No. 694,974. Patented Mar. 11, 1902.

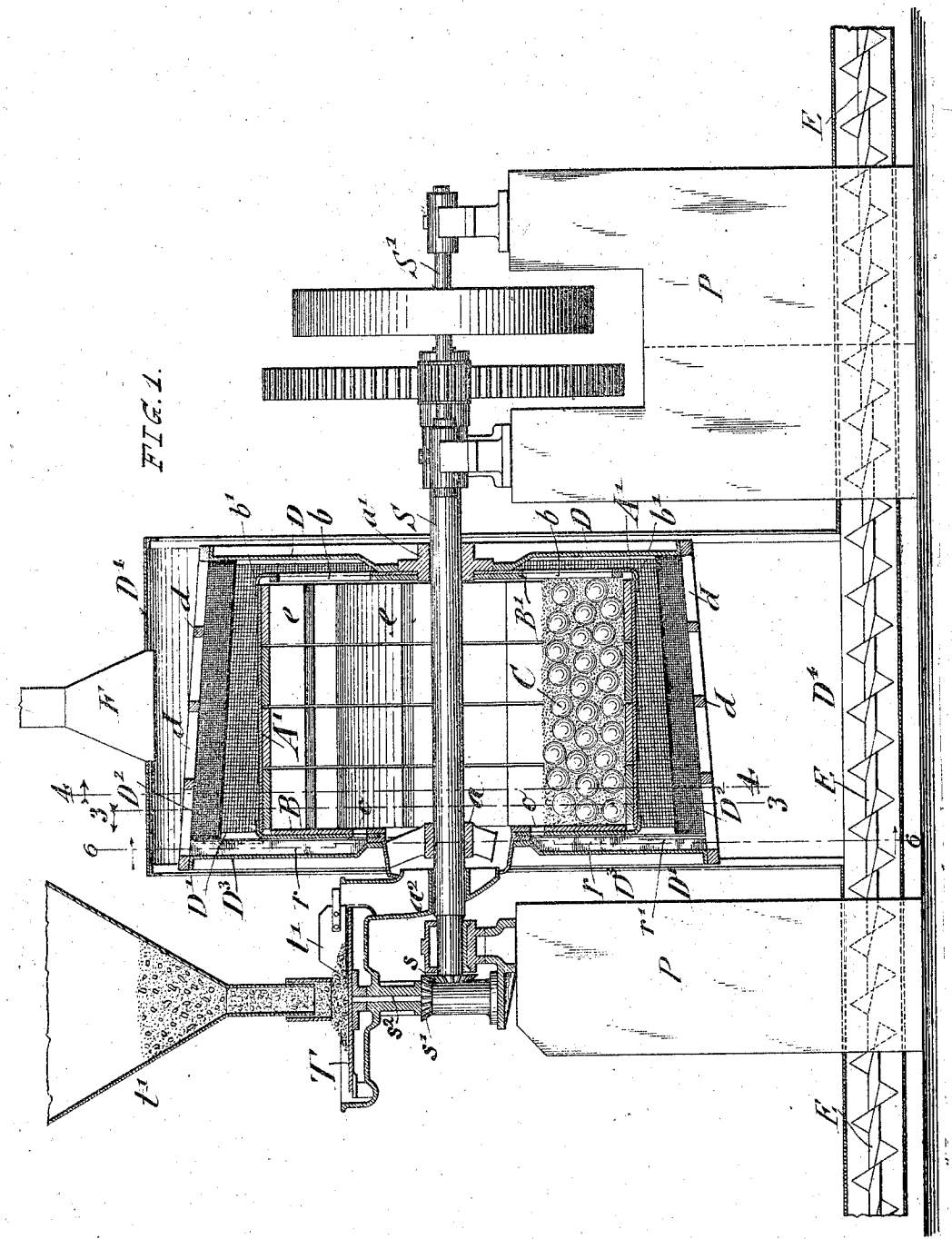
P. T. LINDHARD.

BALL GRINDING MILL.

(Application filed Dec. 28, 1900.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 1.



WITNESSES:

Bruno von Bleitzingslöwen

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INVENTOR

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ATTORNEYS.

No. 694,974. Patented Mar. 11, 1902.

