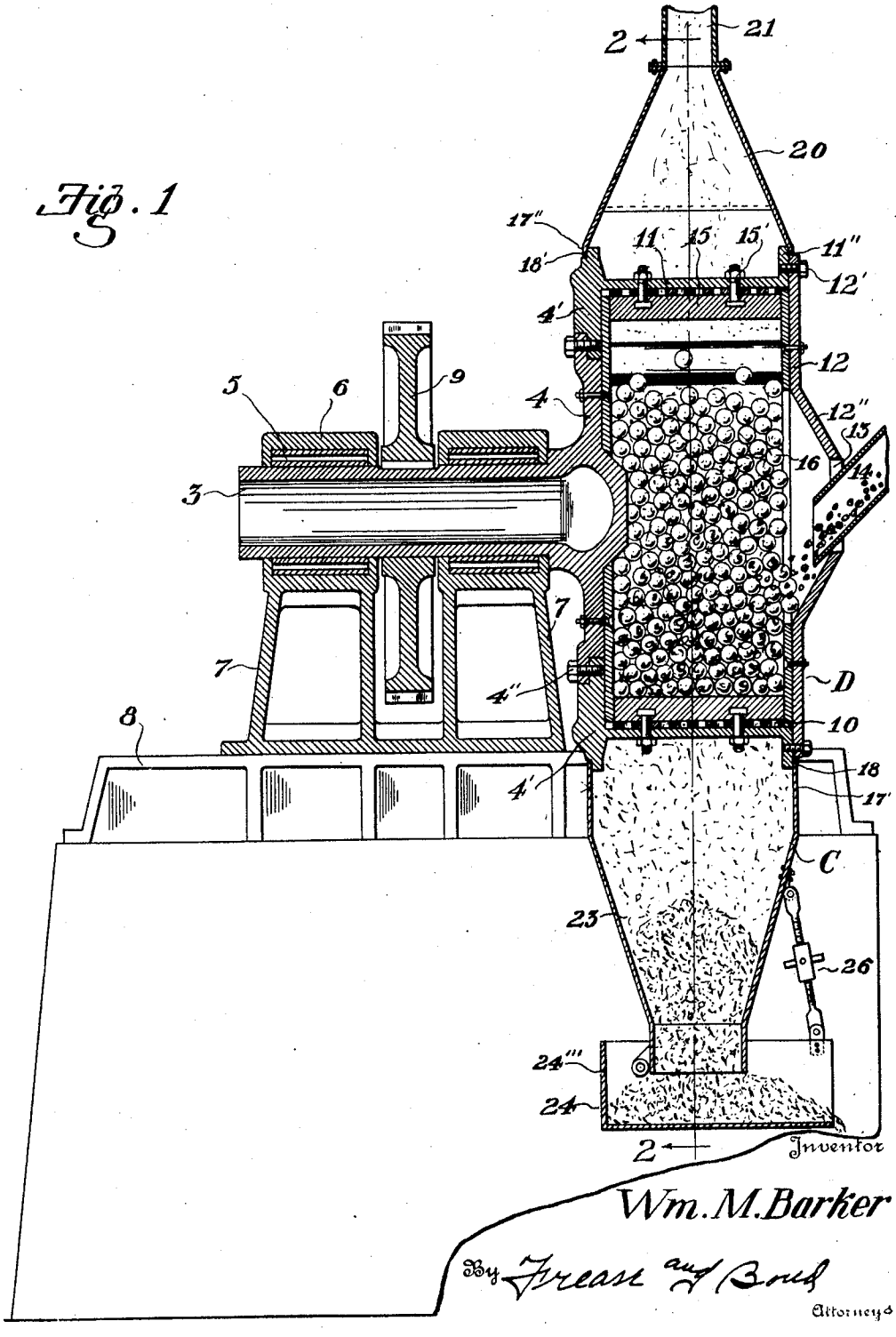
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W. M. BARKER

