3 Sheets—Sheet 1.

J. MILLS.

Apparatus for Degerminating Grain.

No. 223,056. **Patented Dec. 30, 1879.**

Fig. 1

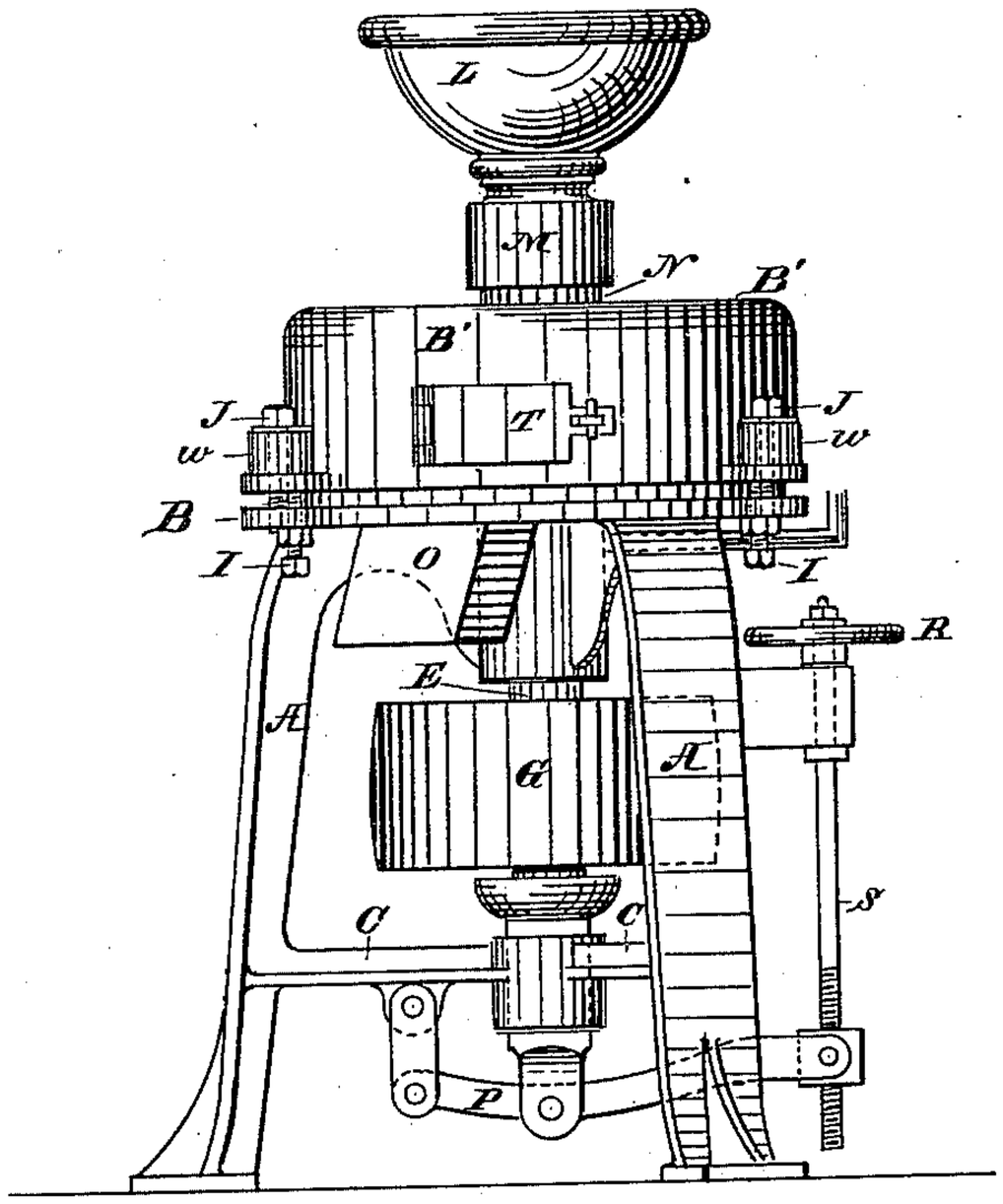
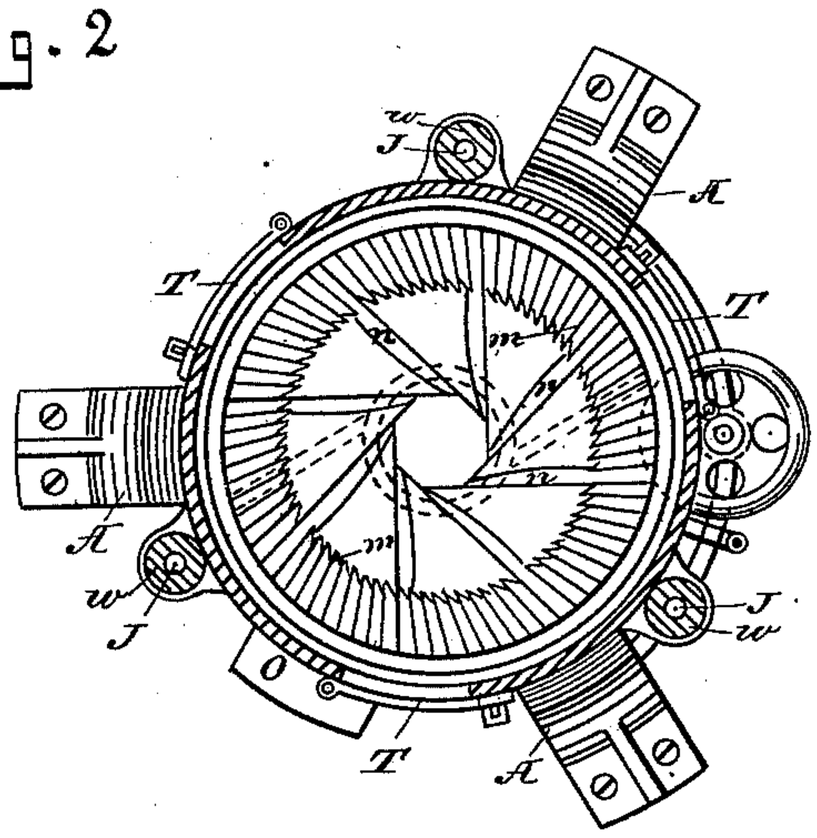


