March 1, 1938. W. A. BEAUDRY 2,109,856

CRUSHING MILL

Filed March 30, 1935 3 Sheets-Sheet 1

Fig. 1

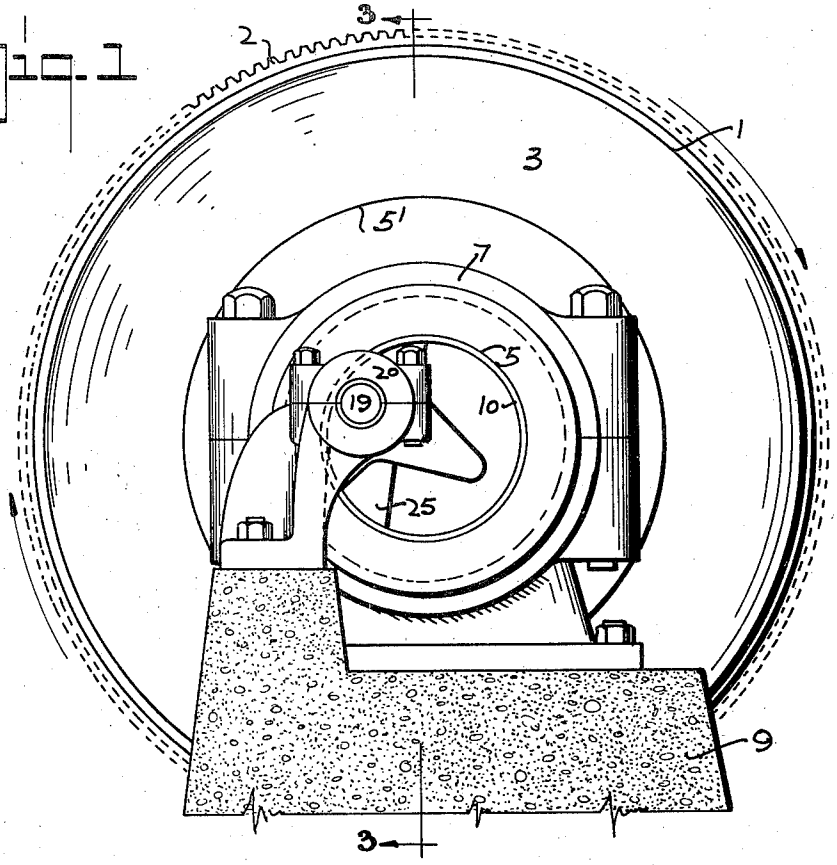
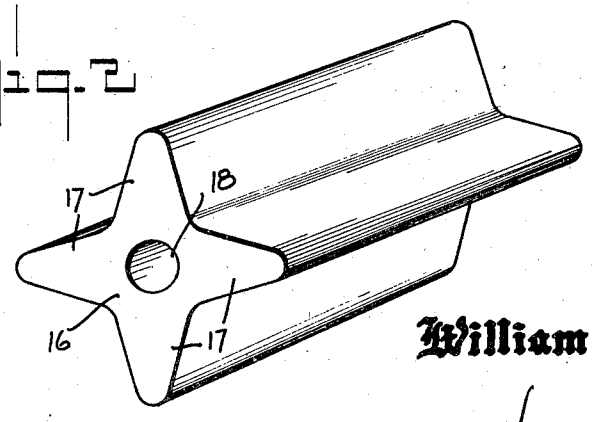


