(No Model.) 4 Sheets—Sheet 1.

E. C. GRIFFIN.

PULVERIZING MILL.

No. 410,756. Patented Sept. 10, 1889.

Fig. 4.

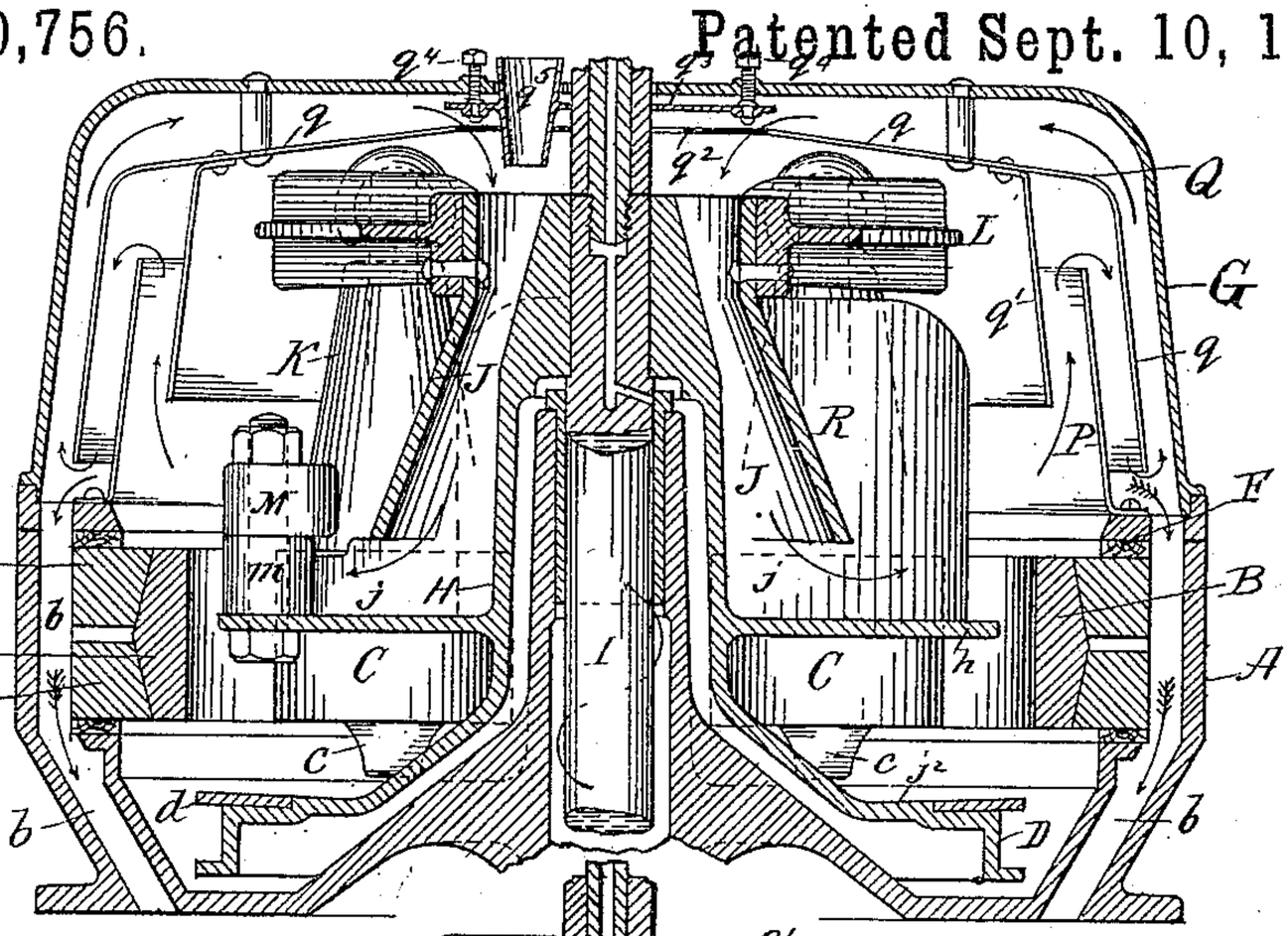
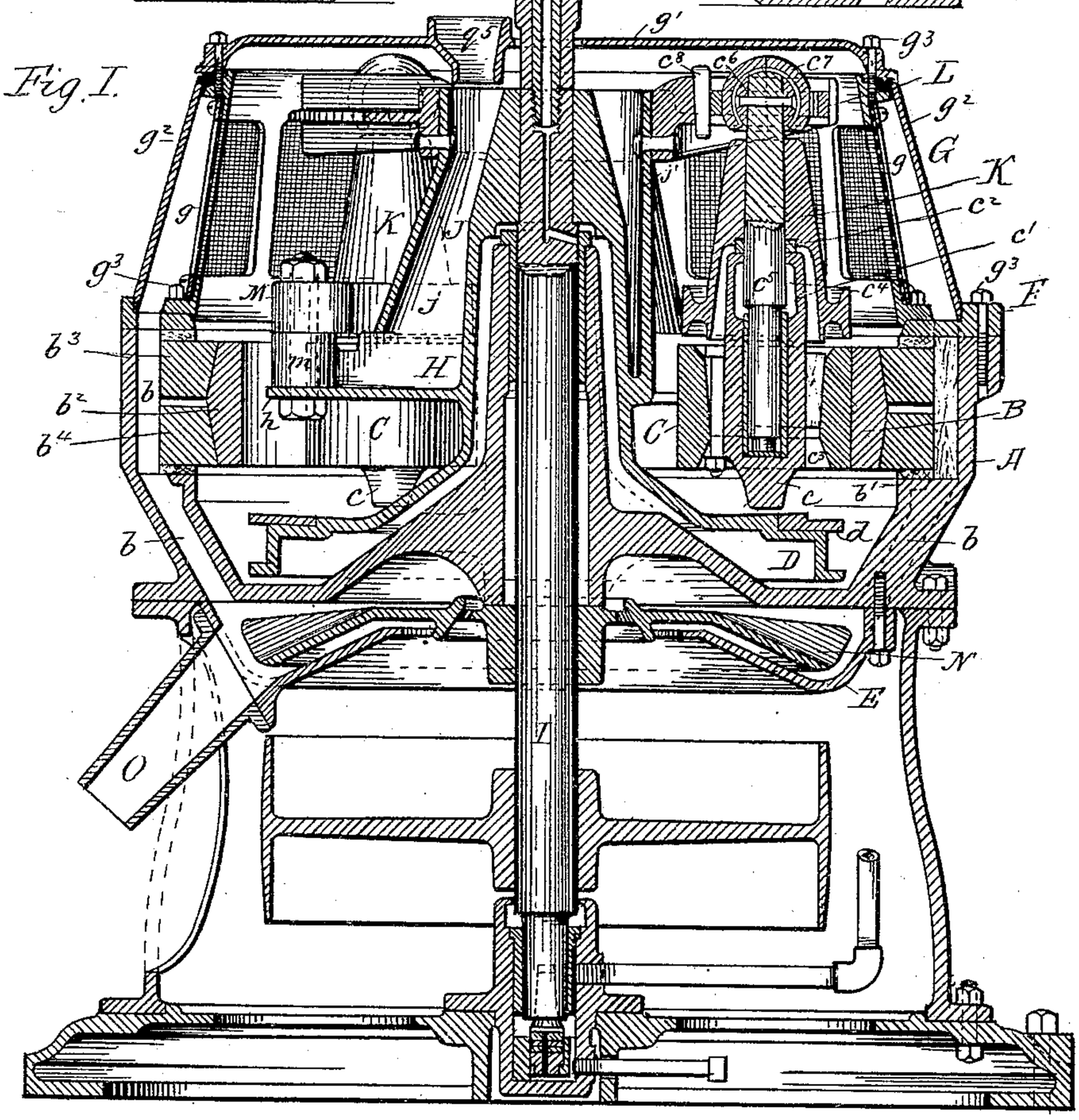


