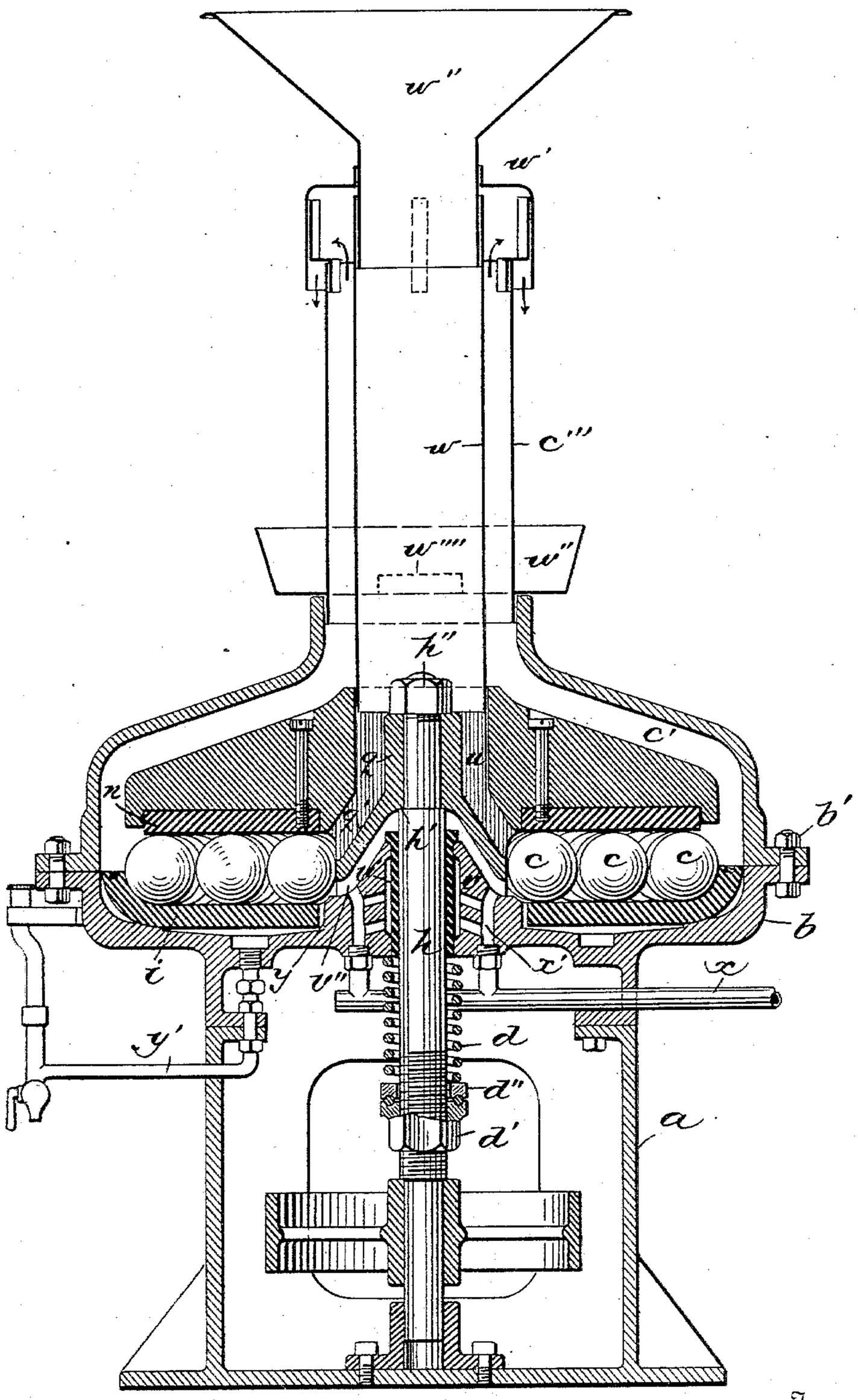
(No Model.)

S. K. BEHREND & C. F. WELLER.

ORE MILL.

No. 563,733. Patented July 14, 1896.



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ORE-MILL.

SPECIFICATION forming part of Letters Patent No. 563,733, dated July 14, 1896.

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To all whom it may concern:

Be it known that we, SAMUEL K. BEHREND and CARL F. WELLER, citizens of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Ore-Mills; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawing, and to the letters of reference marked thereon, which forms a part of this specification.

Our invention relates to those mills which employ rolling balls or spheres for the purpose of pulverizing ore or other substance. In these former devices it has been common to interpose a series of balls between a pair of crushing-surfaces, but these balls have been arranged to travel in grooves or fixed paths, so that one ball always follows in the path of the preceding ball, and only upon a central, vertical portion of its circumference, thereby leaving its right and left sides free from contact with the surface over which it travels. As a consequence, the balls will gradually wear down into substantially the shape of an egg, so that their utility is greatly impaired.

The purpose of our invention is, primarily, to prevent the uneven rolling of the balls before alluded to; secondly, to increase capacity and efficiency, and, thirdly, to provide a mill which will be more simple, strong, cheap, durable, and generally more desirable than those hitherto employed for the same class of work. To accomplish this purpose, we provide a machine of the vertical-axis type, in which a single layer of balls travels indiscriminately in a horizontal plane between two flat, smooth surfaces common to them all. In the present instance we find it advisable to provide a rolling or crushing surface wide enough to receive three balls side by side, but it is evident that the number could be increased or diminished to suit the exigencies of the occasion. The ore is introduced at the top of the machine and is washed through the pulverizing-chamber by means of an upward flow of water, but as the manner of introducing and carrying off the ore is old and well known to the art, we lay no claim to it, excepting in conjunction with the novel features just mentioned.

