No. 705,870. Patented July 29, 1902.

J. F. SANDERS.

CRUSHING AND PULVERIZING MILL.

(Application filed May 10, 1901.)

(No Model.) 2 Sheets—Sheet 1.

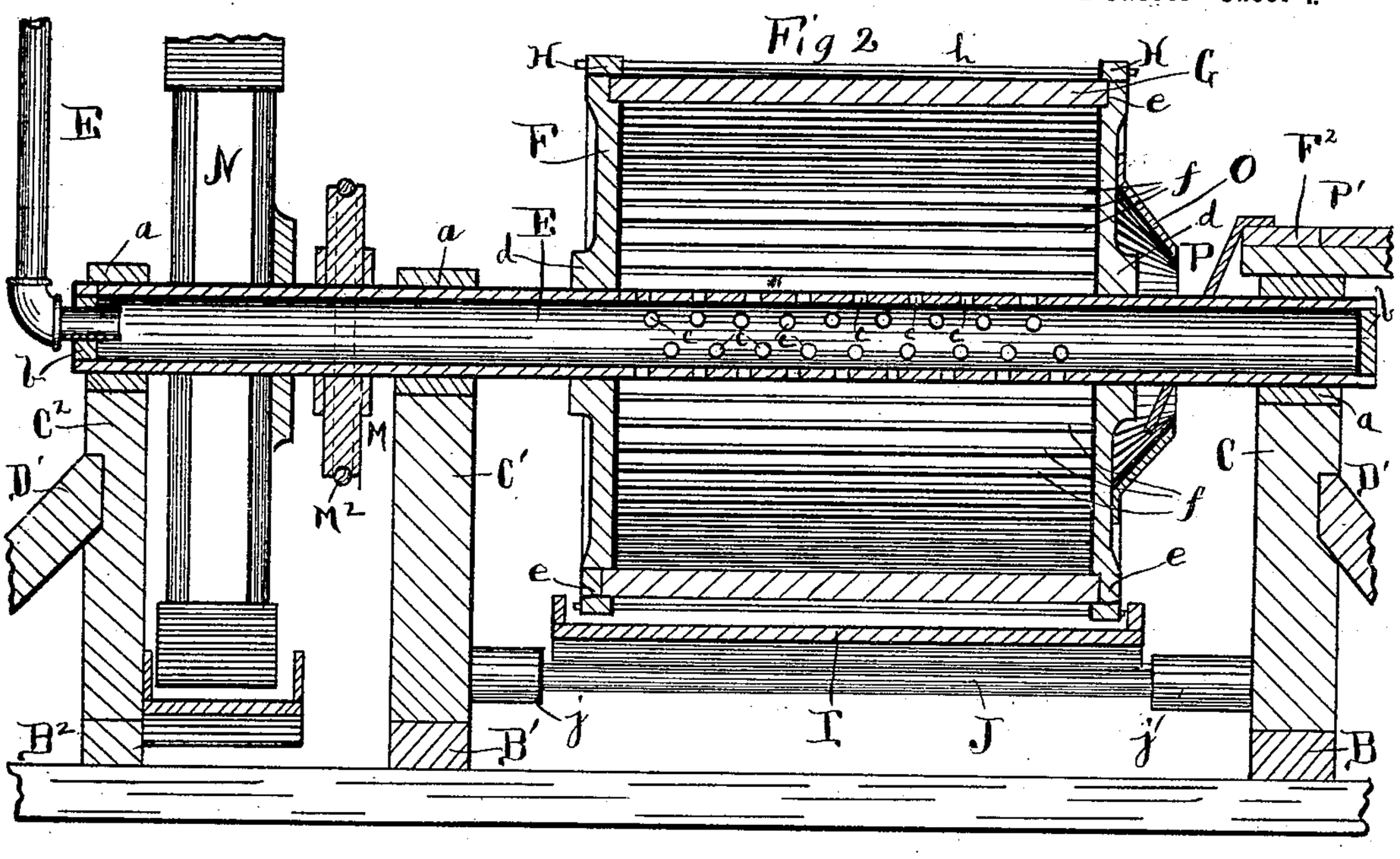
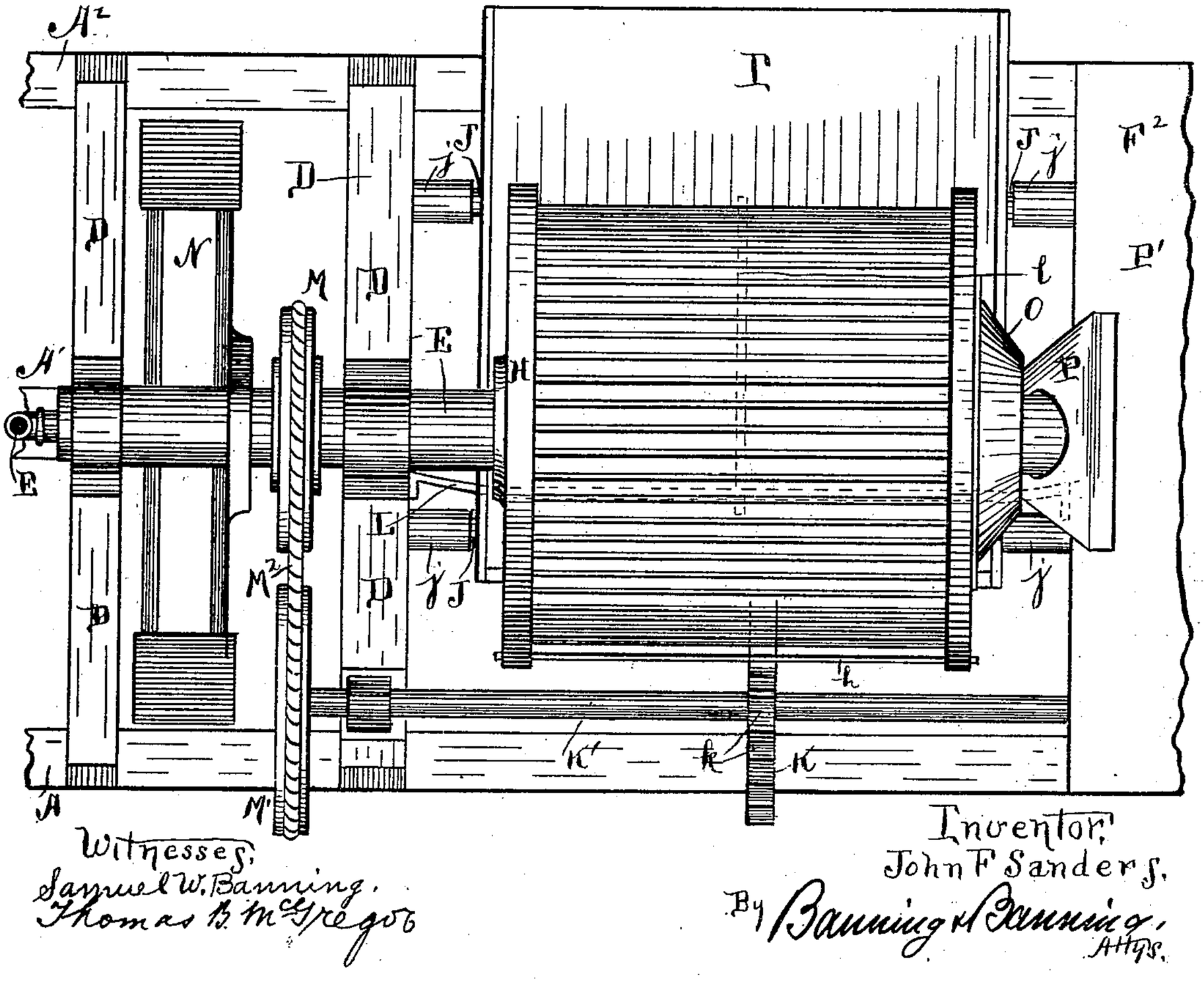


