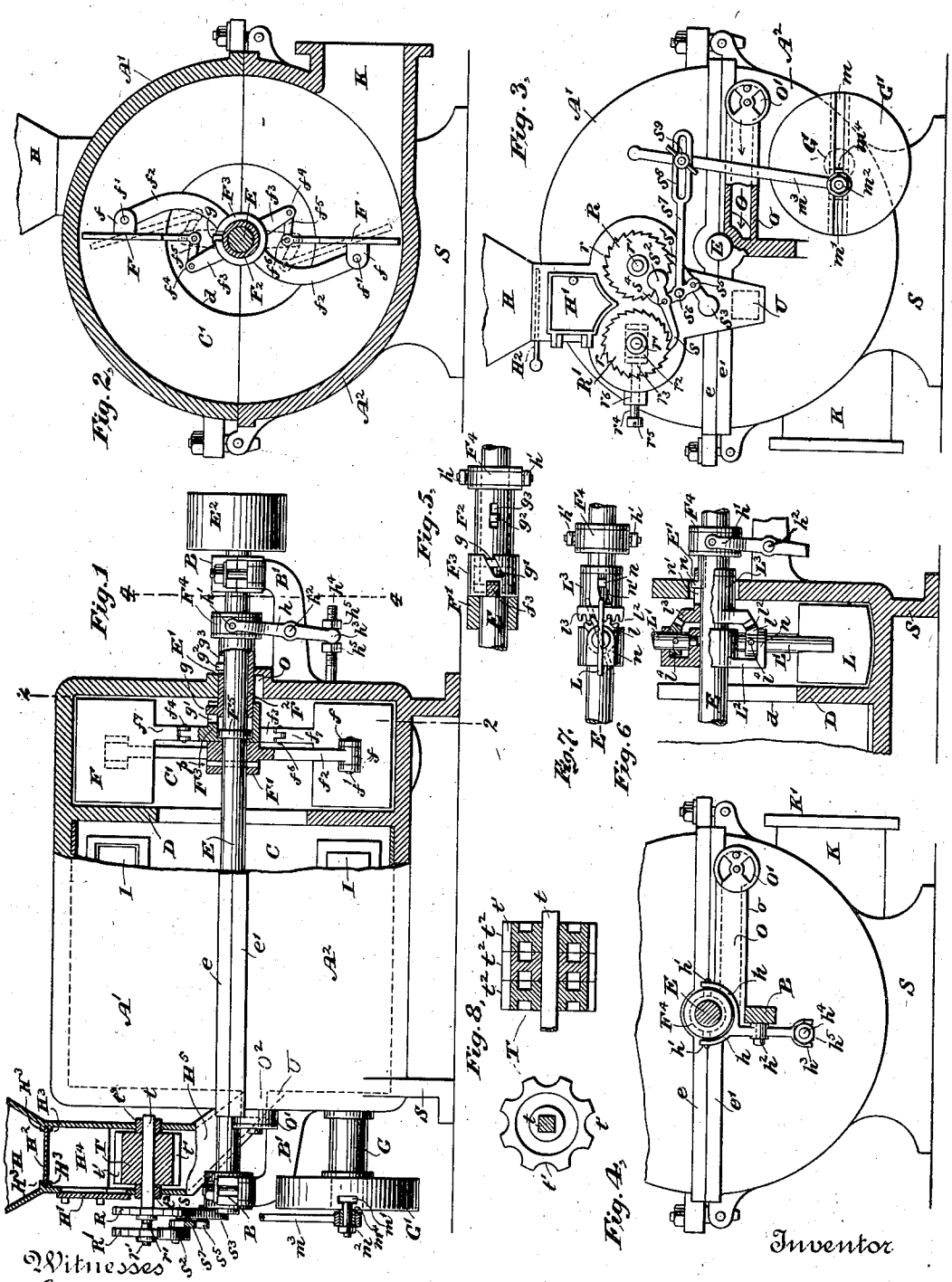
(No Model.) 2 Sheets—Sheet 1.

J. J. BORDMAN.

ROTARY PULVERIZING MACHINE.

No. 416,252. Patented Dec. 3, 1889.



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Millard Parker Butler

(No Model.) 2 Sheets—Sheet 2.

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Fig 12.

