R. E. H. POMEROY.

METHOD OF TREATING PULVERIZED FUEL.

APPLICATION FILED DEC. 14, 1921.

1,423,150. Patented July 18, 1922.

2 SHEETS—SHEET 1.

FIG. 1.

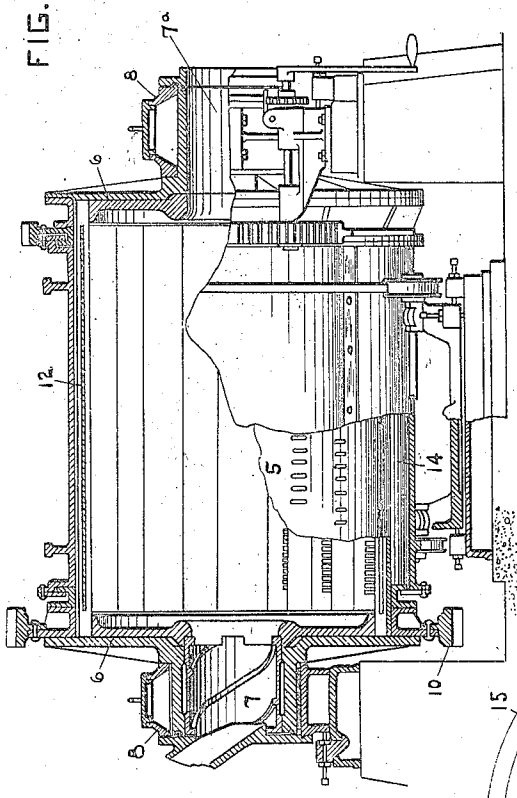



FIG. 3.

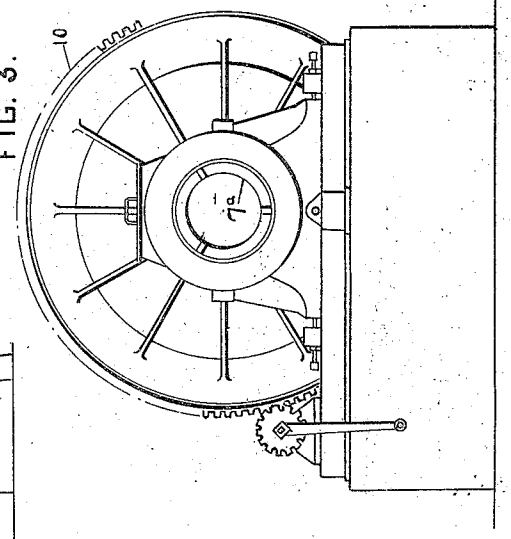
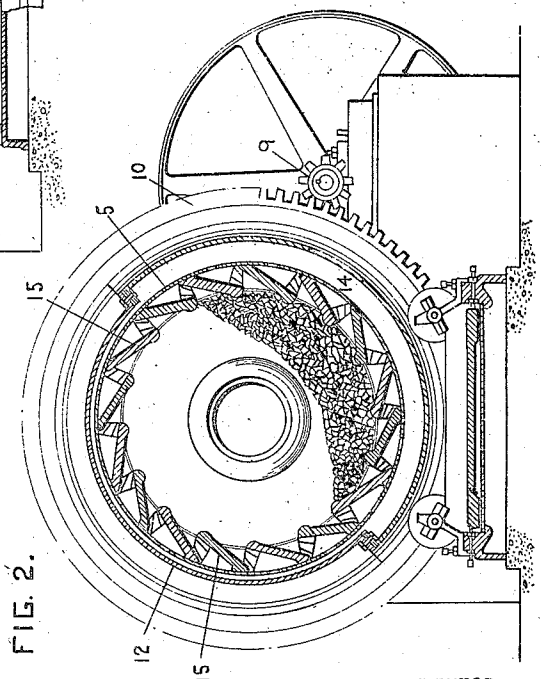



FIG. 2.




