No. 646,507. Patented Apr. 3, 1900.

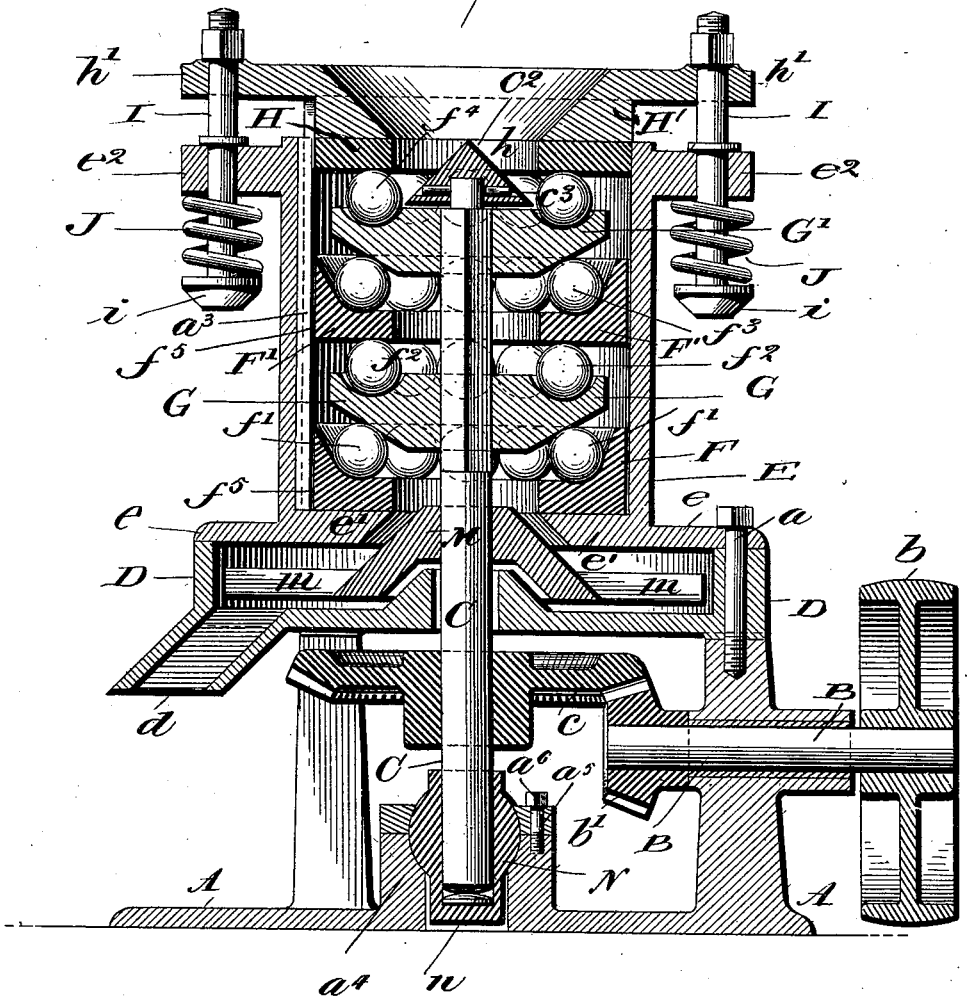
T. J. STURTEVANT.

PULVERIZING MILL.

(Application filed Oct. 11, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



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2 Sheets—Sheet 2

Fig. 2.

