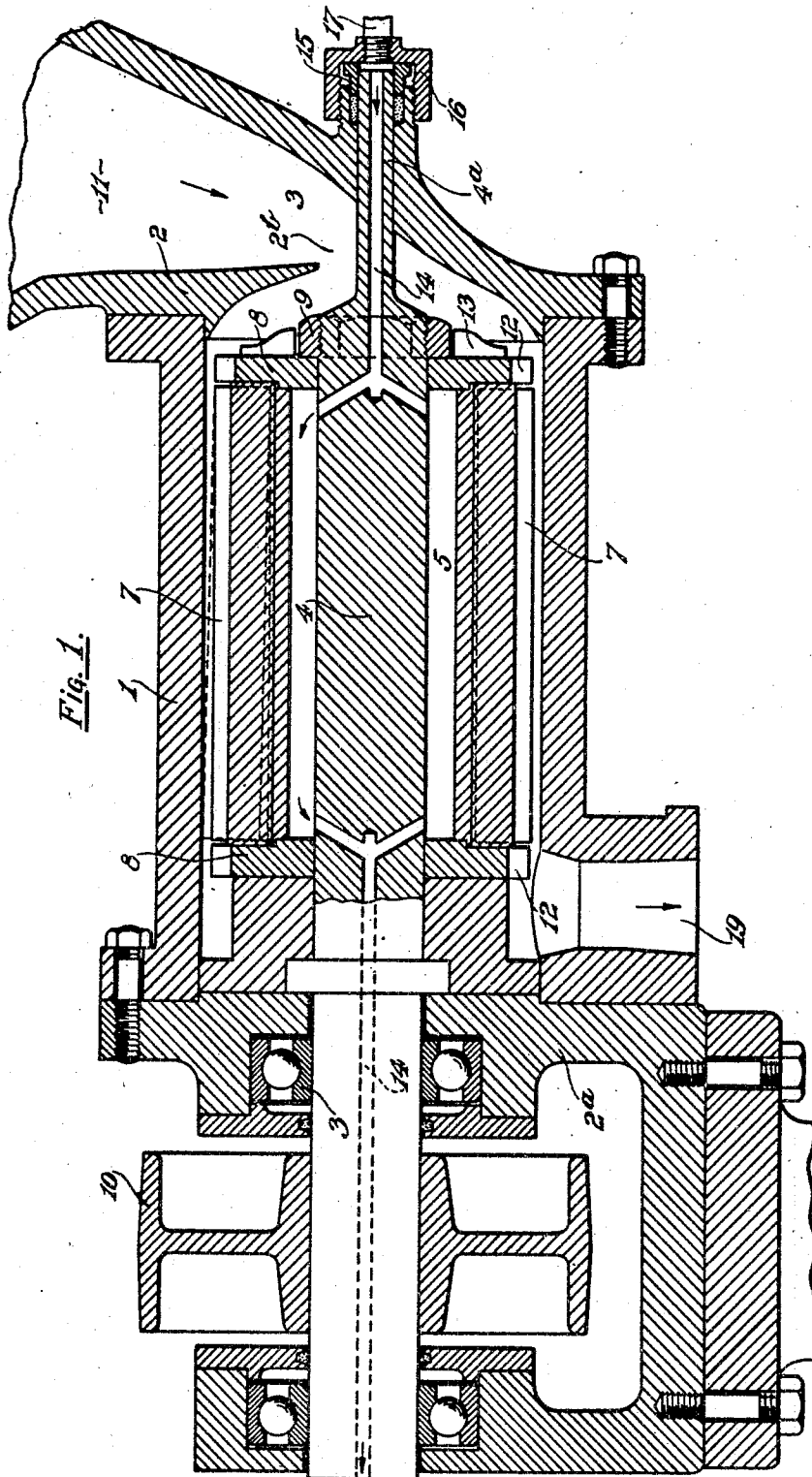


Fig. 1.

