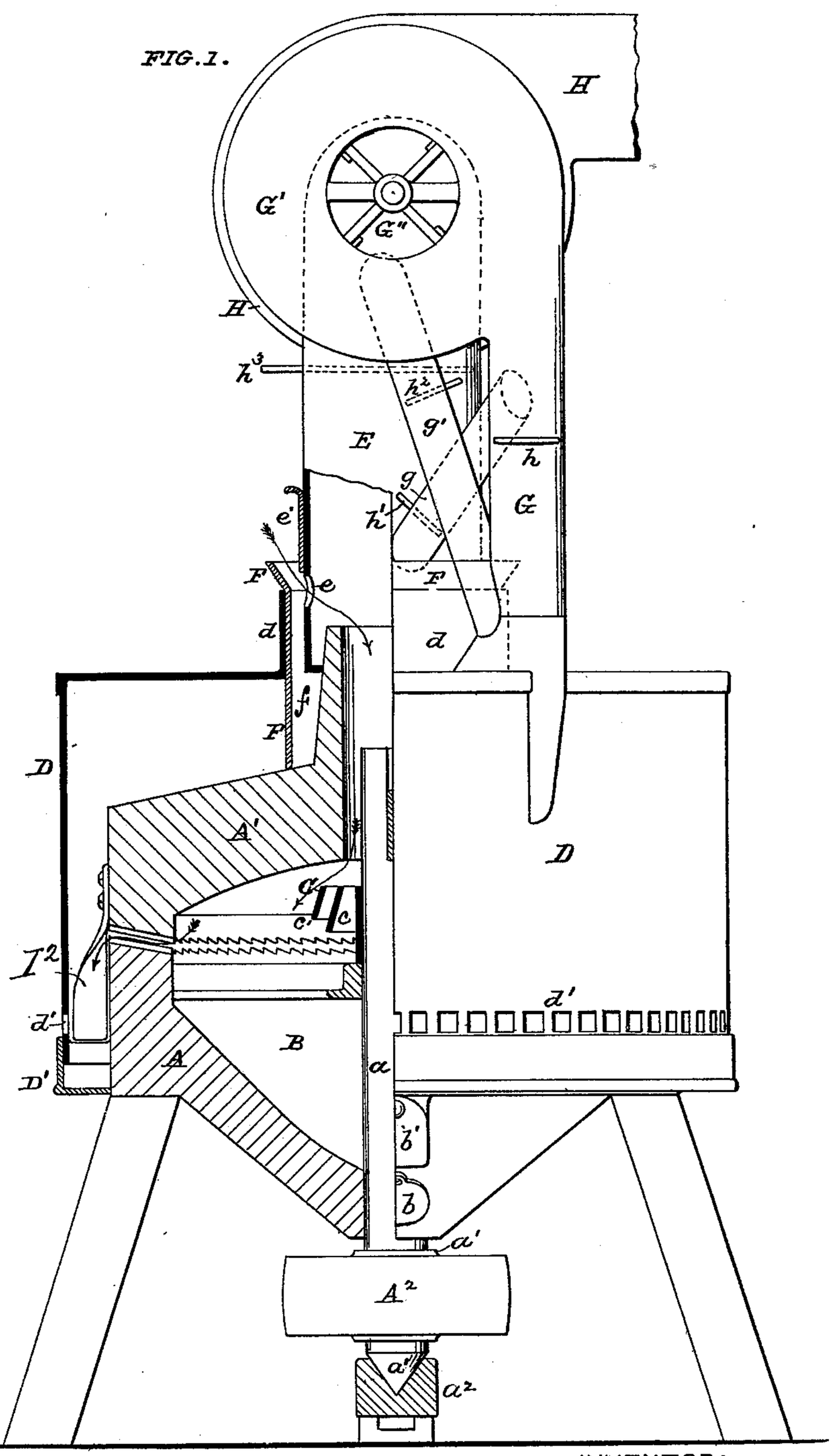
2 Sheets—Sheet 1

G. MILBANK.

Modes of and Apparatus for Reducing Grain and Simultaneously Purifying the Products thereof.