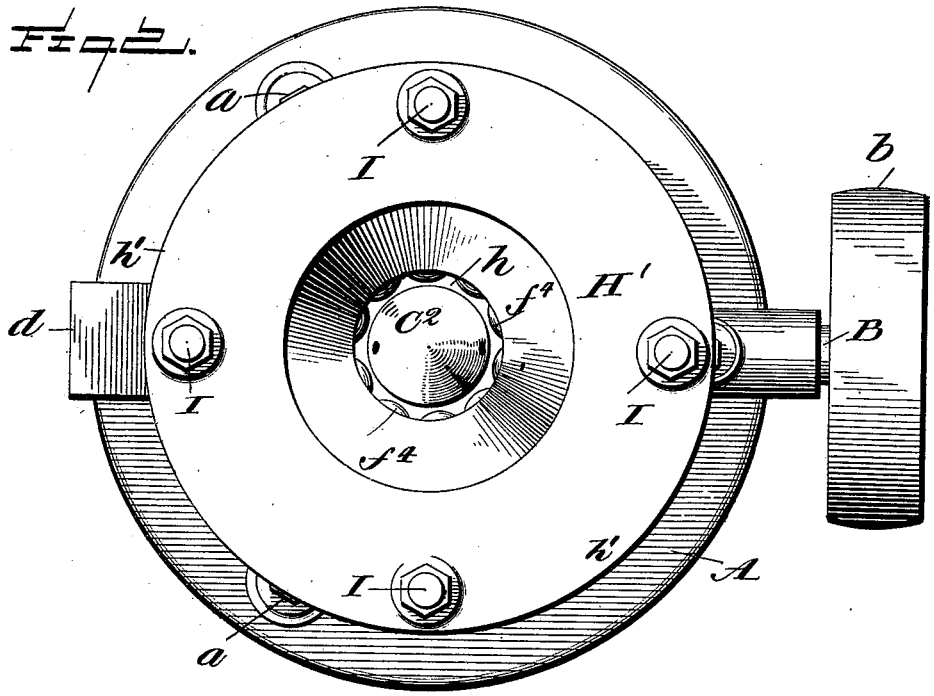


Fig. 4.

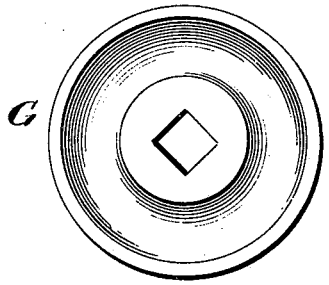
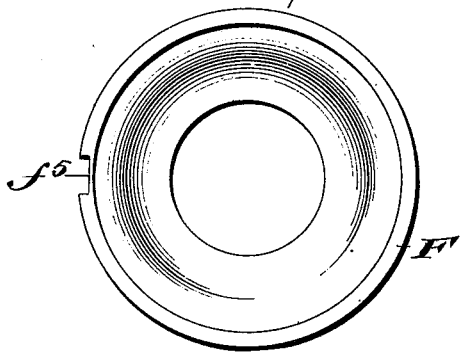


Fig. 3.



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UNITED STATES PATENT OFFICE.

THOMAS J. STURTEVANT, OF NEWTON, MASSACHUSETTS.

PULVERIZING-MILL.

SPECIFICATION forming part of Letters Patent No. 646,507, dated April 3, 1900.

Application filed October 11, 1899. Serial No. 733,262. (No model.)

To all whom it may concern:

Be it known that I, THOMAS J. STURTEVANT, a citizen of the United States, residing at Newton Centre, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Pulverizing-Mills, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention has for its object to provide a pulverizing-mill of simple construction by which ores and other similar hard materials may be reduced to any desired degree of fineness without the aid of a screen or screens and which is so constructed that the mill shaft or spindle may automatically adjust itself so as to prevent objectionable shocks or binding when unusual strain is presented by reason of entrance into the mill of pieces of material of unusually-large size or offering unusual resistance.

In the accompanying drawings, Figure 1 is a central vertical section of my improved mill. Fig. 2 is a plan view thereof. Fig. 3 is a detail plan view of one of the stationary ball-races, and Fig. 4 a plan view of one of the rotating ball-carrying races or disks.

Referring to the drawings, A denotes a base which may be of any suitable construction and in one of the standards of which is journaled the driving-shaft B, provided with a pulley *b* and with a beveled gear or pinion *b'*, meshing with a larger bevel-gear *c*, suitably secured to the mill shaft or spindle C.

Resting on the standard of the base A is a box D, which supports a removable tubular shell or case E, having a lower flange *e*, through which and the said box pass suitable screw-bolts *a* to attach the said shell and box to the standards of the said base. The tubular shell or case E, the interior of which serves as the pulverizing-chamber, is provided at its bottom with an interior flange *e'*, on which rests a stationary or non-rotary ball race or shelf F, which receives a circular series of balls f'. Resting on the balls f' is a rotating race or disk G, having a beveled under surface which impinges against said balls, and which disk is provided in its upper face with a groove or raceway receiving a circular series of balls f^2, on which in turn rests a second stationary or non-rotary race or shelf F, receiving a circular series of balls f^3, on which rests a second rotating race or disk G', constructed like the race or disk G and carrying a circular series of balls f^4. Thus each of the races F' G G' rests upon and is supported by a circular series of balls, so that the mill will run with the least possible friction consistent with a suitable pulverizing pressure. Resting on the balls f^4 is a plate or ring H, and bearing on said plate or ring is a pressure plate or disk H', having a central feed-opening *h* and provided with a peripheral flange *h'*, through which and a flange e^2 on the tube or case E pass bolts I, on which and interposed between the heads *i* of the bolts I and the flange e^2 are springs J, serving to hold the plate H against the balls f^4 with a yielding pressure.

