

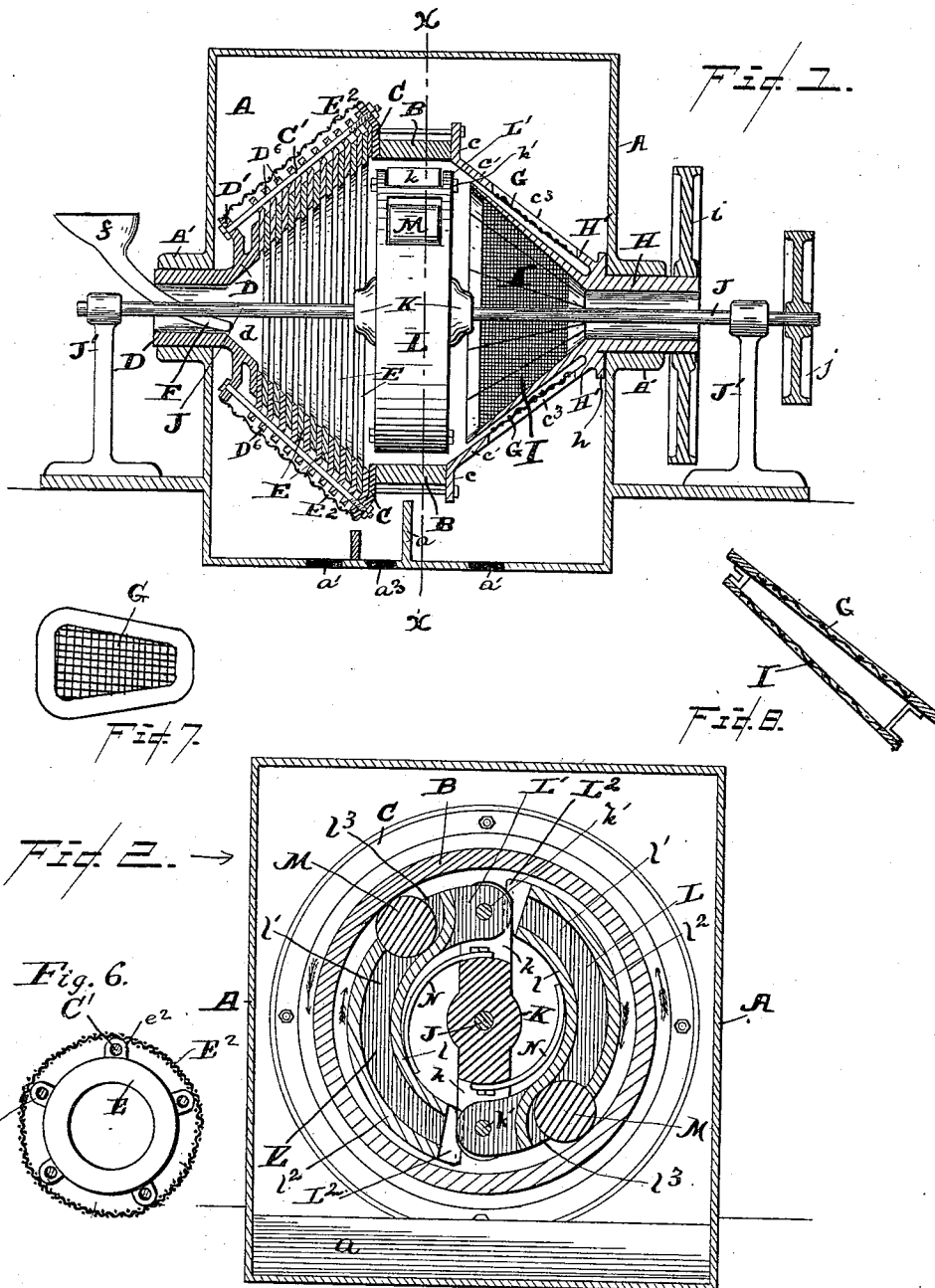
(No Model.)

2 Sheets—Sheet 1.

H. A. DUC, Jr.
GRINDING MILL.

No. 451,111.

Patented Apr. 28, 1891.



WITNESSES:

Permy L. Brooks
C. W. Seville.