Fig. I.



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(No Model.) 4 Sheets—Sheet 2.

E. C. GRIFFIN.

PULVERIZING MILL.

No. 410,756. Patented Sept. 10, 1889.

Fig. 2.

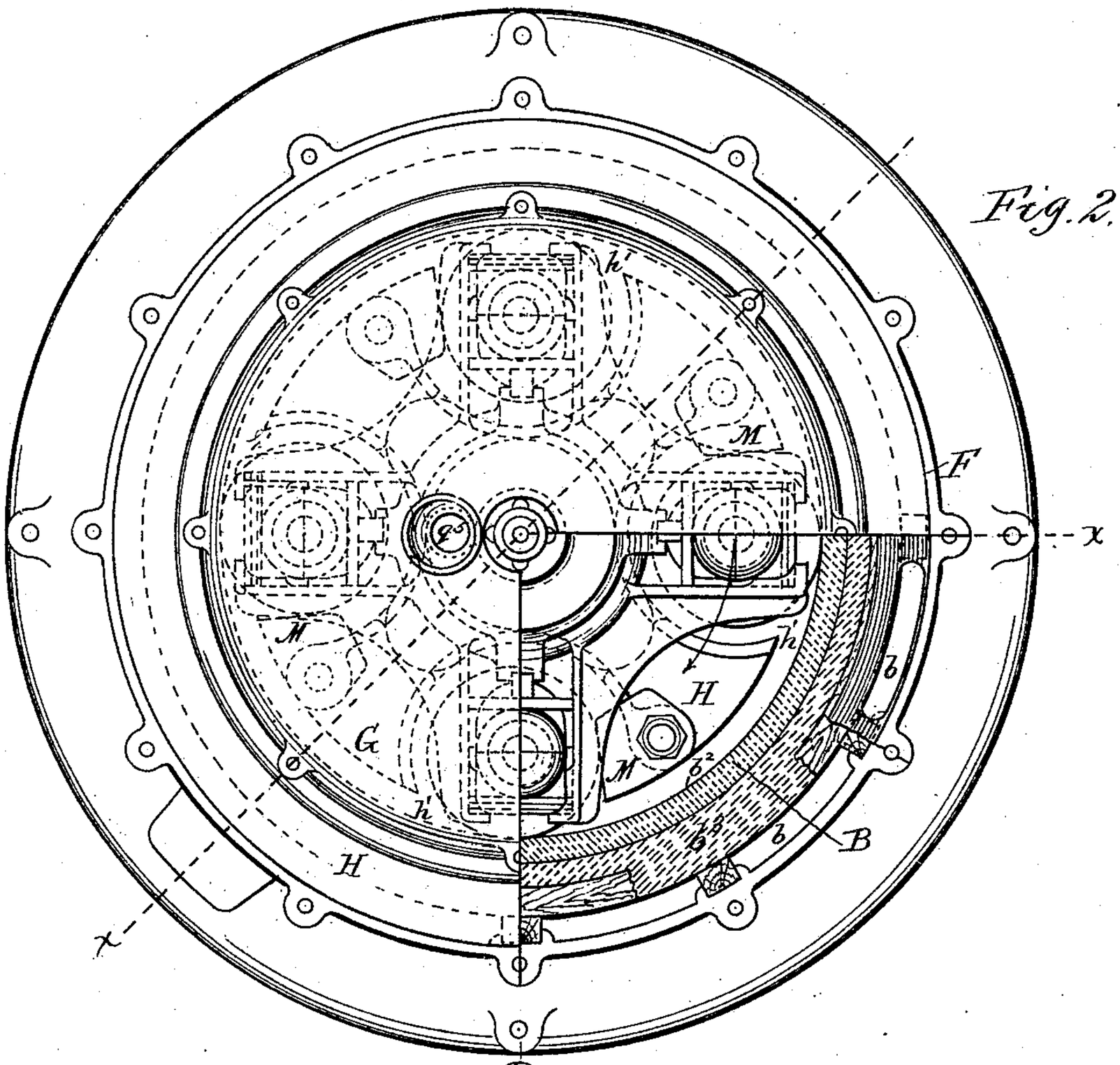
