May 26, 1925. 1,539,237

W. O. BORCHERDT

SCREENING BALL MILL

Filed Feb. 11, 1924

Fig. 1.

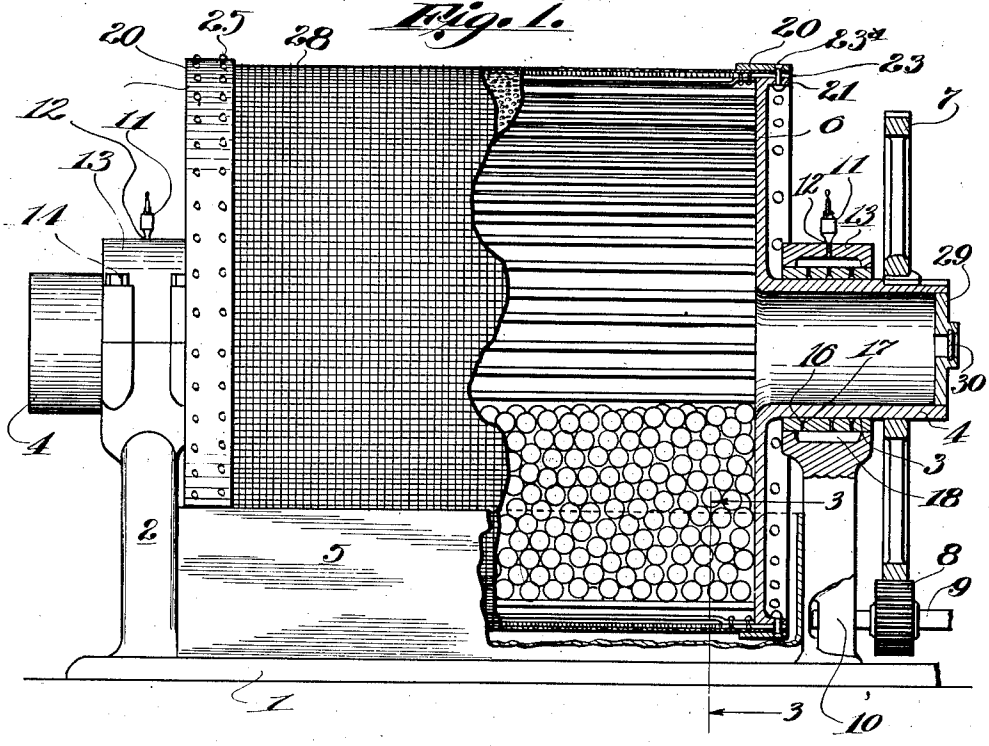


Fig. 3.

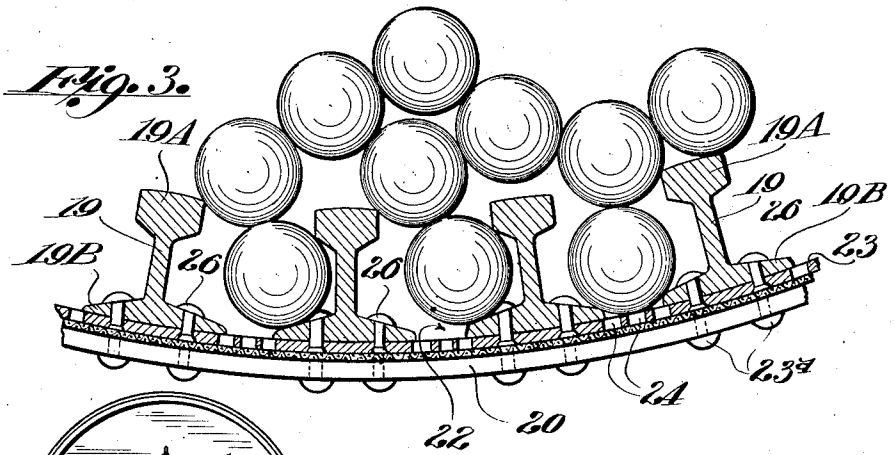
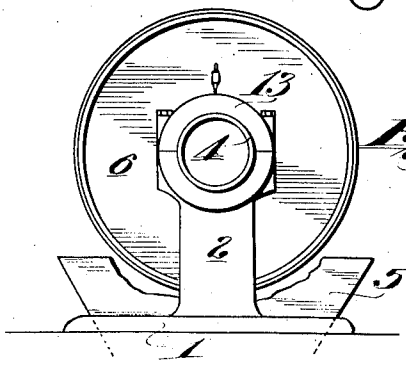


Fig. 2.



