Oct. 12, 1926. 1,602,434

O. H. JOHNSON

MILL

Filed July 7, 1925

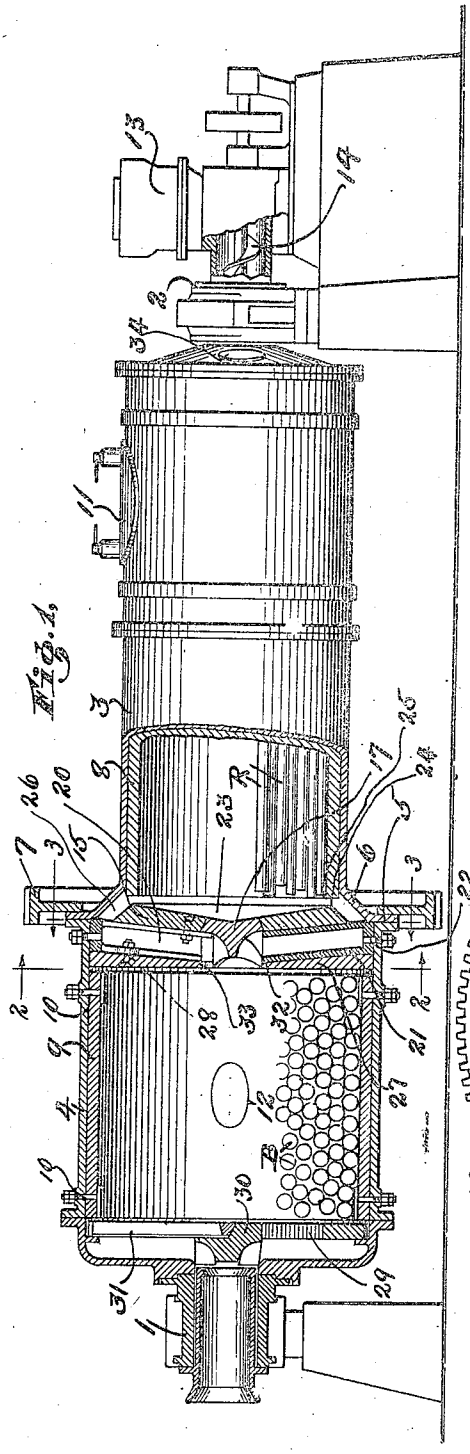


Fig. 1.

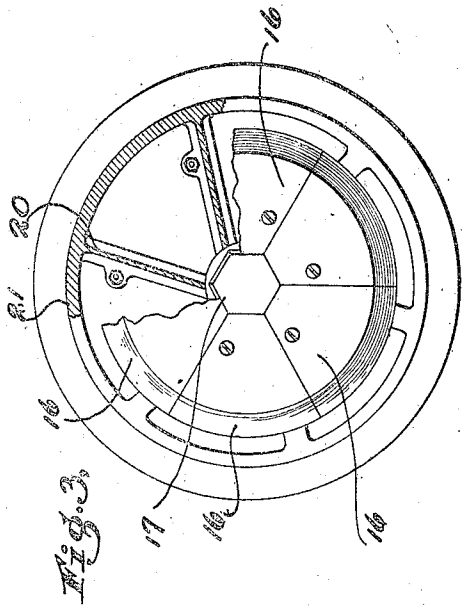


Fig. 3.

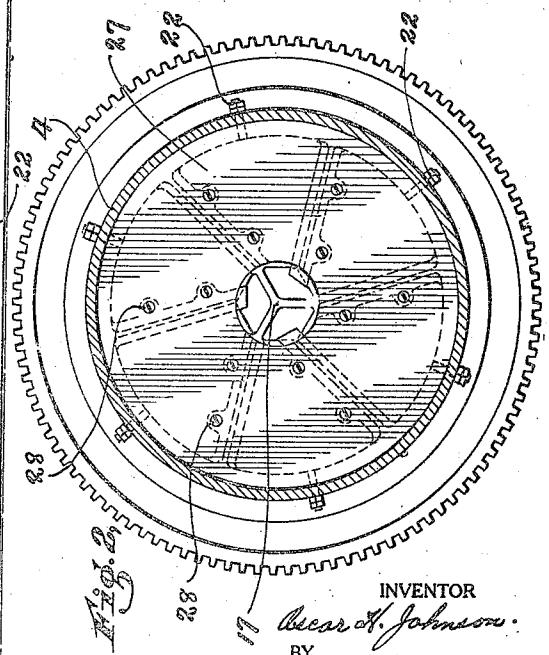


Fig. 2.

