(No Model.) 3 Sheets—Sheet 1.

H. J. SANDERSON & A. H. REED.

DECORTICATION OF WHEAT AND APPARATUS THEREFOR.

No. 458,501. Patented Aug. 25, 1891.

Fig. 1.

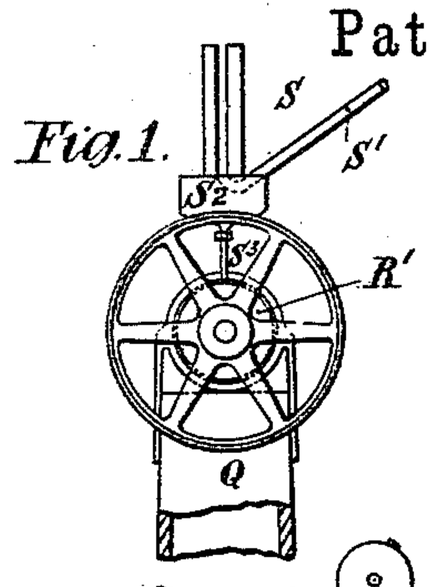


Fig. 3.

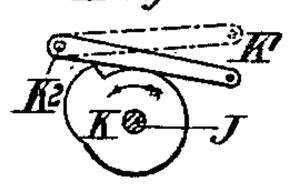


Fig. 4.

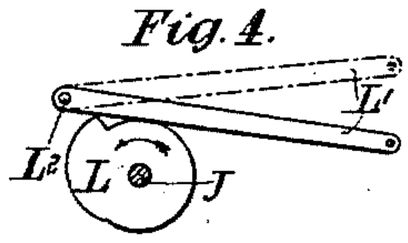
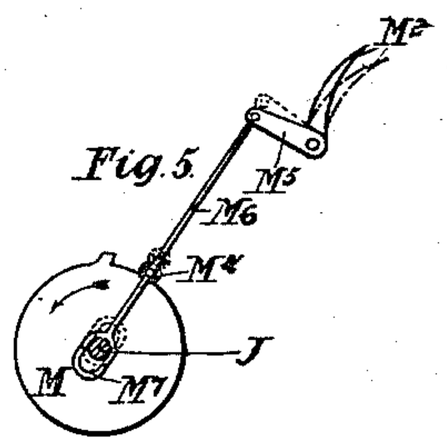


Fig. 5.



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(No Model.) 3 Sheets—Sheet 2.

