(No Model.) 2 Sheets—Sheet 1.

J. HOLLINGSWORTH.

MILL FOR REDUCING GRAIN, &c.

No. 267,347. Patented Nov. 14, 1882.

Fig. 1

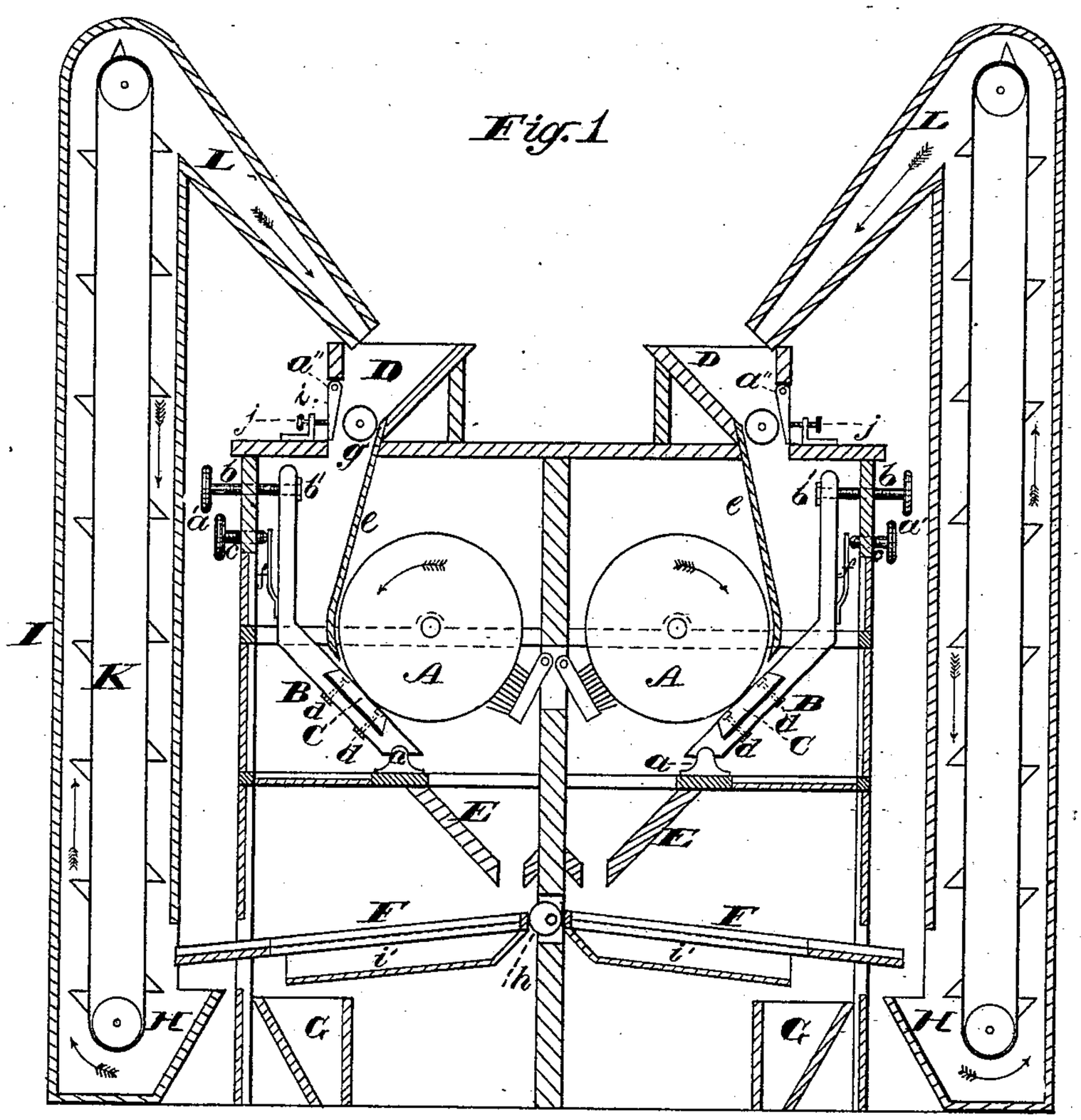
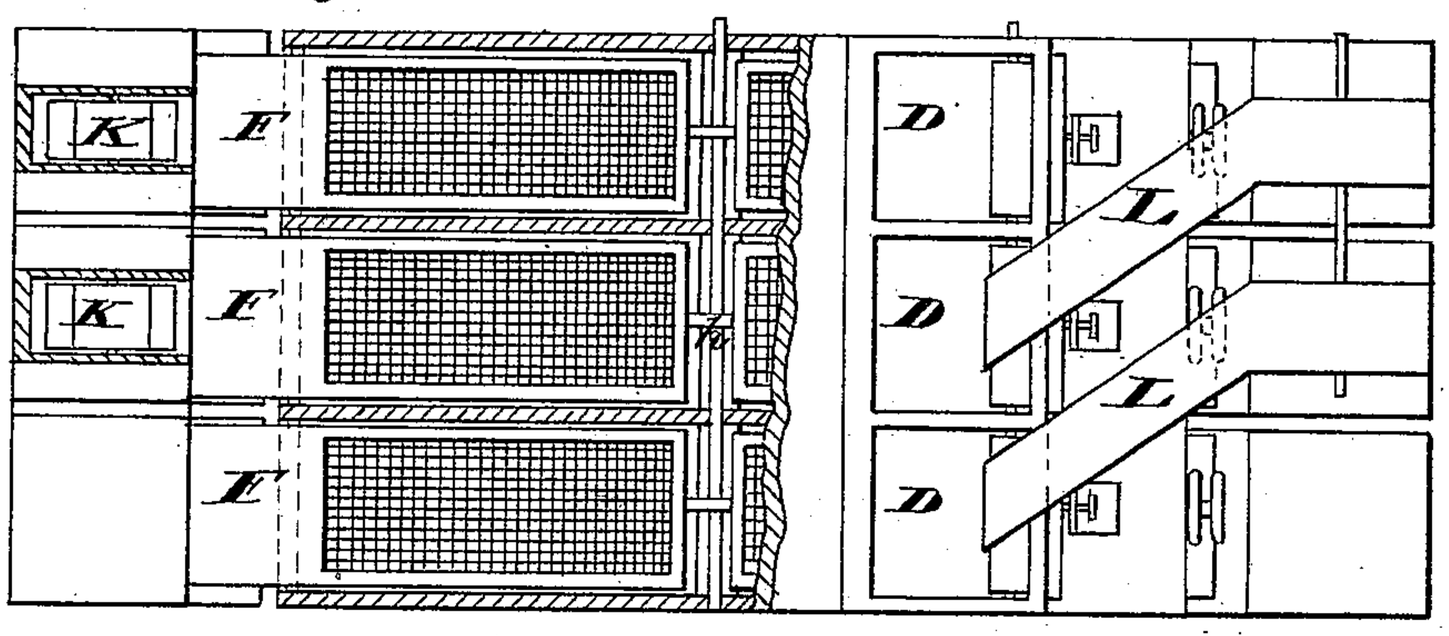


