Nov. 18, 1924. **1,516,467**

J. HERMAN

SCREENING BALL MILL

Filed Jan. 7. 1924 2 Sheets-Sheet 1

Fig. 1.

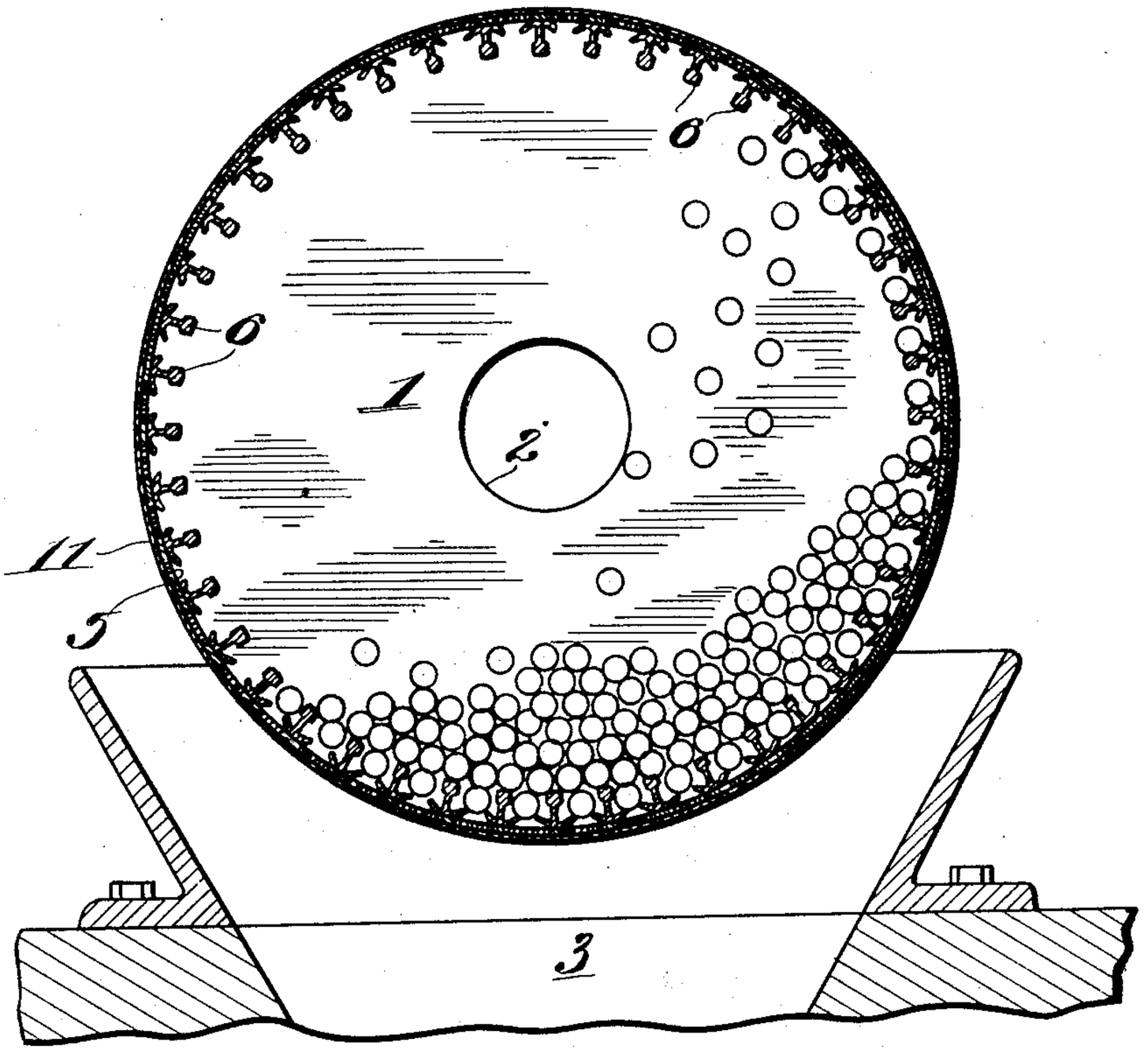


Fig. 2.

