(No Model.) 3 Sheets—Sheet 1.

J. W. MacDONALD.

ORE GRINDER AND SEPARATOR.

No. 531,127. Patented Dec. 18, 1894.

Fig. 1.

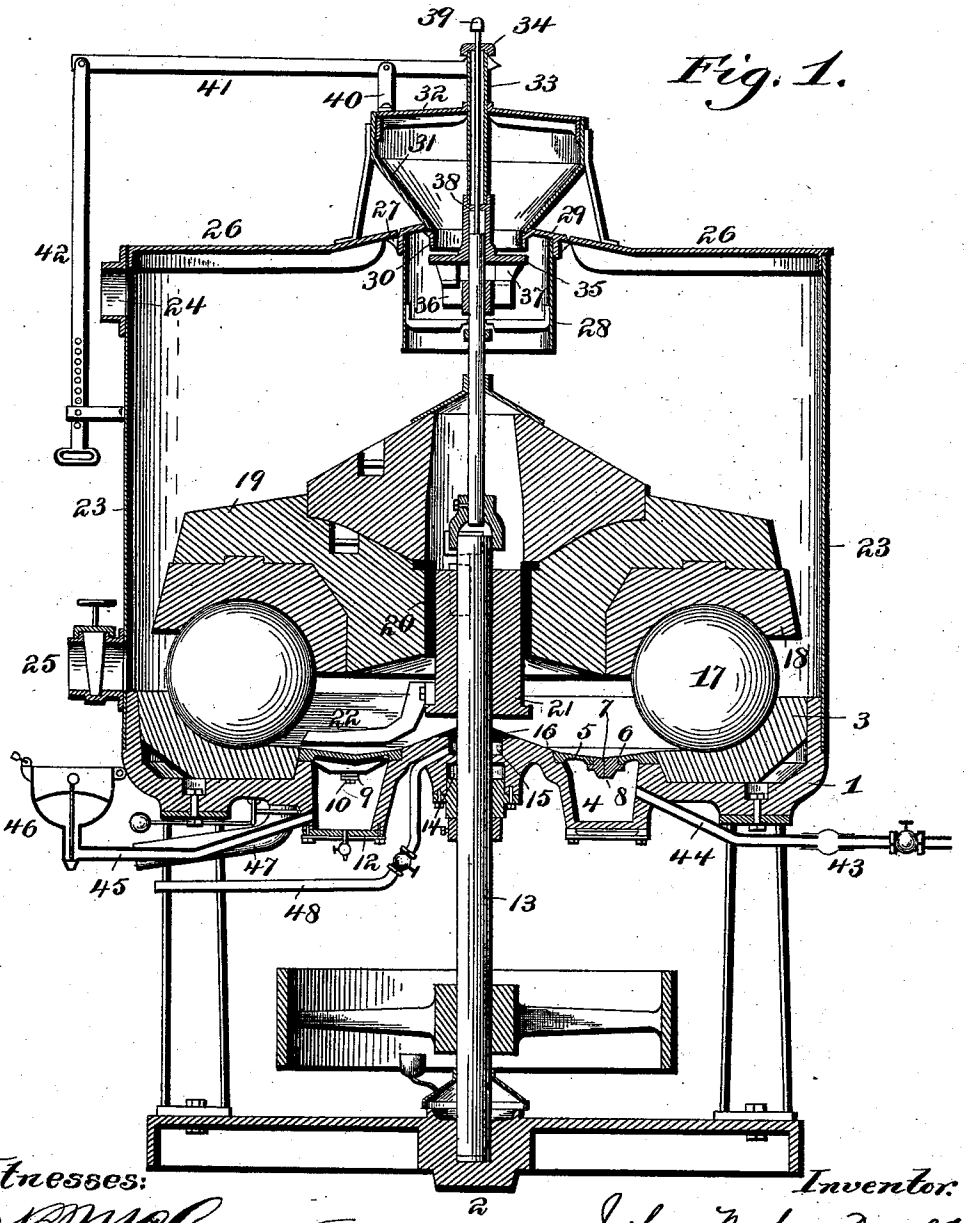

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Fig. 3.

