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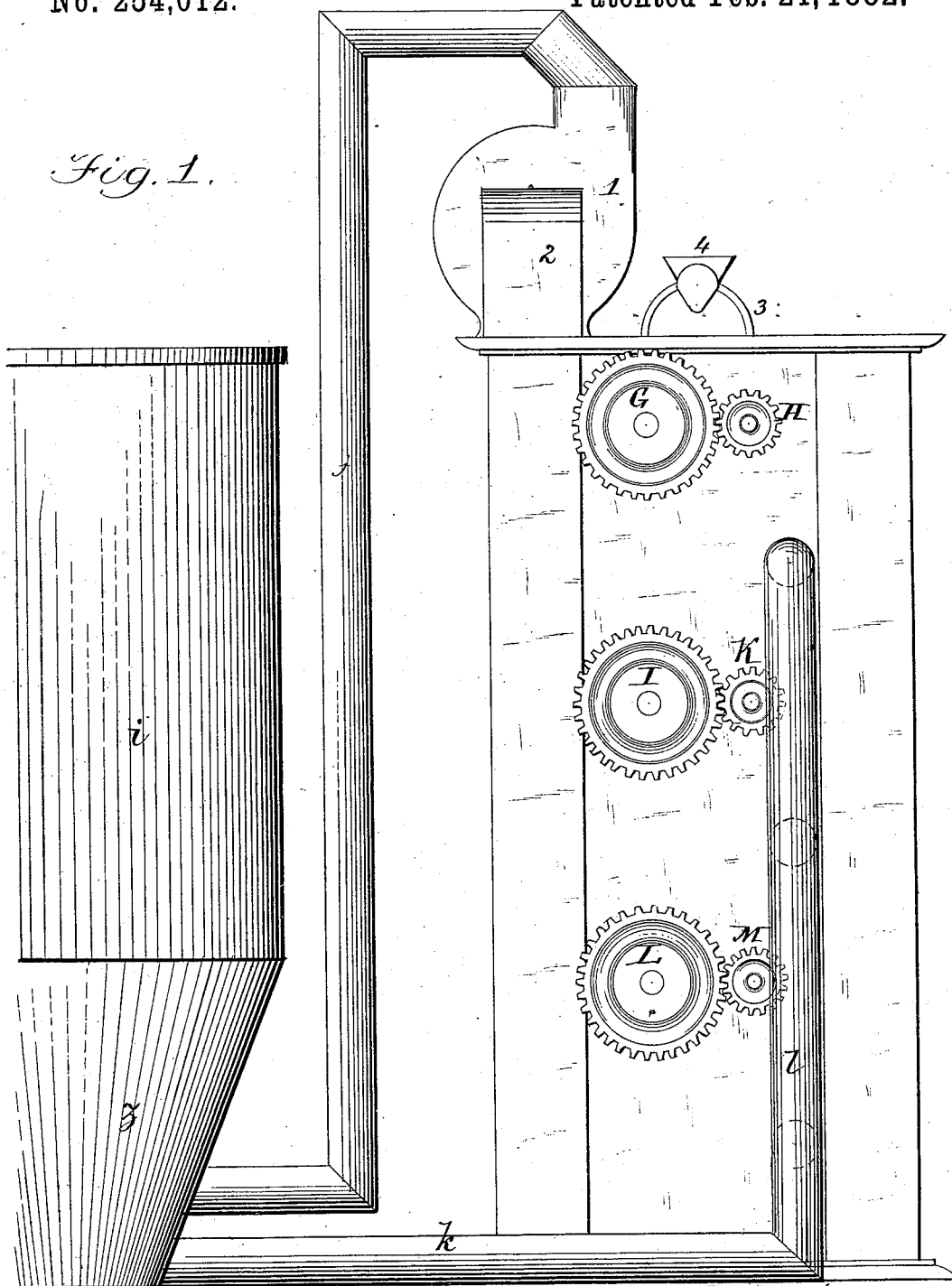
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N. W. HOLT.
PROCESS OF AND MACHINERY FOR GRADUAL REDUCTION OF GRAIN TO
FLOUR AND MIDDINGS.