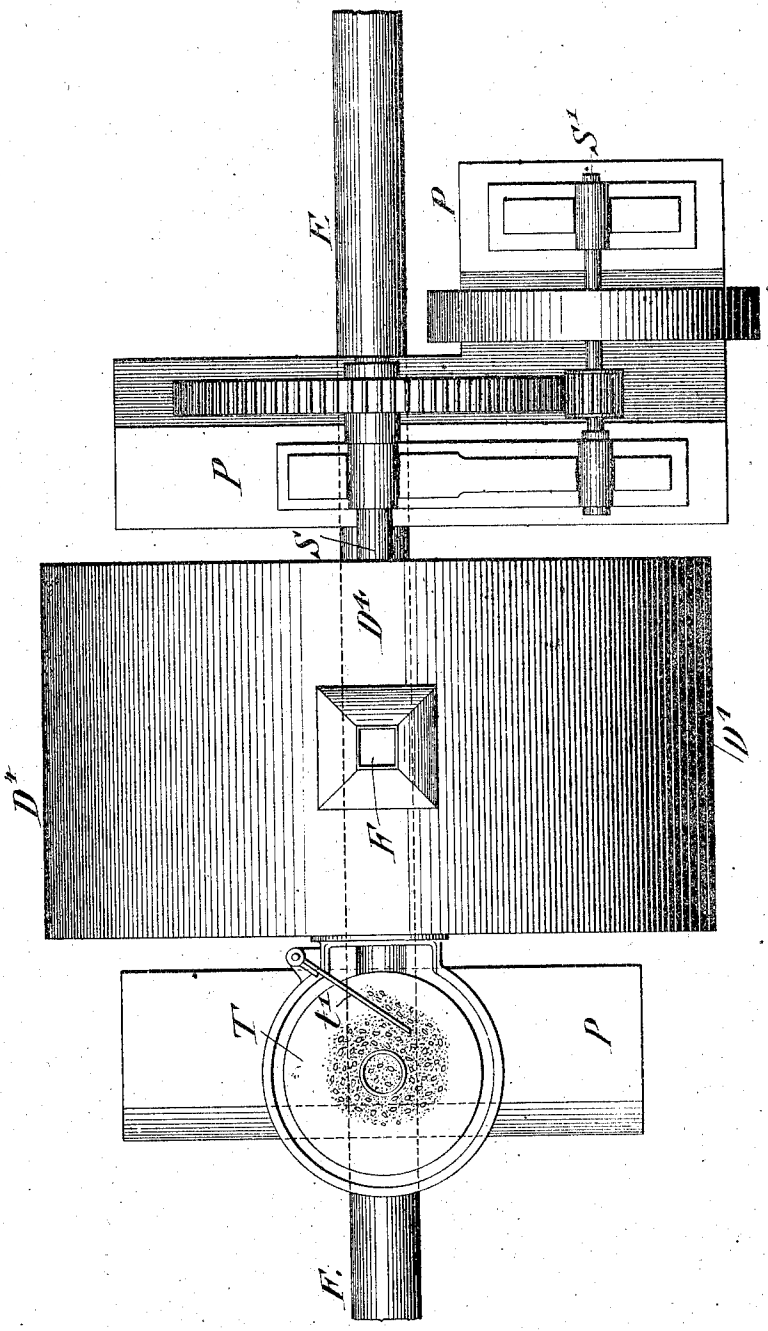
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(No Model.) 4 Sheets—Sheet 2.

FIG. 2.



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BALL GRINDING MILL.

(Application filed Dec. 28, 1900.)

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FIG. 4.