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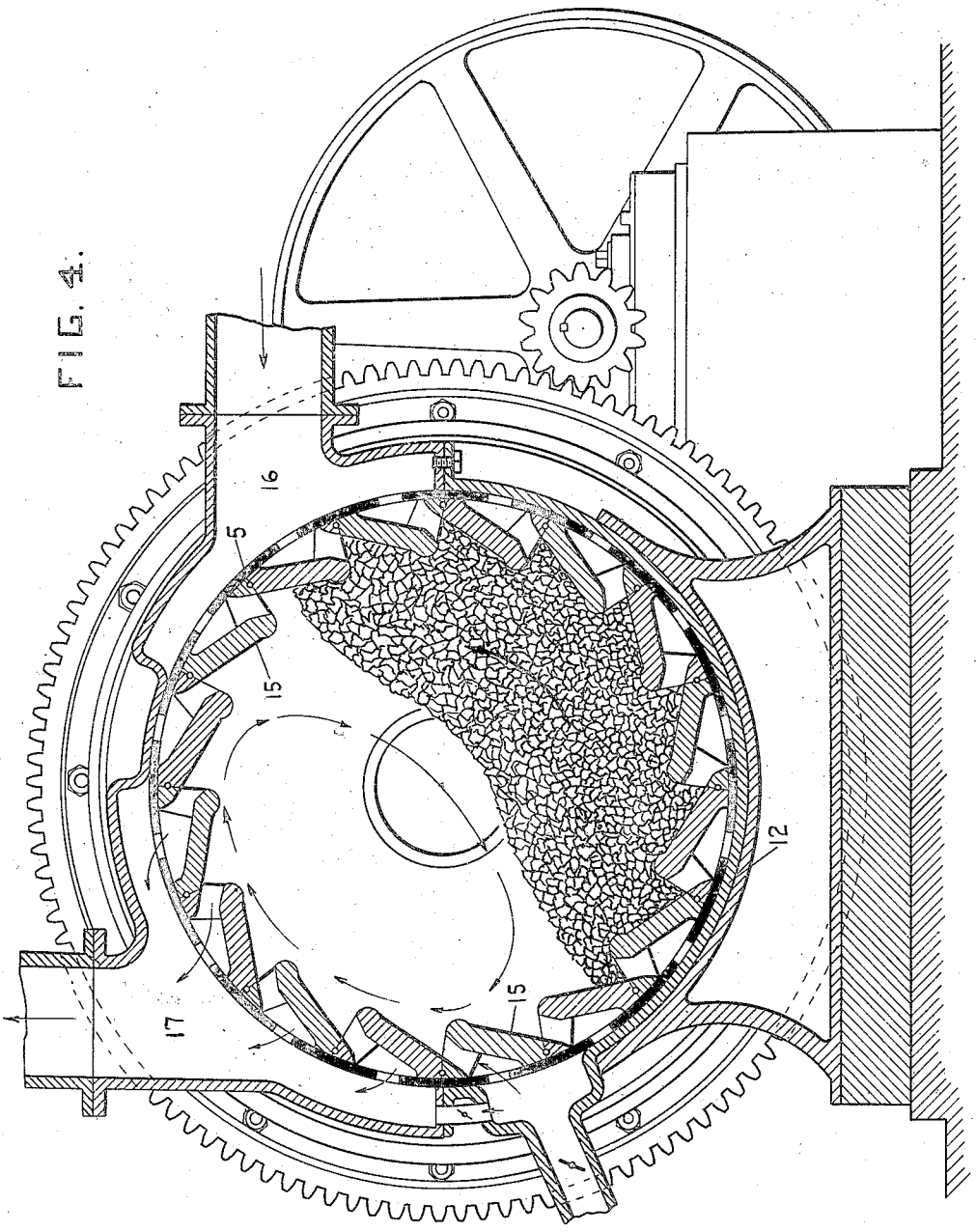
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2 SHEETS—SHEET 2.

FIG. 4.




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# UNITED STATES PATENT OFFICE.

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## METHOD OF TREATING PULVERIZED FUEL.

1,423,150. Specification of Letters Patent. Patented July 18, 1922.

Application filed December 14, 1921. Serial No. 522,360.

*To all whom it may concern:*

Be it known that I, RALPH E. H. POMEROY, residing at Canton, in the county of Stark and State of Ohio, a citizen of the United States, have invented or discovered certain new and useful Improvements in Methods of Treating Pulverized Fuel, of which improvements the following is a specification.

The invention described herein relates to the removal of fine or reduced material by imparting such movements to a loose mass consisting of pieces of frangible material (as coal and hard bodies, as metal balls) that the elements of the mass will have such movements relative to one another that the reduction will be effected in part by the impact of the elements with one another, and in part by abrasion or the rubbing of the elements against one another. While the invention described herein can be practiced by the use of many different types of mills operating in the manner above described, the invention will be described in connection with a familiar type known as the tumbling box, ball mill type, pipe mill, etc., and consisting of a rotatable drum containing a plurality of balls, rods, pipes, cobble stones, or other hard bodies.