No. 254,012.

Patented Feb. 21, 1882.

Fig. 1.



Attest:

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J. S. Barker

Inventor;

Noah W Holt
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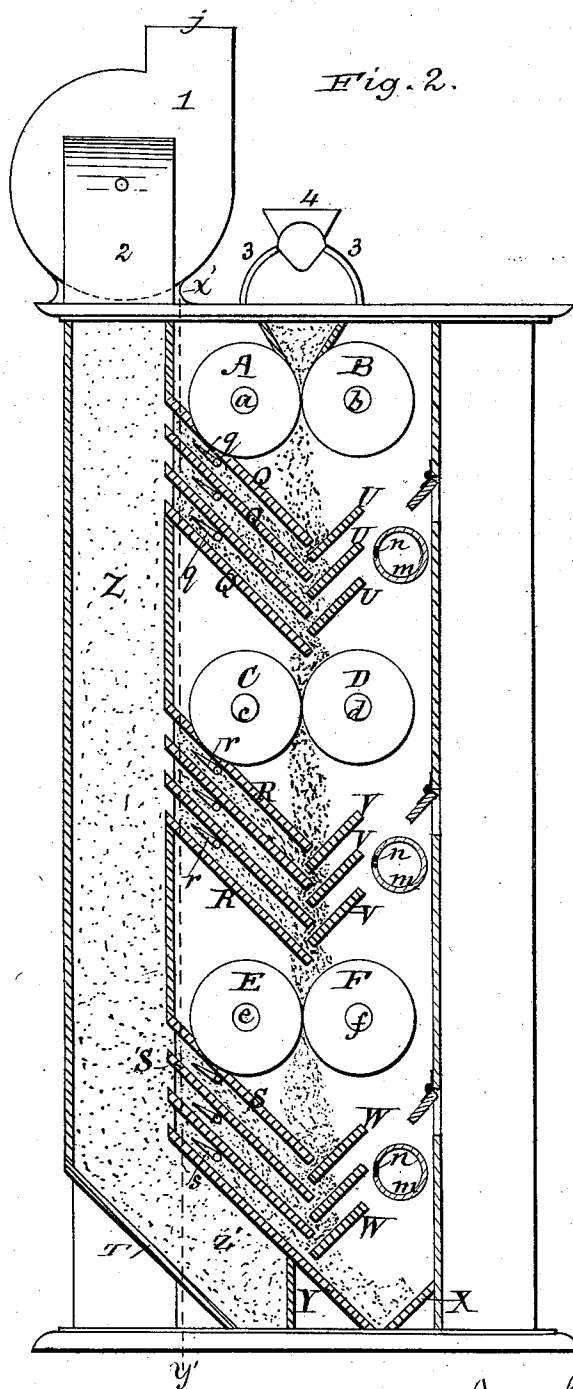
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No. 254,012.

Patented Feb. 21, 1882.



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(No Model.)