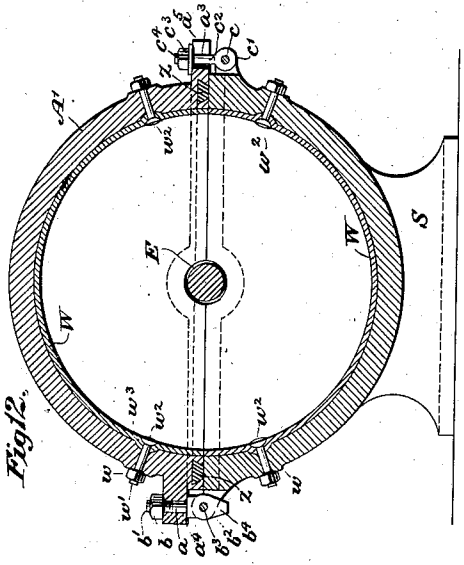


Fig 13.

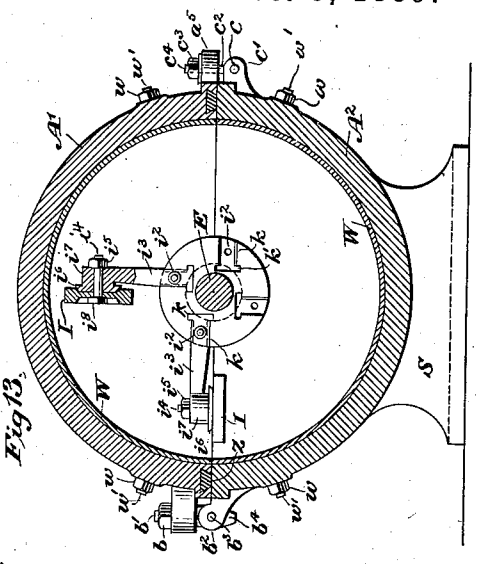


Fig 11.

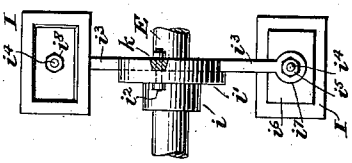


Fig 9.

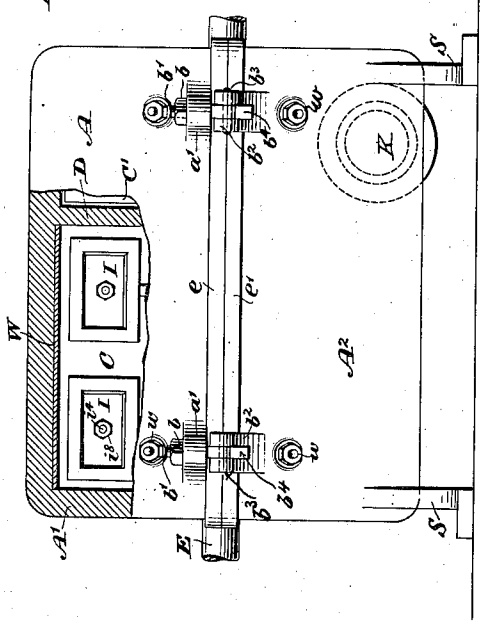
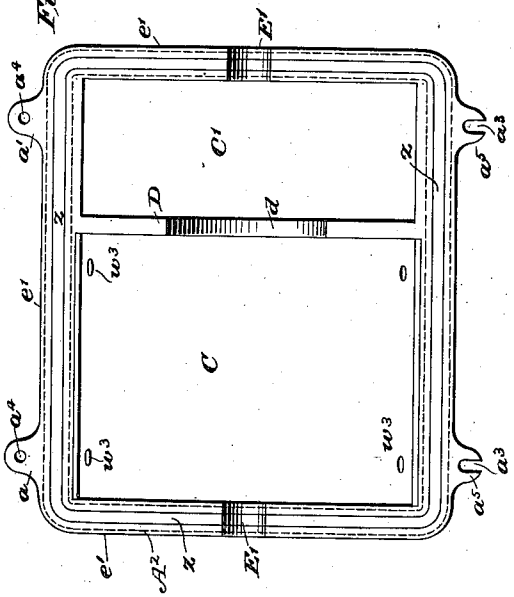


Fig 10.



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UNITED STATES PATENT OFFICE.

JOHN J. BORDMAN, OF BROOKLYN, NEW YORK.

ROTARY PULVERIZING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 416,252, dated December 3, 1889.