Fig. 2



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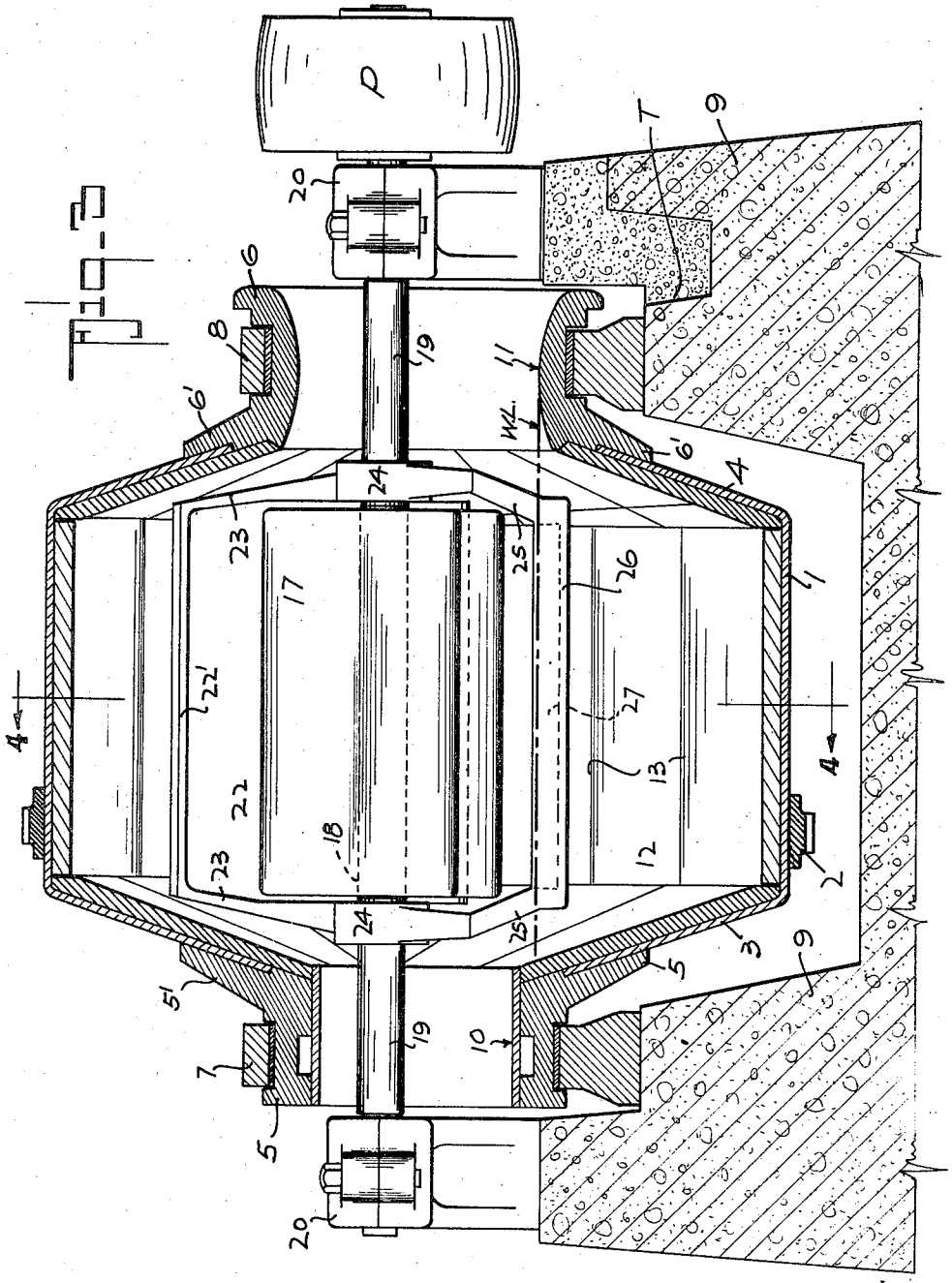


