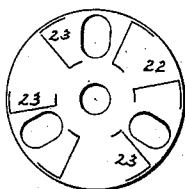
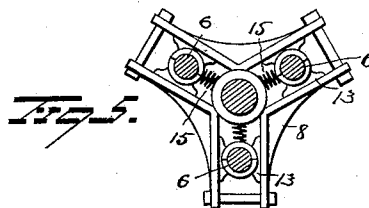
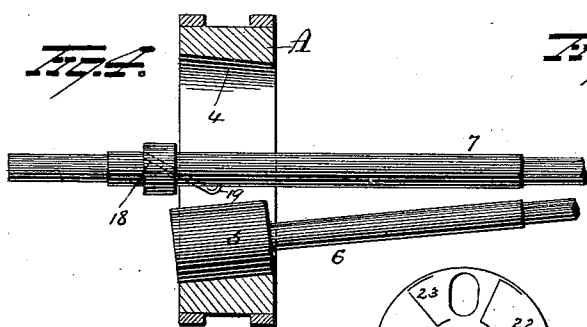
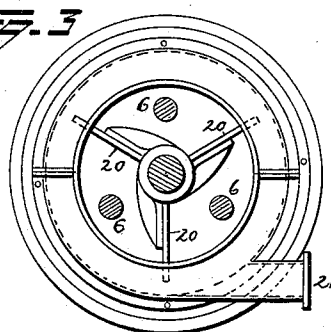
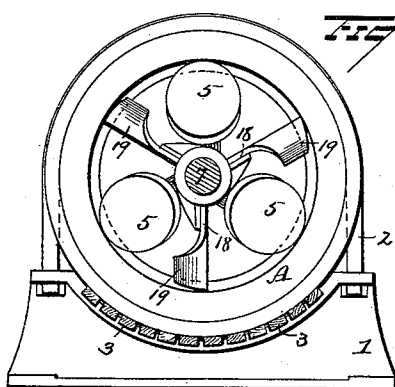
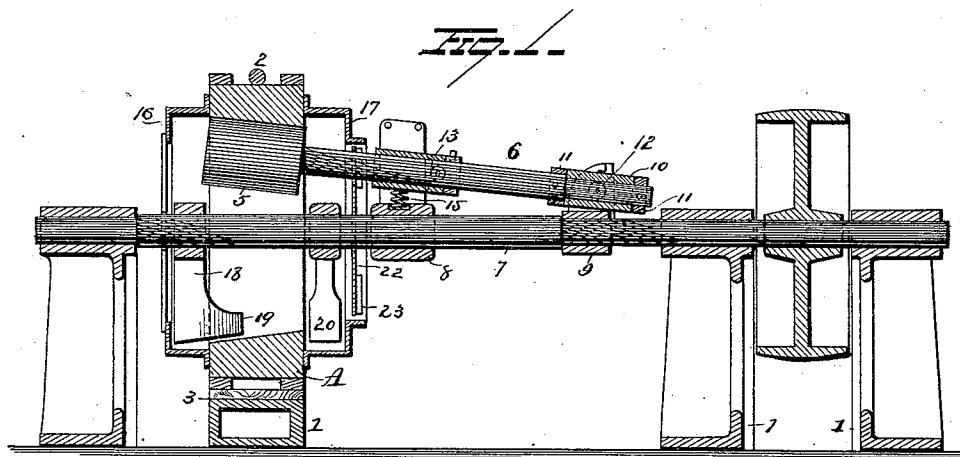


(No Model.)

S. HUGHES.
GRINDING MILL.

No. 469,145.

Patented Feb. 16, 1892.



Witnesses
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UNITED STATES PATENT OFFICE.

SAMUEL HUGHES, OF CHARLESTON, SOUTH CAROLINA, ASSIGNOR OF
ONE-HALF TO WILLIAM B. CHISOLM, OF SAME PLACE.

GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 469,145, dated February 16, 1892.

Application filed April 9, 1891. Serial No. 388,301. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL HUGHES, a resident of Charleston, in the county of Charleston and State of South Carolina, have invented certain new and useful Improvements in Grinding-Mills; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improvement in grinding-mills adapted more particularly for crushing and pulverizing phosphate rock.

The primary object is to provide a machine of such construction that the bulk of the material being operated upon will be thoroughly pulverized and prepared for use during a single passage through the mill.

A further object is to provide a machine of such construction that the material will be immediately removed upon being properly pulverized, and will not remain in the mill indefinitely, as has been the case in many instances heretofore, until it happened by mere luck to work out or be crowded out.

Still further objects of importance are to provide a machine in which all the journals are accessible from the outside, where they can be kept properly lubricated and where they are protected from the grit and dust coming from the material being milled.

Still another object is to provide a machine in which an enormous centrifugal force can be obtained and one in which a combined rotary and grinding or rubbing effect is produced upon the material in the mill.

With these ends in view my invention consists in certain novel features of construction and combinations of parts, as will be herein after described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a longitudinal sectional view of my improved mill. Fig. 2 is a front elevation with the end removed. Fig. 3 is a rear elevation with the end removed. Fig. 4 is a detail showing the fixed circular die, the central shaft, a roll and its shaft, and a feeding-arm. Fig. 5 is a detached view of the large driver, and Fig. 6 is a detached view of the disk fan.

