(No Model.)

B. S. LAWSON.

GRINDING MILL.

No. 346,854. Patented Aug. 3, 1886.

Fig: 1.

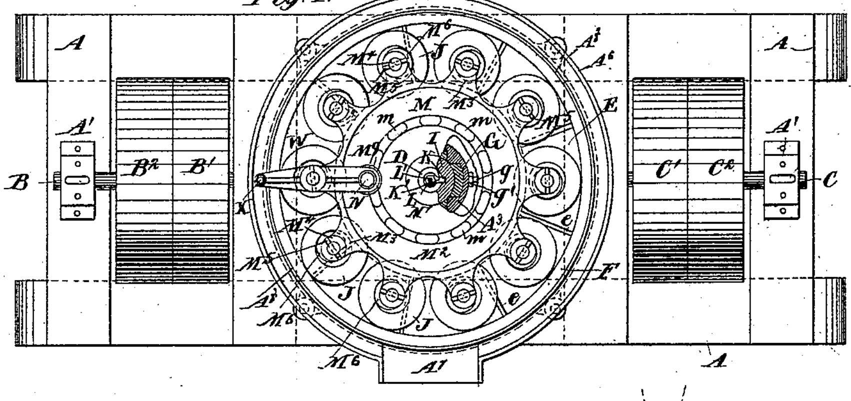


Fig: 2.

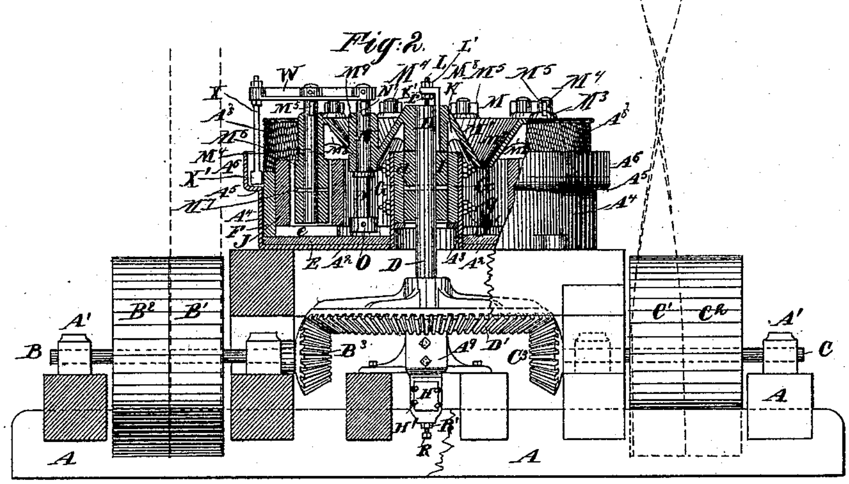


Fig: 3.

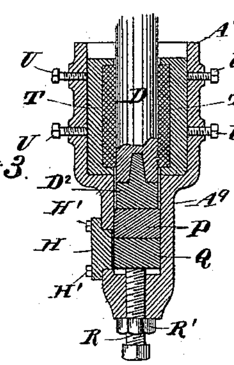


Fig: 4.

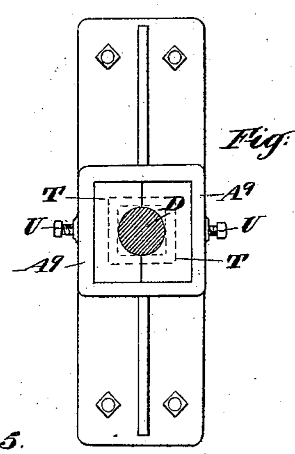
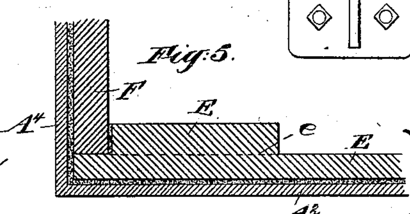


Fig: 5.



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UNITED STATES PATENT OFFICE.

BENJAMIN S. LAWSON, OF BROOKLYN, NEW YORK.

GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 346,854, dated August 3, 1886.