Application filed July 5, 1888. Serial No. 279,017. (No model.)

To all whom it may concern:

Be it known that I, JOHN J. BORDMAN, a citizen of the United States, and a resident of Brooklyn, Kings county, and State of New York, have invented a certain new and useful Improvement in Rotary Pulverizing-Machines, of which the following is a specification.

My invention relates to improvements in machines for reducing and pulverizing mineral and other fuels, and for supplying the same, mixed with air sufficient to insure combustion, to all classes of furnaces, and generally for pulverizing all other materials; and the object of my invention is to supply a cheaper and more efficient machine for pulverizing all kinds of materials than has heretofore been possible.

The invention will be best understood by reference to the accompanying two sheets of drawings, in which—

Figure 1 is a side elevation of the machine, showing the side wall of the machine and of the hopper partly broken away; Fig. 2, a cross-section of the blowing-compartment on the line 2 2 of Fig. 2; Fig. 3, an end view of the machine, showing the air-passage partly broken away; Fig. 4, a sectional view on the line 4 4, Fig. 1; Fig. 5, a view of the mechanism for adjusting the fan-blades; Figs. 6 and 7, an alternative method of adjusting the fan-blades; Fig. 8, a view showing the construction of the feed-rollers; Fig. 9, a side elevation of the machine with a portion of the upper half of the shell broken away; Fig. 10, a plan view of the lower half of the shell; Fig. 11, a detail view of the beaters, and Figs. 12 and 13 views of the method of attaching the lining to the shell and closing the two portions of the latter.

Similar letters refer to similar parts throughout the several views.

The machine is made in the form of a hollow cylinder composed of two hollow sections A′ and A^2. This cylinder will vary in diameter according to the size of the machine. The end walls of the machine are in parallel planes.

The machine and its various parts are made of cast-iron or any other convenient material and the walls may be of any convenient thickness. The cylinder is made in two horizontal sections placed upon each other, as shown in the views. The lower section A^2 is cast with the standards S at either end and a flange e' upon its upper surface, upon which rests a corresponding flange e, cast upon the lower face of the upper section, as shown in the views. The two sections are held together by the devices shown in detail in Figs. 9, 10, 12, and 13. The section A^2 is cast with two pairs of lugs $b^2\,b^2$ upon its rear edge, Figs. 9, 12, and 13, and the upper section A′ with two horizontal lugs $a'\,a'$, each provided with an opening a therein, which receives the bolts $b'\,b'$, which are pivoted in the lugs $b^2\,b^2$ by the bolts $b^3\,b^3$, around which they are free to rotate. The bolts $b'\,b'$ each terminate in a beveled projecting piece $b^4\,b^4$, which comes in contact with the surface of the lower shell A^2 when the upper shell is opened, and holds the latter at any desired angle. The bolts $b'\,b'$ are provided with the screw-nuts $b\,b$, by screwing which down on the bolts the two portions of the cylinder are securely held together. At the front side of the cylinder the two sections of the same are secured in a substantially similar manner. The horizontal lugs $a'\,a'$ are, however, replaced by the open lugs $a^5\,a^5$, Figs. 10, 12, and 13, provided with the openings a^3 for receiving the bolts $c^2\,c^2$, which bolts are swiveled in bearings $c'\,c'$, cast on the upper edge of the lower half of the shell A^2 and rotate on the pins $c\,c$, but are not provided with a projecting head, and when released from the lugs $a^5\,a^5$ drop down and hang loosely. The bolts c^2 are held in the lugs $a^5\,a^5$ by means of the screw-nuts c^3 c^3, which screw over their extremities $c^4\,c^4$ and down upon the upper faces of the lugs, as shown in Figs. 12 and 13. In this way the joint formed by the flanges e and e' of the sections A′ and A^2 may be made more of less tight by screwing the nuts $b\,b$ and $c^3\,c^3$ up or down. When it is desired to open the cylinder, the nuts $c^3\,c^3$ are slackened and the bolts $c^2\,c^2$ released. The nuts $b\,b$ are slackened and the upper half A′ of the cylinder rotated upward around the hinge-joint formed by the pins $b^3\,b^3$ in the lugs $b^2\,b^2$.

