M. W. HUNT.
ART OF CLEANSING GRAIN.
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5 SHEETS—SHEET 1.

Inventor:

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By

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To all whom it may concern:

Be it known that I, MARTIN W. HUNT, a citizen of the United States of America, residing at Portland, in the county of Multnomah, in the State of Oregon, have invented certain new and useful Improvements in the Art of Cleansing Grain, of which the following is a specification, reference being had to the accompanying drawings.

The object of my invention is to promote the economical removal of impurities from grain in its natural state by a washing operation in which water or other liquid is employed as a detergent.

The washing of grain is, in its broadest aspect, not new in the art, but in any washing operation employed for the purpose prior to my invention its complete success has been practically impossible because of three main difficulties. These difficulties, whose removal is a chief object aimed at and accomplished by my invention, are: first, an imperfect cleansing of the grain; second, slow delivery, whereby the output of the machine is disproportionate to the expense of its construction and operation; and, third, the overwetting of the grain, especially wheat-barries, whereby its milling quality is impaired. Of the different methods hitherto employed some may effect a better result in one direction and some in another; but my invention, on the contrary, minimizes all of the aforesaid difficulties at once.

My process is specially, but not exclusively applicable to the cleansing of wheat for shipment, and ultimately for milling purposes. In the following specification the grain referred to may be understood specifically to be wheat with the proviso, that such reference is made only by way of example.

My process operates upon the novel principle of driving a detergent liquid under pressure, and preferably high pressure, into a constant flow of grain that is in its travel confined for a brief space within limits and under conditions which insure a most efficient, and, for practical purposes, a perfect cleansing of each particle of the grain. The cleansing action between the detergent liquid and the grain being accomplished by a differential of movements between the grain and liquid, respectively, it is theoretically possible to reverse the operation by driving the grain into the liquid instead of the liquid into the grain, and this reversal of operation is regarded as coming clearly within the scope of my invention despite the fact that it is perhaps impracticable to use it commercially. Nevertheless it is entirely practicable to approximate such a reversal to the extent of varying the rates of movement of the grain and the liquid and thereby subjecting the differential of their movements to regulation and control. Such regulation and control might be obtained by varying the force of the feed of the liquid exclusively, but by varying the force, or rate, or both the force and the rate of the liquid and grain feed in the same operation either a wider range of differential or a more convenient means of regulation and control of the differential is made available.

My process may be practised through the employment of various forms of mechanism. I specify herein by way of example only one form of mechanism for the purpose, suggesting a wide range of modifications by one or two examples only. The machine is made the subject matter of a separate application for patent filed by me herewith.

What constitutes my present invention will be hereinafter specified in detail and succinctly set forth in the appended claims.

In the accompanying drawings I illustrate a machine in preferred form of embodiment with suggestions of examples of modifications thereof as showing apparatus in simple and preferred form for carrying out my process.

Figure I is a front elevation of one form of my machine with portions broken away to show, in part, its interior construction.

Fig. II is a central vertical longitudinal section partly in elevation of my machine as shown in Fig. I.

Fig. III is an end elevation of the machine shown in Fig. I, looking from right to left.

Fig. IV is a medial transverse vertical section, partly in elevation, of the subject matter of Fig. I.

Fig. V is a view similar to Fig. II showing by way of modification a preferred form of embodiment of my invention.

Fig. VI is a vertical longitudinal section of the grain feed chute and double nozzle water supply shown in Fig. I.

Fig. VII is a section of the same taken as on the line VII—VII of Fig. VI.
Fig. VIII is a detail view on an enlarged scale of the cylinder perforations partially exposed in Fig. I.

Fig. IX is an isometric perspective of the receiver and distributor, as shown in front elevation in Fig. V, but detached and showing the side opposite to that shown in Fig. V.

Referring to the numerals on the drawings, 1 indicates the end frame pieces, and 2 and 3, respectively, the side walls of any suitable casing adapted to inclose and operatively support cylinders 4 and 5. The shape and dimensions of the aforesaid elements, and the manner of uniting them may be varied at discretion. The features there of illustrated, being mere ordinary structural details, are deemed to be clearly legible from the drawings without further description.