Fig. 2



Witnesses

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(No Model.) 2 Sheets—Sheet 2.

J. HOLLINGSWORTH.

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Fig. 3.

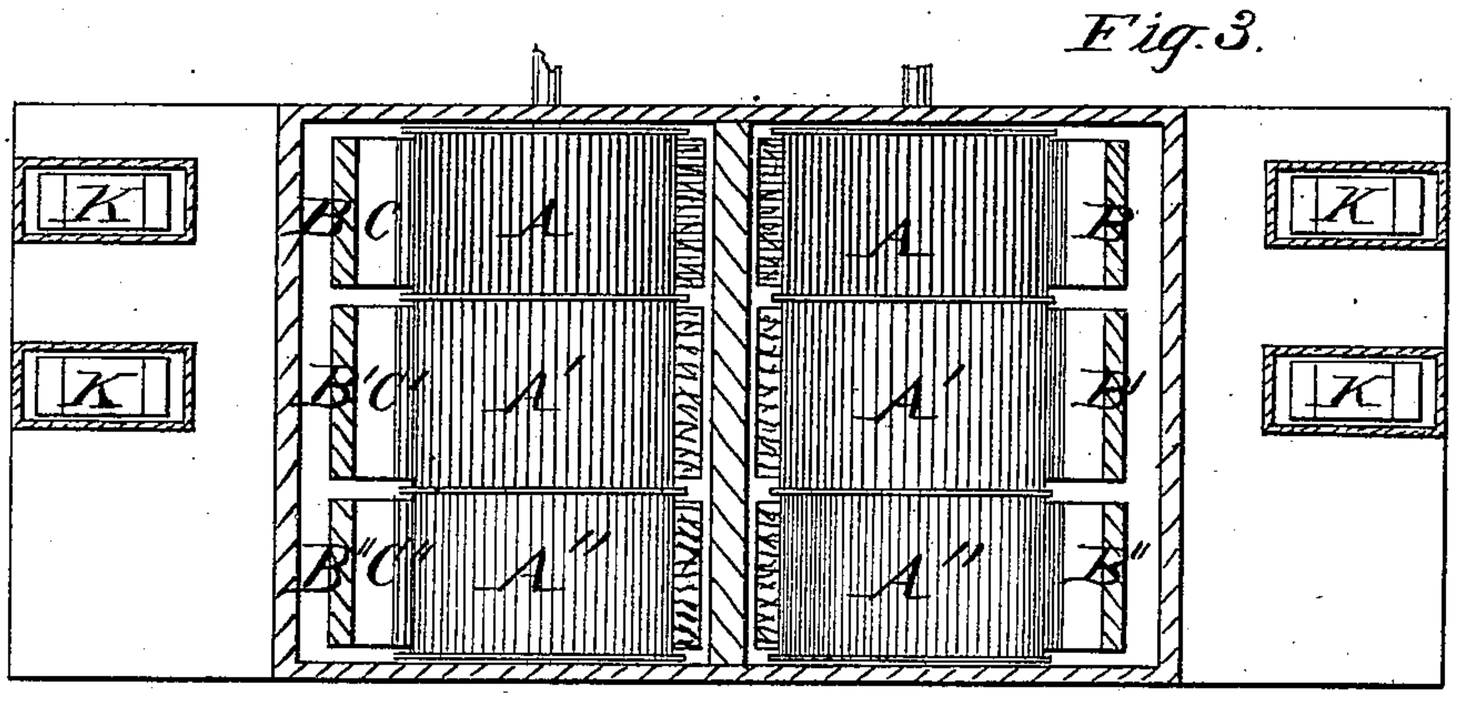


Fig. 5.

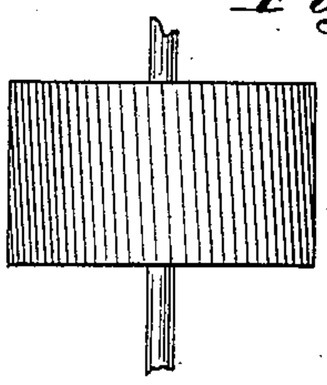
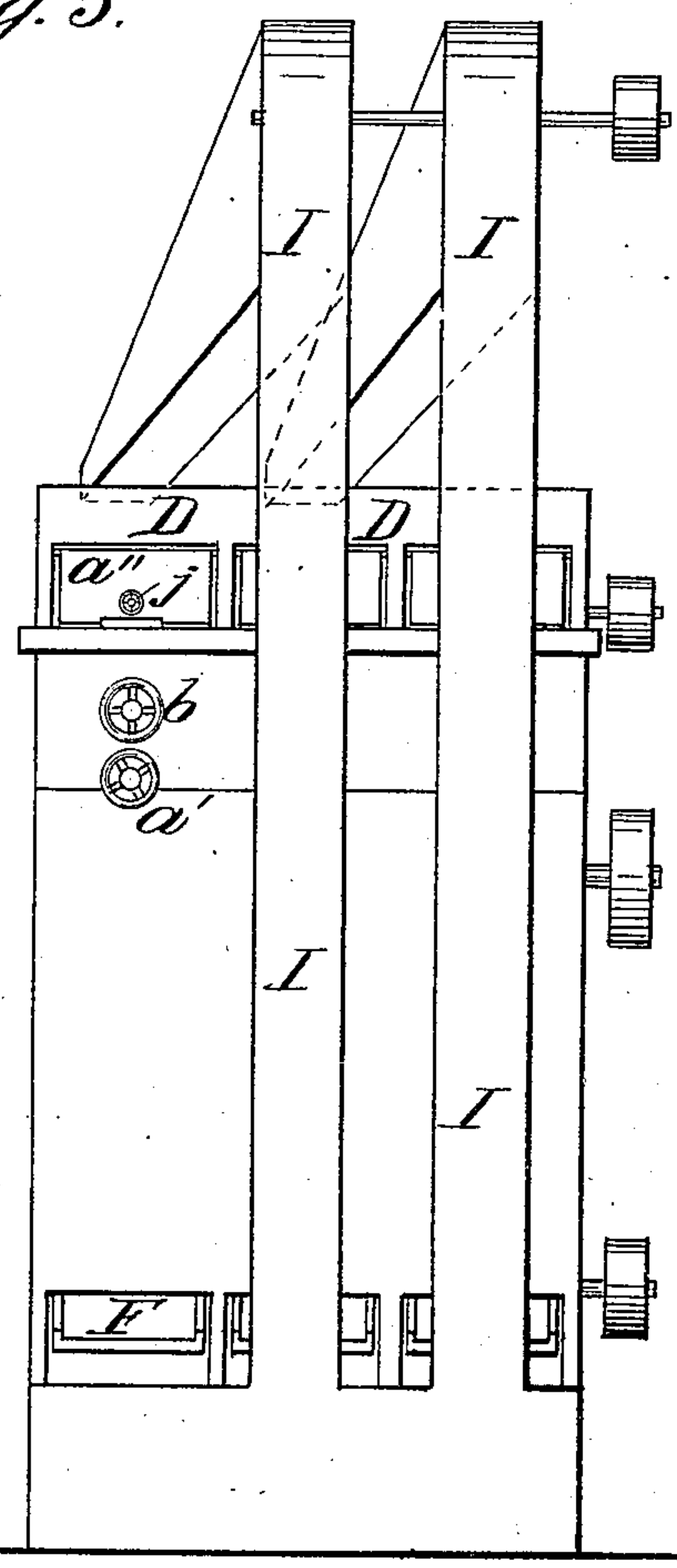