BALL MILL

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Fig. 1



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BALL MILL

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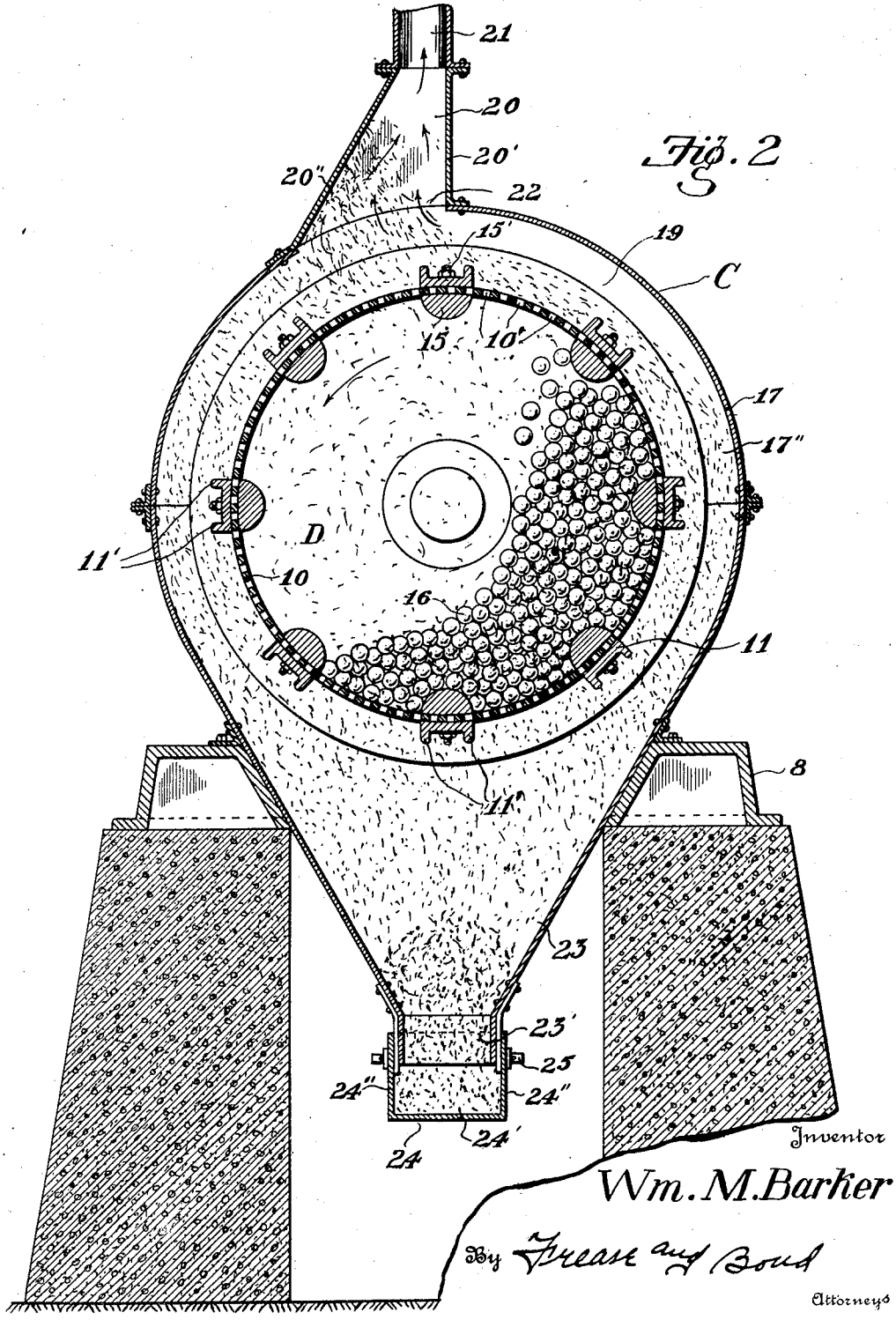


Fig. 2

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UNITED STATES PATENT OFFICE.

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BALL MILL.

Application filed October 13, 1924. Serial No. 743,219.

The invention relates to a grinding mill of the horizontal, rotary ball carrying drum type for granulating coal, coke, coke-breeze and like materials, and the objects of the improvement are to simplify the feed, the granulating, and the delivery devices, to avoid abrasion and facilitate replacement of the screen plates, to reduce the material by the direct action of the balls themselves, and to produce a uniform granulation with a minimum of fine or powdered material.

These and other objects and benefits are attained by the construction and arrangement illustrated in the accompanying drawings forming part hereof, in which:

Figure 1 is an elevation section on the axis of the improved mill; and

Fig. 2, an elevation section on line 2—2, Fig. 1;

Similar numerals refer to similar parts throughout the drawings:

Within a peripheral case C is mounted a rotary drum D which is preferably supported solely by a single trunnion 3, which as shown may be and preferably is formed integral with the central portion 4 of the rear head of the drum. For firmly supporting the drum the trunnion is of relatively large length and diameter and to reduce its weight is preferably formed hollow as shown.

The trunnion is suitably journaled in roller bearings 5 mounted in boxes 6 formed or secured on the top of standards 7 secured on the bed plate 8; and a gear wheel 9 may be keyed on the trunnion between the standards to receive power to rotate the drum.

