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W. H. COWARD.

CRUSHING AND GRINDING MILL.

No. 589,248. Patented Aug. 31, 1897.

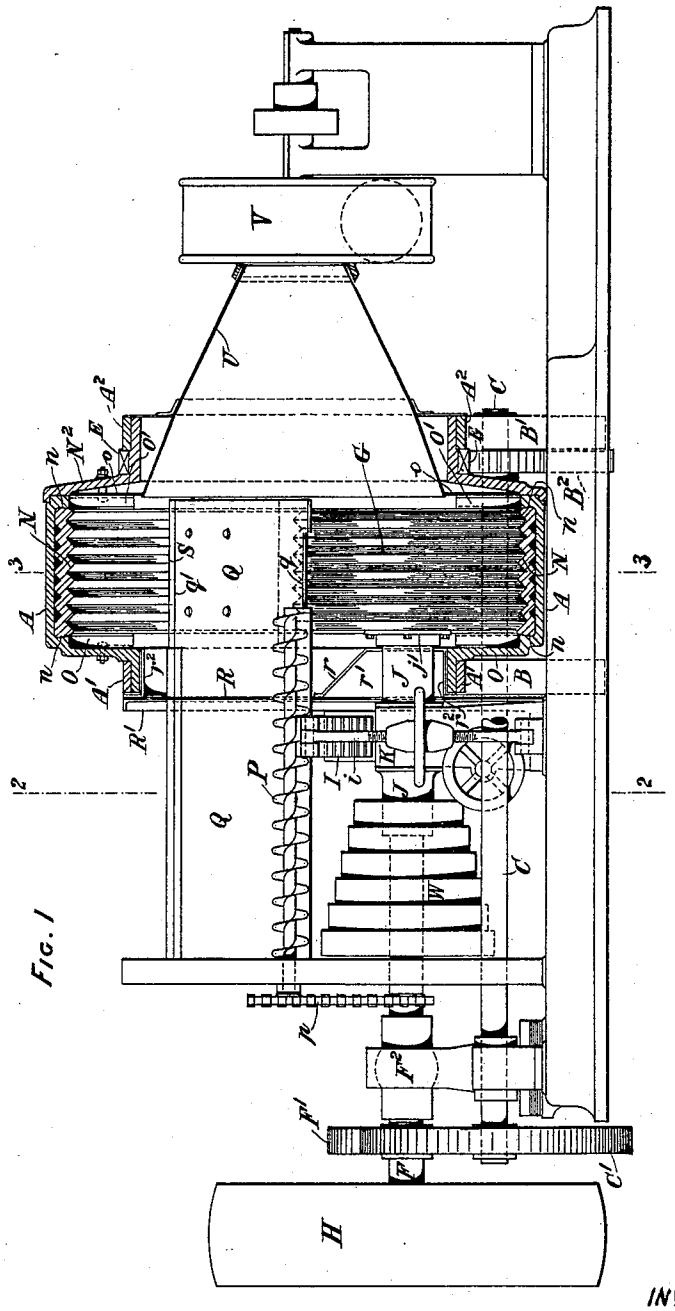


FIG. 1

WITNESSES.

Julius Lutz.

F. W. Hanaford

INVENTOR:

W. H. Coward.

BY Munn & Co.

ATTORNEYS.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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W. H. COWARD.

