(No Model.) 4 Sheets—Sheet 1.

W. E. GORTON.

GRINDING MILL.

No. 292,746. Patented Jan. 29, 1884.

Fig. 1.

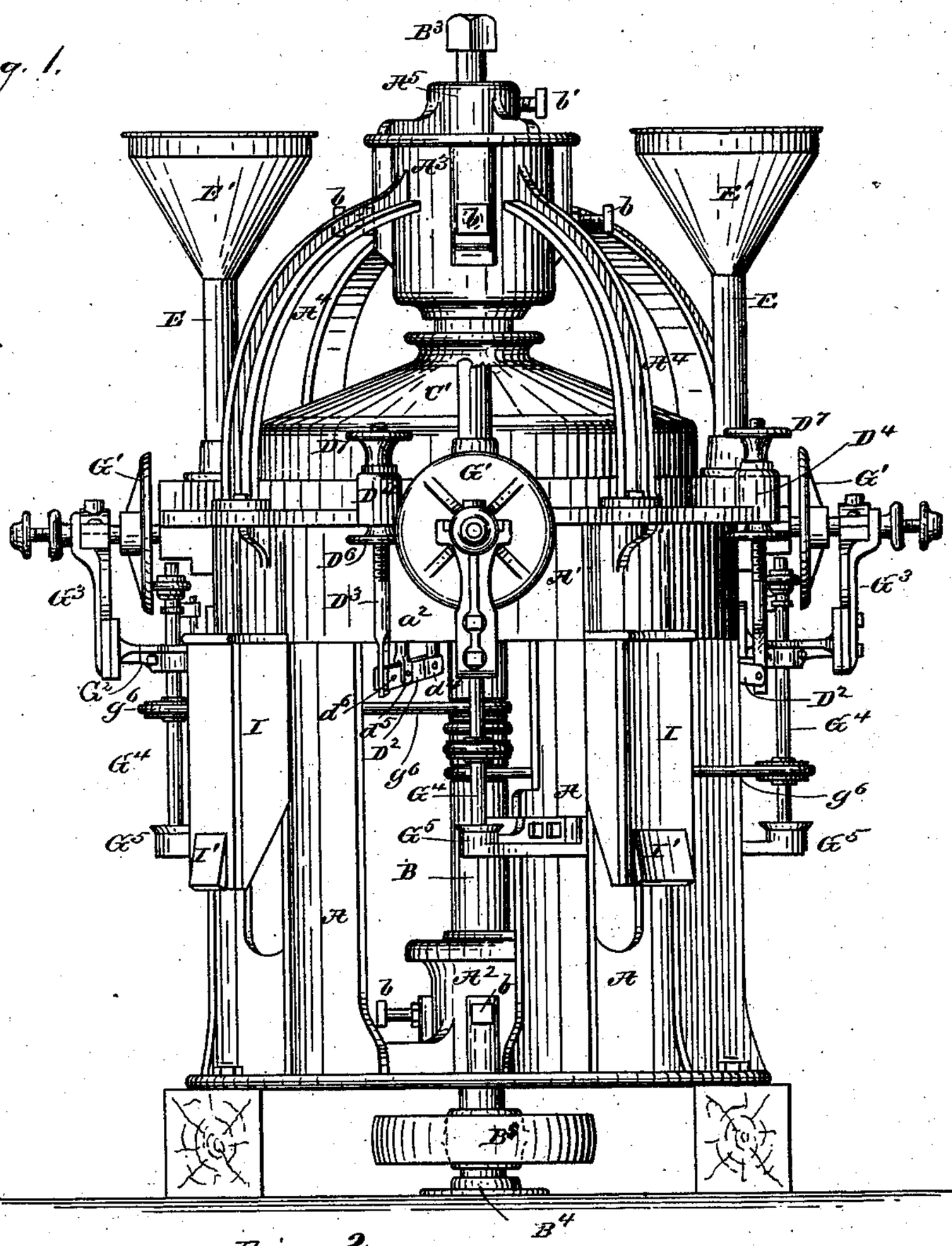
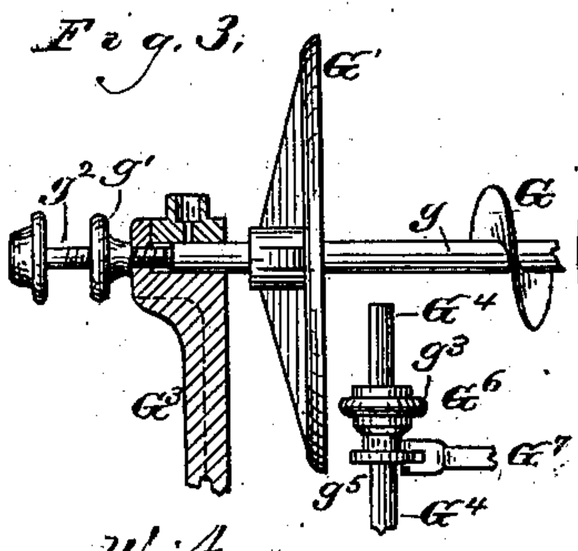


Fig. 2.

Fig. 3.



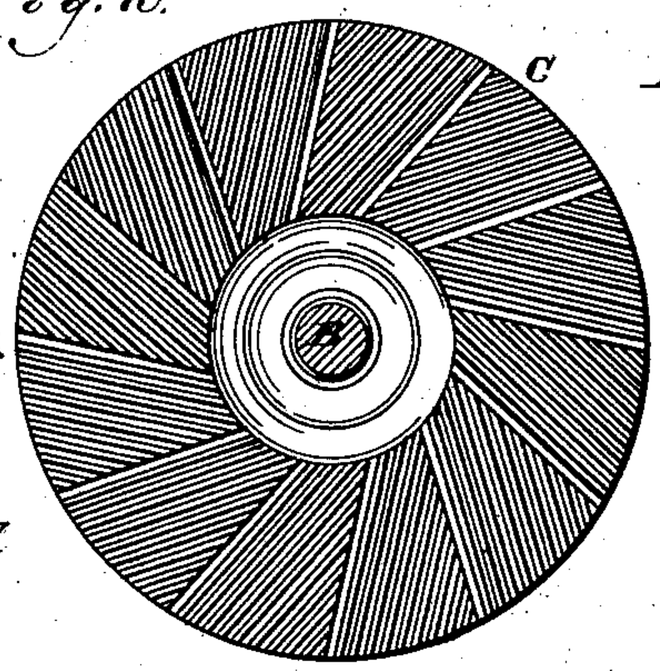
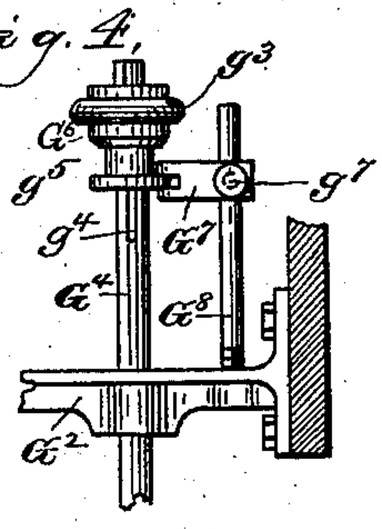


Fig. 4.



