H. W. HARDINGE.

CONICAL MILL.

APPLICATION FILED SEPT. 11, 1919.

1,355,474. Patented Oct. 12, 1920.

Fig. 2.

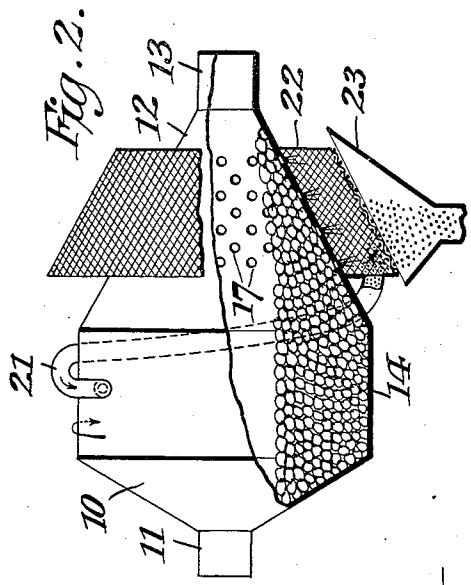


Fig. 3.

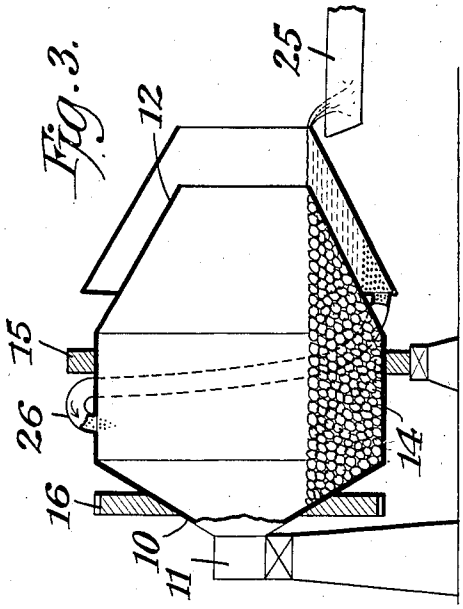
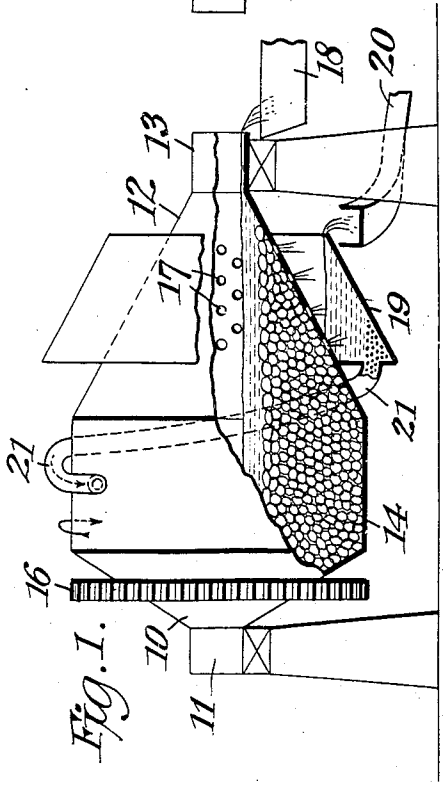


Fig. 1.



H. W. Hardinge
Inventor

By his Attorneys

Kerr, Page, Cooper & Hayward

UNITED STATES PATENT OFFICE.

HARRY W. HARDINGE, OF NEW YORK, N. Y.

CONICAL MILL.

1,355,474. Specification of Letters Patent. Patented Oct. 12, 1920.

Application filed September 11, 1919. Serial No. 323,118.

To all whom it may concern:

Be it known that I, HARRY W. HARDINGE, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Conical Mills, of which the following is a full, clear, and exact description.

The now well known conical mill, for grinding or disintegrating ores and other materials, in its most common form consists of two cones arranged base to base with a short cylindrical section between the two. The material to be ground is delivered into one of the cones and the disintegrated or ground material is discharged from the other (usually through an axial opening at the apex or through apertures in the wall) which may therefore be termed the conical outlet portion of the mill. Another form of the conical mill is conoidal in shape, as in Patent No. 1,202,278. In any case the distinguishing characteristic is the tapering form of the outlet portion. This tapering form causes the material (as the mill is revolved on its longitudinal axis) to assume a sort of vertical stratification or classification according to size, the pieces or masses being largest at the greatest diameter of the mill and decreasing in size progressively toward the apex of the outlet cone, as clearly described in my prior Patent No. 908,861.

Under normal conditions—that is, when the mill is operated at or below the maximum capacity for which it is designed—the assorting of the material according to size permits only particles of the desired fineness to issue from the outlet, but if the material to be reduced or ground is fed at a faster rate, as is often done in the effort to increase the output, it is found that part of the material discharged, sometimes a considerable part, is composed of particles too large for the intended purpose, and in such cases it is necessary to separate the coarse material and return it to the mill for further reduction. My present invention relates to this separation and return of the coarse material, and has for its chief object to provide the mill itself with simple and effective means for the purpose. To this and other ends the invention consists in the novel features and combinations hereafter described.