The peripheral portion 4′ of the rear head of the drum may be in the form of a ring secured by bolts 4″ to the periphery of the central portion 4 thereof, and a frame for the peripheral screening wall 10 of the drum may be formed by a plurality of circumferentially spaced arms 11 extending directly forward from the peripheral ring 4′ of the rear head of the drum, and preferably integral therewith.

The frame arms 11 may be in the form of channel bars with flanges 11′ directed outward to give them the necessary strength and also to form fan vanes on the periphery of the drum, and upon the forward end of each arm is preferably formed an outwardly extending L-flange 11″ to which the front head 12 of the drum may be secured by bolts 12′.

The front head 12 of the drum is in the form of a disk plate having a conical protrusion 12″ in the central portion and in the truncated apex of which is provided an orifice 13 through which an inclined chute 14 may be extended for feeding raw material into the forward side of the drum.

The peripheral screening wall 10 of the drum may be made of sheet metal punched with perforations 10′ of suitable size for passing the desired grade of granulation; and this sheet may be secured to the frame arms 11 by means of ball lifting bars 15 clamped against the inner side of the screen plate along the inner side of the frame bars by bolts 15′ extending from the lifter bars through the screen plate and the frame bars.

The ball lifting bars 15 may be made of metal, rubber or other suitable material to form ribs or abutments for carrying and lifting the balls 16 upward in one side of the drum without abrading the screening wall by sliding thereon.

The peripheral case C surrounding the drum may be made of sheet metal with a peripheral wall 17 and head flanges 17′ and 17″ extending inward to overlap rabbeted peripheral portions 18 and 18′ of the front and rear heads of the drum; thereby forming an annular channel or duct 19 around the periphery of the drum.

Upon the top of the case C is connected an outlet funnel 20 comunicating with an outlet flue 21; one wall 20′ of the funnel being formed to extend directly upward from the axial plane of the mill, and the other inclined wall 20″ of the funnel being located beyond the upright wall in the direction of the rotation of the drum; so that the outlet opening 22 of the case leading into the funnel is located beyond the upright axial plane of the case as the drum rotates.

Depending from the lower side or bottom of the peripheral case is formed an outlet hopper 23 terminating in a restricted outlet mouth 23′ which may be and preferably is formed square in cross section.

A depending trough gate 24 is hinged by a rock bar 25 to the rear side of the mouth of the hopper and is formed with a bottom wall 24′, side walls 24″ and a rear end wall 24‴ and with an open forward end and top. The forward end of the trough gate extends a substantial distance in front of the mouth of the discharge hopper and is

adjustably supported by a turn buckle link 26 so as to be raised and lowered to vary the inclination of the bottom of the trough and its distance below the mouth of the hopper.

In operation the material to be granulated is fed into the mill from the inclined chute 14 extending into the orifice 13 of the drum D. Rotation of the drum by power applied through the gear wheel 9 causes the lifting bars 15 to bodily lift the balls 16 with the raw material upward in the direction of rotation of the drum, until the upper level of the balls exceeds the angle of repose; when the topmost balls successively fall back to the bottom of the drum, thence grinding and granulating the admitted material by direct impact and attrition between the balls themselves in the interior of the drum, and not between the balls and the screen plates.

The fan vane formed by the frame arms 11, upon rotation, create an exhaust fan effect, causing air to be drawn into the drum through the orifice 13 along with the feed, to circulate in the peripheral case, and to be discharged through the outlet funnel 20 and 21.

Any solid material passing through the screen wall into the peripheral case, and which may be carried upward by centrifugal action, or the circulating air, will strike against the inclined wall 20'' of the funnel and be deflected downward into the case.

Any dust that may still remain in the air discharged into the outlet flue may be collected in a cyclone collector and returned to storage.

A continuous automatic air sealed discharge of the material granulated in the mill is effected by properly positioning the turn buckle link 25, so that the angle of the bottom wall 24' of the depending trough gate 24 will be such that the granulated material backs up into the outlet hopper until the material head in the hopper is sufficient to cause the material to slide down the inclined trough at a substantially uniform rate of speed.

The structure of the present invention thus provides a slow speed, quick discharge ball mill, having all the driving mechanism on one side away from the feed end, permitting free access to the interior of the mill by the removal of the front head, thereby enabling easy removal and replacement of the peripheral screening wall and lifting bars.

The single trunnion support simplifies manufacture, maintenance and operation, and the arrangement of balls and ball lifters in the screen drum provides for free discharge of granulated material through the screen perforations without excessive wear upon the screen wall.

The mill may be used to take the place of dry pans and other machines requiring excessive power to grind or granulate clay, shale, and other earths, rocks and ores in a raw state or after calcining.

The mill is particularly adapted to handle efficiently, light and bulky material which accumulates in the drums of other types of mills, cushioning the grinding and granulating effect, and reducing the output capacity.