INVENTOR

H. A. Duc, Jr.
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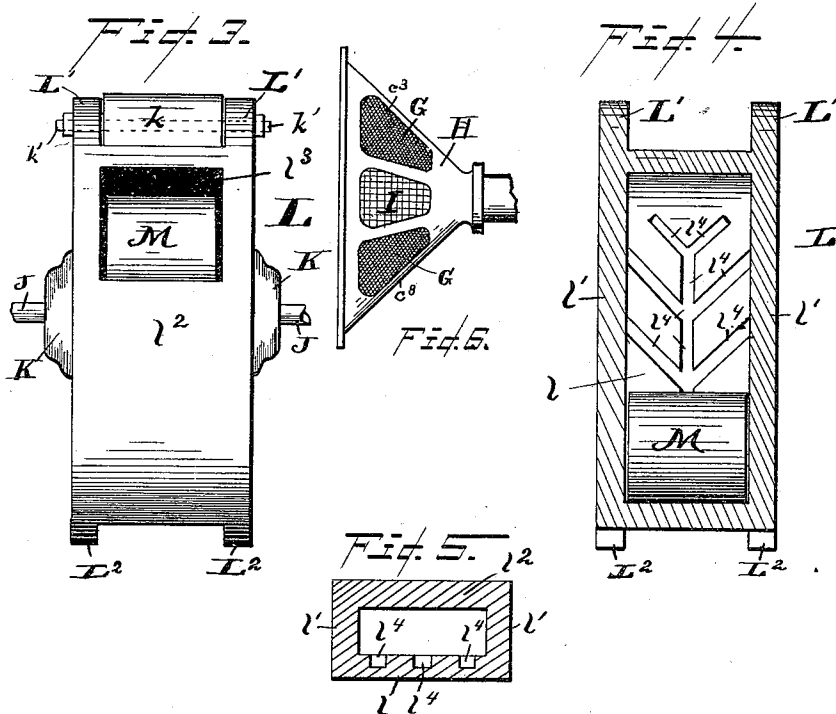
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Percy L. Brooks.
B. W. Sewell.

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UNITED STATES PATENT OFFICE.

HENRY A. DUC, JR., OF CHARLESTON, SOUTH CAROLINA.

GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 451,111, dated April 28, 1891.

Application filed July 16, 1890. Serial No. 358,893. (No model.)

To all whom it may concern:

Be it known that I, HENRY A. DUC, Jr., 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 that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification, in which—

Figure 1 is a central vertical longitudinal sectional view through my improved grinding-mill. Fig. 2 is a transverse vertical sectional view on line *x x*, Fig. 1. Fig. 3 is an edge view of one of the swinging arms as attached to the hub. Fig. 4 is a view thereof with the outer portion removed. Fig. 5 is a transverse sectional view thereof. Fig. 6 is a reduced detail sectional face view of screens E and E². Figs. 7 and 8 are details.

This present invention is an improvement in grinding or pulverizing mills especially designed for working metallic ores, clays, &c.; and its objects are to improve the construction of the screening portion of the mill and to mount the crushing-rollers in swinging or pivoted arms attached to a revoluble hub by which the rollers will be thrown outward and pressed against the annulus by centrifugal force, and to provide springs that may be used, if desired, to augment the pressure exerted on the rollers and arms by centrifugal force in their revolution.

The invention consists in the novel construction and combination of parts in the mill, as will be hereinafter set forth and claimed.

Referring to the drawings by letter, A represents the casing of the mill, having bearings A' A' in its opposite sides for the trunnions of the shell of the mill. The shell is formed of a central grinding ring or annulus B, confined between annular flanged plates C c, as indicated. Plate C is at the receiving side of the shell and is connected by tie-rods C' with the sleeve or trunnion D, which is journaled in one bearing A' of the casing and has on its inner end a flange D', to which rods C' are secured, and the inner end of this sleeve D is made conical, as at *d*. This sleeve and plate C are separated by a series of rings E, arranged parallel and gradually increasing

in diameter from the sleeve to the plate, so that collectively they present a conical appearance. The adjoining rings may be separated by springs or compressible washers D⁶, made of rubber or other elastic material, so that they can be set toward or from each other and plate C and end *d* of the sleeve, and constitute a conical screen over which the material which is fed into the shell through a pipe F, leading through sleeve D from a hopper *f*, has to pass before it reaches the pulverizing devices of the mill, so that all fine particles may be screened out before they reach the crushing-rolls, and thereby relieve the rollers from passing over the part already ground.

By adjusting the position of the rings in relation to each other, which is done by turning the nuts on the bolts, thereby compressing the washers, the coarseness or fineness of the material passing therethrough can be regulated. This construction affords a very durable, strong, and easily-adjusted screen, which is very efficient in ore-working.

The rings E E may be separated by washers of various shapes; or washers might be dispensed with by warping the rings, so that their own elasticity will cause them to open spaces between when the bolts are slackened. This screen might also be made of a suitable piece of strap metal of sufficient length to be wound around and into a large spiral spring without impairing its efficiency.

The washers may be simple strips of rubber or steel strung on rods C', as indicated, which rods may be in close contact with the edges of the rings E to support and prevent shifting of the latter.