Witnesses,

H. Ewing Paul Synnestvedt.

W. L. Baker

Inventor.

William E. Gorton

per. W. L. Baker

Attorney.

(No Model.) 4 Sheets—Sheet 2.

W. E. GORTON.

GRINDING MILL.

No. 292,746. Patented Jan. 29, 1884.

Fig. 5.

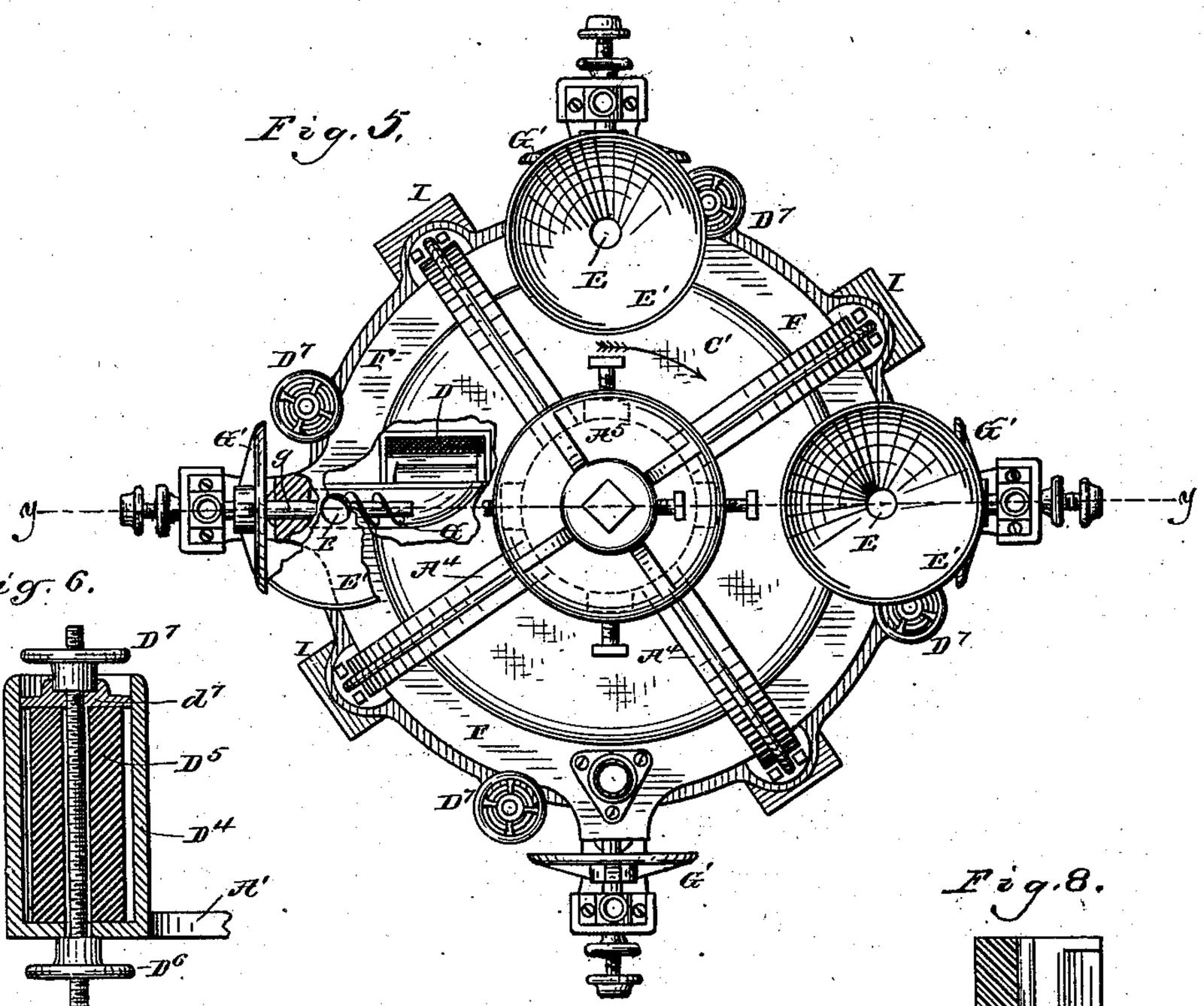


Fig. 6.

Fig. 7.

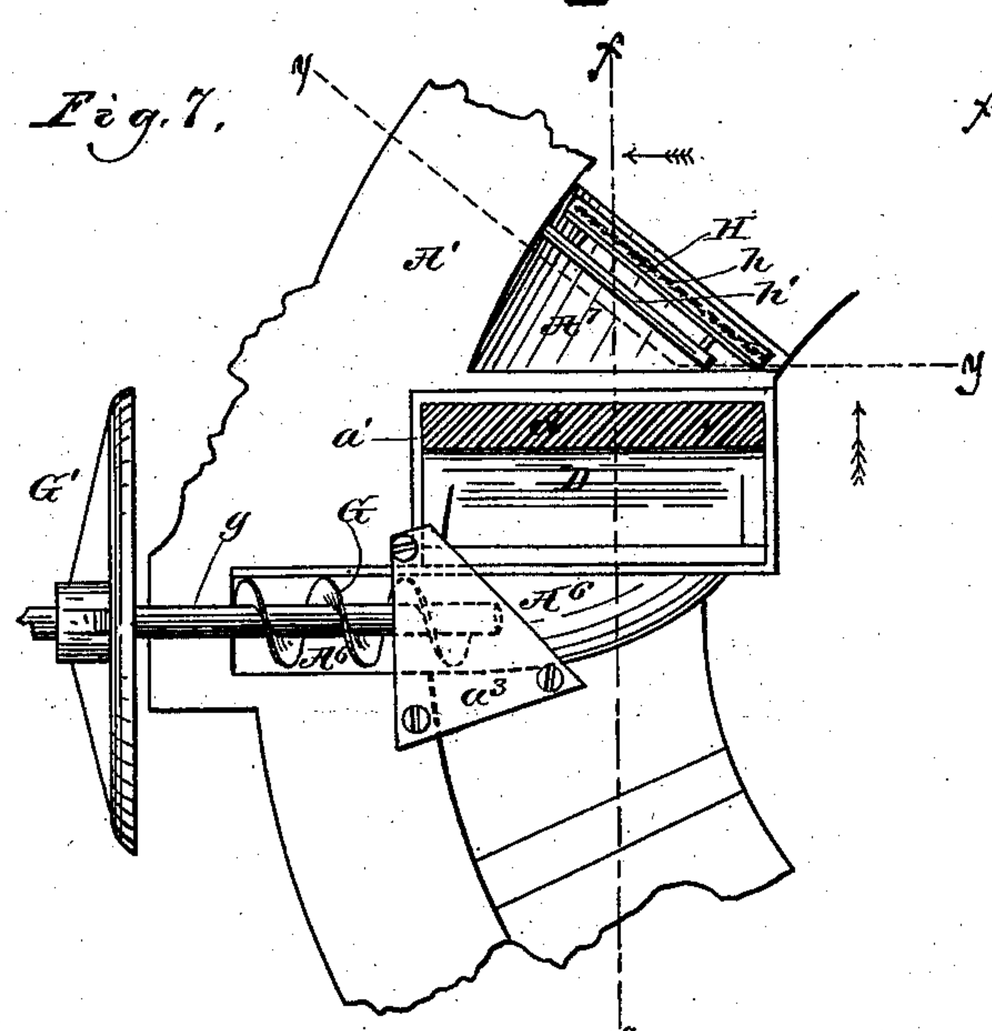


Fig. 8.

