No. 810,830. PATENTED JAN. 23, 1906.

J. C. WEGERIF.

PAN AND ROLLER MILL FOR CRUSHING AND GRINDING.

APPLICATION FILED MAY 12, 1905.

2 SHEETS—SHEET 1.

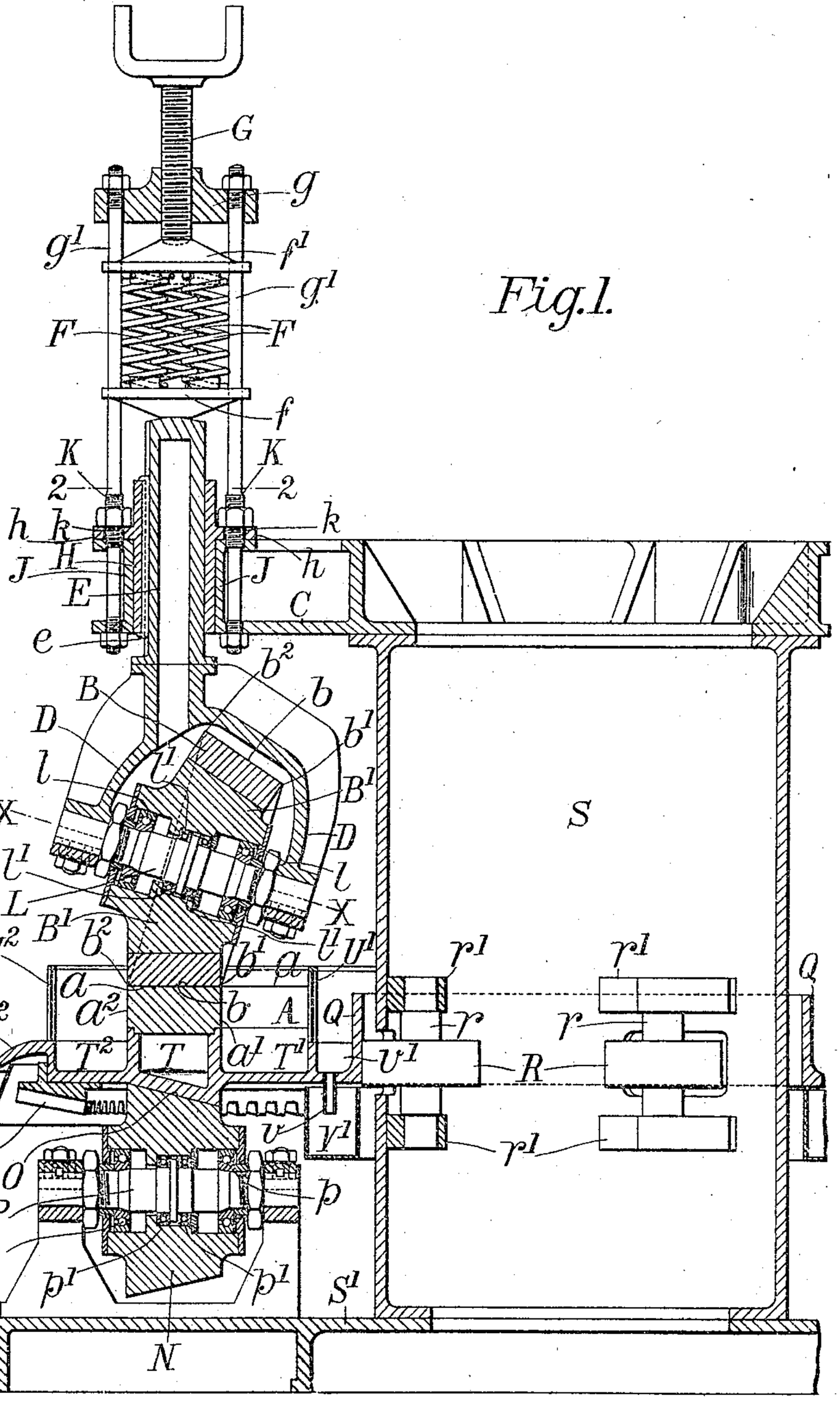


Fig. 1.

