(No Model.)

A. HERZFELD.

BALL GRINDING MILL.

No. 569,828. Patented Oct. 20, 1896.

Fig. 1.

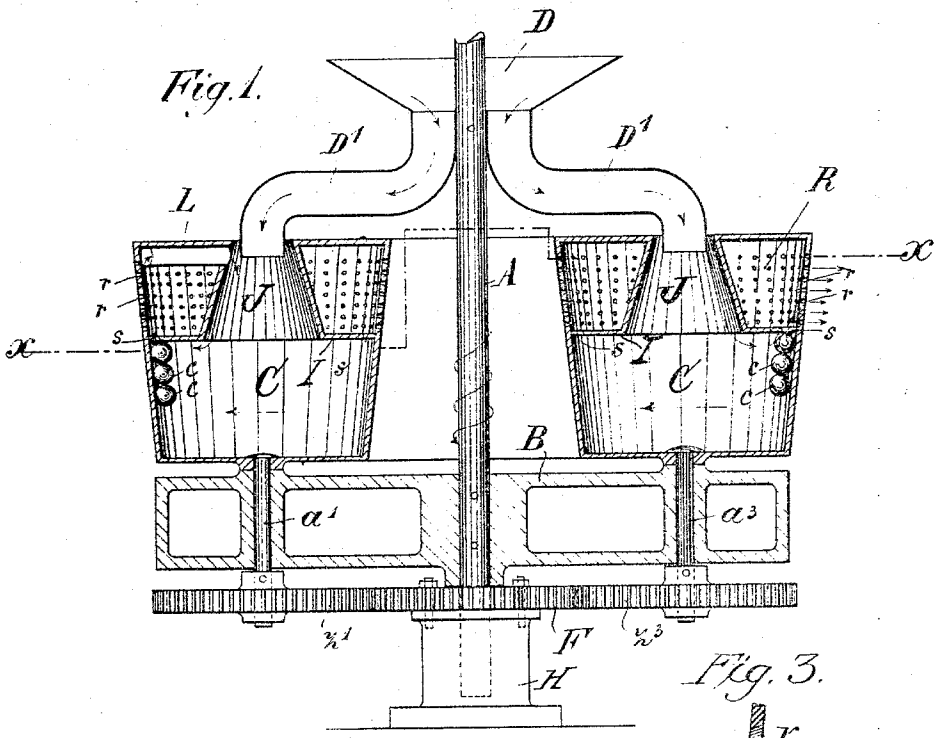

Fig. 3.

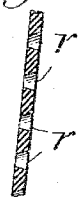

Fig. 2.

Section x-x

WITNESSES:

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UNITED STATES PATENT OFFICE.

ALBERT HERZFELD, OF HALLE-ON-THE-SAALE, GERMANY.

BALL GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 569,828, dated October 20, 1896.

Application filed May 3, 1895. Serial No. 548,021. (No model.)

To all whom it may concern:

Be it known that I, ALBERT HERZFELD, a subject of the King of Prussia, Emperor of Germany, residing at Halle-on-the-Saale, Germany, have invented new and useful Improvements in Ball Grinding-Mills, of which the following is a specification.

This invention relates to an improved construction of ball grinding-mills, in which the grinding vessels have not only a rotary motion around their own axes, but also, simultaneously, a motion around an axis eccentric to those of the vessels, so that a planetary motion is imparted to said vessels.

In the accompanying drawings a ball grinding-mill of this class is described, Figure 1 showing a vertical section of a mill constructed according to my invention; and Fig. 2 a horizontal section on line X X, Fig. 1. Fig. 3 is a vertical section of the wall of the grinding vessels, showing the conical openings on an enlarged scale.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents a vertical main shaft, around which is rotated a horizontal frame B, preferably in the shape of a cross. In the arms of the cross-shaped frame B are mounted rotatable shafts a' a^2 a^3 a^4, to the upper ends of which are firmly attached the grinding vessels C. These shafts and the vessels C are supported on a base H, which serves as the step-bearing for the upright shaft A, and to which is rigidly attached a gear-wheel F, located concentrically with the shaft A. The stationary gear-wheel meshes with the gear-wheels z', z^2, z^3, and z^4, which are keyed to the lowermost ends of the shafts a' a^2 a^3 a^4. By the rotation of the shaft A and the rotary motion of the cross-shaped frame B connected therewith the vessels C are placed in rotation around the shaft A and at the same time around their own axes by the stationary gear-wheel F and the intermeshing gear-wheels z' z^2 z^3 z^4, said vessel receiving a planetary motion.

