L. S. ROPES.

MORTAR BALL MILL.

APPLICATION FILED MAY 22, 1915. RENEWED JUNE 15, 1916.

1,213,264.

Patented Jan. 23, 1917.

2 SHEETS—SHEET 1.

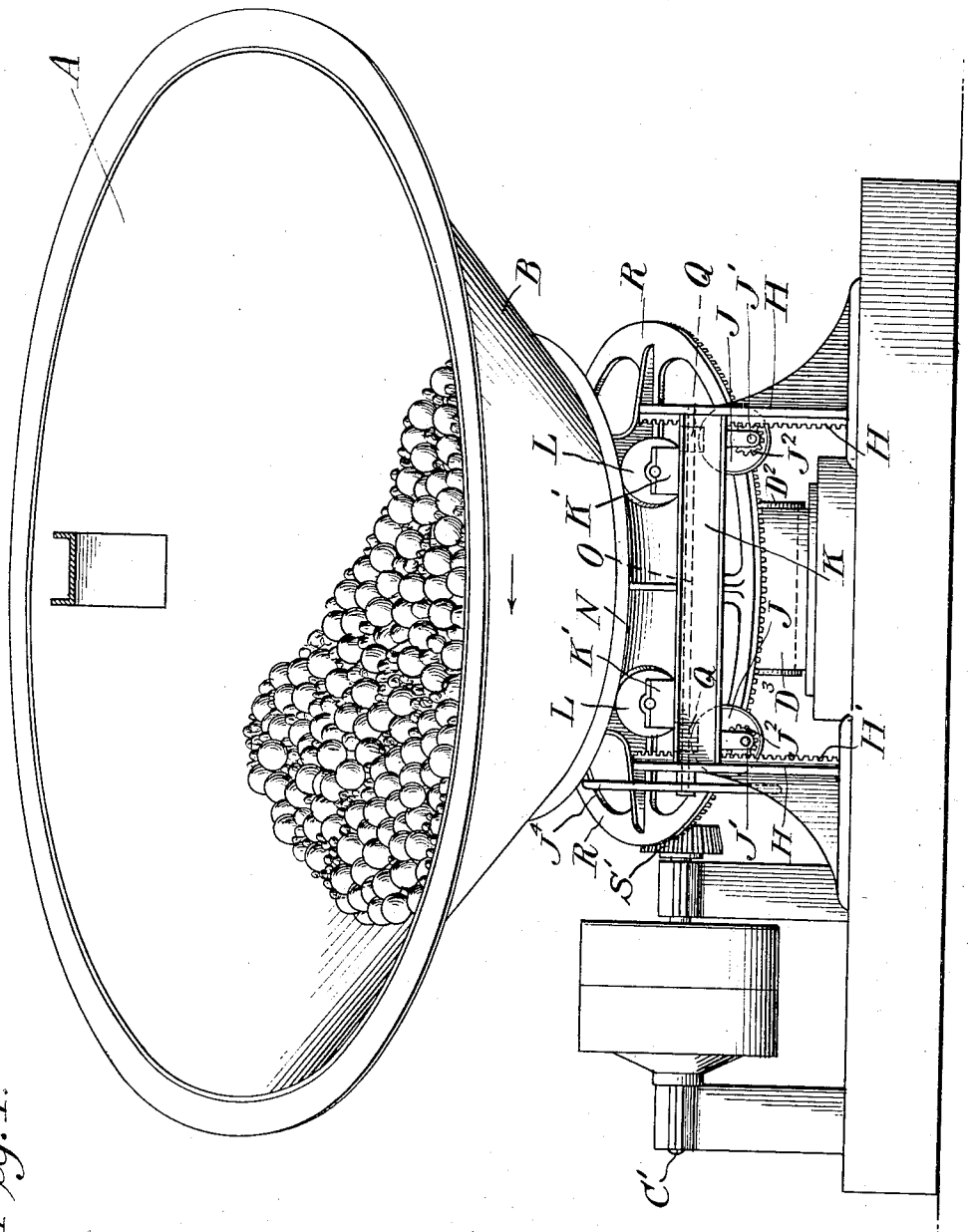


Fig. 1.

