No. 619,012. Patented Feb. 7, 1899.

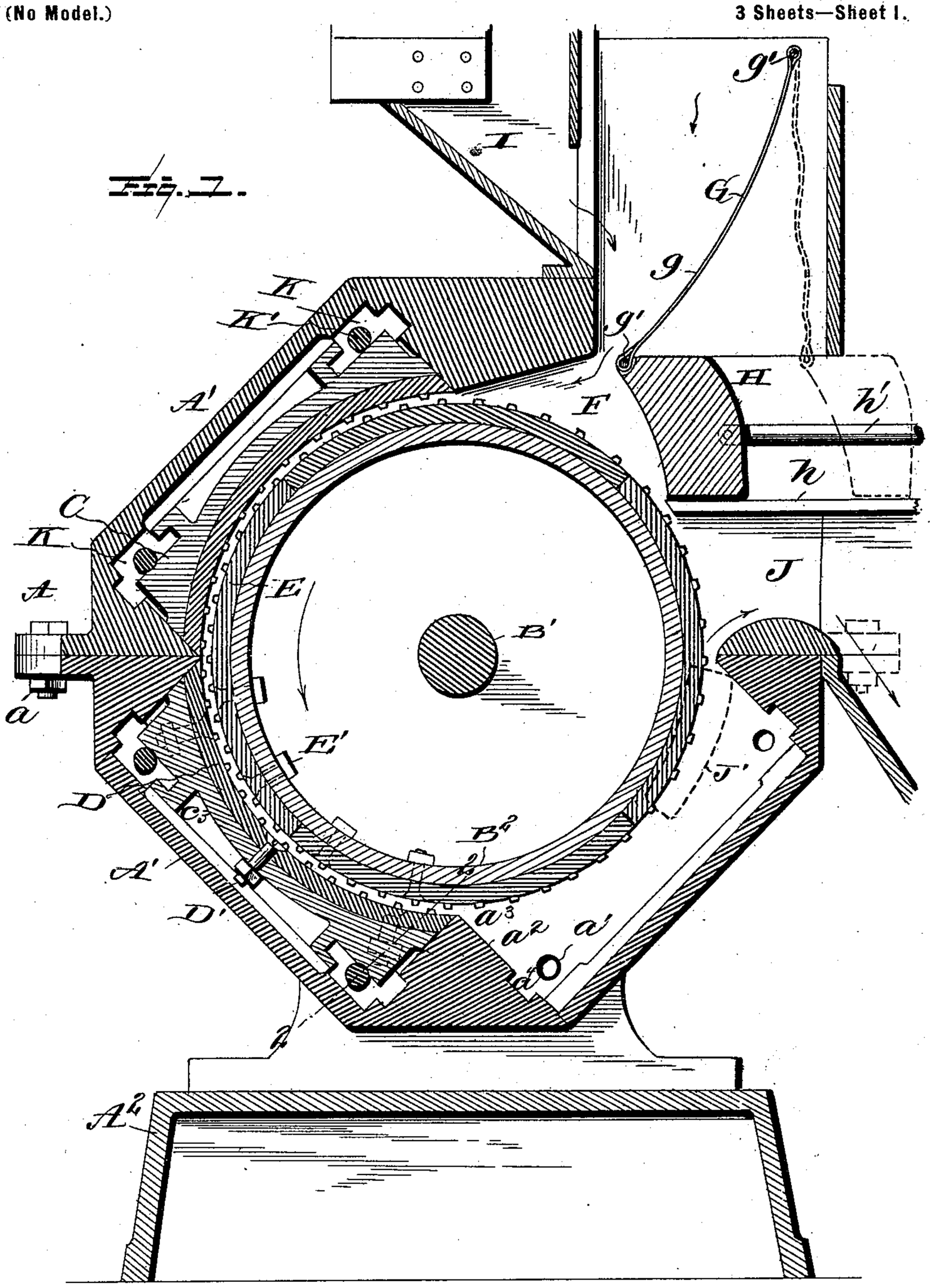
A. F. DAVIS.

GRINDING MILL.

(Application filed Apr. 28, 1897.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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Fig. 2.

