(No Model.)

2 Sheets—Sheet 1.

J. HOLLINGSWORTH.

MACHINE FOR REDUCING GRAIN, &c.

No. 254,974. Patented Mar. 14, 1882.

Fig. 1

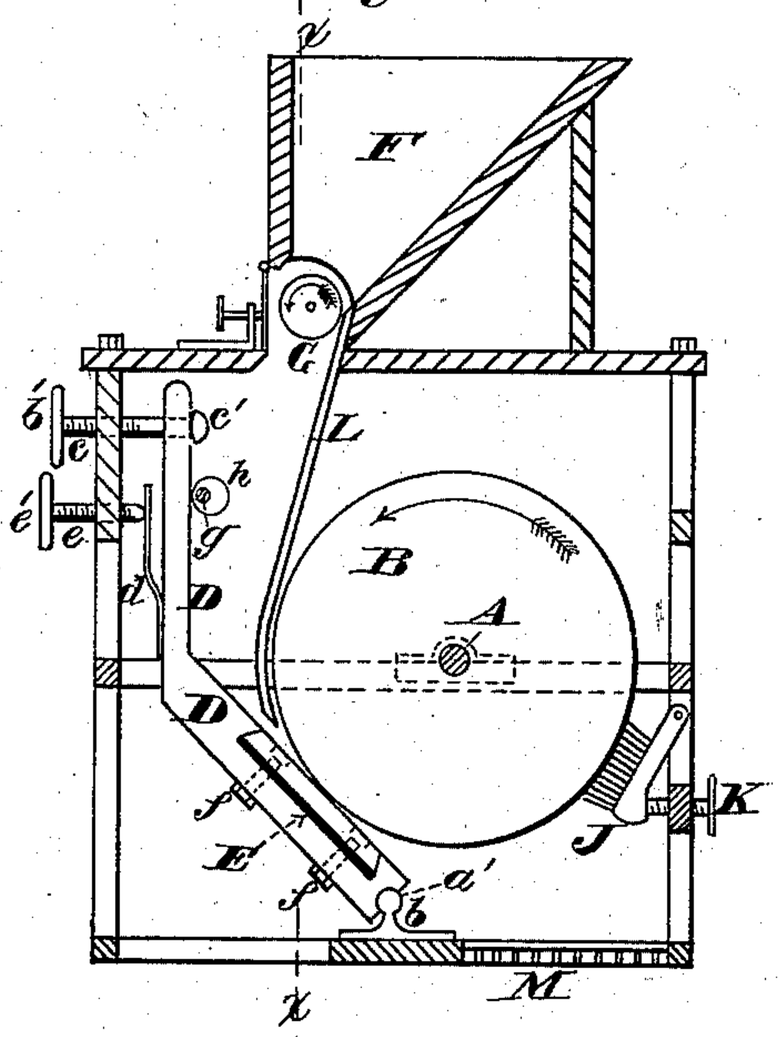


Fig. 2

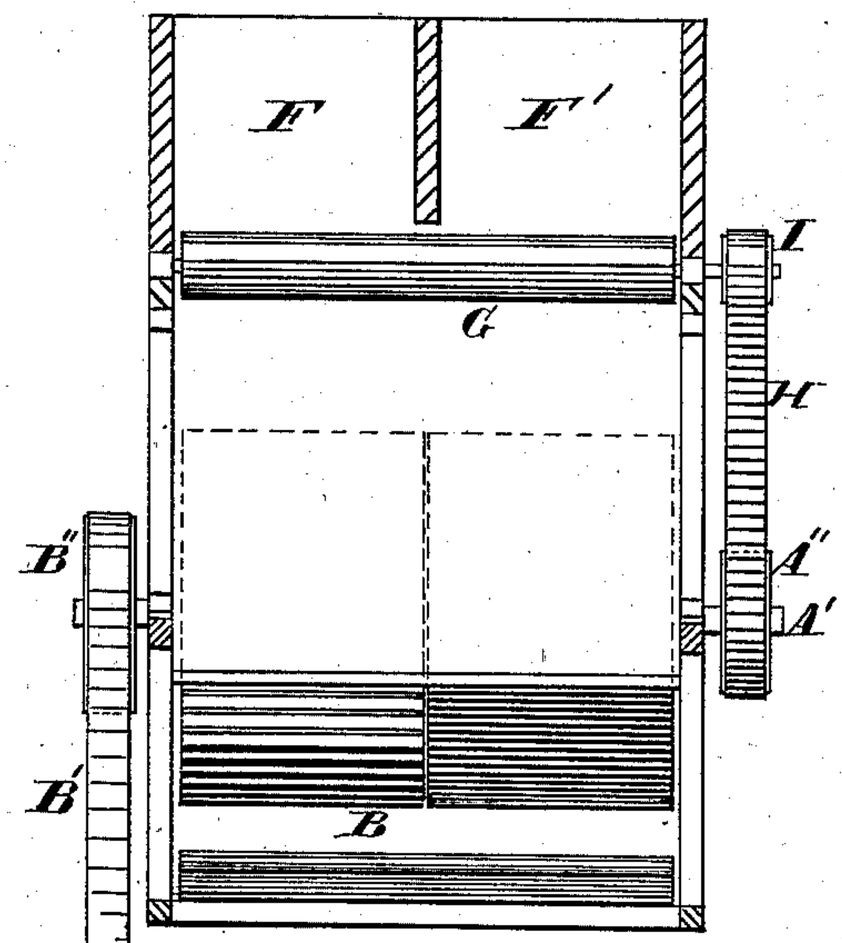


Fig. 3