Fig. 2

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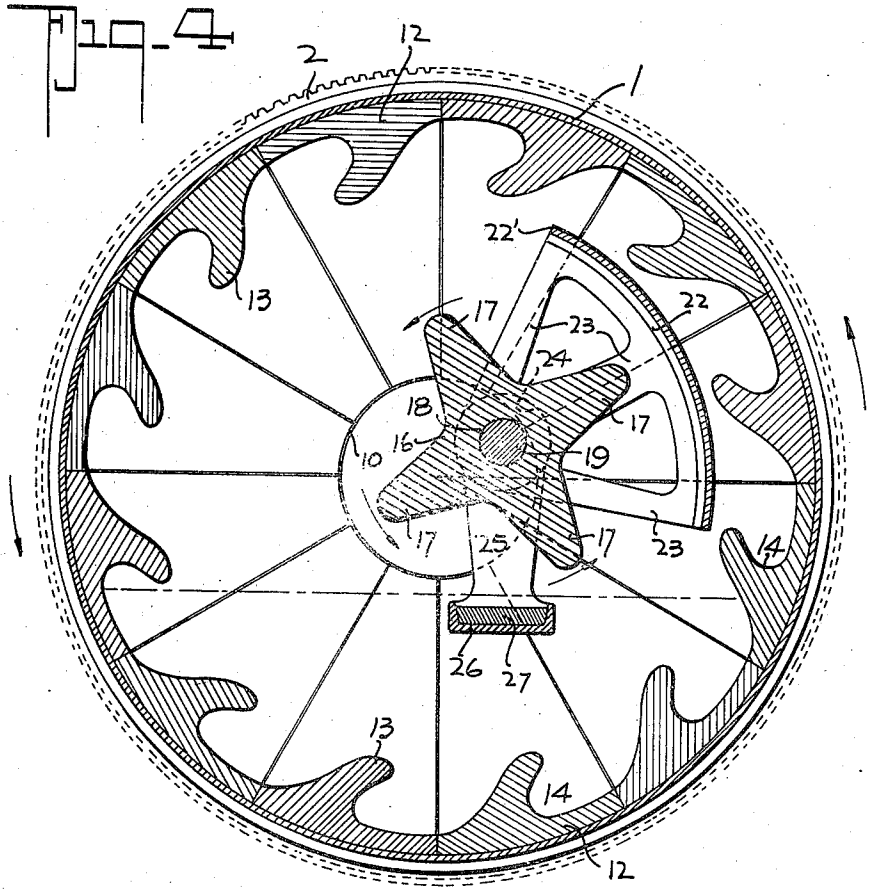
Attorney

March 1, 1938. W. A. BEAUDRY 2,109,856

CRUSHING MILL

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Fig. 4



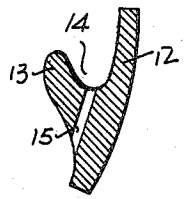


Fig. 5

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UNITED STATES PATENT OFFICE

2,109,856

CRUSHING MILL

William A. Beaudry, Wallace, Idaho

Application March 30, 1935, Serial No. 13,896

4 Claims. (Cl. 83—11)

My present invention relates to improvements in crushing mills of the rotary, horizontal axis type, having an axial feed, wherein the material is first elevated and then permitted to fall freely in a perpendicular shower, or continuous stream, of considerable length or width from end to end, but of screen-like thickness, into the path of a revolving bat, by means of which the material in the stream or screen is continuously batted, or violently tossed against the enclosing wall of the mill. Both the impact of the bat against the stream of material, and the impact of the batted material against the wall of the mill, are effective in breaking up or crushing the material.

While the mill of my invention is adapted for crushing various materials, it is especially designed for use in breaking up or crushing partially prepared rock-ore or mineral rock to a reduced condition of fineness suitable for feed to a mineral separator.

The invention consists in certain novel combinations and arrangements of parts for accomplishing the above results as will hereinafter be more fully set forth and claimed. In the accompanying drawings I have illustrated one complete example of the physical embodiment of my invention wherein the parts are combined and arranged according to one mode I have thus far devised for the practical application of the principles of my invention. It will be understood that changes and alterations are contemplated and may be made in the exemplifying structure within the scope of my appended claims without departing from the principles of my invention.

Figure 1 is an end elevation of a crushing mill embodying my invention, as seen from the intake or feed end.

Figure 2 is a perspective view of the rotary bat.

Figure 3 is a longitudinal, vertical sectional view of the mill at line 3—3 of Figure 1.

Figure 4 is a transverse sectional view through the drum and its enclosed operating parts.

Figure 5 is an enlarged detail sectional view of one of the interior liner-plates of the drum, showing a drain hole for water therein.

The rotary drum, which is of cylindrical shape and designated as 1 is provided with an exterior gearing or gear ring 2 that is engaged by a suitable, complementary, drive gear, to slowly revolve the drum anti-clockwise in Figures 4 and clockwise in Figure 1. The drum is of that type having usual tapered ends or heads 3 and 4, and these ends have trunnions 5 and 6 attached thereto by the respective flanges 5′ and 6′. The open trunnion 5, which forms the intake or feed end of the mill is journaled in the bearing block 7, and the larger, bored, trunnion 6 forms the discharge end of the mill; the bearing blocks 7 and 8, the latter for the discharge trunnion, being supported on a suitable foundation 9.