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FIG. 2

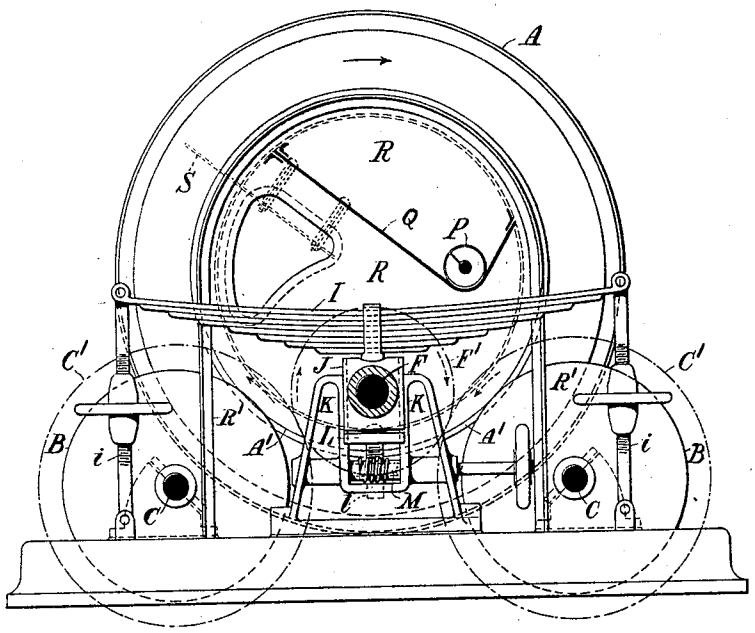
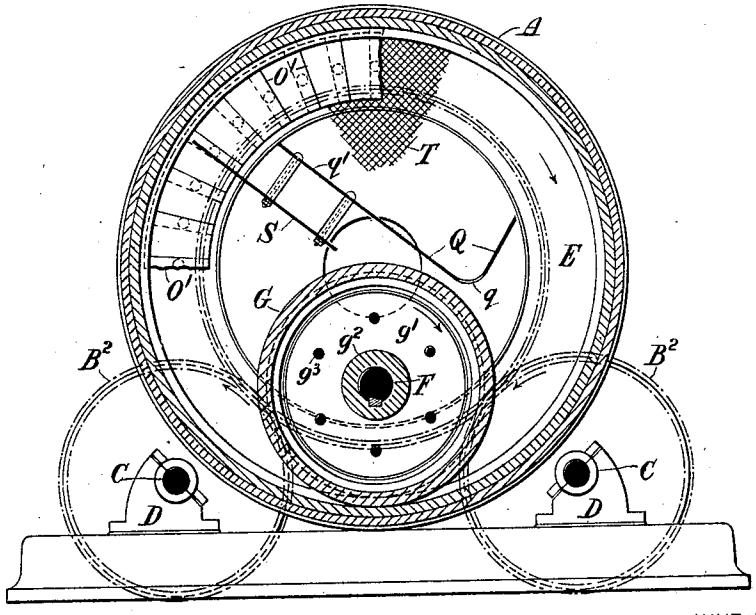


FIG. 3



WITNESSES.

Julius Lutz

F. M. Bancroft

INVENTOR:

H. H. Coward

BY

ATTORNEYS

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.)

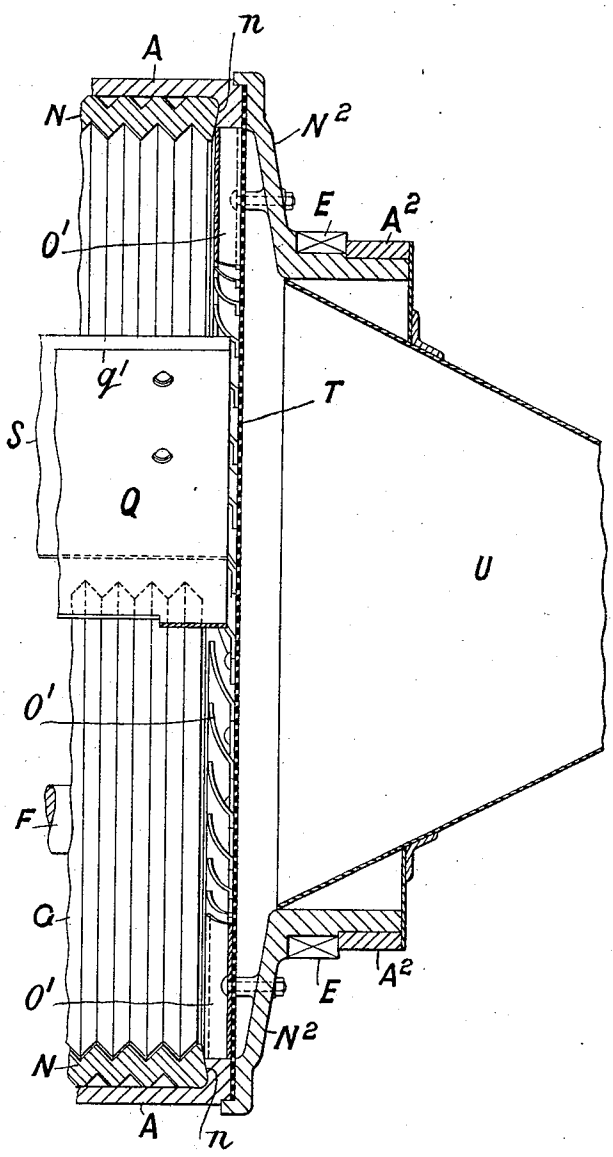
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W. H. COWARD.