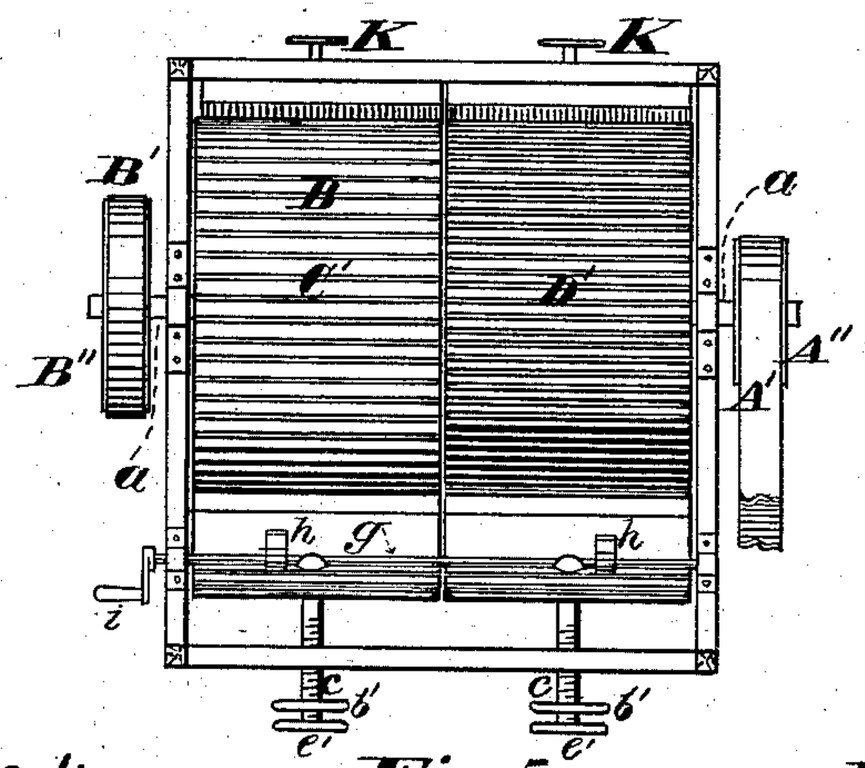


Fig. 4

Fig. 5

Fig. 6

Fig. 7

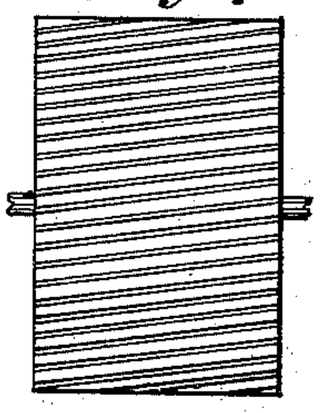
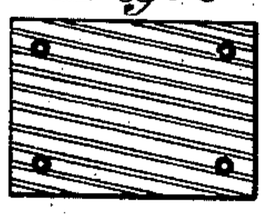


Fig. 8



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(No Model.) 2 Sheets—Sheet 2.