WITNESSES:

W. M. Avery

A. H. Davis

INVENTOR

Johannes Christiaan Wegerif

BY

ATTORNEYS

No. 810,830. PATENTED JAN. 23, 1906.

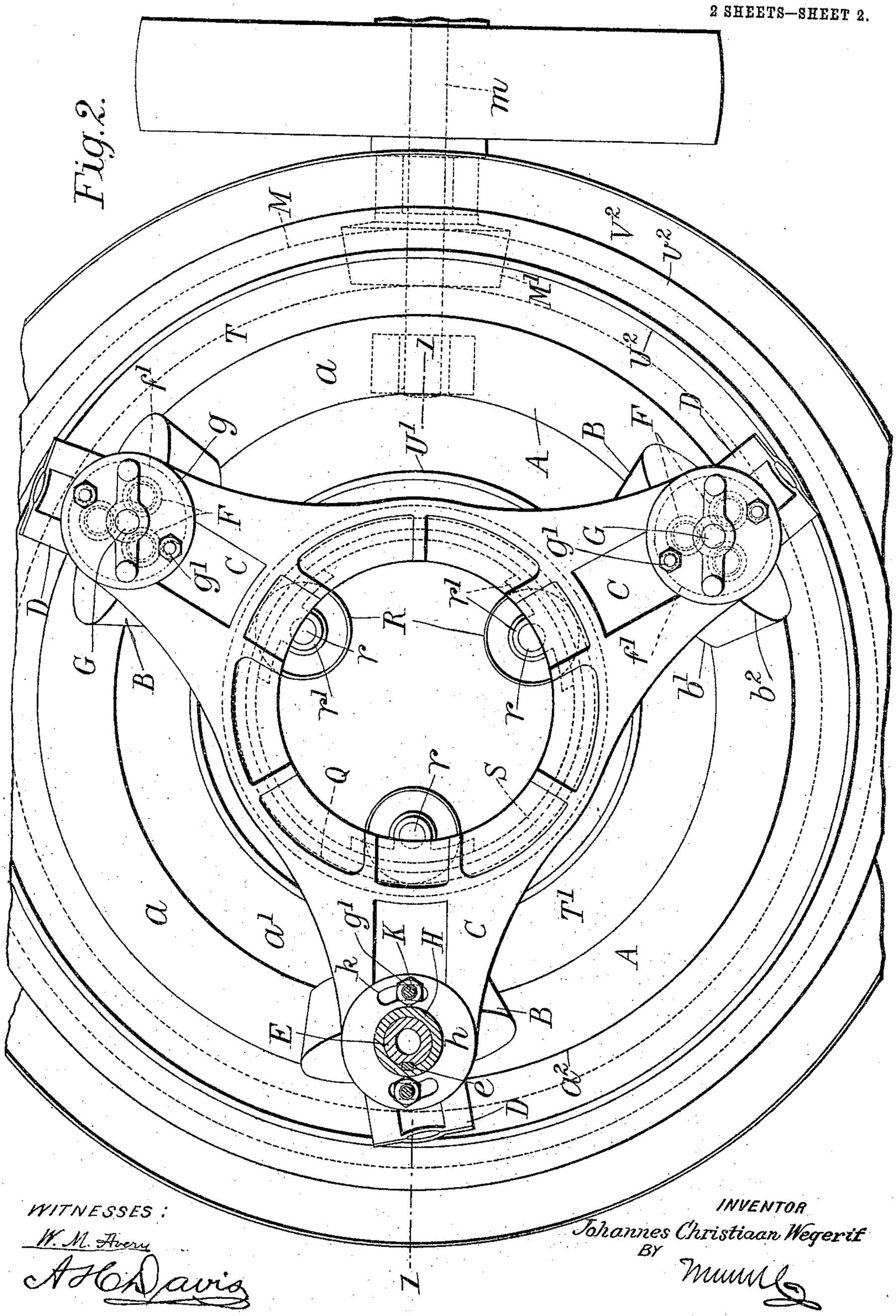
J. C. WEGERIF.

PAN AND ROLLER MILL FOR CRUSHING AND GRINDING.

APPLICATION FILED MAY 12, 1905.

2 SHEETS—SHEET 2.

Fig. 2.