It has been the practice heretofore to so construct and operate this type of mill that the fine is discharged either through openings or screens in the periphery of the drum, or by means of a current of air entering through one trunnion and escaping laden with dust or fine particles through the other trunnion. In some cases, the removal of the fine particles in the first of the above types, has been accelerated by currents of air entering through one trunnion and passing out through the peripheral openings or screens. As the larger pieces of the material are more efficiently affected by gravity and centrifugal force than the finer particles, these larger particles will form a very large per cent of the portion of the charge in contact with the inner periphery of the drum, and being formed of pieces too large to pass through the screen or other discharge openings, reduce the discharge areas of the openings or screens, and hence material is retained in the drum for a considerable time after it has been reduced to the desired degree of fineness.

In the type of mills employing currents of air for the removal of the pulverized material, the current will flow in a substantially straight line from one trunnion to the other, and as the charge is below or to one side of the main line of flow of the air, only such pulverized material as is thrown into the current by the agitation of the charge will be carried from the mill, and consequently this method of removing fine particles is very inefficient.

It is characteristic of the methods heretofore practiced that the segregation of the fine and coarse material has been due to the gradual working of the fine particles outwardly or inwardly through the charge in the mill as the elements of such charge move relative to each other and that in none of these methods was there any attempt to remove material from the mass practically as soon as the desired degree of fineness had been attained.

The invention described herein has for its object the removal of material when it has attained the desired degree of fineness from a mass consisting of material to be treated and the pulverizing elements by means of currents of air passing through the mass from the denser to the less dense or compacted portions and in a direction in which the finer particles are moved by the working or agitation of the elements of the mass by the rotation of the drum. It is a further object of the invention to effect within the mill a grading of the materials forced from the mass by the air currents whereby only the material of the desired fineness is carried out of the mill and the coarser material returned to the charge being reduced. The invention is hereinafter more fully described and claimed.

In the accompanying drawings forming a part of this specification, Fig. 1 is a view partly in elevation of a form of apparatus suitable for the practice of the improvement described herein; Fig. 2 is a transverse section of the construction shown in Fig. 1; Fig. 3 is an end elevation of the same and Fig. 4 is a view similar to Fig. 2, illustrating a modification of the apparatus.

In the practice of the invention the material to be pulverized is charged into the drum through either or both trunnions, said drum containing balls or other hard objects usually employed in this type of pulverizing mill. On the rotation of the drum the charge is turned over and over and the material to be treated is broken up and pulverized

partly by the impact of the balls and partly by abrasion of the balls on the material. During the turning of the drum, portions of the charge adjacent to the inner surface of the drum are carried up until the force of gravity overcomes the centrifugal tendency to press the charge outwardly. When portions of the charge reach this point, they will drop and roll down the inner surface of the charge. By the rotation of the drum all parts of the charge pass through this cycle of movements but there will always be a tendency for the larger and heavier elements to move outwardly through the mass and collect against the drum, but the interstices between the larger or coarser elements will be filled to a greater or less degree by the finer. In order to remove the fine material, currents of air or jets of air are directed inwardly through the charge by perforations in the periphery of the drum. These inflowing jets of air will carry the fine material out of the charge into the space not occupied by the charge. The dust laden air may pass out of the drum either through the trunnion opposite that through which the material was charged as shown in Figs. 1 and 2, or through the ports or perforations in the periphery of the drum as shown in Fig. 3.

The fineness or grade of material carried out of the charge will be dependent upon the quantity and rate of movement of the air passing through the charge, the greater the quantity and the higher the rate of flow, the larger or coarser will be the particles removed and the greater the quantity of material taken out of the charge. It will be generally preferable to effect a rapid removal of the material, but as particles larger than desired will probably be carried out, provision is made for separating the particles of the desired grade from the coarser within the drum and carrying such desired product out of the drum while the coarse particles are returned to the charge undergoing reduction. To this end the ports or passages through which the air enters and through which the dust laden air passes from the drum, are so constructed and arranged that the air will enter the drum at an angle to the radii of the drum and have a cyclonic movement within the drum, the circular movement being the reverse of the direction of rotation of the drum. At a suitable point in its circular movement the air passes out of the drum through the passages in the periphery of the drum arranged at an angle preferably greater than 90 degrees to the path or rotation of the air in the drum. By properly proportioning the rate of flow of the outgoing air, only the particles of the desired degree of fineness will remain with the air, and pass out of the drum, while the larger pieces will by reason of their momentum pass beyond the outlets and be brought back to the tumbling mass for further reduction.