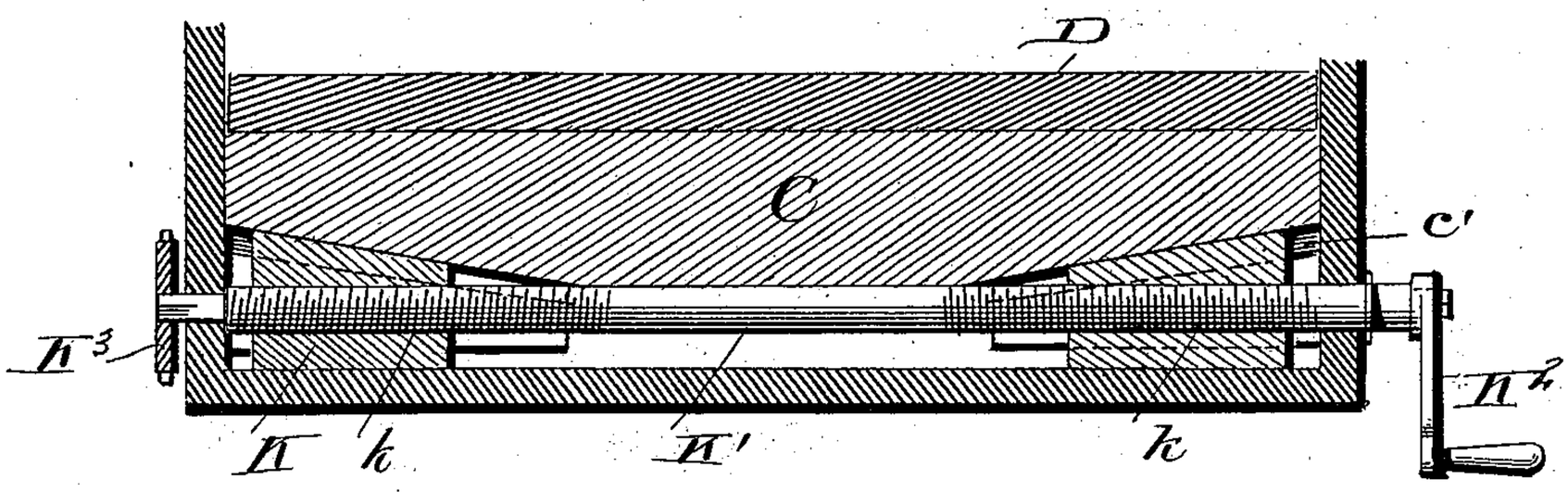


Fig. 3.

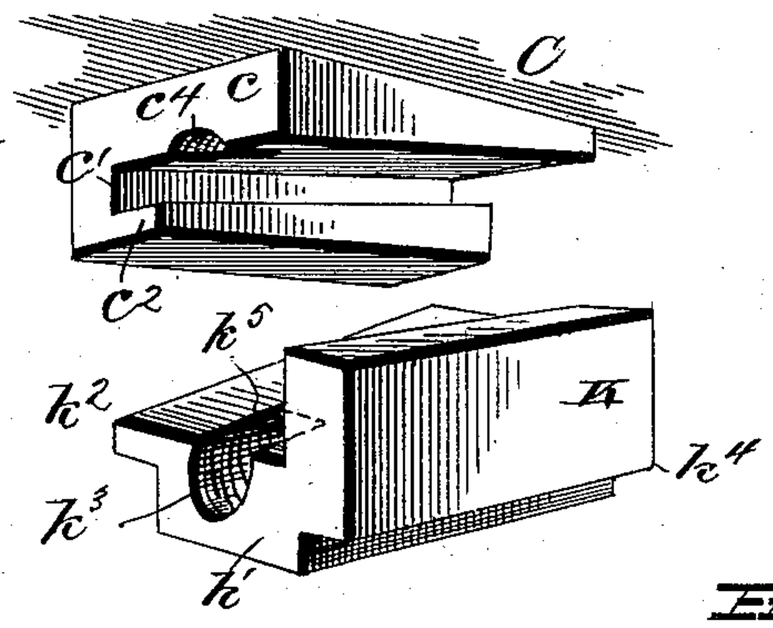


Fig. 4.

