No. 737,750. PATENTED SEPT. 1, 1903.

P. T. LINDHARD.

BALL GRINDING MILL.

APPLICATION FILED JAN. 3, 1902.

NO MODEL.

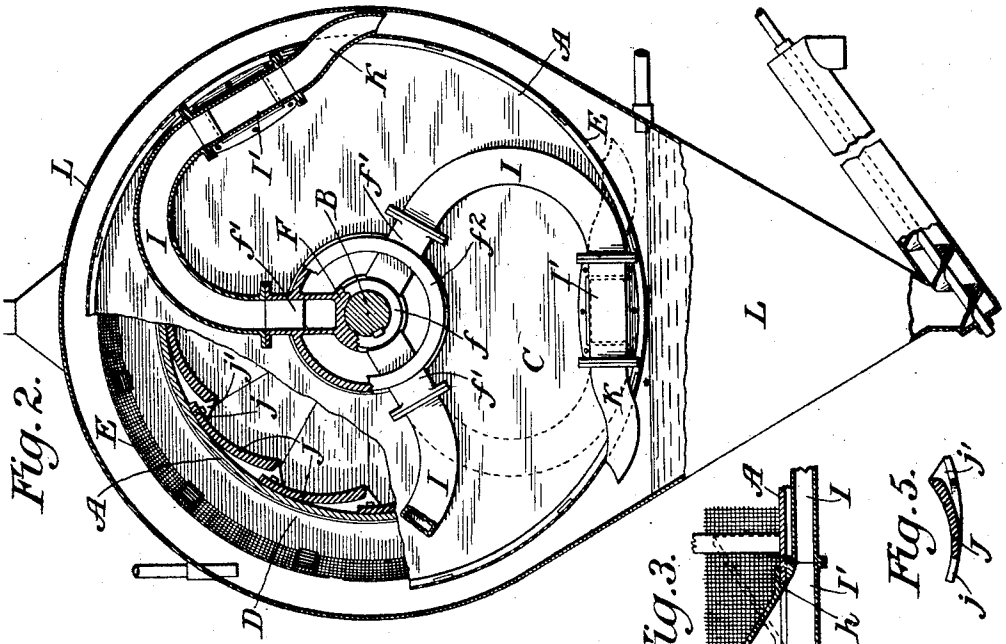


Fig. 2.

Fig. 3.

Fig. 5.

Fig. 4.

Fig. 1.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 737,750. Patented September 1, 1903.

UNITED STATES PATENT OFFICE.

POVL T. LINDHARD, OF NEW YORK, N. Y., ASSIGNOR TO ALEXANDER FOSS AND POUL LARSEN, COPARTNERS DOING BUSINESS AS F. L. SMIDTH & CO., OF COPENHAGEN, DENMARK.

BALL GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 737,750, dated September 1, 1903.

Application filed January 3, 1902. Serial No. 88,279. (No model.)

To all whom it may concern:

Be it known that I, POVL T. LINDHARD, a citizen of the Kingdom of Denmark, residing in the borough of Manhattan, city of New York, and State of New York, have invented certain new and useful Improvements in Ball Grinding-Mills, of which the following is a specification.

The object of this invention is to improve the construction of ball grinding-mills, so as to increase the capacity thereof and permit same to be used either for wet or for dry grinding and to be rotated in either direction desired.

The invention consists in the new and novel features of construction and combination of parts hereinafter set forth.

In the accompanying drawings, Figure 1 represents a vertical longitudinal section of a ball grinding-mill embodying the invention. Fig. 2 illustrates an end elevation of the same, a portion of the casing being broken away in order to disclose the interior construction. Fig. 3 is a detail view of the means for collecting the tailings or partly-ground material and for taking water into the mill. Figs. 4 and 5 are detail views of the plates comprising the lining of the mill.

The drum or cylinder A, which contains the grinding-balls, is mounted upon a rotatable shaft B and is provided with heads C and D. The drum is surrounded by a screen E, which travels with the drum and receives the material from the discharge-openings d of the drum, which may be formed either in the head or in the periphery of the drum adjacent thereto, and delivers the tailings or partly-ground material toward the inlet-head of the drum in the usual manner. The inlet-head of the drum comprises a spider F, consisting of a hub portion f and a plurality of hollow radial arms f', having openings between them. Said openings permit the ingress of the fresh or unground material to the interior of the drum, and the hollow arms provide passages for the return of the tailings or partly-ground material that is rejected by the screen. The spider is also provided with an annular flange f^2, secured to or formed integral with the inlet-head of the drum and projecting outwardly to receive the end of the hopper G, through which the fresh or unground material is delivered, such flange forming a guard to coöperate with the hopper in conducting the unground material to the inlet-openings between the arms f'. The tailings or partly-ground material which gathers at the corresponding end of the screen E is received by scoops or guides H, which are secured to the inlet-head and project within the space between the screen and the periphery of the drum. Each scoop or guide is provided with suitable flanges h, whereby it is secured to the head of the drum and communicates with a tubular head I', by means of which the scoop or guide is detachably connected with a curved pipe I, the latter communicating with one of the hollow arms f' of the spider. Both the scoops H and the pipes I are constructed and secured so that their positions can be reversed, as indicated in dotted lines in Figs. 2 and 3, if it is desired to change the direction of rotation of the drum. The interior of the drum is provided with a lining comprising a plurality of plates J, each of which is provided at one end with an outwardly-projecting lip or flange j and at its other end with inwardly and downwardly projecting flanges j', whereby said plates may be secured to the drum. The flanges j' are a sufficient distance apart to permit the lip or flange j of the next plate to seat between them, so that the plates can be reversed if it is desired to rotate the drum in the opposite direction, and the bolts by which the plates are secured to the interior of the drum are protected from the action of the grinding-balls. The plates are preferably curved and are arranged in rows, so that a vertical movement of the balls is produced by the rotation of the drum, the balls dropping from the raised ends of one row of plates onto the lower ends of the adjacent row of plates.