Witnesses

Fenton S Belt

J. M. Sherwood

Inventor

L. S. Ropes

By Franklin W. Hough

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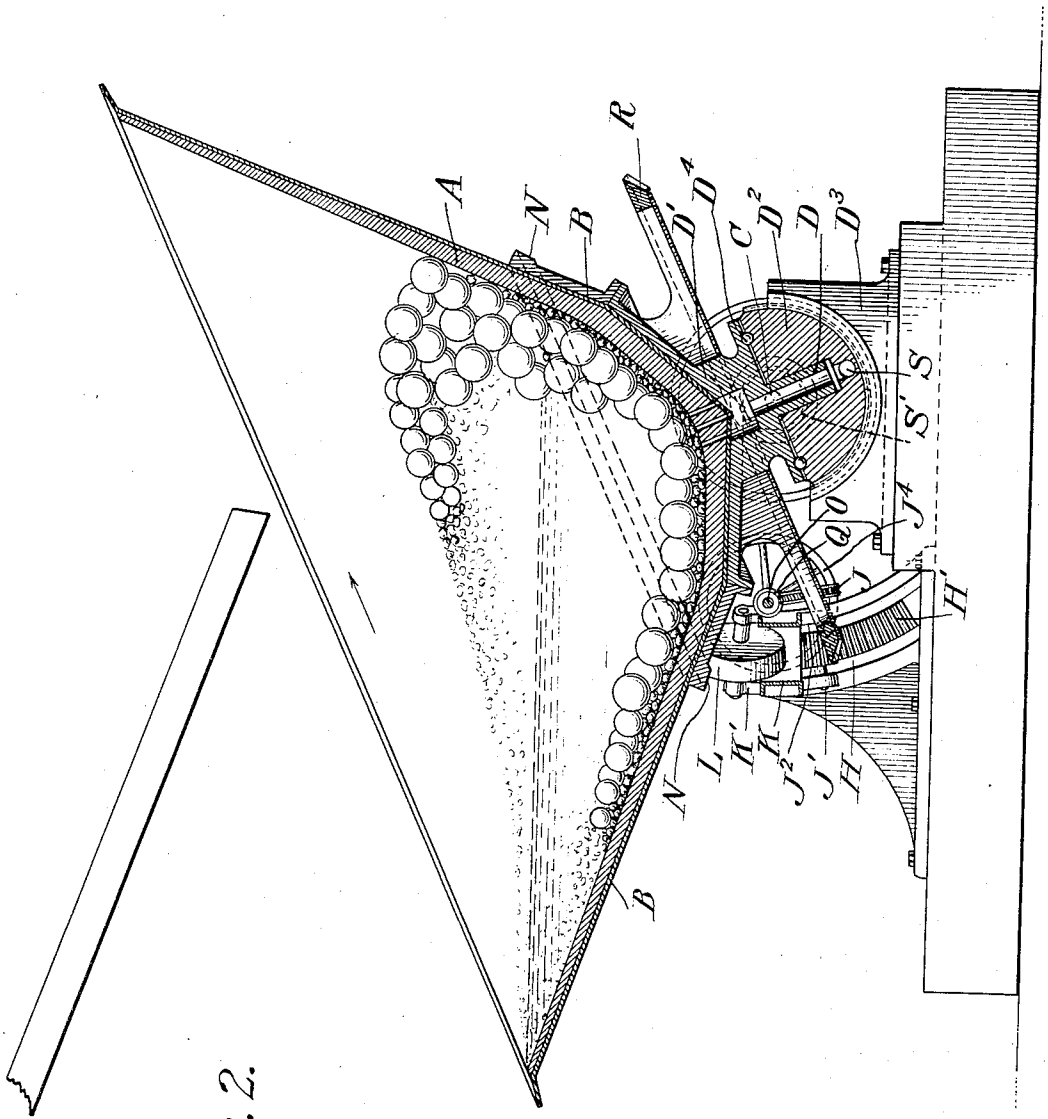


Fig. 2.

Witnesses

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UNITED STATES PATENT OFFICE.

LEVERETT S. ROPES, OF HELENA, MONTANA.

MORTAR BALL-MILL.

1,213,264. Specification of Letters Patent. Patented Jan. 23, 1917.

Application filed May 22, 1915, Serial No. 29,831. Renewed June 15, 1916. Serial No. 103,866.