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UNITED STATES PATENT OFFICE.

WALTER O. BORCHERDT, OF AUSTINVILLE, VIRGINIA, ASSIGNOR TO JOHN HERMAN, OF LOS ANGELES, CALIFORNIA.

SCREENING BALL MILL.

Application filed February 11, 1924. Serial No. 692,044.

To all whom it may concern:

Be it known that I, WALTER O. BORCHERDT, a citizen of the United States, residing at Austinville, in the county of Wythe and State of Virginia, have invented new and useful Improvements in Screening Ball Mills, of which the following is a specification.

My present invention being referred to as a screening ball mill, it may be understood to be an object of this invention to provide means for the economical and efficient grinding of ores and similar materials within substantially cylindrical chambers provided with balls, or the like, freely movable therein, and provided also with apertured cylindrical walls permitting a free exit of subdivided material therethrough.

It is an object of this invention to provide a screening ball mill of the general type described and claimed in the United States Patent granted to John Herman on March 28, 1916, No. 1,176,896, but in which sections of ordinary or special steel T-bars or rails, such as worn or rejected sections of manganese steel rails, may be substituted for the longitudinally-extending bars of triangular or trapezoidal cross-section shown in said patent.

It is an object of this invention to provide a screening ball mill in which T-bars or rail sections are advantageously substituted for the "spaces continuously increasing in cross-section" described in the mentioned patent to John Herman, the construction herein described being advantageous not only in permitting the use of bars of very durable quality obtainable at a very moderate cost, but advantageous also in providing a construction which is effective to lift balls and the material which is to be operated upon or comminuted thereby to a comparatively high level, thereby increasing the effective force of the impacts to which the material is subjected.

As in the mentioned prior patent to John Herman, it is an object of my novel screening ball mill to provide a construction permitting a free exit of material suitably subdivided and at the same time assuring an avoidance of clogging, by permitting a free return of material not sufficiently subdivided, the outermost element or screen of my ball mill being provided with a mesh sufficiently fine to preclude the passage of anything but a satisfactory product, and the base screen over which the mentioned outer or wire screen is retained being provided with larger apertures, which may be either of uniform diameter or slightly expanded toward the interior, and the bases of the respective T-irons or rail sections being in turn spaced apart by a distance exceeding the maximum diameter of the mentioned apertures in the base screen.

It is a further object of my invention to provide a screening ball mill of the general character referred to in which the heads of the mentioned T-bars or rail sections may be of such size and shape that, when the bases of the same are spaced apart in the manner above referred to, the intervals between the heads of said bars or rails will exceed the intervals between the mentioned bases; and the intervals between the heads referred to should moreover be such as to permit a comparatively free movement of balls therebetween, in order that, although balls may advantageously be momentarily trapped within the spaces between the mentioned rails, and thereby carried to a considerable elevation before they are thrown or permitted to roll from said spaces there may be produced a continuous cascading of balls and a rapid comminution of ore or other materials thereby.

It is an object of this invention to provide novel means for the securing of T-bars or rail sections in a relationship favorable to the mode of operation just referred to and favorable to such a rapid elimination of suitably subdivided material through the spaces left between the bases of the mentioned rails or bars as may be effective to avoid any cushioning of coarse material by material already sufficiently subdivided, thereby maintaining my novel screening mill at a comparatively high efficiency.

Further objects of this invention will appear from the following description of an advantageous embodiment thereof and from the appended claims, taken in connection with the accompanying drawing, in which.

Fig. 1 is a side elevation of a screening

ball mill embodying my invention and provided with a hopper for the reception of the subdivided product delivered therefrom.

Fig. 2 is an end view of the same or a similar mill, shown upon a smaller scale.

Fig. 3 is a vertical transverse sectional view upon an enlarged scale, this view being taken upon a line such as the line 3—3 of Fig. 1.