J. HOLLINGSWORTH.

MACHINE FOR REDUCING GRAIN, &c.

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Fig. 9

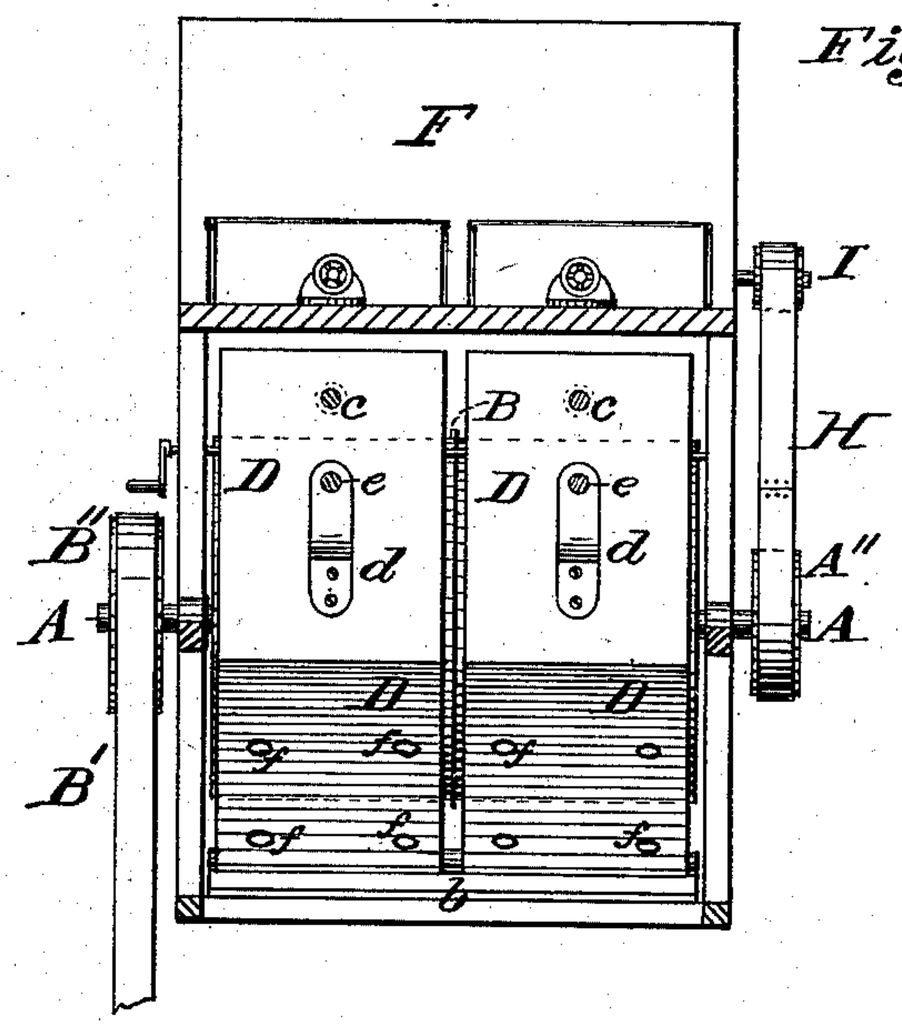
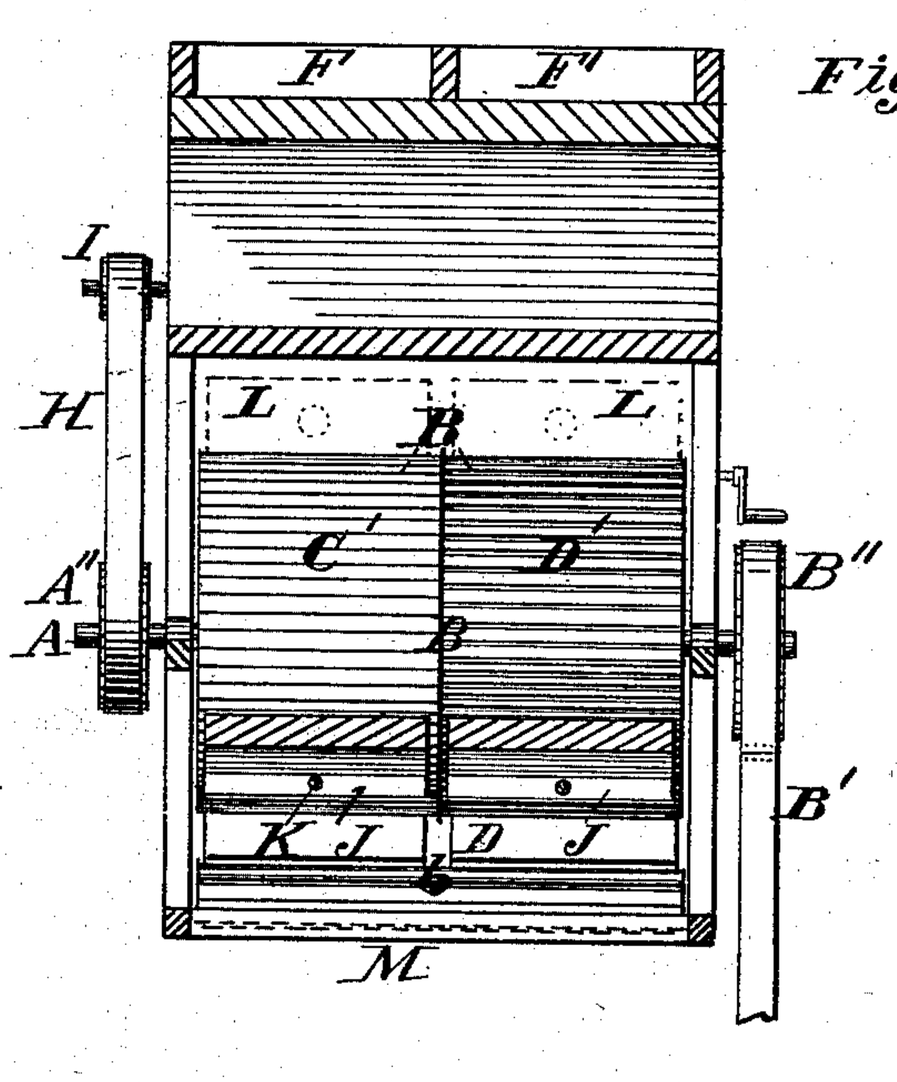