CRUSHING AND GRINDING MILL.

No. 589,248. Patented Aug. 31, 1897.

FIG. 4.



WITNESSES.

Julius Atty.

Geo. B. Bryant

INVENTOR:

W. H. Coward.

BY

Munn & Co

ATTORNEYS

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

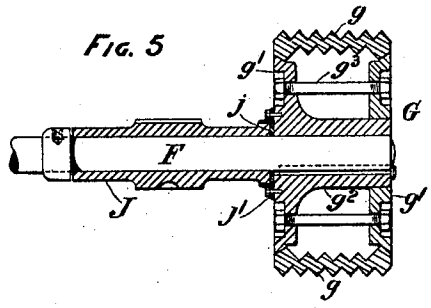
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W. H. COWARD.

CRUSHING AND GRINDING MILL.

No. 589,248. Patented Aug. 31, 1897.

Fig. 5



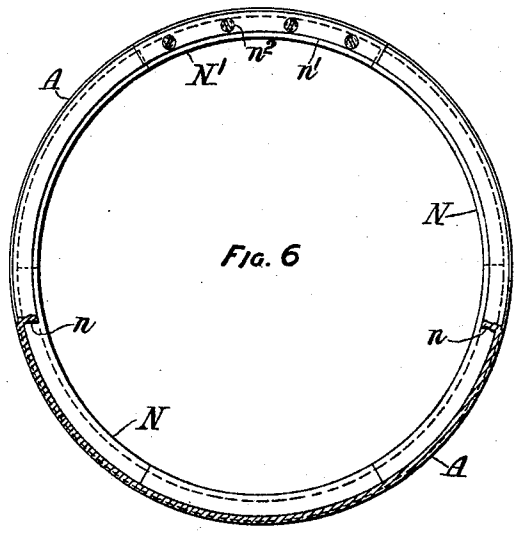


Fig. 6

WITNESSES.

Julius Lutz

F. W. Ramsford

INVENTOR:

W. H. Coward

BY

ATTORNEYS

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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W. H. COWARD.

CRUSHING AND GRINDING MILL.