4 Sheets—Sheet 3.

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Fig. 3

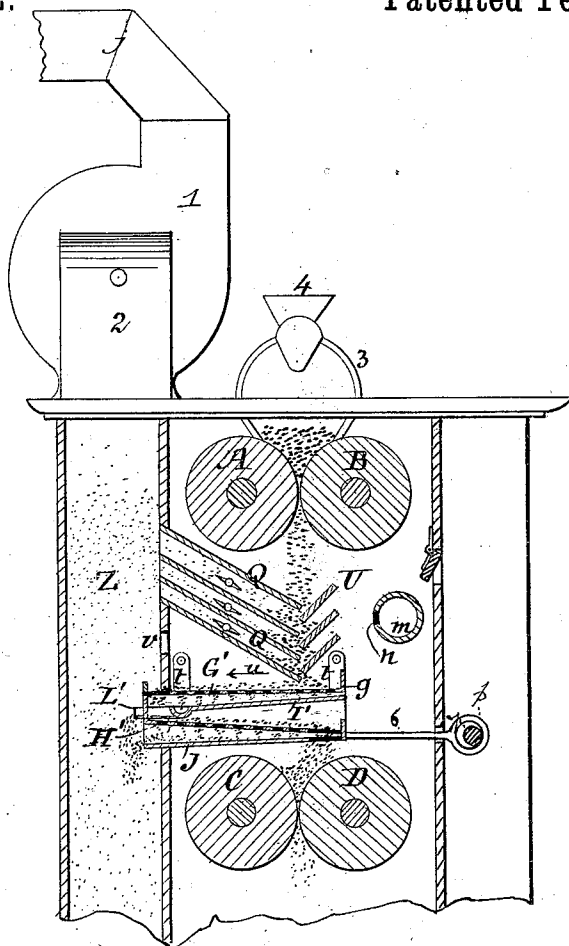
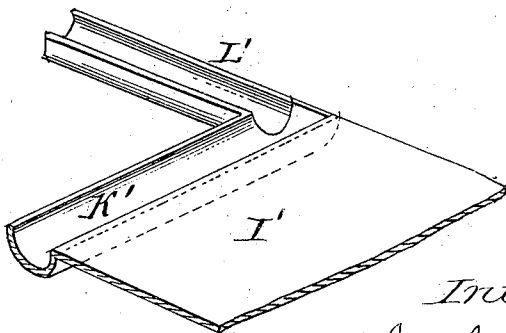


Fig. 5.



Witnesses;

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(No Model.)

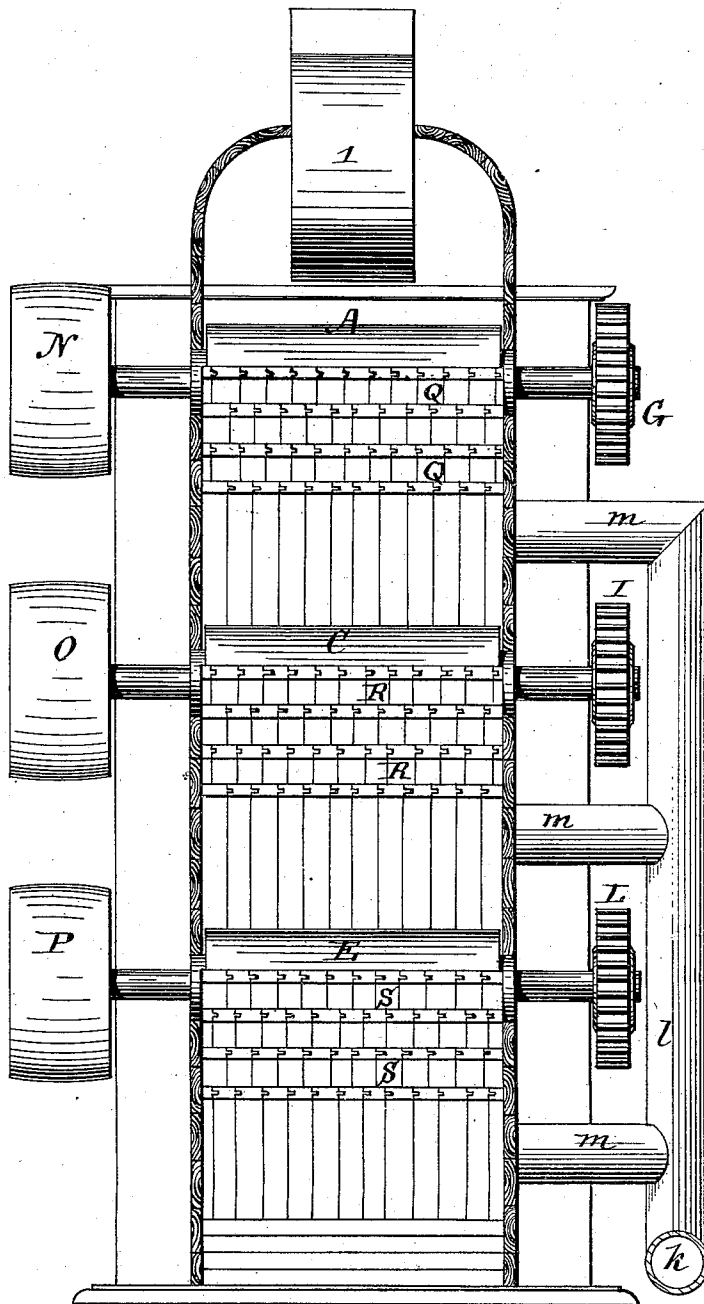
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Patented Feb. 21, 1882.

