March 20, 1934. W. P. EPPERS 1,951,823

GRINDING MILL

Filed April 7, 1930 2 Sheets-Sheet 1

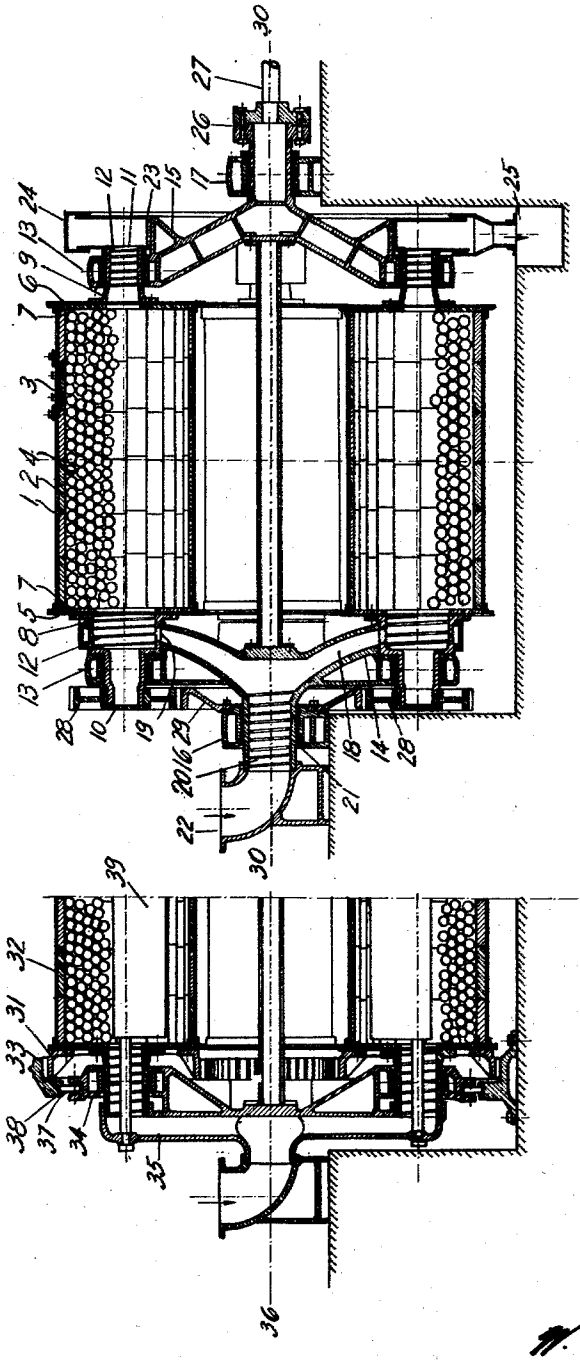


FIG. 1

FIG. 2

W. P. Eppers.

INVENTOR

BY Paul O. Parker

ATTORNEY

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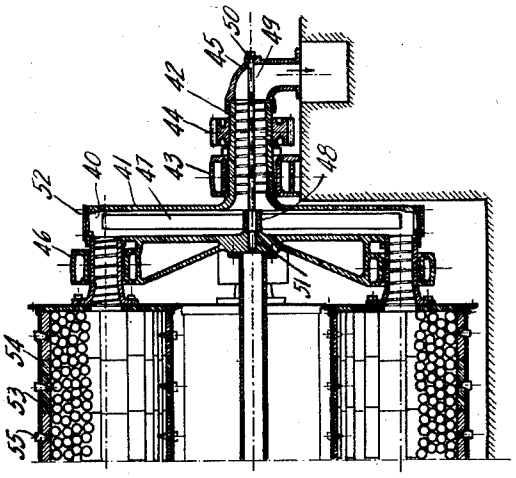


FIG.3

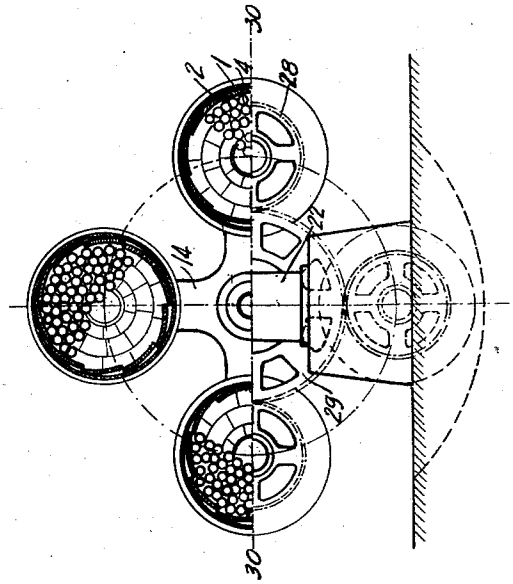


FIG.4

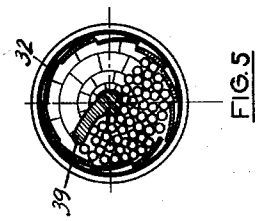


FIG.5

W. P. Eppers.
INVENTOR

BY

ATTORNEY

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UNITED STATES PATENT OFFICE

1,951,823

GRINDING MILL

Walter P. Eppers, Catasauqua, Pa.

