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MILL

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FIG. 1.

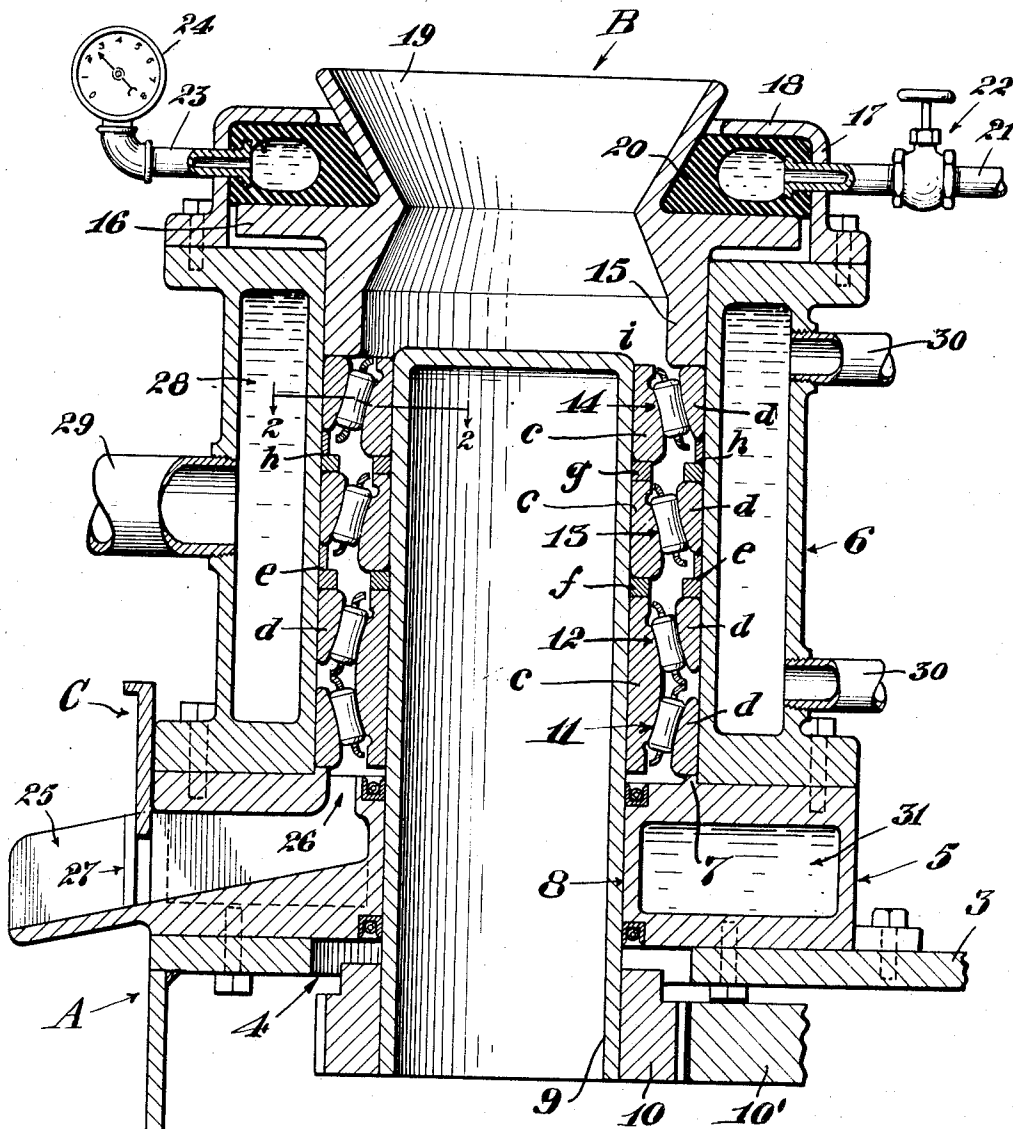
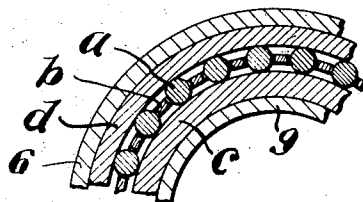


FIG. 2.



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MILL

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1 Claim. (Cl. 83—22)

This invention relates to a mill and more particularly pertains to mills of the type employing crushing and grinding rollers and which is applicable for use in reducing solid particles to a finely comminuted or pulverulent state, and which is also suitable for use in effecting the intermixture or intergrinding of solid particles with liquids or semi-liquids, as in the production of pastes.

10 An object of the invention is to provide an arrangement of the crushing or grinding rollers such that the materials being worked will be subjected successively to a series of grinding and crushing actions and in a manner to effect rapid and thorough reduction of the solids being worked and their intermixture with liquids where the mill is utilized in forming a paste.

15 Another object of the invention is to provide a mill of the above character which embodies an effective means for varying the working pressure of the crushing and grinding elements of the mill and which is adapted to be adjusted finely to a predetermined extent.

20 A further object is to provide a mill with a compression adjustment means adapted to be equipped with an indicator capable of showing the extent of the compression adjustment.