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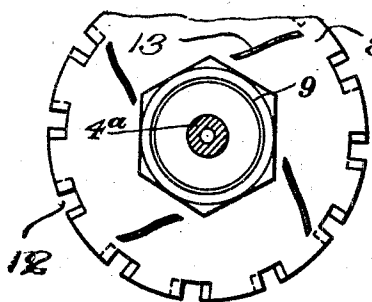
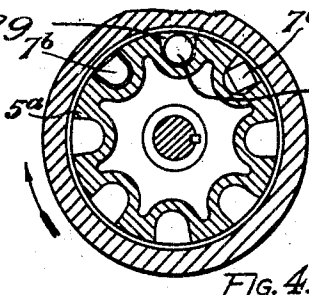
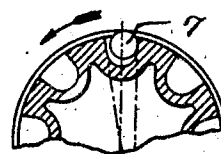


Fig. 5.

Fig. 2.

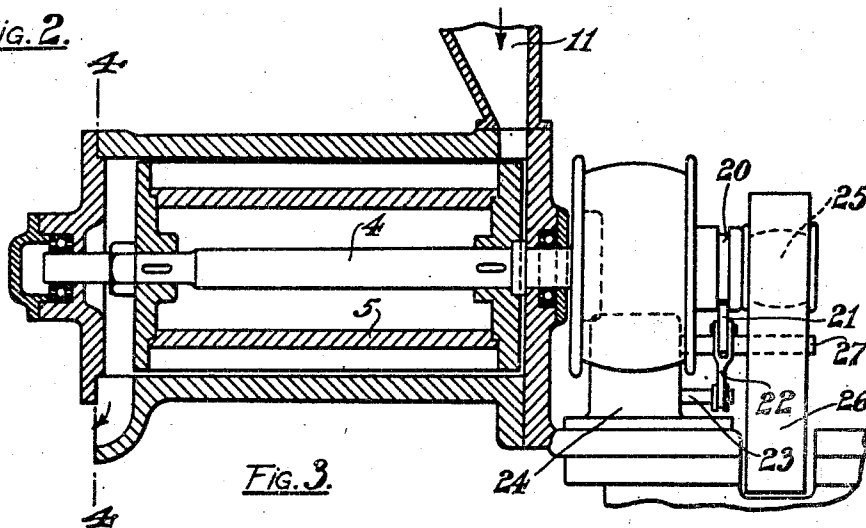


Fig. 3.

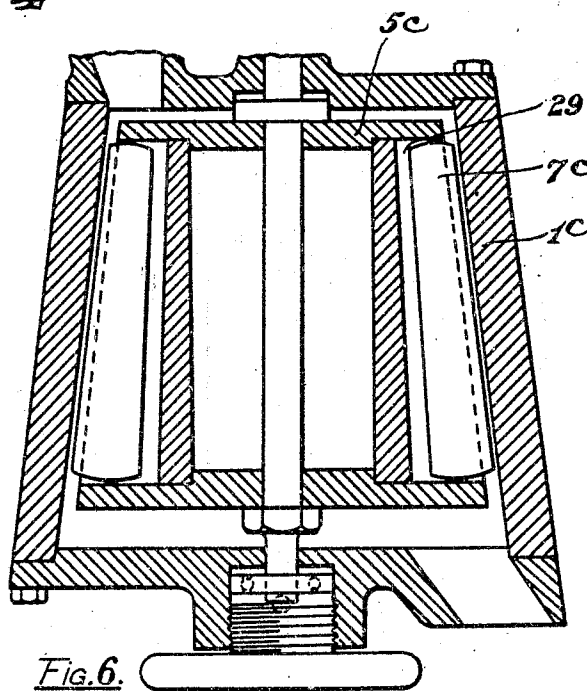


Fig. 6.

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UNITED STATES PATENT OFFICE

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MACHINERY FOR GRINDING, MIXING, AND LIKE OPERATIONS

Application filed May 24, 1928, Serial No. 280,340, and in Great Britain June 7, 1927.

This invention has reference to a method of and means for grinding, mixing and the like operations, and has for its object to provide an improved method of and means for achieving this operation in which the material to be treated is fed in at one end of the device in the crude state, the volume of material passing through the machine being an automatic function of design, and further in which the degree of fineness is also a predetermined quantity, the material passing from the apparatus in a finished state.

The invention relates to that class of grinding or mixing machinery in which the material to be ground or mixed passes between and is subjected to the influence of a rotary and rotating member and a stationary member, the former being subjected to the additional influence of centrifugal force.