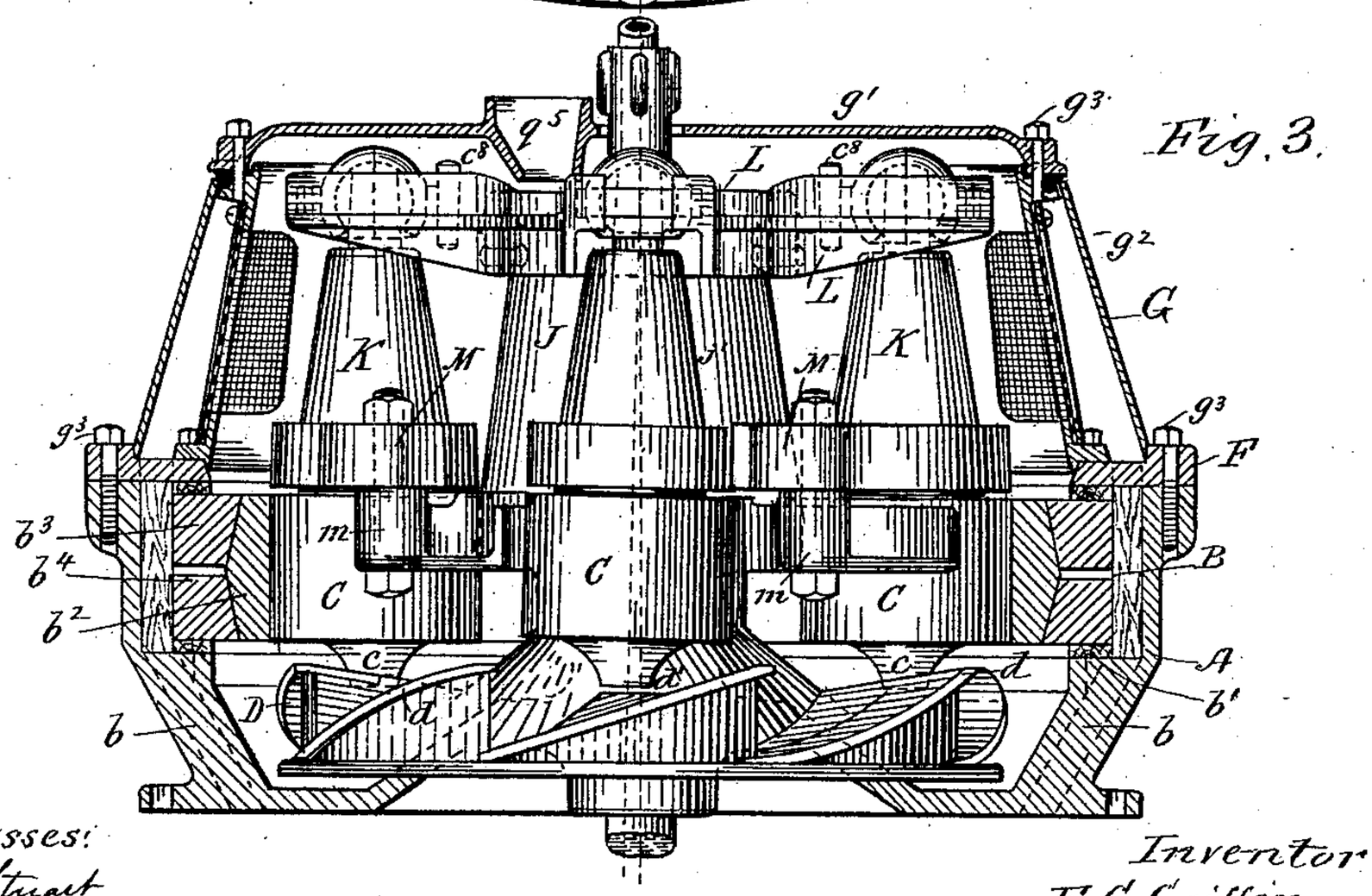


Fig. 3.



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(No Model.) 4 Sheets—Sheet 3.

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PULVERIZING MILL.

No. 410,756. Patented Sept. 10, 1889.

