

R. W. PRINGLE.
 CRUSHING MACHINERY.
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1,237,383.

Patented Aug. 21, 1917.

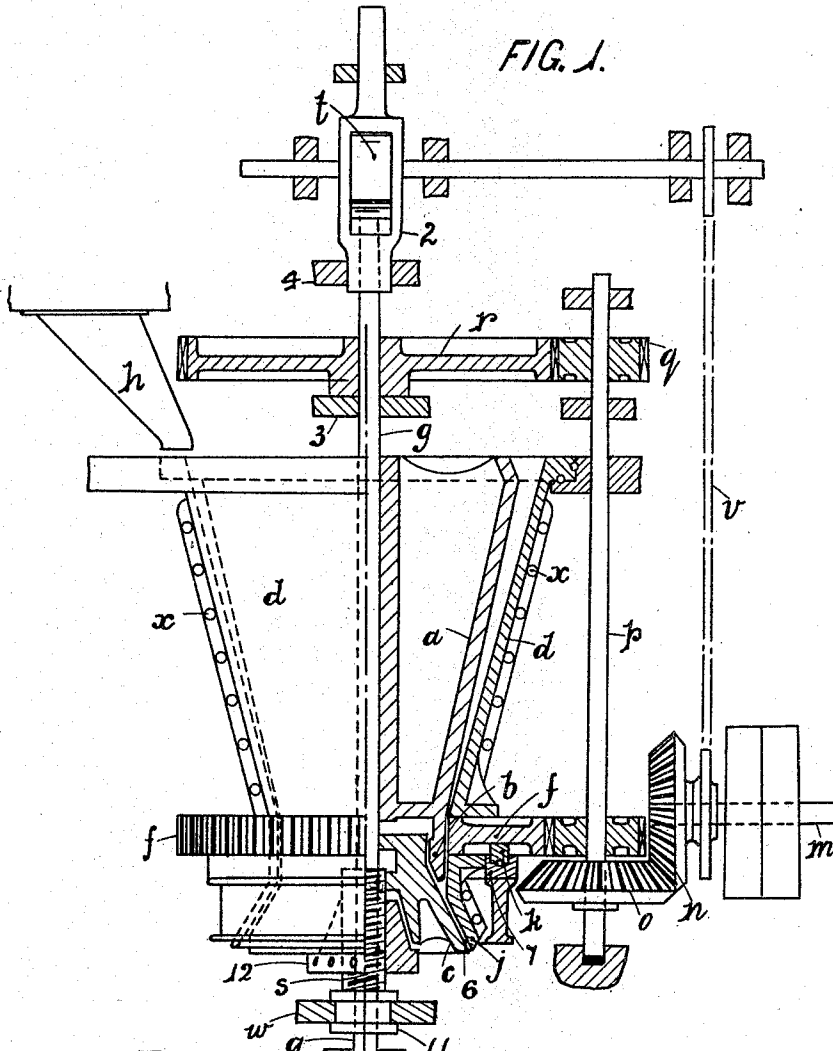


FIG. 2.

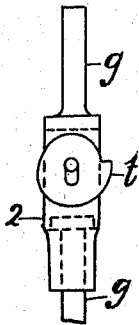
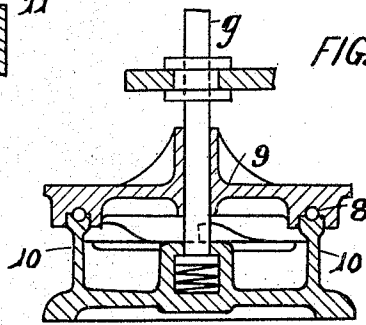


FIG. 3.



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CRUSHING MACHINERY.

1,237,383.

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To all whom it may concern:

Be it known that I, ROBERT WILLIAM PRINGLE, a subject of the King of Great Britain and Ireland, residing at Gatooma, Southern Rhodesia, South Africa, mining engineer, have invented certain new and useful Improvements in or Relating to Crushing Machinery, of which the following is a specification.

This invention relates to crushing machinery. The object of this invention is to provide an improved method of crushing stone, ore or other hard substance and apparatus for carrying this into effect.