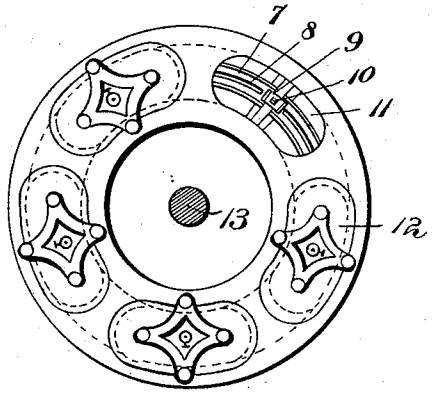

Fig. 2.

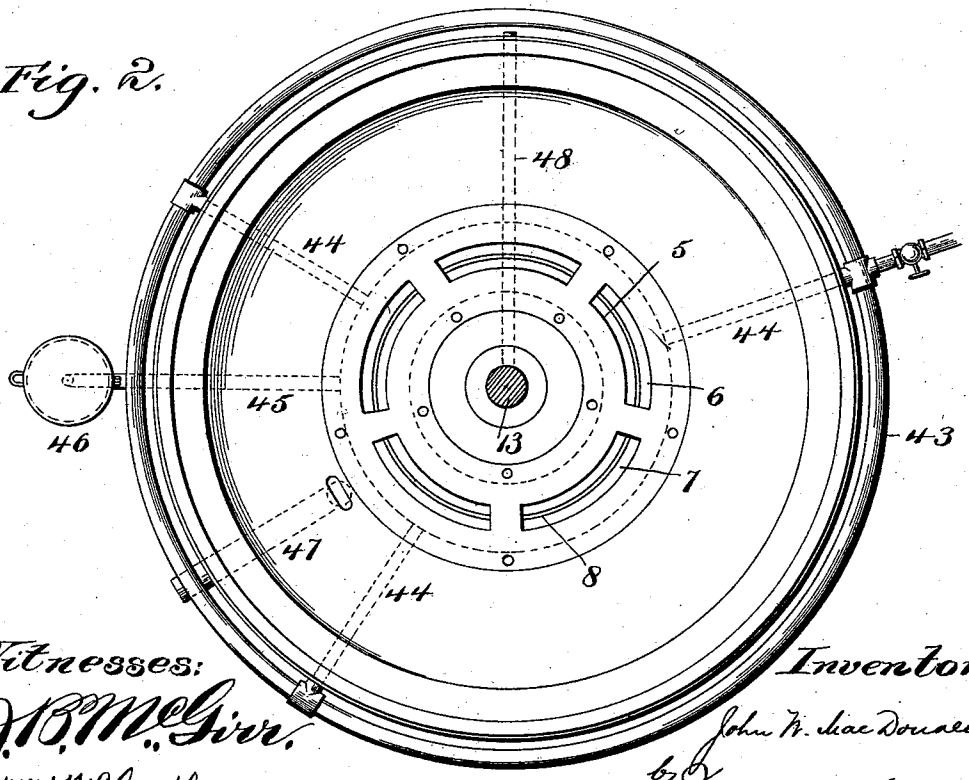

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Fig. 6.

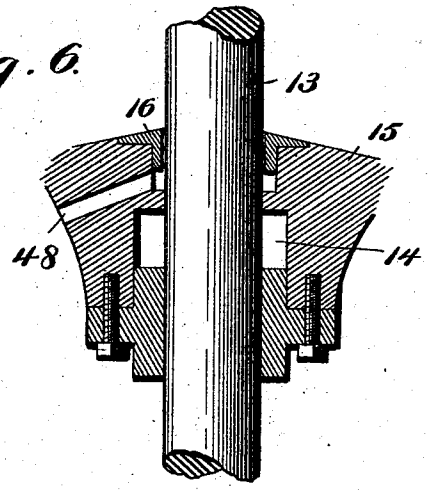
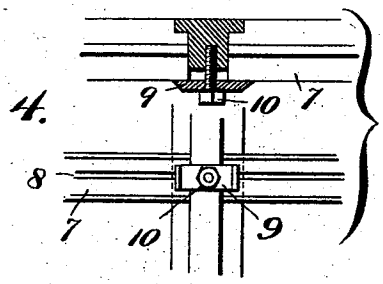


Fig. 4.