Referring to details of that specific embodiment of my invention which I have chosen for purposes of illustration, 1 being a base plate provided with posts or frame elements 2 provided at 3 with bearings of any usual or preferred construction adapted to receive the hollow or other trunnions 4, said trunnions may optionally be formed integral with or rigidly secured to end plates 6; and rotative movement may be imparted to the said trunnions and end plates by any suitable means such as the gear 7, shown as engaged and driven by a smaller or spur gear 8 upon the shaft 9, having a bearing at 10. Lubrication may be provided in any suitable way, as by means of oil cup 11 secured at 12 in complemental or removable bearing element 13, normally retained by means of screws or bolts 14, the bearing ring 3 being shown as provided with grooves 16 and passages 17, through which lubricant may be delivered from the surrounding annular oil passage 18, in a known manner.

Coming now to the novel features of my invention, although it is understood that T-bars or rail sections have heretofore been employed in tube- or ball-mills, such use has been in tube mills not provided with apertured cylindrical walls permitting a free exit of subdivided material therethrough, and in such mills the purpose of the T-bars or rail sections,—although fixed in spaced relationship to one another, and whether placed axially or circumferentially with respect to the shell of the mill,—has been to provide pockets in which the balls or pebbles used as grinding media would become wedged and held, thus providing the interior of the shell of the mill with a wearing surface composed substantially of the balls or pebbles used as grinding media. As will be evident to those skilled in the art to which this invention relates, the combination of the apertured cylindrical walls permitting a free exit of material therethrough, with the T-bars or rail sections of the present invention, provides a construction such that the spaces between the bars become partly filled with the material to be acted upon which is thus most effectively subjected to the impact of the falling balls, whilst at the same time providing effective means for raising the balls to a comparatively high level, and that the purpose of the present invention would be defeated if the bars were spaced so close together that the grinding balls or pebbles would become wedged and held between them.

In order to suitably support the rails 19, or their equivalent, spaced apart in a manner assuring the advantageous results referred to above, I may secure the ends thereof as by bolting or riveting to annular reinforcement bands 20, or their equivalent, these bands being shown as riveted or otherwise rigidly connected to flanges 21 upon the mentioned heads 6; and when it is desired to permit the escape only of materials of a less diameter than the interval 22 between the bases of a pair of adjacent bars or rail sections, I may optionally interpose a base screen 23, provided with apertures 24, which may be of uniform diameter or inwardly expanded; but if I employ such intervening base screen, I may optionally secure the ends thereof by means of the same bolts or rivets 23^a employed to retain the reinforcement end bands 20; and the bars or rail sections 19 may be in turn secured by bolts or rivets 25, extending through both the screen 23 and the end bands 20 or by bolts or rivets 26, extending only through the mentioned base screen, or by both of the mentioned sets of bolts or rivets. When it is desired to permit the escape only of such material as may be subdivided more finely than is necessary to an outward movement thereof through the openings 24 in the base screen 23, I may optionally employ a usual outer screen 28 retained in any suitable way on the exterior surface of the base screen 24 and between the end bands 20, the mesh of this screen being in any case less than the minimum diameter of the holes 24, ring 3 being shown as provided with grooves 16 and passages 17, through which lubricant may be delivered from the surrounding annular oil passage 18, in a known manner.

Coming now to the novel features of my invention, although it is understood that T-bars or rail sections have heretofore been employed in ball mills in which these bases have been brought directly into contact, precluding an outward delivery of suitably subdivided material therebetween, in order to suitably support the rails 19, or their equivalent, spaced apart in a manner assuring the advantageous results referred to above, I may secure the ends thereof as by bolting or riveting to annular reinforcement bands 20, or their equivalent, these bands being shown as riveted or otherwise rigidly connected to flanges 21 upon the mentioned heads 6; and when it is desired to permit the escape only of materials of a less diameter than the interval 22 between the bases of a pair of adjacent bars or rail sections, I may optionally interpose a base screen 23, provided with apertures 24, which may be of