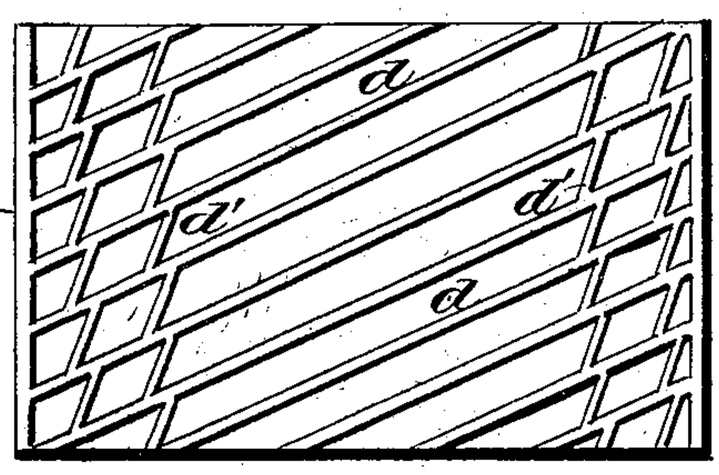


Fig. 5.

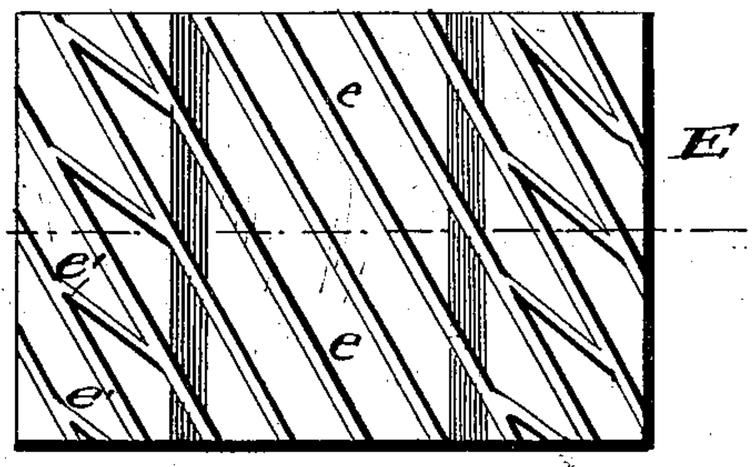


Fig. 6.

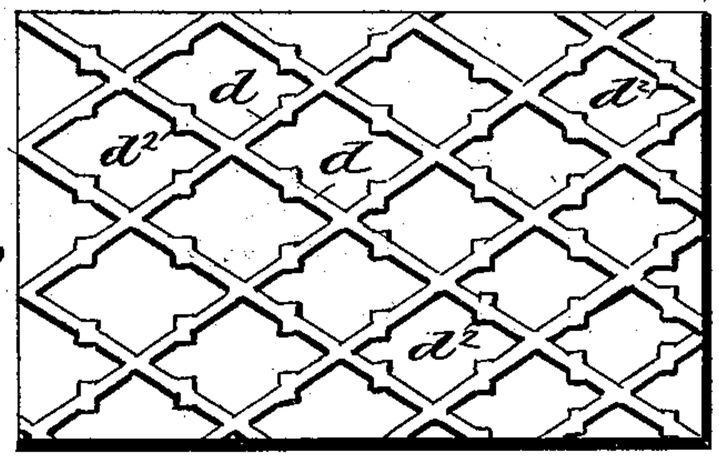
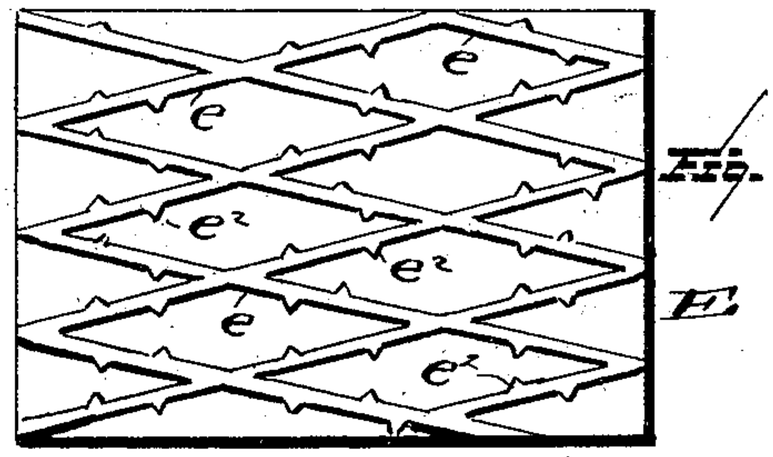


Fig. 7.