Fig. 4.



Witnesses.
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UNITED STATES PATENT OFFICE.

JEHU HOLLINGSWORTH, OF NEW YORK, N. Y.

MILL FOR REDUCING GRAIN, &c.

SPECIFICATION forming part of Letters Patent No. 267,347, dated November 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 Mills for Reducing Grain, &c., of which the following is a specification.

In the manufacture of flour, meal, &c., there are two representative processes in common use, one consisting substantially in crushing the grain or material between rollers with differential motion, the other consisting substantially in subjecting the grain or material to the action of grinding and abrading surfaces, the former involving the use of expensive machinery, but producing an excellent quality of flour or meal, the latter capable of application by means of comparatively cheap and simple machinery, but producing an inferior product and requiring skilled labor in its management. The mechanism employed in the production of flour, meal, &c., by subjecting the grain or material to the action of grinding and abrading surfaces may itself be divided into two classes, one embracing the ordinary millstones, the other the combination of a cylindrical grinding-stone with a concave or sector-shaped grinding-plate, the grinding-surface of which is substantially concentric with the cylindrical grinding-surface of the stone, and generally embracing one-quarter (or more) of its circumference; but these two varieties of apparatus operate on substantially the same principle—namely, that of subjecting the grain or article to be reduced to an abrading and grinding action as distinguished from a crushing action.

The object of my invention is to provide for the manufacture of flour, meal, &c., of a quality equal to that produced by crushing between rollers with differential motion, and with as little attention as is required in the said operation of crushing between rollers, and yet with the simplicity of mechanism characteristic of the operation of grinding between abrasive surfaces, by which means I avoid the drawbacks incidental to both of the former operations of manufacturing flour, meal, &c.—viz., the great expense of rollers and the comparatively poor quality of millstone manufacture—and secure the advantages incidental to both.

My invention consists in certain novel combinations of parts, hereinafter more fully set forth.

Figure 1 is a transverse vertical sectional view, and Fig. 2 is a plan and partial horizontal sectional view, of an apparatus embracing my novel combinations of parts aforesaid. Fig. 3 is a horizontal sectional view through a plane just above the rollers. Fig. 4 is an end elevation of the apparatus, and Fig. 5 is a detail view, showing a modification in the corrugations of the rollers—that is to say, showing said corrugations in a position oblique to the axes of motion of the rollers, instead of substantially parallel therewith.

A A′ A″ are rollers, made of stone, metal, or other suitably hard material.

Placed adjacent to each roller is a beam, B B′ B″, as the case may be, the lower end of which rests on a fulcrum, *a*, while the upper end is capable of lateral adjustment to and from the adjacent roller, A A′ A″, as the case may be, by means of a screw, *b*, which passes through a nut suitably arranged in the strong or solid frame-work of the apparatus.