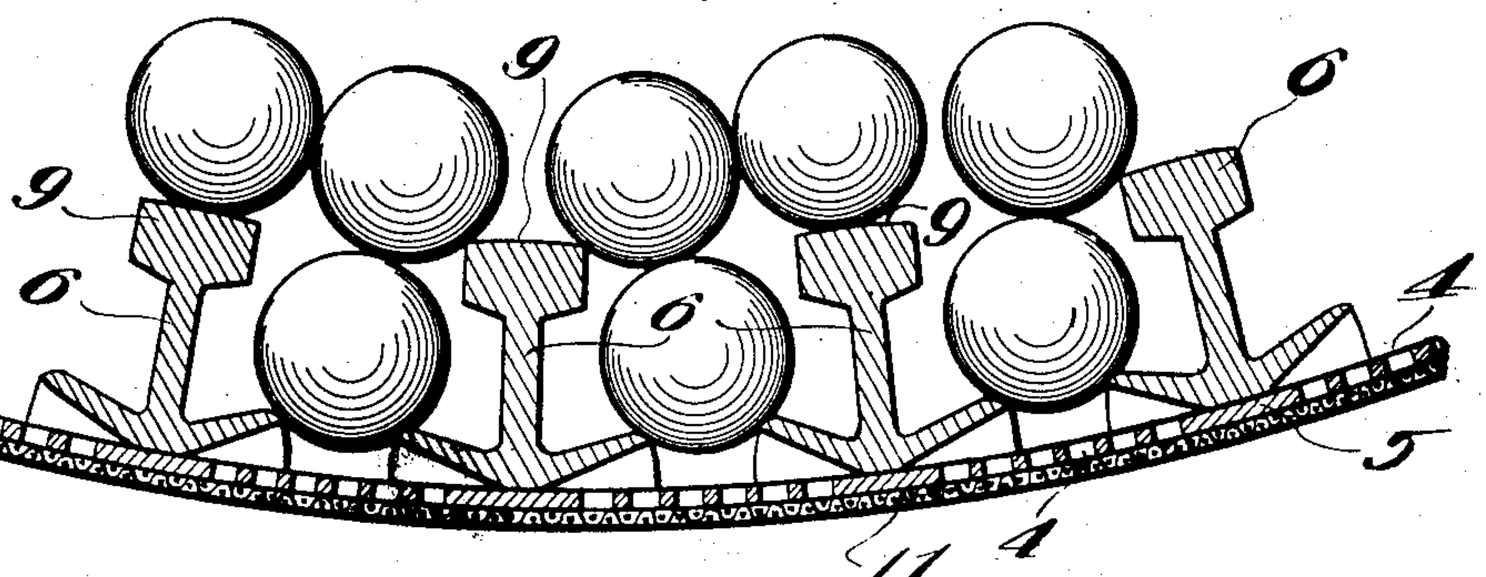
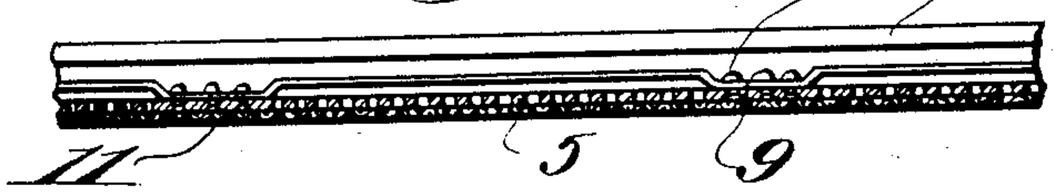


Fig. 3.