Fig. 5

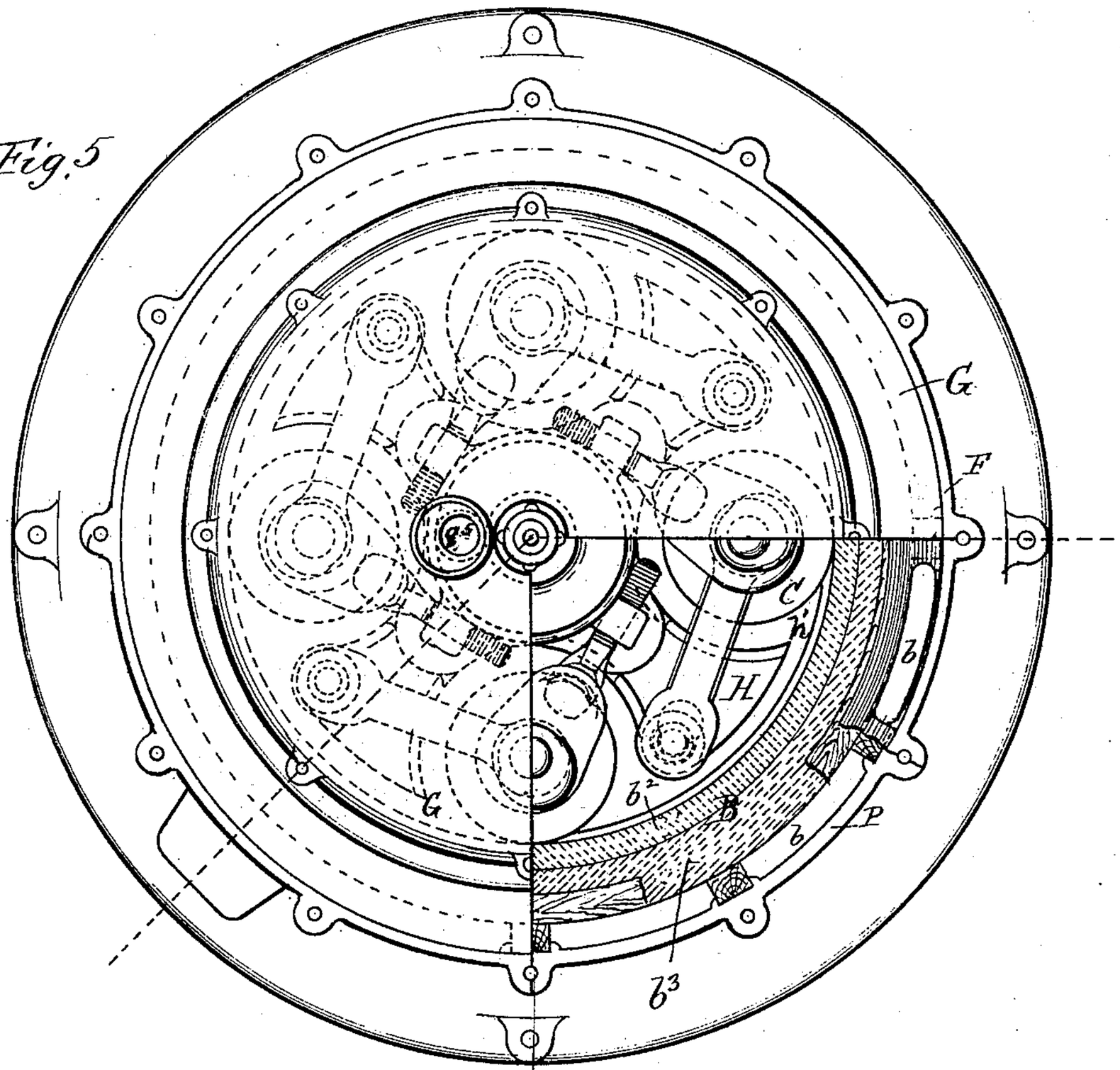
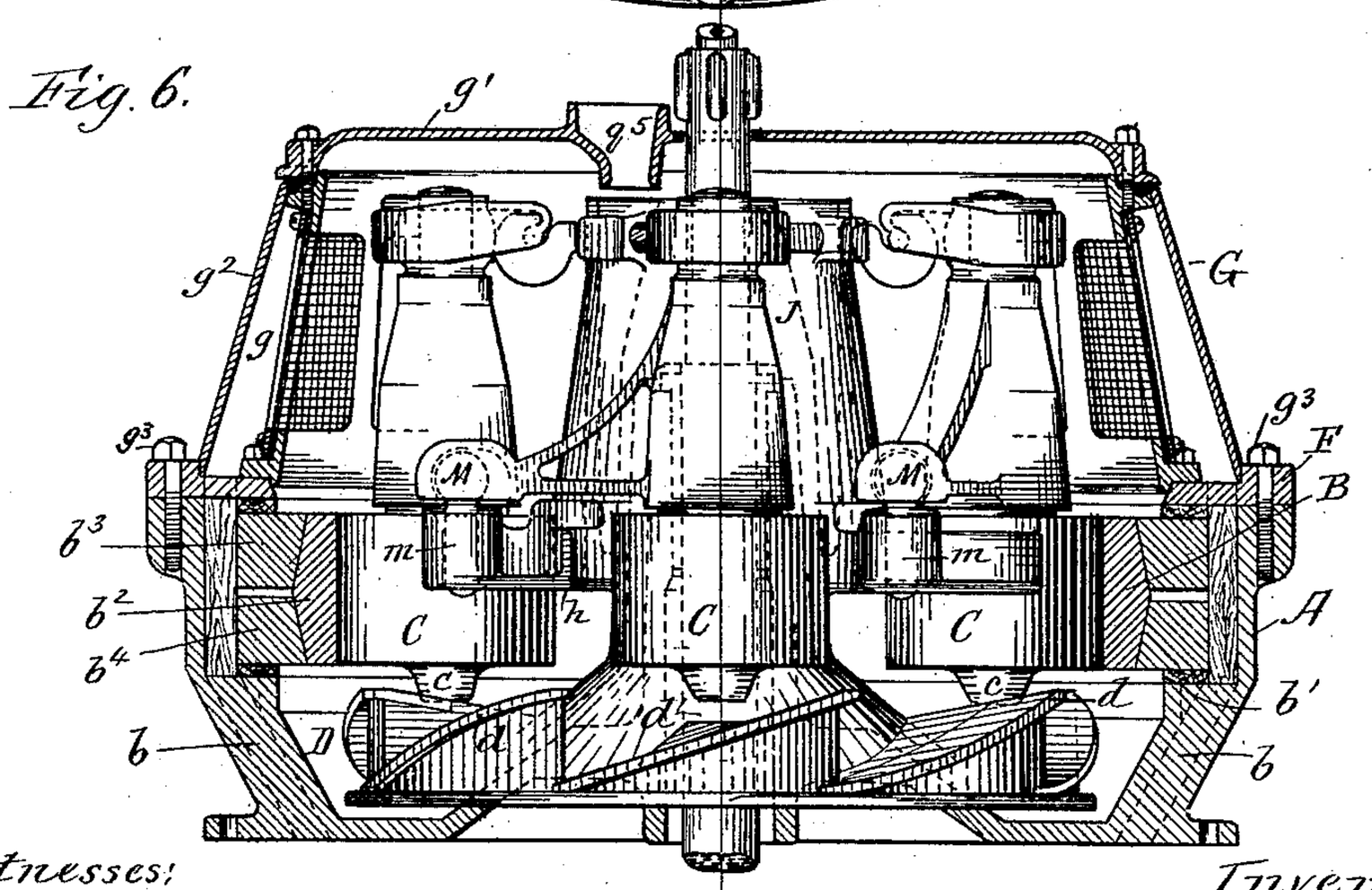


Fig. 6.