25 Another object is to provide a construction and arrangement in the crushing and grinding roller assembly whereby the parts embodying the wearing surfaces may be readily removed and replaced.

30 With the foregoing objects in view, together with such other objects and advantages as may subsequently appear, the invention is carried into effect as illustrated by way of example in the accompanying drawing in which:

35 Fig. 1 is a view in vertical section of a mill with parts shown in elevation;

40 Fig. 2 is a detail in horizontal section taken on the line 2—2 of Fig. 1 showing the manner of forming the roller assembly.

Referring to the drawing more specifically A indicates generally the base portion of the mill which may be of any suitable construction but is here shown as embodying a platform 3 formed with an opening 4 on which platform is seated a hollow base block 5 extending over the opening 4 and on which block is seated and affixed a hollow cylinder 6; the block 5 being formed with an upstanding annular flange 7 which is encircled by the cylinder 6 and by means of which the cylinder is centered on the block with its inner periphery spaced from and concentric with a circular opening 8 formed in the block 5.

55 Extending upwardly through the opening 8 and

revolvable therein is a tubular shaft 9 the lower end of which projects through the opening 4 of the base panel 3 and is fitted with a spur gear 10 engaged by a pinion 10' whereby the shaft 9 may be rotated from any suitable driving mechanism.

5 The upper portion of the shaft 9 is spaced from the inner periphery of the cylinder 6 in concentric relation thereto and interposed between the shaft and cylinder is a series of superimposed annular rows of grinding and crushing rollers; four of such rows being here shown but which number may manifestly be increased or diminished as occasion may require.

10 Each row of the rollers embodies a series of concave rollers *a* carried in a cage *b* and interposed between inner and outer raceways *c* and *d* snugly fitted respectively on the outer periphery of the shaft 9 and on the inner periphery of the cylinder 6. As here shown the raceway *d* of the lowermost row of rollers *a* indicated at 11 is seated on the flange 7 with the rollers *a* bearing on the raceway at an upward and outward inclination. The inner raceway *c* of this row 11 of the rollers bears on the latter and is formed to afford a bearing for the succeeding row of rollers indicated at 12, which latter rollers bear on the upper portion of the double inner raceway *c* at an upward and inward inclination, that is, in a direction of incline opposite that of the lower row of rollers 11.

15 The outer raceway *d* of the second row of rollers 12 bears on the latter and seating on this outer raceway and the upper end of its associated inner raceway *c* is a pair of spacing rings *e* and *f* on which latter is seated the inner raceway *c* of the succeeding row 13 of the rollers *a* the outer raceway *d* of which seats on the spacing ring *e*. The rollers *a* in the row 13 thereof bear on their associated inner raceway *c* at an upward and inward inclination while the associated raceway *d* bears on said row of rollers. Spacing rings *g* and *h* bear respectively on the inner and outer raceways *c* and *d* of the row 13 of the rollers, and bearing on the ring *g* is the inner raceway *c* of the upper row of rollers 14 against which the rollers *a* of the latter row bear at an upward and inward inclination. The outer raceway *d* of the upper row bears on the associated rollers *a* and also on the spacing ring *h*.

20 Owing to the longitudinally concaved character of the individual rollers *a* and the correspondingly convexed shapes of the raceway members *c* and *d* which interfit with them, said rollers are maintained in their grinding positions in a very stable manner and also produce a uniform

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crushing action upon the material being ground.

Seating on the outer raceway *d* of the upper row of the rollers is a crowding ring 15 the outer periphery of which slidably conforms to the periphery of the upper portion of the cylinder 6 and the inner periphery of which is spaced outwardly relative to the outer upper margin of the upper inner raceway *c* to provide a space *i* for entry of materials to be crushed and ground into the space traversed by the rollers *a*.

The crowding ring 15 is here shown as formed on and constituting the lower end of a feed hopper B, which is formed with an outwardly projecting horizontal flange 16 overlying the upper end of the cylinder 6 and spaced a short distance therefrom.

Mounted on the upper end of the cylinder 6 is an upstanding ring 17 formed with an inturned flange 18 on its upper margin extending in spaced relation to the flange 16 to a point proximate the outer periphery of the side wall 19 of the hopper B which side wall is circular and tapers downwardly and inwardly in the form of an inverted truncated cone.

Interposed between the flanges 16 and 18 is a resilient tubular annulus 20 of such cross section as to completely occupy the space bounded by the upper and lower faces respectively of the flanges 16 and 18 and by the inner and outer peripheries of the ring 17 and hopper wall 19 respectively. Connecting with the interior of the annulus 20 is a conduit 21 leading from any suitable source of supply of fluid under pressure and which conduit is fitted with a conventional cut-off valve 22 for regulating the delivery of the fluid under pressure to the interior of the annulus 20 to effect expansion of the latter and thereby impart a downward pressure on the flange 16 and its associated crowding ring 15 and thus impose a pressure downwardly on the crushing and grinding roller assemblage.

As a means for enabling the imposing of a predetermined pressure on the roller assemblage the annulus 20 is fitted with a tube 23 leading from the interior thereof and connecting with a conventional pressure gauge 24.