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2 Sheets-Sheet 2

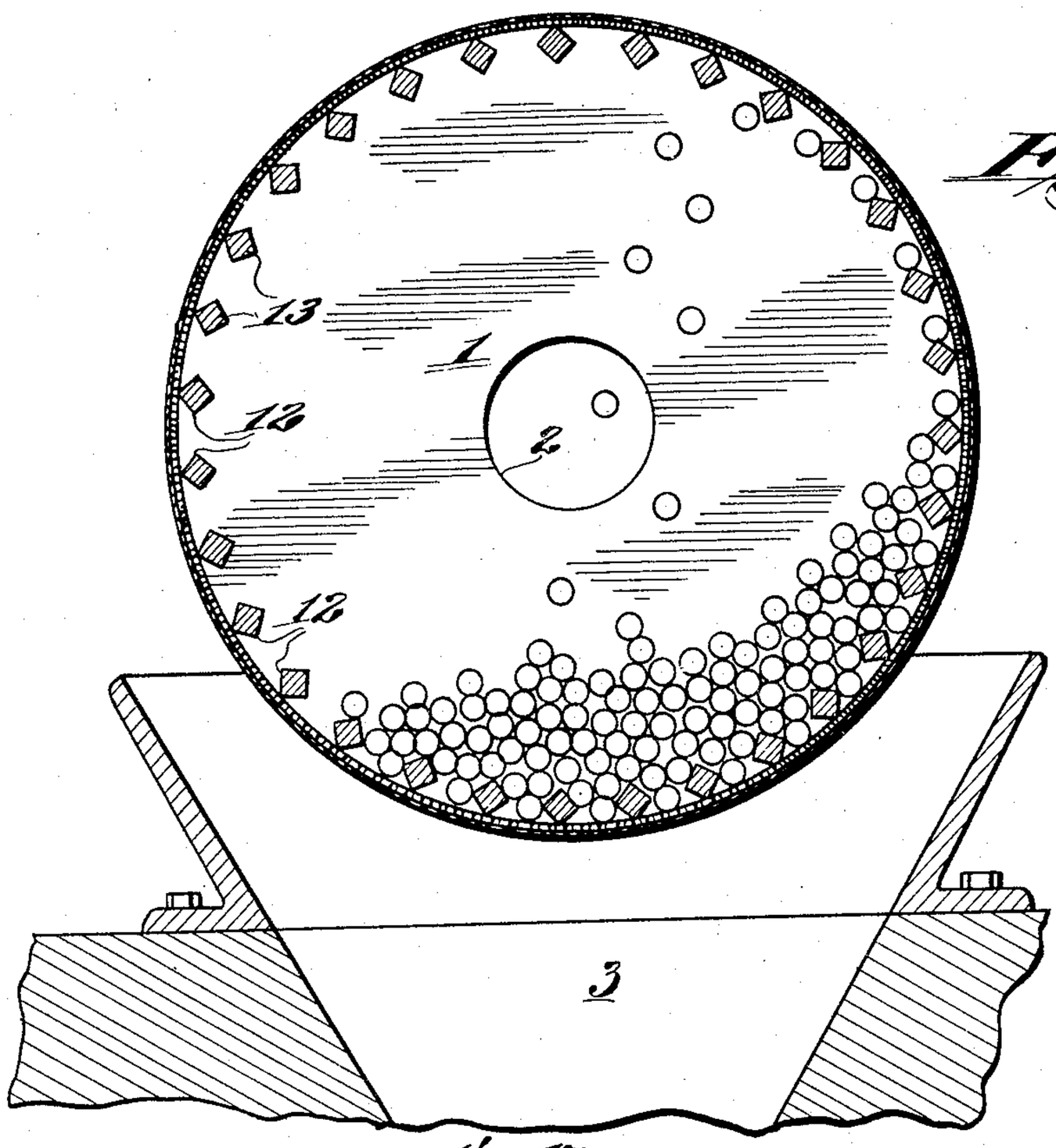


Fig. 4.

