No. 880,808. PATENTED MAR. 3, 1908.

C. O. MICHAELSEN.

MINERAL CONCENTRATOR.

APPLICATION FILED JAN. 30, 1907.

3 SHEETS—SHEET 1.

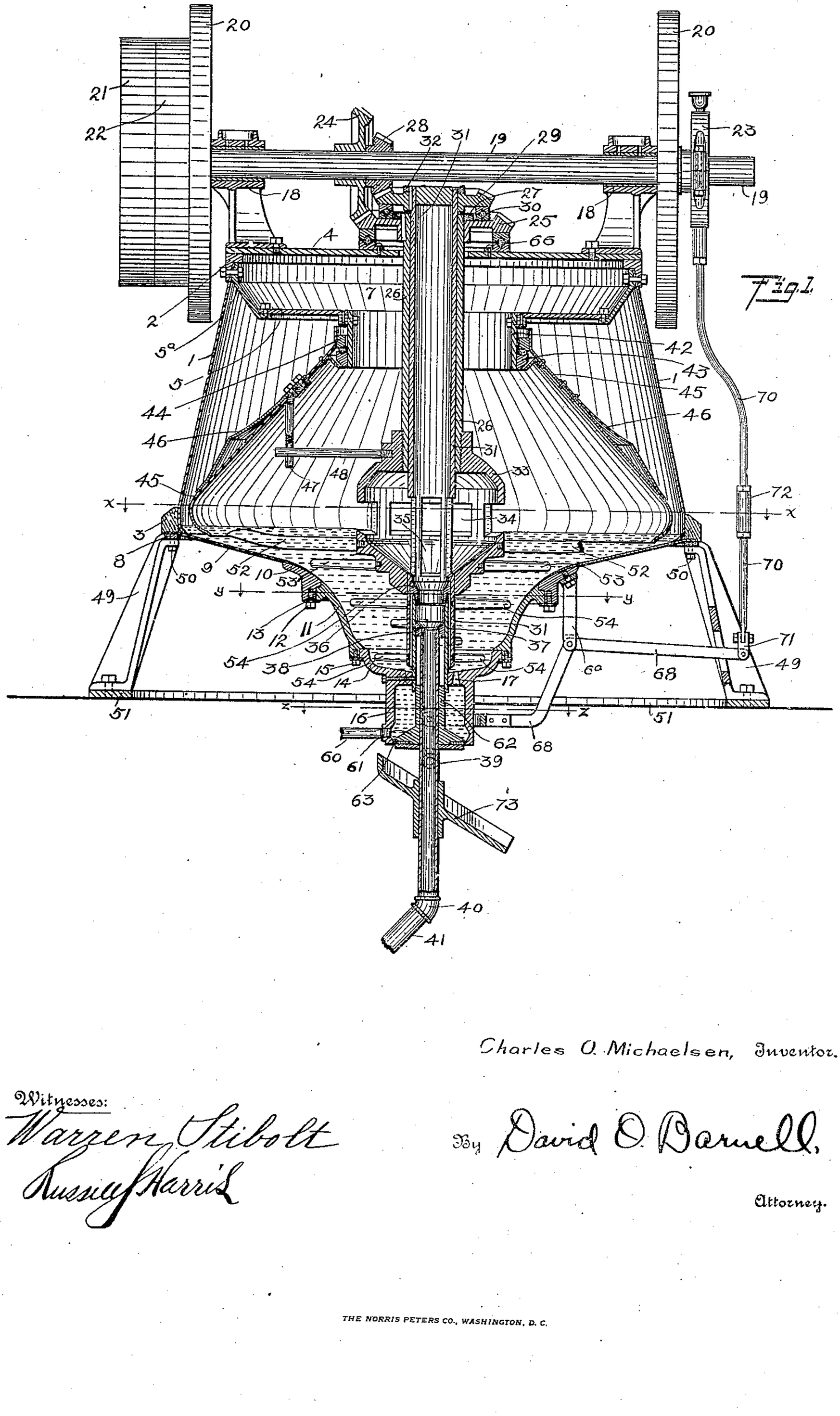

Fig. 1.

Witnesses:
Warren Stibolt
Russell Harris

Charles O. Michaelsen, Inventor.

By David O. Darnell,

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3 SHEETS—SHEET 2.