Fig. 2



WITNESSES:

J. C. Wilcke

Gus. A. Wunderle

INVENTOR:

Jonathan Mills

Per W. E. Dayton

Attorney

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J. MILLS.

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Fig. 5

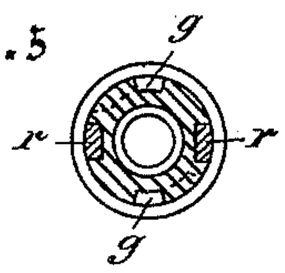


Fig. 3

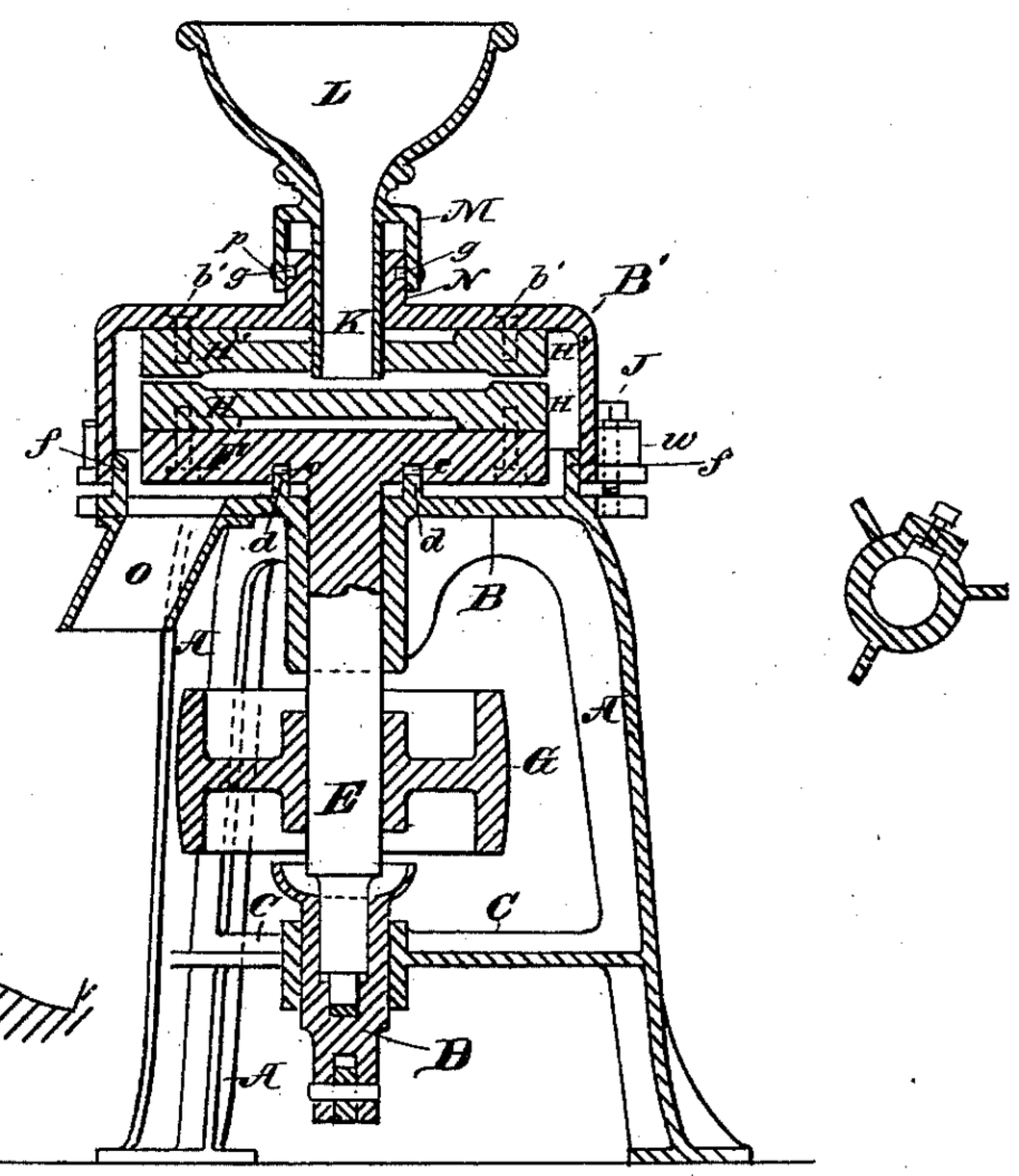


Fig. 4

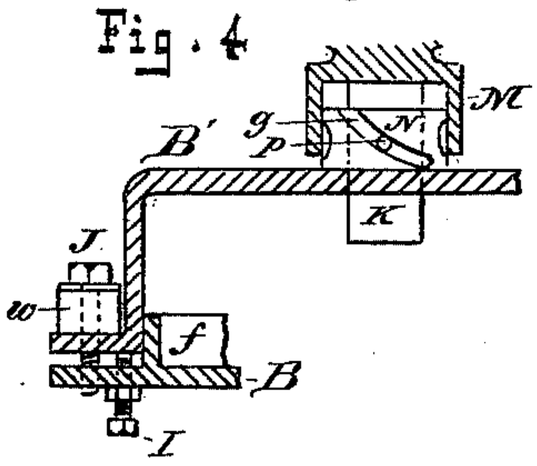
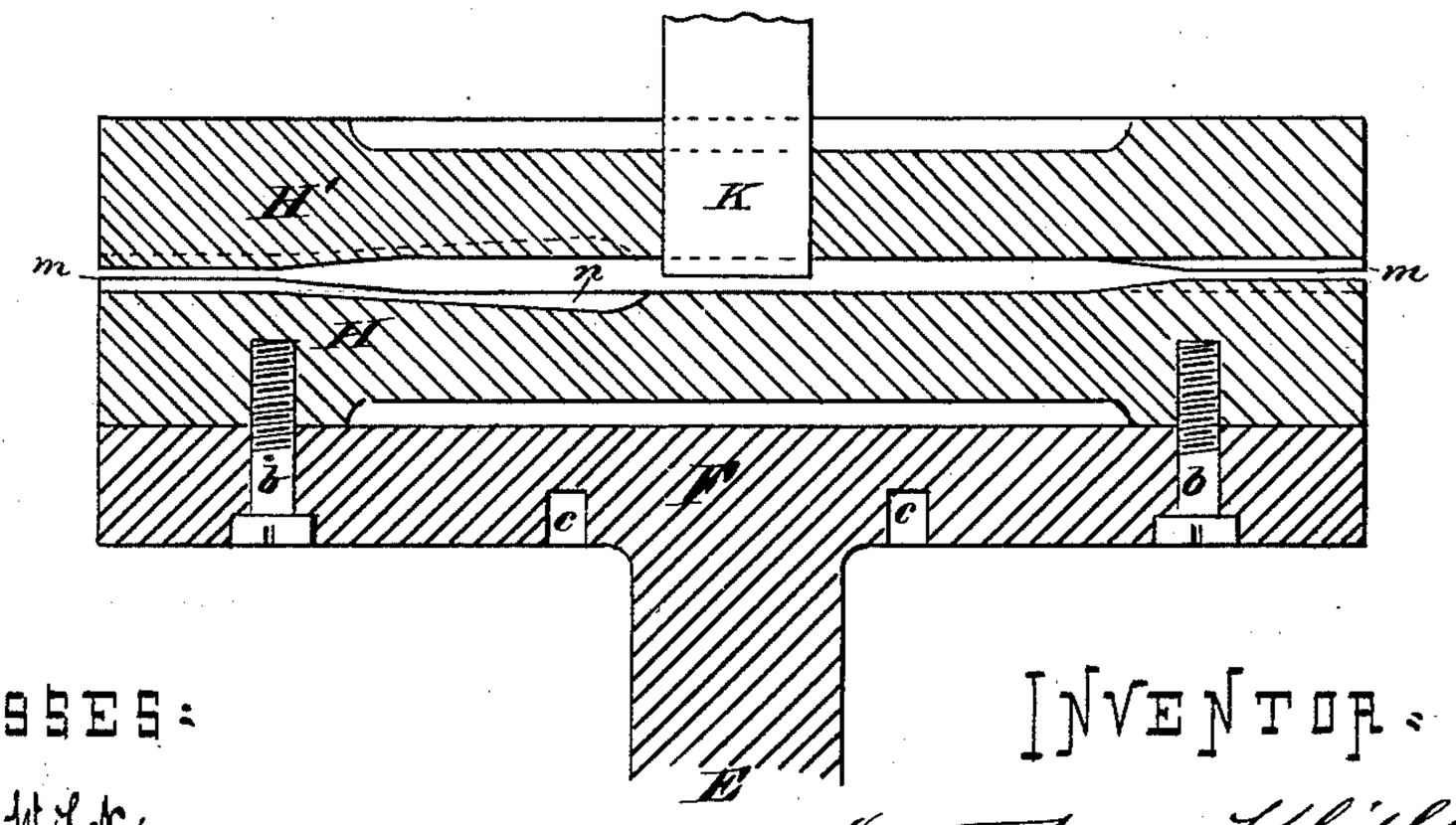