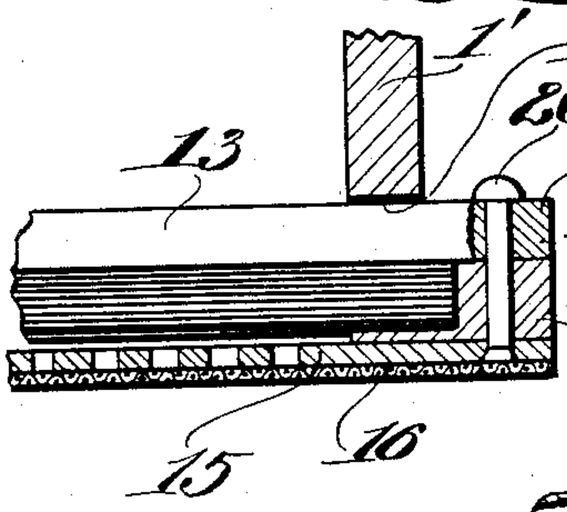
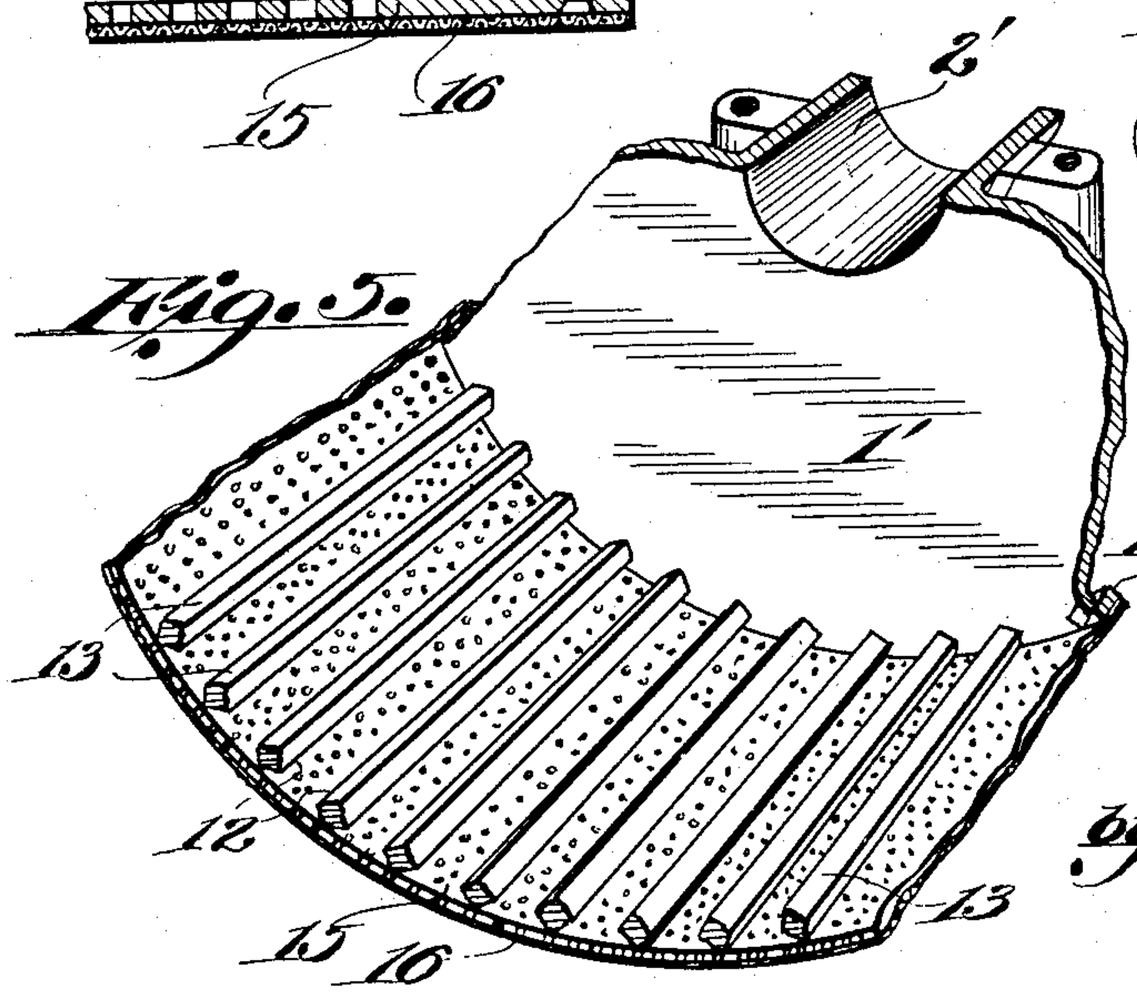