In contradistinction to previously existing types of this character, above described, the material treated by the method constituting this invention is not only progressively and automatically fed along the surfaces of the grinding device but is simultaneously subjected to a progressive grinding action so that each particle is acted upon and reduced in dimensions from a maximum to a minimum with the result that the ultimate form of the ground or mixed material is uniform, homogeneous and of a kindred particle size.

In carrying this invention into effect and in its mechanical essentials it comprises two co-axial cylindrical members, the one within the other with a predetermined equi-spaced annulus between the outer face of the inner cylinder and the inner face of the outer cylinder, the inner cylinder constituting a rotor and the outer the stator secured to a rigid support. The rotor is equipped with grinding rods or bars, freely housed upon its surface in radial planes, which are capable of outward movement under centrifugal force, the material to be ground or admixed being automatically drawn into the machine from a magazine hopper at one end and caused to traverse the angular passage between the outer and inner surface of the two cylinders respectively, during which operation it is progressively advanced and ground therein,

and finally passed out at the opposite end in its required condition.

Although the essential features of the invention are similar for both wet or dry grinding or mixing, there are small differences in the feeding mechanism and design of grinding bar pertinent to each of these physical qualities of raw material to be treated as will be more fully described hereafter, and in order to render the invention more easily understood, reference is made to the accompanying drawings in which are described the preferred means of carrying the invention into effect and in which:—

Figure 1 is a longitudinal sectional elevation of one form of machine according to the invention and as designed for dry grinding and mixing,

Figure 2 is an end elevation of feed distributor at inlet end of Figure 1,

Figure 3 shows a longitudinal sectional elevation of wet grinding and mixing machine,

Figure 4 is an end sectional view of Figure 3 at line 4—4 of Figure 3, showing alternative forms of grinding bars or rods,

Figure 5 shows detail of grinding bar slots in rotor member and

Figure 6 shows detail of modification in sectional elevation.

Referring to the drawings in Figure 1 a cylindrical casing or stator 1 is provided with end plates or equivalent covers 2, 2^a, said covers or cover plates 2, 2^a having journals 3 for housing the driving shaft 4, carrying the rotor or inner member 5. This externally longitudinally slotted cylindrical rotor 5 carries the grinding bars or rods 7 and is held by end flanges or cheeks 8 keyed or pinned to the shaft 4, the assembly being held in operative position by nut 9 on shaft 4. The shaft 4 is driven by a pulley 10 in any convenient manner and at the desired speed. The material to be ground is introduced into the hopper 11 which is provided with any suitable control means for regulating the outlet formed in or upon the cover plate 2 in a crushed or coarsely ground condition, the size being such that it will pass through the apertures cut obliquely in the periphery of

the feeding end rotor flange 8 to which the material is fed by fan-shaped projections 13 also disposed on flange plate 8 (see Figure 2).

As the grinding of coarse material such as silica, barytes, bauxite and the like generates considerable heat it is convenient to cool the shaft 4 and rotor 5. This is achieved by drilling the shaft 4 as shown with passages 14 for cooling fluid, the end of the shaft 4^a being extended and terminating in a gland packed journal 15, the cover 16 thereof being provided with a supply pipe 17 for cooling medium whose circulation may be maintained on thermostatic principles or by a small wheel or equivalent pump (not shown) operated by the shaft 4. The stator may also be provided with a water jacket if desired.

As shown in Fig. 4, the rotor 5^a carries the various shaped grinding bars 7^c, 7^a and 7^b, or may carry a number of like shaped ones.

The operation of this form of machine is as follows:—

The material to be ground or admixed is introduced into the hopper 11, whence it gravitates to the opening 2^b in the cover plate 2. It then comes immediately under the influence of the rotating shaft 4, vanes 13 and slots 12 of the end flange plate 8 of the rotor 5 driving same under centrifugal force into a small annular space between the stator 1 and rotor 5 where it is subjected to the crushing effect of the grinding bars, rods or rollers 7. The effect of this is to make the freely housed bars, rods or rollers 7 be depressed at the point of material entry and forego their parallelism to the rotor axis, and cause them to assume the position shown in dotted lines (Figure 1) the material as it is crushed being fed forward by the oncoming material, the air draught induced by rotation and also by the angle of grinding bar. As the rotor continues to revolve, the centrifugal force exerted upon the grinding bar 7 is evidenced upon the material with which they contact, with the result that not only is the material progressively fed forward, but also subjected to a crushing or grinding effect which is proportioned automatically to the particle size of the previous grinding result. The bars 7 therefore do not have a true rolling action on the grinding surfaces of the stator 1 since they have frictional contact with the wall of the pocket or recess of the rotor 5. This condition results in a certain drag between the surfaces of the bars 7 and the stator, which drag is necessary to obtain an effective grinding or mixing action. The draft induced by the motion of the rotor 5 and its accessories assists in blowing particles capable of aerial transit to the ejection end, 19 of the device, ridding the annulus of unnecessary material which has been already levigated to the desired extent.