Fig. 1.



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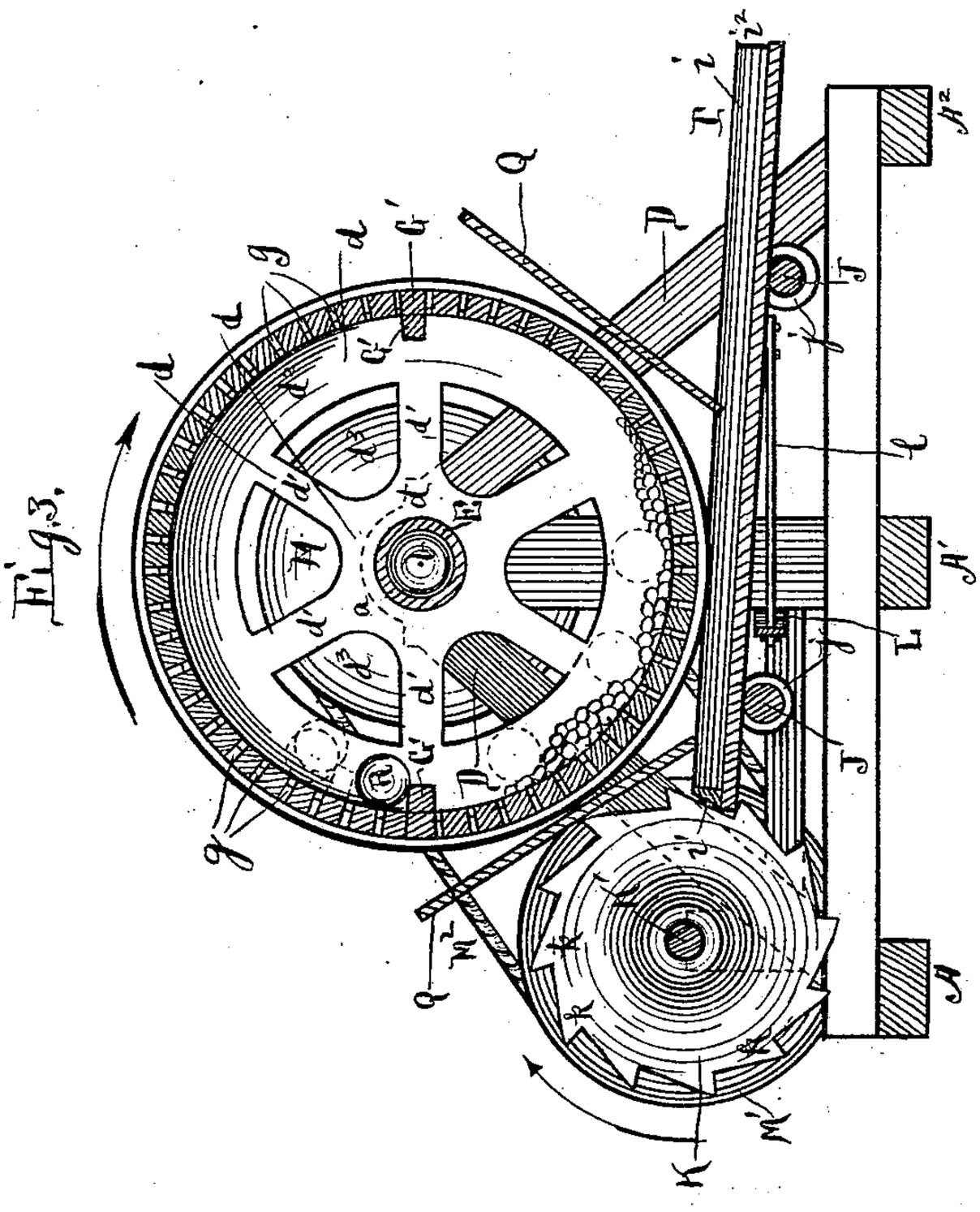

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UNITED STATES PATENT OFFICE.

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CRUSHING AND PULVERIZING MILL.

SPECIFICATION forming part of Letters Patent No. 705,870, dated July 29, 1902.

Application filed May 10, 1901. Serial No. 59,611. (No model.)

To all whom it may concern:

Be it known that I, JOHN F. SANDERS, a citizen of the United States, residing at Boise, in the county of Ada and State of Idaho, have invented a certain new and useful Improvement in Crushing and Pulverizing Mills, of which the following is a specification.

This invention relates to that class of crushing and pulverizing mills used more particularly in breaking, crushing, and pulverizing ore, rock, and other like material or substances, and is especially adapted and intended for use in localities where skilled labor is scarce and transportation facilities inadequate, and has for its objects to construct a mill of the class specified which will be of simple formation, consisting of few parts, and which will be inexpensive to manufacture and which will require in order to use it but little mechanical skill on the part of the operator and by the use of which more beneficial, better, and greater results will be obtained; and the invention consists in the features and details of construction and combination of parts hereinafter described and claimed.

In the drawings, Figure 1 is a plan view of a crushing and pulverizing mill embodying my invention. Fig. 2 is a longitudinal sectional elevation taken on line 2 of Fig. 1 looking in the direction of the arrow, and Fig. 3 is a transverse sectional elevation taken on line 3 of Fig. 1 looking in the direction of the arrow.