According to this invention I provide a machine having an annular crushing chamber, the walls of which are adapted to be rotated in a vertical axis, in the same direction or in opposite directions, at the same or at different speeds, the distance between the walls of the chamber being greatest at, or near, the top and decreasing toward the bottom. The walls for this purpose may be conical. The member forming the inner walls, referred to hereafter as the inner cone, being adapted to be raised periodically or from time to time by a cam or other device, and allowed to drop. Below the conical members forming the annular chamber I arrange a device consisting of a combination of cone shaped members, one attached to the outer conical muller and revolving with it, the other rotating with, but not attached to, the vertical spindle, and therefore not rising and falling with the inner cone. The combination provides a parallel crushing chamber that is an annular conical space with parallel sides and at the same time forms a discharge spout for the crushed material. The width of the parallel chamber is capable of adjustment by means of a nut engaging a sleeve with a screw thread on its outer surface.

The particles to be crushed are fed into the opening between the cones and are caught between the tapering walls.

Where the cones rotate in opposite directions the particles are immediately caused to rotate rapidly around their own axes and if one cone is traveling at a different speed from the other the particle is also compelled to travel around the surface of the conical chamber. A grinding and disintegrating effect is set up, fresh faces of the particle being constantly exposed to the grinding and crushing effect.

Where the cones rotate in the same direction a tearing action is set up, tending to disintegrate the particle and by varying the speeds a similar effect is produced as before, viz:—the particle is compelled to travel around the surface of the cones at a speed determined by the difference in speed of the rotating cones.

The vertical motion of the inner cone performs three functions:

As the cone rises it tends to make each particle follow a slightly spiral path, upward, until the opening between the cones becomes greater than the diameter of the particle. The particle then drops down to a lower position corresponding in width to the size of the particle. When the inner cone has been raised to a predetermined extent and released by the cam or other device it falls with a crushing force on the particle. The attrition due to rotation succeeds this and the process is repeated until the particle reaches the bottom of the annular chamber where the walls are or may be parallel and spaced apart such a distance as to discharge material of the size required.

An electro-magnetic device can be introduced above the annular feed opening to catch any particles of steel which may by accident be fed in with the ore. This may suitably take the form of a soft iron ring attached to but insulated from the inner cone and revolving with it. This ring is magnetized by being wound with thin wire which again is connected to a source of electrical energy. This may be done by a hinged collector as in tramway work, picking up energy from a ring attached to the framing electrified and insulated. The steel thus picked up can be automatically brushed off, every revolution, by a brush or scraper attached to the framing and arranged to discharge the steel collected into a suitable receptacle.

Figure 1 of the drawing is a half elevation and half section of one form of apparatus adapted for carrying out this invention.

Fig. 2. is a side view of the yoke and sleeve with cam.

Fig. 3. is a section of an alternative arrangement for raising the inner cone.

a is the inner cone shaped muller, ending in a cylindrical apron *b* covering the top of the lower cone shaped muller *c*. The outer

cone shaped muller d is fitted so as to revolve concentrically to the inner cone a . This outer muller is attached to the annular gear wheel f which forms a parallel opening slightly larger than the aperture at the end of the upper cone shaped mullers a and d . g is the central spindle to which the inner cone is rigidly attached. h is the feed hopper. The gear wheel f is attached to the lower conical casing j which forms a flared extension of the outer muller. The gear wheel f carries a ball bearing runner guide k . The gear as shown is adapted to run the inner muller a and outer muller d in the same direction from the power shaft m through the bevel gear n , shaft p and gear wheels q and r . The spindle g is square in section where it passes through the sleeve s and also where it passes through the gear wheel r . t is a cam, driven by a chain v off the main shaft m which lifts and releases the spindle c carrying the inner cone a . The bearing w in which the sleeve s works is attached to the main framing of the machine. x is the ball bearing track in which the outer cone revolves, arranged in such a way that the outer cone shaped muller can be withdrawn from the inner cone in two parts for relining and repairs generally. This is effected by combining two parallel tracks with the two circular tracks and arranging points as in ordinary track work. 2 is a yoke and sleeve embracing the cam t and arranged so that the spindle g can revolve in a socket in the sleeve. 3 are bearings through which the spindle g passes. 4 are bearings which support the yoke and sleeve 2. 5 is a spring buffer or dash pot arrangement to carry the end of the spindle g . 6 is a discharge spout. 7 is the lower ball bearing track carrying the outer cone and arranged in a similar manner to the upper track so as to facilitate the separation of the two halves of the outer cone. 8 is a ball bearing track in the alternative arrangement suggested in place of the cam arrangement for lifting the spindle g . This track has an undulating surface by which the inner cone is caused to rise slowly and to drop suddenly, the process being repeated. 9 is the circular casting rigidly attached to the spindle g and forming the upper member of the ball bearing track 8. 10 is the lower member of the ball bearing track 8 and forms the base of the apparatus and carries the dash pot arrangement for the end of the spindle. 11 is collar bearing on sleeve s . A cone shaped adjusting nut 12 is threaded to engage with the sleeve s and arranged so that the cone shaped muller c can be driven on to it in the same manner that a shoe is attached to the head of a stamp. The outer member of the lower crushing chamber j is attached to the gear wheel f and therefore to the outer cone d and revolves with it.