Application filed October 21, 1885. Serial No. 180,514. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN S. LAWSON, of Brooklyn, Kings county, in the State of New York, have invented a certain new and useful Improvement in Grinding-Mills, of which the following is a specification.

My improved machine is intended more particularly for grinding ores, and I will describe it as so used; but the whole or some portions of the invention may be of service in grinding other materials. The mill is of that class in which the material is treated with a liberal quantity of water—a flow of the water outward, bearing the finer particles of the ore, being permitted through a screen of wire-gauze or other uniformly foraminous material. The grinding is effected by a series of rollers, with their axes vertical, traversed around in the interior of a larger hollow cylinder, held with its axis vertical.

The accompanying drawings form a part of this specification, and represent what I consider the best means of carrying out the invention.

Figure 1 is a plan view of a machine constructed according to my invention, with a small portion broken out to show the interior in horizontal section. Fig. 2 is a corresponding central vertical section, partly in elevation. The remaining figures show details on a larger scale. Fig. 3 is a central vertical section through the lower portion of the spindle or upright shaft and parts immediately adjacent. Fig. 4 is a plan view of the same. Fig. 5 is a vertical section through a portion of the stationary grinding-surfaces and the cement and casing adjacent.

Like letters of reference indicate similar parts in all the figures where they occur.

A is a fixed frame-work, which may be made largely of timber.

B and C are horizontal shafts mounted in fixed bearings A′, and equipped with fast pulleys B′ C′ and loose pulleys B^2 C^2. These shafts are in line with each other, and are provided on their inner ends with bevel gear-wheels B^3 C^3. These both engage with a larger bevel gear-wheel, D′, fixed on an upright shaft, D, which constitutes the axis or center of the mill. The rotary motion communicated through this shaft D effects the reception and distribution, the powerful grinding, and the delivery of the minutely-divided material mingled with water.

The grinding is effected in a casing of wrought or cast iron, which is annular in plan.

A^2 is the bottom plate; A^3, a peculiarly-formed portion extending up near the center; A^4, a larger hollow cylinder, which extends upward from the periphery of the bottom A^2. There is an annular offset, A^5, which enlarges the diameter of the upper part.

A^6 is a hollow cylinder extending upward from the periphery of A^5. A spout, A^7, leads from a rectangular notch in one side of this enlarged portion A^5 A^6.

A^8 is an upright cylinder of wire-gauze, having a diameter equal to the part A^4 and fixed thereon so as to form an upward extension therefrom. The fine material, when sufficiently ground, moves outward with a small quantity of water through the uniformly small openings in screen A^8, and is received in the annular trough between this and cylinder A^6, ready to be delivered through the spout A^7.

On the bottom plate, A^2, is placed a thick annular casting of strong and hard material. I propose for ordinary cases to employ for this plate a casting of iron alloyed with zinc, known as "franklinite," obtainable in any desired quantities in New Jersey and other favorable localities. This plate is marked E. The portion lying under the traversing cylinders is thicker than the portion exterior or interior thereto. The rabbet near the periphery of E receives the lower edge of a stout hollow cylindrical casting of franklinite or analogous strong and hard material, (marked F.) These castings E and F constitute the fixed grinding-surfaces of my mill. They are bedded and held in their respective places by a mode of fastening known as "rusting"—that is to say, I work up a mass of iron filings or turnings with water and sal-ammoniac, and coat the upper surface of the annular plate A^2 and the bottom surface of the annular casting E and apply them together. The rabbeted joint by which the parts E and F match together is also similarly coated and joined. So, also, are the adjacent faces of the parts A^4 and F. This means of joining parts is peculiarly effective in this combination. It gives an unusually substantial character to the structure. The part A^3, extending up in the center, surrounds the shaft D, leaving a considerable space between. The exterior of A^3 is cylindrical. The interior is recessed to form housings for adjustable bearing-pieces G, which may be adjusted by screw-bolts g and nuts g', so as to drive them inward to make a close fit against the interior revolving part or parts, and to allow their adjustment inward from time to time to compensate for wear.