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(No Model.) 3 Sheets—Sheet 3.

Fig. 2.

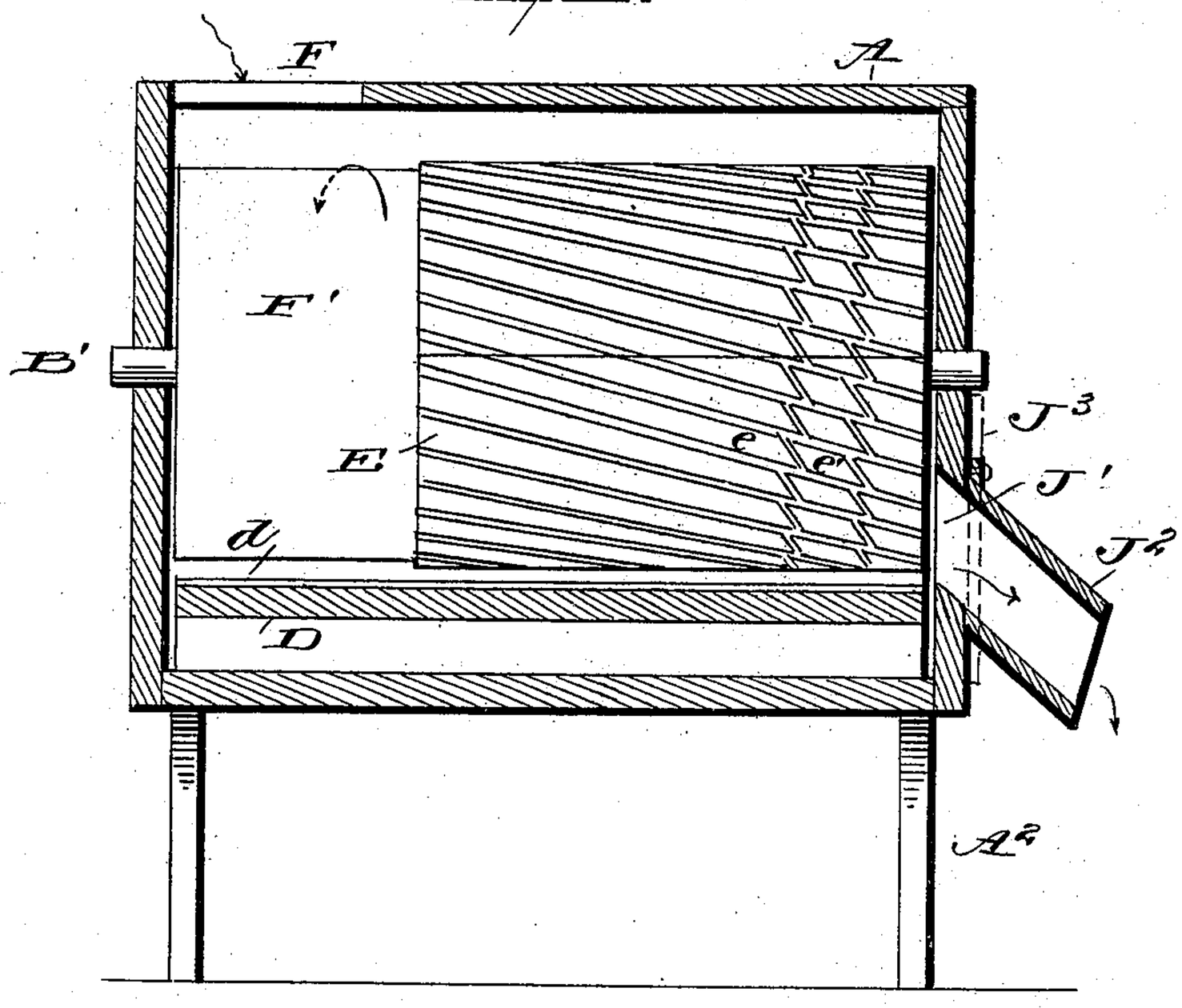
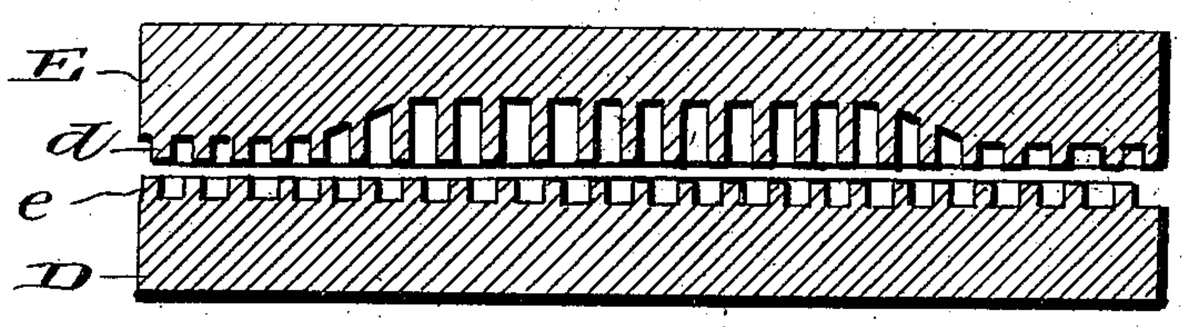