In order to facilitate the maintenance of a perfectly-tight joint between the two parts of the shell, either or both of the flanges e and e', but preferably the flange e, are provided

with a mortised cut or indentation on its upper surface, which is filled with a packing, Figs. 10, 12, and 13, of gutta-percha or other suitable material, the outer surface of which packing is firmly pressed against the surface of the flange e' on the section A^2 when the nuts b b and c^2 c^2 are screwed down on the bolts b' b' c^2 c^2. This packing may be readily renewed if the same becomes worn out.

The interior of the machine is divided by the diaphragm D into two compartments—a blowing-compartment C′ and a pulverizing-compartment C, of any convenient size. The diaphragm D is provided at its center with a circular opening d, for the passage of the material from one compartment to the other.

The interior of the pulverizing-compartment C is lined with a lining of sheet metal, made in two sections, as shown in Figs. 12 and 13. The lining is attached to the shell of the machine by means of the bolts w, passing through the same, with the screw-nuts w'. The heads w^2 of these bolts are made curved both interiorly and exteriorly, as shown in Fig. 12, and the lining is bent in around the edges of the openings to receive the inner curved surfaces of the heads, and the inner surface of the shell is countersunk around the openings through which the bolts pass to receive the cupped portion of the lining, as shown in that figure. In this way an almost smooth surface is presented to the material to be pulverized around the bolt-heads.

Through the center of the cylinder, and consequently through the opening d in the diaphragm, passes a horizontal shaft E, which passes out through openings E′ E′, formed in the end walls of the shell, and is supported upon the exterior bearings B B, made of anti-friction metal, which are carried upon the brackets B′ B′, attached to the vertical end walls of the machine. The shaft E may be of any convenient diameter, but must have sufficient strength to carry the rotary beaters I I and the fan F, and the bearings and their brackets will vary in size according to the size of the pulverizer, the weight of the rotary blowing-fan F, and the rotary beaters.

The pulverizing-compartment C contains any number of sets of rotary beaters, according to its length, arranged as shown in the drawings. Any number of rotary beaters may be arranged radially around the shaft E; but in practice two sets of four will be found most convenient, as shown in the views. In the pulverizing-compartment C the rotary beaters I I I, &c., are mounted rigidly upon the axis of rotation and with their flat surfaces parallel thereto.

Figs. 11 and 13 show in detail the method of securing one set of beaters. In these views, i represents a collar or hub provided with a flange i', which is keyed in any convenient manner to the shaft E. The arms which carry the beaters are designated by the letter i^3, and are of the peculiar shape shown in Fig. 13. At their inner extremities they terminate in short cross-heads k', and are beveled to fit a mortised groove k of corresponding shape in the flange i' of the collar i. They are attached to the collar by means of the screw-bolts i^2 i^2, passing through the beveled cross-head and the collar. At the outer extremity the radial arms i^3 terminate in the cylindrical heads i^7, which have the rectangular cross-heads i^6 i^6, with the beveled edges shown in the views, cast on them in a single piece. The shoes I of the beaters have sunken faces with beveled edges, as particularly shown in Fig. 13, so that webs are formed on the periphery, and they are fastened to the cross-heads by means of the bolts i^4, with the heads i^8, securely held in place by the nuts i^5. When the cross-heads are bolted to the radial arms, the beveled edges of the cross-heads i^6 fit into the corresponding edges of the sunken faces, and so prevent all twisting or turning of the cross-heads on the arms. When the front faces or the webs of the shoes become worn, the bolts can be unscrewed and the shoes turned over and a fresh surface exposed to the wear of grinding, thus saving the necessity of using new shoes each time that the grinding-surface becomes worn down.

The compartment C′ contains the rotary blowing-fan F, which is mounted upon the shaft E, and the blades of which are arranged so as to be adjustable at any angle to the axis of the main shaft, as shown in Figs. 1, 2, and 5, or laterally adjustable at any angle to the axis of the main shaft, as shown in Figs. 6 and 7.