No. 229,445. **Patented June 29, 1880.**

FIG. 1.



ATTEST:
John W. Herthel,
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INVENTOR:
George Milbank
per Herthel & Co

2 Sheets—Sheet 2.

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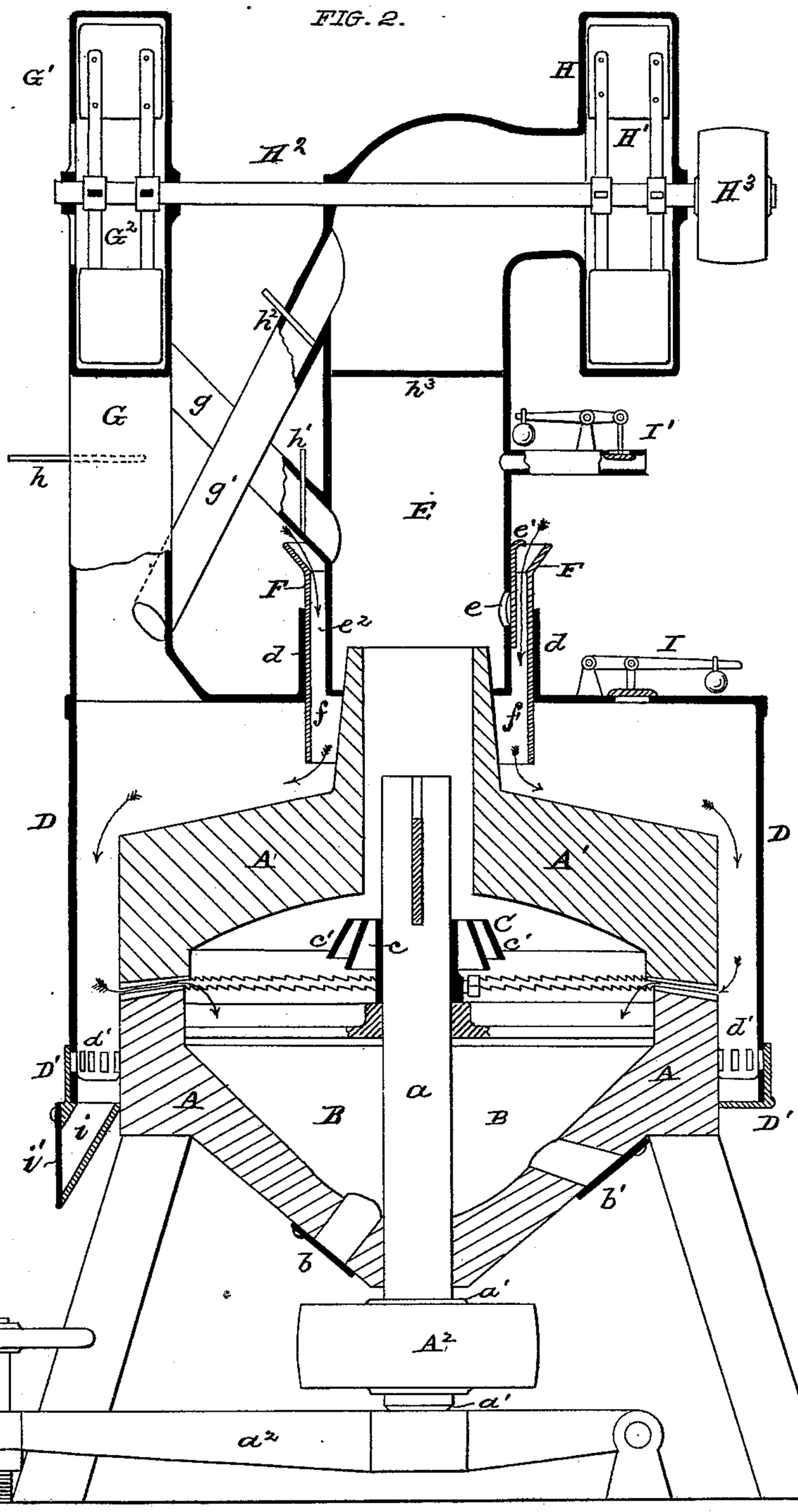
FIG. 2.



