April 29, 1924. 1,491,841

W. J. BELL

APPARATUS FOR PULVERIZING AND SEPARATING GRANULAR MATERIALS

Filed June 16, 1920 2 Sheets-Sheet 1

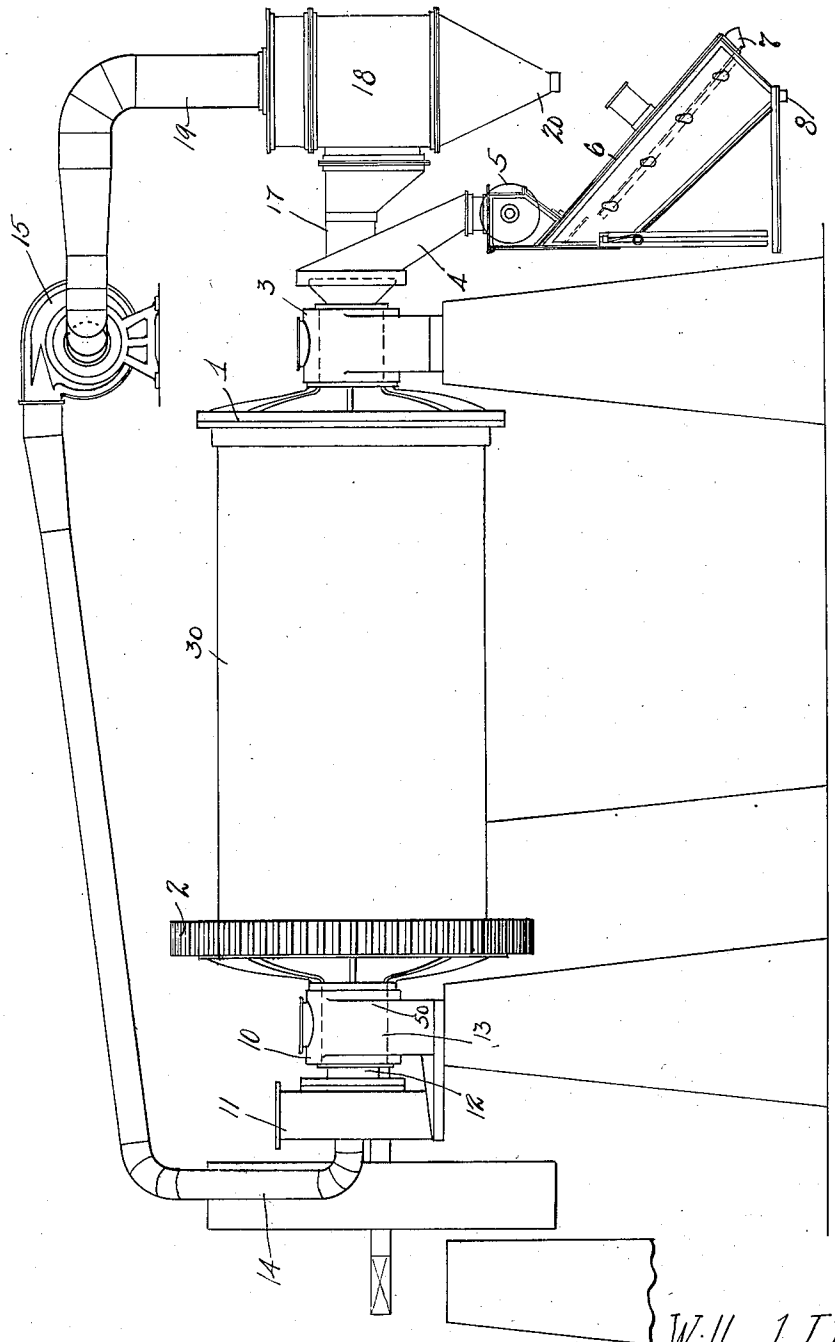


Fig. 1

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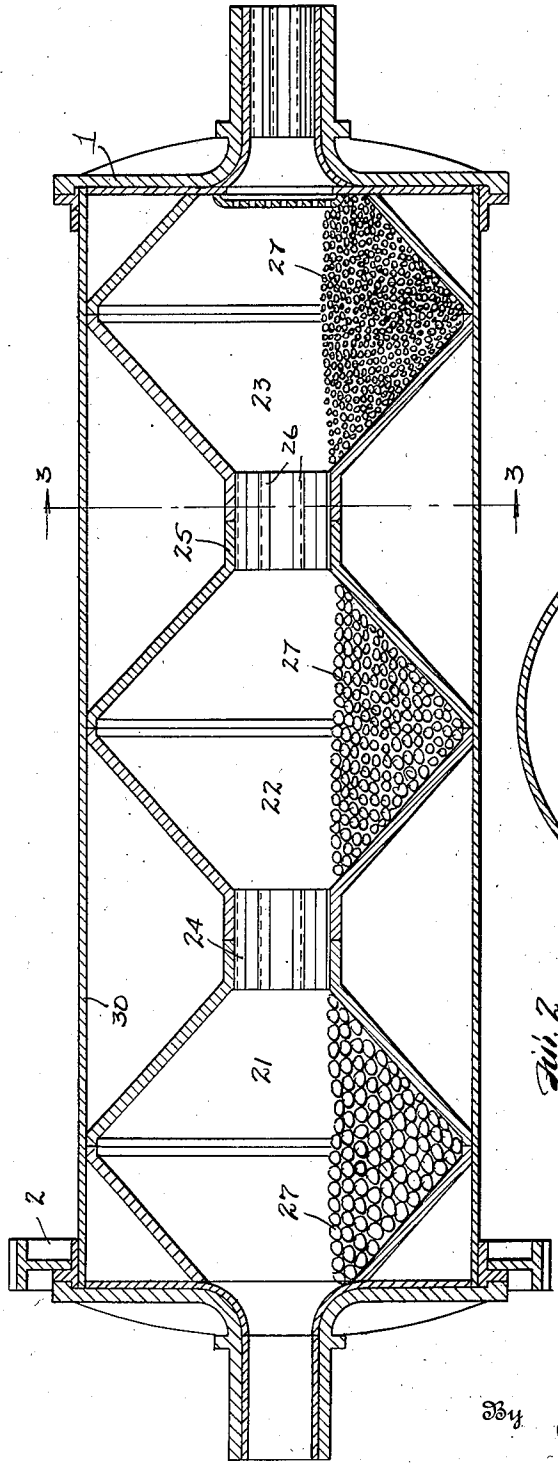


Fig. 2

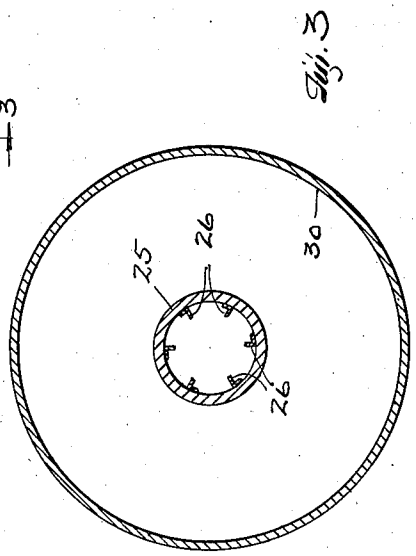


Fig. 3

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR PULVERIZING AND SEPARATING GRANULAR MATERIALS.

Application filed June 16, 1920. Serial No. 389,309.

To all whom it may concern:

Be it known that I, WILLARD J. BELL, a citizen of the United States, and a resident of Newaygo, county of Newaygo, and State of Michigan, have invented a new and useful Improvement in Apparatus for Pulverizing and Separating Granular Materials, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle so as to distinguish it from other inventions.

The present invention, relating, as indicated, to apparatus for pulverizing and separating granular materials, is directed primarily to an improved type of pulverizing drum provided with means particularly adapted for so agitating the material passing therethrough that an air blast forced through the interior of the drum is enabled to pick up all of the very fine particles and dust and continuously remove them from the presence of the other larger particles of material. To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawing and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing:—