Fig. 4.



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UNITED STATES PATENT OFFICE.

NOAH W. HOLT, OF BUFFALO, NEW YORK.

PROCESS OF AND MACHINERY FOR GRADUAL REDUCTION OF GRAIN TO FLOUR AND MIDDINGS.

SPECIFICATION forming part of Letters Patent No. 254,012, dated February 21, 1882.

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

To all whom it may concern:

Be it known that I, NOAH W. HOLT, a citizen of the United States of America, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Processes of and Machinery for Gradual Reduction of Grain to Flour and Middlings; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

Figure 1 is an end view of a mechanism embodying my invention. Fig. 2 is a sectional view of the interior parts of the roller-mill. Fig. 3 is a vertical section, showing the method of combining a reciprocating screen with the parts shown in Fig. 2. Fig. 4 is a vertical section on line $x'y'$, Fig. 2. Fig. 5 is a detail view.

In the drawings, A B represent an upper pair of rolls, C D an intermediate pair, and E F a lower pair, these rolls being respectively carried by the shafts a, b, c, d, e , and f .

G, I, and L are spur-gear wheels carried by the shafts a, c , and e , and with them respectively mesh the smaller wheels H, K, and M on the shafts b, d , and f .

N, O, and P are belt-pulleys on the shafts a, c , and e , said pulleys being driven, if desired, by a common belt running from the motor.

Neither the construction of the rollers nor their method of adjustment forms any part of this invention, and they therefore need not be described or illustrated.

Beneath the upper pair of rollers, A B, I arrange a series of overlapping inclined gather boards or chutes, Q U, in such relation to each other that the products of said rollers pass in a zigzag direction from one board to another of the series alternately, except those materials which are carried away by the action of the air-currents. By using a series of two or more chutes the material is several times spread out in thin sheets or streams, so as to insure that all the lighter particles shall be exposed to the action of the air-currents. Below the next pair of rollers, C D, I arrange a similar series of gather

boards or chutes, R V, and below the third pair, E F, I arrange a third series of boards or chutes, S W, and immediately below these there is a longer board, Y, which, with an oppositely-inclined board, X, forms a hopper.

Z is an air-trunk connected at its upper end with a suction-fan, 1, by means of two ducts, 2 2.

$q q q$ are dampers or valves arranged in the throats formed between the gather-boards Q, there being similar dampers, $r s$, in the throats formed between the boards R and S.

The lower end of the air-trunk Z is provided with an inclined board, T, which, with another inclined board, Y, forms a duct, Z', for receiving the middlings that are carried by gravity to the bottom of trunk Z.

3 3 are brackets supporting a hopper, 4, into which the grain is delivered prior to its being fed to the rolls, said hopper having any approved device for regulating the feed.

i is a dust-collector connected with the fan 1 by an air-trunk, j . The dust-collector may be of any of the constructions now well known, having filters made of cloth or other suitable material, which remove the flour, dust, fine middlings, &c., from the air, which is driven into the collector and against the filtering-cloth.

k is an air-trunk leading back from the dust-collector to the roller-mill, and serving a purpose to be soon described. It communicates with the interior of the casing of the rollers by means of a vertical trunk, l , and horizontal trunks $m m m$, the latter being provided with slots or elongated openings n , as shown in Figs. 2 and 3.