Fig. 7

Fig. 6



WITNESSES:

J. C. Wilkie

Geo. A. Wunderle

INVENTOR:

Jonathan Mills

Per W. E. Dayton

Attorney

3 Sheets—Sheet 3.

J. MILLS.

Apparatus for Degerminating Grain.

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Fig. 8

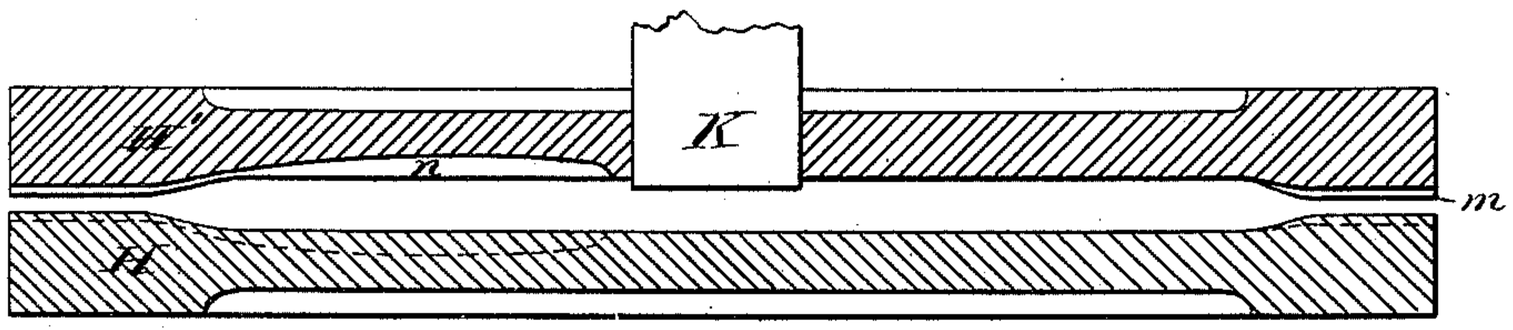
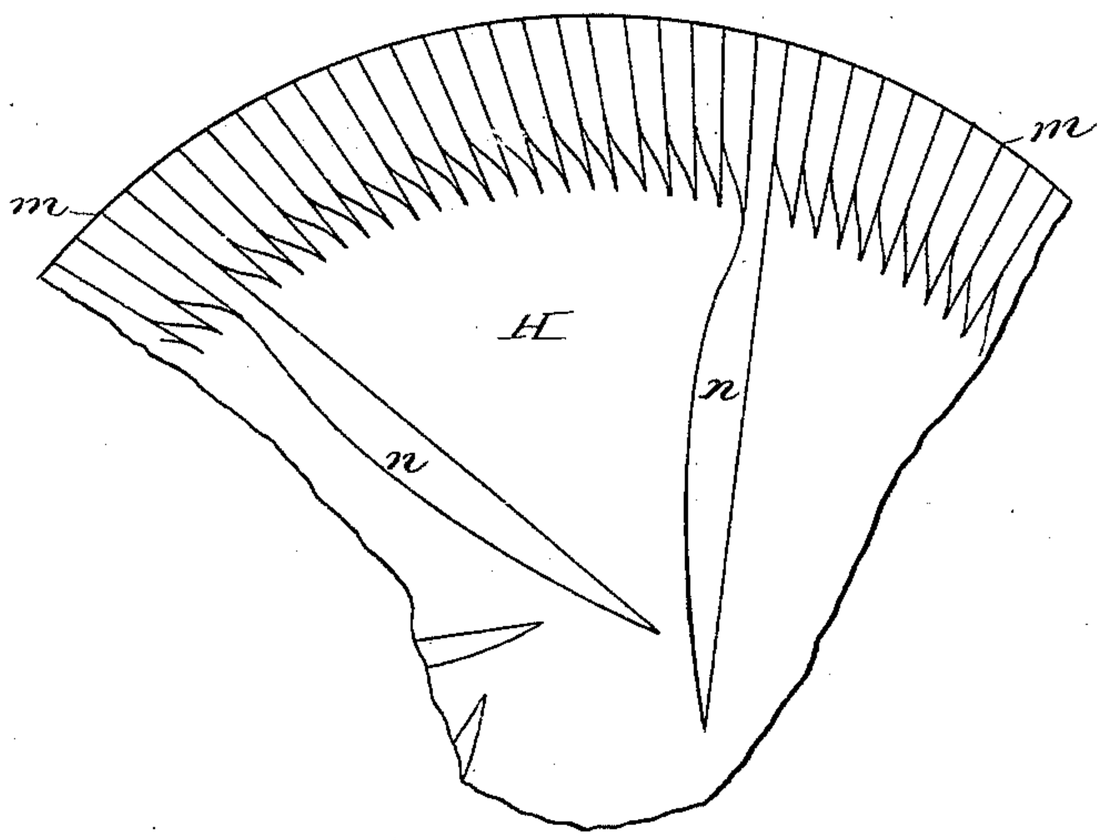