H. J. SANDERSON & A. H. REED.

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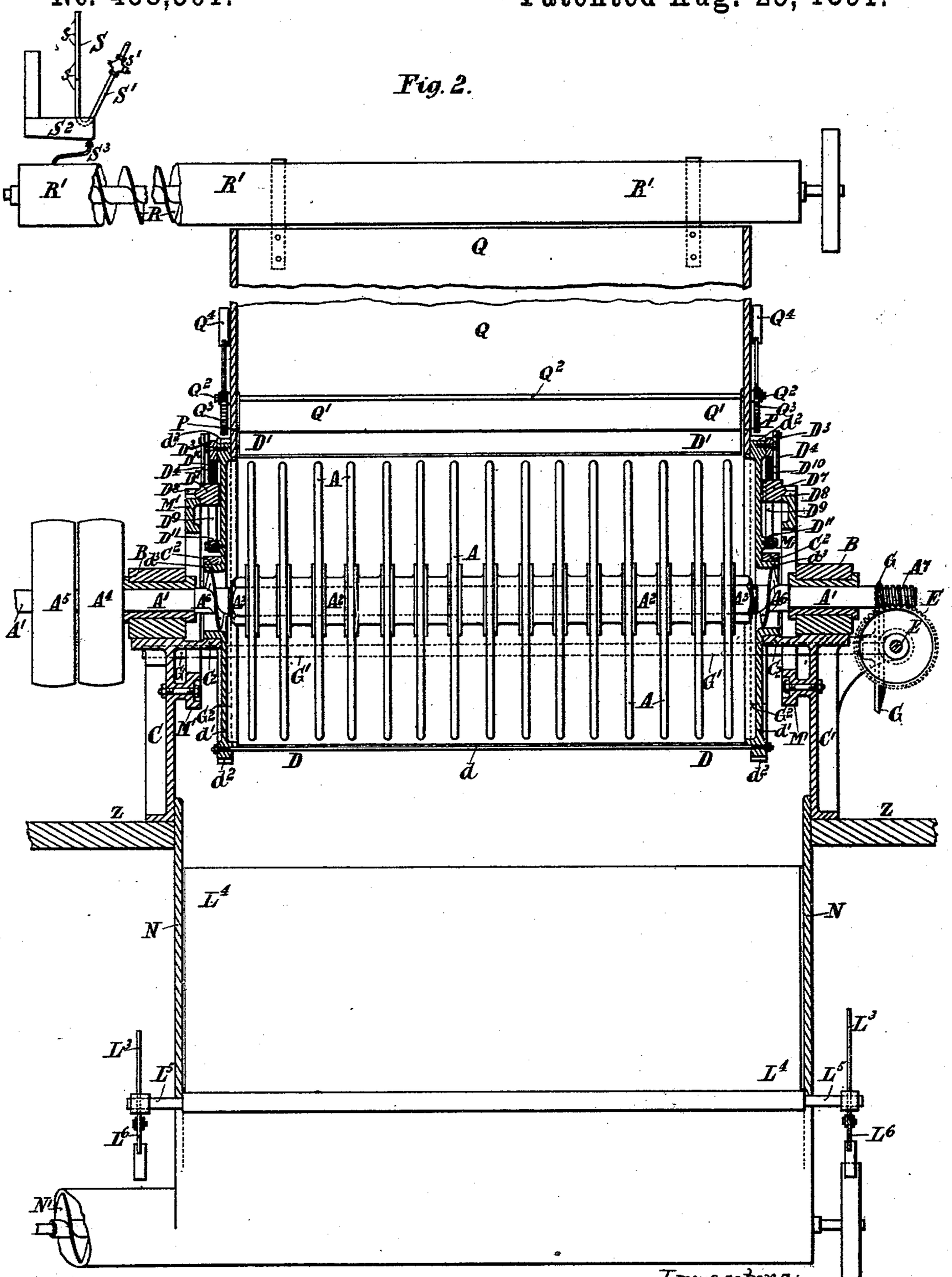
No. 458,501. Patented Aug. 25, 1891.

Fig. 2.



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DECORTICATION OF WHEAT AND APPARATUS THEREFOR.

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Fig. 6.