Fig. 1 is a side elevation of my improved apparatus; Fig. 2 is a longitudinal central section through a pulverizing drum; and Fig. 3 is a section on the line 3—3, Fig. 2.

The general arrangement of the apparatus shown in the drawings is similar to that described in my co-pending application, Serial No. 367,753, filed March 22, 1920. The apparatus consists of a pulverizing drum 1 rotated by means of an external gear 2 and discharging through a trunnion bearing 3 into a discharge conduit 4, which leads to a feed mechanism 5 for distributing the material over the surface of one or more screening machines 6. In the screening machines the over-size and under-size material issue from chutes 7 and 8, respectively, and are then removed into separate bins, or, if desired, the over-size material may be again passed through the pulverizing drum for still finer crushing.

The material is fed into the drum through a trunnion bearing 10 and from a hopper 11, which opens into a conduit 12 leading through the trunnion bearing and into the cylinder. In the conduit 12 there may be mounted a spiral conveyor of the usual type, the location of which is indicated at 50 in Fig. 1 for feeding the material into the drum, the shaft 13 of this spiral conveyor being hollow and extending rearwardly through the conduit 12 where it is connected to an air conduit 14 for supplying an air blast to the cylinder. The shaft 13, for driving the spiral conveyor, is formed hollow, the air blast passing through this hollow shaft.