If it is desired to use the mill for wet-grinding, a bucket K, which is reversible—that is, applicable to either end of the tubular head or T I'—is secured to the exterior of the drum, so that the liquid shall be supplied to the interior of the drum through the hollow radial arms of the spider F. Preferably the bucket is secured to the tubular head I' opposite the curved pipe I and extends a suitable distance

beyond the scoop and beyond the periphery of the screen, so that said bucket may dip into the liquid without requiring the periphery of the screen to come into contact therewith. Preferably the liquid is contained in the casing L of the drum, which may also provide a bin or hopper to receive the finely ground or comminuted material that passes through the screen. By this arrangenent the liquid used in wet-grinding is admitted to the drum through the return-passages, so that not only are the return-passages kept free by the flow of liquid, but the finely-divided material or that most quickly acted upon by the balls is carried downward through the balls toward the discharge-openings of the drum. Since the screen does not dip into the liquid, there is no back pressure, and the flow of liquid through the screen being in one direction promotes the passage of the finely-divided material through the screen. Although the buckets are shown as connected with the scoops, it is obvious that they may be connected with the hollow arms of the spider by separate pipes, if desired, or that the number of radial arms provided in the spider may be varied according to the number of screens used in connection with the mill or the quantity of liquid it is desired to supply to the interior thereof.

It will be understood that in grinding-mills of this class the capacity of each mill is directly dependent upon the weight of the balls with which it is charged and that the weight of the balls is dependent upon the distance from the lowest point of the drum to the lowest point of the inlet-opening in the head of the drum, it being impracticable to let the balls stand above such inlet-opening. It is highly desirable, therefore, that the inlet-opening should be as close as practicable to the axis of the drum, due regard being had to the area of the opening and to the strength of the head or hub by which the entire weight of the drum and its charge must be supported. It is also desirable to avoid breaking through the casing of the mill for the return of the partly-ground material to the drum both to prevent the escape of dust into the room in the case of dry-grinding and the falling of partly-ground material into the discharge-hopper. The mill must also be so arranged as to prevent the fresh material from passing directly to the screens and choking them. All of these requirements are best met by the provision of a spider having hollow arms to receive the partly-ground material rejected by the screen and connected to the central hub of the drum to deliver the material directly into the drum, while openings are left between the ends of these hollow arms through which the fresh material is admitted from the exterior hopper.

I claim as my invention—

1. In a ball grinding-mill, a drum, a spider supporting the drum, said spider having near the axis of the drum hollow arms communicating with the interior of the drum with openings between them, pipes adapted to receive the partly-ground material from the periphery of the drum and deliver the same again to the drum through the hollow spider-arms, and means to deliver fresh material to the drum through said openings, substantially as described.

2. In a ball grinding-mill, a drum, a spider supporting the drum, said spider having near the axis of the drum hollow arms communicating with the interior of the drum with openings between them, pipes adapted to receive the partly-ground material from the periphery of the drum and deliver the same again to the drum through the hollow spider-arms, said spider having an annular flange, and a hopper engaged by said flange and arranged to deliver fresh material to the drum through said openings, substantially as described.

3. In a ball grinding-mill, a drum, a spider supporting the drum, said spider having near the axis of the drum hollow arms communicating with the interior of the drum with openings between them, a screen traveling with the drum to receive the material from the drum and return the same toward the inlet end of the drum, pipes adapted to receive the material rejected by the screen and deliver the same again to the drum through the hollow spider-arms, and means to deliver fresh material to the drum through said openings, substantially as described.

4. In a ball grinding-mill, a drum having a substantially central inlet-opening and discharge-openings, a screen to receive the material from the discharge-openings and deliver the same toward the inlet-opening, a tubular head or T and guide-scoop carried by the drum to receive the tailings from the screen, radial arms also carried on the drum and communicating with the interior thereof and a curved pipe adapted to connect either of said arms with said tubular head or T, whereby the drum may be rotated in either direction for operation, substantially as described.

5. In a ball grinding-mill, a drum, a spider supporting the drum, said spider having near the axis of the drum hollow arms communicating with the interior of the drum with openings between them, pipes adapted to receive the partly-ground material from the periphery of the drum and deliver the same again to the drum through the hollow spider-arms, a water-receptacle below the drum, buckets connected with said pipes and arranged to dip into said receptacle, and means to deliver fresh material to the drum through said openings, substantially as described.

In testimony whereof I sign this application, in the presence of two witnesses, this 24th day of December, 1901.

POVL T. LINDHARD.

Witnesses:

ANTHONY N. JESBERA,

LUCIUS E. VARNEY.