The ball-races F and F' are provided with central openings surrounding the upper portion of the shaft C, said upper portion of said shaft being preferably square or of other polygonal form, so as to fit in square or other polygonal openings in the races or disks G and G', rotating with said shaft.

The rotating races or disks G G' are of less diameter than the chamber of the tube or casing E, so that there will be suitable space outside of said races or disks for the downward feed of the material being pulverized, said material feeding or discharging alternately outward from the rotating races and inward through the central openings of the stationary races.

The stationary races F and F' are provided at one side with notches f^5 to receive a rib or flange a^3 on the interior of the tube or case E, so that the said races will be held from rotation within said tube or case. To the top of the shaft C is secured a conical cap c^2, which is fastened to said shaft by a pin c^3, said cap extending upward within the feed-opening *h* of the pressure plate or disk H.

Connected with the shaft C, so as to rotate therewith, and extending within the receiving-chamber of the box D are scrapers *m*, extending radially from a truncated cone M, which is attached to said shaft and which serves to direct the pulverized material passing downward through the opening in the race F outward into the chamber of said box and within the sweep of said scrapers. The box D is provided at one side with a discharge-

spout d, to which the pulverized material is carried by the rotating scrapers m.

The shaft C is removably stepped in a cup or socket N, which has a spherical exterior portion fitting in a suitable socket formed partly in a small standard a^4, with which the base A is provided, and partly in a plate a^5, attached to said standard a^4 by suitable screws or bolts, as a^6. The lower end of said shaft is preferably formed convex and rests upon a convex button or washer n in the bottom of the socket or cup N. This ball-and-socket adjustable cup N for the shaft C permits the said shaft to automatically adjust itself to accommodate varying resistances when the pulverizing-mill is in operation, as will be readily understood.

The rotating ball-carrying disks G and G′ are of lesser diameter than the chamber of the tube or case E, leaving spaces outside of said disks for the feed of the material downward, while the races F and F′ closely fill the said chamber peripherally, but have central openings for the downward passage of the material. Thus the downward discharge through the mill will be alternated toward the tube or casing of the mill and toward the shaft.

The rotating disks G and G′ and the upper stationary ball-race F′, mounted in the manner above described, are free to move vertically to a limited extent, according to the requirements of the mill when in operation and according to the amount of material which may have at any time accumulated in the ball-raceways of the races F and F′ and the disks G and G′.

The operation of my improved pulverizing-mill will be readily understood from the foregoing. The material to be pulverized is introduced through the feed-opening h in the pressure-plate H and passes downward onto the rotating disk G′, and from thence successively into the receptacle afforded by the race F′, through the central opening of the latter to the rotating disk G and from said disk to the race F, and thence downward into the chamber of the box D, from which it is delivered by the scrapers m to the discharge-spout d of said box. As the material being crushed thus passes downward through the mill it is thrown outward by centrifugal force from the rotating disks G′ and G, so as to pass onto the raceways afforded by the races F′ and F, the material being successively submitted to crushing operations by the several series of balls f^4 f^3 f^2 f' in their several raceways. Thus it will be understood that the material to be crushed not only receives the pressure of the plate or disk H, but also as it passes downward is subjected to the weight of the balls and rotating disks and stationary race or races above, so that when the material is subjected to pulverizing action in the lower ball-race F it is under great pressure due to the weight of the superposed parts of the mill. Owing to the successive crushing or pulverizing operations to which the material is subjected in my improved mill, having a multiple series of crushing-balls, the material can be reduced to any desired degree of fineness without the use of screens.

The arrangement herein described of the superposed ball-races, each of which supports the weight of the races and balls above it, is advantageous in that as the material passes downward through the mill and is gradually reduced in fineness the greatest pressure comes on the lower races, where the finely-reduced material requires the greatest force to reduce it still further, it being well known to those skilled in the art to which the invention relates that the finer the material becomes the greater is the force or pressure required to still further reduce it. There is also a decided advantage resulting in this form of mill, where the superposed rotating and non-rotating races are adapted to have limited vertical movements and in which each race supports the weight of the balls and races above it, in that the races and balls are all so intimately connected that the jarring or jolting action incidental to the running of the balls over the partly-crushed material is communicated from one race to another throughout the mill, this jarring or jolting action assisting very materially the crushing action which results from the weight or pressure of the balls and races. There is, furthermore, a decided advantage in providing a mill of this character with a self-adjusting step-bearing in that such step-bearing permits more or less freedom of movement of the races incidental to the unequal rising and falling thereof on their opposite sides, and which movement, if restrained by a non-adjusting step-bearing, would tend to cause binding of the shaft or lessen the jarring or jolting action in the operation of the mill, and which jarring or jolting action is desirable for the reasons just above stated.