Fig. 5.



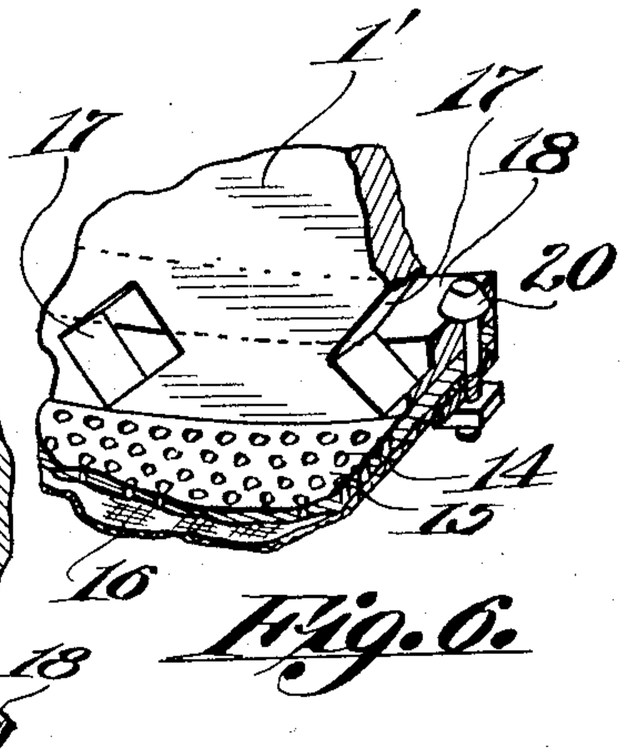


Fig. 6.

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UNITED STATES PATENT OFFICE.

JOHN HERMAN, OF LOS ANGELES, CALIFORNIA.

SCREENING BALL MILL.

Application filed January 7, 1924. Serial No. 684,808.

To all whom it may concern:

Be it known that I, JOHN HERMAN, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, 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 a novel and advantageous mill of the general type disclosed in my prior Patent 1,176,896 granted March 28, 1916, although the mill upon which protection is herein sought does not comprise bars of the specific cross-sectional configuration disclosed in my mentioned patent ("the area between the bars continuously decreasing in cross-section from the inside").

Among the objects and advantages of my novel construction herein presented, I may mention not only an economy of material, which may result from an advantageous use of selected sections of secondhand special steel rails, or their equivalent, but also the fact that by so constructing the pulverizing and screening elements of my novel mill as to secure a superior dragging and lifting action upon a charge placed therein, and by constructing my mill with a progressive although discontinuous outward diminution in the successive sizes of the apertures through which material may be outwardly delivered from the same, I may retain all of the advantages of my prior construction referred to and at the same time gain an efficiency of action not obtainable thereby.