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INVENTOR:
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UNITED STATES PATENT OFFICE.

GEORGE MILBANK, OF CHILLICOTHE, MISSOURI.

MODE OF AND APPARATUS FOR REDUCING GRAIN AND SIMULTANEOUSLY PURIFYING THE PRODUCTS THEREOF.

SPECIFICATION forming part of Letters Patent No. 229,445, dated June 29, 1880.

Application filed November 26, 1879.

To all whom it may concern:

Be it known that I, GEORGE MILBANK, of Chillicothe, Livingston county, and State of Missouri, have invented an Improved Apparatus to Reduce and Purify Grain, &c., of which the following is a specification.

My improvements are designed to achieve a more perfect reduction and purification of larger substances or particles when the same are subjected to a crushing, purifying, or grinding action.

Specially to reduce and purify grain, middlings, meal, &c., when the feed is passed between a pair of millstones, my improvements are designed to produce such a reduction that each or all particles composing the product shall approximate as near as possible to the same or the desired size—in other words, producing a more even reduction of larger substances to smaller and the better purification of same.

When grain is subjected to the action of stones or grinding bodies, as customary, it can be stated that the following forces are called into action—viz., centrifugal force, gravitation, dress of the stones, air-currents, or all forces tending to pass the feed in the same direction—viz., from center to periphery of the stones. More specifically stated, each of said forces acts as follows: The centrifugal force has a greater effect, or will throw farther and with more force the larger substances or grains in proportion to their size or specific gravity. Gravitation, also, under ordinary circumstances, has a greater effect on the larger or heavier bodies, causing them to move downward faster and with more force in proportion to their size and specific gravity. The dress of the stones also tends to move the larger bodies faster than the smaller, the latter naturally lying low and lodging in the hollow of the furrows. Air-currents, however, act with or have a greater effect on the smaller and lighter particles than upon the heavier, in proportion to their size and gravity.

Since, therefore, the ordinary method of arranging the parts is such that each and all of these named forces act in the same direction; further, since these forces act differently upon the larger and smaller particles, and, lastly, since by reduction the substances and particles change their size, weight, and specific gravity, the result or product obtained is necessarily unequaled in this: that some of the particles are ground too fine, others too coarse, and the product lacks uniformity in the size of its particles.

According to my improvements the above-named forces are all utilized, but placed under the control of the operator, and, as will hereinafter appear, enabling him to regulate the passage and time of passage of each and all particles from the eye to the skirt, or in vice versa direction, and at same time subject each and all of the particles to the desired reduction, or like reduction and result as to size.

My improvements in purifying reduced particles consist in separating the lighter pulverulent matter, or matter of less specific gravity, from the purer or more dense matter before said atoms or particles come in contact with each other after being reduced, and before they find a lodgment or resting-place or are massed or bulked.

Ordinarily the reduced product is permitted to have its particles to come in contact with each other or become bulked, and in so doing the impure or pulverulent matter is more or less rubbed in or on to the purer matter, and hence it is rendered the more difficult or impossible to properly purify.

Of the drawings, Sheet I, Figure 1 is a part sectional and end elevation of my improved apparatus adapted to reduce and purify grain, &c., when the same is passed or fed from eye to skirt of stones, as indicated by the arrows. Sheet II, Fig. 2 is a sectional elevation of the same apparatus, showing it adapted to reduce and purify grain, &c., when passed from the periphery to the center of the stones, as indicated by the arrows.

A A′ represent the pair of millstones, the former being the bed and secured stationary, the latter being the runner. This relationship of the stones can be reversed, so that the top shall be stationary, the lower one the moving stone; or both stones can be revolved, each in opposite direction to the other, or revolved both in the same direction but at different speed. Otherwise the stones can be set and operated

in manner usual. The dress of the stones is also, as usual, to suit the direction of the revolving stone, or to feed the grain from the eye to the skirt, or vice versa.

