

C. L. CARMAN.

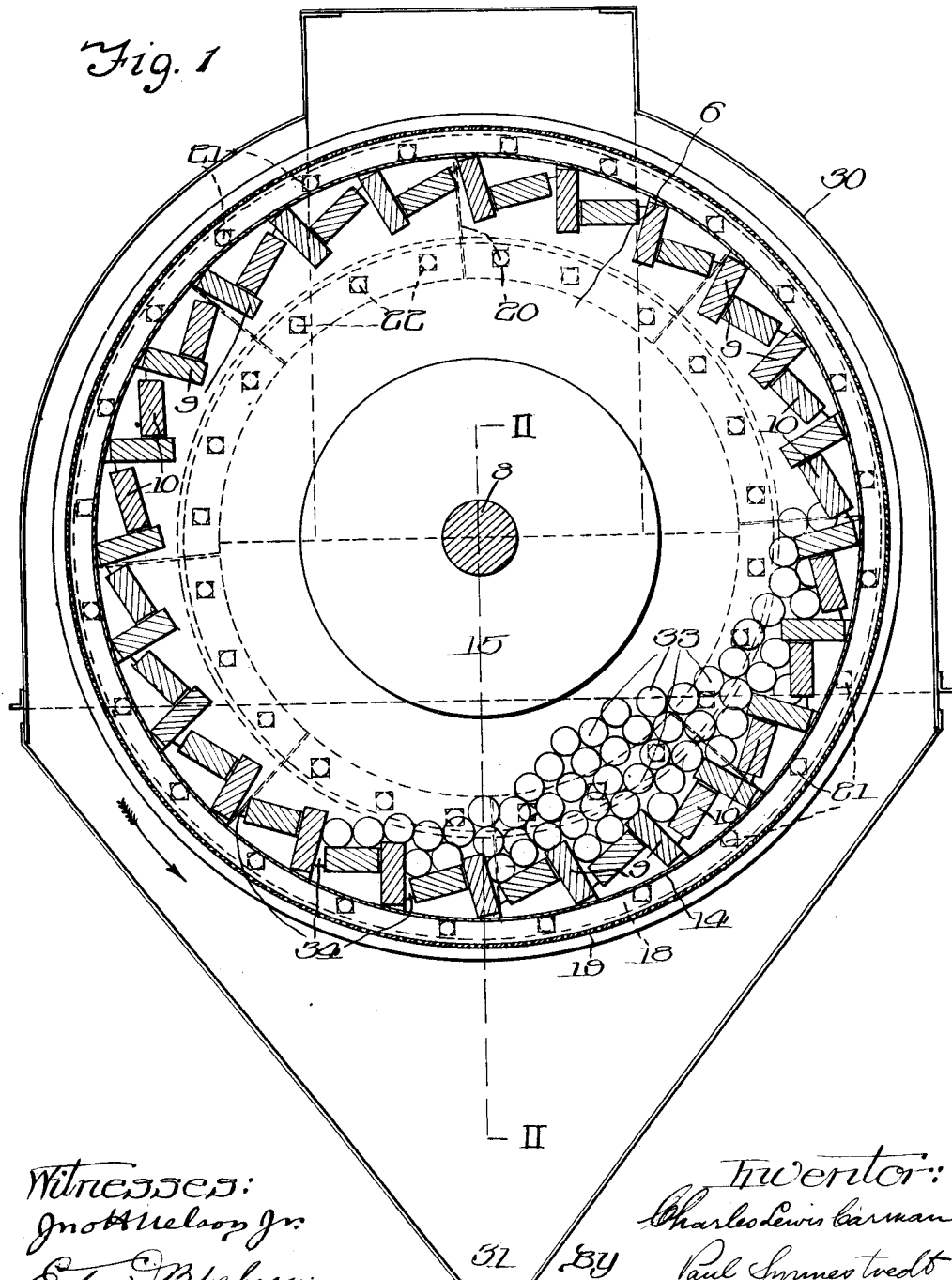
BALL MILL.

APPLICATION FILED JUNE 22, 1912.

1,066,077..

Patented July 1, 1913.

4 SHEETS—SHEET 1.



C. L. CARMAN.

BALL MILL.