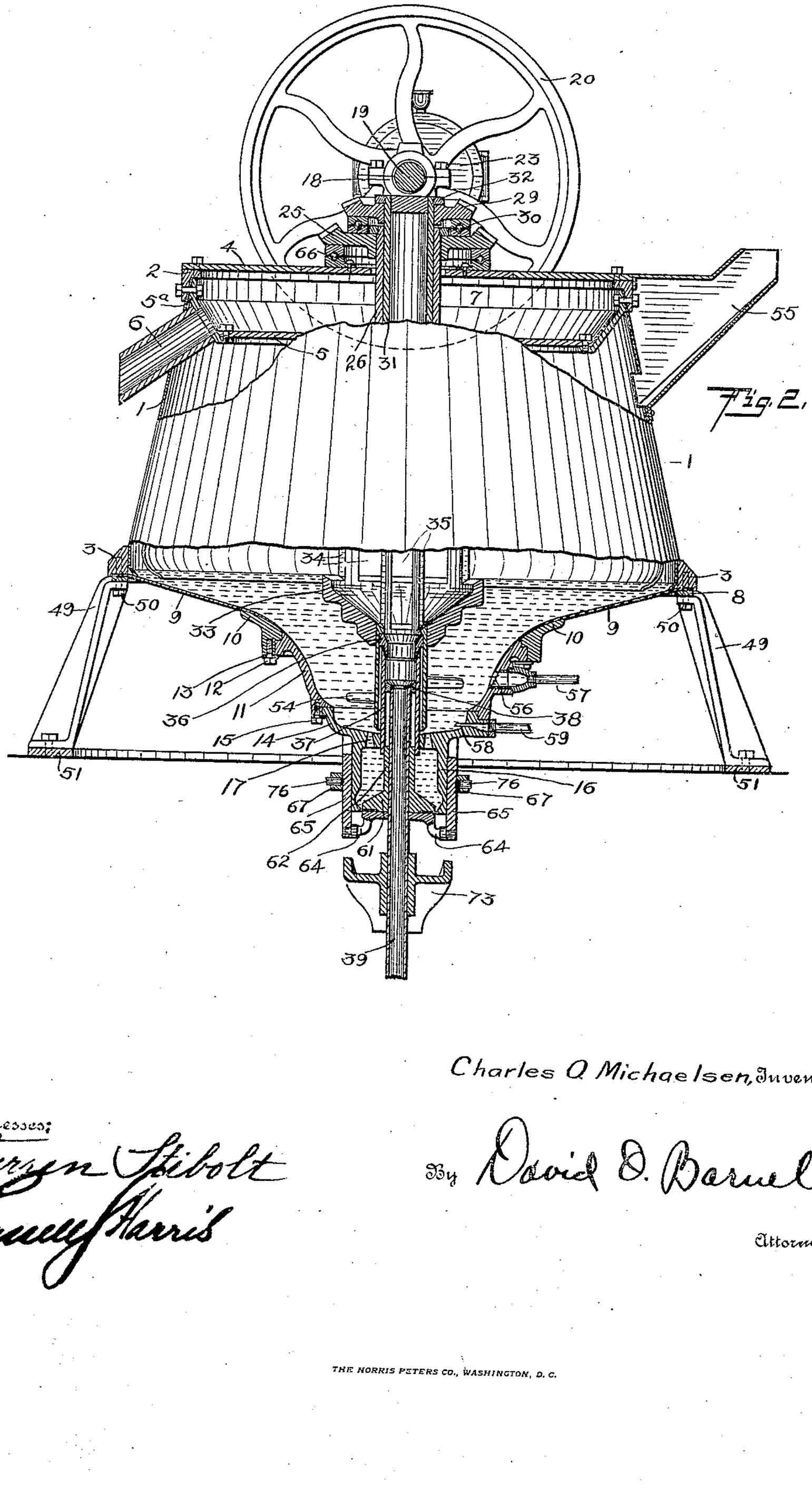

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 3.