The screw *b* is provided at its outer end with a hand-wheel, *a′*, whereby it may be turned, and at its inner end with a head, *b′*, which rests upon the adjacent inner surface of the beam B, the screw *b* passing through a slot in the said end of the beam B B′ B″, as the case may be, so that by turning the screw *b* in the proper direction the beam may be swung away from the roller A to the requisite degree. Another screw, *c*, provided with a suitable hand-wheel, whereby it may be turned, passes through a suitable nut in the frame of the apparatus and bears against the free end of a spring, *f*, the opposite end of which is attached to the beam in such manner that the spring *f* tends to press the beam toward the adjacent roller, the degree of this pressure being adjusted by means of the screw *c*.

Each beam is provided with a transverse dovetailed socket, in which is placed a correspondingly-shaped bed, C C′ C″, as the case may be, the face or outer surface of which is substantially tangential to the adjacent roller A A′ A″, as the case may be. The said bed of each beam is fixed in position by suitable bolts, *d*. By means of the screw *b* the beam is so adjusted that the face or outer surface of the bed is prevent-

ed from coming in absolute contact with the adjacent roller, the said bed being kept a distance equal to, say, the thickness of a sheet of paper from the surface of said roller, this distance being increased according to the size to which it is designed to reduce the material by the action of any one of the rollers and its adjacent bed. Thus, for example, if the degree of comminution is represented by diameters of one-sixteenth of an inch, the distance between the face of the bed and the cylindrical surface of the roller would be one-sixteenth of an inch, and so on proportionately for any other desired degree of comminution.

Above each roller is a hopper, D, from the throat of which extends downward an apron or partition, *e*, designed to prevent the material passed from the hopper D from passing otherwise than downward between the rollers and their adjacent beds, C C′ C″—in other words by preventing the grain or material from alighting upon the roller and receiving abrasion by the movement of the surfaces thereof. In the throat of each hopper D, moreover, is placed a feed-roll, *g*, the object of which is to prevent the grain or material from clogging at the throat of the hopper, and also, in connection with the swinging gate *i*, to regulate the quantity of grain or material passed downward to the roller in any given time. This gate is pivoted at its upper end, as shown at *a″*, and is adjusted toward or from the feed-roller *g* by means of a screw, *j*, working through a nut attached to the frame of the apparatus.

When the grain or other material from the hopper D is fed downward in suitable quantities it is directed by the partition or apron *e* down to the point where the roller and the adjacent bed approach each other, and along the line of suitable, but not actual, contact between the said roller and the said bed, is subjected to a crushing action as great as that to which the same or similar material is subjected when passed between two crushing-rollers having a differential motion, and is thereby reduced to the requisite degree of fineness—that is to say, to a degree of comminution proportioned to the distance between the roller and its adjacent bed. By this means the material is reduced to the degree of fineness just indicated without being subjected to any material degree of frictional contact from the reducing-surfaces, and without being abraded, as would be the case if it were subjected to what may be termed a "grinding" or "abrading" action, as distinguished from a purely crushing action, the result of this being that the fibrous cuticle or bran of the grain is broken or detached without being scoured and without having its particles mingled with the flour or resulting product.

The apparatus is vertically divided into a number of subdivisions or compartments corresponding in number to the numbers of rollers A A′ A″ and their adjuncts, which it is desired to embody in the machine, there being in each of these compartments not only a roller, beam, bed, partition, or apron, *e*, hopper D, and the minor adjuncts hereinbefore described, but also at the lower part thereof a chute, E, which conducts the crushed material, as the latter falls from the roller and bed, to an inclined sieve or screen, F, to which a shaking motion may be given by any suitable means—as, for example, by an eccentric, *h*, working against the end of the said screen. The latter, however, may be actuated by any suitable mechanism, there being required therefor the exercise of mere mechanical judgment.

Under each screen, and attached thereto, is an apron, *i′*, which serves to guide the material which passes through the screen to a receptacle, G, (which said receptacle is in practice the hopper of an ordinary reel, which shakes out the flour from the material passed thereto from the receptacle or hopper G, thereby separating the middlings, of which I shall speak farther on herein,) while the material which does not pass through the screen is shaken off at the end of the latter into another receptacle, H, technically termed the "boot" of an elevator, inasmuch as above it there is placed a trunk, I, in which works an ordinary mill-elevator, K, composed of an endless belt working through suitable pulleys at top and bottom, and constructed with suitable buckets. The operation of this elevator K is to take the material from the boot H and lift it to the spout L, over which the material passes into the hopper of the set of rollers A A′, bed C C′, &c., next adjacent to that from which the material has been passed to the boot H, the spouts L being for this purpose bent laterally, as represented in Fig. 2.