Fig. 3.



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UNITED STATES PATENT OFFICE.

ALBERT FRANCIS DAVIS, OF RUTLAND, VERMONT.

GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 619,012, dated February 7, 1899.

Application filed April 28, 1897. Serial No. 634,251. (No model.)

To all whom it may concern:

Be it known that I, ALBERT FRANCIS DAVIS, a citizen of the United States, residing at Rutland, in the county of Rutland, State of Vermont, have invented certain new and useful Improvements in Grinding-Mills, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in grinding-mills, and more particularly to that construction of mill in which the grinding action is accomplished by the movement of a cylinder carrying grinding-plates over a concave surface also provided with grinding-plates.

The invention has for its object to provide improved means for accomplishing the grinding of grains, fodder, coffee, or other desired substances to different degrees of fineness.

It has for a further object to provide improved means for adjusting the concave grinding-plates in their relation to the cylinder and to effect an improved feeding of the material to the cylinder.

It also has for its object to provide an improved form of grinding-plates which in their action of traversing each other produce a shearing cut in connection with the grinding action by attrition.

The invention has also for a further object to improve the details of construction of the grinding-mill so as to improve the operation thereof, to reduce the cost of manufacture, and materially improve the action of the mill.

The invention consists in the improved construction, arrangement, and combination of parts hereinafter more specifically described and afterward defined by the claims, reference being had to the accompanying drawings, forming a part of this application, in which—

Figure 1 is a central vertical section through the mill with one of the concave grinding-plates removed. Fig. 2 is a detailed transverse section of the adjusting means for the concave plates, taken on the line 2 2 of Fig. 1. Fig. 3 is a perspective view of the coacting wedges for adjusting the plates. Fig. 4 is a face view of one form of the concave grinding-plates. Fig. 5 is a similar view of the convex plate which coacts with the plate shown in Fig. 4. Fig. 6 is a face view of the modified form of the concave plates. Fig. 7 is a similar view of the convex plate used in connection with the plate shown in Fig. 6. Fig. 8 is a vertical cross-section showing the plates located upon only a portion of the cylinder, and Fig. 9 is a similar view in detail of the grinding-plates shown in Figs. 4 and 5 on the line 9 9.

In the drawings the letter A designates the casing of the mill, which is formed in two parts A′ and secured together by bolts *a* or other suitable means. Within the casing a cylinder or feed-roller B is mounted upon the shaft B′ and rotated thereby. Adjacent to the surface of the cylinder the casing is provided with a series of angular recesses *a*′. The walls a^2 of the adjacent recesses meet to form an apex or point a^3. Within these recesses are adjustably mounted plate-holders C, to which the concave grinding-plates D are secured by means of bolts and nuts D′, which pass through the plates and the holder. The cylinder B has secured upon its periphery a series of convex grinding-plates E, held in position by means of the bolts E′. The casing is provided with an inlet or feed opening F, which communicates with a feed-hopper G. At the base of the feed-hopper G a reciprocating follower H travels toward and forces the material into the feed-opening F and prevents the clogging of the material at the base of the hopper G. This follower travels upon a suitable support or way *h* and is rapidly reciprocated by means of a pitman or rod *h*′, which is connected with any suitable source of power. Extending from the upper portion of this follower I locate an apron *g*, which is secured to the upper portion of the hopper G and to the follower H, as shown at *g*′. In the reciprocation of the follower this apron is moved back and forth across the hopper G, so that by decreasing or increasing the size of the opening at the lower portion of the hopper the material to be ground will be fed forward and into the feed-opening F of the casing. When it is desired to mix and grind together two different materials—such, for instance, as grain and hay—to form a fodder, the auxiliary hopper I is provided at one side of the feed-hopper G and has an opening *i*, which communicates with the hopper G, so that the two materials to be ground together