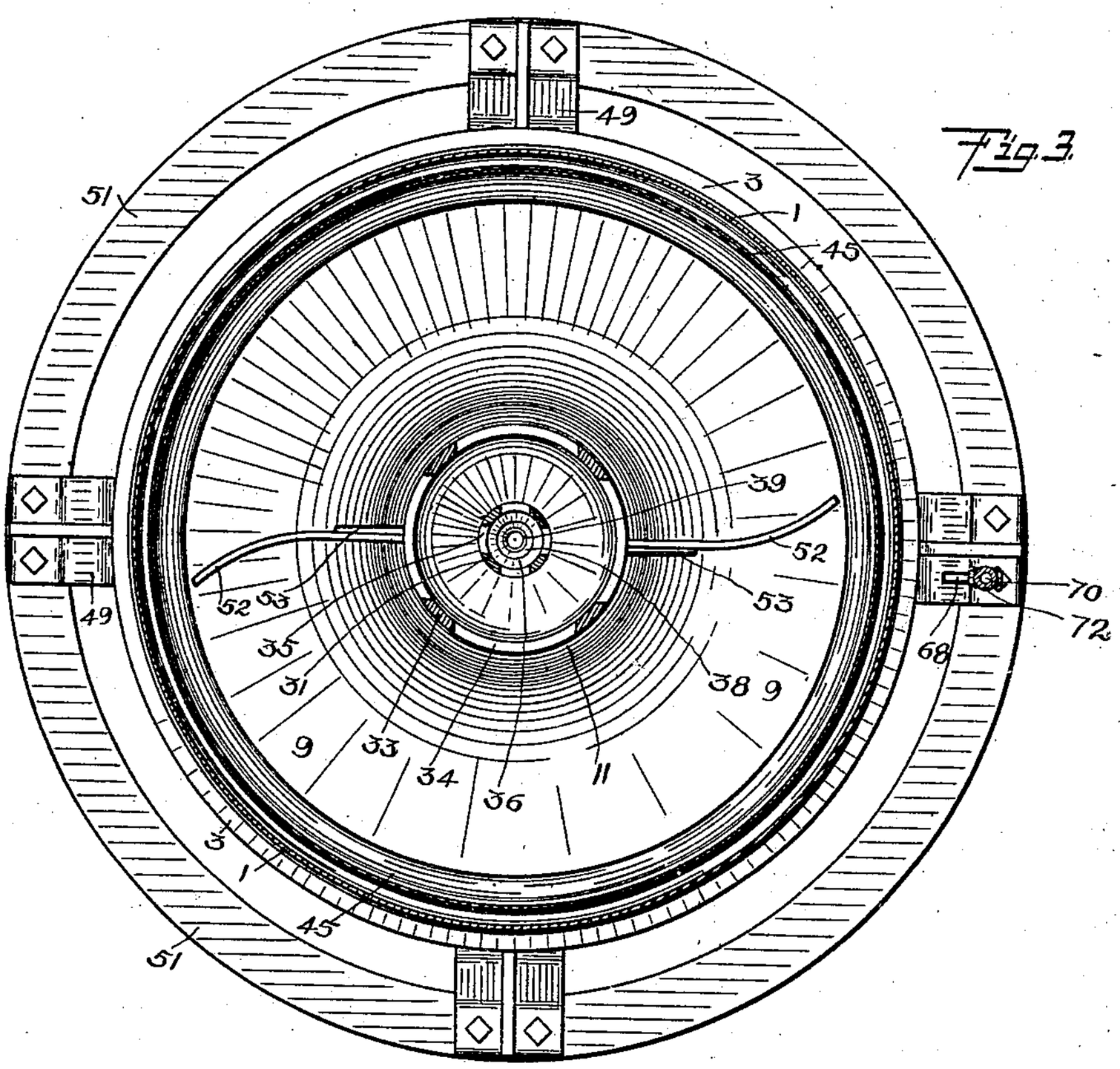


Fig. 4.