The mill, as shown, is constructed with a framework consisting of a foundation or base of three longitudinal beams A A′ A^2 and three cross or transverse beams B B′ B^2, each of which has extending up therefrom at its center an upright or post, making at the center and longitudinal of the frame three uprights or posts C C′ C^2, and, as shown, all of these uprights or posts are firmly held and supported by diagonal lateral braces D, one on each side of each upright or post, and the end uprights or posts each have an endwise support by a diagonal brace D′ between the upright or post and the center longitudinal sill.

A tubular shaft E, of steel or other suitable material, is mounted in journal boxes or bearings *a* on the upper ends of the uprights or posts, so as to be free to revolve, and this shaft at each end is closed by a stopper or plug *b*. This tubular shaft for a portion of its length has through its wall perforations *c*, and one of the stoppers or plugs has entered therethrough a suitable pipe E′, by means of which water can be supplied to the interior of the pipe E to discharge through the perforations or holes *c* for a purpose hereinafter described. The tubular shaft on each side of the perforated portion or section thereof has secured thereto a cylinder or drum head F, each head having a center or hub *d*, by means of which and a spline or key or in some other suitable manner the heads are firmly held in place on the shaft, so as to revolve therewith, and extending out from the center or hub are radial arms or spokes *d′*, attached to a circumferential rim d^2, leaving openings d^3 between the arms or spokes and the center or hub and the rim.

Each head on its inner face at its circumference is provided with a concentric groove *e*, in which grooves are entered the ends of a series of bars G, forming the body or wall of the cylinder or drum. The bars have between them interstices or spaces *f*, which can be varied as to width by means of shims or adjusting-plates *g*, placed between the ends of the bars in the grooves of the head, so that by moving the shims or adjusting-plates the width of the space or interstice between two adjacent bars can be increased or decreased, so as to regulate the size of the particles of ore screened through the cylinder or drum at the interstices or spaces. As shown, two of the bars for the body or wall of the cylinder or drum are wider than the remaining ones, and the extra width projects inside of the cylinder or drum, as shown in Fig. 3, and form out of the inwardly-projected portion a rest or shelf G′, for a purpose hereinafter described. The bars forming the body or wall of the cylinder, after their ends have been entered in the grooves therefor of the heads, are secured in place and firmly held in the construction shown by hoops or bands H, which fit snugly around the heads and over the ends of the bars. These hoops or bands can be applied to the cylinder or drum heads by heating and then driving them while hot onto the heads to encircle the ends of the

bars and after driving the hoops or bands to place allowing them to cool and shrink onto the cylinder or drum heads, making a snug tight fit and holding the longitudinal bars firmly in place, and, as shown, the hoops or bands are further secured in place by tie or draw rods *h*, which may be fastened by riveting down the ends or by nuts screw-threaded onto the ends of the rods or in any other suitable manner.

The construction of mill illustrated is one adapted and intended for use in operating on gold ore in extracting the gold, and for this purpose an amalgamating-plate I is employed. This plate I, as shown, is carried by a reciprocating table or cradle, having on each side a guard or wall *i* and having a guard or wall *i'* at the receiving end, with the discharge end open, so as to allow the pulverized material deposited upon the plate to be discharged therefrom, leaving the gold on the plate. The table or cradle I' is supported on rollers J, located on the under side of the table or cradle and mounted in suitable bearings therefor on the base or framework of the mill, and, as shown, each roller has at each end an enlargement *j*, between which the amalgamating-plate and its table or cradle is located and by which it is maintained in a straight line of reciprocation. The table or cradle in the arrangement shown is given its advance travel or throw by means of a wheel K, mounted on a shaft K' and having its periphery provided with a series of inclines *k*, so that as the wheel K is revolved its inclines *k* are successively brought into engagement with the end wall *i'* or the end of the table or cradle, forcing it forward on the rollers J until the drop-off end of the engaged incline is reached, when the cradle will be returned to its normal position by the action of a bow-shaped spring L, through which a rod *l* passes and has on its projected end a head or nut to engage the face of the spring while its other end is attached to the under side of the bottom of the table or cradle, so that the rod moves with the forward-and-back travel of the table or cradle.