The inner cone a is made hollow but reinforced with ribs and is arranged to be filled with shot or other heavy substance to increase the crushing blow. This can be regulated to suit the ore. Thus a lead and limestone ore would not need the weight required by a quartz ore. This arrangement also facilitates transport as the weight is only added at the mill site, after erection. The mill is also designed so that any one part can be handled by animal transport on packs.

With a machine made in accordance with this invention:—

The power expended is proportional to the resistance of the particle to disintegration.

Apart from overcoming frictional resistance of the machine the power is expended in crushing material and not in wearing out the faces of the machine.

No power is expended in useless lifting of pebbles (as in tube mills) or pounding of material already crushed as in stamp mills, tube mills, etc. Little or no slimes are produced or in other words very little material below that required in size is produced.

The machine, in itself, affords a series of graduated crushings so that each particle when broken drops automatically to the zone where the annular space between the cones corresponds to the particle's then size; until it finally reaches the lower parallel chamber and is discharged. The distance between the faces of this lower chamber corresponds to the smallest space between the cones in the upper annular chamber; and the chamber acts as a control to insure that particles greater in diameter than the size desired do not leave the machine.

Each particle when crushed to the size desired automatically proceeds to the next size and is finally discharged.

Crushing is effected with the minimum of water or altogether dry. This is achieved by keeping the particles continually revolving about their own axes, thus preventing clogging.

Wear and tear is as uniform as it is possible to make it as the particles are caused to rotate around the periphery of the cone shaped chamber.

The working parts are easily accessible. The converging cones can be arranged so that the foot pounds of energy are greatest at the feed end (the base of the cones) and a minimum at the discharge end; due to the decreasing peripheral speed and consequent decreasing power expended.

Theoretically particles of any size could be crushed and any size of product obtained by making the cones long enough. The machine however is intended primarily as an

alternative to tube mills, Chilian mills, and similar fine crushers. In small plants it would come after the crusher (set to a small opening) to replace the stamp mill; in
5 which position it would prove useful, producing a minimum of slimes.

Screens are obviously unnecessary as a particle cannot pass through the parallel sections of the machine until it has been
10 crushed to the size desired.

The action of the revolving cones as already explained causes the particle to be kept in continual motion and therefore clogging and packing are, as far as possible,
15 avoided, and the amount of water (an important item often in mining) is far less than that required where the discharge is effected by splashing the crushed particle through the screen.

20 What I claim and desire to secure by Letters Patent is:—

In crushing machines an inner conical muller having a cylindrical extension at its

smaller end, an outer conical muller having a cylindrical part and a flared extension at
25 its smaller end, said mullers being disposed concentrically and vertically, the larger ends of the cones being uppermost, the distance between the cones being greatest at or near
30 the top and decreasing toward the bottom, a second inner muller and adapted to be rotated with said inner muller, means of adjusting the said inner muller axially so as
35 to increase or decrease the space between said second inner muller and the flared end of the outer muller, and means for raising
the first named inner muller and allowing it to fall periodically during rotation.

In witness whereof, I have hereunto signed my name in the presence of two subscribing
40 witnesses.

ROBERT WILLIAM PRINGLE.

Witnesses:

M. HARRISON,
E. E. OWER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents,
Washington, D. C."