The cylinders 4 and 5, preferably composed each of two sections of sheet metal separably united by longitudinal flanges as indicated at 6, are firmly and rigidly secured to the opposite end frame pieces 1, as shown in Figs. I and II, for example, and have their opposite ends stopped as by screens 7.

The walls of the cylinders are foraminous substantially from end to end, with the exception, preferably, of an imperforate zone 8, as indicated in Fig. VIII, the width of the zone, if employed, being variable. The foraminations of the cylinders are preferably constituted of parallel rows of oblong parallel slits 9 as clearly shown in detail, for example in Fig. VIII.

The casing is supported by the end frame pieces 1 thereof, respectively, upon feet 10 of sufficient height to accommodate underneath the casing a dish-bottomed drip pan 11, draining from the cylinders 4 and 5 toward a preferably medial drain pipe 12.

The number of cylinders employed may be one or more, and, for economy of space, is preferably a plurality. Where more cylinders than one are employed, the lowermost cylinder, indicated in the drawings by the numeral 5, is preferably the intake cylinder, into the lower portion of which, preferably, is introduced, as through the side wall 3 of the casing, an element 14 which, for convenience and because the grain there receives the initial application of the detergent liquid, may be designated the washing chamber. The member 14 is preferably an oblong conduit, open at the end which extends into the cylinder 5 and closed at the opposite end as by a head 15. Into the top, preferably, of the chamber 14 is introduced a grain chute 16, and through the head 15 thereof is introduced a nozzle 17 that communicates from the outside with a liquid supply-pipe 18. The pipe 18 communicates with a source (not illustrated) that is adapted to supply under pressure to the nozzle 17 liquid in sufficient quantity. The term liquid is used because it is practicable, if in any case found desirable, to employ a liquid of special cleansing properties; but I have found that water supplied, for example, from an ordinary main, communicated through a pump if necessary to obtain sufficient pressure, may be relied upon to answer every purpose in ordinary commercial or mill service.

The effect of the relative arrangement illustrated of the chamber 14, grain chute 16, and nozzle 17 discharging into the chamber 14 substantially at right angles to the chute 16, is to make the discharge of grain from the chute 16 dependent upon the liquid discharge from the nozzle 17. This dependency of operation of the grain feed upon the liquid discharge by automatically regulating one to the other lends itself to the success of my process.

If preferred, the pipe 18 may communicate with two nozzles, 20 and 21, instead of with a single nozzle 17. These two nozzles may discharge, respectively, into separate washing chambers, 22 and 23, having separate communication with the grain chute through terminal branches 24 and 25 defined as by a partition wall 26, shown in Figs. VI and VII. The double-nozzle construction referred to is applicable to, and preferably employed in conjunction with the form of embodiment of my invention shown in Figs. I and II. The single nozzle and washing chamber are deemed to be best suited to the accommodation of the preferred modification shown in Fig. V, but the double and single nozzle construction may be interchanged if desired, and the side elevation of the two forms of washing chamber being alike, the illustration thereof afforded in Figs. III and IV is equally applicable to a single chamber or a double chamber.

Referring to Figs. I and II, 27 indicates a shaft which extends lengthwise through the cylinder 5, and has its opposite ends mounted in suitable journal bearings 28 and 29, supported preferably, on the outside of the end frame pieces 1, respectively. The shaft 27 carries a revolvable open frame that is designed and adapted to communicate motion to the grain, as, during the operation of the machine, it is fed into the interior of the cylinder 5 through the chambers 22 and 23, and being observed that the plural chambers are preferably employed in conjunction with the machine shown in Figs. I and II, under consideration. The motion so communicated is multiform and of diverse function. For example, in the first instance, it is a whirling motion about the longitudinal axis of the shaft 27, the effect whereof is to separate the liquid with impurities from the grain by centrifugal force.
driving it through the foraminations of the cylinder 5. In the second instance, the motion produces a further cleansing action upon the grain by the attrition so produced among the grain particles. In the third instance, the motion is effectively diverted to convey the grain in the direction of the longitudinal axis of the cylinder 5 toward the point or points of discharge therefrom.