The base block 5 is formed with a discharge trough 25 which leads downwardly from an opening 26 communicating with the space traversed by the lower row 11 of the rollers *a*, and is fitted with a gate C carried in guides 27.

The cylinder 6 is hollow to provide a water jacket 28 through which water is directed from an intake pipe 29 from any suitable source of supply to fill the water jacket and from which the water is passed through the discharge pipes 30 so as to effect transfer of heat from the crushing and grinding elements during operation.

Cooling liquid may also be circulated through a space 31 in the base block 5 and a spray of cooling liquid may be directed into the hollow shaft 9 from the lower end of the latter to effect a cooling action thereon.

In the operation of the invention the materials to be ground and crushed are fed into the hopper B in a granular form either in a dry state, or with a liquid when it is desired to effect the grinding action in the presence of liquid. On rotating the shaft 9 the inner raceways *c* carried thereon will revolve therewith and accordingly the rotating raceways *c* will effect rotation of the rollers *a* in such manner that the rollers *a* of the several rows thereof will rotate and travel collectively in spaced relation to each other on their respective raceways *c* and *d*, with the rollers traversing the

outer raceway *d* carried on the fixed cylinder 6. The material delivered to the hopper B will feed into the spaces traversed by the upper row 14 of rollers *a* through the space or passage *i* and will be acted on by these rollers as the materials pass downwardly therebetween; the materials passing successively downward from the row 14 of the rollers through the rows 13, 12 and 11 thereof so as to be thereby successively acted upon by the several groups of rollers. The rollers manifestly will act to crush and grind the materials fed thereto and with the result that the materials will be finely pulverized or comminuted when they pass from the lowermost row 11 of rollers through the outlet 26 to discharge through the trough 25. The discharge of the ground material is decelerated by reason of the rollers in the lowermost row 11 being inclined inwardly as well as downwardly, thus decreasing the circumference of the annular discharge space between the lowermost raceways *c* and *d*.

Any desired pressure may be imposed upon the crushing and grinding rollers by applying fluid under pressure to the interior of the expansible resilient annulus 20 which pressure will exert a downward thrust through the crowding ring 15 to the outer raceway *d* of the rows of rollers 14, 13 and 12 respectively, and thereby impart inward and downward pressures on the rollers of these rows and their associated inner raceways *c*; the downward pressure imposed on the lower double raceway *c* being directed outwardly and downwardly against the rollers *a* of the lower row 11 and their associated outer raceway *d* which is fixedly seated on the base block 5.

Rotation of the shaft 9 and the raceways *c* thereon will set up a centrifugal action between the inner and outer raceways tending to throw the materials being worked outwardly which action by reason of the rollers of the three upper rows, 13, 14 and 12 thereof being inclined outwardly and downwardly with the lower ends of the upper raceway spaced outwardly from the upper end of the succeeding raceway such as to afford inward off-sets in the passageway through the successive rows of rollers, will impede the flow of the materials downward so as to insure their being subjected to the crushing and grinding action of the rollers. This flow of the materials is further impeded by inclining the rollers *a* of the lowermost row inwardly and downwardly. This arrangement forces the materials to flow inwardly at this point in opposition to centrifugal force thus effecting a sustained action on the materials preliminary to their discharge.

In imposing pressure on the roller assemblage through the medium of the expansible annulus 20 fluid pressure is directed to the interior of the latter from the conduit 21 by opening the valve 22 until the desired pressure designated by the pressure gauge 24 is reached, whereupon the valve 22 is closed so as to maintain the roller assembly under the established pressure for such length of time as occasion may require.

The annulus 20 being resilient is yieldable under excessive upward thrusts as might be imposed thereon through the crowding ring 15 from the roller assembly.

When it is desired to subject the materials to a more prolonged action of the rollers, the gate C 70 is closed by lowering it in the guides 27 so as to cut off discharge of materials from the mill and accordingly hold the materials in a confined state within the mill.

It will be manifest that the mill herein set

forth is highly suitable for use as a mixer in forming paints and the like, in which the solid materials fed to the mill have been previously ground to requisite fineness and require no further grinding action and merely need to be thoroughly intermixed with a liquid. In some instances the materials fed to the mill may be in fluid or semi-fluid state in which event the roller system will function to effect mixing of the materials without regard to grinding or crushing action thereon.

While I have shown and described a specific embodiment of my invention I do not limit myself to the exact details of construction and arrangement shown, and it will be understood that various changes and modifications may be employed without departing from the spirit of the invention as defined in the accompanying claim.

I claim:

In a mill, a series of superimposed rows of crushing and grinding rollers, inner and outer raceways supporting the rollers of each row, means for rotating the inner raceways collectively, a housing slidably supporting the outermost raceway, a crowding ring seating on the uppermost outer raceway, a hopper formed on said crowding ring, an outwardly extending flange on said hopper, a confined expansible hollow annulus seating on said flange, and means for directing fluid under pressure into said annulus, an increased supply of fluid pressure to said annulus causing said crowding ring to press more heavily upon said uppermost outer raceway.

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