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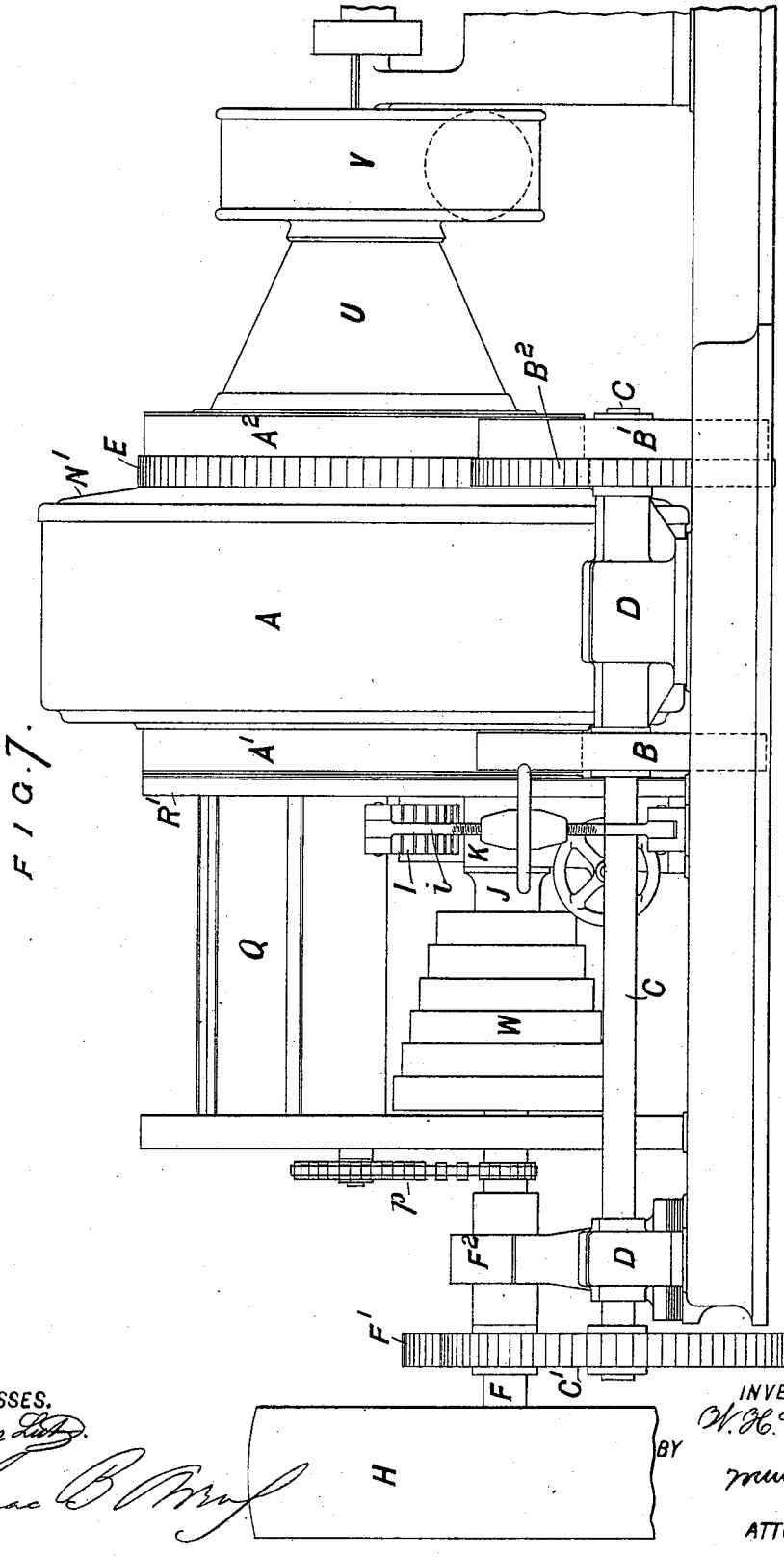


FIG. 7.

WITNESSES.
Julius Lutz.
Isaac B. Morse

INVENTOR:
W. H. Coward
BY
Munn & Co
ATTORNEYS

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM HENRY COWARD, OF ERITH, ENGLAND.

CRUSHING AND GRINDING MILL.

SPECIFICATION forming part of Letters Patent No. 589,248, dated August 31, 1897.

Application filed May 13, 1896. Serial No. 591,330. (No model.) Patented in France November 27, 1895, No. 252,033; in Belgium November 28, 1895, No. 118,591, and in Cape Colony December 5, 1895, No. 514.

To all whom it may concern:

Be it known that I, WILLIAM HENRY COWARD, engineer, of Hastings Villa, Bexley Road, Erith, in the county of Kent, England, have invented new and useful Improvements in Crushing and Grinding Mills, (for which I have obtained Letters Patent in the following countries, namely: France, dated November 27, 1895, No. 252,033; Belgium, dated November 28, 1895, No. 118,591, and Cape of Good Hope, dated December 5, 1895, No. 514,) of which the following is a full, clear, and exact description.

This invention relates to improvements in the crushing or pulverizing mill known as the "Niagara mill," which consists of a drum revolving on a horizontal axis and having an edge-runner rolling therein. Heretofore the motion of the edge-runner has been derived from the rotation of the drum with which it was in mere rolling contact, the roller and drum having the same surface speed.

The present invention has for its object to produce a grinding or rubbing action as well as a crushing action by causing the roller and drum to revolve at different surface speeds and to enable their relative surface speeds and the distance between their acting surfaces to be varied to suit the material operated on.

It has also for its object to increase the efficiency of the grinding-surfaces, to provide improved means for conveying the material to and repeatedly passing it beneath the crushing-roller, to increase the area of the gage-plate used when the crushed ore is to be concentrated, and to insure the return to the drum of the grosser particles which may be carried off with the blast when the gage-plate is not used.

To impart different surface speeds to the drum and roller, so as to produce a grinding action, both the drum and roller are driven positively and are geared together through gearing so proportioned that the surface speed of the drum will differ considerably from that of the roller, being either greater or smaller, according to circumstances, the variation of the relative speed of the roller and drum being provided for by means of change-wheels.