It has been specified that the washing chamber (there being two in the form of embodiment of the machine under present consideration) is preferably located midway of the cylinder 5. A large gain in the capacity of the machine is thereby effected, but the medial location, however desirable for the reason last named, is not essential. Under some conditions it might be considered desirable to so construct the aforesaid revolving open frame as to effect a feed of the solid contents of the cylinder 5 from one end to the other thereof, in conjunction with my washing chamber whose functional operation is, to an obvious extent, complete in itself. In such case the disposition of the washing chamber, relatively to the cylinder 5, may be varied at discretion.

Assuming for the purposes of present description that the chambers 22 and 23 are medially located in respect to the machine shown in Figs. 1 and II, to which reference is now again made, the revolving open frame, secured to the shaft 27 as above specified, is preferably divided, in effect, into two sections by having spirally disposed strips 31 and 32 which enter into their construction disposed in such manner that the two sections will, through the rotation of the shaft 27, convey the grain as it is fed into the cylinder 5 from the middle to the opposite ends of the cylinder. By this arrangement the volume of grain feed supply is split in two, and the capacity of the machine thereby largely increased.

In further explanation of the revolving open frame, it is stated that the strips 31 are carried, respectively, upon arms 33 and 34 that project radially from hubs 33 and 35 secured to the shaft 27. In like manner the strips 32 are carried upon arms 37 and 38 projecting from hubs 39 and 40. The direction of rotation of the shaft 27 being that indicated by the arrow upon the hub 33 in Fig. IV, its rotation imparts motion, as has been suggested, to the contents of the cylinder 5, which, giving up in their travel through the cylinder, the moisture contained therein, proceed in divided mass toward the opposite ends of the cylinder, one part thereof moving in a circular direction followed by a spiral direction toward the conduit 41, and the other part moving in like manner toward the conduit 42. Delivery of the contents of cylinder 5 to the respective conduits 41 and 42 may be facilitated by providing the strips 31 and 32, respectively, with terminals 43, disposed in planes substantially coincident with the longitudinal axis of the shaft 27 and with the arms 34 and 38, respectively.

It is well understood in the art of washing wheat and some other grains, that provision must be made against an over-wetting of the grain from which would result an effect upon the wheat-berry, or the like, injurious to it for milling purposes. For that reason, because of the fact that, in its use, the grain is subjected to application of water for the briefest period, the machine illustrated in Figs. I and II may be, for some uses, preferred.

I have discovered, nevertheless, that, for general purposes, it is desirable to introduce between the sections of the revolving open frame an element of my own invention, which, for identification and not by way of complete definition, I designate a receiver and distributor, indicated by the reference numeral 45 in Figs. V and IX of the drawings.

One function of the member 45 is to subject the mass of grain, as it is fed gradually into the cylinder 5, to a washing operation proper of slightly prolonged duration. The washing operation is, nevertheless, even when accomplished by use of the member 45, of a duration only momentary and timed to avoid over-wetting of the grain.

The details of the receiver and distributor 45, in preferred form of embodiment, are clearly shown in Fig. IX read in comparison with Fig. V. The member 45 is made preferably, but not necessarily, of a single casting, as shown, and comprises a series of fins, as they may be designated, disposed in regular order about the cylindrical surface of a core 46. There is a medial fin 47 that is annular. From it, upon opposite sides thereof, at any selected, preferably opposite points, say 48 and 48', respectively, spring shoulders 49, 50 and 49', 50' from which proceed from points 51, 52 and 51', 52', respectively, fins 53 and 54 that are parallel to the fin 47 and define between it and them, respectively, and the encompassing wall of the cylinder 5, channels whose beginnings, respectively, are made by plowlike members at the points indicated by 48 and 48', respectively. 55, 56, and 55', 56' indicate shoulders, corresponding in function with and parallel to the shoulders 49, 50 and 49', 50', respectively, that conjoin the fins 53 and 54, to a second pair of fins, 59 and 60, which are in turn conjoined to shoulders 61, 62 and 61', 62', that parallel the respective shoulders previously specified. The shoulders 61, 62 and 61', 62' unite the fins 59 and 60, respectively, to lateral terminal fins 64 and 65, so designated because they complete the member 45. They are respectively provided with
discharge apertures of which one or more, and preferably a plurality is employed, two being provided in the fin 64 as indicated by the numerals 67 and 68, and a corresponding number in the fins designated by 65, 69, and 70 as indicated in the drawings. The several fins are preferably all parallel one with another and are consecutively united by their respective shoulders to define two channels setting out in opposite lateral directions from a point or points on the fin 47.