In Figs. 1 and 2 F represents the fan-blades, of which there may be any number, but preferably two, as shown. These are hinged by means of the lugs f f, cast upon their rear faces, and by the pivot f' to the radial arms f^2, cast in one piece with the hub F′, which in turn is keyed to the main driving-shaft E by the key p. At the inner edge of each fan-blade is cast a projecting piece f^7, Fig. 1, which is hinged by the lever f^5 to an arm f^3, cast upon an independently-rotating collar F^3 upon the shaft E, surrounding an interior fixed shoulder F^5. By rotating the collar F^3 on the shaft the angular inclination of the fan-blades may be varied, as shown in Fig. 2. In order to rotate this collar F^3 an independent interior sleeve F^2 is used. This latter sleeve surrounds and rotates on the shaft E, but at the same time rotates freely within the collar F^3, which is held in place by the independent fixed sleeve F^5. The collar F^3 is provided, as shown in the views, with an inclined slot g', in which a stud g, inserted in the sleeve F^2, is arranged to slide freely. The sleeve F^2 extends outward around the shaft E, through the opening E′ in the end walls of the machine, and terminates in a loose strap F^4, working in a groove on the sleeve, to which is attached the extremities of the double forked lever h h by means of the pivots h'. The lever h is pivoted on the arm B′ at

h^2, and its lower extremity h^3 surrounds and is moved on the stationary screw-rod h^4 by turning the screw-nuts h^5 h^5. By turning the nuts on the screw-rod h^4 the sleeve F^2 is caused to slide on the shaft E, and the collar F^3 is rotated by the engagement of the stud g in the slot g'. To prevent lateral movement and to limit the play of the sleeve F^2, an additional stud g^2 is placed on the driving-shaft E and a straight slot g^3 is provided in the sleeve F^2. The driving-shaft E is driven at either end by means of a belt passing over the pulley E^2 from any suitable source of power.

When a lateral adjustment of the fan-blades is desired, the form of adjustment shown in Figs. 6 and 7 is used. In these views, L represents one of the blades; L^2, a collar on the driving-shaft, provided with arms having bearings n, in which the radial arms L′ of the fans rotate. The inner extremity of each arm carries a segment of a gear-wheel l, which meshes into a gearing l^2 l^3, cast on the inner end of a sleeve L^3 on the driving-shaft E. The sleeve L^3 is provided with a bent slot n', one part of which runs in an inclined direction to the axis of the shaft and the other part runs parallel thereto, which slides upon a stud or tongue n, inserted in a slot in the upper surface of the shaft E, and is connected with the sliding sleeve F^4, moved by the forked lever h' in the same manner as the corresponding sleeve F^4 in Figs. 1 and 5. By sliding the collar F^4 on the shaft E the tongue n is moved into the inclined portion of the slot n' and the spur-gear l^3 revolved, so causing the blades to be inclined more or less, according as the spur-gear l^3 is rotated.

In order to supply the necessary amount of air to the machine, to be mixed with the pulverized material, in case the machine is used for pulverizing coal or other fuel, an air-passage O is provided at either end, as shown in Figs. 1, 3, and 4. This passage takes up its air at the periphery of the machine, where a radial valve O′ is provided for regulating the amount of air admitted.

The advantages of carrying the passage outward to the periphery of the cylinder are, first, a stronger draft is produced through the machine, as the passage then serves as a flue, and, secondly, the air-opening is carried away from the moving shaft and feeding mechanism, the proximity of which serves to disturb the flow of the air as it enters and to make the draft irregular. The air-passage enters the cylinder at the point marked by the arrow-head in Fig. 3, directly under and adjacent to or around the shaft E, if necessary.

The discharge from the machine is effected through the tangential discharge-pipe K, opening out of the blowing-compartment C′, and provided on its exterior face with a flange K′, for facilitating the connection between it and the pipe or other receptacle into which the discharge is effected.

The material to be supplied to the machine is subjected to a preliminary crushing by the feed-rolls T T, placed in the hopper H^4.

H^2 is the mouth of the hopper, which is cut off at times from the hopper proper, as may be desired, by the sliding gate H^2, sliding in grooves between the flanges H^3 H^3.