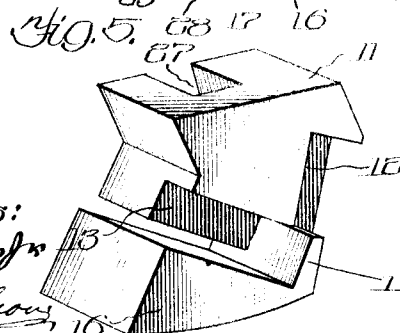
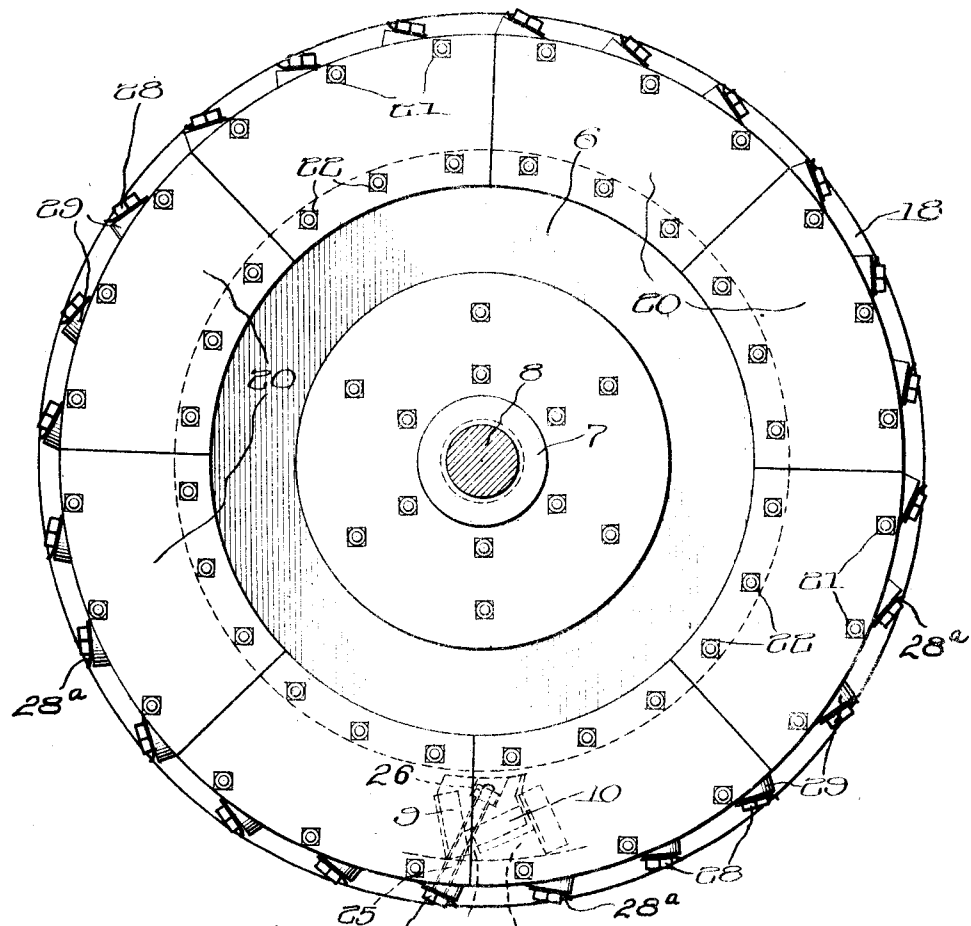
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4 SHEETS-SHEET 2.

Fig. 6.



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4 SHEETS-SHEET 3.