Fig. 9



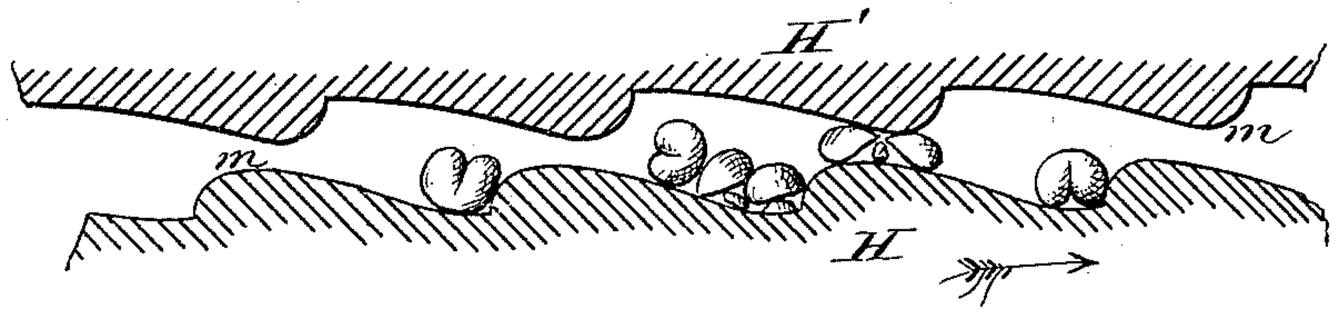


Fig 10.

Witnesses

O. Jelsm-

Gus. A. Wunderle

Inventor

Jonathan Mills

Per M. E. Dayton

Attorney

UNITED STATES PATENT OFFICE.

JONATHAN MILLS, OF MILWAUKEE, WISCONSIN.

IMPROVEMENT IN APPARATUS FOR DEGERMINATING GRAIN.

Specification forming part of Letters Patent No. **223,056,** dated December 30, 1879; application filed May 7, 1879.

To all whom it may concern:

Be it known that I, JONATHAN MILLS, of Milwaukee, State of Wisconsin, have invented certain new and useful Improvements in Methods and Apparatus for Degerminating and Granulating Wheat; 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.

The immediate objects of my invention are, first, to release and remove the germ of wheat, as a primary step in the reduction of the latter to middlings or flour; and, second, to avoid all material abrasion or comminution of the bran in the operation both of degermination and of further reduction. By these means I seek, as the ultimate object of my invention, to more easily and perfectly exclude the germ and bran impurities from the food-products of wheat than is possible by those methods in which these parts are first reduced with the grain and thereafter imperfectly separated.