The hopper proper is designated by H^4, and is provided on its front face with a door H′, whereby access may be obtained to the interior. Below the feed-rolls T T the hopper terminates in an inclined pipe H^5, which enters the cylinder at the point V, through which the material fed by the feed-rolls T T falls. The rolls are driven intermittently by means of an arrangement of devices shown in Fig. 3. The roll-shafts terminate in the spindles r' r', each of which carries a spur-wheel R R′ with the teeth r r. The spur-wheel R′ on the shaft of the left-hand feed-roll is driven from right to left by a pawl s, pivoted at s^4 to the bell-crank lever s^7. The spur-wheel R on the shaft of the right-hand feed-roll is driven from left to right by a pawl s', pivoted at s^5 to the bell-crank lever s^7. The rocking motion is imparted to the bell-crank lever by means of a connecting-rod m^3, connecting with the crank-disk G′. The lower extremity of the rod m^3 is pivoted to a sliding piece m', which can be moved laterally in the slot m in the crank-disk G′. This sliding piece can be fixed in any desired position by means of the screw-nut m^2. The crank-disk G′ rotates upon the shaft G, which can be driven from the main shaft or any other source of power. The connection between the bell-crank lever s^7 and the connecting-rod m^3 is made by means of the thumb-screw connection s^9, which slides in the link s^8 upon the right-hand end of the bell-crank s^7. By turning the handle of the thumb-screw s^9, the connecting-rod may be connected with the bell-crank at any desired point. The left-hand roll is arranged to slide laterally in movable bearings, so as to be made to approach or recede from the other roll. The spindle r' is journaled in the sliding box r^2, which box is moved by means of the screw r^4, which is turned by the screw-head r^5. By turning the screw-head r^5 the left-hand roll is caused to approach to or recede from the other roll any desired distance, and is firmly set in each position. When the crank-disk G′ rotates upon the shaft G, the connecting-rod m^3 rises or falls with the disk and raises or depresses the end of the rocking lever s^7. The raising or lowering of this end of the bell-crank s^7 causes the pawls s and s' to engage alternately with the cogs of the wheels R′ and R, thereby giving a peculiar motion to each of the feed-rolls T T, causing the particles between them to be fed to the machine at any desired rate of speed. The speed of the crushing-rolls can be varied by varying the speed of the shaft G. The form of feed-rolls employed are of the shape shown in Fig. 8. Each roll is made up

of separate segments t^2 t^2 t^2, all fixed in the same shape, which may be replaced from time to time as they wear down without replacing the entire rolls. The grooves t' t' on the surface of the rolls may be of any shape, but preferably, however, of the shape shown in Fig. 8. In Fig. 1 the segments composing the feed-rolls are not shown on account of the smallness of the scale.

The method of operation of the machine is as follows: The material to be pulverized is fed into the hopper H in suitable quantities, falls upon the feed-rolls, and is sized by them to a certain extent and enters the machine at O^2, together with a certain amount of air, and is immediately taken up by the rotary beaters I I, which revolve at a high rate of speed, and is reduced by them to an impalpable powder. The rotary blowing-fans F F or L L cause the currents of air which enter the machine at the points O O to rotate rapidly and to carry with them the particles of pulverized material and discharge them at the periphery of the machine through the discharge-pipe K.

I claim—

1. In a pulverizing-machine, the combination, substantially as hereinbefore set forth, with the pulverizing-chamber, of a blowing-compartment containing a rotating shaft having radial arms thereon and fan-blades pivoted thereto, a rotating sleeve on said shaft extending outward through the end walls of the machine, connected by levers with the fan-blades for varying the inclination of the blades to the axis of rotation from the outside of the machine without opening the shell, and means, substantially as described, for moving and holding said sleeve.

2. In a pulverizing-machine, the combination, substantially as hereinbefore set forth, with the pulverizing-chamber, of a blowing-compartment having in its interior a rotary fan composed of one or more radial arms carried on a shaft rotating therein, a fan-blade pivoted to each said arm, and a projecting arm on the inner edge of said blade, a rotating collar on said shaft provided with an inclined slot, radial arms on said collar pivotally connected to the projecting arms upon the fan-blades, a hollow sleeve surrounding the driving-shaft, projecting at one end into the interior of said collar and provided on its upper surface with a stud engaging with said slot and projecting at the other end outward through the end walls of the cylinder, and means, substantially as described, whereby said sleeve is moved longitudinally on the driving-shaft and the inclination of the fan-blades correspondingly changed.

3. In a pulverizing-machine, the combination, with the end compartment, of an air-duct for admitting air thereto formed upon the end wall of said compartment and terminating at its inner extremity within the compartment at or near the center of the same and at its outer extremity at or near the periphery of the machine.

4. In a pulverizing-machine, the combination, with the end compartment, of an air-duct for admitting air thereto formed upon the end wall of said compartment and terminating at its inner extremity within the compartment at or near the center of the same and at its outer extremity at or near the periphery of the machine, and a valve in said duct for regulating the amount of air admitted thereto.