Reference is to be had to the accompanying drawings, forming part of this specification, wherein—

Figure 1 represents a longitudinal sectional elevation of the improved crushing and grinding mill; and Figs. 2 and 3, cross-sections on lines 2 2 and 3 3, respectively. Fig. 4 is a part longitudinal section of the mill, showing at the outlet side of the mill the perforated gage-plate and the cups attached thereto. Fig. 5 is an axial section of the grinding and crushing roller, showing its construction; and Fig. 6 is a detail face view, partly sectional, of the drum, showing the mode of inserting and fixing the lining. Fig. 7 is a side elevation of the mill.

The same letters of reference denote like parts in all the figures.

The grinding-drum A has hollow trunnions A' A^2 of large diameter at each side, which rests on two sets of supporting-rollers B B', mounted on the drum-driving shafts C, which are supported in bearings D, situated between the two sets of supporting-rollers B B'. The one set of rollers B' has gear-wheels B^2 combined with them which mesh with a ring of teeth E on the trunnion, and the shafts C are driven from the shaft F of the grinding-roller through gear-wheels C' F', which may be changed to vary the relative speeds of the drum and roller. The shaft F of the grinding-roller G is mounted near its outer end in a sleeve supported in a ball-and-socket bearing F^2, so as to accommodate the angular rising-and-falling motion of the shaft F under the variations of work, the shaft being provided at its outer end with a driving-pulley H, and being loaded at a point near the grinding-roller G by a spring I, whose stress is regulated by means of adjusting-screws *i*. The spring bears on a die-block bearing J, which is movable in vertical guides K and rests on a stop L, adjustable by means of screw *l* and nut-operating worm-gear M, whereby contact of the roller with the drum is prevented and the distance between them regulated. The periphery of the grinding and crushing roller G is formed with circumferential V-shaped ribs or corrugations, so as to increase the area of the grinding-surface and improve the grinding action by the obliquity of the surfaces,

and the grinding-surface of the drum is similarly ribbed or corrugated to correspond.

The grinding-roller G is constructed, as shown in Fig. 5, of the corrugated rim g, cast in one piece, and of two cheek-plates g', one of which is formed on a hub g^2, the plates having beveled edges received in corresponding seats in the rim and united by bolts g^3.

The grinding-surface of the drum A is formed by a lining N, made in segments and held between dovetailed gib-flanges n, formed in the drum, a gate being formed at one point by a segment n' of the gib-flange, at one side being removable, so as to admit of the sections of the lining being introduced, and then slid round into position between the gibs, the last segment N′ of the lining introduced being fixed circumferentially by set-screws n^2, passed through the removable segment n', thus preventing circumferential movement of the entire lining N relatively to the drum A, the removable side cover N^2 of the drum serving to hold the gate-segment n^2 in place laterally.

The sides of the drum A are provided with the usual cups O O′, by which the material that has passed beneath the roller G is lifted for the purpose of being repeatedly subjected to the crushing and grinding action.

The material to be ground is fed to the machine in the first instance by a screw conveyer P, which may be driven from the grinding-roller shaft by an endless chain p, as shown. This screw conveyer works in a trough Q, that passes through a stationary disk cover R, by which the trunnion at that side of the drum is closed, the trough Q projecting completely across the drum and having an outlet q situated over the grinding-roller G toward the ingoing or front side thereof. The trough Q is V-shaped and of considerable breadth, so as to admit of the material being readily shoveled or dumped into that part of the trough which is outside of the cover R, one side of the trough being extended upward, so as to form within the drum a chute q', onto which the material that is raised by the cups O O′ falls in order that it shall be conveyed over the grinding-roller G to the front side thereof to be again subjected to the grinding action. A supplementary chute S, supported at a certain distance below this part of the trough Q and extending upward between the two series of cups O O′ nearly to the periphery of the drum, catches the material that first falls from the cups and delivers it onto the top of the grinding-roller G, which by its rotation carries the material over to the front side thereof. By this means the material raised by the cups O O′, which would fall and accumulate behind the grinding-roller, is at once carried over the latter to the feed or ingoing side, so that the whole of the material is continually subjected over and over again to the grinding action, which, therefore, takes effect in a uniformly progressive manner upon the whole contents of the drum. The cups O at the one side of the drum are attached directly thereto, while the cups O′ at the opposite side are held at a certain distance from the side of the drum by tubular distance-pieces, through which the fastening-bolts pass, this side of the drum being made slightly conical, as shown, for a purpose hereinafter mentioned. The drum is provided with a conical outlet-tube U, leading to the inlet of an exhaust-fan V, by which a blast is drawn through the drum to carry off from the falling shower of material the particles which have been ground to a sufficient degree of fineness. The conicity of this outlet-tube is such that any of the grosser particles which may be carried off and fall out of the blast before reaching the fan will run back down the outlet-tube U and be returned to the drum.