Application April 7, 1930, Serial No. 442,408

1 Claim. (Cl. 83—9)

The invention relates to mills and more especially to grinding mills and analogous appliances having hollow working receptacles, barrels or drums for enclosing the material or materials operated upon, such for example as ball or tube mills.

The primary object of the invention is to improve the operation of ball or tube mills, belonging to one of the most important machines for disintegrating in which a receptacle, barrel or drum of tubular or conical form and filled with steel pieces or steel balls is rotating at medium speed, moving, therefore, said pieces or balls constituting the grinding elements which are mixed with the material to be ground. These mills known in the constructural form yield a very low efficiency concerning their weight and outside dimensions.

The invention has for another object to provide a revolving tube mill with an additional rotation around an auxiliary axis, the tube mill itself rotating besides this movement around its own centerline; the grinding elements, therefore, receiving a centrifugal influence by this additional rotation.

A further object of the invention is the provision of a mill of this character, wherein there is the combination of a series of said mills to a unit, two mills each compensating their bearing reactions.

A still further object of the invention is the provision of a mill of this character, which gives the possibility of high speed and extraordinary capacity in comparison with the weight and outside dimensions, strong, durable, requiring little space in respect to their output and reducing the production costs for grinding to a minimum.

With the foregoing and other objects in view, the invention consists in the features of construction, combination and arrangement of parts as will be hereinafter more fully described, illustrated in the accompanying drawings, showing the preferred and modifications of the invention and pointed out in the claim hereunto appended.

In the accompanying drawings:

Figure 1 is a vertical longitudinal sectional elevation through a grinding mill constructed in accordance with the invention.

Figure 2 is a fragmentary vertical longitudinal sectional view of the front portion of a modified form of grinding mill.

Figure 3 is a view similar to Figure 2, showing the rear portion of a further modification of grinding mill.

Figure 4 is a front end view, partly in section and partly in elevation of the grinding mill illustrated in Figure 1,

Figure 5 is a vertical transverse sectional view through one tube of the mill shown in Figure 2.

Similar reference characters indicate corresponding parts throughout the several views in the drawings.

Referring to the drawings in detail, particularly Figures 1 and 4, the grinding mill comprises a series of receptacles, barrels, drums or tubes 1, in this instance four in number, it being understood that the number can be increased or decreased, each having a steel plate lining 2, as generally used for mills and further provided with a manhole 3, while partially filling said receptacle, barrel, drum or tube are steel balls or metal discs as grinding elements 4. Each receptacle, barrel, drum or tube 1, is closed by end covers 5 and 6, these being fitted with linings 7, and the cover 5 is provided with an inlet opening 8, while the cover 6, is provided with the outlet 9.

The inlet opening communicates with a hollow shaft 10, and the outlet opening communicates with a hollow shaft 11, through which the material is transported by conveyor ribs 12. Each receptacle, barrel, drum or tube 1, is journaled by its shafts 10 and 11 in bearings 13, of front and rear supporting frames 14 and 15, combining the said receptacles, barrels, drums or tubes as a unit, rotatably supported in bearings 16 and 17, the forward or front frame 14 handling the feed of the mill by channels 18, leading to the hollow shaft 10, from a common inlet 19 formed by a hollow shaft 20, the latter being provided with transporting or conveyor ribs 21 for the material, which is taken into the mill by an inlet hopper 22, the latter being suitably connected dust-tight to the shaft 20.

Marginally of the frame 15 and connected with the outlet shafts 12 is disposed the discharge ring 23, rotating with the rear supporting frame 15, and discharging the finished material into the ring shaped receiver 24, the latter being dust-tight with the ring 23 and is provided with the outlet opening 25. In order to effect a dust free operation of the mill the receiver 24 or the connection next to the outlet opening 25 has to be connected to a ventilator having a filter. The shaft of the supporting frame 15 is provided with a coupling 26, the latter connecting to a driving shaft 27 driven by an auxiliary motor (not shown), while the shafts 10 are fitted with gears 28 meshing with a stationary gear 29, the latter being mounted upon the bearing housing 16 or upon a foundation.