For the attainment of these purposes my invention consists, first, in an apparatus for degerminating or reducing wheat, in which the operative parts are in the form of disks composed of hard material, having a close homogeneous texture, and having marginal rounded corrugations and smooth or polished surfaces; second, in an apparatus for degerminating wheat, having disks with marginal rounded corrugations and smooth or polished surfaces, a depressed bosom in one or both of said disks; third, in an apparatus for degerminating or reducing wheat having two disks, the lower one whereof is the runner and the upper one whereof is fixed and provided with a central feed.

My invention consists, also, in certain features of construction and arrangement of parts in my machine that will be hereinafter more fully set forth, and indicated in the claims.

In the several drawings my machine is illustrated as being made entirely of metal.

Figure 1 is an elevation, showing the apparatus complete. Fig. 2 is a horizontal section between the two operative disks, and shows, in plan view, the location, direction, and arrangement of the marginal corrugations and of the bosom-furrows of either disk-face. Fig. 3 is a central vertical section of the machine, showing the general arrangement of the parts. Figs. 4 and 5 are detail views, illustrating devices whereby the hopper is raised and lowered in adjusting the feed. Fig. 6 is an enlarged vertical section of the disks detached, more clearly showing the relative contour of the opposite disk-faces; and Fig. 7 is a vertical transverse section of the corrugations, enlarged to plainly illustrate the convex or rounded form of their apices.

A is a portable tripedal frame, supporting the circular plate B, and adapted to be securely fastened to the floor. C C are arms extending inward from the several uprights of the frame, and centrally connected together to form a bridge-tree for the lateral support of the vertically-adjustable socket or bridge-pot D, in which rests the foot of the spindle E. The upper end of the spindle has lateral support from a bearing in the plate B, as clearly shown in Fig. 3. Said spindle is provided with a circular head, F, either cast solid with the spindle or rigidly secured thereto, and carefully turned up or fitted to run perfectly true with the spindle.

To further secure perfect accuracy of motion between the head F and the spindle E, the latter is cast in an upright position, in order that it shall be of equal density across any transverse section, and be the more likely to expand or contract equally by change of temperature. The spindle is driven by the pulley G.

H and H′ are the operative disks of my improved apparatus, the proximate faces of which have the general form and relation in the sectional figures 3 and 6. Their specific features will be hereinafter more fully explained.

The lower disk, H, is firmly secured to the circular head F by the bolts *b b*, or otherwise, and therefore rotates with the spindle. The upper disk is similarly secured by bolts *b′ b′* to the cap-plate B′, and is stationary. The cap-plate extends downward about the disks, forming a curb or housing for the same, and rests on set-screws I in the plate B. Said curb, while vertically adjustable, is held con-

centric with plate B and with the spindle E by the flange *f*, cast on the plate B and carefully turned up to fit within the curb.

The combined cap-plate and curb is secured in place by clamp-bolts J, which pass through suitable ears or flanges on the several plates B and B′. Beneath the heads of these bolts are placed the rubber cushions *w*, for the purpose of allowing the upper disk to rise in case of the accidental admission of any hard foreign substance between the disks, and so to permit the same to escape without breaking the machine. These devices for securing and adjusting the cap-plates are best shown in Fig. 4.

On three sides of the curb or vertical portion of the cap-plate are located apertures, closed by doors T, which, when opened, reveal the inclosed disks for purposes of inspection or adjustment.

Through coincident central apertures in the upper disk and the cap-plate B′ descends the central feed-tube, K, forming an extension of the funnel-shaped hopper L. This tube is made to regulate the feed by being adapted to rise and fall relative to the face of the lower disk, the rapidity of the feed depending upon the distance between the end of the tube and the face of the said lower disk. For the purpose of this adjustment the neck N, which forms part of the cap-plate B′, and within which the tube K works vertically, is provided with one or more spiral grooves, *g*. The hopper, or its tube K, is also provided with a skirt, M, which sits down freely over the neck N. A pin, *p*, passing through the skirt M into each of the grooves *g*, enables the operator, by rotating the hopper, to raise or lower the tube K, and thus to regulate the feed or to entirely shut it off, at his pleasure.

Rubber buttons *r* let into the neck N, and, bearing outward by their elastic force against the inner face of the skirt M, prevent the hopper and its tube K from settling by the jar of the mill, at the same time that they allow the operator to instantly and readily change the adjustment of the feed.

In the operation of the mill the grain is fed through the hopper and tube K directly between the disks, as indicated, and after being operated upon escapes through the spout O. An annular flange, *d*, rising into the corresponding groove *c* on the under face of the head F, excludes the grain product from the spindle-bearing. The spindle is raised and lowered at pleasure by means of the lighter-bar P, linked to the bridge-tree, as shown, in connection with the lighter-screws S and hand-wheel R.