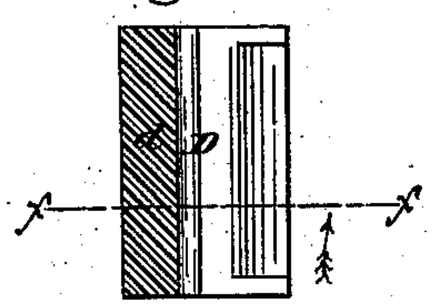
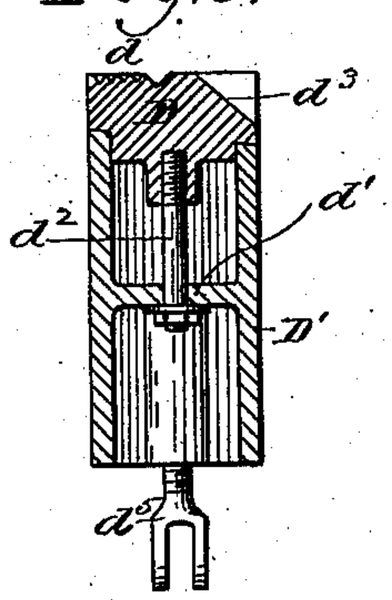


Fig. 9.



Witnesses,
Henry Faulkner.
Jno. W. Stockett.

Inventor.
William E. Gorton
per. W. W. Barstow
Attorney.

(No Model.) 4 Sheets—Sheet 3.

W. E. GORTON.

GRINDING MILL.

No. 292,746. Patented Jan. 29, 1884.

Fig. 10.

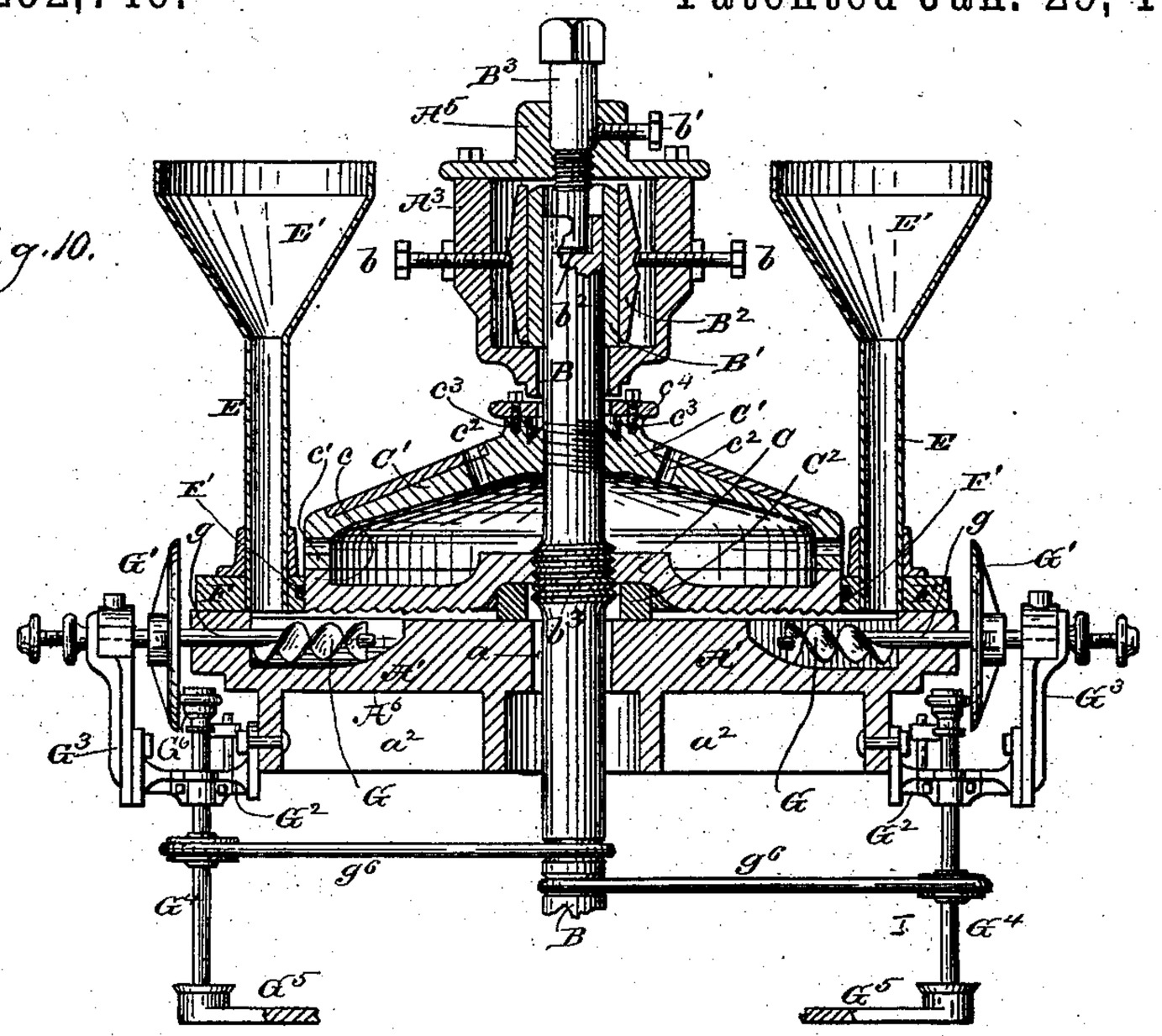


Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

Witnesses.

Henry Frankfurter.

Jno. W. Stockett.

Inventor.

William E. Gorton

per. W. W. Dawson

Attorney.

(No Model.) 4 Sheets—Sheet 4.

W. E. GORTON.

GRINDING MILL.

No. 292,746. Patented Jan. 29, 1884.

Fig. 15.