will be mixed before they are introduced into the grinding-mill. Adjacent to the feed-opening and separated therefrom by the way *h* a discharge-opening J is formed, through which the material delivered from the cylinder will pass and fall into any suitable receptacle therefor. The casing is also provided with a suitable base A^2, but may have its exterior surface formed polygonal or of any desired shape.

The plate-holders C, to which are secured the concave grinding-plates D, are adapted to be adjusted to and from the cylinder B by means of the adjustable feed-wedges K. These adjustable wedges are mounted upon an oppositely-screw-threaded rod K′, which is provided with a right and left handed screw *k*, so that in the rotation of the rod the wedges will be drawn toward or away from each other. These wedges engage with and slide upon wedge-shaped extensions *c*, formed integral with or attached to the plate-holder C. The extensions are formed with a groove *c*′, extending at the incline of the wedge-surface of the same, and with a flange c^2. The feed-wedges K are formed with an angular portion k^4, adapted to fit and travel in a similar-shaped groove or way a^4, formed in the angular recess *a*′, so as to prevent any vertical movement of the wedge. The base *k*′ of the wedge rests and travels upon the bottom of the recess *a*′, and the wedge is further provided with a flange k^2, which is inclined to correspond with the groove *c*′ of the extension C and travels therein. The extensions *c* upon opposite sides of the plate-holder are connected together by a strengthening-web c^3, extending from one to the other. The wedges are provided with interior screw-threads k^3, adapted to mesh with the thread on the rod K′. A portion of the screw-threaded body of the wedge K at the lower portion of the incline is cut away, as at k^5, and the extension *c* has a cut-away portion c^4 to correspond therewith. By providing these cut-away portions the range of adjustment may be increased; but the cut-away portions may be omitted and the same result attained by increasing the inclination of the wedge and extension. The wedges may be adjusted by means of the crank-handle K^2, secured to one end of the shaft K′; but, if found desirable, I may provide sprocket-wheels K^3 upon the ends of the shafts and connect these sprocket-wheels K^3 by any suitable means—for instance, a sprocket-chain—so that the series of wedges and the grinding-plates may be simultaneously adjusted to or from the grinding-plates upon the cylinder. It will be obvious that when the screw-threaded shaft K′ is turned in one direction the grinding-plates will be adjusted toward the cylinder, and when the shaft is reversed the wedges by their action with the extensions will withdraw the plates from the cylinder. By adjusting the plates to and from the cylinder the grinding action may be varied to produce different degrees of fineness in the material ground or to adapt the mill for operation upon different classes of material.

The concave plates D and the opposing convex plates E, which traverse each other in the rotation of the cylinder or feed-roll, are provided with diagonally-disposed ribs or projections *d* and *e*, respectively. These projections or ribs are inclined at an angle to each other, so that as the ribs of one plate pass over the ribs of the adjacent plate the shearing cut or grinding of the material against the edges of the ribs or projections is produced. For instance, as shown in Figs. 4 and 5 in the rotation of the cylinder the ribs *e* on the convex plate E will traverse the ribs *d* upon the concave plate D, and thus produce the shearing action, as well as the grinding action, between the surfaces of the two plates and the ribs thereon. These ribs may be arranged to produce a feeding action on the material transversely of the direction of rotation of the cylinder, and, as shown in Figs. 4 and 5, the ribs or projections are so inclined that as the material travels between the cylinder and concave it will be fed transversely across the cylinder, so that it may be discharged, if desired, at one end thereof through an opening, as shown in dotted lines at J′ in Fig. 1. In the plates shown in Figs. 4 and 5 I have provided cross-ribs or projections *d*′ between the ribs *d* on the plate D. These ribs serve to retard the traverse or lateral feeding of the material and provide additional surfaces to produce a further shearing and grinding action upon the material. The plate E is also provided with the cross-ribs or projections extending between some of the main ribs or projections *e*, which accomplish the same objects as the ribs *d*′ on the plate D; but owing to the greater inclination of the cross-ribs *e*′ in their relation to the ribs *e* they will not retard the feeding to as great a degree as would the ribs when arranged as shown at *d*′. It is obvious that by varying the inclination of the main ribs *d* and *e* and the relation thereto of the cross-ribs *d*′ and *e*′ varying degrees of the feeding of the material may be attained, and by multiplying the ribs and cross-ribs a larger grinding-surface may be secured upon the plates. The plates shown in Figs. 4 and 5 are particularly well adapted for the grinding of grains, coffee, and other similar materials.