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UNITED STATES PATENT OFFICE.

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MILL.

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My invention relates to an improved mill for the grinding or reduction of material, such as cement, ores, etc., and has for an object the provision of an improved structure in which the material to be reduced can be finish-ground or reduced in the one continuous operation.

A further object of the invention is the provision of an improved apparatus wherein the entire reducing operation is performed in the one chamber, an improved construction being provided whereby the material is first subjected to the thorough preliminary reducing action of elongated reducing bodies, which reduces the material to a condition where it can be efficiently handled by balls, pebbles, or the like, which are relied upon for the final reduction of the material to a finish-ground condition. This construction avoids plugging and choking of the mill, insures the highest efficiency in operation with a discharge of material properly reduced, and permits of a continuous feed and discharge.

In certain types of mills now employed in various industries, the cement industry, for example, it is customary to divide the mill into compartments each of which is charged with reducing or grinding balls, the balls in each compartment being gradually reduced in size.

Such mills, however, have not proven satisfactory, for the reason that if the material is fed to the mill at the proper speed for efficient operation so far as input and output are concerned, the material works through the mill too quickly and as a result reaches the last compartment before it has been reduced to a size where it can be handled by the relatively small balls in that compartment. This defect cannot be overcome commercially by increasing the length of the mill and thereby increasing the length of time to which the material is subjected to the reducing operation, for the reason that the mill would then be so long as to be commercially impracticable. Nor can this defect be remedied by increasing the size of the balls in the last compartment of the mill to a size where they would be capable of handling the material in that compartment, for the reason that the balls must not exceed a predetermined size, their size being one of the factors controlling the size to which material can be reduced.

It has been found also in commercial practice that such mills plug in operation, due to the material passing too quickly through the mill, necessitating shutting the mill down or reducing the feed to a point where efficiency is so reduced as to be no longer commercially satisfactory.

In my improved apparatus I provide a construction whereby the difficulties enumerated above are overcome in a simple and effective manner, a greater reduction of the material being obtained before the same reaches the end of the mill adjacent the point of discharge, thereby eliminating entirely the feeding of splinters and coarse over-sizes to a portion of the mill which cannot take care of them.

In general, I have provided a mill comprising a rotatable drum, shell or barrel contracted at the feed end and throughout the major portion of its length to provide a continuous reducing chamber, a portion of which is elongated and of reduced diameter while the remainder of this chamber is of a relatively large diameter.

In the contracted elongated portion of this continuous chamber I subject the material to the action of freely movable elongated reducing bodies, such as rods, for example, the material after being subjected to the action of these members being then still further reduced by the action of balls, pebbles, or the like, with which the relatively large portion of the chamber is equipped.

By this improved and novel construction the material is first of all reduced by the rods to a degree of fineness at which the material may be commercially further reduced by the balls, thereby eliminating plugging of the mill and consequent shutting down of the same, as well as the passing of splinters or coarse over-sizes to a portion of the mill which cannot handle them, the material finally being discharged from the mill in a finished condition.

Other and further objects of my invention will be apparent from the detailed description which follows:

In the accompanying drawings—

Fig. 1 shows my improved mill in part sectional elevation;

Fig. 2 is a section taken on the line 2—2 of Fig. 1; and

Fig. 3 is a section on the line 3—3 of Fig. 1.