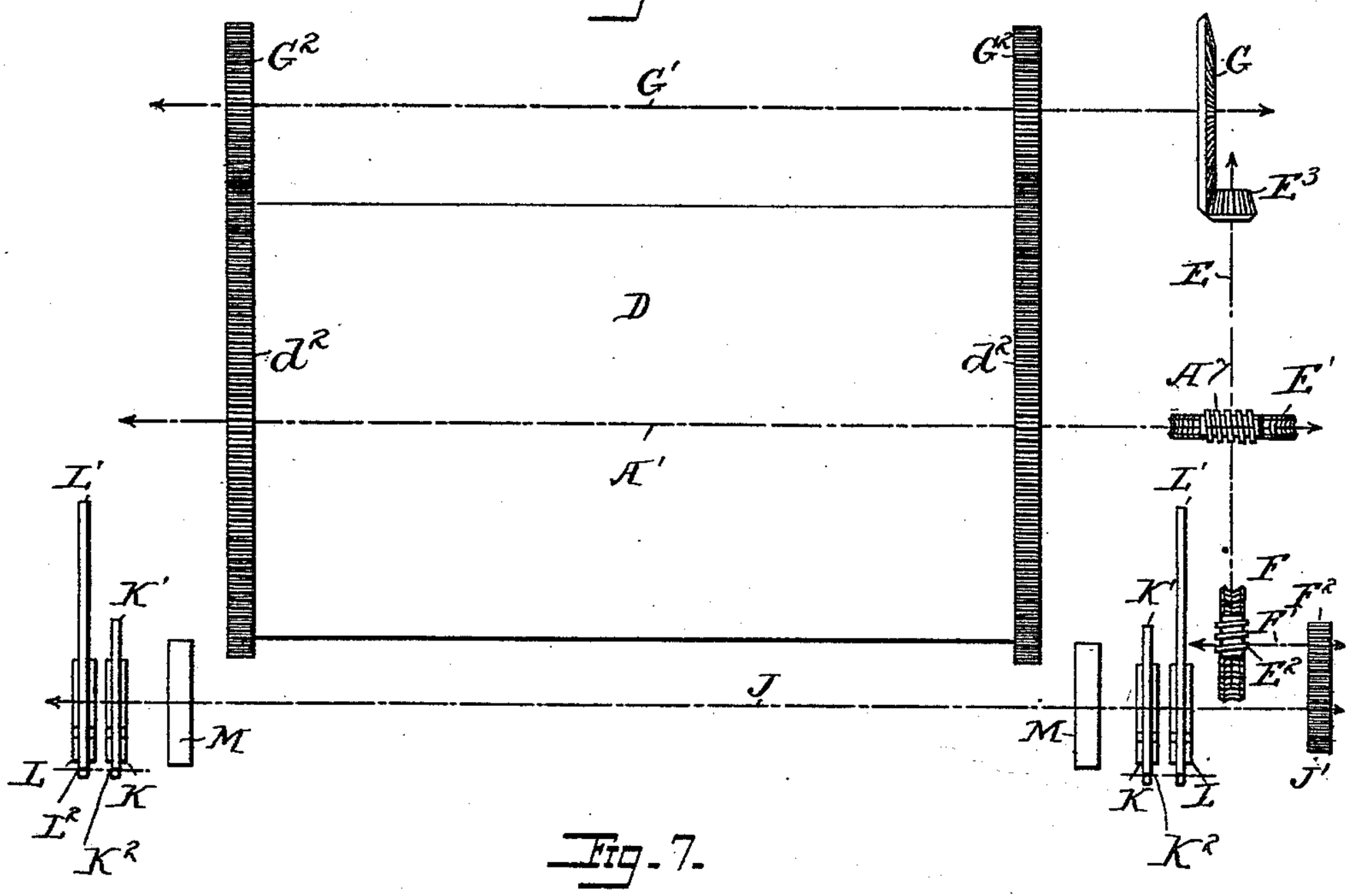


Fig. 7.

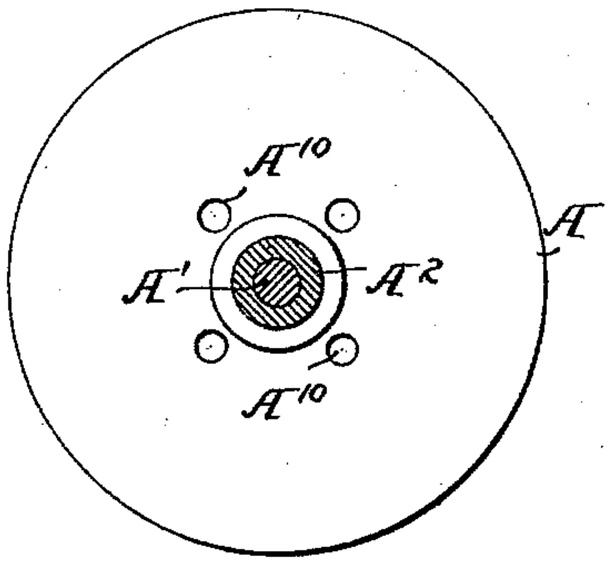
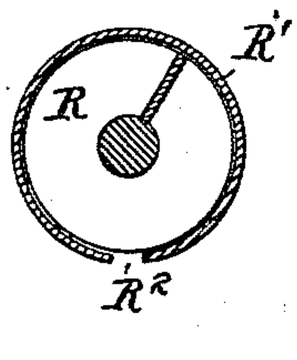


Fig. 8.



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UNITED STATES PATENT OFFICE.

HUGH JAMES SANDERSON AND ALEXANDER HENRY REED, OF LONDON, ENGLAND.

DECORTICATION OF WHEAT AND APPARATUS THEREFOR.

SPECIFICATION forming part of Letters Patent No. 458,501, dated August 25, 1891.

Application filed February 25, 1891. Serial No. 382,708. (No model.) Patented in England February 26, 1889, No. 3,442, and in France February 18, 1890, No. 203,849.