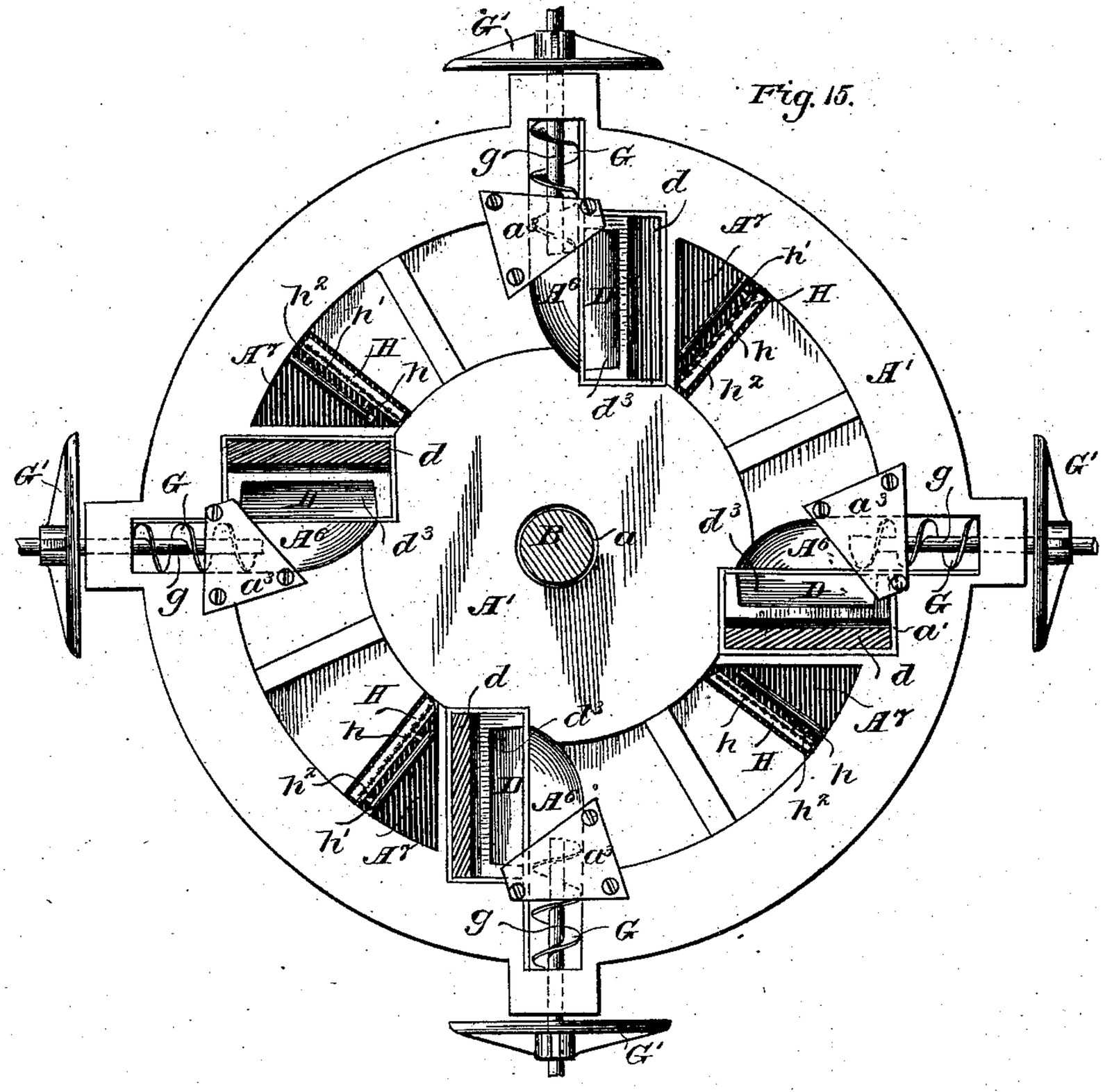
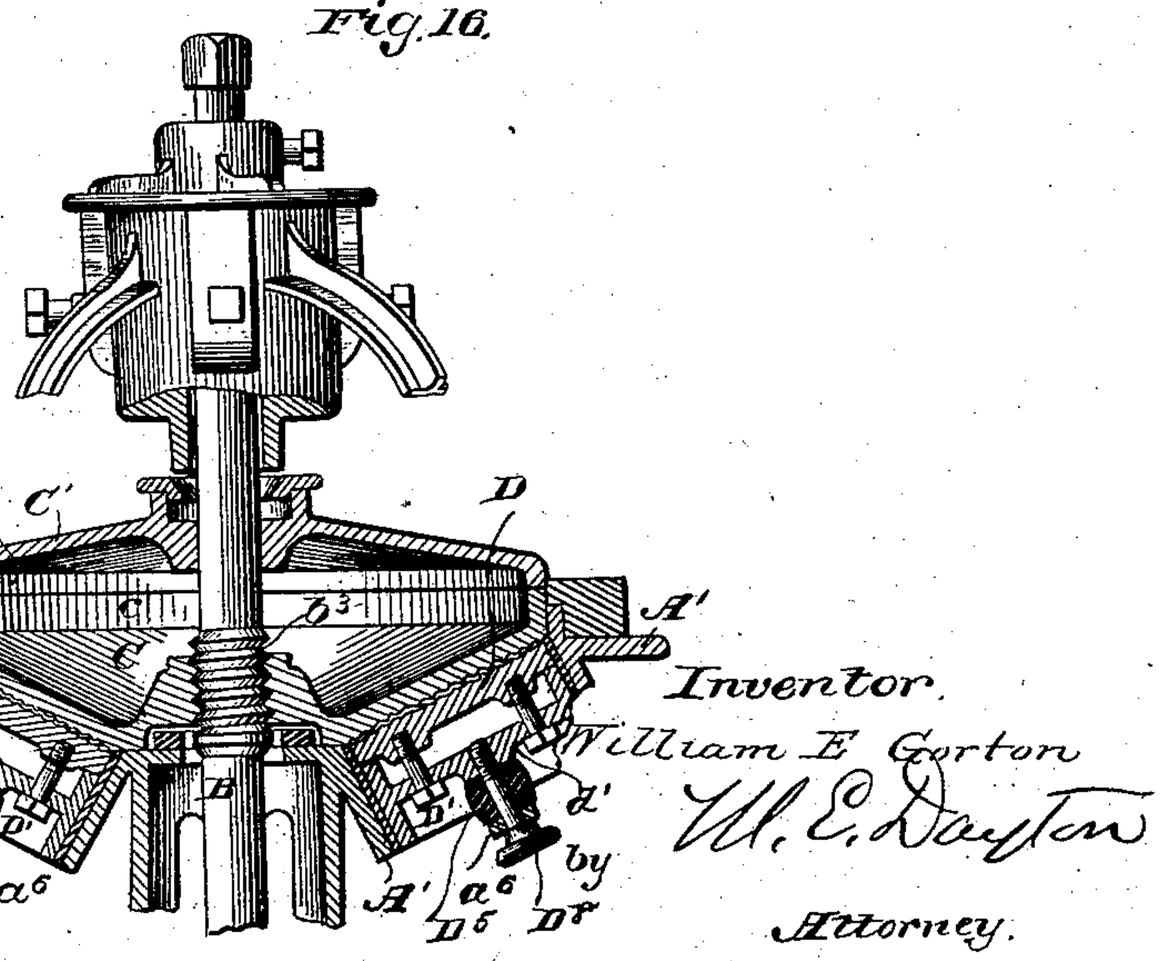


Fig. 16.



Witnesses:
Jno. H. Stockett.
C. C. Poole

Inventor.
William E. Gorton
by W. E. Dayton
Attorney.

UNITED STATES PATENT OFFICE.

WILLIAM E. GORTON, OF CHICAGO, ILLINOIS.

GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 292,746, dated January 29, 1884.

Application filed June 8, 1883. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. GORTON, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Grinding-Mills; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in grinding-mills, principally intended for the reduction of grain, and has for its primary object such a construction in a mill as will enable a single machine to simultaneously perform two or more reductions or different kinds of work on different masses, kinds, or grades of material.

To this end the improved machine comprises two or more grinding plates or surfaces entirely separate and distinct from each other, but both or all arranged in opposition to a single working-face of a disk or other form of runner, and separate feeding and discharging devices for each of the several grinding-plates, whereby one reduction may be performed between the runner and one of the said grinding-plates, and another reduction between said runner and another of said plates, or whereby one grade or kind of material may be fed to one grinding-plate and another to another. In carrying out this purpose the machine is also made to embrace many other novel devices and features of construction, which will hereinafter more fully appear.

The parts, combinations of parts, and features of construction and operation which I believe to be new, and desire to secure by Letters Patent, are specified in the claims appended to this description.

In the accompanying drawings, Figure 1 is a side elevation of a machine containing my improvements. Fig. 2 is a view of the working-face of an annular or disk form of runner employed in the mill as herein illustrated. Fig. 3 is a detached view, partly in section, of the feed mechanism. Fig. 4 is a view showing a part of the feed-driving mechanism. Fig. 5 is a top or plan view of the machine shown in Fig. 1, a part being broken away for the purpose of showing the location of a worm in a feed-passage leading to the grinding-surfaces. Fig. 6 is a detail in section of a part of the devices by which the adjustment of the separate grinding-plates is effected. Fig. 7 is a fragmentary top view of the recessed plate which contains the detached grinding-plates, and also the recesses which afford passages for the admission and discharge of material to and from said grinding-plates, the superposed runner being removed. Fig. 8 is a top view of one of the grinding-plates detached from the machine. Fig. 9 is a vertical section of the grinding-plate and the subjacent frame-work to which said plate is attached, taken in the plane of *x x* of Fig. 8. Fig. 10 is a central vertical section of the upper portion of the machine, shown complete in Fig. 1. Fig. 11 is a vertical section through *x x* of Fig. 7, looking outward or toward the disk G′. Fig. 12 is a vertical section taken in the converging planes *y y* of Fig. 7. Fig. 13 is a perspective view of one of the brushes employed for cleaning the surface of the runner, shown detached. Fig. 14 is a fragmentary view, showing the under or working face of the runner, having a dress of a peculiar and preferred form. Fig. 15 is a horizontal section of the machine, revealing the stationary recessed casting, which contains the separate grinding-plates, in plan view.

First describing the invention as illustrated in Figs. 1 to 15, inclusive, A A represent the frame of the machine; B, a central driving-shaft, and C a horizontal runner-disk mounted on said shaft.

D D are grinding-plates arranged in opposition to the working-face of the runner. E E are feed-spouts for delivering grain or other material to be ground to the several grinding-surfaces. G G are feed worms or screws located in the feeding-passages. H H are brushes arranged in the discharge-openings of the mill for the purpose of cleaning the face of the runner C, and I I are spouts connected with the discharge-openings for delivering the ground products. The shaft B is laterally supported at its upper and lower ends in the bridge-tree A^2 and elevated hub A^3, the latter being supported above the general frame-work of the machine by arms A^4. The shaft is vertically supported by any suitable foot-piece, as B^4, though preferably said foot-piece is attached to the bridge-tree A^2 in a well-known manner,

instead of resting on the floor, as here shown. Said shaft is preferably laterally adjustable, and for this purpose devices may be employed in the hub of the bridge-tree A^2 and in the upper hub, A^3, such as are indicated in vertical section of said upper hub in Fig. 10. These devices, as shown, consist of a close bearing box or brass, B′, usually made in parts, and embracing the shaft B, loose blocks B^2, placed exterior to the box B′, and horizontal adjusting-screws *b*, threaded through the hub in position to bear against the blocks B^2, sufficient room being provided in the hub to allow of all necessary or desired lateral movement of the shaft and the surrounding parts just mentioned and contained in said hub. The shaft B may be vertically adjusted by making the lower hub or bridge-pot, or the bridge-tree itself, vertically movable by any of the common devices now known for this purpose.

In order to prevent end-chase of the shaft and vertical movement of the runner attached thereto, a binding-screw, B^3, threaded through the cap A^5 on the upper hub, A^3, is employed, being arranged to bear against the upper end of the shaft B. Said shaft is preferably provided with a socket, b^2, on its upper end, to admit the lower end of the binding-screw B^3, as plainly shown in Fig. 10. In this case the socket should be of greater diameter than the end of the screw, to allow of lateral movement of the shaft in effecting adjustment thereof by means of the screws *b*, inasmuch as said binding-screw is laterally stationary. Such construction is obviously favorable for the retention of a lubricant in said socket. Said binding-screw B^3 is held in position vertically, after being run down to place on the shaft B, by means of a set-screw, *b*′, or any other suitable device for the purpose.

The runner C may be secured to the shaft B in any suitable manner, but as here shown it is provided with a central threaded aperture fitted to the threaded portion b^3 of said shaft; and a cone-shaped disk or spider, C′, also centrally apertured to closely fit the shaft, is arranged to bear upon the margin of the runner, so as to hold the latter firmly and steadily with its working-face at right angles with the axial shaft. As here shown, the runner C is provided with an upwardly-projecting annular marginal flange, *c*, and the support C′, of disk or corresponding form, has a corresponding downwardly-projecting flange, *c*′, which meets the flange *c*. Between the runner and supporting-disk C is thus formed a space communicating with the outer air by passages c^2, for the purpose of keeping the runner cool. When the support C′ is of open or spider form, this effect will be more perfectly attained.

By arranging the direction of the thread b^3 so that the runner will tend to rise on the shaft in the operation of the machine, and by keying, pinning, or otherwise fastening the disk C′ to the shaft, the runner C will be held vertically immovable. The same result may be obtained by providing the shaft within the aperture of the disk C′ with a thread of different pitch or size from that shown at b^3, or one running in an opposite direction.

As indicated in Fig. 10, the disk C′ is recessed at c^3 around the shaft, to receive any oil that may drip from the upper shaft-bearing, and over said recess c^3 is removably fastened the cap or cover c^4, (preferably made in two parts, unless room be provided for lifting it well up from the disk,) through which the oil is free to descend about the shaft into said recess provided for its reception.

The runner C is of any preferred material, and when of disk form its working-face is annular, and preferably confined to the outer margin of the disk, as shown in Fig. 2. The dress of said runner may be of any suitable and desired form, a common form of such dress being also indicated in Fig. 2. I prefer, however, to employ a particular form of dress for the runner, consisting of alternating furrows of different dimensions, and curved or ogee in sectional contour, as indicated in Fig. 14.

As this particular form of dress will constitute the subject of separate application for patent, it will not be here further explained.

Between the plate A′ and the runner is placed the wooden ring C^2, surrounding the aperture for the shaft, to prevent escape of dust or other substances at this point, said ring being preferably secured to the said plate A′.