Referring to the drawings in detail, my improved mill comprises a rotary elongated straight-sided drum, shell or barrel supported at each end in trunnions 1 and 2, respectively, this drum throughout the major portion thereof being materially reduced or contracted in diameter, as indicated at 3. The remainder or relatively large portion of the mill, drum or shell is designated 4, which as will be seen from Fig. 1, for example, is considerably larger in diameter than the portion 3. This construction provides a continuous straight-sided reducing chamber of varying diameter, that portion of the chamber provided by the part 3 being relatively long and narrow, while the remainder provided by the portion 4 is relatively short and of large diameter. The portions 3 and 4 of the drum or shell may be united in any manner desired, but as illustrated, they are joined or united along the line 5, by bolts or otherwise, to provide a continuous straight-sided reducing chamber having different diameters, the mill drum at the joint 5 being flared or frusto-conical, as indicated at 6, to provide a bell the purpose of which will appear hereinafter.

The mill may be driven in any desired manner, a gear 7 having been illustrated for this purpose. It is to be understood also that if necessary or desirable the mill may be supported on rollers or other suitable supports intermediate its ends instead of employing the trunnion bearings illustrated.

The mill is provided with wall liners 8 and 9, preferably made in sections. These liners may be held in place by bolts 10, for example, or in any other manner desired. The contracted portion 3 of the mill drum is provided with a manhole 11 in the periphery thereof, affording access to the interior of the mill for the purpose of relining, etc., which avoids jacking up of the mill for this purpose. The enlarged portion 4 of the mill may likewise be relined or other repairs or renewals effected through the manhole 12 in its periphery.

The mill is provided with a feed hopper 13 and feed screw 14 at the feed end of the mill, by which material is passed into the mill through the trunnion 2.

The loose, freely movable rods R or their equivalent employed in the mill are retained in the elongated contracted portion of the reducing chamber by an imperforate guard plate 15, which in and of itself is of novel construction. This guard plate is composed of sectors or segments 16, assembled about a central imperforate, non-circular, more or less cone-shaped member or plug 17, the several sections of the plate being bolted or otherwise attached to lifters 18. These lifters are in the form of a web 21 (see Figs. 1 and 3), bolted to the mill drum by bolts 22.

The rear of the guard plate 15, including the central cone or plug 17, is concave, as indicated at 23, so that the rods will not only be retained in the contracted portion of the reducing chamber, but as they strike this inclined or concaved portion of the plate they will be forced rearwardly toward the feed end of the mill, where they properly belong, for most efficient operation.

It should be noted that the edge of the concavity in the guard plate, and which I will designate 24, lies below the inner edge 25 of the liners 8, so that although the guard plate is spaced from the wall of the mill drum, the reducing rods are effectually prevented from catching between the edge of the plate and the ends of the liners, and are also unable to injure the edge of the plate.

The guard plate 15, as above noted, is roughly frusto-conical in form, and when in place in the mill the base thereof faces the enlarged portion of the continuous reducing chamber, and inasmuch as the plate is smaller in diameter than the mill, an inclined passageway or slot 26 is thus provided circumferentially of the mill between the wall of the mill and the edge of the guard plate, so that the flow of material through the mill is uninterrupted.

The reducing chamber adjacent the discharge end is provided with a liner 27, bolted to the lifters 21 by bolts 28. This liner may be made in one piece or in sections, as desired, and prevents the balls, pebbles, or the like in this portion of the mill drum from injuring the lifter section or injuring the guard plate 15.

At the discharge end of my improved mill I provide a sectional grate 29, which may be assembled about a central plug 30, the several sections of this grate being held in place in any suitable manner. Forward of the grate are lifters 31.

In the operation of my improved mill, it being assumed that the same has been charged with the proper load of reducing bodies and that the mill is being rotated, material is dumped into the feed hopper 13, from which it is continuously fed into the feed end of the reducing chamber by the screw 14. As the material gradually works forward through the reducing chamber it is first of all subjected to the reducing action of the rods R in the contracted portion of the chamber, and as the partially reduced material enters the lifter compartment adjacent the ends of the rods it is raised by the lifters and dumped through an opening 33 in the liner 27 into the enlarged portion of the reducing chamber, flowing past the face of the cone-shaped plug 17, which is cut away at 32 for this purpose. The material is now subjected to the action of the balls B in the enlarged portion of the reducing chamber, passes through the grate 29, after which it is raised by the lifters 31, and

finally in a finish ground condition is discharged through trunnion 1.