WITNESSES:

W. M. Avery

A. H. Davis

INVENTOR

Johannes Christiaan Wegerif

BY

Munn & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHANNES CHRISTIAAN WEGERIF, OF BATTLESBRIDGE, ENGLAND, ASSIGNOR TO THE RENFREW CRUSHER COMPANY LIMITED, OF LONDON, ENGLAND.

PAN-AND-ROLLER MILL FOR CRUSHING AND GRINDING.

No. 810,830. Specification of Letters Patent. Patented Jan. 23, 1906.

Application filed May 12, 1905. Serial No. 260,079.

To all whom it may concern:

Be it known that I, JOHANNES CHRISTIAAN WEGERIF, engineer, a subject of the King of Great Britain, residing at Rawreth Rectory, Battlesbridge, in the county of Essex, England, have invented certain new and useful Improvements in Pan-and-Roller Mills for Crushing and Grinding, of which the following is a specification.

This invention relates to pan-and-roller mills for crushing and grinding, and has for one of its main objects to enable equality of pressure to be maintained throughout the entire length of the line of bite or mutual contact between pan and roll in a direction normal to the surfaces of both and to insure as far as possible the maintenance of an equal rate of wear of the grinding-surfaces of both the pan and the roll or rolls throughout their entire width.

Another main object of the invention is to provide means whereby each roll may, if desired, be set skewwise relatively to the direction of rotation of the pan (or, in other words, may be so set that the prolongation of its axis will not intersect the axis of the pan) and whereby the degree of such skewing or obliquity of the roll-axis may be varied according to requirements in order that every point in the periphery of the roll may at the moment of its contact with the grinding-surface or race of the pan be moving in a path not tangential to but intersecting at any desired angle the path followed by the corresponding point of the race, with the result that the particles of material under treatment will be subjected not only to the usual crushing stress, but also to a cross-grinding or tensile stress tending to tear each individual particle asunder.

In the accompanying drawings, which illustrate a convenient arrangement of apparatus for carrying the invention into effect, Figure 1 is an elevation of the mill, partly in section on line 1 1 of Fig. 2; and Fig. 2 is a sectional plan view of the same on line 2 2 of Fig. 1 with the overhead pressure-springs of the grinding-rolls removed.

According to the present invention the grinding-surface *a* of the race A is horizontal, while each grinding-roll B is of truncated conical form, the smaller end being toward the interior of the pan and the axis *x x* of the roll having a corresponding downward inclination in the same direction, as indicated, so as to enable parallelism to be maintained between the grinding-faces of the pan and roll at their line of bite. The degree of conicity of each roll relatively to the diameter and width of the grinding-surface *a* of the race is made such as to insure as far as possible an approximately equal rate of wear being maintained throughout the width of both race and roll.

The race A consists of an annular block or die upstanding from the bottom of the pan, the inner and outer faces *a'* a^2 of the race being perpendicular to the grinding-surface *a*, so that as the surface *a* is worn away parallel to itself its width will remain unaltered. Similarly, the marginal portions of the inner and outer ends *b'* b^2 of each roll B are made normal to the grinding-surface *b*, the inner end *b'* being concavely and the outer end convexly coned, as shown, so that as the surface *b* is worn away parallel to itself its width will remain unaltered.

Each roll B is mounted with the acting portion of its grinding-surface *b* directly over that of the race, the center of the one coinciding with that of the other, as indicated, and the relative widths of the grinding-surfaces *a* and *b* of the race and rolls, respectively, are made such that when a roll is set skewwise, so as to produce a cross-grinding effect, as before mentioned, the action of the roll will not be liable to cause the formation of a groove or step on the surface of the race, or vice versa.

In order that the pressure exerted by or through the roll may act in a direction normal to the surfaces *a* and *b* at their line of bite or mutual contact and may also be equally distributed over the length of said line, each roll B is mounted, preferably, in a U-shaped frame or yoke D, which straddles the roll and is attached to or integral with an upwardly-extending vertical ram E, the downward prolongation of whose axis intersects perpendicularly the horizontal line of bite at the center of the latter, as shown. The ram E is fitted to slide through a bearing provided in an overhead member C of the framing of the mill, elastic pressure being applied, if necessary, to the ram, so as to reinforce the weight of the roll. For this purpose it is

preferred to employ a battery of, say, three helical springs F, confined between a plate *f*, bearing upon the upper end of the ram E, and a plate *f'*, which takes its abutment against a screw G. The latter passes vertically through a cross-head *g*, mounted directly above the ram upon rods *g'*, attached to the framing of the mill, the screw G being adjustable—as, for instance, by means of a crank-handle fast upon it—and the plates *f f'* being guided by the rods *g'*.