The stationary grinding-plates D are supported in any suitable manner in opposition to the working-face of the runner C, but preferably by a single continuous circular plate, A′, secured at its margins to the frame-uprights, and provided with a central aperture, *a*, large enough to admit the free passage of the shaft B, and to allow of such lateral adjustment of said shaft as may from time to time be necessary. Said grinding-plates may, however, be independently supported by separate plates or parts secured to the frame, but for the purposes of this patent such supports for the grinding-plates will be generally designated as the plate A′, whether they be of a single piece and continuous, or made in separate and detached parts, or otherwise.

The grinding-plates are here shown as being placed with their sides parallel with equidistant radii of the plate A′, or of the runner. Said plates may, however, if preferred, be located in other positions upon the said plate—as, for example, a central line drawn longitudinally through the grinding-surface of the plates may be a radius of the said plate A′, or of the runner. The plate A′, when located below the runner, as in Figs. 1 to 15, inclusive, is of greater diameter than the runner C, and, as shown in said figures, is constructed with deep rectangular apertures *a*′, (best seen in Figs. 7 and 11,) for the reception of the grinding-plates D. Said plate A′ is also constructed with recesses open at the top or adjacent to the superposed runner, so as to afford feed and discharge passages to and from the grinding-plates, the feed-passages A^6, Figs. 7

and 11, being located in front of the grinding-plates, and the discharge-passages A^7 being located to follow said grinding-plates, reference being had to the direction of motion on the part of the runner. The feed-passages A^6 in this arrangement of the grinding-surfaces extend outwardly beyond the margin of the runner, and their outer ends are covered by a ring, F, closely encircling the runner, and provided, if desired, with any suitable packing in contact with the runner for the confinement of dust.

In Fig. 10 a packing is shown consisting of a rubber tube or gasket, F', set in a groove in the inner vertical face of the ring F, so as to bear against the adjacent periphery of the runner. The feed-spouts E are set in this ring F, as shown, or otherwise connected to communicate with the outer ends of the feed-passages A^6. The discharge-openings A^7 are of about equal extent, radially, with the grinding-plates, and being located to immediately follow said plates, as shown, the ground product from each grinding-plate is discharged by itself.

The separate feed-spouts E E are obviously adapted to receive material of different kinds or grades or degrees of reduction from different sources—as, for example, one may receive whole grain, another may receive grain partially reduced, another grain still further reduced, and so on—and, if the number of grinding-plates be sufficient, all the reductions, or any desired number of reductions, may be accomplished on a single machine. By means of the discharge-spouts I I or openings A^7, moreover, the products of the several grinding-plates may be delivered into separate receptacles, and, if desired, a receptacle or spout receiving the product from one grinding-plate or discharge-opening may be connected by a suitable conveyer with the feed spout or passage leading to another grinding-plate of the same mill, and thus the material to be ground may be automatically carried from one set of grinding-surfaces to another.

Any desired dissimilarity in dress between the working-faces of the several grinding-plates may be employed, such dissimilarity of dress being for the purposes of this patent sufficiently illustrated in Figs. 5, 8, and 15.

In the use of the horizontal feed-passages A^6, located beneath the surface of the runner, as shown, it will generally be necessary (particularly in feeding broken or partially-reduced grain) to employ devices for forcing the feed of said material to the grinding-surfaces. For this purpose I have shown a worm or screw, G, located in each of said passages A^6, being so driven as to carry the material inward. The inner end of said worm is preferably free, as indicated, and it is supported at its outer end by passing through a suitable aperture of the plate A' exterior to said passage, and by an outer bracket, G^2 G^3, upholding its outer extremity.

To further facilitate the feeding of material to be ground to the space between the runner and the adjacent grinding-plate, the passage A^6 is inclined toward the surface of the grinding-plate, as shown plainly at d^3 in the sectional figure 11. The inclination of this passage may be provided in the construction of the plate A' or upon the grinding-plate D, as may be preferred, or by giving to each a portion of the inclination desired, as indicated in the accompanying drawings.

To still further facilitate the feeding of the material to be ground to the grinding-faces, the inner end of the recess A^6 is preferably curved or inclined toward the grinding-plate, as shown plainly in Fig. 7.

In order to insure the distribution of the material to be ground equally throughout the length of the grinding-plate, a plate, a^3, is let into the surface of the plate A' and secured in position to cover the outer part of the passage A^6 beneath the runner, the said plate a^3 being of such shape as to allow the material to be ground to rise in contact with the runner-face about centrally opposite the grinding-plate. If desired, said plate a^3 may extend to the outer end of the recess A^6 and take the place of the ring or part F as an exterior covering for said recess.

The grinding-plates D may be of any desired construction and dressed in any suitable manner. Generally, however, they will be dissimilarly dressed, in order that each may be better adapted for a special reduction or kind of work. For certain kinds of work—as, for example, for the splitting of wheat—one or more of the plates in the mill may be entirely without dress or perfectly smooth upon its working-face, and of such sectional conformation as may be best suited to the work. When provided with a dress and intended for the reductions which follow splitting, the grinding-surface of said plates will usually be flat or horizontal and parallel with the face of the opposing runner, as indicated clearly in Fig. 11. While said plates may be made of a single continuous piece of metal of any desired thickness or width equal to or greater than the width of the working-face thereof, I prefer to make said grinding-plates in two parts, as indicated in Figs. 9 and 11, wherein the working-plate proper is marked with the letter D, and is supported by a downward extension, D', consisting of a chambered rectangular metal frame or casting of equal lateral dimensions with the plate D and somewhat smaller than the recess a' in the plate A'. The plate D is, in this case, constructed to retain its place laterally upon the chambered casting D' by being let down into the latter as well as resting upon the same, as shown in Fig. 9, or by equivalent means. The plate D is vertically and permanently held down upon the casting D', as here shown, by means of vertical bolts d^2, passing through a horizontal diaphragm, d', provided centrally in the casting D', said bolts being threaded into the lower surface of the plate D. The working-face of

the plate D is made sufficiently hard for durability either by making said plate of steel and hardening the same, or by making it of cast-iron and chilling its face in the operation of casting. The vertical faces of the casting D′ are planed off or otherwise finished, so as to be smooth and parallel, and the walls of the recesses a' in the plate A′, which are to retain said grinding-plates or castings, may be cheaply fitted to the smooth faces of the latter by a filling of babbitt, (indicated at a^4 of Fig. 11.) In running in the babbitt, the plate A′ is inverted or placed with its face upon a plane surface, and the grinding-plates are set in the recesses, with their working-face also resting on said plane surface, and with equal spaces on all sides or between said casting and the walls of the recess a'. Said space is stopped at the bottom, so as to retain the babbitt, and centrally of each side of the casting D′ is inserted a vertical strip of tin, paper, or other material dividing the space into parts, so that the babbitt, when run into the space, will form in four parts, and in shrinking will not hug the grinding-plate or draw away from the rough surface of the recess-walls, but will adhere to the latter, and form fixed and suitably close guiding-surfaces for the grinding-plate.