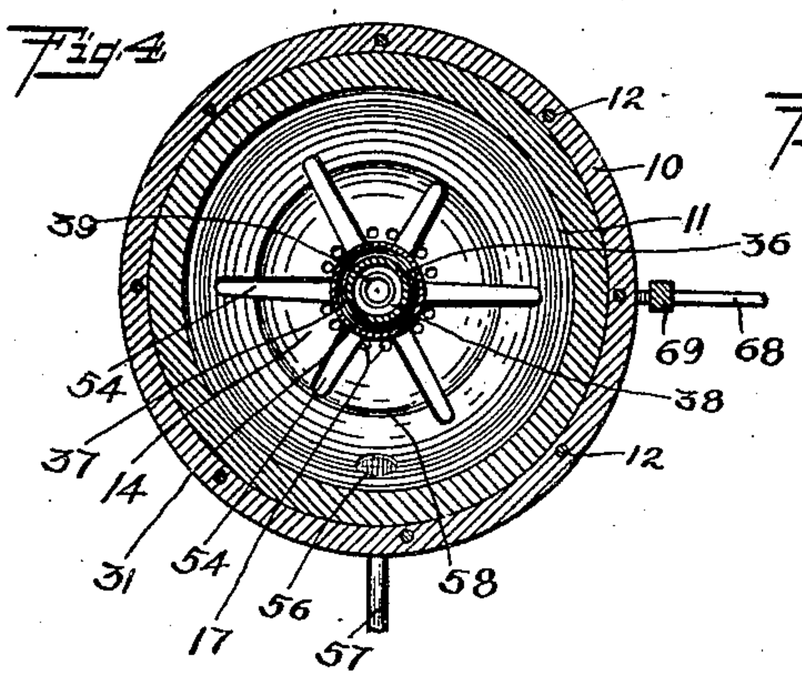


Fig. 5.

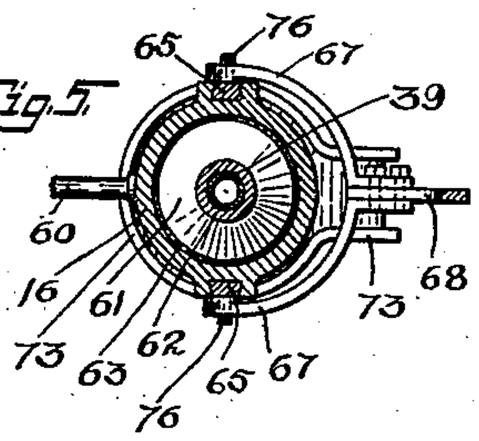
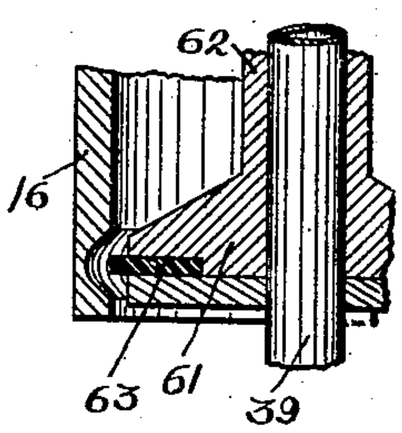


Fig. 6.



Witnesses:

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Russell Harris

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UNITED STATES PATENT OFFICE.

CHARLES O. MICHAELSEN, OF OMAHA, NEBRASKA.

MINERAL-CONCENTRATOR.

No. 880,808. Specification of Letters Patent. Patented March 3, 1908.

Application filed January 30, 1907. Serial No. 354,905.

To all whom it may concern:

Be it known that I, CHARLES O. MICHAELSEN, a citizen of the United States, and a resident of Omaha, in the county of Douglas and State of Nebraska, have invented certain new and useful Improvements in Mineral-Concentrators, of which the following is a specification.

My invention relates to mineral concentrators or separators for treatment of crushed, pulverized or granular ores, in which the gangue or lighter, non-metalliferous portions of the ore are by a washing operation decanted from the heavier, metalliferous portions of the ore, preparatory to smelting or refining operations.

It is the object of my invention to provide a machine of this class capable of handling large quantities of materials, operating continuously and automatically, and using a small amount of power relative to its output.

A machine embodying my invention is illustrated in the accompanying drawings in which

Figure 1 is a section of the machine on a vertical plane intersecting the axis of the driving shaft, Fig. 2 is a side elevation, partly in section, Fig. 3 is a plan section on the plane indicated by the line *x*—*x* of Fig. 1, Fig. 4 is a detail plan section on the plane indicated by the line *y*—*y* of Fig. 1, Fig. 5 is a detail plan section on the plane indicated by the line *z*—*z* of Fig. 1, and Fig. 6 is a detail showing the operation of the automatic valve for discharging the concentrates.