By the employment of the two plowlike members, indicated at 48 and 48', respectively, the fin-defined channels may be regarded as beginning at either point. One point only could be used but two give the advantage of two plowings to each revolution of the member 45 instead of one. The number not restricted to that shown and described, but may be increased or diminished according to the desired lengths of the fin-defined channels. The same observation, of course, applies to the shoulders which are, in effect, nothing more than deflections in two continuous members surrounding the core 46, each comprising a set of fins and shoulders.

The member 45, being secured to a shaft 70', corresponding to the shaft 27, derives motion therefrom in the same direction as that heretofore indicated in reference to the shaft 27. In its rotation, being located opposite the washing chambers to which it acts as a partial closure, it advances the shoulders 49 and 50 and 49-50', successively, into the mass of grain, as it is delivered into the cylinder 5 in continuous flow from the washing chamber or chambers, and thereby, splitting it substantially in half, causes one portion to travel through the channel, defined around the core by one set of fins and shoulders, toward the discharge openings 67 and 68, and causes the other portion to travel along the other fin and shoulder defined channel toward corresponding openings 69 and 70 in the fin 65.

The divergent channels as above defined about the core of the member 45 are not spirals, but produce somewhat the effect of spiral channels, with this variation, that the respective channels serve to convey their contents by a constant motion in general with sharp lateral deflections therein occurring at fixed intervals, instead of by a constant free motion, such as a spiral channel would impart. The effect of such lateral deflections is to produce a tendency slightly to pack or choke the contents of the channels as it passes through them thereby insuring proper cleansing action of the liquid. The angle of inclination of the shoulders to the fins which they respectively unite, is a factor in determining the resistance offered to the passage of grain through them and may be accordingly varied at discretion.

Secured to the shaft 70' on opposite sides of the member 45 are revolveable open frames designated as a whole, respectively, by the numerals 71 and 72. They are so designated because they correspond in every respect to the revolveable open frames shown in Fig. II, and therefore do not require to be specified in detail, the only material variation in them being that the lengths of the members 71 and 72 are diminished sufficiently to accommodate the introduction between them of the member 45.

By the employment of the member 45, not only is the retardation of the travel of the grain through the cylinder 5 slightly increased, whereby the grain is detained momentarily and held subject to a brief prolongation of the washing action of the liquid at the inlet of the cylinder, already been suggested, it is practicable, by the timing of the speed of the rotation of the shaft 70', to regulate the scouring action of the liquid upon the grain, by regulating the speed of the grain feed relatively to the force of the water supply. In other words, through regulation of the speed of the shaft 70', the previously specified packing or choking action exerted by the fin-defined channels upon their solid contents, may be, within certain limitations, increased or diminished at discretion, thereby retarding or accelerating the feed through said channels relatively to the force of the water supply, and so controlling the cleansing efficiency of the machine.

The cylinder 4 is substantially identical in construction with the cylinder 5, with the omission of the chamber 14. Coaxially within the cylinder 4 is disposed a shaft 75 carried in journal bearings 76 and 77, corresponding substantially to the bearings 28 and 29 previously specified. Secured to the shaft 75 within the cylinder 4 are open frames 78 and 79, which, corresponding with the construction of similar members carried by the shaft 27 with the omission of the terminals 43 of the latter, require no further specification of details. The direction of rotation of the shaft 75 being opposite to that of the shaft 27 the open frames 78 and 79 feed toward the middle portion of the cylinder 4 where they discharge their load of material into a discharge chute 80.

The discharge chute 80 as shown in Figs. III and IV, for example, is illustrated as one making final discharge of the cleaned product from my machine and adapted to convey the same to any desired point.