When using the plates shown in Figs. 4 and 5 or other plates to secure a feeding of the material toward the end of the cylinder and casing, I find it desirable to locate the plates only upon a portion of the peripheral length of the cylinder, as shown in Fig. 8. In this structure the material is fed at one end of the cylinder upon the plane portion F′ thereof and by the plates and ribs carried toward the opening J′ in the end of the casing, from which opening the grinding material is directed by means of the spout or hood J^2 to a suitable receptacle. When it is desired to feed the material by the use of proper grinding-plates

to the side discharge of the casing, the end discharge-opening may be closed by a suitable plate, as indicated in dotted lines at J^3 in Fig. 8. By this structure the grain to be ground will be fed from the plane end of the cylinder and ground at a number of points, and finally discharged at the opposite end of the cylinder, as described.

In Figs. 6 and 7 the ribs *d* and *e*, respectively, are arranged to intersect each other and thus form a series of diamond-shaped figures of different sizes, the ribs or projections upon the convex plate (shown in Fig. 7) extending at an angle relative to the ribs or projections upon the concave plate. (Shown in Fig. 6.) It will thus be seen that when the plate E traverses the plate D the ribs or projections *e* will pass over the ribs or projections *d* and produce the shearing action between the edges of the ribs, as described in connection with Figs. 4 and 5. In this form of the grinding-plates the material will not be fed in a transverse direction to the rotation of the cylinder to as great a degree as in the forms shown in Figs. 4 and 5. The feeding of these plates is practically straight around the periphery of the cylinder and the discharge at the point J, although there will be a slight transverse movement of the material while passing between the plates. The ribs *d*, Fig. 6, are provided with lugs or projections d^2 at various points, which retard the feeding of the material and form additional cutting and grinding surfaces when the ribs of the plate E traverse the same. In Fig. 7 similar lugs or projections e^2 are provided and serve to coact with the ribs or lugs upon the plate D. These lugs or projections serve to perform in a degree the objects and functions of the cross-ribs or projections shown in Figs. 4 and 5. Both the convex and the concave plates are arranged so that they may be reversed when desired, so as to permit both cutting edges of the ribs to be utilized by changing the platen end for end, and thus accommodate the plate for reversal when one edge of the ribs thereon becomes worn. The form of the plates shown in Figs. 6 and 7 is especially adapted for the grinding of fodder, such as cut hay, and also for such fodder when mixed with a grain. When the hay and grain are passed through the mill, they are intimately mixed and ground together, so as to form a fodder, in which the grain and hay are commingled in a powdered or very finely divided form.

The ribs upon the several forms of grinding-plates may be of equal depth, as shown in Fig. 1. Preferably, however, those upon the one plate may be deeper than those upon the other, as shown in Fig. 9. In this figure the ribs at the central portion of the convex plate E are made of greater depth or length than those at the end portion of said plate, while the ribs upon the concave stationary plate D are of equal length throughout. By forming the central ribs deeper a more rapid feeding of the material will be secured and the coarse grinding performed at the central portion of the plate, while the finer grinding will be performed at either end portion of the plate adjacent to the discharge. This particularly adapts the plates for grinding material of such size that it is advantageous to first break up or coarse-grind the particles before the final grinding action. In the use of these grinding-plates the material is fed at the central portion of the cylinder and is coarsely ground by falling into the deeper grooves at that portion of the plate. The feeding action of the ribs carries the material toward the ends of the plates, and it is there more finely ground by coming into contact with the cross-ribs *d'* and *e'*, as shown in Figs. 4 and 5, which retard the feed and at the same time present additional grinding-surfaces. The deeper central grooves receive a larger quantity of material than would be the case if all the grooves were of the same depth, and thus a constant feed is maintained at the end of the plate where the final grinding action takes place, and the discharge may be either at the opening J, Fig. 1, or at the end opening J'.