In carrying out the invention in the preferred manner I provide outside of the conical outlet portions of the mill a conical hood, into which part or all of the more or less disintegrated material is discharged either through an opening at the apex of the outlet portion or through suitable openings in its wall. This hood is fastened to the outlet portion of the mill in any suitable manner so as to revolve with it. Extending back from the base of the conical or tapering hood I provide one or more pipes leading to the interior of the mill, preferably at a point in rear of the base of the outlet cone which operate on the principle of the Archimedean screw to return the coarse particles while the fine or finished particles are discharged from the apex of the conical hood or through its walls.

Referring now to the accompanying drawing, in which several embodiments of the invention are illustrated, somewhat diagrammatically,

Figure 1 is a side view, partly in longitudinal section, showing a form designed particularly for "wet grinding."

Fig. 2 is a similar view of the barrel or drum of a mill designed for definite sizing of the material, particularly in "dry grinding."

Fig. 3 is a longitudinal section of a form in which all the disintegrated material is discharged from the apex of the conical outlet portion of the barrel.

In the mills illustrated, 10 designates the conical inlet portion, provided with an axial inlet trunnion 11 through which the material to be ground is introduced. 12 is the conical or tapering outlet portion, which may be provided with an axial outlet trunnion 13. The barrel or drum, composed of the two cones (and, in the present instance, an intermediate cylindrical part 14) may be mounted in suitable bearings for rotation on its trunnions, as in Figs. 1 and 2, or, where the outlet trunnion is omitted, the barrel may be supported by the inlet trunnion and by a ring, as 15, Fig. 3. A gear 16 (not shown in Fig. 2) is provided to rotate the barrel.

Referring to Fig. 1, the conical outlet portion 12 is provided with outlet openings 17 of suitable size to discharge fine or finished particles and also coarse particles up to a certain size, say an eighth of an inch, or even larger, in diameter, so that fine material may be discharged not only from the outlet trunnion 13 into the launder 18 but also (together with coarse material) through

the openings 17 into the conical classifying hood 19. In the latter the fine, finished particles flow over the edge at the apex with the water into the launder 20, while the larger and therefore heavier particles sink to the bottom and collect at the base of the hood. Here they enter the helical conveyer pipe 21 and as the mill revolves are carried back and discharged into the interior for further reduction.

Where a definite sizing of the finished material is desired, and especially where the material is to be ground in the dry state, the classifying hood is made of foraminous material, for example a screen of woven wire of suitable "mesh," as 22, Fig. 2. In this case fine particles sift through the screen into the receiving hopper 23.

In Fig. 3 the conical outlet portion 12 is imperforate, and all the material is discharged from the apex into the classifying hood 24, which may be made proportionately longer than in Figs. 1 and 2. From the hood 24 the fine, finished particles flow over the edge into the launder 25 while the heavier, coarse particles sink and are returned to the mill by the conveyer 26 for further reduction as in Figs. 1 and 2.

It is to be understood that the invention is not limited to the specific constructions herein described but can be embodied in other forms without departure from its spirit.

I claim:—

1. In a conical mill, the combination with a rotating barrel or drum having a conical outlet portion, of a classifying hood carried by the barrel or drum and surrounding the conical outlet portion only and rotating therewith to receive coarse and fine material therefrom and adapted to discharge only the fine material, and means at the base of the hood to receive coarse or over-size material and return the same to the barrel or drum for further reduction.

2. In a conical mill, the combination with a rotating barrel or drum having a conical outlet portion, of a conical classifying hood carried by the barrel or drum and surrounding the conical outlet portion to receive therefrom coarse and fine material and adapted to discharge only the fine material, and a conveyer pipe extending from the base of the conical hood and discharging into the barrel or drum to return thereto the coarse or over-size particles for regrinding.

3. In a conical mill, the combination with a rotating barrel or drum having a perforated conical outlet portion, of a conical classifying hood carried by the barrel or drum and surrounding the conical outlet portion only to receive coarse and fine material from the perforations in the said outlet portion and adapted to discharge only the fine material, and means at the base of the classifying hood to return the coarse or over-size material to the barrel or drum for regrinding.

4. In a conical mill, the combination with a barrel or drum having a perforated conical outlet portion, of a conical classifying hood carried by the barrel or drum and surrounding the said outlet portion to receive coarse and fine material from the perforations therein and adapted to discharge only the fine material, and a helical conveyer pipe extending from the base of the hood and discharging into the barrel or drum to return the coarse material thereto for regrinding.

5. In a conical mill, the combination with a rotating barrel or drum having a conical outlet portion, of a conical classifying hood of foraminous material carried by the barrel or drum and surrounding the conical outlet portion only to receive coarse and fine material therefrom and adapted to discharge only the fine material, and means at the base of the hood to receive coarse material and return the same to the barrel or drum for regrinding.

6. A grinding mill comprising in combination, a rotatable drum provided with means, comprising a conical outlet portion, for preventing oversize material from leaving the drum when the mill is operated at or below a predetermined capacity, a classifying hood secured to said drum and surrounding the conical outlet portion thereof to receive oversize and fine material therefrom when the mill is operated above said predetermined capacity, and means connected to said hood and drum for returning the oversize to said mill for regrinding.

In testimony whereof I hereunto affix my signature.

HARRY W. HARDINGE.