To all whom it may concern:

Be it known that we, HUGH JAMES SANDERSON and ALEXANDER HENRY REED, subjects of the Queen of England, residing at London, England, have invented certain new and useful Improvements in the Decortication of Wheat and Apparatus Therefor, (for which we have obtained Letters Patent in Great Britain, No. 3,442, dated February 26, 1889, and in France, No. 203,849, dated February 18, 1890,) of which the following is a specification.

In this invention, which relates to the treatment of grain for the purpose of decorticating it, we employ a machine or apparatus having one or more, but preferably several, disks secured at suitable distances apart upon a shaft and so arranged as to dip into the grain to any required depth. The distance between the disks may vary with the coarseness of the material of which the disks are made or with which they are covered, the peculiarities of the grain, or the speed of the shaft; but we have obtained excellent results with disks thirty inches diameter, five-eighths inch thick, and three and one-half inches apart and revolving at a speed of four hundred and fifty revolutions per minute.

Different ways may be adopted for the manufacture of the disks, as making them of solid emery or other sharp material or setting emery in silica or coating centers of metal or other suitable material with emery; but after exhaustive trial we have obtained the best results from metal centers coated with emery or emery and sand and cement in the proportions of thirty-six parts emery, seven sand, nine magnesia, and nine chloride of magnesia. The sand may, however, be omitted altogether and emery substituted. The shaft we find is best placed horizontally in a cylinder or chamber of perforated steel or other suitable material, which cylinder is caused to revolve and the whole cased in, and a blast or exhaust applied, if required, for the removal of the loose bran or dust as produced.

The grain is fed to the machine in a moist condition, more or less, according to circumstances or the character of the grain, and preferably directly after wetting. Speaking generally, the grain should be well moistened or even wet—that is to say, the bran or outer coating is to be thoroughly wetted; but the interior must either not be wetted at all, which we prefer, or at all events so little as not to damage the flour. The bran is removed by the attrition of the disks and with little or no damage to the grain itself. This excellent result is due to the disks working in wetted grain, as we find that if we work the grain dry the bran becomes broken and dusty and at the ends of the grains are knocked off, as has been the case with the previous obortive attempts to decorticate grain by the action upon it of roughened surfaces. For the revolving cylinder we find perforated steel as thin as is consistent with strength the best material. We have tried thicker steel and the perforations became stopped up. We have also tried wire-gauze, but this also became stopped up, and we have found in practice that steel of about one thirty-second of an inch in thickness with perforations three thirty-seconds of an inch in diameter (but the size of the perforations would be varied to suit the material to be treated or the results required) gives the best and satisfactory results.

In the accompanying drawings, Figure 1 is an end elevation of an apparatus constructed according to this invention, and Fig. 2 is a longitudinal vertical section of the same. Figs. 3, 4, and 5 are views of some of the cams detached from the apparatus, and Fig. 6 is a plan showing diagrammatically the arrangement of such cams and levers therefor upon the apparatus. Fig. 7 is a side view of one of the disks, and Fig. 8 is a cross-section of the conveyer-cylinder R′.

Like letters indicate like parts throughout the drawings.

A are the disks, which, with suitable distance-pieces A^2 between them, are mounted on the shaft A′, and A^3 are nuts which screw these disks and distance-pieces tightly up against each other and hold them securely on the shaft A′. If desired, the disks A may be secured to the shaft A′ by a feather or other suitable means. The disks are by preference

provided with openings A^{10}, Fig. 7, outside the edge of the distance-pieces A^2, so as to allow of a flow of air from the helices A^6 to the spaces between the disks.

A^4 A^5 are respectively the fast and loose pulleys mounted on the shaft, and B are the bearings in which the said shaft is carried and which are supported on the end frames C and C′.

D is the revolving drum, the circular wall *d* of which is preferably constructed of perforated sheet steel, as before explained.

d′ are the plates or disks which close in the ends of the drum D, and each of which at its edge is provided with gear-teeth d^2 and at its center with a hollow trunnion d^3, by which the drum D is supported and free to rotate in the bearings C^2, preferably formed in part with the frames C C′, as shown most clearly in Fig. 2.

A^6 are two helices, one right and the other left handed, and both working closely in the hollow trunnions d^3.