uniform diameter or inwardly expanded; but if I employ such intervening base screen, I may optionally secure the ends thereof by means of the same bolts or rivets 23 employed to retain the reinforcement end bands 20; and the bars or rail sections 19 may be in turn secured by bolts or rivets 25, extending through both the screen 23 and the end bands 20 or by bolts or rivets 26, extending only through the mentioned base screen, or by both of the mentioned sets of bolts or rivets. When it is desired to permit the escape only of such material as may be subdivided more finely than is necessary to an outward movement thereof through the openings 24 in the base screen 23, I may optionally employ a usual outer screen 28 retained in any suitable way on the exterior surface of the base screen 24 and between the end bands 20, the mesh of this screen being in any case less than the minimum diameter of the holes 24 in the base screen over which it is superimposed. By the relative arrangement referred to, it will be obvious that although the openings between the bars or rails 19 are not, as were the corresponding elements of the mentioned patent to John Herman "continuously decreasing in cross-section from the inside" they are progressively decreasing, in the sense that the intervals between the heads 19^a of the rails exceed the interval 22 between the bases 19^b thereof, which distance in turn exceeds the extreme diameter of the openings 24 in the base screen, the mesh of the outer screen 28 being the closest of all; and my described construction has all substantial advantages, not only of permitting a utilization of old sections of manganese or other special steel rails, cold-rolled in their previous use and exceedingly durable, but also the advantage of very effectively carrying the mixture of ore and balls to a comparatively high level and projecting the latter in a cascade having a very high efficiency in the pulverizing of material,—one important factor in this efficiency being the rapid outward elimination of material which has been sufficiently ground and another factor being the mentioned graduation in the sizes of the respective openings referred to in such manner as to permit a free inward return of any material which may reach any one of the apertures referred to but may be incapable of passing outwardly therethrough. The free inward return referred to may be assured, as indicated above, by the initial introduction of balls and materials to be comminuted only in such sizes as shall enable the same to pass freely in either radial direction between the heads 19^a, or their equivalent, of the rails or bars 19.

Although advantageous results may be obtained by the employment of my novel construction in any one of a variety of ways, I may mention that a suitable installation for usual mill purposes may comprise a cylinder or drum of the general type illustrated having a diameter of 6 feet, more or less, the associated parts then having approximately the relative sizes indicated in the drawings; and a drum of the character referred to may advantageously be initially filled about half full of balls, which may be, at the time of their introduction, of substantially uniform diameter, the charge of ore or other material to be comminuted being preferably only such as may be approximately contained within the interstices between the balls, and additional material being fed as required to compensate for that delivered outwardly through the mentioned openings during the continued rotation of my mill,—which may advantageously be at a rate such as twenty revolutions per minute, more or less. When both of the trunnions upon which my mill rotates are hollow, one of these, such as the trunnion T, may optionally be used as a feed opening, and the other may advantageously be provided with any convenient closure, such as a mere wooden block or plate 29, shown as provided with a window 30 adapted to serve as a peep hole.

Although I have herein described one complete embodiment of my invention, it should be understood that various features thereof might be independently employed, and also that various modifications might be made therein, without the slightest departure from the spirit and scope of my invention as the same is indicated above and in the following claims.

What I claim is:

1. In a screening ball mill, a base screen forming a hollow cylinder, railroad rails secured against the inner face of the base screen parallel with the axis of the screen, the bases of the rails being spaced apart to expose apertures in the screen but prevent a ball of the size to be used from bearing upon the screen, the ball being supported by the bases, the heads of the rails being separated a distance greater than the diameter of one ball and less than twice the diameter of one ball, the rails being of such a height whereby a grinding action may take place between the rails.

2. A screening ball mill having a base screen forming a hollow cylinder, railroad rails having their bases secured against the inner face of the screen parallel with the axis of rotation of the screen, the rail bases being spaced apart to expose apertures in the screen, combined with balls, said balls being of such size as to contact with the bases and be retained thereby from bearing upon the screen, said balls and the spacing of the rail heads being proportioned to permit only

one ball at a time to pass between the rails in a plane crosswise thereto.

3. A screening ball mill having a base screen forming a hollow cylinder, railroad rails having their bases secured against the inner face of the screen parallel with the axis of the screen and on the same radius, the rail bases being spaced apart to expose apertures in the screen, balls in the hollow cylinder, said balls being of such size as to contact with the bases and be retained thereby from bearing upon the screen.

In testimony whereof I have signed my name to this specification.

WALTER O. BORCHERDT.