The vessels C are preferably made of circular shape with flat bottom and upwardly-flaring side walls. The tops of the vessels are closed by covers having central openings for the supply-pipes D'. Below each of the covers of the vessel is formed an annular space R, which is connected with the lower part of the vessels by openings *s*, which are formed in the outer edge of a diaphragm I, fixed to the side wall of the vessel, and having a central cone J opening up through the cover of the vessel and downwardly into the lower part of the same. The outer wall of the annular space R is formed by the upper part of the outwardly-flaring side wall of the vessel C, said upper part being preferably provided with small screening-openings *r r* of conical shape, which are wider at their outer than at their inner ends, as shown clearly in Figs. 1 and 3.

The material to be ground is supplied to the vessels C by a hopper D, that extends around the upper part of the upright shaft A, and supply-tubes D', which connect the lower part of the hopper with the central hollow cones J of the vessels. The hopper D, as well as the supply-tubes D', rotate with the upright shaft A. In the lower part of the vessels C are arranged balls *c c*, by which the grinding of the mass in the vessels is produced.

Owing to the outward-flaring shape of the side walls of the vessels, the balls are moved during the rotation of the vessels in upward direction, so as to move along the diaphragm I, forming the bottom of the annular space R, into which the comminuted material is passed through the slots or openings *s*, so as to be forced by centrifugal power through the conical openings *r* to the outside of the vessels C. This screened material is collected by a casing that extends around the vessels C or in any other suitable manner. The slot-like openings *s* are made of such dimensions that the balls *c c* cannot pass through the same into the annular space R. Coarser particles of the ground mass which cannot pass in outward direction through the screened openings in the outer wall of the annular space R are conducted into the lower part of the vessel C by a curved tube L, which is arranged in the upper part of the space R. The reconducting of the coarser particles is produced by the action of the centrifugal force, as the finer particles of the mass pass along the upwardly-flaring walls in upward direction, so that the coarser particles can enter

the curved tubes L and be returned by the inner ends of the same into the lower part of the vessels C.

In the ball grinding-mill described the action takes place under the influence of two separate centrifugal forces, first, that which is obtained by the rotation of the vessels C around the main shaft A, and, second, that which is obtained by the rotation of the vessels C around their axes $a'' a^2 a^3 a^4$. The balls $c\ c$ remain, therefore, always on that side of the vessels which is farthest away from the main shaft A. The proportion of the number of teeth of the stationary gear-wheel F to the number of the teeth of the gear-wheels $z' z^2 z^3 z^4$ has to be so arranged in connection with the size of the vessels C that the centrifugal force which is produced by the rotation of the vessels around the main axis is greater than the centrifugal force that is obtained through the rotation of the vessels C around their own axes. It is not material whether the shafts $a' a^2 a^3 a^4$ are parallel to the main shaft A or placed at an inclination to the same. It is further not material whether they are rotated in the same direction or in an opposite direction to the main shaft.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

In a ball grinding-mill, the combination of central main shaft, a frame mounted on the same, grinding vessels mounted on shafts of said frame, a stationary gear-wheel below the supporting-frame and through the center of which said main shaft turns, gear-wheels on the shafts of the grinding vessels intermeshing with the stationary gear-wheel whereby a planetary motion is imparted to the vessels around the main shaft, a diaphragm at the upper part of each grinding vessel, provided with a central hollow cone, opening both upwardly and downwardly, said diaphragm, cone and the upper part of each vessel forming an annular screening-chamber communicating with the lower part of said grinding vessel by slot-like openings in the diaphragm and located near the side walls of the vessel, openings in the upper portions of the side walls of the grinding vessels, grinding-balls in the lower parts of said grinding vessels, said grinding-balls being of greater diameter than the width of the slot-like openings, means for supplying the material to be ground into said vessels, and curved tubes arranged in the upper part of the screening-chamber for returning the coarse particles into the main vessels.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALBERT HERZFELD.

Witnesses:

RUDOLPH FRICKE,

OTTO DOEDERLEIN.