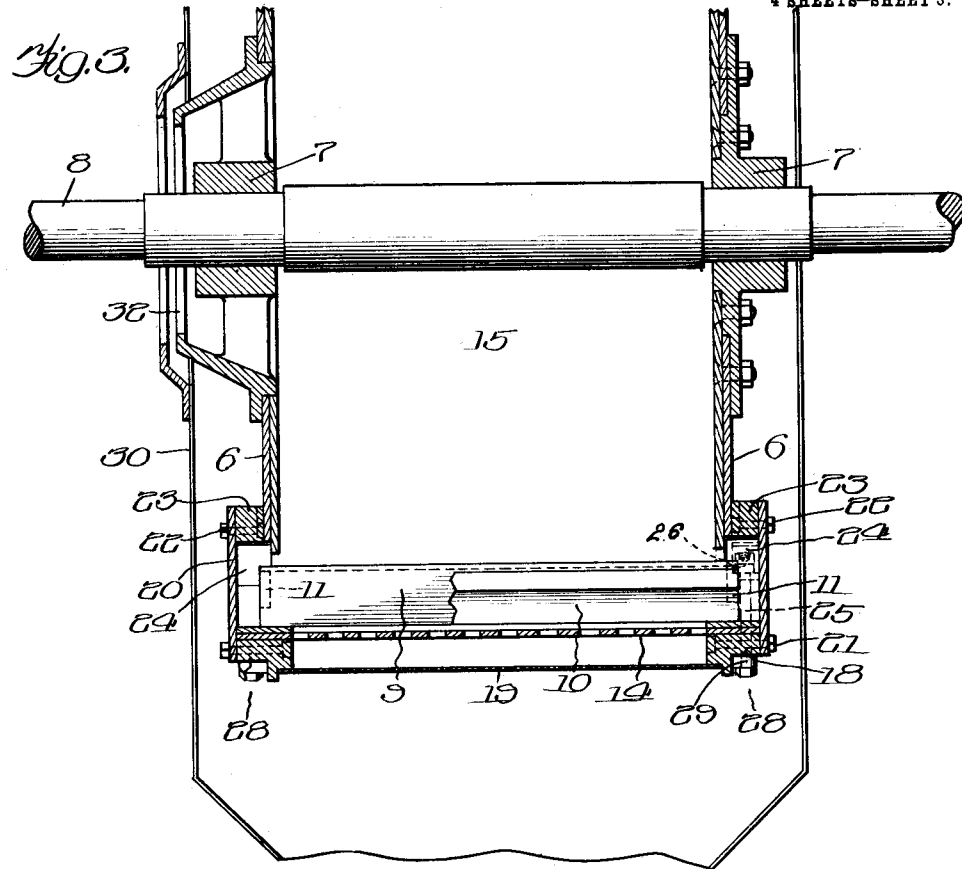
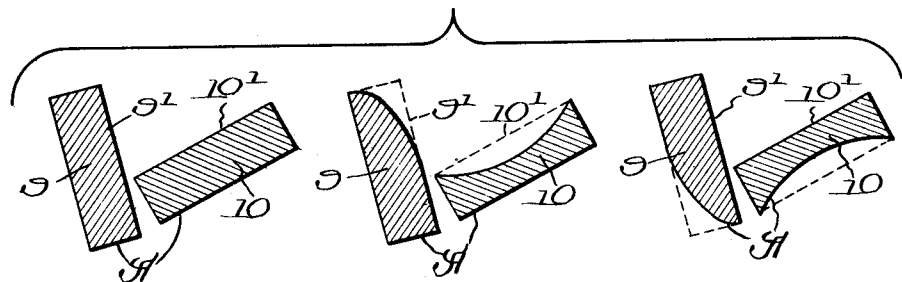


Fig. 4.



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4 SHEETS—SHEET 4.

Fig. 7.

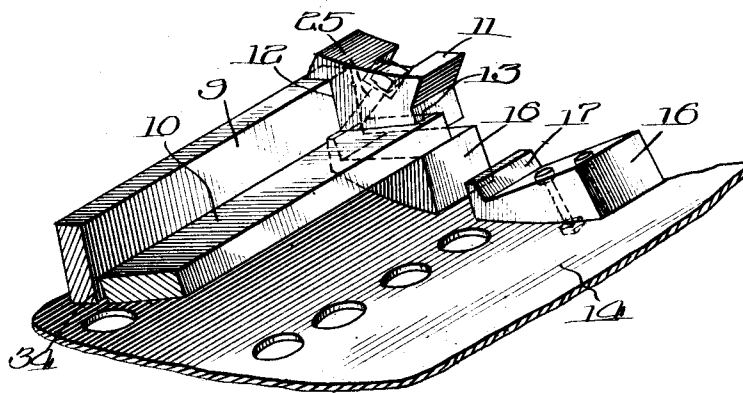
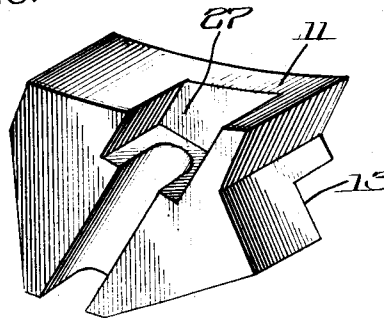


Fig. 6.