In Figure 3 the invention is shown as applicable to wet grinding and mixing such as

applied to paint, oil colours, distempers, slurries and the like. In this form of the invention the inlet hopper is placed as shown, the material entering the annular space and being ground or mixed as it passes therealong. As, however, in wet grinding there is a tendency for grinding to take place in defined areas over the surface of the stator, the rotor 5' is caused to reciprocate as a whole within the stator. This is achieved by providing a race path 20 on the driving shaft 4', with which cooperates a race roller 21 engaging therein, the said roller being mounted in fork 22 fast on reciprocating shaft 23, said shaft being caused to reciprocate by means of a cam and cam race (not shown) situate within the gear box 24, the main shaft of which is driven by pulley 25 on shaft 4', which in turn operates pulley 26 on shaft 27 of gear box. The gear box 24 enables any desired reciprocation of the rotor to be achieved per number of revolutions.

Reference is now made to Figure 4 in which the housing of the grinding bars or rods is illustrated. For coarse and dry material the round rod 7^c is preferred. This is housed in a slot 29 formed in the rotor body 5^a. The rod revolves in a reversed direction to the rotor itself. When grinding takes place a certain part of the material to be ground or mixed is dragged into the slot and suffers a supplementary grinding action adjacent the face of the slot. It has been found convenient to make the side or faces of the slots converge toward the bottom, the point of convergence being eccentric as shown by the dotted lines in Figure 5, this arrangement allowing greater freedom in egress than entry, and thereby obviating choking which might otherwise ensue.

For wet grinding and especially in the case of enamels an edged bar 7^a or 7^b may be employed its outward throw during rotation producing a finer drag on the suspended particles in any medium than a roller, due to the fact that it does not revolve, but rather wears down the particles thrown as a film on the stator surface with which it engages.

In Figure 6 is shown a further type of machine with a tapering rotor 5^c and stator 1^c and having also tapered slots 29 and tapered grinding elements 7^c. Machines so constructed are particularly adapted for use in the vertical position, and are eminently suitable for powdering friable material such as coal, coke, breeze and the like, but when used vertically no feeding can take place until the rotor is in motion.

It will be seen from the foregoing that the volume of wet or dry material treated depends upon the width of the annulus between the stator and the rotor. In cases where the material merely requires to be broken down such as in the case of moulding

sand, the annulus width may be increased and the volumetric output rises in proportion. Where, however, fine grinding and mixing is required, the width of the annular space is diminished. Further, the length of the grinding member determines to some extent the fineness of the material after treatment, and the time period over which the treatment takes place. Hence in designing machines according to this invention the volume of material treated and its fineness can both be made predetermined quantities, when the qualities of the raw material are known.

15 Claims.

1. A grinding machine including in combination a stator housing of a length greater than its diameter into one end of which material to be ground is fed and from the other end of which the ground material is discharged. a rotor in said housing axially aligned therewith and provided with a plurality of continuous longitudinal pockets in its periphery, and grinding members freely housed, one in each pocket of said rotor whereby a drag between the surfaces of said stator and the grinding members produces a grinding effect progressively and longitudinally through the machine.

2. In combination with a grinding machine as set forth in claim 1, of means for reciprocating the rotor and grinding elements during the rotation of the rotor.

3. In combination with a grinding machine as set forth in claim 1, said rotor being hollow, of means for circulating cooling fluid in said rotor.

4. In a grinding machine as set forth in claim 1, said rotor being hollow, a rotary perforated shaft passing therethrough, glands supporting said shaft, and fluid circulating devices in communication with said shaft.

5. In a grinding machine as set forth in claim 1, in which the rotor and stator are tapered, and in which the grinding members are aligned to the resultant annulus.

In witness whereof I affix my signature.
JOSEPH HERBERT JAMES WOOD.

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