The tubular shaft E has fixed thereon a driving-pulley M, from which a driving-belt M' runs over a driving-pulley M^2 on the shaft K', so that with the rotation of the tubular shaft the shaft K' will be driven, revolving the wheel K and operating the amalgamating-plate. The tubular shaft in the construction shown is driven by a water-wheel N, and where running water is obtained a water-wheel will furnish the necessary power; but a steam, electric, or other suitable engine or motor can be employed for driving the tubular shaft, and the revolving of the tubular shaft revolves therewith the cylinder or drum and actuates the amalgamating-plate.

The head F at one end of the cylinder or drum in the construction shown has secured thereto a converging rim or annular plate forming a funnel or hopper O, into which is entered the end of a spout or chute P for the purpose of depositing the ore into the interior of the cylinder or drum of the mill, the ore being taken from a floor or platform P', from which the spout or chute depends. The cylinder or drum on each side has inclined guide or dash boards Q, by means of which the pulverized ore and water escaping from the cylinder or drum will be prevented from splashing or spattering, so that the machinery will be protected against the effects of any splashing or spattering of the water, and at the same time all of the discharged pulverized material will be so directed as to pass onto the amalgamating-plate for operation thereon.

The operation of the mill for use in pulverizing ore and extracting gold is as follows: The ore containing the gold and which is to be pulverized in order to extract the gold therefrom is discharged from the floor or platform P' into the hopper or funnel N by the spout or chute O, and from the hopper or funnel the ore enters the interior of the cylinder or drum through the openings between the radial arms or spokes of the cylinder-head and when the required quantity of ore has been deposited in the cylinder or drum the power is started to rotate the tubular shaft and revolve the cylinder or drum. A stream of water is allowed to flow into the tubular shaft from the pipe E', and the water so entering the tubular shaft flows out through the perforations or holes *c* into the interior of the cylinder or drum and escapes through the interstices or spaces between the longitudinal bars forming the body or wall of the cylinder or drum, carrying with it the loose gravel and pulverized portions of the ore for the gravel and pulverized portions so discharged from the cylinder or drum to drop onto the amalgamating-plate. The amalgamating-plate at the same time is reciprocated by the operation of its actuating-wheel, with the result that the gravel and waste portions from the pulverized ore are washed away, leaving any gold that there may be caught on the amalgamating-plate. After the gravel and pulverized portions of the ore and other loose material have been washed away the larger pieces of ore are left in a condition so that with the revolving of the cylinder or drum they commence to grind one against the other, thereby pulverizing them more or less, and in the operation with the revolving of the cylinder or drum some of the pieces of ore will be caught by and carried up on the rests or shelves G' until a rest or shelf reaches a position above the horizontal, as shown by the dotted lines in Fig. 3, at which point the caught pieces of ore will fall from the rest or shelf, and such falling will be from a considerable height, causing the larger pieces to break and crush the smaller pieces, thus pulverizing the ore into particles sufficiently small for the particles to pass through the spaces or

interstices between the bars and fall on the amalgamating-plate, where the waste portion will be separated from the gold.

The ore itself where not too hard will furnish the means for pulverizing by the larger pieces falling from the rests or shelves, as above described; but for harder and coarser grades of ore additional breaking and crushing means need to be provided, and such means in the construction shown is furnished by balls R, formed of iron or other suitable material. These balls should be of a sufficient weight, so that when they roll from a rest or shelf and descend to the lower level of the cylinder or drum they will have a breaking and crushing capacity that will effectually pulverize the ore. The balls will be caught on and carried up by the rest or shelf until a point above the horizontal is reached, at which point the balls will fall from the rest or shelf and roll down, breaking, crushing, and pulverizing the ore. The balls will add greatly to the effectiveness of the mill in pulverizing and disposing of hard and coarse grades of ore.