Forming part of the bed-stone A is a receptacle, preferably a cone-shaped chamber, B. This chamber receives the reduced product in case the feed is from periphery to center, the discharge taking place through the valve *b*, and said valve is closed when the feed is in the opposite direction to that just stated. Also through said chamber B the air-currents pass during the operation of reduction and the process of purifying the product.

b' is an air-inlet valve, and is to regulate the admission of air into said chamber B, said valve being closed when the feed is from center to periphery.

The runner A' is supported, as usual, by an adjustable step consisting of the spindle *a*, arranged to pass through the bed-stone and its chamber B, the spindle foot-stalk having its toe resting in a foot-bridge, *a'*, secured to the bridge-tree a^2, controlled by the lighter screw a^3, all as shown. The runner A' can therefore be raised or lowered, so as to place the faces of the stones farther apart or closer together, as required.

A^2 is the pulley connecting to power source to revolve the runner. Arranged in the center of the runner A', and secured to the spindle *a*, are cone-shaped deflectors C. These deflectors consist of an inside cone rim or face, *c*, with one or more duplicates, *c'*, on the outside, leaving clearances or passages between, as shown. The special purposes for which these deflectors C are intended is to cause the air-currents in the chamber B to pass up or through or between the cone-faces *c c'*, and thus become more divided and more equalized.

D is the outside cylinder-casing, and is supported stationary to surround the pair of millstones. The casing D has its closed top formed with a short cylindrical neck, *d*, while the bottom of said casing is left open. Near the bottom edge of the casing, and entirely surrounding same, are apertures *d'*, for the entrance of air from the outside.

D' is a bottom rim, consisting simply of a horizontal rim joined at right angles to a vertical rim, and said bottom rim is fitted movably to the bottom edge of casing D. By moving the bottom rim, D', more or less over the inlet-apertures *d'* the passage of air-currents can be regulated or controlled.

E is the central or main spout, its lower end partly extending below the cylinder-neck of the top stone, as shown. At *e* this spout E has a feed-opening, and this is controlled by a slide or valve, *e'*, as shown. In case the feed is to pass to the center or eye of the stones it is fed through this opening *e*, the feed so passing being easily regulated by the valve *e'*. In case the feed is to pass to the periphery of the stones the feed-spout or hopper F is used, and, as shown, it is movably arranged between the neck *d* of the casing and the central spout, with feed-passage *f* for the downward passage of the grain. When, therefore, the feed-hopper F is raised (see Fig. 2) to clear the back of the top stone the feed or grain can pass down *f* over the back of the stone to the periphery, and said feed-hopper is moved down to close the passage-way *f* in case the feeding of the grain is to the center, as shown in Fig. 1.

G is the blast-fan spout, communicating to the skirt of the stones by being connected to the top of the cylinder-casing D. G' is the blast-fan casing. G^2 is the blast-fan inside said casing. *g* is the blast-fan spout, having its one end in communication with the spout G, its other end with the central spout, E. *g'* is the branch suction-fan spout, having its upper end communicating with E and its lower end to G.

The central spout, E, connects at top to the suction-fan chamber H, which contains suction-fan H'. Both blast-fan and suction-fans are connected to the shaft H^2 and revolved by power-source applied to the pulley-wheel H^3.

h h' h^2 h^3 represent the respective slides in each of the spouts just enumerated. By means of these slides the operator can regulate and control the blast and suction or upward and downward acting air-currents to suit the operation in either case—that is, passing the grain or substances from the periphery to the eye, or vice versa.

I is a pressure-valve, similar in construction and operation to an ordinary steam safety-valve. By means of this pressure-valve the operator can regulate the pressure of the air force in the casing D to suit the reduction of the grain, and specially to cause said air force to determine the size to which the particles shall be reduced. Also, said valve can be set to form the required inlet or outlet for air to and from the casing D.