Having described above the general construction and operation of my apparatus, I proceed to complete the description of the disks H and H′ and to point out their specific action upon the grain, whereby the principal objects of my invention are attained. As hereinbefore stated, these disks may be made of metal, glass, or other substance suitable for the purpose, as that purpose is herein disclosed. I have hitherto preferred to make them of hardened steel or chilled iron, and in size about sixteen inches in diameter. On their proximate faces both disks are slightly and uniformly depressed from the center to from two to three inches of the periphery, so as to leave space between them for the grain to freely pass outward in a horizontal position or upon its side, but not sufficient to allow it to pass otherwise. The skirt of the disks, being that raised portion of their surfaces lying outside the depressed bosom already mentioned, is divided into ridges or corrugations *m*, directed preferably on a draft of about three inches, as shown in Fig. 2. Each ridge is about five-eighths of an inch wide at the periphery of the disk, and the inner ends of the ridges slope at an easy incline to the level of the depressed bosom of the disk. The general sectional contour of the ridges somewhat resembles that of a millstone-dress, being at a small angle of incline on one side and more abrupt on the other; but, unlike the lands of the millstone, the summit of each ridge is rounded, as shown in the enlarged figure 7, so as to present nothing corresponding to the well-marked feather and track edges of the millstone-dress.

From and continuous with depressions between ridges *m* of both disks the furrows *n*—eight, more or less, in number—extend inwardly across the bosom of the disks and terminate about the draft-circle, as shown in Fig. 2.

For reasons that will hereinafter more fully appear, the entire face of each disk, including the corrugations described, is polished or made smooth as possible, and all salient angles whatever are rounded away.

Preparatory to the operation of degerminating wheat by the apparatus described, the grain to be treated is first sized or graded by any suitable appliances for the purpose. The upper disk is trammed parallel with the lower one by means of the set-screws I and bolts J, and the space between the disks is properly adjusted with reference to the size of grain to be operated upon by working the hand-wheel R. The distance apart at which the disks should be set will be, say, little more than one-half the thickness of the grain-berry, but more precise adjustment will be obtained by observation of the grain as it leaves the mill.

In working the apparatus the spindle is run at about five hundred to seven hundred rotations per minute, giving a peripheral speed to the lower disk of, say, two thousand to three thousand feet per minute. By the united action of centrifugal force and the bosom furrows or leaders *n*, grain fed to the mill is gradually led into the depressions between ridges *m*, where, by reason of the shallowness of these depressions, it is received in a horizontal position. In this attitude it is made to rise the easy incline of the ridges *m* by the great speed of the surface on which it rests, and in rising it is rotated on its own axis until it bears with its creased side on one or the other of the op-

posite disk-faces. Since the smallest transverse diameter of the berry lies through the crease, the kernel is held in this relation to the proximating surfaces of the corrugations, and is thereafter slid along over one or the other or both of these surfaces until split apart and allowed to escape in fragments or half-kernels from the mill. (See Figs. 9 and 10.)

That slight pressure applied by opposite smooth surfaces to a kernel in this position—that is to say, in a position such that one smooth surface bears upon the grain at the central point of the arch opposite the crease, and the other surface bears upon the two points of prominence separated by the crease—will serve to force the lobes apart or to split the berry longitudinally through the crease, is obvious.

It is obvious also that it is necessary, both to the slipping movement of the grain upon the disk-surfaces and to the spreading action of the disk-surfaces upon the lobes of the grain, that said surfaces shall be extremely smooth; for otherwise they would, in the first instance, rotate the grain out of the position required and described, and, in the second, even if that position were accidentally assumed by the berry at the instant of rupture, the lobes would be held together and the rupture would be parallel with the disk-surfaces, instead of vertical thereto, as in the operation described. It is still further plain that neither in the slipping or gliding movement of the grain upon the polished disk-surfaces, nor in the pressing action by which the berry is longitudinally split, can there be any material comminution of the bran.

The ordinary rough or broken surfaces of millstones or other grinding-faces hitherto employed for reducing grain are, therefore, not at all adapted to my purpose, which is to cleanly split the berry through the crease in order to expose or release the germ; to do this with as little force as possible, in order that the inner structure of the grain may not be broken down and dislodged to any material extent in the operation, and to avoid, as far as possible, all rasping or grating of the bran-surface in the action and movements of the disks thereon during the passage of the grain through the mill.