To all whom it may concern:

Be it known that I, LEVERETT S. ROPES, a citizen of the United States, residing at Helena, in the county of Lewis and Clark and State of Montana, have invented certain new and useful Improvements in Mortar Ball-Mills; and I do hereby 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 drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to new and useful improvements in mortar ball mills and the object in view is to generally improve upon and render more efficient this type of apparatus. As an axiom in grinding machines of this nature, provision should be made for a progressively increasing grinding surface and grinding medium in the treatment of a given quantity of material. In the segregation of the finished product from the balls of the incompletely ground material by the use of water and without screens, the flow of water will determine the size of the particles which will be discharged from the mill.

Heretofore, the tube mill commonly in use with a grinding medium of balls or pebbles is built with a uniform grinding surface, its cross section being also uniform and the flow of the current of water passing through the mill has the same carrying capacity in all sections of the machine. By this construction and operation, the apparatus lacks the essential principles and requirements of an efficient mill.

In the operation of the conical tube mills, which is diametrically opposite the desired requirements, it is evident that, as the material is ground finer and approaches the discharge and in so doing traveling the conical section of the mill, the grinding surface will become more and more diminished and at the same time the burden of the grinding medium will grow less until near the discharge where it is reduced to nothing. The flow of water, upon which depends the discharge of the final ground product, is the least at the large cross section of the mill and near the feed end. Beyond this cylindrical cross section, the flow is restricted more and more toward the discharge until at the discharge the maximum velocity and maximum carrying capacity are obtained. This results in the discharge of particles much too large for treatment and the necessity of their return in closed circuit to the mill for further grinding in another mill.

In the present invention, the principle of the mortar is utilized simply with a multiplicity of pestles in the shape of balls or pebbles and in principle the grinding surface increases as the material feeds toward the discharge and the area of the grinding medium likewise will be increased and which is an important requisite. The flow of water will be from the axle of the conic section toward the base on an ever increasing radius until at the lip of the discharge it reaches its maximum cross sectional area. This is at the line beyond the charge in the mill and the flow over this lip is at its minimum velocity. Only such material will be discharged as this current is sufficient to support.

The present invention consists of an apparatus of this nature, having various details of construction, combinations and arrangements of parts which will be hereinafter fully described, shown in the accompanying drawings and then specifically defined in the appended claims.

My invention is illustrated in the accompanying drawings, in which:

Figure 1 is a front elevation of a mortar ball mill. Fig. 2 is a central vertical cross sectional view at right angles through the same.

Reference now being had to the details of the drawings by letter, A designates a built up shell, having its slopes of approximately 90 degrees, one from the other, and supported by a smaller shell B of similar shape, of approximately 130 degrees, between slopes, lined with a suitable refractory material, the whole being inverted and adapted to rotate about a central axis C at the apex and which is inclined, when in working position at approximately 20 degrees to 30 degrees from the vertical. The

central axis at the apex of the shell B is provided with a bearing block D′ having a gudgeon D projecting therefrom, journaled in the semi-cylindrical member D^2 which in turn has a bearing in the concaved block D^3, affording means for a pivotal movement to the mortar. Suitable ball bearings D^4 are mounted in grooves in the adjacent faces of the members D′ and D^2. By this arrangement, the tilting of the mill will be permitted while in operation and its adjustment may be effected at any time and the discharge of the material grinding medium in emptying the mill for repairs. Standards H, having curved series of gear teeth H′, guide the frame K in its vertical movements and which carries the bearings K′ in which the anti-friction wheels L are journaled and which bear against the inclined surface of the circular track N, formed upon the outer marginal edge of the shell B and serve as additional support to the mortar mill. Said frame has journaled therein a shaft O with worm wheels Q fixed thereto and which are in mesh with gear wheels J which are fixed to the shafts J′ upon which the pinion wheels J^2 are mounted and which are in mesh with the gear teeth upon the standards, while an operating member J^4 is fastened to the shaft O and forms means whereby the latter may be rotated when it is desired to thrown the mortar at different inclinations. A gear wheel R is fixed to rotate with the mortar and is in mesh with a gear wheel S′ mounted upon the driving shaft C′ which may be operated from any suitable source of supply of power. Suitable balls or pebbles of various diameters are mounted within and gravitate to different positions, due to the rotation of the hopper. A suitable drain pipe S at the apex of the mortar is provided and through which the quicksilver and amalgam may be drawn off at suitable intervals, a suitable valve being provided in the pipe.