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(No Model.) 4 Sheets—Sheet 4.

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PULVERIZING MILL.

No. 410,756. Patented Sept. 10, 1889.

Fig. 7.

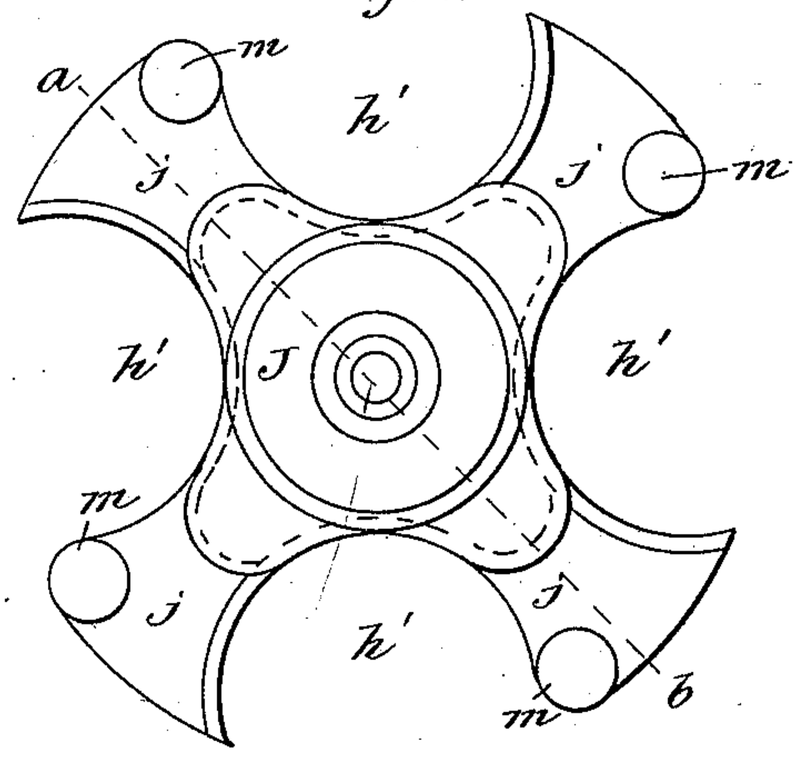


Fig. 8.

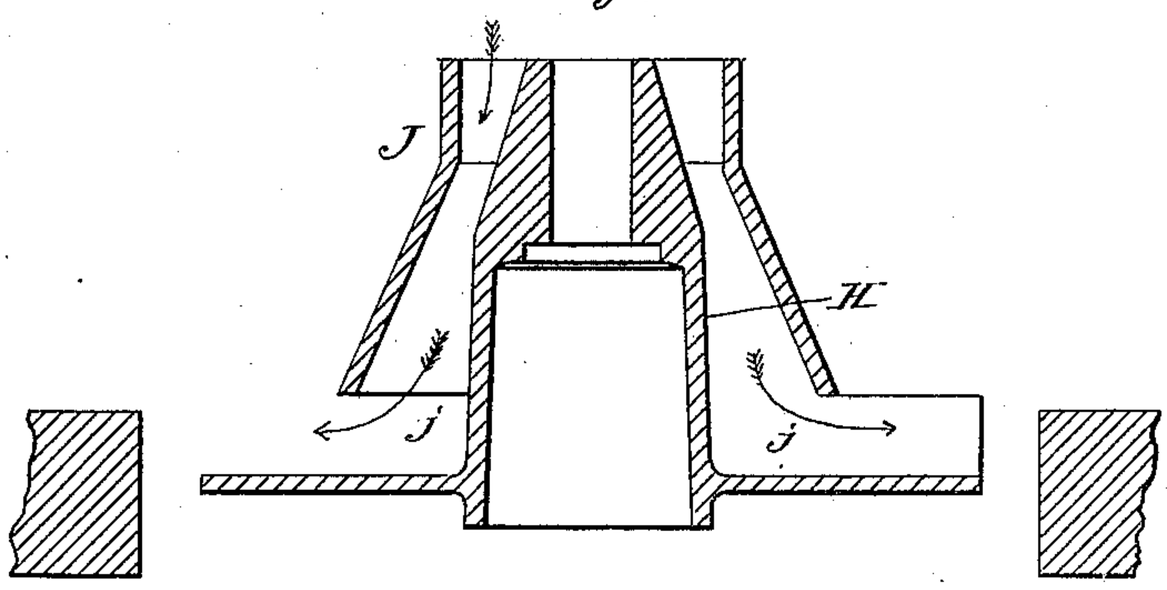
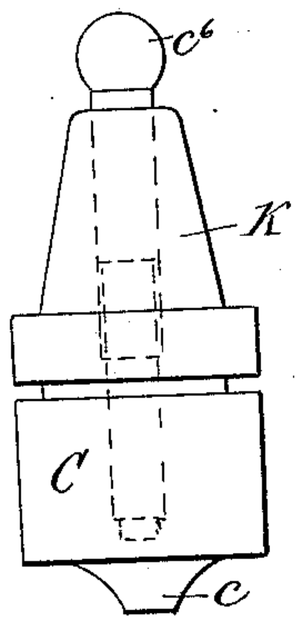


Fig. 9.