The mill may contain any desired number of stationary or non-rotary races, as F and F′, or any desired number of rotating ball-carrying races or disks, as G G′, with their ball-raceways, and to this end interchangeable casings or tubes, as E, of different lengths, and interchangeable shafts, as C, having squared upper portions of different lengths to receive a greater or less number of rotating ball-carrying disks, will be provided, so that by varying the number of the series of crushing-balls and of the elements necessarily cooperating therewith the improved mill can be adapted to an output of any desired degree of fineness.

I do not wish to be understood as limiting my invention to the details herein shown and described, as it will be understood that these may be varied widely without departing from the spirit of the invention. It will also be clear from the foregoing that the mill may contain any desired number of circular series of pulverizing-balls, according to the number

of stationary ball-races and rotating ball-carrying disks employed.

The term "stationary" as employed in this specification in connection with the non-rotating ball-races F and F′ is used in contradistinction to "rotating" as applied to the disks or ball-races G G′ and will not be understood to mean that the stationary or non-rotating races are absolutely fixed in position, as where a number of said races are employed all of them excepting the lowermost (in the construction herein illustrated) will have a limited vertical movement when the machine is in operation by reason of the accumulation of material being crushed in the ball-races, and the lowermost non-rotating race might be yieldingly supported, so as to have a limited vertical movement also, or might be adjustably supported. In case the lower non-rotating race were yieldingly supported the upper presser-plate H might be fixed instead of yielding, as will be understood.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. A pulverizing-mill containing a plurality of alternating, superposed, rotating and non-rotating races each of which is provided with a circular series of pulverizing-balls, said races, excepting the lowermost non-rotating race, being constructed and arranged to have limited vertical movements, and each of said races supporting the weight of the balls and races above it, combined with a non-rotating pressure plate or disk bearing upon the uppermost of said series of balls.

2. In a pulverizing-mill, the combination with a tube or casing, of alternating, superposed, rotating and non-rotating ball-races within the said tube or casing, each of the said races being provided with a circular series of pulverizing-balls, said non-rotating races closely fitting the interior of said tube or casing and having central openings, and said rotating races being of lesser diameter than the chamber of said tube or casing, and each of said races supporting the weights of the balls and races above it.

3. In a pulverizing-mill, the combination with an upright tube or casing, of superposed, rotating and non-rotating ball-races arranged alternately one above the other in the chamber of said casing, said races being each provided with a series of pulverizing-balls, said rotating races being constructed to discharge the material onto said non-rotating races and the latter, excepting the lowermost, being constructed to discharge the material onto the said rotary races, and each of said races supporting the weight of the balls and races above it.

4. A pulverizing-mill provided with a series of superposed, alternate rotating and non-rotating ball-races, each receiving a circular series of pulverizing-balls and loosely arranged so as to have vertical movements, combined with a non-rotating pressure-plate bearing on the top series of balls, and a rotating vertical shaft having a self-adjusting step-bearing, said shaft serving to impart motion to said rotating ball-races.

5. In a pulverizing-mill, the combination with a vertical shaft having a ball-and-socket step-bearing, of means for rotating said shaft, a plurality of superposed rotating races driven by said shaft, a plurality of superposed, non-rotating races alternating with said rotating races, and all of which races, excepting the lowermost, are so mounted as to be adapted to have limited vertical movements, each of said races being provided with a circular series of pulverizing-balls, and each of said races supporting the weight of the balls and races above it.

6. In a pulverizing-mill, the combination with a tube or casing the interior of which affords a pulverizing-chamber, of a plurality of superposed alternating rotating and non-rotating races within said chamber, each of said races being provided with a circular series of pulverizing-balls, each of said races supporting the weight of the balls and races above it, and each of said races discharging the crushed material on the race beneath it, a lower chamber beneath said pulverizing-chamber for receiving the pulverized material and provided with a discharge-opening, and rotating scrapers within said lower chamber for conveying the pulverized material to the said discharge-opening.

In testimony whereof I affix my signature in the presence of two witnesses.

THOMAS J. STURTEVANT.

Witnesses:

LLOYD MAKEPEACE,

W. H. ELLIS.