The upright shaft D may be of wrought-iron or semi-steel. A key, d, extends transversely through it and through a surrounding bushing of franklinite or other strong and hard material, (marked I.) This bushing, turning with the shaft, receives the friction of the bearing-pieces G. As it wears away, the latter may be adjusted inward to maintain a proper contact. When too much worn, the bushing I may be renewed, and the bearing-pieces G are then set out nearly or quite to their original positions or renewed, or both.

A casting, M, which may be ordinary tough cast-iron, keyed on the upper end of the shaft D, performs important functions. There is an annular depression, giving a **V**-shaped section, M' M^2. Exterior to M^2 is a series of uniformly-spaced projecting arms, M^3, each carrying a boss, which forms a substantial support for a vertical arm, M^4, extending down so as nearly to touch the high part of the stationary grinding-plate E. The bolt M^4 is held against turning by a transverse key, M^5, which fits in notches in the top of M^3. The portion of M^4 which extends below M^3 receives an eccentrically-mounted shoe, M^6, of franklinite. It is reliably secured on M^4 by a transverse key, M^7. Loosely surrounding each shoe M^6 is a loose hollow cylinder or upright roller of franklinite, J.

In the bottom of the **V**-shaped annular depression formed by M' M^2 is a series of apertures, m.

Webs M^8 (see Fig. 2) bridge across angular spaces in the casting, as will be readily understood, so as to afford ample strength and stiffness.

Each eccentric shoe M^6 is arranged to stand in front or in advance of the center of the corresponding arm, M^4. The rubbing action of the inner surface of the corresponding hollow roll, J, against this shoe contributes to the grinding action of the mill, and in doing so abrades or cuts away the material of the roll on the inner face. The abrasive effect is still more marked on the forward side of the shoe M^6. The eccentric position of this shoe compensates for the rapid wear occurring all on one side.

A counter-shaft, (not represented,) driven by a steam-engine or other suitable power, communicates motion by one open belt and one cross-belt (partly shown in dotted lines in Fig. 2) to the pulleys B' C', and consequently to the shafts B C. It will be understood that the shafts B C are rotated strongly and uniformly in opposite directions one to the other. Their respective gear-wheels B^3 C^3 engage at opposite points with the gear-wheel D'. Both contribute equally to impart rotary motion to the shaft D. It follows that there is no side strain on the latter. The bushing I, which surrounds the top, and the step, now to be described, at the bottom, have only to steady the motion. They are not subjected to any strong and constant side strain. The casting M is fixed on the upper end of the shaft D by the aid of a spline-key, K, formed, as shown, with a stout lateral arm, K', extending inward from its upper end. To engage the parts, the key is driven down tightly. To disengage them, the key is lifted by a lever or other means applied under the arm K'. I have shown a screw-bolt, L, tapped in the upper end of the shaft D and carrying nuts L' L^2, which engage the arm K'. Such arrangement holds the key reliably against ever being displaced, and affords a means of lifting the key by the working of the nuts, if desired. The step at the bottom of the shaft D is important. I provide a casing, A^9, of cast-iron, with an opening in one side thereof, covered with a plate, H, secured by efficient screw-bolts H', making an oil-tight joint. The lower end of the shaft D is steadied by babbitted bars T, adjusted by screws U, tapped through the casing A^9. In the bottom of the step in the line of the axis of the shaft is set a stout adjusting-screw, R, firmly held in the required position by a jam-nut, R'. The considerable weight of the shaft D and its attachments is received on this screw R through a steel foot, D^2, which is fixed to the lower end of the shaft D by means of a taper arm extending up from the foot into a conical hole provided in the shaft. Below this foot is a loose disk, P, which is circular, and is inclosed in a circular space. It is free either to stand at rest with the step or to turn with the shaft. Below this is a block, Q, which may be of the same thickness or of a greater or less thickness. It is preferably rectangular, and fits in a rectangular cavity in the step. I have shown but one circular disk P. There may be more than one, resting one upon another, if desired. When the parts are properly adjusted and the cover H tightly fitted, the entire casing A^9 is filled with oil, and care is taken to prevent the access of dust or water. The weight on the shaft D induces friction between its lower end and the disk P, in case this disk stands stationary; but if heating or other cause induces increased friction between these parts the disk P will adhere to D and turn with it, and the friction will occur at the joint below. I believe a single disk P is sufficient for all ordinary cases. The casing A^9 is supported by broad flanges, which are bolted on the adjacent cross-timbers in the position shown. By jacking up the revolving parts so as to take the weight off the step and removing the plate H, I can remove or exchange the bearing-plates P Q. The casting M is formed with a stout boss, M^9, which receives a vertical arm, N, of wrought-iron or soft steel, extending down nearly into contact with the bottom grinding-plate, E. Its lower end carries a shoe, O. Its upper end carries a cross-key, N′, which engages in notches in the top of the boss M^9, and prevents its turning.