It is in keeping with these several objects that all salient angles are avoided in the disk-faces, and particularly that the summits or vertices of the corrugations *m* are rounded off, as shown in Fig. 7. If the ridges presented a sharp track edge, such as is sought to be maintained in a millstone, each fragment of grain as it would pass off the land-face into the adjacent furrow would be in part under extreme pressure, and in part wholly relieved from pressure, so that the interior structure would be seriously broken down and the bran cut or abraded. The rounded form herein shown, on the other hand, presents a surface more favorable to the splitting action than a plane would be, and the relief from pressure upon the berry is instant and complete.

Usually the germ, which, as is well known, lies between the lobes of the berry at its base, and has only limited attachment thereto, will be detached in the act of splitting the kernel, as described; but if, in some cases, this is not accomplished, it will generally be disengaged by the further agitation of the fragments before their final escape from the mill, or during the operation of bolting.

In splitting the berry longitudinally through the crease, as set forth, not only is the germ liberated, but also any body of dirt or other substance that may from a great variety of causes have accumulated in the crease, and that is inaccessible to all devices for cleaning the whole grain. Both dirt and germ are obviously easily screened out from the mass in which the principal body is not smaller than half-kernels.

But little of the interior grain substance is dislodged in the operation of degerminating by splitting through the crease, as described, for the reason that each half of the berry so split is still largely enveloped by a shell, and also for the reason that only slight pressure, from which disintegration can result, need be applied to the berry to effect the splitting, as already stated. The limited quantity of such substance, which is, however, inevitably detached and mixed with the germ and dirt, may be separated as perfectly as possible and utilized in an inferior grade of flour.

For the purpose of separating the germ and dirt from the split berry after the operation of splitting, I prefer to use a short reel, covered with wire-cloth of from, say, sixteen to twenty-four meshes to the inch. Both these numbers may be advantageously used in the same reel, half of the reel at the head being covered with the number 24, and the remainder or tail with the number 16.

By readjusting the disks to the several grades or sizes of grain obtained by the preliminary grading, they may be severally and successively degerminated by passing them through the same mill; or a number of mills may be simultaneously run on the several grades.

I may employ essentially the same apparatus for the further reduction of the grain. For this purpose, however, I modify the disk-faces by extending the skirt-corrugations down into the depressed bosom of the disk, say, three-fourths of an inch to one inch, as shown in Fig. 8. The same polished surface is preserved, and the rounded form of the ridges is also retained in all respects, as described, for the purpose of avoiding all abrasion of the bran.

By passing the grain first split in the degerminating-mill through a series of four or five reduction-mills, conveniently arranged and properly adjusted for the purpose—that

is to say, having the disks set closer together for each succeeding operation—or through the same mill an equal number of times, the same being readjusted for each operation in the manner stated, and by bolting out the middlings and flour after each operation, I am able to accomplish the complete reduction of the grain, practically, without comminution of the bran, and to secure a product substantially free from germ and bran impurities.

The peculiar action of the disk-faces in the gradual reduction of grain is obviously such that the interior grain structure is broken down and the granules are detached in a space not narrow enough to further compress or to flatten them. The object being to make as large a proportion of middlings as possible, there is, therefore, but a small percentage of flour produced, and the entire product, whether of middlings or flour, is of that sharp granular form constantly sought to be obtained by modern methods of milling.

In the gradual reduction of grain by my improved apparatus the low grades of flour are taken out in the first and second operations; or, in the case of damp wheat, in the first, second, and third. In each of these operations some middlings are produced, which are dusted from the flour on an ordinary bolting-reel, and in the succeeding operations the product is chiefly middlings, accompanied by a small percentage of flour, of quality generally superior to the grade known as "first" flour made by other methods of reduction.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. In an apparatus for degerminating or reducing wheat, the disks H H′ of hard homogeneous material of close texture, having rounded marginal corrugations *m* and smoothly finished or polished surfaces, substantially as described.

2. In a machine for degerminating or reducing wheat or other grain, the disks H H′, of solid homogeneous material, capable of receiving a smooth or polished surface, and having rounded marginal corrugations and a depressed central bosom in one or both of said disks, as set forth.

3. In a machine for degerminating or reducing wheat, the disks H H′, having in one or both a depressed central bosom, surrounded by marginal rounded corrugations *m* and leaders *n*, and the whole surface smoothly polished, as set forth.

4. In a machine for degerminating or reducing wheat, the disks H H′, of hard material, capable of receiving a smoothly-polished surface, and having in one or both a central depressed bosom, with leaders *n*, and having marginal rounded corrugations, the lower of said disks being the runner, and the upper of said disks being fixed and provided with a central feed.

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

JONATHAN MILLS.

Witnesses:
M. E. DAYTON,
S. S. CHISHOLM.