With the devices shown in Figs. 1, 2, and 4 my process of gradual reduction and separation may be carried on as follows: The grain is passed through the rolls A B, and as the pulverized or partially-pulverized product is passing over the boards Q U the air-current caused by the fan l to pass between the boards will take out the lighter portion of said product, the amount thus taken out being determined by the strength and velocity of the air-currents. The air enters the casing through orifices $o o$ (except the air which enters from the trunks $m m m$, as will be explained) and passes between the boards Q U in the directions indicated by the arrows. Its strength and velocity can be regulated by the valves or

dampers *q q*. Of the material taken out by the air one portion will drop to the bottom of the air-trunk and another portion will be forced into the collector *i* by the fan. That part which drops to the bottom of the trunk *Z* consists of heavier middlings, and will be guided by the board *T* to a spout, conveyer, or elevator, whence it is carried to the purifier. The other portion (that which goes through the fan) consists of flour and fine middlings, which are collected from the air by the collector at *i*, and which, after being thus collected, are taken away by conveyer for treatment by bolts or otherwise. The material which passes over the end of the lower board, *Q*, is delivered to the second pair of rolls, *C D*—that is, if the machine be used with the parts shown in Fig. 2 and without the screening mechanism to be hereinafter described. These second rolls, *C D*, should be set somewhat closer together, and the material, after passing between them, falls upon the second set of gather-boards, *R V*, and in its zigzag path over these boards it is subjected to the action of air-currents in a manner similar to that already described. The third crushing and separating are effected by rolls *E F* and air-currents passing between gather-boards *SW*. The material which passes down the lower board, *Y*, of the series is discharged at the throat of the hopper formed by the boards *X Y*. This material may be sent to the bran-rolls, after which it may be subjected to the action of additional air-currents, and thus a further separation of the flour-producing portion of the berry from the bran may be effected. With this process of separating by air-currents I am enabled to take out the coarse middlings and send them to a purifier without subjecting them to the action of bolting-cloths, which, as is well known, is often objectionable, as the bolting injures their sharpness; but, however, under some circumstances it will be found that a limited bolting or screening can be used to advantage, as the air-currents cannot always be made strong enough to carry to the air-trunk *Z* all the materials which should be carried thither; and it will also be found that under other circumstances the air-currents, if strong enough to carry up the material which it is desired should be taken, will have been made so strong as to carry up also material which ought to fall to the rolls below.

To obviate the necessity of such strong currents, which may at times be required if no other means were provided, I have devised and shown a screening mechanism which can readily be combined with the devices already described. It does not operate as do the bolting and screening mechanisms which have been heretofore used in the process of gradual reduction, and which have been employed for the purpose of removing the fine flour, dust, fine middlings, &c., by a sieving action, but it operates simply to assist in separating the coarser middlings from the material which is

passing to a lower pair of rolls, leaving the flour, dust, fine middlings, &c., to be carried off by the air-currents the same as I do when the screening mechanism is not employed. It is constructed and operates as follows:

G' represents an upper sieve, and *H'* a lower one, which sieves are supported and arranged to reciprocate horizontally above the rolls *C D* (or any other pair of rolls below the first pair) and immediately below the gather-boards *Q*. The sieves may be mounted in any suitable frame, and they are reciprocated in a manner substantially similar to that now well known for operating screens and similar devices—as, for instance, by a counter-shaft at *p*, connected to the screen-frame by a rod, *6*, and an eccentric, *7*.

Below the upper screen, *G'*, there is a chute, *I'*, and below screen *H'* there is another chute, *J*, said chutes being supported and reciprocated in the screen-frame.

K' is a spout or trough at the lower end of the chute *I'*. It is preferably inclined somewhat, and its lower end communicates with a short inclined spout, *L'*, that projects into the air-trunk *Z*.