By providing the casing with the angular recess *a'*, having the inclined walls a^2, the plate-holders covering the concave plates are located so that the meeting edges of the concave grinding-plates will practically meet each other, so as to leave no space between the plates. This forms a continuous concave grinding-surface around the periphery of the cylinder, so that the grinding action is thorough and continuous in the action of the mill.

From the foregoing description the operation of the mill will be apparent, and the material having been fed upon the revolving cylinder by a rapidly-reciprocating follower H will be carried by the cylinder and ground, as described, between the concave and convex plates and finally discharged at either the outlet-opening J or the side opening J', provided in the cylinder. The cylinder is rotated at a high rate of speed, so that the grinding action by attrition, as well as by the shearing cut of the ribs or projections in traversing each other, is produced.

The details of construction of this invention have been described with particularity; but it is obvious that numerous changes may be made in these details without departing from the spirit of the invention.

Having described my invention and set forth its merits, what I claim, and desire to secure by Letters Patent, is—

1. In a grinding-mill, the combination with a cylinder provided with a grinding-surface, of an adjustable plate-holder provided with opposite extensions having inclined faces and grooves therein, oppositely-located threaded wedge-blocks provided with flanges to travel in said grooves, and adjustable screws engaging said blocks to move the same toward and from each other; substantially as specified.

2. In a grinding-mill, the combination with

a cylinder provided with a grinding-surface, of a surrounding recessed casing provided with angular ways in the side walls of said recesses, plate-holders located in said recesses, wedge-blocks for adjusting said plate-holders and provided with an angular extension adapted to travel in the ways formed in said recesses, and means for adjusting said wedge-blocks toward and from each other; substantially as specified.

3. In a grinding-mill, the combination with a cylinder provided with a grinding-surface, of a surrounding recessed casing, the walls of which meet to form an apex at their ends next to the periphery of the cylinder and are provided with angular ways, plate-holders located in said recesses, wedge-blocks for adjusting said plate-holders and provided with an angular extension adapted to travel in the ways formed in said recesses, and means for adjusting said wedge-blocks toward and from each other; substantially as specified.

4. In a grinding-mill, the combination with the casing having a hopper, of opposing grinding-surfaces located within said casing, a horizontal reciprocating follower located beneath the hopper and in line with one of said grinding-surfaces, and a flexible apron extending from the inner end of said follower to a portion of the hopper above the follower; substantially as specified.

5. In a grinding-mill, the combination with a casing provided with a hopper, of a grinding-cylinder within the casing, a reciprocating follower located beneath the hopper and adapted to travel toward and from the upper surface of said cylinder, a support or way on which said follower travels, an outlet-opening for said casing beneath said support or way; and an apron carried by said follower and adapted to reduce the feed from the hopper as the follower approaches the cylinder, substantially as specified.

6. In a grinding-mill, the combination with a casing provided with a feed-hopper, a grinding-cylinder within the casing beneath said hopper, a horizontally-reciprocating follower traversing and closing the lower end of the hopper to feed material therein upon the upper surface of said cylinder, an apron carried by said follower and adapted to reduce the feed-opening from the hopper as the follower approaches the cylinder, a support or way on which said follower travels, a discharge-opening from said casing immediately beneath said support or way; and a concave grinding-surface extending substantially from said hopper to said discharge-opening, substantially as specified.

7. In a grinding-mill, the combination with a cylinder provided with a grinding-surface, of an adjustable plate-holder provided with opposite extensions having inclined faces and grooves therein, oppositely-located threaded wedge-blocks provided with flanges to travel in said grooves, adjustable screws engaging said blocks to move the same toward and from each other; a concave grinding-plate carried by said holder and having parallel main ribs or projections and intersecting ribs or projections between the main ribs and at an angle thereto, and grinding-plates carried by said cylinder and provided with parallel ribs or projections extending at an angle to the main ribs or projections upon the concave plate and with cross-ribs or projections extending at an angle thereto and to the cross-ribs upon said plate; substantially as specified.

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

ALBERT FRANCIS DAVIS.

Witnesses:
HENRY A. HARMAN,
WAYNE BAILEY.