The trunnion 5 at the intake end is preferably provided with an interior wear ring 10, or bushing, of suitable hard material to enhance the durability of the mill, and the mouth of the discharge trunnion 6 which is larger in diameter than the axially alined opening in the trunnion 5, has a rounded face 11 over which the wet pulp may flow to the conveyer trough indicated at T in Figure 3.

During a wet process of crushing, the wet pulp is fed to the mill to the depth of the water line W. L. which is slightly below the intake end and slightly above the outlet or discharge end of the drum, and the wet pulp is continuously fed, and the crushed material is discharged, to maintain this level.

The interior of the drum is lined for ready repairs and replacements, and in some instances a sound cushioning or insulating material may be interposed between the lining and the wall of the drum, for the purpose of reducing the noise when the mill is in operation.

The cylindrical body of the drum is lined with specially formed plates 12, curved on their outer faces to conform to the inner periphery of the drum, and on their inner faces these plates are each fashioned with a longitudinally extending rib 13, spaced from the plate, forming a carrier, or elevator bucket 14, extending from end to end of the drum, and in some instances drain holes 15, for water, may be provided between the ribs and their respective plates, as indicated in Figure 5.

These conveyer-troughs or elevator buckets, traveling to the right through the wet pulp in Figure 4, pick up quantities of solids with the pulp, and just before reaching the zenith point or greatest height of the interior of the drum, the buckets dump their contents. The solids flow from the buckets in successive, thin streams, the length of the ribs 13, and the stream falls in a perpendicular plane at one side of the longitudinal axis of the drum.

In the falling path of the stream of solids a rotary bat 16, having batting vanes 17, and a longitudinal bore 18 is located. The bat as shown is in the form of a solid body, with integral vanes, and of course the faces of the vanes, and the faces of the spaces between the vanes, form

barriers that prevent passage of the material through the bat. The spaces between the vanes form receptacles in which the material is deposited in successive charges, and these charges of material are successively batted or tossed violently by the vanes against the side wall of the drum. The bat is rigidly mounted on a shaft 19, which, as shown is laterally offset from the longitudinal axis of the drum, and also elevated slightly above the axis of the drum, and the ends of the shaft protrude through the upper portions of the hollow trunnions 5 and 6 of the drum. The ends of the shaft are journaled in bearings 20, exterior of the trunnion bearings, and the bat and shaft rotate in the same direction, but at a higher speed than the drum; a drive pulley P on the shaft being used for this purpose. The rotation of the drum and that of the bat are synchronized so that the successive streams dropping from the buckets will each be "batted" by a vane 17 as the bat rotates.

The impact of the falling solids on the bat may break up some of the solids, but the main crushing action, or reduction of the solids takes place when the successive vanes violently toss the solids laterally, across the interior of the drum against the opposite wall of the drum. This impact of the batted solids against the wall reduces the size of the solids to the desired fineness.

The face of the descending portion of the wall of the rotary drum, or the lining plates 12—13, thus form anvils against which the material is violently tossed, or hurled, or batted, by the rotary bat. The rotary bat is offset toward the conveyer-side or ascending side of the drum to be in the path of the falling stream of material, which, it will be noted, falls from the successive buckets or recesses 14 just before they reach the zenith point of the drum. This eccentric location of the bat also provides the required distance between the bat and the anvils to insure the necessary speed of the batted material so that it will be smashed and broken by its impact against the anvils.

To assist in the delivery of the successive streams of solids to the bat I employ a stationary, counterbalanced, and adjustable weir-plate, or dropper 22, of arcuate shape, and located in close proximity to the lips of the troughs or buckets 13. In area, this weir-plate is approximately the quadrant of a circle and substantially the length of the buckets or troughs. The upper or delivery edge 22' of the plate is in position to drop the contents of a bucket in a thin stream, as the bucket or trough dumps its contents at this delivery point, and the upper portion of the weir-plate prevents the contents of the bucket from being prematurely dumped from the elevator buckets.