The screen-frame is sustained by suitable hangers at *t t*, and is arranged as shown in Fig. 3—that is to say, so that the material which falls from the bottom board, *Q*, shall fall upon the head *g* of the screen *G'*, and so that the tail end of the screens or frame shall project a short distance into the air-trunk *Z*, though this latter is not necessary, as the screens can be supported entirely within the roll-chamber and require but two comparatively small apertures to allow the coarse middlings to pass to the air-trunk from the spout *L'* and the chute *J*. The upper screen is inclined toward the air-trunk and the lower one is inclined toward the rolls *C D*. The material passes over the upper screen in the direction of the arrow *u*. The coarse middlings drop through the meshes of the screen, and the material which requires further reduction goes over the tail of the upper screen and falls upon the screen below. The coarser middlings from the upper screen are caught by the chute *I'* and carried to the trough *K'*, and thence through spout *L'* to the air-trunk *Z*. The material which falls over the tail of the screen *G'* to the screen *H'* passes back toward the next lower rolls, *C D*, and any coarse middlings that may be still mixed therewith drop through screen *H'*, and are guided by chute *J* into the air-trunk *Z*, leaving the remainder of the material to be further reduced by succeeding rolls. The air is drawn by the fan *1* from the space above the screens through suitable apertures, as shown at *v*, carrying with it the lighter materials. The air may be admitted to the space below the screens in any preferred way. Thus an open space may be left between the head of the chute *I'* and that of screen *G'*, as shown at *w*, and a corresponding opening also between the lower screen and chute; or the frame may be sup-

ported in a casing provided with openings in the sides through which the air can be admitted at the necessary points.

Although in the drawings I have shown but one screening mechanism of the character described, yet it will of course be understood that they can be used in any desired number in proportion to the number of rolls employed. This screening mechanism can be readily removed when it is desired to use only the devices shown in Fig. 2. When the machine is thus adapted to have the screens detached there should be slides or doors to close the apertures in the wall *z* of the air-trunk, so as to prevent the currents from interfering with the proper downward movements of the stream of material.

I am aware that use has heretofore been made of a reducing mechanism having a series of sets of crushing-rollers (each set having two rollers) and a series of screens respectively situated immediately beneath the sets of rollers, each screen being so arranged as to receive all the material coming from the rollers above it and immediately after leaving them. Through this screen all the light fine particles are compelled to pass, as well as the middlings and heavier flour. This requires the use of brushes or equivalent devices for the purpose of forcing the coarser particles through the screen, owing to the tendency of the small particles to clog. This screen has consisted of a concave stationary cloth (having its upper edge immediately below the rollers above) and a rotary part, which crowds the material through the cloth, said rotary part, while revolving, operating to bring the material forcibly into contact with the screen. With the screen thus constructed and operating the material is most effectively acted upon below the rotary part, and therefore the concave must be extended upward on the side opposite to that on which the material falls, and the rotary part is compelled to elevate the material, (before it passes to the rollers below,) and in such elevating scrapes and crowds it against the screen. Forcing the materials in a common mass (containing flour, dust, middlings, and bran) against the meshes of the screen by an action of this kind is disadvantageous, as it destroys the sharpness of the particles, which sharpness it is very desirable to retain; and the main object of my invention is to avoid the bad results that are experienced in following this very system of reduction—that is to say, I aim to produce a separation without screening the flour, dust, and the fine middlings from the residue, and therefore avoid the necessity of crowding any of these materials against a screen. I, before subjecting any of the material to a screening action or the next crushing action, remove from it by air-currents, immediately after it leaves the rollers, all of the light particles of dust, flour, and fine middlings—first, that I may thus produce a final separation of the flour and dust, and, secondly, that I may prevent these por-

tions from interfering with an easy screening or with a further reduction. These portions are withdrawn through unobstructed air-passages immediately below the rollers successively. Therefore when the residue of the material (the coarser middlings and bran) reaches the screening mechanism or the succeeding reducing devices it is not interfered with by dusty, light, clogging particles. In my case, if screening be used, it operates merely to produce a division between the heavier middlings and the bran portion, or the portion not sufficiently reduced. The object of my mechanism (considered as a whole) is not only to reduce the grain, but also to effect such separations at each stage in the reducing that a large part of the material can be sent directly to the purifiers, the flour portion being sent to reels, and the bran portion to mechanism for further reducing.