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UNITED STATES PATENT OFFICE.

EDWIN COLVER GRIFFIN, OF BROOKLYN, ASSIGNOR TO THE GRIFFIN MANUFACTURING COMPANY, OF NEW YORK, N. Y.

PULVERIZING-MILL.

SPECIFICATION forming part of Letters Patent No. 410,756, dated September 10, 1889.

Application filed June 1, 1888. Serial No. 275,718. (No model.) Patented in England January 25, 1888, No. 1,162.

To all whom it may concern:

Be it known that I, EDWIN COLVER GRIFFIN, a citizen of the Dominion of Canada, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Pulverizing-Mills, (for which I obtained Letters Patent in England January 25, 1888, No. 1,162;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to that class of pulverizing-mills in which the reduction or pulverization of ores and other substances is accomplished by the revolution of one or more rollers within and against the inner wall of an annular die or ring, and in which said rollers are held in contact with the annular dies or rings mainly by centrifugal force when the mills are in operation; and it consists of certain improvements on the construction and arrangement or combination of the parts of my former ore-pulverizing mill, patented October 19, 1886, No. 351,321, as hereinafter disclosed in the description and claims.

The object of my invention has been the production of a mill in which ores and other substances, however refractory and of whatever degree of hardness, may be rapidly, cheaply, and thoroughly crushed and pulverized or reduced to an almost impalpable powder.

I am aware that other mills have been devised with a view of accomplishing the same results; but, so far as I am informed, they have been only partially successful.

The essential features of my present improvements on the ore-pulverizer disclosed in my patent above named consist, first, of a modification or change of construction in the main central carrier which receives and discharges the material to be pulverized, in which the rollers are mounted, and by which the pulverized material is elevated for being discharged, whereby greater strength and efficiency and better operation of the parts are secured; second, of a change in the construction of the devices for securing and driving the spindles on which the rollers rotate; third, of the construction and relative arrangement of the rollers, the annular die or ring, the material-discharging devices, the cover, the receiving-trough, and the sweep therein, whereby the material is more thoroughly pulverized and more rapidly and efficiently delivered from the mill; fourth, of the construction and substitution of a sectional or three-part annular die or ring in lieu of the solid one heretofore employed, whereby wear is lessened and greater facility secured in holding it in place and in removing and replacing the same, and, fifth, of the provision of the revolving central carrier with vanes or wings and the stationary part of the mill with air ducts or channels, whereby air-currents are caused to circulate within the cover and raise and discharge the sufficiently-pulverized material without causing the fine dust to escape into the room or building in which the mill may be operated.

In the accompanying drawings, wherein the same reference-letters indicate the same or corresponding parts, Figure 1 represents a vertical section of the mill, taken on the angular dotted line *x x* of Fig. 2; Fig. 2, a plan view of the mill, a portion of the cover being removed and interior parts shown in dotted lines; Fig. 3, a vertical section through the center of the upper portion of the stationary part of the mill, the revolving part thereof being shown in side elevation; Fig. 4, a vertical section through the cover, the pan or casing, and the revolving carrier, showing a modified construction and arrangement of the parts for generating air-currents for separating and delivering the pulverized material from the mill; Figs. 5 and 6, respectively, a plan view, with a portion of the cover removed and interior parts shown in dotted lines, and a vertical section, with parts in side elevation, of a mill embodying my present improvements, in combination with the "swinging arms" employed in the mill disclosed in my former patent; Figs. 7 and 8, respectively, a plan view and vertical section of that portion of the main central carrier which constitutes the feed-directing shell; and Fig. 9, a detail view, in side elevation, of a roller, a spindle, and a

driver arranged at a slight inclination, or with the lower part of each slightly in advance of its top part.

In the drawings, A represents the casing or pan which incloses the ring or annular die B, the grinding-rollers C, and the elevating mechanism D, and is provided with a number of openings *b*, which extend downward between the upper portion of its outer wall and the outside of the annular die, and thence through its body portion for the remainder of its depth. These openings are for conveying the ground or pulverized material that passes through the screens down into the receiving-trough E.

F is an annular plate or ring which is bolted to the casing or pan, and, in connection with the annular shoulder *b'* of said casing or pan, serves to firmly secure the die B in operative position. This die is composed of three separate rings, of which b^2 is the inner, wearing, removable, and renewable ring, and b^3 and b^4 the outer, strengthening, and clamping or binding rings, which are fitted to the outer beveled faces of said inner ring, as shown, so that by drawing or pressing them together by screw-bolts and nuts or wedges, or other ordinary suitable means, the said inner ring will be securely but removably held in place.

The housing or cover G of the mill is composed of three parts—the screen-frames *g*, the top portion *g'*, and the outer inclined or conical part g^2. These parts are removably secured together and to the pan A and the annular plate F by screw-bolts g^3, as shown in the drawings.

The combined roller-carrier, feed-distributer, and elevator H is cast integrally, is secured to and driven by the shaft I, and is formed with an annular web or plate *h*, provided with semicircular recesses or pockets *h'*, as shown in Fig. 2, in which the rollers C freely rotate, with a feed-directing shell J, provided with openings *j*, arranged to deliver the material in front of each roll, and also with the circular rim or disk D, arranged beneath the rolls and provided with a series of elevating-inclines *d*, which are arranged to follow each other in the manner shown, the inclined faces thereof being made of chilled iron or other hard-metal plates for resisting wear; also, said plates are to be so secured as to permit of their easy removal when desired. This circular disk, with its inclined surfaces, is made of smaller diameter than the interior surface of the ring or annular die, so that during its rotation it will operate to throw the material upwardly against the inner surface of said die and above the same. On this circular disk or elevating device are also formed small horizontal surfaces or rests *d'*, as shown in Figs. 3 and 6, which act as supports for the rollers when the mill is not in operation.