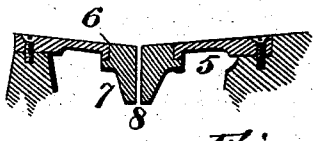
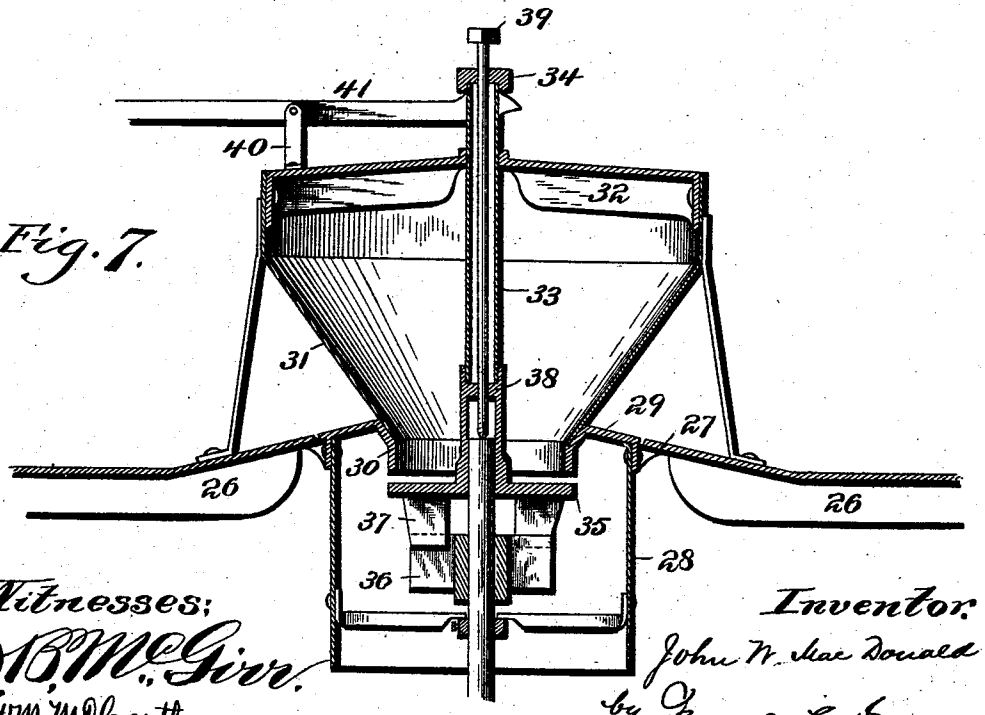


Fig. 5.

Fig. 7.



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UNITED STATES PATENT OFFICE.

JOHN W. MACDONALD, OF PITTSBURG, PENNSYLVANIA.

ORE GRINDER AND SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 531,127, dated December 18, 1894.

Application filed December 13, 1893. Serial No. 493,579. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. MACDONALD, a citizen of the United States, residing in the city of Pittsburg, in the county of Allegheny, in the State of Pennsylvania, have invented certain useful Improvements in Ore Grinders and Separators, of which the following, taken in connection with the accompanying drawings, is a full description.

This invention relates to that class of devices that have for their object the grinding and separating at one operation, of ores composed of elements of different specific gravity, and is especially adapted to the working of gold ores.

Figure 1 is a vertical cross section of said device with improvements shown. Fig. 2 is a top view of bottom of body of machine, showing concave plate 5 and water conduits 7, in place. Fig. 3, is a bottom view of the auxiliary chamber or trough 4, showing one of the closing plates removed and showing also portions of removable water conduits. Fig. 4, is a vertical section and a bottom view of removable water conduits showing manner of supporting same in place. Fig. 5 is an enlarged cross section of removable water conduits and concave plate to which it is attached. Fig. 6 is a vertical cross section of device for preventing the ground pulp from reaching the stuffing box of the central shaft, and Fig. 7 is an enlarged vertical cross section of hopper and feeding device.