I' is also a pressure-valve, to regulate and suit the suction force to determine the size to which the particles shall be reduced, and otherwise can be used as an inlet and outlet for air.

I^2 is a scraper secured to the revolving stone, and only used, in case the feed is passed from the eye to the skirt, for purposes of moving the reduced product, which falls out at the periphery into the bottom D', to be discharged at the outlet *i*. *i'* is a flap-valve to open or shut the outlet *i*.

All the parts thus constructed and arranged, the complete operation of reducing the grain or substances in both cases—that is, passing the feed from the periphery to the eye of the stones, or from the eye to periphery—will now be described.

By referring to Fig. 2 the position of the various parts is shown when the operation is to reduce the feed fed to and passing from the periphery to the center.

More particularly stated, the hopper F is set to open the passage *f* to permit the feed to pass over the back of the stone to the periphery, the

bottom rim, D′, is set to form a closed bottom for the casing D, and hence a receptacle for the feed to collect and fill until a level is reached that further passes the feed between the faces of the stones, the discharge-valve at i' is closed, the scraper I^2 is removed, and, so far as producing an air-current, this can be done, first, by—

Blast.—Hence, open slide h, close h' h^2 h^3, and the blast can then be directed down G to fill the chamber of D, and pass between the faces of the stones into the chamber B, and out with the reduced product at b. Here be it noted that I have an air-current entering at the periphery and out at the eye, in opposition to centrifugal force.

Suction.—In place of the blast just stated, suction can be used. Thus, open slide h^3, also pressure-valve I, for air to enter D; close all remaining valves, and suction or air-currents will pass in at I over the stone, in at the periphery, between the faces of the stones, to the center. Here, again, the suction or air-current is in opposite direction to centrifugal force.

Suction and blast combined.—I can use suction and blast combined. Thus, open slides h h^3, close h^2 h' and all remaining openings. The blast will then pass down G and suction up E, producing together an air current or currents, acting in the same direction as blast and suction alone, and in opposite direction to centrifugal force.

Opposed to gravitation.—Also, the blast or suction, each singly or combined, can be made to produce air-currents in opposition to gravitation. For this purpose the same means just described are used. The faces of the stones, however, are made such as to have their incline lowest at the periphery and highest point near the center.

Opposed to dress.—Also, by the same means, in case the dress is made to pass the material from the center to circumference, the air currents or force can operate in reverse direction to the dress. Also, by the same means—that is, passing the air-currents from periphery to the eye—I can cause the furrows or dress, or gravitation, either singly or both combined, to assist the said currents or force so directed. Thus, in the case of the dress, this is done by simply changing said dress to suit the direction or, as another way, by revolving the stone in opposite direction. In case of gravity this action is achieved by suiting the inclination of the faces of the stones to be in the same direction as the said acting air-current.

By referring to Fig. 1, the position of the various parts is shown when the operation is to reduce the feed fed from the eye to the skirt. The hopper F closes the passage-way f below. The slide e' is properly opened to permit the feed to pass down the center and fill the chamber B until a level is reached, permitting the feed to pass between the faces of the stones and outward from same. The bottom of B is therefore closed.

Blast from center to periphery.—This can be done by closing slides h^3 h, opening h'. In case the inclination of the faces of the stones is such as to have gravity to be directed inward, then the said blast or air-current through g is in opposite direction to gravity. In case the dress is laid to move the material inward, the said air-current so derived through g down the center directed to the periphery will or can be in opposite direction to said dress. Likewise the suction can be directed to pass from center to periphery. Hence, close slides h h^3, open h^2 and pressure-valve I′; close apertures d' below. The suction-inlet will then be at I′ down or through the center, between the faces of the stones, to their periphery, and upward through g' into suction-fan.

In case the dress or furrows or the inclination of the faces of the stones is made the same as just stated in using the blast—that is, said dress and gravitation directed inward—then the suction so acting through g' will be in opposition to said dress and gravitation; or blast and suction can, combinedly, act from center to periphery. Thus, close h h^3, open h' h^2. The blast will then pass down the eye out at the periphery at same time with suction up and out at g'.