I claim:

1. A ball mill including a rotatable drum having opposite drum heads, a sole and relatively short supporting trunnion on one drum head, and a sole bearing bracket for the trunnion, a material inlet orifice in the other drum head, a removable blower case about the drum, communicating openings between the drum and the case, a material outlet for the case, and a separate air outlet for the case.

2. A ball mill including a drum having opposite drum heads, a sole and relatively short supporting trunnion on one drum head, and a sole bearing bracket for the trunnion, the trunnion being rotatable in the bearing bracket, a material inlet orifice in the other drum head, a removable blower case about the drum, communicating openings between the drum and the case, a material outlet for the case, and a separate air outlet for the case.

3. A ball mill including a rotatable drum having opposite drum heads, a sole and relatively short supporting trunnion on one drum head, a sole bearing bracket for the trunnion, and a material inlet orifice in the other drum head, fan arms on the outside of the drum, a removable blower case about the drum, communicating openings between the drum and the case, a material outlet for the case, and a separate air outlet for the case.

4. A ball mill including a rotatable drum having opposite drum heads, a sole and relatively short supporting trunnion on one drum head, and a bearing bracket for the trunnion, the other drum head being removable, a material inlet orifice in the other drum head, a removable blower case about the drum, communicating openings between the drum and the case, a material outlet for the case, and a separate air outlet for the case.

5. A ball mill including a single rotatable annular ring, arms connected to the ring, and screen drum walls supported by the arms, and the arms being outside of the drum walls, a material inlet orifice for the screen drum, a removable blower case about the screen drum, a material outlet for the case, and a separate air outlet for the case.

6. A ball mill including spaced arms, a rotatable drum supported by the arms and

removable lifting bars secured to the inner wall of the drum and to the arms.

7. A ball mill including a single rotatable trunnion, a bearing bracket for the trunnion, circumferentially spaced fan vane arms connected to the trunnion and screen drum walls supported by the arms, and the arms being outside of the drum walls, a material inlet orifice for the screen drum, a removable blower case about the screen drum, a material outlet for the case, and a separate air outlet for the case.

8. A ball mill including a rotatable annular ring, fan vane arms connected to the ring, and screen drum walls supported by the arms, and the arms being outside of the drum walls, a material inlet orifice for the screen drum, a removable blower case about the screen drum, a material outlet for the case, and a separate air outlet for the case.

9. A ball mill including a case and a rotatable annular ring in the case, there being fan vane arms connected to the ring and screen drum walls supported by the arms, and the arms being outside of the drum walls, a material inlet orifice for the screen drum, a removable blower case about the screen drum, a material outlet for the case, and a separate air outlet for the case.

10. A ball mill including a rotatable drum, a case enclosing the drum, and an upwardly extending air outlet for the case, the outlet having an inclined wall for deflecting solids into the case and a solid outlet for the case below the air outlet, and communicating openings between the drum and the case.

11. A ball mill including a rotatable drum, a case enclosing the drum, discharge communication between the case and the drum, and adjustable gravity means controlling the rate of continuous discharge of solids from the case.

12. A ball mill including a rotatable drum, a case enclosing the drum, discharge communication between the case and the drum, and gravity means controlling the rate of discharge of solids from the case, including a hopper having an outlet mouth, a depending trough gate hinged to the hopper below the mouth, and means for adjusting the position of the gate with reference to the mouth.

13. A ball mill, including a single rotatable annular ring, arms connected to the ring, and screen drum walls supported by the arms, the arms being outside of the drum walls, and there being a blower case spaced from and enclosing the arms and drum, and adjustable means controlling the rate of continuous discharge of solids from the case.

14. A ball mill including a single rotatable trunnion, a bearing bracket for the trunnion, circumferentially spaced fan vane arms connected to the trunnion and screen drum walls supported by the arms, the arms being outside of the drum walls, and there being a blower case spaced from and enclosing the arms and drum, and adjustable means controlling the rate of continuous discharge of solids from the case.

15. A ball mill including a rotatable annular ring, fan vane arms connected to the ring, and screen drum walls supported by the arms, the arms being outside of the drum walls, and there being a blower case spaced from and enclosing the arms and drum, and adjustable means controlling the rate of continuous discharge of solids from the case.

16. A ball mill including a case and a rotatable annular ring in the case, there being fan vane arms connected to the ring and screen drum walls supported by the arms, the arms being outside of the drum walls, and there being a blower case spaced from and enclosing the arms and drum, and adjustable means controlling the rate of continuous discharge of solids from the case.

In testimony that I claim the above, I have hereunto subscribed my name.

WILLIAM M. BARKER.