The rollers C may either be made sectional, as shown in the drawings, or they may be made solid. In either case they are provided with supporting-bosses *c* on their under sides, which rest on the horizontal surfaces *d'*, and with extensions *c'* on their upper sides, which reach up into and are covered by the combined drivers and hoods K. The joints between these parts are packed by leather or other suitable washers c^2, which prevent dust or grit from gaining access to the journals. The rollers are also provided with bronze or other suitable bushings c^3, in which the spindles work freely; also, in the upper or extended part of each roller is formed a recess c^4, for collecting surplus oil and preventing it from coming in contact with the ground material.

The spindles c^5, on which the rollers rotate, are fastened in the combined drivers and hoods or dirt-protectors K, which are used in place of the swinging arms shown in my former patent. These spindles are further secured at their tops by ball-and-socket joints to the top frame L, secured to the main central carrier, the balls c^6 being formed on or secured to the spindles, and the sockets c^7 being made in two parts and secured in said top frame by wedges c^8, as shown, or otherwise.

In the rear of the semicircular pockets *h'*, and secured to the main carrier H, are elastic or other anti-friction pushing pieces or blocks M, mounted upon bosses *m*, secured to the main carrier, as shown in Figs. 1, 2, and 4. These pushing-pieces, however, are preferably made of elastic material, as they then permit of some yield of the rollers when they come into contact with hard or foreign substances, and thus prevent their injury. Against these pushing-pieces press the spindle-drivers K, and against the faces of which said drivers may freely rotate as the rollers move in and out toward and from the center of the machine when the mill is in operation.

It will be observed that the rollers, spindles, and drivers are not perpendicularly arranged, but that the lower part of each of them is slightly in advance of its top, as more plainly shown in Fig. 9 of the drawings. This inclination of the spindles causes the rollers when in motion to rise from their horizontal supports *d'* on the upper surface of the elevating device D and to constantly maintain their position solely by their centrifugal force and adhesion to the die B.

A sweep or circular conveyer N rotates in the trough E, being secured to and driven by the main shaft, and carries the pulverized material around and discharges it through the spout O.

In Figs. 5 and 6 of the drawings the swinging arms and spindles of my former patent are shown combined with parts of the present invention as illustrating an instance of the capabilities of use of the latter.

Inside of the housing or cover G, as shown in Fig. 4, a circular ring of sheet metal P is secured to the ring F. A secondary or internal cover Q is secured to the top of cover G, and consists of a hood *q* and an inner ring *q'*

secured thereto, as shown, said hood and ring respectively projecting downwardly outside and inside of the upwardly-projecting ring P and in connection therewith, and the outer cover G forming ducts or passages for the air-currents generated in the mill and operating to elevate and separate the lighter or sufficiently-pulverized material from the heavier or unpulverized particles. An opening q^2 is formed in the upper portion of the hood q, and over this opening is arranged a plate or valve q^3, which is adjustably secured to the outer cover by screws q^4 and operated to regulate the intensity of the air-currents passing down through said opening and back into the interior of the mill. The air-currents are produced by the wings or vanes R on the revolving center, Fig. 4, which are arranged in front of the rollers, said wings or vanes, when the mill is in operation, causing the air-currents to circulate within the mill in the directions indicated by the plain arrows in Fig. 4. As the air-currents are prevented from escaping by the outer cover, no fine and often deleterious dust is carried out into the room or building in which the mill may be operated.

The operation of my improved mill is as follows: The material to be ground or pulverized, being introduced through the hopper or chute q^5 by any suitable feeding device, falls within the revolving feed directing or distributing shell J and to the bottom thereof, from which it is thrown out by centrifugal force through the openings j and discharged against the annular die B, immediately in front of the rollers C, and is by them crushed or pulverized. It then falls upon the elevating-inclines d beneath the rolls, and is by them directed or thrown upward across the face of the die and against the screens when they are employed. Such portions of the material as are sufficiently pulverized or fine pass out through the screens and fall downward through the openings b into the receiving-trough E, from which they are driven out by the sweep or conveyer N through the spout O. The material that does not pass through the screens falls back upon the top and across the face of the die and is again acted upon by the rollers. By this means, the feed being evenly distributed upon the die and the ground material being driven from the mill as fast as produced, the greatest possible amount of work is accomplished by a given number of rollers. As the ground material does not strike the screens at right angles, but at a tangent or inclination, the wear on said screens is comparatively small, and a much finer product is obtained than the meshes of the screens would indicate.

The construction, arrangement, and operation of the feeding, grinding, or pulverizing and elevating mechanisms of the mill shown in Fig. 4 of the drawings are the same as in the mill in which the screens are employed, but the delivery or discharge of the material therefrom is different. The pulverized material when thrown up by the inclines follows the same course as when discharged through the screens; but instead of striking the screens it is thrown against the upwardly-extending ring P, when such of the material as is sufficiently fine will be carried by the air-currents produced by the wings or vanes R over said ring and downward under the edge of the hood q. Then as the current of air rises again between said hood and the outer cover G the greater portion of the ground material will drop out of the air-currents, follow the direction of the feathered arrows, pass down through the openings b in the pan A, and be discharged from the mill in the same manner as when delivered through the screens. By raising or lowering the plate or valve q^3 the size of the opening q^2 can be varied, and consequently the strength of the current of air can be increased or decreased, and thus the fineness of the product discharged regulated.

Having thus fully described the construction, arrangement, and operation of the parts of my invention, what I claim as new is—

1. In a pulverizing-mill, the casing or pan, the annular die, and the crushing or pulverizing rollers, in combination with the revolving centrally-arranged carrier provided along its upper portion with a feed receiving and distributing shell having openings arranged to deliver in front of the rollers, and also provided with an annular web or plate arranged beneath said shell and formed with pockets for the rollers, and with a disk or circular shaped lower end provided with inclined elevating-faces and horizontal supporting-surfaces, said carrier and its parts being integrally formed, substantially as described.