The weir-plate, at its opposite ends, is provided with spokes 23, which are rigid with hubs 24, and these hubs are loosely journaled on the shaft 19 in order that the weir-plate may remain in stationary position.

The weir-plate may be adjusted to vary the relation of the delivery edge 22' to the dumping point of the elevator buckets, in order to secure greatest efficiency in the proper formation of the streams to be batted. For this purpose the hubs are fashioned with depending arms 25, which arms are joined by means of a receptacle 26 in which a weight 27, of suitable character, is placed. As indicated in the drawings Figure 4, the weight 26 counterbalances the weir-plate, so that the load is perpendicular to the axis of the shaft 19. If the load 26 were lightened, the weir-plate would swing down to the right in Figure 4 until the weight and the plate were counterbalanced. This counterbalancing movement would retract the delivery edge 22' away from the zenith of the interior of the drum, and consequently move the falling stream of the solids to the right in said figure of the drawings. After the plate has been once adjusted to effective position, and counterbalanced in that position, the plate remains stationary during the operation of the mill.

As the solids are crushed and reduced in size, and due to the agitation of the wet pulp, the fine particles are gradually flowed over the annular lip of the revolving mouth 11 together with excess water. The heavier particles, or coarse material that may not be broken during the first batting performance, are again picked up, delivered to the batter, and crushed, and this performance is repeated until the material is reduced to sufficient fineness that it may be flowed with the water through the discharge trunnion. The feed of the material is of course governed or controlled in accord with the discharge.

The discharged material, being of a substantially uniform size, is thus classified as it leaves the mill, and therefore does not require further treatment of this nature, in preparation for the mineral separator.

The number of vanes 17 of the batter may be varied to suit different conditions, and if found desirable, and the batter and drum, although revolving in the same direction, move at a predetermined ratio of speeds to synchronize the vanes with the dumping buckets. The exposed faces of the walls of the drum, the faces of the vanes, and other interior parts of the mill, are preferably hardened in suitable manner, to enhance the durability of the parts, and the longevity of the mill.

In some instances the mill may be operated according to a dry process, wherein the use of water is omitted, and an exhaust fan is employed at the discharge end of the mill to remove the dust or finely reduced material. In the dry process the crushing or reducing of the material is accomplished in the same manner as that of the wet process.

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

1. The combination with a rotary drum having hollow intake and outlet trunnions and journal bearings for the trunnions, and conveyer buckets mounted on the inner face of the drum, of a solid rotary bat having longitudinally extending, exterior, vanes and alternating spaces forming receptacles and located within the drum and offset toward the conveyor-side thereof, a shaft for the bat having its ends protruding through the trunnions, journal bearings for the shaft, and said shaft disposed in eccentric relation to the longitudinal axis of the drum.

2. The combination with a rotary drum having hollow intake and outlet trunnions and journal bearings therefor, and conveyer buckets mounted on the inner face of said drum, of a solid rotary bat having longitudinally extending, exterior, vanes and alternating spaces forming receptacles, said bat being located in the drum in position for the receptacles to receive material from the buckets, a shaft for the bat and journal bearings for the shaft, a stationary

weir-plate journaled on the shaft and located above the lower portion of the bat adjacent the buckets, and a counterweight rigid with the weir-plate and located below the bat.

3. The combination in a crushing mill of the horizontal axis type with a rotary cylindrical drum having a series of conveyer troughs on its inner surface, of an arcuate-shaped weir plate within the drum and having its delivery edge adjacent of the drum for co-action with said troughs to deliver the solids in a falling stream, and a rotary bat having a closed periphery and located below the weir plate in the path of the falling streams.

4. The combination in a crushing mill with a rotary drum having an interior lining comprising plates, said plates having longitudinally extending ribs forming carriers at the ascending side of the drum and also forming anvils at the descending side of the drum, of a rotor mounted in the drum and offset toward the ascending side thereof, said rotor having batting faces located in the path of a falling stream of material from said carriers and adapted to violently toss solids therefrom against said anvils.

WILLIAM A. BEAUDRY.