Again, in the reducing mechanism above alluded to, having the concave screens and the rotary parts for forcing the fine material through the screen, said rotary part is made to operate also as a blast-fan. Upon this fan falls the material coming from the rollers above, and it is intended to operate to blow the lighter particles against the screen and assist in crowding them through. Such fans, even if it be attempted to divide with them the material according to my plan, are very disadvantageous, in that a separate fan is required at every stage in the reducing, making a cumbersome and heavy machine; but, on the other hand, it is not possible practically to produce by such fans the separation which I effect by a single suction-fan. If blast-fans were employed, they would seriously interfere with the proper division of the material in the receiving-trunk—that is, flour and dust would be carried by downward currents of air through the middlings-exit, said exit being open for a continuous discharge to the purifiers. By employing a suction-fan, arranged substantially as I have shown, I can draw away from below all of the rollers the flour, dust, and fine middlings into the adjacent trunk, can mingle all the streams of flour and dust into one mass, and can drop the fine middlings in a common mass to the bottom of the trunk, the regulating of this division being accomplished entirely by the suction-current.

I am aware that with the blast-fans above alluded to a small suction-fan has been combined; but its purpose has been solely to cool the material in the trunk and to draw off the lightest dusty particles without affecting the flour or middlings. The light dusty particles which this small suction-fan withdraws are blown into the dust-room of the purifiers, while in my case it is possible to withdraw by reels from the mass blown out by the fan all the flour that may be carried out with it.

Again, it has been customary, when using these previously-known machines of the character above described, to leave in the trunk adjacent to the rollers the flour of the wheat,

the lighter middlings, and the coarser middlings, and then immediately conduct them back to a point directly below the last set of rollers, where they mingle again with the bran portion of the wheat—that is, the purpose has been simply to reduce, without aiming at the essential features of my invention. My method is very different from this. I separate simultaneously with the reducing. I employ no blast-fans, but simply the above-mentioned suction-fan, this being capable, without the assistance of screens or blasts, of withdrawing not only the dust, but also the flour and lighter middlings. The flour thus removed, after being caught by suitable collectors, is bolted, but is not again mingled with the middlings or the bran portion. If the middlings are of such nature as to require a screening while passing from one set of rollers to the next to remove the middlings, in addition to the action of the air-currents I employ a reciprocating screen of substantially the nature shown in Fig. 3. This screen does not operate to purify—that is to say, operate to separate dusty and lighter particles from the middlings and the coarser stuff—but operates simply to separate the coarser middlings from the residuum of bran and unbroken material, which requires further reduction. The lighter middlings which drop from the air-currents in the receiving-trunk and the heavier middlings separated by the screen are not at the close of the operation remingled either with the floury portion or with the bran portion, but are, while isolated, carried to the purifiers.

I do not in this case claim anything except what is specifically set forth in the claims, reserving to myself the right to claim all other patentable features described and shown herein in a division of this case which I have filed.

As said above, the air which is drawn off by the fan is forced into a dust-collector through a suitable air-trunk, and is in this collector forced against a filtering-cloth, which intercepts the flour, dust, &c. In practice it is found that the facility with which the air passes through the cloth is variable from several causes. At times the air-current is so largely resisted and stopped that the reaction upon the fan is very great, and seriously impedes it in performing its work. To obviate this difficulty I have combined with the dust-collector and the crushing-mill the air-trunks *k l* and *m m*, the first communicating with the air-receiving chamber *z* and the last communicating with the interior of the roller-mill or crusher-mill. When the pressure of air in chamber *z* becomes too great it will be relieved by the flowing of air back through air-trunks *k l m* to points behind the fan again. Although this backward current of air may be more or less laden with flour or dust, it matters not seriously, as this flour or dust will be immediately taken back by the fan again and be kept suspended in the air until it shall be caught by the filtering-cloth in the collector, the object

of the air-currents not being in this case to purify the material passing through the rolls, but simply to produce a separation between the coarse middlings on the one hand and the flour, fine middlings, and dust on the other.

I am aware that use has been made of rollers arranged in a vertical series of pairs, and that with them have been combined devices for passing air-currents through the material as it descended from one pair of rollers to another, but believe myself to be the first to have used the method and the devices herein described for producing the several divisions herein named by means of air-currents.