In the construction shown I provide a thin outer casing 1 of slightly conical form to which at the top and bottom, respectively, are secured rings 2 and 3. To the upper ring 2 is secured the cover 4, while within the casing is secured a ring 5^a supporting the partition plate 5, as shown. A suitable overflow tube 6 is provided connecting with the chamber 7 formed between the partition plate 5 and the cover 4, said overflow tube passing through the casing wall 1, as shown in Fig. 2. Below the ring 3 is secured a thin ring 8 between which and the ring 3 is clamped the thin, annular bottom plate 9 which is of funnel-like form, being inclined slightly toward the central part thereof, as shown. At suitable positions below the thin ring 8 the legs 49 are secured by bolts 50 passing through said ring 8 and the plate 9, and being threaded into the ring 3, as indicated. At the bottom of the legs the same are secured to a ring 51 upon which the entire weight of the machine is thus supported. At the inner edge of the plate 9 is secured a ring 10 to which the bowl 11 is removably secured by the screws 12 which are tapped into the ring 10 and have under the heads thereof washers 13 which engage the lip of the bowl and press the same upwardly against the inwardly extending shoulder of the ring 10. The lower part of the bowl 11 has a shouldered opening therein within which is fitted the shallow bowl or pan 14, the same being removably secured to the bowl 11 by screws 15 arranged similarly to the screws 12. On the bottom of the pan 14 and integral therewith is a downwardly extending cylindrical shell 16 having an open bottom and an internal annular recess formed therein near the bottom edge thereof. A number of tapering holes 17 are formed in the bottom of the pan 14, communicating with the interior of the shell 16, as shown.

Suitable bearing standards 18 are secured on the cover 4 at diametrically opposite edges thereof, in which bearings is journaled the main or driving shaft 19. Adjacent the bearings, on the outer ends of the shaft, are placed the fly wheels 20, tight and loose pulleys 21 and 22 being disposed on the shaft adjacent one of said fly wheels, and an eccentric 23 being secured to the shaft near the other of the fly wheels. Near the center of the shaft 19 a bevel gear 24 is secured thereto, said gear meshing with a similar gear 25 which is supported by a ball bearing 66 on the cover 4. Passing axially through said gear 25 and keyed thereto is a section of pipe or tubing 26 which extends downwardly therefrom through an opening in the cover 4. On the upper end of the pipe 26 is screwed a ring or nut 27, as shown, the same resting on top of the gear and serving to support the pipe and to provide also a slight vertical adjustment thereof. On the shaft 19 adjacent the gear 24 is a bevel pinion 28, the same meshing with a bevel gear 29 which rests on a ball bearing 30 on the upper face of the gear 25. From the gear 29 a pipe 31 extends downwardly, fitting within the pipe 26, said pipe 31 being keyed to the gear 29 and having a nut 32 screwed on the upper end thereof and resting on the gear, the connection thus being the same as that of the gear 25 and pipe 26. The speed ratios of the gears 24 and 25, and the pinion 28 and gear 29 are such that the pipe 26 is driven more rapidly than the pipe 31.

On the lower end of the pipe 26 is screwed

the hollow cylindrical body 33, having a number of circumferentially extending ports 34 in the sides thereof, the lower part of said body being funnel shaped internally and shouldered externally, as shown. The pipe 31 extends entirely through the body 33, terminating adjacent the bottom of the pan 14. In that portion of the pipe 31 passing through the body 33 are formed a number of ports 35 of which the lower edges are inwardly inclined and coincident with the funnel-shaped interior surface of the body 33. Immediately below said ports 35 a funnel-shaped ring or bushing 36 is secured in the pipe 31, said bushing having a downwardly projecting lip which fits within the upper end of a pipe or tube 37 secured to and extending upwardly from the pan 14. Near the upper end of the pipe 37 is secured a bushing 38 in which is screwed the drain pipe 39 which extends downwardly therefrom to a point considerably below the lower edge of the shell 16. At the lower end of the said pipe 39 an angle connection 40 connects the same with a pipe 41 which may be led to any suitable point for the final discharge of the materials passing thereinto.