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UNITED STATES PATENT OFFICE.

CHARLES LEWIS CARMAN, OF RIVERSIDE, CALIFORNIA.

BALL-MILL.

1,066,077.

Specification of Letters Patent.

Patented July 1, 1913.

Application filed June 22, 1912. Serial No. 705,182.

To all whom it may concern:

Be it known that I, CHARLES LEWIS CARMAN, a citizen of the United States, residing at Riverside, in the county of Riverside and State of California, have invented certain new and useful Improvements in Ball-Mills, of which the following is a specification, reference being made to the accompanying drawings.

My present invention relates to grinding machines in general and more particularly to a new and improved form of ball mill.

The principal objects of this machine are the provision in a grinding machine of a novel arrangement of the passive grinding element whereby slippage of the active grinding element is effectually prevented; the provision in a ball mill of symmetrical grinding surfaces adapted to be readily reversed when worn so as to present new surfaces to the active grinding element and the material being pulverized; the provision of a novel arrangement of grinding members relative to the angular presentment of surfaces to the ball mass with reference to the rotation of the mill, adapted to produce a more efficient cascade of the active grinding element; the provision in a ball mill of a plurality of grinding units, comprising symmetrical members removably held in place, presenting a series of projecting angular surfaces to the ball mass, each unit adapted to be readily reversed and replaced, presenting unimpaired and similar angular surfaces as before; the provision of novel means in a grinding machine adapted to permit the ready removal of the grinding surfaces and their replacement without disturbing screening surfaces; and in general the provision of an improved construction and economical arrangement of symmetrical grinding surfaces in a preliminary grinding machine removably held in position by novel means so that reverse unimpaired surfaces may be readily presented to the ball mass and material in course of pulverization.

These and such other objects as may hereinafter appear or are incidental to my invention I attain by a construction illustrated in preferred form in the accompanying drawings, wherein:—

Figure 1 is a sectional view through a ball mill embodying my invention.

Figure 2 is an end elevation showing one of the drum heads with the segmental plates in position.

Figure 3 is a section on the line II—II of Figure 1.

Figure 4 is an enlarged detail drawing showing sections of the grinding plates when new, worn, and when reversed.

Figure 5 is an enlarged perspective of the retaining clip and saddle for the plates.

Figure 6 is another view of the retaining clip.

Figure 7 is a perspective showing a section of a grinding unit in position.

The grinding plates arranged about the periphery of a ball mill are subject to severe and continual wear from the charge of steel balls, which charge usually amounts to several thousand pounds, and is introduced into the chamber of the mill as the active grinding element. It is obvious that a time arrives in the operation of the mill when replacement of the grinding plates must be made, if for no other reason than to preserve the mechanical integrity of the machine, which replacement causes more or less dismantling of the mill. To reduce this wear it is common to arrange the grinding plates eccentrically within the mill, each plate similarly positioned in the heads as to present a series of obtuse angles to the ball mass in the direction of its movement. Such an arrangement however results in a direct loss of efficiency permitting slippage of the ball mass instead of the desired continuous cascading and bombardment of the balls upon the material to be pulverized. This slippage is distinct and is readily noticeable at the top of the cascade when those balls in direct contact with the plates, but superimposed upon others, stay in contact with the plates until they have reached a point considerably higher than the crest of the cascade, then slip down along the plate and enter the cascade.

It is evident that where a machine is in continuous operation, this constant slippage of the ball mass causes excessive wear of the grinding plates and balls producing polished surfaces which increase the total slippage of the ball mass; reducing the output of product per unit of power applied and lessening the grinding life of the plates.

My new and improved construction and arrangement of breast plates is primarily adapted to relieve this condition and eliminate these objectionable features in an apparatus of the class described; which together with the novel means designed to permit the ready removal of any plates having a worn surface, so that on reversing and replacing them in the mill, new and unimpaired plate surfaces are presented to the ball mass without dismantling the mill or screens in any way.