To permit of the skewwise adjustment of the rolls (as before mentioned) being effected, the ram E has a groove-and-feather or equivalent connection, (as at *e*, Fig. 2,) with a bush H, which is rotatably mounted in a bearing J in the frame, so that while the ram E is free to slide vertically through the bush H in accordance with the rise and fall of the roll B as the latter passes over the material presented to it upon the race A the angular position of the axis *x x* of the roll as viewed in plan will be dependent upon the angular adjustment of the bush H in the bearing J. This adjustment may be effected and maintained by any convenient means, the bush being locked in position after adjustment by means, for example, of clamping bolts or studs K screwing into tapped holes in the framing F and passing through segmental slots *k* in a flange *h* integral with the bush H. In the example illustrated the bolts K are integral with and form downward prolongations of the rods *g'*, already mentioned. The length of the ram E and its capacity for sliding through the bush H are made sufficient not only to permit of the rise and fall of the roll B during the working of the mill, as above mentioned, but also to allow of the roll descending permanently in consequence of the reduction in its diameter and the lowering of the level of the race A due to wear.

Each roll B is preferably mounted to rotate on a dead-axle L, fixed in the yoke D, the rotation being produced by frictional contact of the roll with the race A and the material spread thereon. Preferably the roll comprises a renewable outer shell B, fixed on an inner body portion B', ball-bearings being interposed, as at *l l l' l'* between the roll-body B' and the axle L, so as to reduce friction while counteracting the tendency of the roll to move lengthwise of its axis.

The pan is rotated, preferably, from beneath by means of bevel-gearing, as shown, a ring of teeth M on the under side of the pan toward its outer periphery being engaged by a bevel-pinion M', keyed on a horizontal shaft *m*, extending radially of the pan, as indicated. The weight of the pan is supported by antifriction-rollers N, which are of conoidal form with their smaller ends toward the center of the pan, the conicity of these rollers being made such as to insure as far as possible uniformity of wear throughout their own width and that of the correspondingly-coned annular bearing-surface O, with which they contact at the under side of the bottom of the pan. The antifriction-rollers N may be set at any convenient points around the circumference of the pan; but it is desirable that one roller N should be placed directly beneath each grinding-roll B, as indicated. Each roller N is preferably mounted to rotate on a dead-axle P, carried by the foundation frame of the mill, ball-bearings, as at *p p p' p'* being interposed between the roller and axle, as already described with reference to grinding-rolls B.

The pan is of annular trough-like form in cross-section and in consequence of the conicity of the bearing-surface O, whereby it rests on the rollers N, is self-centering. As a safeguard, however, against lateral displacement the inner margin of the pan may be provided with a vertical cylindrical rim Q, (which may form the inner wall of the pan itself, as indicated,) adapted to take a bearing against a series of (say three) antifriction-rollers R, rotatably mounted on vertical spindles *r*, journaled in bearings *r'*, carried by the central member S of the mill-framing, the depth of the rim Q or the width of the rollers R being sufficient to allow for descent of the pan in consequence of wear of the rollers N and bearing-surface O. The member S consists, preferably, of a cylindrical pillar of relatively larger diameter, so as to practically fill the circular space left in the center of the annular pan, the bearings *r'* being mounted on the inner side of the pillar S and the rollers R projecting through apertures in the wall of the pillar. The latter rises from the base S', which carries the rollers N and supports at its upper end laterally-projecting cantaliver arms C, in which, as before stated, are provided the bearings J. This arrangement while providing a central member S, having great strength and stability, enables all framework outside the periphery of the pan to be dispensed with, and consequently simplifies the construction of the mill and facilitates access to the pan from outside.