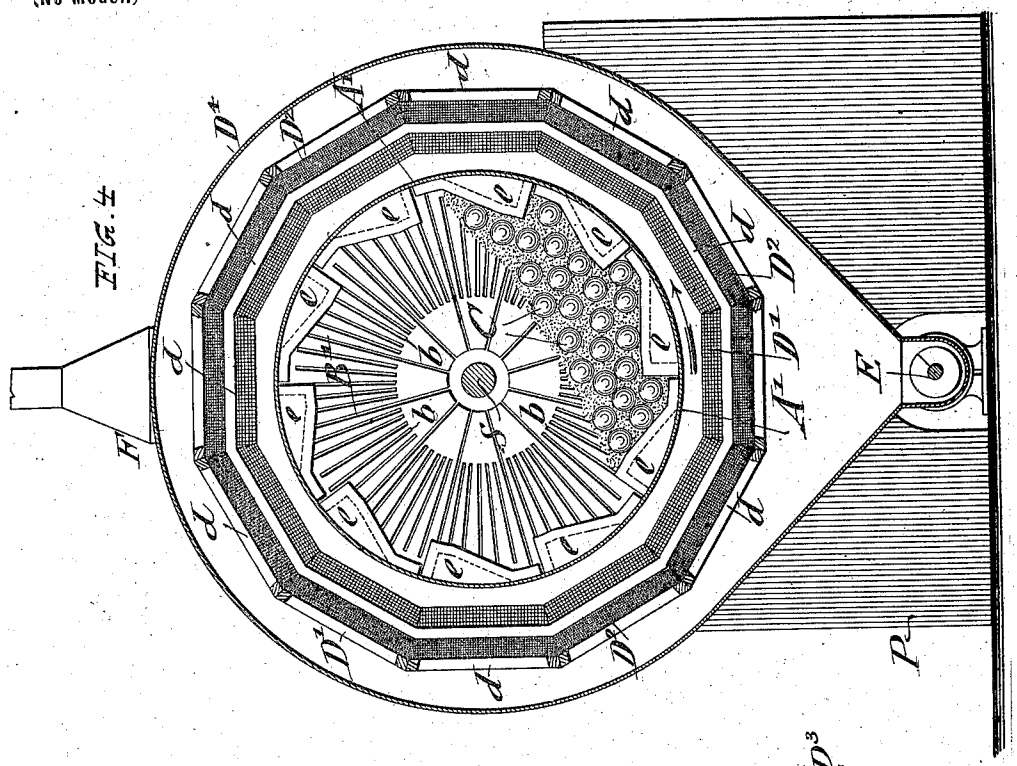


Fig. 5.



FIG. 3.

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(Application filed Dec. 28, 1900.)

(No Model.) 4 Sheets—Sheet 4.

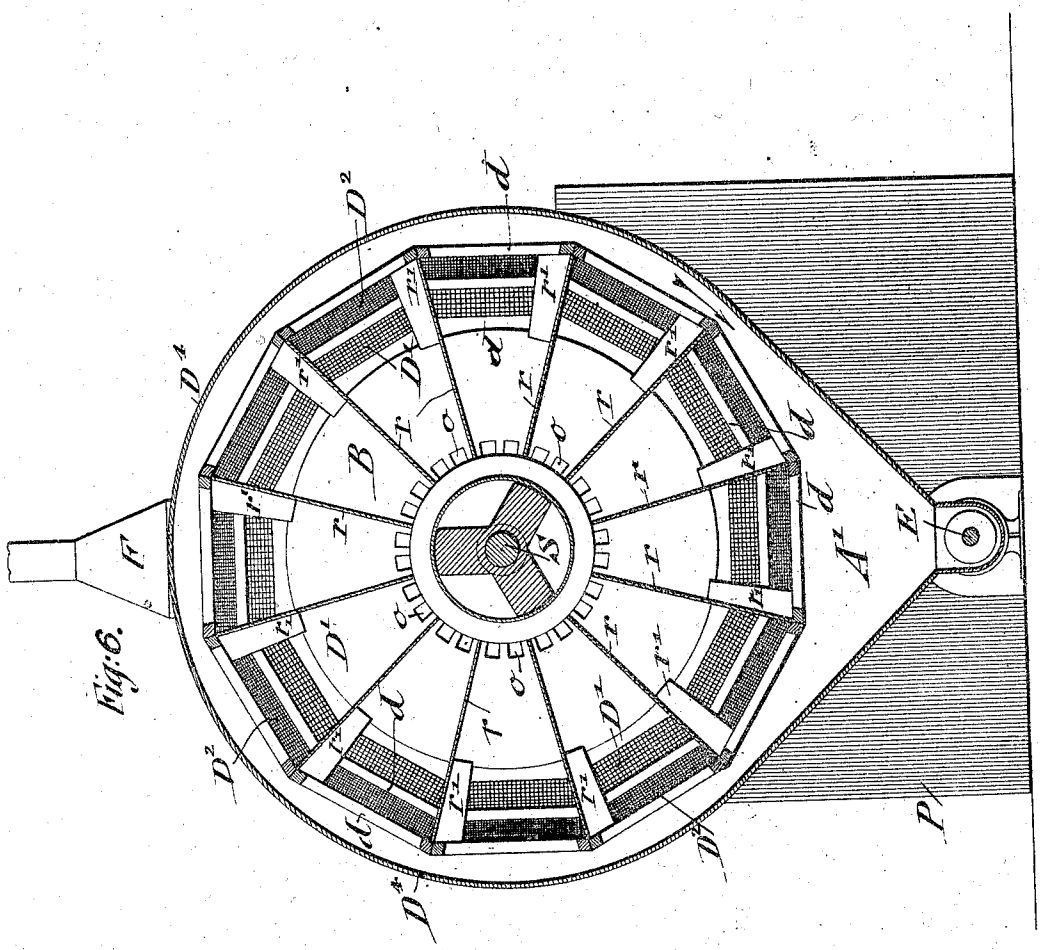


Fig. 6.

WITNESSES:

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H. Suburbier.