A^7 is a worm or screw cut or otherwise provided on one end of the shaft A′ and gearing with a worm-wheel E′, secured upon the shaft E, which is supported in bracket-bearings C^3, preferably formed in part with the frame C′. The shaft E at one end is provided with the worm E^2, which gears with the worm-wheel F, and at the other end with the bevel-pinion E^3, which gears with the bevel-wheel G. This wheel G is secured upon the shaft G′, which extends right across the back of the machine, as shown in dotted lines in Fig. 2, and is supported in bearings formed in the frames C C′, the said shaft having secured upon it two wheels or pinions G^2, gearing with the toothed rings d^2 on the before-mentioned end plates *d′*. The said pinions G^2 are represented in dotted lines in Fig. 2 and in the diagram Fig. 6, but a portion of one of them is clearly shown in Fig. 1, where part of the before-mentioned bevel-wheel G is broken away for the purpose.

The worm-wheel F (shown in Fig. 1 and in diagram in Fig. 6) is secured upon the short shaft F′, which is supported in a suitable framing H, which also supports one end of what is herein termed the "cam-shaft J," which extends right across the front of the apparatus and may be similarly supported at its other end. On the shaft F′ is mounted a wheel F^2, gearing with another wheel J′, mounted on the shaft J, both of these wheels F^2 and J′ being readily removable and interchangeable, so as to serve as change-wheels for regulating the rate of rotation of the cam-shaft J in relation to that of the drum D.

On the shaft J, as illustrated in Fig. 6, are mounted six cams, three marked in the drawings K, L, and M at each end of the apparatus—that is to say, one cam of each pair operating in conjunction upon similar parts at the respective ends of the apparatus to avoid any twisting or straining of the parts, and only one of each pair is shown in the other drawings.

In order that the bran, richer offal, and wheat may be directed into their proper respective receptacles, and that the doors D′ may be open when at the under side of the drum for discharging the wheat, and the doors Q′ may be open when the doors D′ are at the top of the drum and open for recharging the drum, it is necessary that a certain relation be maintained between the rotation of the drum D and the parts operating the said valves and doors, and no matter at what speed the machine may be operated or how many times it is desired to rotate the drum D between the operations of the valves and doors this relation must always be maintained, and it is for this purpose that the change-wheels F^2 and J′ are employed, and it will be understood that, although only two change-wheels are shown in the drawings, any requisite number may be used.

The cam K (shown most clearly in Fig. 3) raises the lever K′, which at one end is pivoted at K^2 to the frame C′, as in Fig. 1, and at the other end to the rod K^3, and the cam L (shown most clearly in Fig. 4) in a similar manner raises the lever L′, pivoted at L^2, and connected at its free end to the rod L^3.

M′ are cams spiral on their exterior surfaces and which are secured to the frames C and C′, one at each end of the apparatus, and each of which at its interior is circular and concentric to the drum D and provided with a pivoted point M^2, between which and the other end M^3 of the cam exists a space M^4. The point M^2 forms with an arm M^5 a bell-crank lever, to which is connected the upper end of the rod M^6, the lower end of which is forked, or, as shown most clearly in Fig. 5, formed with a slot M^7 to guide it on the shaft J, while also permitting it to be moved longitudinally.

M is the cam by which, through the anti-friction roller M^8 or its equivalent, the longitudinal movement is imparted to the rod M^6 in one direction, it being moved in the other direction back to its normal position by spring or weight.

N is a casing suitably secured below the floor Z and provided with the valves K^4 and L^4, the projecting ends of the respective shafts K^5 and L^5 of which have fitted to them the weighted arms K^6 and L^6, to which are pivoted the lower ends of the before-mentioned rods K^3 and L^3. The casing N can be arranged to discharge the material which it receives either to the right or left of Fig. 1. When it falls to the right, it passes to the conveyer N′, and when to the left either through the then open valve K^4 or down the chute N^2, in all cases to be delivered into the receptacles, each of which may be provided for receiving a special grade of the material resulting from the treatment of the grain in the apparatus.

O, Fig. 1, is an inclined plate, which is adapted to be vibrated or jogged by any convenient means, and preferably the lower part of which, to the right of the partition N^3, may be heated by steam, hot water, or other suitable medium. The said lower part of plate O is not shown on the drawings, but it is to be understood that the partition N^3 extends down to within a short distance of the said plate. If desired, the whole of the plate O may be heated.