In making the grinding-plates of the compound structure last above referred to, I prefer to make them relatively broad or materially broader than their working-faces, as shown, in order that the working-plate proper may be held firmly in its attachment to the subjacent casting D′, and in this case I also prefer to construct said working-plate proper with one of its faces inclined, as seen at d^3, so as to form a part of the feeding-passage A^6, as seen in Fig. 11. The grinding-plates being fitted to work vertically in the recesses a', as above described, any suitable means for their separate vertical adjustment may be employed, whereby they may be set at any desired distance from the face of the opposing runner C. One suitable means for such vertical adjustment of the grinding-plates is shown in Fig. 1. In this device D^2 is a horizontal lever, pivoted at d^4 to a stud depending from the lower surface of the plate A′ or to any stationary part of the machine, also pivoted at d^5 between its ends to a depending stud upon the grinding-plate, and at its outer end, or d^6, pivotally connected with the vertical adjusting-screw D^3. Said screw D^3 rises through a marginal projection of the plate A′ and through a spring, D^5, resting upon said projection, as seen in Fig. 6. To said screw D^3 are applied two hand-nuts, D^6 and D^7, one arranged beneath the projection of the plate A′ and the other above the spring D^5, as also shown in Fig. 6, a plate, d^7, being preferably interposed between the upper of said hand-nuts and said spring. As here shown, the spring D^5 is surrounded by a cylindric housing. D^4, cast upon or applied to the projection of the plate A′, in which housing said spring works loosely, and in which also the plate d^7 is fitted to freely move. By constructing the plate d^7 to hold the nut D^7 concentric therewith, the housing D^4 has the advantage of holding the screw D^3 permanently upright, and of concealing said spring and protecting it from injury. In this construction, which is essentially the same as that heretofore applied to stationary grinding-disks, the grinding-plate is allowed to yield whenever a hard substance enters the space between the same and the opposing runner, and to thereby avoid injury to the machine.

The feed-screw G may be rotated by any suitable mechanism. The devices here shown for this purpose consist of a friction-disk, G′, secured to the shaft g of the screw or worm, and an opposing friction-pulley, G^6, on a vertical shaft, G^4, which is driven by a belt, g^6, from the central driving-shaft, B, of the machine, as generally indicated in Fig. 10. Said shaft G^4 has bearing at its lower end in the socketed extremity of an arm, G^5, projecting from the frame, and, near its upper end, in the horizontal arm G^2, bolted to the plate A′, a pulley being affixed to said shaft between its points of bearing to receive the belt g^6, as shown in said Fig. 10.

Provision is made for varying the speed of the feed-worm G by a longitudinal adjustment of the pulley G^6 on its shaft G^4, whereby said pulley may be made to bear upon the disk G′ nearer to or more remote from its axis, as may be desired. Such radial adjustment of the pulley with reference to the disk G′ may be effected by a vertical movement of the shaft G^4; but it is preferably effected, as here indicated, by making said shaft vertically stationary and mounting the pulley G^6 thereon by means of a spline, g^4, as shown in Fig. 4. The pulley is in this case upheld by being provided with a flange, g^5, fitted to engage an arm, G^7, that is movably secured to a post, G^8, by means of a set-screw, g^7. The shaft G^4 having a uniform speed derived from the shaft B by raising the pulley G^6, the speed of the feed-screw will be increased, and by lowering the pulley the speed of said screw will be lessened.

As a means of insuring proper pressure between the surface of the disk G′ and that of the pulley G^6, the shaft g is made longitudinally movable in its bearings, and an adjusting-screw, g^2, Fig. 3, is arranged in the bracket-arm G^3 to bear against the outer end of said shaft g, so as to carry the disk inward with any desired force against the pulley. A binding-nut, g', on the screw g^2 serves to hold the latter after adjustment, and a ring, g^3, of rubber or other suitable substance, on the wheel G^6 gives the desired adhesion of said wheel with the disk G′.

For the purpose of removing any substance or material that may adhere to the runner after passing one of the grinding-plates and delivering the substances removed into the discharge-opening next following the grinding-plate, a brush is preferably employed. Such brush may be constructed in cylindric form and made to rotate in contact with the

runner; but a stationary non-rotating brush will generally be adequate to the purpose. The latter construction only is herein shown.

Referring to Figs. 11, 12, and 13, H is a block arranged vertically in each of the discharge-passages A^7, and supporting filaments forming a brush, *h*, along its upper edge. At its lower edge said block is provided with two horizontally-directed arms, h^2, fixed in a shaft, *h'*, which latter is pivotally mounted by end bearings in the outer and inner vertical walls of said recess A^7. The arms h^2 preferably project from the shaft in the direction in which the runner travels. A coiled torsion-spring, h^3, properly arranged about the shaft h' or about an outer prolongation of the latter, and having its ends secured one to said shaft and the other to the adjacent frame by a stud, h^4, Fig. 12, will operate to press the brush upward into forcible contact with the face of the runner. The brush being located within, or so as to bear upon the runner at a point over the discharge-opening A^7, the material detached thereby falls into said opening and escapes as part of the product of the adjacent grinding-plate.

In Fig. 16 the working-face of the runner is shown as being of conical form, whereby the material to be ground may be fed inwardly from the margin of the runner to the grinding-faces by gravity or without the aid of feed-worms. The feeding and discharge devices for use in this form of machine may be substantially similar to those before described, and illustrated in Figs. 5 and 10, with the exception that the feed-worm is omitted. The feed devices may consist, for instance, of a suitable feed-spout and radial passages connected at their outer ends with said spouts and extended inwardly at the sides of the grinding-plates, the material falling into said passages being caused to pass into the space between the grinding-surfaces by the action of gravity.

In Fig. 16 is also shown a modification of the devices for adjusting the several grinding-plates, consisting of a screw-shaft provided with a hand-wheel, and connecting the plates with a stationary part of the plate A', a rubber spring being arranged between the plate and the stationary part, and permitting said plate to yield automatically on the passage of a hard substance between the grinding-faces. D^8 is a hand-screw, which passes freely through a cross-bar, a^6, rigidly attached to the plate A', said screw being inserted in a threaded aperture in the diaphragm *d'* of the casting D'. A spring, D^5, is interposed between the diaphragm and the bar a^6, said spring being placed around the screw and acting to retain the grinding-plate firmly in the position in which it is held by the opposing hand-screw.

It is manifest that the worm or screw for forcing the feed may be practically located in any portion of the feed-passage constituted of the feed-spout E and feed-pocket A^6, and the general claims relating to such force-feed device are intended to operate without reference to the particular location of such device.

A mill constructed with sectional grinding-plates opposed to a single runner, and having conveyers, hereinbefore referred to, for carrying the product from one pair of grinding-surfaces to another, may constitute the subject of a separate application for patent.

I claim as my invention—

1. The combination, with a runner of a grinding-mill, of a series of separate stationary grinding-plates opposed to a grinding-surface of the runner, a corresponding series of feed passages or devices for delivering materials to be ground to the several grinding-plates, and means for separately discharging the product of each of the grinding-plates from the mill, substantially as described.

2. The combination, with a runner of a grinding-mill, of a series of separately-adjustable stationary grinding-plates opposed to a grinding-surface of the runner, means for feeding the materials to be ground separately to the several grinding-plates, and means for discharging the products of the several grinding-plates from the mill, substantially as described.