Fig. 10



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UNITED STATES PATENT OFFICE.

JEHU HOLLINGSWORTH, OF NEW YORK, N. Y.

MACHINE FOR REDUCING GRAIN, &c.

SPECIFICATION forming part of Letters Patent No. 254,974, dated March 14, 1882.

Application filed July 15, 1881. (No model.)

To all whom it may concern:

Be it known that I, JEHU HOLLINGSWORTH, of the city, county, and State of New York, have invented certain Improvements in Machines for Reducing Grain or other Substances, of which the following is a specification.

This invention is more particularly designed for the manufacture of flour; but it may also be employed for reducing or comminuting materials other than grain, and its object is to provide a simple and efficient means of reducing or comminuting the material to the requisite degree of fineness without subjecting the same to a grinding and scouring action, such, for example, as occurs in the operation of ordinary mill-stones, a further object of the said invention being to secure a reducing action upon the material of equal or greater efficiency than that obtained by the use of grinding-rollers with differential motion and at a much less expense in the manufacture of the apparatus, and in the replacement of its essential parts as the same may from time to time become worn and require to be renewed, repaired, or newly adjusted.

The invention comprises certain novel combinations of parts hereinafter more particularly set forth and specified.

Figure 1 is a vertical transverse sectional view of an apparatus embracing my said invention. Fig. 2 is a vertical sectional view, taken in the line *x x* of Fig. 1. Fig. 3 is a plan view with the top plate and hopper removed, and Figs. 4, 5, 6, 7, and 8 show certain modifications in the structure of some of the elements of my said invention. Fig. 9 is a rear view of the apparatus, as represented in Fig. 1, with the adjacent part of the casing removed to show the internal parts; and Fig. 10 is a vertical transverse sectional view, showing the opposite side of the said apparatus in a plane parallel with but slightly within the adjacent parts of the casing thereof.

A is a shaft, upon which is placed a grinding or reducing roller, B, the latter composed of cylindrical sections C′ and D′, two or more of the said cylindrical sections being placed upon the said shaft A. These sections may be made of stone or iron or of any other suitable material, or one of the sections may be made of one material and the other or others of a different material. In any case, however, the circumferential or comminuting surfaces of these several sections have their own peculiar surface, different in character from the corresponding surfaces of the other sections. Thus, for example, the section C′ will have a surface of a character adapted to a coarse or rough crushing of the grain or other substance when subjected to the action of the said section, whereas the next adjacent section, D′, will have a surface of a character adapted to still further reduce the comminuted material formed by the action on the grain or other substance of the comparatively coarse or rough surface of the preceding section, C′, and so on with reference to any additional sections that may be employed. The roller, composed of the cylindrical sections aforesaid, is attached to the shaft A to rotate therewith, and the said shaft is supported in suitable bearings, *a*, provided in the framework of the apparatus, the said shaft preferably receiving motion from the belt A′ on pulley A″, provided upon the end of the shaft A. Below and in front of the roller B, and more clearly represented in Fig. 1, are placed a series of supporting-beams, D, the said beams corresponding in number and position to the sections of the roller B aforesaid, each of the beams D having its lower end formed with a step, *a′*, which fits upon a substantially circular or cylindrical bearing, *b*, fixed to the bottom of the frame of the apparatus, to provide a pivotal support for the lower end of the beam, and upon or around which the said beam may be moved toward or from the roller B.

The distance of each beam D from the roller B is regulated as follows: A screw-bolt, *c*, provided with a suitable cross-handle or hand-wheel, *b′*, by which it may be turned, is passed through a nut provided in the frame of the apparatus, and extends through a slot in the upper part of the beam D, the said screw *c* having at its inner extremity a head, *c′*, which rests against the inner surface of the beam D, to form a stop, which limits the inward movement of the beam toward the roller B, so that by turning the screw *c* the end of the movement of the beam D toward the roller B may be regulated to any desired extent. Upon the back of the beam D is a spring, *d*, against which

bears the inner end of a screw, *e*, which, like the screw *c*, works through a suitable nut in the frame of the apparatus, and is provided with a cross-handle or hand-wheel, *e'*, by which it may be turned. By turning the screw *e* to increase or diminish the tension of the spring *d* the beam D may be forced to the limit of its inward movement with any desired degree of pressure, the object of this being, as will hereinafter appear, to hold the beds E in due relation with the roller B and yet permit the said beds E to recede when the pressure of the grain between the roller B and the bed E may exceed a certain limit. The beds E are fitted into and upon the beams D at the sides thereof adjacent to the roller B, the beds being themselves preferably made of a dovetailed form, as indicated in Fig. 1, and placed in corresponding seats formed in the beams D, and there retained by suitable screws, *f*, as indicated in Fig. 1. The outer faces of the beds E constitute grinding or reducing surfaces, which act in conjunction with the corresponding surfaces of the section of the roller B, there being, of course, one beam, D, and consequently one bed, E, opposite to and coincident with each of the sections of the roller B, and each of the said beds having its outer or reducing surface made of a degree of roughness differing from that of the other beds, but corresponding with the reducing-surface of the section opposite it of the roller B—thus, for example, the bed E opposite to and coincident with the section C' should have a coarse or comparatively-rough surface adapted to break the grain or substance to be ground into fragments of smaller size, while the bed E, opposite the section D', should have one adapted to reduce these fragments to a still smaller degree of division or comminution, and so on through each one of the beds embraced in the series. These beds, like the sections of the roller B, may be made of metal or artificial or natural stone, or one section may be made of one material and the other or others of other material. In like manner the outer or reducing surface of the beds may be stone or metal, corrugated or smooth, and may be either flat, as represented in Fig. 4, or convex, as represented in Fig. 5, or slightly concave, but not concentric with the roller-surface, as represented in Fig. 6; but in any case the reducing-surface will be substantially tangential to the circumference of the roller B. The convex form shown in Fig. 5, departing from the tangent in one direction, while the concave form represented in Fig. 6 departs from the tangent in the opposite direction, but both in their *modus operandi* approaching, to a greater or less degree, the operation of the flat face or reducing-surface, represented in Fig. 4, and shown applied in position tangentially to the roller B in Fig. 1.