As represented in the drawings, the apparatus is formed with six compartments, and consequently is designed for use with six sets of rollers A A′ A″, &c., and their adjuncts. Three of these rollers and their adjuncts are placed in line in their several compartments at one side of the apparatus, and the other three are similarly situated at the opposite side of the apparatus. The elevators K and the devices connected therewith are so arranged that the first elevator takes the material passed from the first of the rollers, A, and its bed C and carries it to the hopper of the second roller, and so on, in succession, to each of the sets of devices, which embrace as their essential elements a roller and bed. Furthermore, it is to be observed that the first set, composed of the roller A and bed C, is adjusted to coarsely crush the material. The next, A′ C′, is adjusted to crush the already broken material still finer, and so on, until the quantity is exhausted, leaving nothing but the bran to pass through, say, the third set of rollers, A″, and bed C″, respectively.

Now, in the aforesaid operation, inasmuch as the separation of the middlings from the flour is a matter well understood by millers, and in the

present state of the art capable of being carried on by well-known mechanical means, I need not here describe it in detail. There has been, as hereinbefore explained, a separation of the middlings from the other material passed down therewith through the receptacles or hoppers G, there being such a separation of middlings, by the use of apparatus hereinbefore explained, from the product passed down separately through each of the receptacles or hoppers G. After the grain itself has been exhaustively treated by being passed through a number of the rollers and their adjacent beds, as hereinbefore explained, there remains the further step of similarly treating the middlings, and this is done by supplying the middlings to that one of the hoppers, D, succeeding the next adjacent to that one at which the conclusion of the direct treatment of the grain itself is reached. In practice this will be accomplished by the three sets of rollers A A′ A″ and beds C C′ C″ at the opposite side of the apparatus, the middlings being successively reduced to flour in substantially the same manner as the grain has been previously reduced to middlings and flour, the operation comprising the two successive stages of first reducing the grain to middlings, flour, and bran, and then, after the separation of the middlings, reducing the latter to flour by substantially the same mechanical process employed in the first stage. It will be seen, therefore, that the grain is finally brought to the condition of flour by a method of gradual reduction, and that a degree of excellence in the product and of cheapness in the operation is secured, fully equal to that resulting from the use of costly differential rollers, by means of mechanism as simple and cheap in construction as the simpler forms of grinding-mills hitherto in use.

As concerns the construction of the rollers A A′ A″, &c., and their beds C C′ C″, &c., the same may be made of stone or iron, or of any other suitable material; or one of the rollers may be made of one material and the other or others of a different material. In any case, however, the circumferential or comminuting-surface of these rollers should have its own peculiar surface different in character from the corresponding surfaces of the other rollers. Thus, for example, the roller A will have a surface of a character adapted to a coarse or rough crushing of the grain when subjected to the action of the said roller and its adjacent bed. The next adjacent roller, A′, should have a surface of a character adapted to still further reduce the comminuted material formed by the action on the grain of the comparatively coarse or rough surface of the preceding roller A, and so on with reference to any additional rollers that may be employed. When the rollers are made of metal their circumferential surfaces are corrugated, the depth, width, and general character of the corrugations corresponding to the function of the roller, according as it is designed for a coarse or for a finer crushing of the grain. These corrugations may be in a direction across the rollers—that is to say, substantially parallel with their axes of motion, as indicated in Fig. 3; or they may be made oblique to said axes of motion, as represented in Fig. 5.

What I claim as my invention is—

1. In an apparatus for comminuting or reducing grain, &c., to meal or flour, the combination of a series of rollers, A A′, &c., having suitable grinding-surfaces of different degrees of fineness, and placed side by side upon the same axis with a series of resisting-beds, C C′, &c., each arranged substantially tangential to the circumference of its adjacent roller, all substantially as and for the purpose herein set forth.

2. In an apparatus for comminuting or reducing grain, &c., to meal or flour, the combination of a series of rollers, A A′, &c., having suitable grinding-surfaces of different degrees of fineness, with a series of grinding-beds, C C′, &c., pivoted and separately adjustable beams B, stops *b*, springs F, screws *a*, and mechanism, substantially as described, for conducting the comminuted material from one roller and its adjacent grinding-bed to another, the whole constructed and arranged substantially as and for the purpose herein set forth.

JEHU HOLLINGSWORTH.

Witnesses.

DANFORTH BECKER,

THOMAS E. CROSSMAN.