At the center of the partition plate 5 is a circular opening within which is secured a short tubular section 42 which extends downwardly therefrom. At the lower end of the tubular section 42 is secured a ring 43 which, together with the ring 44 forms a ball-bearing support for the conical, rotatable, sheet-metal distributer 45. The said distributer extends from its ball-bearing support outwardly and downwardly to a point adjacent the lower edge of the casing 1 and then curves inwardly, terminating adjacent the bottom plate 9, as shown. Around the central outer portion of the distributer is secured a circular, outwardly and downwardly inclined shelf 46. On the inside of the distributer is secured a downwardly extending forked bar 47 which engages a radially extending rod 48 carried by the hollow cylindrical body 33. By means of the said rod and forked bar the distributer is driven at the same speed as the pipe 26 and the body 33. To the said body 33 below the ports 34 therein are secured the flat blades 52 which extend out radially therefrom, passing over the bottom plate 9 near the surface thereof and terminating near the lower edge of the distributer 45. The said blades are given a slight lateral curvature near their ends in the direction of motion of the body 33, so that materials passing over the bottom plate are drawn inwardly thereby. On one of the external shoulders of the lower portion of the body 33 are the radially extending flat blades 53 of which the faces are arranged at an incline and with such relation to the direction of movement of the body that their tendency is to lift materials engaged thereby. To the pipe 31 below the body 33 are secured a plurality of flat, radially-extending blades 54, the inner ends of said blades being arranged in two helical lines passing around the said pipe 31, and the length of the blades gradually increasing from the lower to the upper so that the outer ends thereof are uniformly distant from the inner surfaces of the pan 14 and bowl 11. The faces of the said blades 54 are arranged at an incline similar to that of the blades 53 and with such relation to the direction of motion that they will tend to lift materials engaged thereby.

At one side of the casing 1 near the top thereof is connected the inclined inlet chute 55, as shown in Fig. 2, the said chute being arranged to discharge materials upon the distributer 45 above the inclined shelf 46 carried thereby. At one side of the bowl 11 near the top thereof is a screened water inlet 56 to which is connected a suitable supply pipe 57, as shown. At one side of the pan 14 is a water inlet of which the inner opening is in the form of a long, narrow circumferentially extending slot 58, which is merged into a cylindrical outer opening to which is connected the supply pipe 59. A third, water supply pipe 60 is connected with the cylindrical shell 16 adjacent the annular recess therein, as shown in Fig. 1.

Arranged within the shell 16 and surrounding the pipe 39 is the conical discharge-valve body 61 which is provided with an upwardly extending stem 62 fitting within the tube 37 carried by the pan 14. The lower part of the valve body is of cylindrical form and of a diameter slightly smaller than the normal bore of the shell 16. In the edge of the said cylindrical portion is held a renewable outwardly projecting ring 63, preferably of fiber or similar material, and of which the diameter is such as to fit snugly within the normal bore of the shell 16. The lower end of the shell is thus closed by the discharge valve when the same is in the position shown in Figs. 1 and 2, but the same is openable by lowering the valve to bring the ring 63 below the lower edge of the shell or by raising the valve to bring the ring opposite the annular recess in the shell, as shown in Fig. 6. The valve is arranged to be intermittently opened and closed, automatically, by the following means: Extending laterally from the lower part of the valve body are the fingers 64 which are connected with the slides 65 movably held by suitable guides formed on the outside of the shell 16. On said slides are laterally extending studs 76 which connect with the forked ends 67 of a lever 68 which is pivoted on a bracket 69 secured to and extending downwardly from the ring 10, as shown in Fig. 1. From said bracket an arm of the lever extends laterally through a vertical slot in one of the legs 49 and to the outer end of said arm the eccentric rod 70 is con-

nected by the knuckle connection 71. The rod 70 is given a reciprocating motion by the eccentric 23 which reciprocating motion is transmitted by the lever 68 and slides 65 to the discharge valve. In the rod 70 is a turn-buckle 72 by which the length of the rod may be varied and the travel of the discharge valve adjusted so that the same will be caused to open to the extent desired and most suitable for the material on which the machine is being operated. Surrounding the pipe 39 and secured thereto below the shell 16 is the inclined receiver pan 73 which is adapted to receive the materials discharged from the shell and in turn discharge the same into a spout or other suitable device for receiving the same.