Air under pressure is supplied by means of a pump 15, through a conduit 14, and is then passed through the interior of the pulverizing drum. After discharging from the other end of the pulverizer it goes through a conduit 17 into a centrifugal collector 18, from which the air is returned through a conduit 19 to the pump 15, while the granular material and dust which is separated from the air in the collector is discharged through a chute 20 and may then be admitted either to the separator or lead directly to storage bins as may be desired.

In Fig. 2 I have shown the interior construction of the drum 1. This drum is provided with a series of spaced chambers 21, 22 and 23, which are connected by conduits 24 and 25, which are of reduced cross-section compared to the maximum cross-section of the three chambers and are provided with a series of shelves or internally extending flanges in the form of angles 26. By this construction it is possible to progressively grind the material with the use of a considerably less number of grinding elements, which are usually in the form of balls or pebbles 27, than is possible in the ordinary pulverizing drum. The coarsest particles are crushed in the chamber 21 and when brought to approximately the size of the balls therein they are discharged through the conduit 24 into the chamber 22, where they are crushed still further and are then discharged through the conduit 25 into the chamber 23. In this last chamber they are crushed to approximately the fineness desired and are then discharged and screened in the apparatus already described.

A pulverizing drum is notoriously ordinarily inefficient in action and wasteful of

power because the finely crushed material packs around the larger uncrushed lumps and around the pebbles and cushions the grinding action of the pebbles or balls. Furthermore, it takes a relatively long time for the material which happens to be crushed soon after its entrance in the pulverizer to finally work to the discharge end of the apparatus, and all of the time that this finely crushed material is present it is retarding the further crushing action, and is also requiring power to lift it up the sides of the drum as the latter is rotated.

The crushing action in the present pulverizing drum is similar to that secured in the drum of my United States Patent No. 971,108, in that the material is rapidly discharged from one chamber to another, and each chamber is so formed as to secure a maximum crushing action with a minimum of dead material, and with a minimum of power. By placing the three chambers in the manner shown and interposing restricted conduits between them equipped with devices for lifting material and causing it to fall transversely of the conduit it is possible, by forcing an air blast through the entire apparatus, to immediately remove all of the very fine particles from the presence of the coarser ones. As the material is carried into the conduits 24 and 25 it is lifted by the shelves or angles upon rotation of these conduits, and is then dropped back to the bottom of the conduits and passed transversely across the air blast which is forced through the entire drum. The air blast is of sufficient strength to carry with it all of the relatively fine material, which is then separated out from the air in the collector 18 and returned either to the screening machines or the bins.

It is immaterial whether the pulverizing drum is covered by means of an enclosing shell 30, as shown in Fig. 1, or is merely built up of the various chambers and conduits rigidly fastened together as shown in Fig. 2, as the action in either case is of course the same. The present apparatus requires much less power for its operation than a pulverizing drum of the usual type and of equal capacity, and present types of drums can be changed into the present apparatus by inserting in the drums the conical chambers and connecting conduits, which I have shown in Fig. 2, and also of course by equipping the pulverizing drum with means for supplying a continuous air blast through the entire drum.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In an apparatus of the dry air blast, pulverizing type, a pulverizing drum having a plurality of chambers in axial alinement and spaced relation, a conduit of restricted area rigidly connecting and spacing each two adjacent chambers, means for rotating said drum, said chamber having conical end walls for diverting pulverized material into said conduits, means provided on the interior of said conduit for dropping said material across the space within said conduit and means adapted to force an air blast through said chambers and said conduit for carrying said pulverized material progressively through said interconnected chambers and conduits.

2. In an apparatus of the dry air blast, pulverizing type, a cylindrical drum provided with end plates, hollow trunnions provided on said end plates, driving connections provided on the outside of said drum for rotating the same, a plurality of hollow members of frusto-conical cross-section fitted transversely within said drum, the bases of adjacent members being placed in close contact to form pulverizing chambers, collars formed on the smaller ends of certain of said members to form conduits with the collars of adjacent members, a plurality of longitudinally extending flanges provided on the inner surface of the conduits located between adjacent pulverizing chambers for dropping the material operated on across the space within said conduits, and air and material inlet and outlet passageways provided by the hollow trunnions connected with said end plates.

Signed by me, this 9th day of June, 1920.

WILLARD J. BELL.