While as hereinbefore stated, the method described and claimed herein can be carried out in different types of mills, the constructions described and claimed in applications Serial Numbers 474,079 and 516,380, filed by me June 1st, 1920 and November 19, 1921, respectively, and also so far as is necessary for the purposes of this case, shown in Figs. 1, 2, 3, and 4 have been found suitable.

In the construction shown herein the mill consists of a rotatable shell 5 having its ends secured to heads 6 provided with trunnions 7. In the construction shown in Figs. 1 to 3, inclusive, both trunnions are made hollow and provision is made for the feed of fuel through one of these trunnions as 7 while the opposite trunnion $7^a$ is employed as an outlet for the air carrying the dust as hereinafter described. The trunnions are mounted on fixed bearings 8 and the shell is driven by pinion 9 engaging a gear wheel 10 secured to one of the heads of the shell. As described in said application a suitable quantity of loose grinding material or devices such as metal balls, cobble stones, rods or bars of hard material are charged into the shell or drum and operated for pulverizing the material for impact or rubbing. For convenience the term "balls" will be used as a generic term including thereunder any and all devices usually employed in such a mill.

The shell is enclosed by a casing 12 closely fitting against the shell but not with sufficient closeness to prevent the free rotation of the shell. The interior surface of the shell is covered with a lining preferably composed of a series of longitudinal sections or liners 15 of metal extending substantially the full length of the shell and having passages thereunder, the outer ends of which register with perforations formed in the shell 5.

In constructions of mills shown in Figs. 1, 2 and 3, where the material escapes from the shell 5 through the trunnion the enclosing casing 12 is provided with an enlargement forming an air chamber 14, the portion of the casing forming this air chamber being preferably adjustable peripherally of the shell and casing so that the point of entrance of the air may be varied as required. In the construction shown in Fig. 4 where the material passes from the shell through the peripheral openings the casing is provided with enlargements forming chambers 16 and 17, the former being the inlet chamber and the latter the outlet chamber. The inlet chamber is preferably so located as described in the application Serial Number 516,380, as to extend from a plane

approximately coincident with the horizontal diameter of the drum along for a suitable distance, as for example, a little further than the material would be carried in the rotation of the drum, above this horizontal plane. In other words, this inlet chamber preferably extends circumferentially from about the point where the charge in the shell begins to loosen up to a point a little beyond that to which the elements of the mass move away from the surface of the shell. This chamber is provided with an air inlet which, in case air at a presssure above atmospheric is employed, is connected to a fan or other suitable air compressor. The other chamber extends preferably for about one-fourth of the circumference of the shell and is located so that the air after passing through the charge can escape through the perforations in the shell into the chamber from whence it is carried by suitable means to a point of use.

I claim herein as my invention:

1. The method herein described of removing material from a pulverizer which consists in imparting a rotary tumbling movement to a loose mass composed of pieces of frangible material and balls of a more durable material causing streams or jets of air to traverse said mass in a direction opposed to the direction of movement of the mass and carry the reduced particles from between the elements composing the mass.

2. The method herein described of removing material from a pulverizer which consists in imparting a rotary tumbling movement to a loose mass composed of pieces of frangible material and balls, directing streams or jets of air into said receptacle and through the loose mass in the zone of reduction whereby reduced particles are removed from between the elements composing the mass permitting the escape of the air carrying the particles from the receptacle and changing the direction of flow of the air at the outlet from the receptacle to effect a segregation of the fine particles from the coarse particles.

3. The method herein described of removing material from a pulverizer which consists in enclosing in a suitable receptacle a loose mass composed of pieces of frangible material and balls imparting a rotary tumbling movement to such mass, causing currents of air to traverse said mass in a direction opposed to the direction of rotation of the mass, whereby a circular movement is imparted to the air escaping from the mass, and causing the air and reduced material to pass out of the chamber in a direction at an angle to the circular movement of the air in the chamber.

4. The method herein described of removing material from a pulverizer which consists in imparting to a loose mass composed of pieces of frangible material, and objects of more durable material that the elements of the mass will have such movement relative to one another as to effect a progressive reduction of the frangible material and so directing currents of air through the moving mass that the currents will enter at points where the elements of the mass are relatively dense or in close grinding relation and will emerge through the less dense portions of the mass.

In testimony whereof, I have hereunto set my hand.

RALPH E. H. POMEROY.