The ore to be ground should be previously broken by a Blake crusher or other suitable device. It is introduced either constantly or at intervals by dropping it in the space between the conical surfaces M′ and M^2. The broken fragments, which may be about the size of wheat, descend through the apertures *m*.

The mill is liberally supplied with water. For a mill having the casing A^6 four (4) feet in diameter the shaft D and its attachments may make, say, forty (40) revolutions per minute. The shoe O, traversed around at this rate, keeps the unground material properly agitated. The high portion of casting E is grooved radially across, as indicated by strong lines *e* in Fig. 1 and dotted lines in Fig. 5. The broken pieces of ore agitated in the water move outward in the grooves *e*, and are caught by the revolutions of the rollers J, and ground between these and the high part of E. The rollers J can rise independently to any extent required to accommodate the irregularities induced by the reception of these masses. They can also move inward to a considerable extent, when required, by the reception of coarse particles between them and the stationary grinding-cylinder F. The only escape for the material is by moving upward in the agitated water and outward through the wire-gauze A^8. This movement will occur only after the particles are very finely ground.

W is a radial arm fixed on the tops of the arms M^4 and N, and carrying on its outer end a vertical arm, X, provided at the bottom with a stirrer, X′, which, by the rotation of the shaft D and its connections, is carried around in the space within the cylinder A^6, and agitates and hastens the removal of the fine material which would otherwise tend to rest therein. After the mill is properly working every passage of this stirrer X′ past the trough or spout A^7 delivers some of the ground material.

Modifications may be made in the forms and proportions. I can increase or diminish the number of the radial grooves *e*. I can vary the inclination of the sides of these grooves. The inclination of one side of these grooves facilitates the dragging upward of the broken ore and initiating the grinding thereof; but I esteem it important not to make these grooves so wide as to seriously reduce the grinding-surface. I can use a less number of the arms M^3 and loose rollers J.

I attach importance to the means of communicating power to the mill by the shafts B C revolving in opposite directions. They give the required powerful turning motion to the shaft D and its attachments without subjecting it to any side strain.

Although I prefer to use the machine in all ordinary cases with a flow of water, as described, the quantity of water may be varied. In treating some ores the finely-ground material will work with little water.

I do not confine the invention to working it with water. I believe some materials may be worked dry.

I claim as my invention—

1. In a grinding-mill, the center shaft, D, and suitable driving means therefor, in combination with the bushing I, bearing-pieces G, the casting M, rollers J, casing A^2 A^3 A^4, and means for supplying and taking away material, as herein specified.

2. In a grinding-mill, the step-case A^9, adjusting-screw R, and intermediate bearing-pieces, P Q, in combination with each other and with the removable plate H, lateral bearings T, and adjusting means U therefor, arranged for joint operation substantially as herein specified.

3. In a grinding-mill, the eccentric shoes M^6, arms M^4, and revolving casting M, in combination with each other and with the loose rollers J, grinding-plate E, having grooves *e*, grinding-cylinder F, and suitable means for supplying and taking away material, as herein specified.

4. In a grinding-mill, the stirrer X′ and revolving shaft D, in combination with each other and with the foraminous casing A^8, offset A^5, cylindrical part or casing A^6, spout A^7, grinding means J E F, and suitable means for supplying material, as herein specified.

In testimony whereof I have hereunto set my hand, at New York city, this 19th day of October, 1885, in the presence of two subscribing witnesses.

B. S. LAWSON.

Witnesses:
CHARLES R. SEARLE,
H. A. JOHNSTONE.