In constructing a machine to carry out said improvements, a circular base 1 of the general form shown in Fig. 1 is placed upon suitable standards resting upon a bed plate having a central cup journal 2. Into an annular depression formed in the base 1 is placed an annular casting 3, shaped in cross section as shown, to form the lower part of a grinding track. Concentric with the grinding track 3 and within the inner circumference thereof, the base 1 is so shaped as to form an annular trough 4, preferably of the relative size shown, for the purpose hereinafter described.

Over the annular trough 4 is fitted an annular plate 5, the upper surface of which is made concave, through which, and in the line of the circle thereof, a number of openings 6 are made. From suitable metal, preferably non-corrosive under ordinary circumstances, a number of movable parts 7 are constructed in the form of segments of a circle and in cross section as shown, and of such length and width as to fit closely into the openings 6 in the annular concave plate 5. Through the movable parts 7 and in the center line thereof, a narrow slotted opening 8 is cut, the size of which is determined by the work to be done. The movable parts 7 are fitted into the openings 6 in the annular plate 5 from the under side thereof, and are secured in place by a strap 9 and bolt 10. The movable parts 7 with slotted openings 8 being now in place form a series of conduits between the body of the machine and chamber 4, for the purpose hereinafter stated.

The auxiliary chamber or trough 4 is provided with openings 11 through the bottom thereof, adapted to be closed by suitable plates 12, which openings are to be of sufficient size to permit of the free passage through the same of the movable conduits 7.

In the center of the under side of the base 1 an ordinary stuffing box 14 is formed. From the cup journal 2 a central vertical shaft 13 passes up through said stuffing box into the body of the machine. Above the stuffing box 14 but below the body of the machine, a chamber 15 is formed around the shaft 13. At the top of said chamber 15 a bushing 16 is fitted having an inside diameter large enough to leave a passage around and between it and the shaft 13.

Upon the annular track 3 a number of metal balls 17 are placed and resting upon said balls is a somewhat similar casting 18, forming the upper part of the grinding track, which is fitted to a heavy circular rider 19, that for convenience in handling may be made in two parts, one of which is provided with a central square opening fitted with a bushing of hardened steel 20, to receive a clutch 21 attached to the vertical shaft 13, and which clutch is provided with a depending arm 22 to form a plow. To the base plate 1 is fitted a casing 23 of sheet metal to form the body of the machine, and which reaches in height nearly three times the diameter of the balls 17 and is provided with outlets 24 and 25 at top and bottom respectively. From the upper edge of casing 23, radial arms 26 project inward

to an annular plate 27, to which latter is attached a depending pipe or ore chute 28. By means of the arms 29 a centrally placed collar 30 is held in position within the chute 28 to support a hopper 31. Centrally suspended within the hopper 31 from a bridge 32 placed across the top thereof, is a hollow tube 33 provided upon the upper end thereof with a cap 34. To the lower end of said tube 33 is secured a disk 35 provided with a hollow hub open at its lower end. Said disk should hang below and be of slightly larger diameter than the collar 30 and be concentric with the vertical shaft 13. The vertical shaft 13 in a reduced diameter is continued up through the body of the machine and into the hollow hub of the disk 35. Fitted to the shaft 13 near the upper end is a clutch 36 adapted to interlock with lugs 37 formed on the under side of the disk 35.

Passing through the cap 34 and extending down through the hollow tube 33 and through a threaded opening 38 in the lower part of the hollow hub of the disk 35 is a rod 39, the lower end of which rests upon the upper end of the shaft 13, the function of said rod being to adjust and support the disk 35 to the proper position on the shaft 13 when in operation. To a standard 40 resting upon the bridge 32 is pivoted a lever 41, one end of which is loosely fitted around the hollow tube 33, and under the cap 34, the other end being provided with a hand rod 42. A water pipe 43 extends around the lower part of the body of the machine from which lead other smaller pipes 44, and enters the chamber 4, near its top. There is also connected with the chamber 4 at a point sufficiently near its bottom to drain the same, a pipe 45 which leads to a mercury reservoir 46 placed outside the body of the machine. A drain pipe 47 having a suitable closing valve is arranged to enter the body of the machine through the base 1. The chamber 15 above the stuffing box or shaft 13 is fitted with a pipe 48, provided with a stop cock to drain or supply the same.