Having thus explained the nature of my invention, what I claim is—

1. The combination of the following elements, namely: the rollers *A B*, the inclosed trunk *Z* adjacent thereto, the boards *Q Q*, arranged to have unobstructed air-passages between them communicating with said trunk *Z*, a screening mechanism below said unobstructed air-passages, mechanism which forces the air through said passages and through the material immediately below the rollers *A B* before it reaches the screen, and the rollers *C D*, which receive the tailings from the screening mechanism when said rollers *A B*, the air-passages, the screen, and the rollers *C D* are all arranged to have the material pass downward from one to the other entirely by the action of gravity.

2. The combination of the series of rollers, the air-forcing mechanism which withdraws the flour, the dust, and fine middlings from the crushed material immediately below each pair of rollers before subjecting it to the action of screens or of succeeding rollers, the inclosed trunk which receives said flour, dust, and fine middlings, devices which mingle in said trunk the middlings from the several rollers of the series and guide them to a receptacle, devices which receive the bran portion from the rollers and guide it to another receptacle, and devices which receive the flour and dust from the inclosed trunk and guide them to a third receptacle, whereby the remingling of the middlings either with the flour or bran is avoided.

3. The combination, with two or more pairs of crushing-rollers and the hopper or receptacle for conducting away in a separate mass the bran portion of the material which they do not reduce, of a suction-fan which causes an air-current to pass below all the rollers and carries with it a portion of the crushed material, a separating chamber adjacent to the rollers, which receives the materials removed by the air-current, and which is provided with one outlet for the light material carried by the air-current, and another outlet, separate from the flour-outlet and from the bran-outlet, for the heavier material which drops by gravity from said air-current.

4. The combination of rollers *A B*, fan 1, rollers *C D*, the inclined reciprocating screen *G' H'* between the pairs of rollers, air-passages adapted to guide the air-current through the

material as it passes down from the upper rollers and before it reaches the said screen G' H', the trunk Z, in which the air-current carries the flour, dust, and fine middlings, a duct at X which receives the bran from the rollers, the duct Z', in which the middlings pass by gravity, and the duct j, into which the flour is forced by the air-current, substantially as set forth.

5. The combination of the rollers A B, the lower rollers, C D, the reciprocating screen above the lower rollers, which removes the coarser middlings from the material before it reaches the lower rollers, an inclosed adjacent air-trunk into which said coarser middlings are delivered, air-passages above said screen, mechanism for forcing air through said passages into said trunk to remove the flour, dust, and fine middlings before the material reaches the screen, whereby clogging of the screen is prevented, substantially as set forth.

6. The combination, with the upper rollers, A B, the lower rollers, C D, and the screening mechanism above the lower rollers, of a series of two or more chutes, Q Q, above said screen, arranged to have inclined air-passages between them and to successively receive the material one from the other before it passes to the screen below, substantially as set forth.

7. The combination of the crushing-rollers, the casing around them, the dust-collector, the fan, the air-trunk leading from the fan to the collector, and the air-trunk leading back from the collector to the roller-casing, substantially as set forth.

8. The herein described method for treating

grain in the manufacture of flour, it consisting in first subjecting the grain to the action of rollers, then by means of a current of air removing from the crushed material the flour, dust, and middlings, and carrying them into a common compartment, then removing from the residue of the crushed material the coarser middlings by the action of a screen, then subjecting the tailings of the screen to further crushing, air-currents, and screening, then separating the flour and dust from the middlings by an air-current, then conducting the middlings in a separate mass to a purifying mechanism, conducting the bran portion in a separate mass to other mechanism for further reducing it, and conducting the flour and dust to a third mechanism for collection.

9. The herein-described method for treating grain in the manufacture of flour, it consisting in first subjecting the grain to the action of crushing-rollers, then by means of air-currents dividing the crushed material into a mass of light particles, a separate mass of coarser particles, and another mass of mingled coarser particles and bran, next conveying the first aforesaid mass to a dust-collector, the second to a middlings-purifier, and the third to a mechanism for further reduction, substantially as set forth.

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

NOAH W. HOLT.

Witnesses:

ED. F. WALSH,
C. G. REULING.