Referring now more particularly to the preferred construction illustrated in the accompanying drawings, I provide a ball mill with circular drum heads 6, said heads carrying at their centers hubs 7, which are mounted upon a shaft 8 driven from any suitable source of power.

Running from head to head and removably secured thereto is a series of metal grinding plates of symmetrical section, alternately arranged to form back plates 9 and flat plates 10, which plates form the passive grinding element of the mill. Each pair of adjoining plates 9 and 10 are brought together into a removable unit A by circumferential retaining clips or blocks 11 adjacent the peripheries of both drum heads 6, the plate 9 being adapted to removably fit into recesses 12 and the plate 10 similarly fitting into recesses 13 in the retaining clips 11, in a manner more fully hereinafter described. The clips are further cored for the reception of suitable bolts 25 adapted to maintain the clips in position.

A cylindrical perforate shell 14 forming a grinding chamber 15 is concentrically positioned about the heads 6, the shell being spaced away by an angular saddle block 16 from each unit A formed by the plates 9 and 10 at each end thereof. The saddle block 16 forms a seat for the plates, its outer surface resting against the inner surface of the shell, and carries a lip 17 adapted to space the plates 9 and 10 apart. The screening mechanism comprises the perforate shell 14 and screen 19, the shell and screen being secured to and spaced apart by rings 18. The flanges or rings 18 are secured to a series of segmental plates 20 by bolts 21 and the plates in turn are fastened by bolts 22 to external rings 23 fastened on the heads in such a way as to leave recesses 24 for the reception of the retaining clips 11. By this arrangement, the screening mechanism is securely fastened to the heads 6.

The breast plates are maintained in their relative position by the bolts 25 passing through the clips and the rings 18, and provided with nuts 26 engaging the recess 27 in the inner surface of the clips, the bolt heads 28 engaging the lugs 29 on the flange 18 and being locked by any preferred form of locking means 28^a. This arrangement

eliminates any machining of the breast plates.

The mill proper is inclosed by a housing 30 provided with a hopper discharge outlet 31 leading to any suitable conveyer means for the disposition of the finished product. A feed opening 32 is provided in the housing 30 and one of the heads and is preferably located about the hub.

To avoid slippage of the ball mass already referred to and to provide effective cascading of the balls, each back plate 9 of a unit A presents a substantially right angular projecting surface 9' to the balls 33 with regard to the direction of their movement when the mill is rotated. The flat plate 10 immediately preceding the plate 9 relative to the direction of the mill lies substantially in the same plane with regard to the direction of the movement of the balls, and as such offers a resting place 10' for the balls which come in direct contact with the angular surface 9' of the plate 9 until the crest of the cascade is reached, when the balls in falling have a bombarding action upon the material in the grinding chamber. The outer edges of each unit A are spaced apart, forming apertures 34 permitting the pulverized product to work through to the perforated drum shell 14, and thence to the screening surface 19.

To operate the ball mill, a normal charge of balls is placed inside of the drum and the latter caused to rotate in a direction indicated by the arrow in Figure 1. The material to be pulverized is then introduced in the usual manner through the feed opening near the hub of one end plate.

This material is quickly reduced to a pulverized condition by the bombardment of the balls upon the cascaded material and by the wearing action of the plates and escapes through the apertures 34, working past the perforated shell 14 to the screening surface 19 and thence to the discharge outlet. Owing to the substantially right angular presentment of the grinding units A, the ball action is effective and slippage of the ball mass prevented. The balls also cannot slip while being carried up the ascending side of the drum, and upon reaching the apex of their travel fall clear without slippage or undue wear of plate, resulting in a more active cascade and practically all of the balls being in action except those immediately in contact with the plates. At the foot of the cascade the first balls coming on to a plate arrange themselves against the face of the succeeding plate and protect it from further bombardment, transferring excessive wear from an expensive plate to comparatively cheap ball material.

As those surfaces of the plates presented to the action of the balls and material become worn, they are removed from the drum

by loosening up the bolts 21 and 22 thereby releasing the segmental plate 20. Then the bolts 25 are withdrawn, permitting the removal of the plates 9 and 10 so that they may be reversed and replaced, presenting new and unimpaired plate surfaces to the material as will be readily seen by referring particularly to Figure 4.