The drum D is provided with two doors D′, which in Fig. 1 are represented one in dotted lines and the other partly in full lines at the place where the casing P is shown broken away.

The casing P closes in the upper part of the apparatus. The pivot-rods D^2 of the doors D′ at each end of the drum D projects out beyond the face of the end plate *d′* and have secured to their projecting ends the arms D^3, the free ends of which are pivoted, respectively, to the links D^4 and D^5, at the free and extended end of the latter of which is provided the head D^6. The lower ends of D^4 and D^5 are pivoted to opposite sides of a block D^7, which is provided with a stud D^8 or the like projecting outward, so as to be operated upon by the adjacent cam M′, and which is arranged to be moved in the guide D^9, attached to the end plate *d′* radially outward by the cam M′ and radially inward by the spring D^{10}, which always tends to push it toward the end D^{11} of the guide D^9.

Q is an oblong charging-hopper, which may be secured to the upper part of the casing P, as shown, and which is provided with doors Q′, which, like the doors D′, are shown in Fig. 1, one in dotted lines and the other partly in full lines. On the outwardly-projecting ends of the pivot-rods Q^2 of these doors are fitted the toothed quadrants Q^3, which gear with each other, and one of which may be provided with the weighted arm Q^4 and the other with the lever-arm Q^5.

The before-described mechanism for operating the doors D′ and Q′ at one end of the drum is duplicated at the other end.

R is a screw conveyer supported, preferably, directly above and arranged lengthwise of the hopper or chute Q, and the casing R′ of which is open along the bottom, as shown at R^2, Fig. 8, to distribute the grain along the hopper.

S S′ is a bent pipe, the portion S of which is perforated or provided with jets at *s*, Fig. 2, and the other portions S′ may be provided with a stop-cock *s′*, Fig. 2.

S^2 is a trough into which falls the water issuing from the perforations or jets *s*, and S^3 is a pipe for conducting such water into the casing R′; but the water for wetting the grain may be introduced in any other desired way.

In the drawings, the doors D′ and Q′ are represented open, as though the drum were receiving from the hopper Q a charge of wetted wheat. Assuming that to be the starting-point of the apparatus, its operation may be described as follows: Rotary motion is imparted to the shaft A′ through the fast pulley A^4, so as to drive the disks A in the direction (indicated by the arrow *a* in Fig. 1) at, say, five hundred revolutions per minute, according to circumstances. This through the worm A^7 and wheels E′, E^3, G, G^2, and d^2 will rotate the drum D in the same direction at a very slow speed—say one revolution in one minute. As soon as the stud D^8 at each end of the apparatus is moved over the end M^3 of the cam M′ the spring D^{10} will force the block D^7 down to the end D^{11} of the guide D^9, and thereby through the links D^4 and D^5, and arms D^3 will close the doors D′. The support of the head D^6 of the extended link D^5 also being withdrawn from the lever-arm Q^5, the weight on the arm Q^4 will, through the toothed quadrants Q^3, close the doors Q′, this being effected at such a time as will not interfere with the closing of the doors D′. The apparatus will now continue to work with the grain inside the drum D and the disks A rotating among it, so that by attrition the said disks will remove from the wheat the wet bran, which will be discharged through the perforated wall *d* of the drum D and fall through the casing N past the valve K^4 and onto the upper or cool portion of the vibrating plate O, and will be jogged down below the lower edge of the partition N^3 onto the heated part of such plate, where it will be dried and by which it will be discharged into any suitable receptacle, the valves K^4 and L^4 at this time and for this purpose being in the positions in which they are represented in full lines in Fig. 1. The partition N^3 prevents the steam given off in the drying of the bran from passing through the then open valve K^4 to the apparatus above. Other means may, however, be employed for drying the bran. It is found that the centrifugal force imparted by the disks A to the bran and air forces the bran through the perforations in the wall *d* of the drum D; but, if desired, additional air-pressure may be introduced. After the lapse of a predetermined time allowed for the removal of the bran, as provided for by the change-wheels F^2 J′ and extent or position of the operating-surface of the cam K, the other cam L raises the lever L′, and thus through the rod L^3 and arm L^6 throws over the valve L^4 from the position in which it is shown in full lines to that shown in dotted lines—that is, from right to left of Fig. 1. At or about this time the cam K raises the lever K′, and thus through the rod K^3 and arm K^6 throws over the valve K^4 into the position in which it is represented in dotted lines in Fig. 1—that is to say, it causes the said valve to move from left to right in the drawings, this being to prepare for the subsequent discharge of the wheat down the chute N^2. As thus adjusted, with the valve L^4 to the left of the drawings, the richer