5. In a pulverizing-machine, the combination, substantially as hereinbefore set forth, with the end compartment, of an air-duct cast in one piece with said compartment upon the outer wall of the same and terminating at its inner extremity within the compartment at or near the center of the same and at its outer extremity at or near the periphery of the machine, and a valve in said duct for regulating the amount of air admitted thereto.

6. In a pulverizing-machine, the combination, substantially as hereinbefore set forth, with the blowing-compartment, of a rotary shaft carrying one or more radial arms, a fan-blade pivoted to each of said arms and connected by pivoted levers with a sliding collar provided with an inclined slot upon said shaft, whereby the inclination of the blades is varied, a double-forked lever pivoted to the exterior of the machine, one fork of which encircles the sleeve and actuates the same, and a stationary rod upon the exterior of the machine, which the other fork of said lever encircles, and screw-nuts on said rod for actuating and holding said lever, substantially as described.

7. In a pulverizing-machine, the combination, substantially as hereinbefore set forth, with the feeding-hopper, of a pair of crushing-rolls in the interior of the same, a gear-wheel outside of the hopper upon the extremity of the shaft of each roll, a pair of weighted pawls engaging with and actuating each gear-wheel, a bell-crank to which said pawls are pivoted, a rotary crank-disk actuated from a suitable source of power, and a connecting-rod connecting the extremity of the bell-crank with the crank-disk.

8. In a pulverizing-machine, the combination, substantially as hereinbefore set forth, with the feeding-hopper, of a pair of crushing-rolls in the interior of the same, a gear-wheel outside of the hopper upon the extremity of the shaft of each roll, a pair of weighted pawls engaging with and actuating each gear-wheel, a bell-crank to which said pawls are pivoted, a rotating crank-disk actuated from a suitable source of power, a connecting-rod connecting the bell-crank, and means, substantially as described, for varying the vibration of the bell-crank.

9. In a pulverizing-machine, the combination, substantially as hereinbefore set forth,

with the feed-hopper, of the crushing-rolls in the interior of said hopper, the gear-wheels R R′ upon the axes of the feed-rolls, the pivoted pawls *s s′*, engaging with the teeth *r r* of the gear-wheels, the bell-crank s^7, with the adjusting-link s^8 and the thumb-screw s^9, the connecting-rod m^3, engaging with the bell-crank s^7, the cam-disk G′, rotating on the shaft, the groove *m′* in the cam-disk, and the screw-nut m^2, for setting and holding the connecting-rod at any point therein, and means for imparting motion to the cam-disk, substantially as described.

10. In a pulverizing-machine, the combination, with the upper section of the shell, of the open lugs a^3 on one side and the perforated ears *a′* upon the other, the bolts c^4, passing through the former, and the bolts *b′*, passing through the latter, swiveled to the lower section, and the screw-nuts upon the bolts for adjusting the two parts of the shell to each other.

11. In a pulverizing-machine, the combination, with the outer shell, of an interior lining containing openings, the edges of which are bent in to receive bolt-heads, corresponding openings in the outer shell through which said bolts pass, cupped or countersunk on the inner surface of the shell to fit the cupping of the lining, and bolts provided with rounded heads in the interior of the machine, passing through said openings and secured by screw-nuts on the outside of the machine, for the purposes set forth.

12. In a pulverizing-machine, the combination, with the flanged collar upon the driving-shaft of the machine, of radial arms provided with beaters upon their extremities terminating in beveled cross-heads, beveled mortises of the same shape in the flange of siad collar, into which the extremities and cross-heads are so formed as to fit, and bolts for fastening said arms to the collar, substantially as described.

13. In a pulverizing-machine, the combination, with each of the radial arms of the beaters, of a rectangular and beveled cross-head at the extremity of the radial arm, a shoe provided with countersunk faces, beveled on their edges, into which said cross-head fits, and a bolt passing through the shoe and cross-heads for securing the former to the latter.

14. In a pulverizing-machine, the combination, with the radial arms i^3, of the cross-heads i^7, with the beveled rectangular faces i^6, the shoes I, with the rectangular countersunk faces arranged to fit the faces i^6 on the cross-heads, and the bolts i^4, with the heads i^8 and the screw-nuts i^7, for securing the shoes to the cross-heads.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 29th day of June, 1888.

JOHN J. BORDMAN.

Witnesses:

WILLARD P. BUTLER,

EDWIN T. RICE, Jr.