This operation can be carried out at any time, and without interfering in any way with the screening surfaces or other parts of the machine. Other advantages will occur to those skilled in the art.

Having thus described my invention and illustrated its use what I claim as new and desire to obtain by Letters Patent is the following:—

1. In a mill, the combination of a grinding chamber mounted for rotation about a substantially horizontal axis, an active grinding element, a relatively passive grinding element arranged within the grinding chamber, said passive grinding element consisting of a series of reversible members of symmetrical section so disposed therein that alternate members present successive flat and angular surfaces respectively to the active grinding element.

2. In a ball mill, the combination of a grinding chamber comprising a perforate shell and heads therefor, a charge of balls, a series of wearing plates arranged longitudinally the grinding chamber and positioned between the heads, said plates being of symmetrical section and alternately disposed to present resting and retaining surfaces to the balls.

3. A rotatable pulverizer having a grinding chamber with a charge of balls therein, a series of reversible grinding plates of similar symmetrical section alternately disposed within the grinding chamber to present successive flat and projecting surfaces to the balls, and means adapted to removably hold the plates in position within the chamber.

4. In a mill of the class described, the combination of a grinding chamber with a charge of balls therein, grinding units in the chamber each consisting of a pair of interchangeable plates arranged to present resting and agitating surfaces therein, a retaining member in the grinding chamber adapted to hold and retain in place the ends of said plates thereby assembling the grinding unit, and releasable means arranged exteriorly of the grinding chamber, uncoupling of which permits interchange or reversal of the plates forming the unit whereby new and integral surfaces are presented to the charge of balls, substantially as described.

5. In a ball mill, the combination of a grinding chamber consisting of a perforate shell and heads therefor and adapted to rotate upon a shaft, a charge of balls, a series

of grinding plates alternately positioned within the grinding chamber to form retaining plates and resting plates for the balls, retaining members suitably recessed to accommodate the ends of the plates, and means to maintain the said retaining members in position.

6. In a ball mill, the combination of a grinding chamber consisting of a perforate shell and heads therefor and adapted to rotate about a centrally located shaft, a charge of balls, a series of breast plate units comprising a back plate and a flat plate of symmetrical section positioned within the grinding chamber so as to present alternate retaining and flat surfaces to the balls, a pair of retaining clips provided with recesses for the reception of the plates, a circumferential flange encompassing the exterior of the grinding chamber, and a connection between the flange and the grinding chamber.

7. In a ball mill, the combination of a grinding chamber consisting of a perforate shell and heads therefor and adapted to rotate about a centrally located shaft, a series of breast plate units comprising back plates and flat plates both of symmetrical section spaced apart and positioned within the grinding chamber to present alternate projecting and flat surfaces, a pair of retaining clips provided with recesses in which the ends of the grinding units are received, an annular flanges encompassing the grinding chamber and secured to the heads, and a connection between the clips and the aforesaid flanges.

8. In a ball mill, the combination of a grinding chamber consisting of a perforate shell and heads therefor and adapted to rotate about a centrally located shaft, a charge of balls, a series of wearing plate units comprising a back plate and a flat plate of symmetrical section spaced apart and positioned within the grinding chamber, so as to present alternate retaining angular surfaces and flat resting surfaces for the balls, a plurality of retaining clips adapted to receive the ends of the plates, an annular flange encompassing the grinding chamber and secured thereto, a saddle block or seat interposed between the flange and the wearing plate units, and removable means to secure the retaining clips in position.

9. The combination in a rotatable ball mill, a grinding chamber consisting of a perforated cylindrical shell and heads therefor, and provided with an inlet opening, a charge of balls and a series of wearing plates arranged longitudinally the chamber, said plates being of symmetrical section and alternately disposed with reference to their angular presentment to the balls to form a substantially right angular surface and a substantially flat surface in succession.

10. The combination in a rotatable ball

mill, a grinding chamber, a charge of balls, a plurality of grinding plates arranged longitudinally in the chamber, said plates being alternately disposed with reference to their angular presentment to the ball cascade to form a substantially right angular surface and a substantially flat surface thereto in succession, and retaining members shaped to receive the ends of one or more plates.