In operation of my improved mortar ball mill, it will be observed that the grinding surface will be increased as the material feeds toward the discharge and the area of the grinding medium likewise increased. The flow of water when introduced in the mortar with the material will be from the apex of the conic section toward the base on an ever increasing radius until at the lip of the discharge end of the shell will reach its maximum and only such material will be discharged as the current is sufficient to support. This discharge may be regulated to a nicety, three factors entering into the flow of the discharge, volume of water in the feed, tilting of the mortar and centrifugal force, the latter controlled by the velocity at which the mill is rotated. A wide range of adjustment is thus afforded for the control of discharge. Such particles as are not in suspension near the discharge will be at rest and will be carried by the revolving surface of the mortar in a circle at right angles to the axis and away from the discharge lip, ultimately to be acted upon by gravity and returned to a heavier grinding area. This will form a "closed circuit" within the machine for grinding the "reject" and discharging a perfectly finished product for subsequent treatment.

In the operation of the mill, driven in any suitable manner and rotated to the left, the charge of balls and ore will be carried around and toward the back of the mortar and up the increasing slope of the walls and also against the increase of gravity, until they reach a critical position, when they will topple over or cascade as in the usual type of ball or conical mills. This operation sets up a pounding, grinding and abrading action between the grinding medium (the balls) and the lining of the mortar, reducing the ore to such state of fineness as will remain suspended in the agitated water, when water is used, to be carried over the lip a finished product.

In practising amalgamation by the use of my improved mortar mill, the mercury will be positioned in the well or trap at the apex of the shell from which the drain pipe leads and through which pipe the amalgam may be withdrawn when desired, it being preferable to maintain the level of the quicksilver to just flood the upper surface of the lining at the lowest point of the mill, the quicksilver being fed with the ore, much as with the usual stamp mill practice.

In practising screening of the discharge from my improved mortar ball mill, an annular screen is attached to the lip of the mortar at the circumference, of suitable width and in a position normal to the axis of the mortar, having an upturned edge about its outer circumference. In action, the discharge from the mortar passes onto this screen, the water and fine material passing through on to an annular diaphragm, spaced a little below the said screen, thence discharging over the outer rim of this diaphragm to its distribution and further treatment. The material remaining on top of the said annular screen, too coarse to pass through, is carried by the rotation of the mortar and with it the screen, to the highest edge, whence it may be washed back into the mortar for further reduction.

In practising dry crushing in my improved mortar ball mill, the discharge of the comminuted material is facilitated by the use of a fairly close fitting hood or cap over the mortar to which is attached, near the discharge lip, a receiving conduit, having connection with means of exhausting the contained air and with suitable settling chambers. The exhaustion of the air sets up a current of air from the loosely fitted space between the hood and the rim of the mortar,

to and through the said discharge conduit, facilitating the discharge of the comminuted material.

What I claim to be new is:—

1. A mortar ball mill comprising a base having a concaved bearing recess, a semi-spherical bearing block mounted in said recess, a hopper, a block secured thereto and having a spindle journaled in a recess in said bearing block, the adjacent faces of said blocks having annular raceways and ball bearings therein, a gear wheel fixed to said hopper, and gear means for rotating said wheel.

2. A mortar ball mill comprising a base having a concaved bearing recess, a semi-spherical bearing block mounted in said recess, a hopper and shell in which the same is mounted, said shell being provided with an annular track, a block projecting from said shell provided with a spindle journaled in a recess in said bearing block, a gear wheel integral with said shell, means for driving the wheel, a rack and means for raising and lowering the same and antifriction wheels carried by the rack and engaging said rack.

3. A mill comprising a rotary bowl-shaped receptacle having a substantially spherical inner bottom surface and straight flaring side walls constituting continuations of said bottom surface, means for supporting and rotating said receptacle with its axis inclined to the horizontal, and a multiplicity of tumbling crushers in said receptacle adapted to be given a whirling and tumbling movement in a circular path by the rotary movement of said receptacle.

In testimony whereof I hereunto affix my signature.

LEVERETT S. ROPES.