I am thus enabled, when the feed is passed from the periphery to the eye and out at the center, to cause an air current or force to act in reverse direction to centrifugal force, or to gravitation, or to the dress of the stones; or I can cause the said air-current to assist (or be assisted by) the dress, gravitation, or both said forces combined. In a similar manner, in case the feed is passed from the eye to and out at the periphery, I can cause an air current or force to act in the same direction as centrifugal force, but in reverse direction to gravity or to the dress; or said air-current can assist (or be assisted by) the dress of the stones, or gravity, or both said forces combined.

In so causing one or more forces to operate in one direction while one or more forces operate in another direction, I achieve the following important results and desirable advantages: The larger particles can be retained longer between the faces of the stones, and by that means reduce said particles more, while the smaller particles can be passed quicker or sooner from out between the faces, and by that means stop the further reduction of said smaller particles.

The centrifugal force, as previously stated, naturally having the greatest effect on the larger particles, these would be thrown outward or toward the periphery; but the air-current when passed in the periphery and out at center, in its nature having the greatest effect upon the smaller particles, the latter are forced out at the center immediately, and hence separated from the larger particles and saved from further reduction.

In cases where the upper body is revolving and its face is set suitably distant from the face of the lower stone, by passing an air-current in opposite direction to centrifugal force the

latter force loses all power over the particles when the same becomes smaller than the space between the faces of the two bodies, and the air-current, having no opposing force, (the upper face not reaching the small particles,) requires therefore no more power than sufficient to sweep or pass the particles off from the lower face or surface.

In all cases the required power of air current or currents or air pressure or force can be obtained by opening or closing the slides or by loading with or relieving from weight the pressure-valves.

If necessary to assist the air-current to pass the grain or other substances in at the periphery, the dress is laid in such a direction as will carry the material toward the center. The dress acting with the greatest effect upon the largest particles (the same as centrifugal force) assists the air-currents to pass the larger particles inward to the center and counteract the tendency of centrifugal force to throw the larger particles outward.

To assist or oppose centrifugal force or air-current or dress by gravity, the faces of the stones will be made to incline inward toward the center or outward from the center, as may be necessary. If, however, I pass an air-current from the center to periphery, the air-current will be assisted by centrifugal force, and it can be in opposite direction to the movement of the material by the dress or by gravity, or be in the same direction as the movement of the material by the dress and gravity, according to the way the dress is laid or the faces are made to incline, and as previously stated.

Specially it will be noted that by arranging the air-current to move in one direction (and having the greatest control upon the smallest particles) and centrifugal force or the dress or gravity operating in reverse direction, said forces having the greatest effect or control on the largest particles, the reduction going on in the meanwhile, that while the said forces acting on the larger particles or losing control by said particles becoming smaller, the air-current is gaining control over the particles to the same extent that the said other named forces are losing; and hence, when the equilibrium is passed, the air-currents are the controlling force to give freedom to the particles that have been reduced to the desired size by passing the same out from between the faces.

During the operation of so reducing the grain or other substances the purification of the reduced product according to my invention is as follows: When the reduced product is to be received in the chamber B, my improvement consists in separating and purifying the said product before it lodges or is bulked or massed in the said chamber. This result I achieve by using suction-force through chamber B, its valve *b'* being suitably opened, the said force then passing upward from the center to suction-fan. The air-currents so produced by the suction, acting in the said direction, catch or act upon the reduced particles immediately or as soon as the same are freed from the stones, causing the lighter stuff and impurities to be separated from the heavier and purer, the former to be forced upward with the suction, the latter to fall into the bottom of chamber B. Be it noted the action of suction to separate and purify the particles takes place before these touch each other and before they find a resting-place, and consequently insures a better and more perfect purification of the product. The air-currents passing between the faces of the stones assist the suction and air-currents ascending upward, and by this means still further enhance the process of purification. The deflectors C also enhance the process of separating the pure and impure particles by establishing a more uniform action on the part of the air-currents throughout the interior of the chamber B. Also, blast and suction can both be used to carry out this process of purification.