It is a further object of this invention to provide a screening ball mill in which the openings through which material may be delivered shall be progressively diminishing in size but in which the effective screening area of a base screen shall not be unduly diminished by the contact of the bases of bars or rail sections therewith; and a preferred embodiment of my invention may comprise rail sections whose bases are secured against or in proximity to a base screen in such manner as to permit an outward movement of material under upturned or suitably spaced flanges, which may be formed by a suitable inward or upward deflection of the bases of selected sections of secondhand manganese or other special steel rails; and when I employ, instead of said rail sections, bars of rectangular cross-section, I may so position the latter also that their surfaces in proximity to a base screen shall be inwardly and upwardly divergent therefrom.

Other objects of my invention will appear from the following description of selected embodiments thereof, taken in connection with the appended claim and the accompanying drawings, in which

Fig. 1 is a somewhat diagrammatic transverse section through a ball mill employing modified sections of secondhand rails, or their equivalent.

Fig. 2 is an enlarged detail view corresponding thereto.

Fig. 3 is a longitudinal sectional view showing a preferred manner of securing suitably transformed rail sections to a base screen, as hereinafter referred to.

Fig. 4 is a view corresponding to Fig. 1 but showing a proposed use of bars which may be square in cross-section, although so positioned as to gain advantages referred to above.

Fig. 5 is a detail or fragmentary perspective view showing an organization of the general character illustrated in Fig. 3.

Figs. 6 and 7 are perspective and longitudinal views showing a possible method of setting rectangular bars of the character last referred to in the end plates of a screening ball mill.

Referring to the details of that specific embodiment of my invention shown in Figs. 1 and 2, 1 may be the substantially circular end plates of a mill, these end plates being preferably integral with hollow trunnions 2 through one of which suitably subdivided material may be fed, an outward screening delivery being effected in a known manner, and the product being caught and collected in any suitable way, as by means of a hopper 3 conventionally shown.

Instead of employing bars substantially trapezoidal in cross-sectional outline, as described and claimed in my mentioned prior patent, I propose to employ, in the embodiment of my invention shown in Figs. 1 and 2, sections of secondhand rails, or their equivalent, these being preferably selected sections of manganese or other special steel rails which are obtainable at a comparatively low cost, although the cold-rolling to which they may have been sbjected in their

previous use may be distinctly advantageous as contributing to their durability in a ball mill; and I propose, when I employ rail sections of the character referred to, not only to space them apart in a manner favorable to the outward delivery of suitably pulverized material between the bases thereof, but also, as by upsetting or deforming said bases in the manner best shown in Fig. 2 or by equivalent means, to avoid an undue covering of a base screen to which the same may be secured. For the purposes referred to I may secure a base screen 5 (which may optionally be formed, in the case of a mill having a transverse diameter of six feet, more or less, of ¼ inch material provided with longitudinal rows of apertures 6, whose diameter may be approximately ½ inch—these dimensions being suggested by way of illustration and not by way of limitation)—to end plates 1, in a usual or preferred manner, as by riveting through an outwardly turned flange upon said end plates; and I may support the rail sections 6, or their equivalent, wholly or entirely from the mentioned base screen. When the construction last referred to is employed, I consider it advantageous to deflect the bases of the rail sections 6, bending intermediate portions thereof upwardly and inwardly in such manner as substantially to diminish the area of their contact with said base screen, although I may optionally retain, between the upwardly deflected sections 7 of the base 8 of a rail 6, undeflected or substantially flat areas 9 adapted to receive rivets 10 extending therethrough and through said base screen; and it is of importance that the rails 6 shall be so spaced throughout the circumference of a shell or cylinder provided therewith that the intervals between the heads 9 of a pair of substantially parallel rails 6 shall exceed the interval between a pair of upturned flanges 7, and that the elements referred to should be used in conjunction with balls and materials of such size as to be capable of free lateral movement between the heads 9, although the diameter of the mentioned balls should exceed the distance between the flanges 7; and the intervals between the said upwardly deflected flanges should be not less than twice the perpendicular distance thereof from the base screen 5, whose apertures 10 should either be inwardly expanded or of a uniform diameter less than the distance between the upturned flanges 7 and greater than the mesh of the outer screen 11, shown as in contact with said base screen.