2. In a pulverizing-mill, the combination of the casing or pan, the annular die, the crushing or pulverizing rollers rotating within and against said die, the spindles upon which said rollers are closely fitted, the combined hoods and spindle-drivers, the ball-and-socket joints, and the revolving carrier provided with the top frame, said spindles being connected at their upper ends to the top frame of said carrier by said ball-and-socket joints, substantially as described.

3. In a pulverizing-mill, the combination of a casing or pan, an annular die, a central revolving carrier, pulverizing-rollers which are substantially vertically connected to said carrier, spindles to which said rollers are closely fitted, combined hoods and spindle-drivers, and pushing-blocks mounted on said carrier and arranged to engage said combined hoods and spindle-drivers and drive said rollers from the rear, substantially as described.

4. In a pulverizing-mill, the combination of a casing or pan, an annular die, a central revolving carrier having elevating-inclines provided with rests, pushing-blocks, and pulverizing-rollers loosely journaled on said carrier and

in front of said pushing-blocks, said rests being arranged below said rollers for supporting them when not in operation, substantially as described.

5. In a pulverizing-mill, the combination of a casing or pan, an annular die, a central revolving carrier, pulverizing-rollers loosely journaled on said carrier, and elastic pushing-blocks mounted upon said carrier and arranged to engage said rollers, substantially as described.

6. In a pulverizing-mill, the combination of the casing or pan, the annular die, the revolving carrier provided with the pushing-blocks, the rollers provided with upward extensions, and the combined hoods and drivers, which freely rotate against said pushing-blocks as the rollers move in and out toward the center of the machine, substantially as described.

7. In a pulverizing-mill, the combination of the casing or pan, the annular die, the crushing or pulverizing rollers, the revolving carrier, the ball-and-socket joints, the spindles secured at their upper ends by said ball-and-socket joints, the elastic pushing-blocks secured to said carrier, and combined hoods and drivers which roll in and out to and from the center of the mill against said pushing-blocks, substantially as described.

8. In a pulverizing-mill, the combination of the casing or pan, the annular die, the rollers, spindles, spindle-drivers, and the revolving carrier provided with the semicircular pockets in which the rollers rotate, with the pushing-blocks arranged in rear of said spindle-drivers, with a feed-directing shell having the discharge-openings, and with a set of inclines by which the material is thrown upward against the face of and across the die, substantially as described.

9. In a pulverizing-mill, the combination of the casing or pan, the annular die, the revolving carrier provided with horizontal supports or rests, as described, and the spindles and rollers arranged at an incline from the perpendicular, whereby when in operation said spindles and rollers rise from said supports or rests and remain in operative position against said die by centrifugal force, substantially as described.

10. In a pulverizing-mill, the combination of the casing or pan, the annular die, the revolving carrier having horizontal supports or rests formed on its lower portion and provided with a horizontal frame at its top, the ball-and-socket joints, the rollers, and the spindles having bosses at their lower ends, and, together with the rollers, arranged at an inclination from the perpendicular and secured to said top frame by said ball-and-socket joints, substantially as described.

11. In a pulverizing-mill, the combination of the casing or pan having downwardly-leading discharge-openings in its body, the annular die, and the rollers rotating within and against the same, with a revolving circular disk or carrier arranged below said die and provided with inclined surfaces arranged in a vertical line falling inside of the interior surface of the die for the purpose of throwing material against the die and above the same, substantially as described.

12. In a pulverizing-mill, the combination of a casing or pan having downwardly-leading discharge-openings in its body, an annular die, pulverizing-rollers, elevating devices arranged below said die and adapted to throw the ground material above the same, and a cover or housing arranged around and above said die and having air ducts or passages for carrying the heavier ground material toward said discharge-openings, substantially as described.

13. In a pulverizing-mill, the combination of a casing or pan having downwardly-leading discharge-openings in its body, an annular die, pulverizing-rolls, feed-elevating devices arranged below said die, and a cover or housing arranged above said die and having tortuous air ducts or passages for carrying the heavier ground material toward said discharge-openings and for permitting the air and fine dust to pass upward within the mill, substantially as described.

14. In a pulverizing-mill, the combination of the casing or pan, crushing or pulverizing mechanism, and an inner revolving part provided with vanes or wings, with an outer stationary cover, an inner cover, and the upwardly-projecting ring, said parts being so arranged by the revolution of said inner part and its vanes or wings that currents of air are caused to circulate within the mill and carry away or discharge the sufficiently-pulverized material without permitting air and fine dust to escape, substantially as described.

15. In a pulverizing-mill, the combination, with the crushing or pulverizing mechanism and the revolving carrier provided with wings or vanes, of the upwardly-projecting ring, the outer cover, the internal cover consisting of an outer hood and an inner ring secured thereto and projecting, respectively, outside and inside of the ring first named, and the casing or pan provided with downwardly-leading openings, substantially as and for the purpose described.

16. In a pulverizing-mill, the combination, with the crushing or pulverizing mechanism and the revolving carrier provided with wings or vanes, of the upwardly-projecting ring, the outer cover, the internal cover consisting of an outer hood and an inner ring secured thereto and projecting, respectively, outside and inside of the ring first named and formed with an inlet-opening in its top, an adjustable plate or valve arranged over said opening, and the casing or pan provided with downwardly-leading openings, substantially as and for the purpose described.

17. In a pulverizing-mill, the combination, with the crushing or pulverizing mechanism

and the revolving carrier provided with wings or vanes, of the upwardly-projecting ring, the outer cover, the internal cover consisting of an outer hood and an inner ring secured thereto and projecting, respectively, outside and inside of the ring first named, and the casing or pan provided with downwardly-leading openings, the trough, and the sweep, substantially as and for the purpose described.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN COLVER GRIFFIN.

Witnesses:
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THOMAS J. HUSTON.