The accompanying drawing shows a vertical section of our complete machine, in which the reference-letter *a* denotes the frame, and *b* a tank mounted upon the frame and adapted to contain the pulverizing-balls. These balls travel over a flat, smooth, circular bed-plate *i* placed over the bottom of the tank. This plate is composed of hard steel, chilled iron, or any suitable material that will resist wear the best, and the balls are actuated to travel indiscriminately over it by means of a rotating circular disk *g*, mounted upon a vertical spindle *h*, and driven by a pulley *k*. The number of balls should not be great enough to crowd each other, but should be sufficient to permit them to shift about and change places upon the bed-plate, so that no grooves will be worn in the latter. The bottom of this disk is provided with a hardened facing *n*, having a smooth, flat face which bears upon the tops of the balls. The bed-plate *i*, upon which the balls travel, is parallel with the face of the plate above, and is provided with a circumferential upturned flange *m*, which keeps the balls within proper limits. The means by which the disk *g* is attached to the spindle consists of a hub *q*, cast integral with the disk *g*, and fixed to the spindle by a nut *h''*, which locks it down upon a shoulder *h'*.

A flaring skirt *q'* extends downward from the hub and over a conical projection *v*, which is provided with a box *v'*, surrounding the spindle *h*. Passages *u* extend through the disk from the receiving-pipe above to the grinding-chamber below for the ore. The skirt *q'* and the projection *v* are so disposed as to leave a water-space *v''* between them for the reception of incoming wash-water.

The ore is fed to the center of the machine through a funnel *w'* at the top of the pipe *w*. The bottom of the latter fits within the top of the revoluble disk *g*.

The ore is washed through the mill by means of water introduced at the bottom through the water-pipe *x*. This water-pipe *x* is connected with a plurality of vertical inlets *x'*, which divide and discharge the water laterally through the sloping sides of the central pro-

jection v into the space v'', whence it flows outward away from the axis of the machine into the pulverizing-space where the balls are revolving, and out at the edge and up the water-space c'. After passing through the duct the water is guided in its upward course between receiving-pipe w and an outer pipe c''', thence into a hood w', which extends down over the top of said outer pipe and directs the water downward into a pan w'' surrounding the pipe, out of which it is discharged through a trough w''''.

The covering just described can be so arranged as to be readily taken apart and removed by means of bolts b' whenever it becomes necessary to do so for cleaning or repairs.

In operating our machine we cover the bottom of plate i with quicksilver, which submerges the lower portions of the balls during the pulverizing operation. This quicksilver is drawn off, when sufficiently loaded with gold, by means of ducts y, leading to a valved drawing-off pipe y'.

To regulate the pressure of the revolving disk g upon the balls and to permit the disk to rise and fall, a spring d is provided. This spring encircles the central portion of the spindle h, which extends beneath the bottom of the pan b, against which it is seated so as to expand downwardly. The free end of this spring bears against a nut d', operating up and down on threads on the spindle to regulate the strength of the spring, and hence the downward pressure of the revoluble plate upon the balls, and the latter upon the ore. A ball-bearing washer d'' is interposed to prevent the spring from revolving with the spindle.

The preferred construction of our device having been set forth, we will now proceed to briefly describe its operation. As before stated, ore is introduced into the machine through the funnel w'' in the top of the vertical feed-pipe w. Passing down this pipe it is distributed and fed to the revolving balls through the passages u. As it enters the pulverizing-space beneath the revolving plate g streams of water are made to flow through the inlets x'. This water comes in contact with the ore and washes it outwardly between the balls and away from the axis of the revolving plate.

The feed being gradual in its nature will allow the balls to operate upon the particles of ore successively, and to come in contact with and crush it at all portions of their peripheries, for it will be seen that the two surfaces between which the balls revolve being flat, parallel, and smooth, will not make them travel in fixed paths, but will allow them to constantly change position. The rapidity with which the balls travel, the ore fed, and the water introduced will regulate the degree of pulverization. As soon as the tailings leave the pulverizing-space the water carries them up and out of the machine through the passage c', thence up around the feed-pipe w and down and out, as hereinbefore described, while the quicksilver retains the liberated gold. It will be observed that the quicksilver will not be separated or floured by the compression which usually takes place in roller-mills, because the balls plow through the silver instead of pushing it before them and compressing it. The latter operation is impossible in our machine, because the rolling of the balls on a flat surface always leaves communicating passages for the free circulation of the quicksilver.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In an ore-mill a layer of crushing-balls interposed between two parallel horizontal surfaces or plates, in such a manner as to be free to shift laterally and change their relative positions whereby they travel in irregular paths, and wear down uniformly to maintain their true spherical contour, in combination with means for actuating one of the plates, and devices for feeding and carrying off the ore, substantially as described.

2. In an ore-mill the combination with a layer of crushing-balls, of horizontal plane, smooth upper and lower surfaces between which the balls are revolved by the motion of one of said plates, and means for feeding ore and water centrally and discharging it outwardly in relation to the axis of the moving surface, substantially as described.

3. In an ore-mill, the combination of a horizontal pan provided with a flat, smooth bottom, a layer of balls upon said bottom, a horizontal revolving plate adapted to bear upon the balls, and centrally disposed ore and water feeding devices, substantially as described.

4. In an ore-mill, the combination with a horizontal pan or receptacle having a smooth bottom and adapted to hold quicksilver, a plurality of balls loosely placed within the pan so as to travel in irregular paths, a revolving member having a plane under surface bearing upon the balls whereby the latter are revolved within the pan, and means for feeding and carrying off the ore.

In witness whereof we affix our signatures in presence of two witnesses.

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