The mill of my invention has a breaking, crushing, and pulverizing capacity unequaled in proportion to the power required to operate it owing to the ore being confined in the cylinder or drum, so that the heavier portions thereof will be caught and raised by the rests or shelves, together with the balls when used, and the heavier pieces of ore and the balls when used by falling from the rests or shelves act to break, crush, and pulverize the ore with the force of their descent. The mill has a greater discharging capacity than that of other mills of the same size, owing to the great freedom provided for the escape of the pulverized particles of ore as soon as they become small enough to pass through the spaces or interstices between the bars, and the discharge of the particles is facilitated and increased by the water which is projected into the interior of the cylinder or drum through the perforations or holes of the hollow shaft. The interstices or spaces, in conjunction with the escaping water, furnish a free and open discharge which will prevent the sliming of the ore, and especially the gold. The discharged pulverized ore is deposited direct onto the amalgamating-plate, which plate by reason of its rapid reciprocating movements causes the fine particles of gold to settle down into the amalgamatum with which the plate is covered, thereby insuring the retention of the gold, while the coarse and worthless material is washed away by the water and discharged at the end of the table or cradle. This amalgamating-plate with its rapid reciprocating movements prevents the washing away of the very fine particles of gold, which otherwise would be carried off with the water and escaping material and lost. The mill is especially adapted for use in sections of the country where water-power is cheap and ready at hand and where skilled labor is expensive and hard to obtain. The mill as a whole is simple in construction and can be easily transported over rough mountain-roads which would be impassable for crushing and pulverizing mills of the usual construction. The mill requires no mechanical ingenuity to assemble the parts, and the parts are constructed so as to have the mill strong and durable and so as to have the danger of breakage reduced to a minimum. These features of simplicity of construction, ease of transportation, facility in setting up, and capability of successfully operating without the requirement of any skilled labor result in a mill possessing advantages and merit over crushing and pulverizing mills of the usual construction.

What I regard as new, and desire to secure by Letters Patent, is—

1. In a crushing and pulverizing mill, the combination of a rotatable cylinder or drum, longitudinal bars set apart to leave spaces or interstices between them and forming the body of the cylinder or drum, supporting-heads one at each end of the cylinder or drum each head having a circular groove open to its periphery or rim and receiving the ends of the bars, a continuous circumferential hoop or band for each head circumscribing the head and the ends of the bars for retaining the bars in place, a rotatable tubular shaft on which the cylinder or drum is mounted, holes or perforations in the shaft within the cylinder or drum, a pipe leading into the shaft for supplying water thereto and discharging the water into the interior of the cylinder or drum through the holes or perforations, an amalgamating-plate located beneath the cylinder or drum, a cam-wheel engaging the end of the amalgamating-plate, a shaft on which the cam-wheel is mounted, and a power connection between the shaft of the cam-wheel and the tubular shaft for revolving the cylinder or drum and reciprocating the amalgamating-plate from a common source of power, substantially as described.

2. In a crushing and pulverizing mill, the combination of a rotatable cylinder or drum, longitudinal bars set apart to leave spaces or interstices between them and forming the body of the cylinder or drum, supporting-heads one at each end of the cylinder or drum receiving and retaining the ends of the bars, a rotatable tubular shaft on which the cylinder or drum is mounted, holes or perforations in the shaft within the cylinder or drum, a water-supply pipe entered into one end of the shaft and discharging water thereinto and escaping the water through the holes or perforations into the interior of the cylinder or drum, openings in one of the heads of the cylinder or drum, a funnel or hopper attached to the head having the openings and revolving therewith and receiving thereinto the ore for depositing the ore within the interior of the cylinder or drum, means for crushing or pulverizing the ore within the cylinder or

drum subject to the action of the discharged water from the tubular shaft, an amalgamating-plate located beneath the cylinder or drum and receiving thereon the pulverized material discharged through the spaces or interstices of the cylinder or drum, a cam-wheel engaging the end of the amalgamating-plate, a shaft on which the cam-wheel is mounted and a power connection between the shaft of the cam-wheel and the tubular shaft for revolving the cylinder or drum and reciprocating the amalgamating-plate from a common source of power, substantially as described.

3. In a crushing and pulverizing mill, the combination of a rotatable cylinder or drum, longitudinal bars set apart to leave spaces or interstices between them and forming the body of the cylinder or drum, supporting-heads one at each end of the cylinder or drum receiving and retaining the ends of the bars, a rotatable tubular shaft on which the cylinder or drum is mounted, holes or perforations in the shaft within the cylinder or drum, a water-supply pipe entered into one end of the shaft and discharging water thereinto and escaping the water through the holes or perforations into the interior of the cylinder or drum, openings in one of the heads of the cylinder or drum, a funnel or hopper attached to the head having the openings and revolving therewith and receiving thereinto the ore for depositing the ore within the interior of the cylinder or drum, means for crushing or pulverizing the ore within the cylinder or drum subject to the action of the discharged water from the tubular shaft, an amalgamating-plate located beneath the cylinder or drum and receiving thereon the pulverized material discharged through the spaces or interstices of the cylinder or drum, a rod attached to the bottom of the amalgamating-plate, a resistance-spring operating against the rod, a cam-wheel engaging the end of the amalgamating-plate, a shaft on which the cam-wheel is mounted and a power connection between the shaft of the cam-wheel and the tubular shaft for revolving the cylinder or drum and reciprocating the amalgamating-plate from a common source of power, substantially as described.