What I claim is—

1. The described method of reducing grain or other substances, consisting, essentially, in subjecting the material under treatment to the action of reducing-disks and an air-current simultaneously, the said air-current passing between the disks and conveying the reduced material in opposition to the centrifugal action of the same.

2. The described method of reducing grain or other substances, consisting, essentially, in subjecting the material under treatment to the action of reducing-disks and an air-current simultaneously, the said current passing between the disks and conveying the reduced material in opposition to the action of the dress of the same.

3. The described method of reducing grain or other substances, consisting, essentially, in subjecting the material under treatment to the action of reducing-surfaces set in a plane other than the horizontal and an air-current simultaneously, the said air-current passing between the reducing-surfaces and conveying the reduced material in opposition to the action of gravitation.

4. The described method of reducing grain or other substances, consisting, essentially, in subjecting the material under treatment to the action of reducing-disks and an air-current simultaneously, the dress of the reducing-disks and the air-current combined conveying the reduced material in opposition to the centrifugal action.

5. The described method of reducing grain or other substances, consisting, essentially, in subjecting the material under treatment to the action of reducing-disks having reducing-surfaces inclined from the horizontal and an air-current simultaneously, the dress of the inclined disks and the air-current combined conveying the reduced material in opposition to the action of gravitation.

6. In combination with the reducing-disks A A', the casing D and fan mechanism, sub-

stantially as described, connected therewith, the construction being such that an air-current is delivered by the fan mechanism to the periphery of the disks and through between the same to the eye.

7. In combination with the reducing-disks A A′, an interior chamber and fan mechanism, substantially as described, connected with the chamber, the construction being such that an air-current may be drawn through between the disks from the periphery to the eye, as described.

8. The combination, with reducing-disks having the periphery of the grinding-surfaces higher than the eye, of mechanism, substantially as described, for producing an air-current, the construction being such that the action of the air-current is opposed to the action of gravitation.

9. The combination, with reducing-disks having the periphery of the grinding-surfaces lower than the eye, of mechanism, substantially as described, for producing an air-current, the construction being such that the air-current is opposed to the action of gravitation.

10. The receiving-chamber B, located within the reducing-disks and in open unbroken communication with the eye of the same, in combination with mechanism for reducing the grain or other substances, and mechanism for furnishing an air-current, and thereby delivering it to the receiving-chamber in opposition to the centrifugal action of the reducing-disks.

11. In combination with the reducing-disks delivering material at the eye and mechanism, substantially as described, for producing an upward air-current, the deflector C, for breaking up or dividing the air-current.

12. The described method of reducing and purifying grain and other substances, consisting, essentially, in passing the material between the reducing-disks, with an air-current opposed to the centrifugal action, and in carrying upward from the eye the lighter particles by an ascending air-current, by means of which action the heavy and light particles are separated before being bulked.

13. In combination with the millstones A A′, having their faces dressed and made to incline so as to be lowest at the periphery and highest near the center, the casing D, the feed-hopper F, the bottom rim, D′, the chamber B, closed at bottom, the spouts G and E, having slides, the suction and blast-fan connections, by means whereof the blast singly, or suction singly, or both suction and blast combined, can be passed from the periphery to the eye of the bodies that produce reduction.

14. In combination with the bodies A A′, having their faces dressed to pass the material from the center to circumference, the casing D, feed-hopper F, the bottom D′, the chamber B, the spouts G E, having slides, suction and blast-fan connections, by means whereof the blast singly, or suction singly, or both blast and suction combined, can be passed from the periphery to the eye in opposition to the dress of the said bodies, producing reduction, in the manner and for the purposes set forth.

In testimony of said invention I have hereunto set my hand.

GEORGE MILBANK.

Witnesses:

WILLIAM W. HERTHEL,

JOHN M. HERTHEL.