3. The combination, with a runner of a grinding-mill, of a series of separate dissimilarly-dressed grinding-plates opposed to a grinding-surface of said runner, means for feeding material or materials to be ground from separate sources to the several plates, and means for separately discharging the products of the several grinding-plates from the mill, substantially as described.

4. The combination, with a runner of a grinding-mill, arranged with its working-face downward, of a series of separate stationary grinding-plates opposed to said runner, a corresponding series of feed-spouts exterior to the periphery of the runner, ducts constructed to convey the material to be ground from the spouts to the several grinding-plates, and means for discharging the products of the several plates separately, substantially as described.

5. The combination, with a runner of a grinding-mill and a series of separate stationary grinding-plates opposed to the runner, of a series of feed-spouts located exterior to the periphery of the runner, a part or parts provided with a passage extending from each feed-spout to the space between the runner and a grinding-plate, and means constructed to force material through said passage into position to be ground, substantially as described.

6. The combination, with a runner of a grinding-mill, the stationary grinding-plates, and the feed-spouts exterior to the periphery of the runner, of the stationary plate A', provided with upwardly-opening recesses anterior and adjacent to the grinding-plates, and in communication with the feed-spouts, and with recesses following the grinding-plates for the discharge of the ground products, substantially as described.

7. The combination, with a runner of a grinding-mill, a series of separate grinding-plates opposed thereto, and feed-passages leading inward from the periphery of the runner to the grinding-surfaces, of feed-worms located in the feed-passages, and suitable means for operating said worms, substantially as described.

8. The combination, with the friction-disk G′ on the feed worm-shaft and the pulley G^6 and its shaft, of the post G^8 and movable arm G^7, constructed to engage with the pulley, substantially as described.

9. The combination, with the feed worm-shaft and the disk G′ thereon, of the splined shaft G^4, the pulley G^6, movably fitted to said shaft, the post G^8, the movable arm G^7, engaged with the pulley, and means for securing said arm at a desired elevation, substantially as described.

10. The combination, with the adjustable frictional drive-pulley G^6 and its shaft, of the feed worm-shaft *g*, the disk G′ thereon, and devices for adjusting the pressure of the friction-surfaces, substantially as described.

11. The combination, with the stationary plate A′, provided with the recess *a′*, and the runner C, parallel with said plate, of the grinding-plate D, and means for adjusting said plate, constructed to yield automatically when a hard substance enters the space between the grinding-faces, substantially as described.

12. The combination, with a runner of a grinding-mill, of a series of separate grinding-plates opposed to the runner, and means for holding said grinding-plates in proper relation to the runner, constructed to allow said grinding-plates to separately and automatically yield when a hard substance enters the space between either of the grinding-plates and the opposing runner, substantially as described.

13. The combination, with a runner of a grinding-mill and a plate, A′, opposed to said runner, and provided with the recess *a′*, of a grinding-plate fitted to said recess so as to move vertically therein, a lever, D^2, pivoted to the frame, and constructed to support the grinding-plate, a threaded rod, D^3, stop-nut D^6, and adjusting-nut D^7 thereon, and a spring, D^5, interposed between the plate A′ and nut D^7, substantially as described, and for the purpose set forth.

14. The combination, with the plate A′, provided with a recess, *a′*, and an opposing grinding disk or runner, of a grinding-plate consisting of a working-plate, D, a casting, D′, and means for securing the parts D and D′ to each other, said casting being fitted to and constructed to slide freely in the said recess *a′*, substantially as described.

15. The combination, with the working-plate D, of the chambered casting D′, provided with the cross-plate *d′* and bolt or bolts d^2, the plate D and the casting D′ being constructed to preserve their relation laterally, substantially as shown and described.

16. The combination, with a runner of a grinding-mill and a series of separate grinding-plates opposed to the runner, of a part or parts forming feed-passages which have their side walls adjacent to the working-faces of the grinding-plates inclined, and means constructed to force the material to be ground through the said passages, substantially as described.

17. The combination, with a runner of a grinding-mill and a plate, A′, provided with feed-passages, of a series of separate grinding-plates located contiguous to said passages, and having their upper faces adjacent to the passages inclined, and means constructed to force the material to be ground inwardly through said passages, substantially as described.

18. The combination, with a runner of a grinding-mill and a series of grinding-plates opposed to the runner, of a plate, A′, constructed to retain said grinding-plates, and provided with feed-passages whose inner ends are curved toward the grinding-plates, and devices for forcing the feed radially inward toward said curved ends of the passages, substantially as described.

19. The combination, with a runner of a grinding-mill and with a grinding-plate opposed to said runner, of a plate, A′, constructed with a feed-passage leading to the grinding-surfaces, and a plate, a^3, cutting off a portion of the feed-passage from the runner, substantially as and for the purpose set forth.

20. The combination, with the runner, of the opposing stationary plate A′, provided with radial pockets extending from points beneath the runner outward beyond the runner, a part or parts covering the part of the pockets exterior to the runner, feed-spouts communicating with the outer ends of the pockets, grinding-plates whose working-faces communicate with the pockets, and means for separately discharging the products from the several grinding-plates, substantially as described.

21. The combination, with a runner and a series of separate grinding-plates opposed to said runner, of means for supporting said grinding-plates, constructed to afford feed and discharge passages leading to and from the several grinding-plates, and means for removing substances adhering to the runner after passing the several grinding-plates, and delivering the substances so removed into the next adjacent discharge-opening, substantially as described.

22. The combination, with the runner, the grinding-plates, and the discharge-openings, of brushes set in the discharge-openings, constructed to operate on the face of the runner, substantially as and for the purpose set forth.

23. The combination, with the runner, the separate grinding-plates, and the discharge-openings, of movable brushes H, set in the discharge-openings, and automatic devices for causing them to bear against the opposing disk, substantially as described.

24. The combination, with a sectional grinding-plate and an opposing disk, of a brush, H, hinged or pivoted outside a plane at right

angles with the opposing disk at the line of its bearing upon said disk, and a spring operating to throw the brush against said disk, substantially as described.

25. The combination, with the runner and with a series of detached and separately movable grinding-plates, of a plate, A′, provided with recesses *a′* for the grinding-plates, and constructed to afford feed and discharge passages leading to and from the grinding-surfaces, substantially as described.

26. The combination, with the shaft B, provided with the screw-thread b^3, of the runner-disk C, centrally apertured and fitted to said thread, the plate C′, secured to the shaft B, and means for holding the plate C′ in opposition to the runner, substantially as described.

27. The combination, with the disk-runner and the plate A′, provided with recesses or feed-passages *a′*, extending beyond the periphery of the runner, of a ring, F, arranged exterior to the runner, substantially as and for the purpose set forth.

28. The combination, with the runner and the opposing stationary plate A′, of the ring F, exterior and adjacent to the runner, and the packing F′, interposed between the vertical faces of the runner and ring, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

WILLIAM E. GORTON.

Witnesses:

M. E. DAYTON,

JOSEPH H. KRAEMER.