Over the roller B is placed a hopper composed of compartments F F', &c., one compartment over each section of the roller B. Horizontally through the throats or outlet-openings of these compartments F F' is placed a small feed-roller, G, the shaft of which works in suitable bearings provided in the frame of the apparatus, and is rotated in the same direction as the roller B by means of a band, H, extending from the pulley I on the shaft of the roller G to the pulley A'' on the shaft A' of the roller B.

Placed behind the roller B is a brush or scraper, J, which may be braced against the roller by a set-screw, K, working through a nut in the frame of the apparatus or any equivalent device for cleaning the roller.

The requisite degree of roughness is given to each of the sections of the roller B, and also to the reducing-surface of each of the beds E, either by using stone having the proper coarseness of grade, or, preferably, when the said parts are made of metal, by corrugating the said reducing-surfaces of the said parts. The corrugations may, if desired, be longitudinal upon each of the sections of the roller B, and those upon each of the beds E may correspond in direction to those upon the sections of the roller aforesaid. It is preferred, however, that the corrugations upon each of the sections of the roller should be diagonal, as shown in Fig. 7, and that in like manner the corrugations of the beds E should be made oblique, as indicated in Fig. 8, in order that a more efficient and rapid reducing action may be exerted upon the grain or other material subjected to the conjoined operation of the sections of the roller B and the beds E.

Placed in front of the upper part of the beams D is a shaft, *g*, upon which is placed a long eccentric, or, in lieu thereof, a series of eccentrics, *h*, bearing against the front of the said beams D, so that when it is desired that beds shall be quickly brought away from their normal proximity to the roller B the turning of eccentric *h*, which may be accomplished by a crank, *i*, on one end of its shaft, will force backward the upper ends of the beams D, and thereby cause the beds E to recede from the roller B. The shaft *g* has its bearings, of course, on the frame of the apparatus.

In the operation of the machine the grain or other material to be reduced is thrown into the first compartment, F, of the hopper, and by the rotation of the feed-roller G receives a direction which causes it to fall as nearly as may be toward the point of conjunction of the bed E and the section C' below, this being further provided for by a curtain or partition, L, which extends from the back part of the throat of the hopper downward in front of the roller B, as represented in Fig. 1. The reducing-surface of the bed E being substantially tangential instead of concentric to the cylindrical reducing-surface of the section C', the grain or other material passing between the two is crushed and reduced by the pressure of the comparatively-rough surface of the section C' upon the comparatively-rough and substantially-flat sur-

face of the bed E, and is thereby rapidly and effectually brought to a comminuted condition with practically no abrasion, the result and product being composed of fragments much smaller in size than the original material, but larger than the size of the ultimate product desired, saving and excepting a portion which, being brought in the first instance to the requisite degree of fineness, passes downward through the sieve M, below the roller B, into any suitable receptacle placed to receive it. The more coarsely comminuted material is then taken out by any suitable means and thrown into the compartment F′ of the hopper, through which it falls between the second section, D′, of the roller B and the second one of the beds, E, which said second section and bed, having a reducing-surface of finer character than those preceding, will further reduce the material, bringing the same in some cases to the required degree of fineness; but where the degree of fineness is more than can be obtained by the use of the two sections C′ D′ of the roller B and their corresponding beds E, any number of sections of the said roller having surfaces of different character and gradually progressing from coarse to fine may be employed, the number of sections which may be used in the roller B and the number of the corresponding beds which may be used being practically without limit.