The operation of my improved device is as follows: The shaft 13 is caused to revolve, which gives motion to the upper grinding track 18, which in turn causes the balls 17 to travel around the lower grinding track 3. The stuffing box of the shaft 13 being properly packed, the chamber 15 is filled through the pipe 48 with any heavy liquid substance preferably mercury. Water under pressure is supplied to the pipe 43 and passes thence by pipes 44 into the chamber 4, and when the latter is filled moves upward through the reduced area of the movable conduits 7 at a high rate of speed, the volume of water passing through said conduits 7 being sufficient, but not more than enough to maintain within the body of the machine a gentle current toward the top where it overflows through the outlet 24. If the rod 42 be now raised, the disk 35 will drop down the vertical shaft 13 and be set in motion by coming in contact with the clutch 36 on the revolving shaft 13. The function of the threaded rod 39 being to support the disk 35 by resting upon the upper end of the shaft 13 as well as to regulate the opening between the lower end of the hopper 31 and said disk 35, the latter should therefore be dropped down until the lower end of the threaded rod rests upon the upper end of the said shaft, and it will be seen that by an adjustment of said rod the opening between the hopper 31 and disk 35 can be made larger or smaller, and the passage through the same of the material to be ground can be regulated accordingly. Ore that has been previously reduced to small size is fed into the hopper 31 where it will reach the disk 35, and the latter revolving will carry the ore outward through the opening beneath the collar 30, whence it passes by way of the chute 28 into the body of the machine and is there carried out against the casing 23 to fall down upon the grinding track 3 beneath the traveling balls 17.

The successful operation of this device contemplates the grinding of the ore fine enough to free from one another the elements composing it, and as this operation goes on, that element which is of the greatest specific gravity will settle toward the lowest point in the bottom of the body of the machine—the concave of the plate 5—and all others will be carried off by the upward current of water. As that element of the ore sought to be saved—which is the heavier of all the elements theretofore combined in the ore—falls to the bottom of the machine, it is important that it finds a resting place away from the agitation within the body of the machine and a position in which, when once separated from the pulp it will remain so, and where it may be drawn off without interference with the operations of the machine. To this end a separate body of comparatively still water is provided within the auxiliary chamber or trough 4, beneath the concave plate 5.

From the concave plate 5, a number of conduits 7 reach down into the chamber 4 and connect the same with the body of the machine. These conduits are of such length that the water passing through them will be given a well directed upward current and a speed proportionate to the area of the conduits and the pressure of the water in the chamber 4, both of which are to be adjusted from time to time to the character of the ore to be worked and the specific gravity of the element sought to be saved. To facilitate this adjustment as required by the change in the character of the ore, said conduits are made removable, and to permit of easy examination thereof without interference with the heavy parts of the machine, suitable openings are provided in the bottom of the chamber 4, through which they can be reached. In the course of the operation of this device, particles of ore small enough to pass through said conduits but still in original combination, will settle upon the concave plate 5, and

would pass from there through said conduits into said chamber 4, were it not for the rapid upward current of water flowing through the same. These particles being thus rejected soon come in contact with the revolving arm 22 and are carried outward and under the moving balls where they are finally pulverized and the heavier substance being freed, again finds its way back to the concave plate 5 and now unencumbered by the lighter elements of the original ore, is able to resist the rapid current of water flowing up through conduits 7 and drops through the same into the quiet water in the chamber 4.

In working gold and silver ores with this machine, the bottom of the chamber 4 should be covered with mercury to receive particles of mineral that drop into said chamber, and this is supplied from the resevoir 46 through the pipe 45 and is drawn off again through the same pipe after it has amalgamated with the mineral dropping into it and is replaced with fresh mercury.