4. In a crushing and pulverizing mill, the combination of a rotatable cylinder or drum, longitudinal bars set apart to leave spaces or interstices between them and forming the body of the cylinder or drum, supporting-heads one at each end of the cylinder or drum receiving and retaining the ends of the bars, a rotatable tubular shaft on which the cylinder or drum is mounted, holes or perforations in the shaft within the cylinder or drum, a water-supply pipe entered into one end of the shaft and discharging water thereinto and escaping the water through the holes or perforations into the interior of the cylinder or drum, openings in one of the heads of the cylinder or drum, a funnel or hopper attached to the head having the openings and revolving therewith and receiving thereinto the ore for depositing the ore within the interior of the cylinder or drum, means for crushing or pulverizing the ore within the cylinder or drum subject to the action of the discharged water from the tubular shaft, an amalgamating-plate located beneath the cylinder or drum and receiving thereon the pulverized material discharged through the spaces or interstices of the cylinder or drum, rollers on which the amalgamating-plate is supported one of the rollers located in a higher plane than the other, a cam-wheel engaging the end of the amalgamating-plate, a shaft on which the cam-wheel is mounted and a power connection between the shaft of the cam-wheel and the tubular shaft for revolving the cylinder or drum and reciprocating the amalgamating-plate from a common source of power, substantially as described.

5. In a crushing and pulverizing mill, the combination of a rotatable cylinder or drum, longitudinal bars set apart to leave spaces or interstices between them and forming the body of the cylinder or drum, supporting-heads one at each end of the cylinder or drum receiving and retaining the ends of the bars, a rotatable tubular shaft on which the cylinder or drum is mounted, holes or perforations in the shaft within the cylinder or drum, a water-supply pipe entered into one end of the shaft and discharging water thereinto and escaping the water through the holes or perforations into the interior of the cylinder or drum, openings in one of the heads of the cylinder or drum, a funnel or hopper attached to the head having the openings and revolving therewith and receiving thereinto the ore for depositing the ore within the interior of the cylinder or drum, means for crushing or pulverizing the ore within the cylinder or drum subject to the action of the discharged water from the tubular shaft, an amalgamating-plate located beneath the cylinder or drum and receiving thereon the pulverized material discharged through the spaces or interstices of the cylinder or drum, rollers supporting the amalgamating-plate one of the rollers located in a higher plane than the other, a rod attached to the under side of the amalgamating-plate, a resistance-spring operating against the rod, a cam-wheel engaging the end of the amalgamating-plate, a shaft on which the cam-wheel is mounted and a power connection between the shaft of the cam-wheel and the tubular shaft for revolving the cylinder or drum and reciprocating the amalgamating-plate from a common source of power, substantially as described.

6. In a crushing and pulverizing mill, the combination of a rotatable cylinder or drum, longitudinal bars set apart to leave spaces or interstices between them and forming the body of the cylinder or drum, supporting-heads one at each end of the cylinder or drum receiving and retaining the ends of the bars, a rotatable tubular shaft on which the cylin-

der or drum is mounted, holes or perforations in the shaft within the cylinder or drum, a water-supply pipe entered into one end of the shaft and discharging water thereinto and escaping the water through the holes or perforations into the interior of the cylinder or drum, openings in one of the heads of the cylinder or drum, a funnel or hopper attached to the head having the openings and revolving therewith and receiving thereinto the ore for depositing the ore within the interior of the cylinder or drum, means for crushing or pulverizing the ore within the cylinder or drum subject to the action of the discharged water from the tubular shaft, an amalgamating-plate located beneath the cylinder or drum and receiving thereon the pulverized material discharged through the spaces or interstices of the cylinder or drum, a cam-wheel engaging the end of the amalgamating-plate, a shaft on which the cam-wheel is mounted a power connection between the shaft of the cam-wheel and the tubular shaft for revolving the cylinder or drum and reciprocating the amalgamating-plate from a common source of power, and deflecting-plates one on each side of the cylinder or drum at the bottom thereof with their lower ends adjacent to the upper face of the amalgamating-plate for guiding the material discharged from the cylinder or drum onto the amalgamating-plate, substantially as described.

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