offal at this time being driven through the perforations of the drum D falls onto the valve L^4 and is directed by it down to the conveyer N′, to be discharged by it into any suitable receptacle. All this time the drum D will have been slowly rotating with the stud D^8 at each end at the inner or concentric side of the cam M′; but at a predetermined time the cam M will move the rod M^6 and arm M^5, so that the cam-point M^2 will be moved from the position in which it is shown in full lines to that in which it is shown in dotted lines, so that when next the stud D^8 is presented to it it will travel over the outer surface of M^2 onto the external spiral surface of the cam proper, after which the projection of the cam M will be withdrawn from the roller M^8 and allow the point M^2 to be returned to its normal position by the before-mentioned spring or equivalent means. At about this time, at which it may have been considered that all the richer offal will have been removed from the wheat, the operating-surface of the cam L is withdrawn from the lever L′ and allows the weight on the arm L^6 to move the valve L^4 back into its first position, (full lines in Fig. 1.) Now as the drum D rotates the stud D^8 is gradually moved farther outward from the axis of the drum D by traveling over the cam M′, and thus through the block D^7, arms D^3, and links D^4 and D^5 the doors D′ are gradually opened and are open when at the under side of the drum, so as to discharge the wheat contained in the said drum into the casing N, when the said wheat will be directed by the valves L^4 and K^4 down to the chute N^2, by which it may be conducted into any suitable receptacle or into any desired machine—such as a brushing-machine—for subsequent treatment. At or about this stage the cam K may effect the turning over of the valve K^4 into the position represented by full lines, so as to be ready for directing into its proper course the bran from the batch of wheat next introduced into the apparatus. When the doors D′ are directly under the chute Q they will still be open, and the head D^6 having engaged in passing with the arm Q^5 the doors Q′ will also be opened and the fresh charge of grain will be dumped into the drum D. The doors Q′ will remain open so long as the head D^6 is in engagement with the arm Q^5; but upon this engagement ceasing as D^6 travels onward the doors Q′ will close under the influence of the weighted lever Q^4. Since the open doors D′ could not pass while the doors Q′ are open, it will be understood that the engagement and disengagement of D^6 and Q^5 and the termination of the cam M′ will be so adjusted that the doors Q′ will only be opened after the passage of the first door D′ and will be closed before the passage of the second door D′. The drum always moving on the apparatus thus proceeds through another cycle of the operations before described. During the operation of the apparatus the disks A tend to form a vacuum in the drum D by centrifugally driving the air out through the perforated wall *d*. The helices A^6 in their rotation cause or allow air to enter the drum to take the place of the air expelled by the disks A and at the same time prevent the escape of grain through the hollow trunnions in which they work. This results from the directions or inclination of the helices A^6 being such as to tend to move anything presented to them toward the interior of the drum D. The extent to which the grain may be wetted before being introduced into the drum D is adjustable by means of the stop-cock *s*′, by turning which sufficient water may be introduced into the pipe S to enable it to escape from one, two, or any number more of the holes or jets *s*, and thus allow it readily to be seen how much water is being introduced into the conveyer-chamber R′ to be therein mixed with the wheat; but other means may be employed for wetting the grain.

From the foregoing it will be seen that the charge of wheat is placed bodily in the drum and retained there until finished, when it is dumped bodily, while in other processes the operation is usually continuous, the grain always entering and always leaving the apparatus.

Another important feature of this invention is that in the before-described apparatus the bran by being dried on a vibrating plate does not ball or cake together.

We wish it to be understood that we are aware that attempts have been made to decorticate grain by passing it between roughened surfaces and by the use of disks and cones of various kinds; but these have all failed to attain the results which we have accomplished by the use of the roughened disks revolving in the wetted grain.