11. The combination in a rotatable ball mill, a grinding chamber consisting of a shell and heads therefor and provided with a feed opening, a charge of balls, a plurality of grinding plates arranged longitudinally in the chamber, said plates being alternately disposed with reference to their angular presentment to the ball cascade to form a substantially right angular surface and a substantially flat surface thereto in succession, retaining members shaped to receive the ends of one or more plates, and means adapted to removably hold the members in position.

12. The combination in a rotatable ball mill, a grinding chamber consisting of a shell and heads therefor and provided with a feed opening, a charge of balls, a plurality of grinding plates arranged longitudinally in the chamber, said plates being alternately disposed with reference to their angular presentment to the ball cascade to form a substantially right angular surface and a substantially flat surface thereto in succession, retaining members suitably recessed to receive the ends of adjacent plates, removable means adapted to hold the retaining members in position, and a connection between the removable means and the retaining members.

13. In a mill of the class described, the combination of a grinding chamber, a charge of balls, retaining clip members, and a series of grinding units, each unit consisting of a plurality of symmetrical plates disposed at substantial right angles to each other so as to present successive wearing and agitating surfaces to the active grinding element, the ends of the said unit being held in said retaining clip members.

14. The combination in a rotatable grinding mill, a grinding chamber consisting of a perforate shell and heads therefor, a charge of balls, a series of wearing plates arranged between the heads in the chamber, retaining members suitably shaped to receive the ends of the wearing plates, a saddle block between the plate retaining members and the shell, and means adapted to hold the members in position substantially as described.

15. In a rotatable ball mill, the combination of a grinding chamber consisting of a perforated cylindrical shell and heads therefor and provided with a feed opening in one

of the heads, a charge of balls a series of grinding units comprising a plurality of symmetrical plates positioned within the grinding chamber having the surfaces which contact with the charge of balls alternately differing with respect to adjacent plates relative to the angle of presentment, a plurality of retaining members suitably shaped to receive the ends of the plates, and means comprising the annular flange 18 and plate 20, adapted to removably hold the retaining members to the heads, removal of said plate permitting the withdrawal and replacement of the plates in the manner set forth.

16. In a mill of the class described the combination of a grinding chamber and heads therefor, a screening member about the heads, one or more detachable plates circumferentially connecting the screening member to the heads, a plurality of grinding members located in the grinding chamber circumferentially of the heads and substantially in alined relation with the said detachable plate or plates, so arranged that any of said grinding members may be readily removed from the grinding chamber by the uncoupling of a plate in alinement therewith, substantially as described.

17. In a mill of the character described, the combination of a grinding chamber, a foraminous plate circumferentially arranged about the grinding chamber, a series of wearing plates in the grinding chamber, and a plurality of detachable segmental plates exteriorly arranged between the foraminous plate and the grinding chamber whereby any one or more of the said wearing plates may be removed from the grinding chamber by the uncoupling of a corresponding segmental plate.

18. In a mill of the class described, the combination of a grinding chamber provided with heads, grinding plates and clips therefor, a perforated plate arranged about the grinding chamber, and releasable means positioned between the perforated plate and one of the heads to space them apart to permit ready reversal or removal of any of the grinding plates by uncoupling the said releasable means.

19. In a mill of the class described, the combination of a grinding chamber, retaining clip members, and saddle blocks therefor, and grinding units consisting of a pair of wearing plates having their ends fitting into the said clip members and spaced apart by the said saddle blocks, the said plates being positioned in the clip members substantially at right angles to each other.

20. In a grinding mill having a grinding chamber and wearing plates positioned therein, the combination of a retaining clip member recessed to receive the ends of a pair of wearing plates, and a saddle member adapted to hold the retaining member and

wearing plates in fixed relation, said saddle member being provided with a lip adapted to space apart the said wearing plates.

21. In a mill of the class described the
5 combination of a grinding chamber, a plurality of grinding plates in the chamber, removable holding means therefor, and detachable means in alinement with said holding means and releasable exteriorly of the
10 chamber, so that when the detachable means are uncoupled any of the grinding plates

may be removed without affecting the alinement of the other plates in the grinding chamber.

In testimony whereof I have hereunto 15 signed my name in the presence of the two subscribed witnesses.

CHARLES LEWIS CARMAN.

Witnesses:

W. HERBERT FOWKES,
M. H. ERICKSON.