When the beds E (which I term "resisting-beds," inasmuch as they hold the grain or article to be ground in proper relation with the sections of the reducing or grinding roller B) become worn they may be set up more closely to the adjacent sections of the roller B by means of the screws *c* and *e*, and if broken or worn out may be readily replaced by detaching the old from the beams D and inserting new ones in their places.

It is of course to be understood that each of the beds E will receive its own separate adjustment with reference to the adjacent and coincident section of the roller B. Any flour material which might otherwise adhere to the roller B or any of the sections thereof is swept off by the brush or scraper J, it being borne in mind that the beds are not to be brought into actual contact with the reducing-surfaces of the sections of the roller B, but are to be brought extremely close thereto. As an illustration, but not as a positive instruction, I would say that the thickness of any ordinary sheet of tissue-paper represents substantially the distance that should be maintained between the reducing-surfaces of the beds E and the corresponding and coincident surfaces of the sections of the roller B—that is to say, the surfaces should not be allowed to approach each other more closely under any circumstances than just above indicated, but the distance should be made greater in proportion as a coarse granulation of the grain or material is desired. Thus, for example, if the average size of the granules to which the grain or material is to be reduced is intended to be, say, one-sixteenth of an inch in diameter, then the distance between the surfaces above mentioned should be one-sixteenth of an inch, each roller and its adjacent bed being arranged with a space between them corresponding to the degree of comminution which said roller and bed are designed to effect upon the grain or other material to be reduced.

It is of course to be understood that the spring behind each bed is of sufficient tension and is so applied as to hold the bed in the required position and at the requisite distance from its adjacent roller during the normal operation of reducing the material passed between the said bed and roller, and yet be capable of yielding when a foreign substance of greater hardness or of unusual size finds its way between the bed and the roller, thereby preventing injury to the said parts.

When it is only desired that the machine shall subject the grain or other substance to a single reducing operation one reducing-roller, beam, and resisting-bed, spring, tension-regulating screw, and adjustable stop-bolt may be combined for this purpose, the roll and resisting-bed being of suitable length and the relation of the parts being such as is indicated in Fig. 1. In such cases the apron L should still be retained to secure the most advantageous operation of the apparatus.

What I claim as my invention is—

1. The combination, in a mill for reducing grain or other substances, of a reducing-roll, a beam, D, carrying a resisting-bed, E, a spring, *d*, a tension-regulating screw, *e*, and an adjustable stop-bolt, all substantially as and for the purpose herein set forth.

2. The combination, in a mill for reducing grain or other substances, of a reducing-roll, a beam, D, carrying a resisting-bed, E, a spring, *d*, a tension-regulating screw, *e*, an adjustable stop-bolt, and an apron, L, for directing the grain or other substance between the bed E and the reducing-roll, all substantially as and for the purpose herein set forth.

3. The combination, in a mill for reducing grain and other substances, of the series of supporting-beams D, pivoted at their lower ends and adjustable at their upper ends, the stop bolts or screws *c*, arranged to limit the inward movement of the beams D, the series of resisting-beds E, supported by the said beams, and the reducing-roller composed of parts or sections having surfaces of substantially-different character, all substantially as and for the purpose herein set forth.

4. The combination, in a mill for reducing grain or other substances, of the series of supporting-beams D, carrying the series of resisting-beds E, the springs *d*, tension-regulating screws *e*, stop bolts or screws *c*, and a reducing-roll composed of two or more parts or sections having surfaces of substantially-different character, all substantially as and for the purpose herein set forth.

5. The combination, in a mill for reducing

grain or other substances, of a cam or equivalent actuating device with the pivoted supporting-beams D, carrying the series of resisting-beds E, a reducing-roller composed of parts or sections having surfaces of substantially-different character, and the springs for holding the beams D and resisting-beds E toward the reducing-roller, all substantially as and for the purpose herein set forth.

JEHU HOLLINGSWORTH.

Witnesses:
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THOMAS E. CROSSMAN.