Referring to the specific embodiment of my invention shown in Figs. 4 to 7 inclusive, it will be obvious that the relationships between the parts herein referred to may be substantially the same as have been described above, in the sense that the distances between the lateral edges 12 of the bars 13 may be substantially greater than the diameter of the openings 14 in the base plate 15 and such as to permit a free movement of balls and subdivided material either inwardly or outwardly in a radial direction therebetween, the mesh of the wire screen 16, shown as in contact with the outer surface of the base screen 15 being, moreover, preferably such that the successive diameters of the apertures through which material may pass outwardly are progressively, although not continuously, diminishing. The configuration of the bars 13 is advantageous not only in causing drag of material therewith but in permitting a comparatively free access of finely subdivided material to the base screen 15, through which it may promptly find exit, if capable of passing also through the wire screen 16, or from which it may freely return into a position suitable for further comminution, in case it has not been sufficiently ground.

Instead of securing the bars 13, or their equivalent, directly to a socket plate rigidly connected with the end plate 1, or its equivalent, I may optionally provide this end plate 1′ not only with a hollow trunnion 2′ but also with rectangular seats 17 cooperating with a flange 18 in the retention of the ends 19 of said bars, these ends being shown as halved away in a manner permitting them to overlap the flange 18 and to be secured thereto in any suitable way, as by means of bolts or rivets 20, shown as extending also through the base screen 16 and maintaining all of the mentioned parts in their intended relationships.

By either of the constructions above described it will be obvious that I have provided a construction comprising rails or bars capable of both a more effective dragging and lifting action than the bars therein described and a more effective delivery or release of material which may have been already sufficiently subdivided; and that, although the apertures through which material may pass outwardly are not continuously decreasing in cross-section, as required by said prior patent, they are progressively decreasing in the sense that the diameter of the openings in the base screens employed is less than the distance between the bars or rails used, and in the sense that when rails of a character best shown in Fig. 2 are employed, the distance between the upwardly deflected flanges 7 is less than the distance between the heads 9 thereof,—the mesh of the outermost screening element, to wit, the wire screen 11 or its equivalent, being the finest of all.

It may be understood that when bars or rails of the character herein described are employed, both the materials fed to my mill and the balls used therein should be small

enough to permit their free movement in either an inward or outward radial direction between the heads 9 of the mentioned rails or between the lateral edges 12 of the mentioned bars, thereby practically obviating the risk of a permanent lodgement of balls or materials in a manner detrimental to the efficiency of my mill.

In the operation of a mill of the general character described, a mill may advantageously be initially filled practically half full of balls, either of uniform or of graduated sizes, the interstices between the balls being initially occupied by material to be ground, and balls and additional material being thereafter fed, preferably through one of the hollow trunnions, at a sufficient rate and in a suitable ratio to substantially maintain the condition initially established; and it will be obvious that both the prompt elimination of suitably subdivided material, by reason of the extensive exposition of the base screen employed, and the cascading of balls from a comparatively high elevation, as may result from the rotation of a 6 foot mill, or the like, at a rate of about twenty revolutions, more or less, per minute, may and do cooperate effectively in a rapid and economical grinding of ores or other materials.

Although I have herein described two advantageous embodiments of my invention, it will be understood that various features thereof might be independently employed and also that various additional modifications might be made by those skilled in the art without involving the slightest departure from the spirit and scope of my invention as the same is indicated above and in the following claim.

What I claim is:

In a screening ball mill, a base screen forming a cylinder, railroad rails fitting against the inner face of the base screen and extending longitudinally, portions of the bases of the rails being riveted to the base screen and the remaining portions of the bases being bent inwardly away from the base screen, and the rails being so spaced apart that the balls will not pass between the rail bases.

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

JOHN HERMAN.