The screen E is made of annular plates, as described, which present a wearing-surface several inches in depth to the action of the incoming material. The bolts C' pass through ears e², Fig. 6, on the peripheries of the plates E and through the washers, as shown, and in order to screen and grade the particles of material falling through screen E, I employ a finer screen E², inclosing screen E and attached thereto, as indicated in Figs. 1 and 6. The finer screenings escape through opening *a'* and the coarser screenings escape from screen E² over the lower edge thereof between the rows of ears e² on plates E and through a discharge-opening *a*³ in the bottom of the cas-

ing, and can be subsequently ground. Plate *c* has an outwardly-projecting conical flange *c'* on its inner edge, which is connected by arms *c³* to a flange *H'* on the inner end of a sleeve *H*, which is journaled in the opposite bearings *A'* of the casing, thus sustaining the shell therein.

G G designate fine-screen sections secured over the openings between flanges *c'* and *H'* and the arms *c³*.

I designates a coarser cone-shaped screen and lying close to and within screen *G*, but extending inwardly slightly beyond the edge of flange *c'*, as shown, so as to protect screen *G* from injury or choking by coarse particles of material falling thereon, and should any coarse particles pass through screen *I* onto screen *G* they will slip back between screens *G* and *I* to annulus *B* and be reground and again thrown on the screens until they pass out through the outer screen. Screen *I* is preferably made in segments *I'* or parts which can be put together through the openings carried by sections *G*, and some of segments *I'* may be attached to sections *G*, so that when the fine-screen segment is bolted in position it will have a segment of the heavy screen over it and projecting onto the shell to protect it. By this sectional construction of the screens if one section be removed access can be readily had to the crushing-rollers without taking the entire mill apart. The shell is kept from longitudinal vibration in the casing by a flange *h* on sleeve *H* within the casing and a pulley *i* on the sleeve exterior to the casing, and by which the shell can be rotated from any convenient power.

J indicates a shaft passing centrally through the shell and freely through the sleeves thereof, being supported independently of the shell in bearings *J'* exterior to the casing. A hub *K* is fixed on the shaft centrally within the shell, and has opposite offstanding ears *k k* on its periphery.

L L are curved arms almost semicircular, and respectively connected to ears *k* by bolts *k'*, which pass through the ears *k* and lugs *L'* on the ends of the arms, as shown. The other ends of arms *L* are free to swing outwardly, but are kept from lateral movement by means of lugs *L²*, that loosely embrace the edge of the ear *k* opposite that to which the arm is pivoted. These arms are hollow and have a bottom portion *l*, that extends from the free end of the arm to the lugs *L'* and then turns upward to close the end of the channel or hollow, and the sides *l'* of the arm may project beyond the upturned end of bottom *l* to form the lugs *L'*. The top *l³* of the arm may be formed integral therewith or separate and bolted, or otherwise secured to the sides *l'*. This top does not extend to the upturned end of the bottom, but leaves an opening *l³*, in which is loosely placed an impact or crushing roller *M*, which contacts with the inner surface of annulus *B* when the mill is in operation. The sides *l'* of the arm keep

the roller in position, and the top *l³* acts as a drag to draw or push the roller around as the hub revolves and as a brake to make it slip or drag on the surface of the annulus. This top portion will gradually wear out and let the roller move toward the end of the arm, and hence it is necessary after the mill has been used some time either to renew the arms or to make the top portions *l³* removable and replaceable. The bottom *l* has a series of channels *l⁴* in it, which converge from sides to center, as shown, and whose function is to keep the roller in true position and to clear the surface of the rollers by scraping the same and to conduct small particles of ground material behind the roller into and through the hollow arm.

The arms *L* are made hollow and curved, as described, so as to hold the rollers *M*, which are forced outward against the annulus with a pressure varying according to the weight of the arms and the centrifugal force of arm and roller developed during the rotation thereof and the energy of the spring. The arms act as brakes on the rolls, so that they drag partially over the material, but rotate sufficiently to prevent their peripheries flattening. The top or outer portions of the arms wear more rapidly than the bottoms or inner portions thereof, because the grit and powdered material are carried by rotation of the roll first between it and the top and the roll-surface is scraped before it comes into contact with the bottom, and as the top wears the roll moves back toward the end of the arm, and thus constantly comes in contact with a new wearing-surface on the bottom.

The channels *l⁴*, Fig. 4, are designed to reduce wear between the roll and the bottom of the arm and to assist in keeping the roll in true position. The side channels being oppositely inclined, it will be seen that if the roll turns diagonally in the arm one end thereof will turn more or less over the adjoining channel, thereby lessening the contact-surface between the roll and floor of the arm, while the opposite end simultaneously turns off the channel at its side, increasing the extent of contact-surface at that end of the roll. The bottom of the arm is covered usually with gritty dust, so that where there is contact between the roll and bottom the friction is great, but there is no friction on the surface of the roll which overlies the channels. Hence as the friction on the ends of the roll is unequal the natural tendency will be for the roll to shift its position until the friction on its ends is equal, which is when the roll is exactly transverse to the arm. It will be observed, also, that the conical screens *G* and *I* both return the tailings to the annulus.