The cups O′ are made without backs, and a loose annular backing-plate o is applied, as shown in Fig. 1, when the crushed and ground material is to pass directly to the fan without being concentrated. When, however, the ore is to be concentrated, this back o is removed and a perforated gage-plate T introduced in its place, as shown in Fig. 4. This perforated gage-plate T, which covers the entire outlet from the drum, is only intended to be used when the material is to pass at once to a concentrator, which takes the place of the cone U. The gage-plate T is clamped between the periphery and side N^2 of the drum, and the coned form of the side of the drum is intended to afford clearance behind the gage-plate, which forms the backing for the cups, and thus has an area corresponding to the full internal diameter of the drum. The fan receives motion through a countershaft driven from a cone of pulleys W on the shaft F of the grinding-roller, whereby its speed may be varied to suit the work.

The bearing J of the roller-shaft F is a long sleeve, and in order to prevent leakage of oil and clogging with dust the bearing is continued through the cover R nearly up to the roller G and a gasket-packing j is applied round the shaft between the end of the bearing and the roller and is inclosed by a collar j', bolted to the latter. To prevent dust collecting in the trunnion and escaping at the aperture in the cover R, a dust-guard r is fixed to the inside of the cover, the upper part of the guard being sloped, so as to throw the dust inward, and the lower part, which is close up to the roller, being apertured to allow of the passage and up-and-down play of the shaft and bearing, the space r' between the dust-guard r and cover R being loosely filled with packing to prevent the escape of dust without impeding the play of the shaft. The stationary cover R has a flange r^2 fitting within the trunnion A′ and, together with the feed-trough, is supported by the frame R′.

Having now particularly described and as-

certained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

1. The herein-described roller-mill, consisting of a revolving drum having large trunnions and lateral lifting-cups, the cups at the one side being attached to the side of the drum and the cups at the other side being attached to a perforated gage-plate extending across the full area of the drum at a distance within the side of the drum so that clearance is left between the gage-plate and the side of the drum, and of an edge runner or roller revolving within the drum, the drum being geared with and driven positively from the roller-shaft and at a different surface speed therefrom.

2. The combination, with the roller-mill having a drum with a series of cups at each side, of a feed-trough and screw conveyer passing into the drum through the cover thereof, the trough being formed as described so as to act as a hopper outside the drum and as a chute within the drum and of an under chute attached below the trough and passing up between the two sets of cups, the double chute thus formed being in position to receive the material which falls from the cups and return it over the grinding-roller to the front thereof as described.

3. In the herein-described roller-mill, the perforated gage-plate extending across the whole area of the drum at the outlet side thereof and forming the backing of the cups at the side of the drum, the cups mounted on the inside of the gage-plate and the end of the drum dished outwardly from the gage-plate so as to leave clearance between it and the gage-plate in order that the effective area of the gage-plate shall correspond to the full internal diameter of the drum.

4. A grinding-mill having a driven rolling-drum, a roller located within the drum and bearing on the lower portion thereof, cups secured to each side of the drum and lifting the material upward from the roller, a trough projecting into the drum and feeding the material on one side of the roller, and a chute attached to the trough and extending upward between the two sets of cups, substantially as described.

5. A grinding-mill having a rolling-drum, one side of which is slightly tapered, a roller located within the drum, a perforated gage-plate held within the drum and directly adjacent to the tapered side thereof, the diameter of the gage-plate being equal to the diameter of the drum, and a series of cups attached to the gage-plate and lifting the material upward from the roller, substantially as described.

6. A grinding-mill having a turning drum, a roller located within the lower portion of the drum, a perforated gage-plate located within the drum, the diameter of the gage-plate being equal to the diameter of the drum, and a series of cups carried by the gage-plate and lifting the material upward from the roller, substantially as described.

WILLIAM HENRY COWARD.

Witnesses:
C. G. CLARK,
T. W. KENNARD.