INVENTOR

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ATTORNEYS

UNITED STATES PATENT OFFICE.

POVL T. LINDHARD, OF RICHMOND HILL, NEW YORK.

BALL GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 694,974, dated March 11, 1902.

Application filed December 28, 1900. Serial No. 41,330. (No model.)

To all whom it may concern:

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

This invention relates to improvements in ball grinding-mills; and the object of the invention is to provide a mill of compact construction and simplicity of operation in which the crushing, grinding, and screening of material can be simultaneously accomplished; and for this purpose the invention consists in the combination, in a ball grinding-mill, of a rotary grinding-drum, grinding-balls therein, the inlet and outlet heads of said drum being provided with inlet and discharge openings, respectively, screens arranged around and rotating with said drum and delivering toward the inlet-head, means for conducting the ground material from the discharge-openings onto the screens, and means for conducting the material rejected by said screens into said inlet-openings; and the invention consists, further, of certain other combinations of operative parts, which will be fully described hereinafter, and finally pointed out in the claims.

In the accompanying drawings, Figure 1 is a vertical longitudinal section of my improved ball grinding-mill, shown in connection with a device for feeding the material to be ground and a conveyer for the ground and screened material. Fig. 2 is a plan view of the machine. Figs. 3 and 4 are vertical transverse sections on line 3 3 and 4 4, Fig. 1, showing, respectively, the inlet and outlet ends of the mill. Fig. 5 is a detail section on line 5 5, Fig. 3; and Fig. 6 is a vertical transverse section on line 6 6, Fig. 1.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A indicates a drum having a closed circumference. The drum may have a plain interior surface or may be provided with the usual step-shaped grinding-plates *e*, supported by the sheet-metal shell A', forming the drum circumference. The heads B B' are provided with hubs *a a'*, by which the drum is attached to the driving-shaft S, to which rotary motion is imparted by gear-wheel and pinion transmission from a counter-shaft S' or in any other suitable manner. The bearings for the shafts are supported in pillow-blocks attached to masonry pillars P. The shaft S imparts, by means of gears *s s'*, motion to the vertical shaft s^2 of a horizontal feed-table T, to which the material to be ground is conducted by means of the hopper *t*, an adjustable dividing-plate *t'* serving to conduct the material into the channel a^2, leading to the inlet-opening located around the hub *a*; but any other suitable feed device may be used.

The ingoing head B of the drum is provided at a point above the level of the balls C in the drum with inlet-openings *o*. The outgoing head B' is closed in the center and provided with discharge-openings in the form of slots *b* and also with openings *b'* between the head B' and circumference A' of the drum. These openings *b b'* in the outgoing head of the drum may both together be employed or either may be employed alone, as may be desirable in any particular case, and the size and form of the openings will be regulated according to the circumstances.

At the outside of the drum is located a casing, which receives the ground material passing the openings at the outgoing head of the drum. The outgoing head D and ingoing head D^3 of the casing are connected with the respective drum-heads circumferentially within the openings *b b'* and *o*, and thereby form annular spaces communicating with the interior of the drum by means of said openings. The heads D D^3 are connected by the screens or sieves D' D^2, arranged around the drum and rotating therewith. The screens are longitudinally inclined, so as to deliver toward the inlet-head of the drum.

In the annular space formed between the heads B and D^3 are arranged conducting-ribs *r*, which extend from the openings *o* to the circumference of the casing. At that part of each rib adjacent to the screens the rib is provided with a flange or ledge *r'*, which serves to retain the material discharged by the screens on the rib and direct the same downwardly into the annular space between the heads B and D^3 as the drum revolves. Two polygonal screens are shown, the coarser

arranged within the finer, and the conducting-ribs *r* are shown arranged one for each section of the polygonal screens opposite the junctions of the screen-sections; but one or any number of screens may be employed in any desired number of sections, and the conducting-ribs may be arranged one for each section or otherwise. The drum is inclosed by a suitable casing D^4, communicating with the conveyer E and serving to collect the material passing through the screens D′ and D^2 and discharge the same into the conveyer, by which it is conducted off. The screens are supported by cross-pieces *d*.

From the foregoing description of the construction the operation of the mill will readily appear. By the rotation of the drum the balls break up the material fed in through the channel a^3 and inlet-opening in the head B, crush and grind it, and discharge it through the openings *b b′* onto the screens. The ground material passes back on the screens by gravity, and that portion which has been ground to sufficient degree of fineness passes through the screens into the casing or box D^4 to the conveyer beneath. The material rejected by the screens passes over the same to the annular space between the inlet-heads of the casing and drum, is caught in the pockets formed by the ribs *r* and their flanges, and is lifted, upon rotation of the drum, until it slides down the ribs and through the inlet-openings *o* into the interior of the drum, where it mixes with the material in the same and passes again through the balls, receiving further grinding, this being continued until the material is reduced to such an extent as to pass through the screens. Any escaping dust is drawn off through the ventilating-pipe F, connected with the box D^4.