In the operation of the machine the shell 16, the pan 14, bowl 11 and the lower part of the casing are filled with water, through the various water inlets from the pipes 57, 59 and 60, to the level of the ports 34 in the body 33, as indicated in Figs. 1 and 2. Power is applied to the pulley 21, which drives the shaft 19, the same actuating the eccentric 23 and the bevel gears 24 and 28, these devices in turn actuating the discharge valve, the bevel gears 25 and 29, the tubular shafts 26 and 31, the body 33, the distributer 45, and the blades 52, 53 and 54 carried by the body 33 and pipe 31, as hereinbefore described. The crushed, pulverized or granular ore is fed into the chute 55 with sufficient water to cause the same to move and flow freely. Water in regulated quantities is also admitted from the pipes 60, 59 and 57 into the shell 16, the pan 14 and the bowl 11, respectively. The stream of ore and water entering from the chute 55 falls upon the distributer and, while flowing down over the same and the inclined shelf 46 thereon, is carried around the casing and distributed with comparative uniformity at the outer edges of the bottom plate 9. Passing over the bottom plate 9 the materials are drawn inwardly by the blades 52 and gradually descend through the bowl 11 to the pan 14, being constantly agitated and thrown upward by the blades 53 and 54, and also tending to be carried upward by the flow of water from the pipes 57 and 59. A constant overflow occurring through the ports 34 of the body 33 and thence downwardly through the central passage to the pipe 39, the lighter non-metalliferous portions of the ore are thereby decanted and carried off, while the heavier, metalliferous portions of the ore continue to descend and finally pass through the holes 17 into the shell 16. The discharge valve being intermittently opened, the concentrates pass out around the same and are caught by the inclined receiver pan 73, as before mentioned, the flow thereof being assisted by the water from the pipe 60. It should be noted that, on account of the relatively large area of the discharge valve, the same during the reciprocation thereof acts as a piston and causes a certain pulsatory motion to be given to the entire fluid contents of the machine, this pulsatory motion combining with the action of the blades 52, 53 and 54 and the flow of water from the inlets 56 and 58 to raise and carry off the lighter portions of the material operated upon. The speed of the machine and flow of water through the said inlets is, of course, so regulated that the agitation of the materials will not be sufficient to cause any appreciable quantity of the valuable portions of the ore to be washed away and lost, and it will be apparent that by the construction shown such regulation may be affected and the materials handled as gently as the nature thereof may require.

Now, having described my invention, what I claim and desire to secure by Letters Patent is:

1. In a machine of the class described, the combination with the casing having a centrally inclined bottom plate, the removable central bowl, and the means forming a central discharge passage, of the two sets of agitating blades working adjacent the inclined bottom plate and within the bowl and moving at different speeds, and an automatically actuated discharge valve intermittently openable and adapted to impart a pulsatory motion to the fluid contents of the bowl and casing.

2. In a machine of the class described, the combination with the casing, the removable concave bowl and pan, and the means forming a central tubular discharge passage having ports opening thereinto above the level of the bowl, of the agitating blades working within the bowl, there being water inlets to the bowl and pan, a shell forming a chamber arranged below the pan to receive materials therefrom, and an automatically operated valve for intermittently discharging the contents of said chamber, said valve being adapted to impart a pulsatory motion to the fluid contents of the casing.

3. In a machine of the class described, the combination with the casing having a centrally inclined bottom plate, the bowl removably secured thereto, the rotary distributer, the curved blades working adjacent to the inclined bottom plate and rotating at the same speed as the distributer, and the means forming a central tubular discharge passage, of agitating blades working within the bowl, means carrying said agitating blades and rotating at a speed slower than that of the distributer, there being a screened water inlet to said bowl, means arranged below the bowl to receive materials therefrom, and an intermittently actuated valve controlling the final discharge of such materials.

4. In a machine of the class described, the combination with a casing having a centrally

depressed bowl-shaped bottom, a conical rotary distributer working within said casing, agitating blades moving adjacent the bottom of the casing, and means forming a central tubular discharge passage having ports opening thereinto above the level of the outer portion of the bottom, of a shell forming a chamber arranged below the lowest part of the bowl-shaped bottom and communicating therewith, means for supplying a stream of water to said chamber, and reciprocating means working within said chamber and adapted to impart a pulsatory motion to the fluid contents of the chamber and casing.

5. In a machine of the class described, the combination with a circular casing, a feed chute leading thereinto, a rotary distributer arranged to distribute materials received from the feed chute around the outer edge of the casing bottom, said bottom having a central bowl-like depression, and means forming an overflow or discharge passage opening into the casing above the level of the outer edge of the bottom, of a cylindrical shell arranged below the bowl-like central depression of the bottom and communicating therewith, there being in said shell an internal annular recess, a piston-like valve working within said shell adjacent said annular recess, driving mechanism for actuating said valve, and means for adjusting said driving mechanism to vary the opening of the valve.

In testimony whereof I have hereunto subscribed my name in the presence of two witnesses.

CHARLES O. MICHAELSEN.

Witnesses:
D. O. BARNELL,
WARREN STIBOLT.