If desired, springs *N* may be employed to assist in forcing arms *L* outward, whereby additional pressure will be exerted upon the rollers, increasing the capacity of the mill for crushing hard substances. Spiral springs or other kinds may be substituted for those

shown. The arms L being hollow, prevent wedging of the rollers, as particles of material passing beneath and behind the rollers will enter the hollow of the arm and be discharged therefrom during its ascent. Shaft J may be revolved in the same direction or contrary to the rotation of the shell by a pulley j and belt from any suitable source of power.

10 The casing A has a transverse partition *a* just below annulus B to separate the screenings falling through the sieves on the receiving and delivery sides of the shell, which screenings can be withdrawn through openings *a'*.

The screen G is protected by screen I, and, being exterior thereto, can be readily repaired from the exterior of the mill.

20 The adjustable screen formed by rings E E will need little or no repairing and is very durable.

The screens G and I may be made entire, but preferably are in segments, as indicated in Figs. 1 and 6, so that by removing the outer screen the inner one may be taken apart, and thereby give ready access to the crushing-rollers to either examine or renew them without the necessity of taking the machine apart, whereby much time and labor will be saved.

30 I do not confine myself to the conically-shaped screens, since they can be made in other shapes, when required, without affecting and without altering the general plan of the mill, while but two roll-bearing arms are illustrated as mounted on the shaft or hub, yet three or more such arms can be readily employed according to the diameter of the annulus, if desired.

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

1. The combination, with the shell and a revoluble annulus, of a shaft, a hub fixed thereon, hollow curved swinging arms pivotally connected by one end to said hub, and the rollers carried loosely in said arms and adapted to be thrown by centrifugal force into contact with the inner surface of the annulus as the arms swing outward, substantially as described.

2. The combination of the annulus with the shaft and the hollow arms pivotally connected to said shaft and adapted to swing outward by centrifugal force, and the rollers loosely mounted in and carried by said arms, substantially as specified.

3. The combination, with the ring L and rolls M, of the conical series of annular plates, the interposed elastic washers, and the bolts confining said plates and washers, whereby the plates can be adjusted toward or from each other to vary the spaces between them, substantially as and for the purpose specified.

4. The combination of the ring L, rolls M, a conical series of annular plates, the interposed washers, and the confining-bolts therefor, together constituting a coarse screen, with

a finer screen inclosing said coarse screen, for the purpose and substantially as specified.

5. The combination, in a grinding-mill, of the annulus, the revolving screens G I, the opposite screen E, composed of annular plates, interposed washers, and confining-bolts, and the crushing devices acting against said annulus, substantially as described.

6. The combination of the shaft and hub and the hollow channeled arms L, pivotally attached thereto, and the rollers carried by said arms, with the annulus surrounding said shaft and arms, substantially as described.

7. The herein-described grinding-mill, consisting of the shell having a central annulus, a sieve formed of a series of adjustable rings at one side thereof and a conical sieve at the opposite side thereof, with a coarse conical sieve secured within the shell to protect the latter sieve, and the crushing-rollers, substantially as specified.

8. The combination, with the shell and its annulus and the double conical screens at opposite sides thereof, of the shaft passing through the shell and having a hub, and the hollow roller-bearing arms pivoted at one end to said hub and adapted to force the rollers against the annulus by centrifugal force when the shaft is rotated, and the rollers loosely mounted in said arms, substantially as and for the purpose described.

9. The combination of the shell and annulus with the shaft, the hub thereon having peripheral ears, the curved arms pivoted at one end to said ears and having lugs on their free end, loosely embracing an adjoining ear, and the rollers mounted on said arms, substantially as specified.

10. The combination of the annulus, the shaft passing therethrough, and the hub on said shaft having peripheral ears, with the hollow curved and channeled arms L, pivotally connected to one of the ears at one end and having lugs on the opposite end loosely embracing the adjoining ear of the hub, and the rollers carried by said arms, substantially as described.

11. The herein-described grinding-mill, consisting of the shell having a central annulus, conical sieves on opposite sides thereof, constructed substantially as described, and connected to the annulus and to sleeves journaled in bearings on the casing, the shaft passing freely through said shell and carrying hollow swinging arms pivotally connected to a hub on the shaft by one end, and the rollers loosely mounted in the free ends of said arms, all substantially as specified.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

HENRY A. DUC, JR.

Witnesses:

B. B. FLADGER,
A. B. SCHACHTE.