As above explained, when it is desired to effect repairs and to replace broken or worn out parts, access may be had to the interior of the mill through the manholes 11 and 12 and through a manhole 34 which is provided in the feed head of the mill. As a matter of fact, the mill may be charged with its reducing load through these manholes in the first instance, if desired.

It will be seen from the foregoing that I have provided a mill of improved construction and comprising a continuous straight-sided reducing chamber of different diameters, through which the material is fed continuously, being first subjected to the continuous reducing operation of rods, bars, or other loose, freely movable elongated reducing bodies, throughout the major portion of the travel of the material through the mill, to thereby reduce the material to a size where it can be handled by balls, pebbles, or equivalent reducing means, to the action of which it is finally subjected and by which the material is finally reduced to the desired degree of fineness to be discharged from the mill in a finish-ground condition, eliminating all necessity of further reducing operations. It will be apparent also that the reducing rods and pebbles or balls are always maintained in proper relation to each other and in proper relation to the reducing chamber by means of a novel structure, which at the same time, however, permits of the passage of the material through the mill at a speed which not only does not reduce but commercially may even increase the efficiency of the mill.

While I have described a specific embodiment of my invention, it is to be understood that changes may be made in the details of construction and arrangement of parts herein illustrated and described within the purview of the invention.

What I claim is:—

1. A mill comprising a rotatable drum, shell or barrel, reducing rods and reducing balls in the mill, the said drum adjacent the discharge ends of the rods being enlarged, and a plate within the mill at the enlarged portion thereof extending transversely of the drum for preventing admixture of the rods and balls, the periphery of the plate being spaced from the wall of the drum throughout, the diameter of said plate exceeding the diameter of that portion of the mill containing the rods.

2. A mill comprising a rotatable drum, shell or barrel contracted in diameter throughout the major portion of its length to provide a continuous reducing chamber a portion of which is elongated, the remainder of the chamber being of increased diameter, loose, freely movable elongated reducing bodies in the elongated portion of the said chamber, reducing balls in the remaining portion of the chamber, a plate extending transversely of the mill for preventing admixture of the rods and balls, said plate being frusto-conical, and having its base facing the portion of the reducing chamber containing the balls, said plate being of less diameter than the interior of the drum, the face of the plate opposite the base extending beyond the plane of the interior of that portion of the mill containing the rods.

3. A mill comprising a rotatable drum, shell or barrel contracted in diameter throughout the major portion of its length to provide a continuous reducing chamber a portion of which is elongated, the remainder of the chamber being of increased diameter, a transversely extending frusto-conical plate within the mill at the junction of the two portions of the reducing compartment, the base of said plate facing that portion of the chamber which is of increased diameter, the periphery of the plate throughout its extent being spaced from the interior face of the drum wall, the opposite face of said plate being concaved, and its diameter exceeding the interior diameter of the elongated portion of the mill drum.

4. A mill comprising a rotatable shell or drum contracted in diameter throughout a part of its length to provide a continuous reducing chamber a portion of which is elongated, the remainder of the chamber being of increased diameter, a frusto-conical sectional plate within the drum, extending transversely thereof and having its periphery spaced from the walls thereof, the face or apex of the plate being of greater diameter than the interior of the elongated portion of the drum, and a frusto-conical plug located centrally of said plate and about which the sections of the plate are assembled.

5. A mill comprising a rotatable shell or drum contracted in diameter throughout its length to provide a continuous reducing chamber a portion of which is elongated, the remainder of the chamber being of increased diameter, loose freely movable elongated reducing bodies or rods in the elongated portion of the drum, balls in the remaining portion, and a plate intermediate the elongated and enlarged portions of the mill for preventing admixture of the rods and balls, said plate in diameter exceeding the diameter of the elongated portion of the mill drum, said plate being formed to effect a rearward motion of the rods toward the feed end of the drum as the drum is rotated.

This specification signed this 25th day of June, 1925.

OSCAR H. JOHNSON.