If preferred, however, the number of cylinders corresponding to the cylinder 4 may be multiplied so as to effect an indefinite extension of the final drying mechanism represented by the cylinder 4 and the mechanism which it contains, it being observed that if more than one cylinder 4 is used,
the shaft of each, corresponding to the shaft
75, rotates in the opposite direction from that of the next preceding cylinder, and that the feed of material from one cylinder to
another alternates from its end to its middle portion and vice versa, after the manner previously shown and specified.

The object of the multiplication of the cylinders represented by the cylinder 4 is to
insure that the cleaned product when delivered to the discharge chute, represented by that indicated by the numeral 80, shall be reduced to such a state of dryness as to meet all practical requirements. As has
been previously indicated this end might be accomplished by the employment of a single cylinder of adequate longitudinal extent, but the employment of a plurality of cylinders is preferred by reason of the economy of floor space which the latter construction
affords.

Any suitable driving mechanism may be employed, as for instance, separate belts (not illustrated) applied to pulleys 81 and
82, secured to the ends of the shafts 27 or 70 and 75, respectively. Such details being matters of ordinary mechanical adaptation may be, of course, varied at convenience.

It has been specified that the employment of the Imperforate zone 8 in the cylinder 5 is optional, and that its width also is variable. In the form of machine shown in Figs. I and II it may be minimized to the narrow width indicated in Fig. VIII. In the machine shown in Fig. V, the zone 8, if used, should be substantially coextensive with the axial extent of the member 45.

The conduits 41 and 42, previously specified as affording egress for the solid contents of the cylinder 5, preferably communicate, if the feed of the machine be upward as is preferred and indicated, for example, in Fig. IV, with the upper part of cylinder 5, and the lower part of cylinder 4, respectively. They are preferably inclined with their axes parallel to tangents to the respective cylinders, as shown in Fig. IV, so as to receive and conduct with least resistance material delivered to them from the opposite ends, respectively, of the cylinder 5.

From the foregoing specification the following statement of what characterizes my invention will, it is believed, be clearly intelligible.

My invention is based upon the introduction into a confined body of grain, while in motion through the place of confinement, of a detergent liquid discharged into the same under pressure. The detergent action of the liquid upon the grain is obtained by the differential of movements between the grain and liquid, respectively. The result may be obtained, intensified, or regulated by varying the rates of movements of the grain and liquid, respectively, or by disposing the movements of the grain and liquid, respectively, in opposite directions.

Assuming the machine as shown in Figs. I and II to be in operation, the shafts 27 and 75 being rotative in the directions, re- spectively, of the several arrows shown in Fig. IV, grain is supplied in constant flow through the terminal branches 24 and 25 to the washing chambers 22 and 23, respectively. The grain may be fed by gravity or under forced feed, as desired, and if by gravity the supply is regulated as by an ordinary gate or gates, such, for example, as is indicated by reference numeral 83 in Figs. III and IV. Upon entering the washing 80 chambers, the mass of grain, its initial movement being there momentarily subjected to a tendency to interruption, is further determined by operation of the force of inertia and by friction between its individual particles and the walls of the said chambers. A constant flow of water under pressure from the pipe 13 is discharged into the washing chambers from the nozzles 20 and 21, respectively. The water pressure may be varied from, say 15 pounds upward, depending upon conditions present. I have found, in practice, that with very smutty grain, a pressure as high as 75 pounds may be employed to advantage. The direct action of the water upon the grain made available, in the form of embodiment of my machine under present consideration, by the resistance to movement against the force communicated from the water jet, is determinable mainly by the resistance offered by the walls of the washing chamber or chambers of proper dimensions, but continues to the point of discharge of the commingled grain and water into the cylinder 5 and momentarily beyond that point. The greater portion of the water is immediately separated from the grain upon its discharge with the grain into the cylinder 5, finding ready egress from the cylinder through its formations whence it falls, along with impurities from the grain held in solution, into the drip pan 11, whence it is drained off as by the pipe 12. The cleansing operation upon the grain is, in the main, effected by powerful hydraulic action in the washing chamber or chambers, but is continued, in some measure, until the grain leaves the cylinder 5, at which time the grain may be rendered, by my machine, substantially free of water, although still in a somewhat moist state. The degree of moisture retained by the grain upon its discharge from the cylinder 5 will, of course, measurably depend upon the dimensions of that cylinder.