The mill performs the grinding, crushing, and screening operations simultaneously and delivers the finished product ready for use. The material that is rejected by the screens travels along same until it is returned through the inlet-openings to the grinding-drum. Since the periphery of the grinding-drum is solid, the material is forced to travel the entire length of the drum before it reaches the outlet-openings and is subjected to the action of the balls to the same extent as the fresh material is supplied to the drum, whereby a thorough and complete grinding of all the material is absolutely assured. The entire surface of the screens is utilized, so that with screens of relatively narrow width a screening capacity equal to the grinding capacity of the drum is obtained. This construction also enables the apparatus to be made very compact and with a minimum number of parts, thus correspondingly reducing the cost of manufacture.

It will be noted that the inlet-opening of the drum or cylinder A, which surrounds the hub *a*, is shown as substantially axial, while the inlet-openings *o* are located at a distance from the axis of rotation. The outer boundary of the outlet-openings *b′* is obviously further distant from the axis of rotation than is the outer boundary of the inlet-openings at *o*. The sieve D′ being inclined is nearer to the axis of rotation at its end where it receives the material from the cylinder A than at the opposite end, where it delivers said material to be conveyed to the outlet of the cylinder A. This sieve is therefore the outer boundary of both the inlet and the outlet openings to the casing or cylinder formed by the head D D^3 and sieve D′, and said outer boundary is nearer to the axis of rotation of said cylinder at the inlet end of said casing than at the outlet end thereof.

I do not limit myself to the particular construction of outer screening-cylinder herein shown.

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

1. In a ball grinding-mill, the combination of a rotary grinding-drum having a closed circumference, grinding-balls therein, the inlet and outlet heads of said drum being provided with inlet and discharge openings respectively, screens rotating with the drum and delivering toward the inlet-head, said screens communicating both with the inlet and discharge openings of the grinding-drum, substantially as described.

2. In a ball grinding-mill, the combination of a rotary grinding-drum having a closed circumference, grinding-balls in said drum, the inlet and outlet heads of said drum being provided with inlet and discharge openings respectively, screens arranged around and rotating with said drum, and inclined toward the inlet-head of the same, and means for conducting the material rejected by said screens from the delivery ends of the same to said inlet-openings, substantially as set forth.

3. In a ball grinding-mill, the combination of a rotary grinding-drum having a closed circumference, grinding-balls in said drum, the inlet and outlet heads of said drum being provided with inlet and discharge openings respectively, screens arranged around the drum and rotating therewith, said screens being inclined toward the inlet-head, and having their delivery ends located adjacent thereto, and ribs on said head between the screens and said inlet-openings for conducting the material rejected by the screens into said inlet-openings of the head, substantially as set forth.

4. In a ball grinding-mill, the combination of a rotary grinding-drum having a closed circumference, grinding-balls in said drum, the inlet and outlet heads of said drum being provided with inlet and discharge openings respectively, a casing surrounding said drum and rotating therewith, said casing being composed of heads arranged at the outer sides of the heads of the drum, screens supported by said heads and inclined toward the inlet-head of the drum, and ribs located between

the delivery ends of said screens and said inlet-openings of the inlet-head of the drum, substantially as set forth.

5. In a ball grinding-mill, the combination of a rotary grinding-drum having a closed circumference, grinding-balls in said drum, the inlet and outlet heads of said drum being provided with inlet and discharge openings respectively, screens arranged around said drum and rotating therewith, said screens being inclined toward the inlet-head of the drum, ribs on said inlet-head between the screens and said inlet-openings, and a lateral flange on each of said ribs and located adjacent to the screens, substantially as set forth.

6. In a ball grinding-mill, the combination of a rotary grinding-drum having a closed circumference, grinding-balls in said drum, the inlet and outlet heads of said drum being provided with inlet and discharge openings respectively, screens arranged around said drum and rotating therewith, said screens being inclined toward the inlet-head of the drum, and extending at each end slightly beyond the heads of the drum, closed casing-heads supporting said screens, and ribs between the delivery ends of the screens and the inlet-openings in the inlet-head of the drum, said ribs being located between said inlet-head and the adjacent casing-head, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

POVL T. LINDHARD.

Witnesses:

PAUL GOEPEL,

GEORGE C. GEIBEL.