Heretofore in machines of this class it has been found most difficult to preserve the main shaft from destruction at that point where it works through a stuffing box and enters the body of the pulp, for the reason that the finely ground pulp finds its way between the shaft and the packing of the stuffing box where it acts to cut it away. To avoid this difficulty, the construction here shown provides a small chamber 15 immediately above the stuffing box 14 having an opening into the body of the machine to contain a liquid substance much greater in specific gravity than the pulp above it. It is obvious that under such conditions the pulp will not go below the service of the substance in said chamber, and as it will not therefore come in contact with any frictional part of said shaft it cannot act to destroy it. With the same construction water may also be used to protect the said shaft from destruction in the following manner, viz: The pipe 48 being connected with the chamber 15 is supplied with water under pressure, whence it passes to said chamber 15 and from there makes its exit by way of opening between said shaft 13 and bushing 16, up into the body of the machine. It will be understood that the quantity of water supplied to said chamber must be great enough to cause it to flow therefrom up into the body of the machine with such pressure as to reject any of the heavy pulp that might otherwise work into said chamber and finally reach the stuffing box 14.

What I claim, and desire to secure by Letters Patent, is—

1. The combination, in an ore grinder and separator, of a casing, an annular grinding track within said casing, and an annular auxiliary chamber having an opening or a series of openings circularly arranged inside the circle of said grinding track and concentric therewith, substantially as and for the purposes set forth.

2. The combination, in an ore grinder and separator, of a casing, an annular grinding track, and an auxiliary chamber provided with a series of openings through the top thereof, and with removable bottoms substantially as and for the purposes set forth.

3. The combination, in an ore grinder and separator, of a casing forming a body portion containing an annular grinding track, an annular chamber formed in the bottom of said body portion within the circle of said grinding track and concentric therewith; an annular concave plate shaped to cover said annular chamber and provided with openings in the center thereof, adapted to receive a series of conduits substantially as and for the purpose set forth.

4. The combination, in an ore grinder and separator of a casing forming a body portion and provided with an annular auxiliary chamber beneath the same, a series of removable sectional covers having slotted openings therein, and adapted to form conduits, substantially as and for the purposes set forth.

5. The combination, in an ore grinder and separator, of a casing forming a body portion, a chamber or trough 4, within said body portion, a series of conduits in the upper part of said chamber or trough, a lower grinding track outside of said chamber or trough and concentric therewith, a vertical shaft passing through the body portion, an upper grinding track mounted upon said shaft, grinding rolls between said upper and lower grinding tracks, a stuffing box for said shaft in the bottom of the body portion, a chamber 15, surrounding said shaft above said stuffing box, and a bushing 16 surrounding said shaft above said chamber 15, substantially as set forth.

6. The combination, in an ore grinder and separator, of a casing forming a body portion, a chamber beneath the said body portion, a series of conduits in the upper part of said chamber, a lower grinding track in said casing and outside of said conduits, a vertical shaft mounted within the casing, an upper grinding track mounted on said shaft, grinding balls or rolls between said upper and lower grinding tracks, a hopper mounted above the casing, a distributing disk mounted beneath said hopper and a clutch between said vertical shaft and said distributing disk, substantially as described.

7. The combination in an ore grinder and separator, of a casing forming a body portion, a chamber beneath said body portion and communicating with the same, a lower grinding track in said body portion, a vertical shaft mounted within the casing, an upper grinding track mounted on said shaft, grinding balls or rolls between said upper and lower grinding tracks, a hopper in the upper part of the casing, a distributing disk beneath said hopper, and adjacent to the upper end

of said vertical shaft, clutch connections between said vertical shaft and said distributing disk, and an adjusting rod 39, for adjusting the position of said distributing disk, substantially as described.

8. The combination, in an ore grinder and separator, of a casing forming a body portion, a chamber beneath said body portion and communicating with the same, a series of conduits in the upper part of said chamber, a lower grinding track within the casing and outside of said conduits, a vertical shaft mounted within the casing, an upper grinding track mounted on said shaft, grinding balls or rolls between said upper or lower grinding tracks, a water supply pipe 43, extending around the machine, and branch pipes 44, from said supply pipe leading into said chamber substantially as described.

9. The combination, in an ore grinder and separator, of a casing 23, a chamber 4, in said casing, removable conduits 7, for said chamber, a lower grinding track 3, adjacent to said chamber, a vertical shaft 13, an upper grinding track 18, mounted on said vertical shaft, grinding or crushing rolls 17, between said upper and lower grinding tracks, a mercury vessel 46, on the outside of the machine, and a pipe 45, connecting said mercury vessel with a chamber 4, substantially as described.

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