The function of the first as well as that of the second cylinder will be mainly a dehydrating or drying operation, although a certain cleansing action upon the grain by attrition is doubtless attained in the second
cylinder as well as during the operation upon it in the first cylinder.

The effect of the rotation of the shafts 27 and 75 is, in consequence of the fanlike construction of their open frames, respectively, to produce intake of air through the several cylinders on all sides through the formations thereof and the several end screens 7 with which the cylinders are respectively provided.

In order to afford to the reader some adequate conception of the degree of efficiency arrived at by my machine in practice, it may be observed that in a machine having a capacity for cleaning 150 to 250 bushels of wheat per hour (the variation depending for the most part upon the quantity of smut or other impurities in the grain) the grain is delivered in a state of practical dryness to the discharge chute 80, the time which the grain takes in passing from the washing chamber to the discharge chute being about four seconds. Consequently, the time during which the grain is submerged in the water before the drying action begins to be effective, is but momentary, with the result that the wheat-berries are delivered to the discharge chute 80 without any material injury or deterioration.

In respect to the form of embodiment of my invention shown, for example, in Fig. V, the foregoing description equally applies, but modified by the additional explanation which follows.

In the machine whose operation is already described, movement of the grain after it reaches the washing chamber is effected first by the driving force of the liquid supply, and then, immediately, by the mechanical drying operation of the open frames on the shaft 27. The same is also true of the machine shown in Fig. V, except that by the introduction into the latter of the member 45, an intermediate action upon the grain is effected by prolonging the action of the liquid on the grain, and by a modification of the mechanical action through the instrumentality of the member 45, which may be caused also to intensify, to some extent, the washing operation.

To the description already given of the operation of the member 45 in conjunction with its correlated elements may be added further explanation as follows. The location of the member 45 opposite the discharge end of the washing chamber (or chambers if more than one is employed) has a tendency to intercept the free discharge of the contents of the chamber, and, thereby, to increase the differential of the movements of the liquid and the grain, respectively, through the chamber, the flow of liquid being but little, if any, impeded by the slight stoppage of movement of the grain. Moreover, in the absence of the member 45, the effect of the washing operation proper is substantially eliminated, or nearly so, upon liberation of the grain into the spacious and foraminated cylinder 5. On the other hand, the presence of the member 45, by continuance of the narrow confinement of the grain within its channels, serves to prolong the washing operation, and that, in consequence of the rotation of the member 45, without material reduction of the rate of travel of the grain toward its points of discharge from the cylinder 5. The possible intensification of the washing operation, previously indicated, is obtained, partly, by the crowding of the grain into the channels of the member 45, with increased resistance therefrom to the flow of liquid through the grain, but especially by control of the rate of rotation of the member 45. The member 45 therefore becomes, in effect, a movable section or extension of the washing chamber, with an increase of efficiency in the machine derived from its movement.

What I claim is:

1. The improvement in the art of cleansing grain, which consists in effecting a momentary violent contention of forces between a moving mass of grain and a moving volume of detergent liquid, and then immediately separating the grain and the liquid, substantially as and for the purpose specified.

2. As an improvement in the art of cleansing grain, the feeding of the supply of grain to be cleansed, through the discharge into it of a liquid jet of sufficient force to effect a continuous flow of grain from its source of supply.

3. The improvement in the art of cleansing grain which consists in subjecting a confined mass of grain in continuing movement to the powerful hydraulic action of a continuing flow of liquid, and in quickly thereafter separating the grain and the liquid so as to render their contact substantially momentary.

4. The improvement in the art of cleansing grain which consists in subjecting a volume of grain to momentary powerful hydraulic action, and, immediately thereafter to effective dehydration.

In testimony whereof, I have hereunto set my hand in the presence of two subscribing witnesses.

MARTIN W. HUNT.

Witnesses:
HOWARD O. ROGERS,
MABEL NEVILLE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D.C."