The operation of the mill will be as follows:

A driving motor will turn the shaft 27 and moving the receptacles, barrels, drum or tubes around the centerline indicated at 30 with high speed forcing the grinding elements 4 to follow their centrifugal power and to lay against the parts of the mill lining with the greatest distance from said centerline, the level of the mentioned elements, therefore, always showing the same distance from the center regardless of the position of the receptacles, barrels, drums or tubes, these latter rotating further by the train of gearing 28, and 29 around their own axes, are going to take along said elements according their rotation as long as they are falling back to their original position by the centrifugal influence of the first mentioned rotation around the axis 30, producing therefore, a grinding action between the mill lining and such elements. The feed of the mill is handled as heretofore mentioned, namely, through the hopper 22 and the channels 18, the outlet of the mill being effected through the discharge ring 23 and the receiver 24, as hereinbefore described.

In Figures 2 and 5, of the drawings there is shown a slight modification, wherein the gears 31 mounted on the front ends of the receptacles, barrels, drums or tubes as at 32, are in connection with a stationary external gear 33, the latter being mounted on a foundation. The receptacles, barrels, drums or tubes are journaled in bearings 34 of the front supporting frame 35 and the rear supporting frame, these frames turning around the axis 36 by rollers 37 travelling in raceways 38, the latter being connected with the gear casting 33. Each receptacle, barrel, drum or tube is supplied with a ball retaining plate 39 mounted in the front and corresponding rear frames and which is in tight conection with said frames.

The retaining plate 39 is designed to retain the balls in lining up a ring around the mill center for an instance where the rotation of the receptacles, barrels, drums or tubes for some reason is selected out of proportion with respect to the main rotation, otherwise these plates 39 would not be necessary. The installation of a retaining plate as at 39 is applicable for a single receptacle, barrel, drum or tube with a single rotating axis, the retaining plate being stationary in this case, and avoiding the mentioned lining up of the balls to the ring around the centerline, when the speed of the mill is increased.

In Figure 3 of the drawings there is shown a further modification of the invention for the rear or outlet end of the mill, wherein the cylindrical discharge chamber 40, of the rear frame 41 is in communication with a hollow shaft 42, the latter being journaled in main bearings 43 and driven by a gear 44, and discharges into a hopper 45. The rear frame supports the mill in bearings 46. The receiving or discharge chamber 40 has therein a series of radial blades 47, which are connected with the hub 38 on the shaft 49, the blades being stationary and divide the chamber into compartments, and this shaft 49 is stationary through its connection 50 with the hopper 45. The inner end of the shaft 49 is supported in a bearing 51 in the rear supporting frame. The discharge chamber 40 is closed by the plates 52. The blades retard the discharging material from rotation with the rear frame in order to prevent packing resultant from the centrifugal action.

Between the lining 53 of the receptacles, barrels, drums or tubes are provided orifices 55 adapted for connection with an air pressure line or air pressure in a mill room, in order to separate the ground material from the unfinished material, the ground material being discharged by the air into the hopper 45, the latter being adapted to be connected with a ventilator having a filter or separator device (not shown). The arrangement of orifices 55 between the lining 53 also is applicable for a single receptacle, barrel, drum or tube and has the advantage of taking off the fine material at the place where it is finished in order to prevent a useless regrinding.

The arrangement of the invention eliminates the limitation of the mill capacity according to a maximum favorable speed by replacing the gravity with the effect of the centrifugal power of the main rotation around the axis 30, on the contrary, the faster the mill is revolving the more efficient the grinding action will be. In order to create a sufficient centrifugal power the mill requires a certain speed for its operation, otherwise the proportion of the revolutions of the system and of each mill that is the ratio of the gear mechanism 28 and 29 has to be selected to a most favorable one.

A further modification of the invention is contemplated wherein there will be the successive connection of several of the mills in the material flow so that the material, after passing the first mill will go through the second and third ones or more before leaving the machine, the communicating connections between the mills being supplied with a screening or separating device for taking off the material already ground and passing into the following mill the coarse material only. Otherwise this modification includes the division of the mills into two or three chambers filled with different kinds of grinding elements, said chambers being divided by separating walls with screening devices, returning into former chamber the material not sufficiently ground.

From the foregoing it will be apparent that the invention resides in the improvements of the output of the machine and in the possibility of the application of the modern system of high speed machines within small outside dimensions and great capacity.

What is claimed is:

A mill of the kind described, comprising a plurality of spaced parallel drums, hollow center trunnions on each drum at opposite ends thereof, conveyor ribs formed on the inner surfaces of the trunnions, rotatable front and rear hollow frames having bearings for the trunnions and forming intake and outlet, respectively, for the drums at opposite ends thereof through said trunnions, a driving connection with one frame, a train of meshing gears connected with the other frame and the trunnions to rotate the frames and drums respectively in unison with each other, rolling grinding elements in the drums, and linings in the drums and having risers at intervals thereof.

WALTER P. EPPERS.