The level of the grinding-surface *a* of the race A is preferably made not lower than the normal level of the liquid in the pan in order that the distribution upon the race of the material under treatment may not be affected by waves created in the liquid by the revolution of the pan. This raising of the race results in the pan comprising an inner trough T' and an outer trough T^2, separated from one another by the race A (or by the annular rib or ribs T supporting the race) and bounded, respectively, by inner and outer screens U' U^2, formed of or covered with straining fabric, the screens extending beyond the highest level attained by the liquid in the pan. This liquid which holds the ground particles in suspension passes through the screens U' U^2 and flows into suitable station-

ary annular launders V′ V² for conveyance to any desired point, the liquid in the inner trough T′ being discharged into the inner launder V′ through nozzles *v*, fixed in holes in the bottom of the trough *v′*, comprised between the inner screen T′ and the inner wall Q of the pan, while the liquid in the outer trough T² is free to overflow into the outer launder V², to which it is delivered by the dependent outer lip *v²* of the pan, which according to this arrangement requires no wall at its outer periphery.

The distribution upon the grinding-surface *a* of the race of the material under treatment may be effected by any suitable means.

I claim—

1. In a pan-and-roller mill, the combination with a pan provided with a horizontal grinding-face upstanding from the bottom of the pan and having its inner and outer faces vertical, of a grinding-roll of truncated conical form disposed with its smaller end toward the interior of the pan, the axis of the roll being set skewwise in the pan and at such an inclination as to enable parallelism to be maintained between the grinding-faces of the pan and roll at their line of bite, the relative widths of said faces being adapted to prevent the formation of a groove or step on either of them, and the marginal portions of the inner and outer ends of the roll being respectively concave and convex so as to be normal to the grinding-face; a dead-axle whereon the roll is mounted to rotate; a yoke-frame straddling the roll and carrying the ends of said axle; a vertical ram integral with said yoke-frame and having its axis alined to intersect the line of bite of the pan and roll at the center of said line; and a bearing in the frame of the mill adapted to permit of said ram moving vertically without turning, substantially as described.

2. In a pan-and-roller mill the combination with each grinding-roll of a yoke-frame wherein the roll is mounted to turn on its own axis, a vertical ram integral with said frame and having its axis alined to intersect the line of bite of the pan and roll at the center thereof, a bush in which the ram is splined so as to be free to slide without turning, a bearing in the frame of the mill wherein said bush is fitted to rotate, and means for angularly adjusting said bush in its bearings so as to enable the roller to be set skewwise in the pan, substantially as specified.

3. In a pan-and-roller mill the combination with each grinding-roll of a yoke-frame wherein the roll is mounted to turn on its own axis, a vertical ram integral with said frame and having its axis alined to intersect the line of bite of the pan and roll at the center thereof, a bush in which the ram is splined so as to be free to slide without turning, a bearing in the frame of the mill wherein said bush is mounted to rotate, means for angularly adjusting the bush or sleeve in said bearing so as to enable the roller to be set skewwise in the pan, and means for applying adjustable spring-pressure to the ram so as to reinforce the weight of the roll, substantially as specified.

4. In a pan-and-roller mill the combination with an annular pan having a vertical inner wall bounding its central aperture and a conoidal bearing-surface on its under side, of supporting-rollers for the pan of truncated conical form mounted to rotate on bearings carried by the foundation of the mill, and adapted to contact with the conoidal bearing-surface of the pan, an upright hollow cylindrical pillar carried by the foundation of the mill concentric with the pan and extending through its central aperture so as to occupy approximately the entire area thereof, openings in the wall of said pillar, and antifriction-rollers mounted to turn on vertical axes so as to project through said openings to contact with the vertical inner wall of the pan, substantially as specified.

5. In a pan-and-roller mill the combination of an annular pan, an upright cylindrical pillar carried by the foundation of the mill concentric with the pan and extending through its central aperture so as to occupy approximately the entire area thereof, a cantaliver arm projecting from the upper part of said pillar over the pan, a grinding-roll adapted to coact with a race in the pan, a yoke-frame wherein said roll is mounted to turn on its own axis, a vertical ram integral with said frame, a bush wherein said ram is splined so as to be free to slide without turning, a bearing in said cantaliver arm wherein said bush is fitted to rotate, and means for angularly adjusting said bush in its bearing so as to enable the grinding-roll to be set skewwise in the pan, substantially as specified.

JOHANNES CHRISTIAAN WEGERIF.

Witnesses:
H. D. JAMESON,
A. NUTTING.