A represents a circular die. This die is set

horizontally on a suitable block or support 1, where it may be held securely by a bolt or band 2 or other convenient means and wooden blocks 3 3, as shown. The die is preferably constructed with a slightly-inwardly-tapering bore 4, and rolls 5 5, preferably cylindrical in form, are arranged to co-operate with this die to crush, grind, and pulverize the material fed into the mill. To properly balance the machine, I find that three rolls are desirable. These are secured on shafts 6 6, which in turn are arranged equidistant from one another around a horizontal drive-shaft 7. The manner of connecting these shafts may be varied; but as the plan shown is a practical one I will proceed to describe it as being a part of my present invention. A pair of drivers 8 and 9 are secured to the main shaft 7 at suitable distances apart. In the former the shafts are arranged to vibrate or slide radially from the shaft 7, and in the latter they have pivotal connection. The pivotal connection is effected by passing the end of the shaft through a sleeve 10, wherein it is capable of revolving freely as occasion requires it, and to prevent endwise movement collars or equivalent devices 11 11 are secured on the shafts at the ends of the sleeves. The sleeves themselves are provided with trunnions 12, by which they are supported in driver 9. In the large driver sliding journal-boxes 13 13 are arranged to slide in and out and the shafts revolve in these journal-boxes. Stout spiral springs 15 15, of sufficient tensile strength to sustain the weight of the rolls and their shafts, are interposed between the journal-boxes and the hub of the driver, their purpose being simply to resist the downward tendency of the uppermost roll or rolls when not held outward by centrifugal force. The drivers hold the rolls to their work and prevent twisting or other lateral strain which would otherwise result. The heads 16 and 17 are secured to the opposite ends of the circular die, as shown in Fig. 1, and the rock is fed at some convenient point or points through the former.

To regulate the passage of the material through the machine and prevent its being fed through too rapidly, feeding-arms 18 18 are secured to the main shaft 7 just inside

the head or casing 16. These arms are preferably about three in number, and as they rotate they catch the material and drive it inward. From the enormous speed there is a tendency to drive the material entirely through the die at once before it is ground; but this is prevented by bending the arms at their ends to form hooks 19 19. These catch the material and tend to stop it or retard its progress. At the opposite end of the circular die the paddles or fans 20 20 are secured. These devices create a draft, which, together with their contact with the pulverized rock, forces it out through a discharge 21, located at some convenient place, and, in this manner, the material is removed from the mill, after which it may be screened, and if necessary the coarser material can be again passed through the mill.

To prevent dust from blowing out of the openings formed for the shafts 6 6 in the head 17, a disk fan 22 is provided. This is secured to the main shaft and its wings 23 23 are turned to create an inward draft. This fan not only prevents the escape of air by creating an inward suction, but also prevents the inflow of too much air.

The main shaft may be supported in any suitable bearings, as illustrated, and it is provided with a belt-wheel or other means by which it may be driven. Thus it will be seen from the construction set forth that by the shape given the die and rolls not only is there a rolling and crushing effect produced, but from the fact that the interior of the die has a conical or tapering form and the rolls a cylindrical shape a grinding and rubbing of the material is caused. In other words, the outer ends of the rolls have to travel farther than the inner ends as the circumference at the outer end of the die is greater than it is at its inner end. Hence to compensate for this there must be a slipping as well as a rotary motion caused by one end trying to catch up with the other or one end waiting for the other, so to speak, and as it seldom happens that the rolls bear equally at any time on the die on account of unequal quantities of material getting between them and the die it follows that the bearing-point is continually shifting, and hence the remaining portion of the rolls have to be retarded or accelerated, and consequently the rubbing and slipping of the rolls alluded to. This makes the action doubly effective in pulverizing the rock, and in fact rock that would not be as readily crushed by a mere rotary motion is pulverized with ease by this combined rolling and rubbing action. Further, it will be observed that the journals are pro-

ected from dust, being all outside of the machine, as dust is prevented from escaping, and by my arrangement of shafts and rolls enormous centrifugal force is attainable.

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

1. In a grinding-mill, the combination, with a horizontal circular tapering die, means for supporting the die in this position, and a horizontal drive-shaft extending centrally through the latter, of a series of rolls having rotary pivotal connection with the drive-shaft and adapted to co-operate in connection with the circular die, substantially as set forth.

2. The combination, with a die and a main drive-shaft, of rolls, shafts to which the latter are connected, said shafts having rotary pivotal connection with the drive-shaft, and drivers secured to the main shaft and having loose sliding connection with the roll-shafts, substantially as set forth.

3. The combination, with a circular die and heads or shells located at the opposite ends of the die, of a main shaft, rolls connected therewith, and feeding-arms connected with the shaft, substantially as set forth.

4. The combination, with a die and main drive-shaft, of shafts having rolls thereon and drivers secured to the shaft outside of the die for supporting the roll-shafts and the latter having loose sliding connection with the drivers, substantially as set forth.

5. The combination, with a die and main drive-shaft, of shafts having rolls thereon adapted to co-operate with the die, drivers secured on the main shaft, sleeves in which the shafts are revolvably supported, said sleeves having pivotal connection with the driver, journal-boxes having sliding connection with the other driver in which the shafts revolve, and springs interposed between the hubs of the driver and the journal-boxes for holding the rolls normally outward, substantially as set forth.

6. The combination, with a die, heads located at its ends, a main shaft, roll-shafts, and rolls thereon, of feeding-arms having hooks thereon, a fan for forcing the material out of the machine, and a disk fan for preventing escape of dust and regulating the inflow of air, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

SAMUEL HUGHES.

Witnesses:

W. F. TAYLOR,
V. E. HODGES.