We are also aware that the mere wetting of the grain is known in milling operations where it is employed for the purpose of toughening the bran to prevent it from being broken by the fluted rollers and mixed with the flour, the color of which would thus become spoiled. We, however, wet the grain for an apparatus where and at a time when the grain itself is not crushed or broken and for the simple purpose of causing the bran to readily leave the berry. It will therefore be understood that no claim is here made to the use of roughened surfaces or disks or to the wetting of grain, apart from the decortication part of the process of milling grain.

We claim—

1. The combination, in an apparatus for preparing wheat for grinding, of means for damping the grain, so as to wet the outer covering thereof, a perforated cylinder for receiving a charge of the wet grain, the said cylinder containing a number of disks rotating in the grain, and doors arranged, substantially as described, to separate the product into bran, richer offal, and cleaned wheat, substantially as described.

2. In an apparatus for preparing wheat for grinding, the combination of means for wetting the outer covering of the grain, a conveyer-cylinder, a hopper having doors for closing the hopper, a perforated rotating cylinder having doors, and a series of guiding-doors for directing the products into different chutes to deliver the bran, the richer offal, and the cleaned wheat, substantially as described.

3. In apparatus such as described, the combination, with two pivoted doors D′ on the rotating drum, and arms D^3, links D^4 D^5, and block D^7, of a cam M′ M^2, substantially as and for the purpose described, and illustrated in the accompanying drawings.

4. In apparatus such as described, the combination, with the revolving drum, its pivoted doors, and devices for operating the latter, of the mechanism for operating the hopper-doors Q′, consisting, essentially, of the toothed quadrants Q^3, weighted arm Q^4, arm Q^5, and link-extension, and head D^6, the whole constructed and operating substantially as described, and illustrated in the accompanying drawings.

5. In apparatus such as described, the combination of cams K and L upon a rotatable shaft, levers K′ L′, rods K^3 L^3, weighted arms K^6 L^6, and valves K^4 and L^4, working within a casing for the purpose of automatically separating the products resulting from the treatment of the grain, substantially as described, and illustrated in the accompanying drawings.

6. In apparatus such as described, the combination, with the cylinder, of a revolving disk A, having openings for the passage of air, and the helices A^6, adapted to admit air and retain the grain within the cylinder, substantially as described.

7. In apparatus such as described, the combination, with the revolving drum having doors D′ pivoted in it, of a fixed cam M′ and connecting parts, as D^2, D^3, D^4, D^7, D^8, D^9, and D^{10}, substantially as and for the purpose described, and illustrated in the accompanying drawings.

8. In apparatus such as described, the combination, with a fixed casing having doors Q′ and revolving drum D, having doors D′, a fixed cam M′, and door-operating mechanism, of an elongated arm D^5, head D^6, arm Q^5, toothed quadrants Q^3, and weighted arm Q^4, substantially as and for the purpose described, and illustrated in the accompanying drawings.

9. In apparatus such as described, the combination, with a revolving drum having a door and a fixed hopper having a door opposite the drum, of mechanism for opening the drum-door while the drum is in motion and mechanism for opening the hopper-door as the drum-door comes opposite to it, substantially as described.

10. In an apparatus such as described, the combination, with a revolving drum having a door, of a fixed cam M′, having a pivoted point M^2 automatically operated, and connections between the cam and the door for operating the latter, substantially as described.

11. In apparatus such as described, the combination, with the revolving drum having discharging-doors D′ and means for periodically opening them, of doors L^4 K^4 on the operating mechanism, such as described, for periodically changing their positions to direct the separated portions of the grain into different chutes, substantially as described.

12. In apparatus such as described, the combination, with the revolving drum, of a shaft carrying the revolving disk, and mechanism between the shaft and the drum, consisting of the worm on the disk-shaft, the shaft E, carrying the worm-gear, and the shaft G′, geared to the shaft E and to the drum, substantially as described.

13. In apparatus such as described, the combination, with a fixed casing carrying the revolving drum, of the oblong hopper Q, worm R′, arranged lengthwise of the hopper and having a casing with an opening along the bottom to distribute the grain in the hopper, and bran-moistening apparatus, substantially as and for the purpose described.

In testimony whereof we have hereto set our hands in the presence of the two subscribing witnesses.

HUGH JAMES SANDERSON.
ALEXANDER HENRY REED.

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