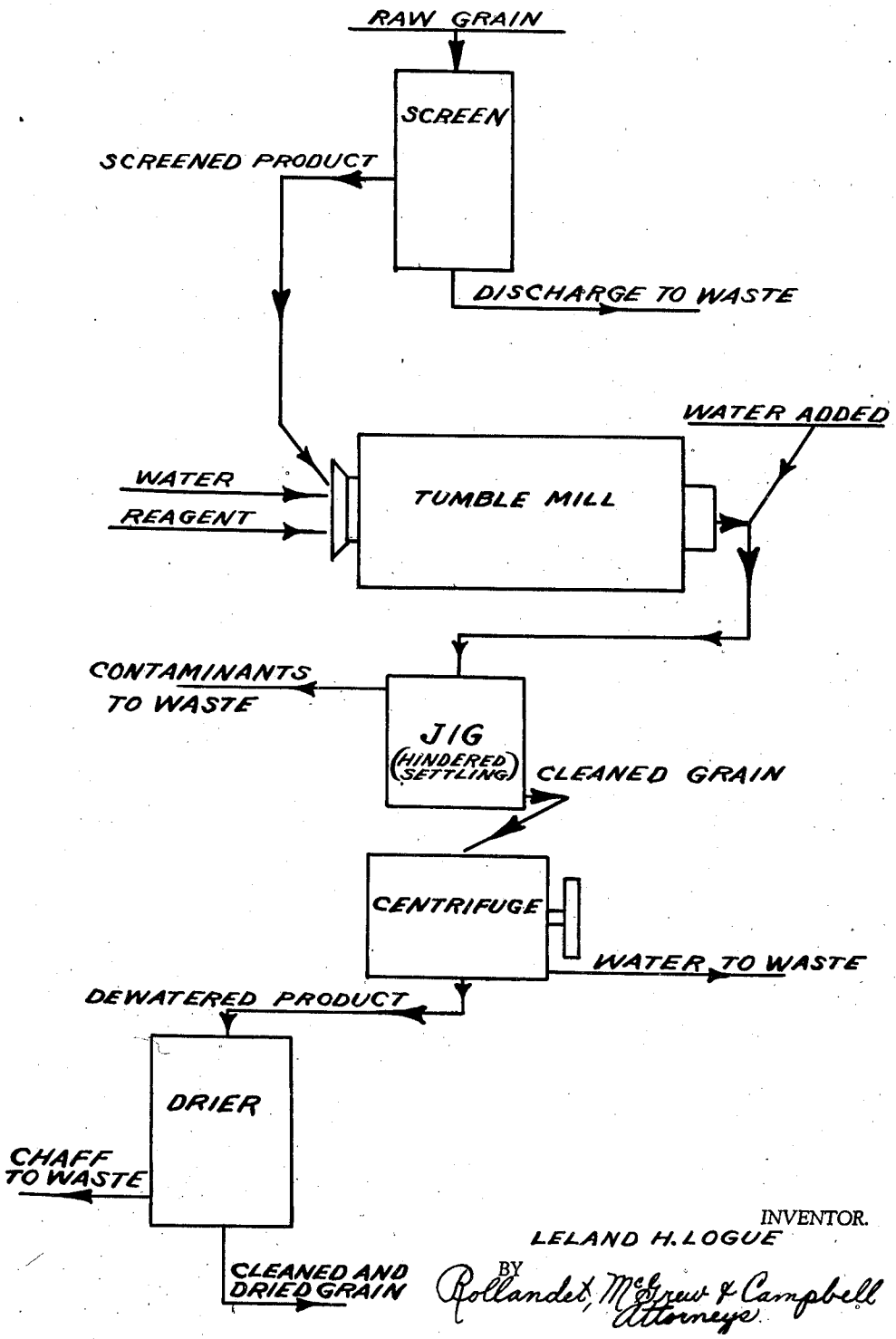
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CLEANING OF CEREAL GRAINS

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CLEANING OF CEREAL GRAINS

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6 Claims. (Cl. 83—94)

This invention relates to the cleaning and beneficiation of grains and the like and is illustrated herein as applied to the treatment of cereal grains for the removal of chaff, dirt, smut, insect eggs, insects and the like from grain prior to milling.

The process also may be applied to the treatment of cereal grains prior to milling for the removal of the hull or outer skin, which, in reality, is the true bran and has little, if any, food value.

A further application of the present invention to the treatment of grains is a selective separation of the grains or kernels into fractions, one of which would be most suitable for seed purposes, while another fraction would be separated according to a variation in protein content for its food value.

It is an object of the present invention to provide a simple, inexpensive and expeditious process for removing contaminating matter from cereal grains.

Another object of the invention is to provide a method for increasing the food value per unit of weight of cereal grains by removing therefrom the outer hull or bran content of negligible food value.

A further object of the invention is to provide a treatment for grading cereal grains according to variations in the protein content thereof.

Other objects reside in novel steps and treatments, all of which will appear more fully in the course of the following description.

According to the present invention, the final separation is effected by what may be broadly termed a hydraulic classification, but also includes film or skin flotation in which the waste materials ride upon the surface of the wetting medium, while the valuable constituents comprising the cereal grains are wetted and sink, permitting separate removal.

In this connection, it will be understood that anything in the nature of a contaminant, inclusive of the bran content, will differ from the grain kernels in size, shape and specific gravity so that it is possible to get a sufficiently clean separation to satisfy ordinary requirements by hydraulic classification. As a consequence, the materials taken for treatment may be conditioned for the separation according to differential wetting properties, but it is also possible to render the material better suited for certain separations by the use of suitable dispersing reagents and a variety of separating methods may be employed in conjunction therewith.

A typical separation involving the treatment of cereal grains primarily for the removal of bran, but also effective for removal of dirt and other contaminating matter will now be described in detail.

The grain delivered to an elevator or the like is first fed in dry condition to a screening operation for the removal of coarse foreign matter, such as wood chips, wire, bolts and the like.

The screened product of this operation is collected and fed to a revolving cylinder or the like, such as a large trunnion ball mill, which allows only a low pulp level to be carried. In this mill, the grain is mixed with sufficient water to make a semi-fluid mass, and where reagents are to be used in the treatment, they preferably are introduced into the mill to attain the desired degree of mixing.

Reagents well suited to act as dispersants in the present treatment are soda ash and sodium silicate, although other reagents possessing similar properties which will not have a deleterious effect on the grain may be used in place thereof. The amount of reagent required in the treatment will vary according to the nature of the subsequent treatment and the condition of the material, but from one-tenth pound to five pounds of reagent per ton of grain will give satisfactory results.

Either the wetting medium, usually water, or the reagent of the treatment tend to loosen and remove the outer skin from the grain kernel and the combined presence of these agents in the mill serves to soak the individual kernels and loosens the outer skin, causing it to become detached from the kernels.

The tumbling action and the continual movement of kernels against one another also assists in loosening and separating this outer skin. The mill preferably is rubber lined to insure the desired degree of attrition without producing excessive wear or deterioration on the particles themselves.

As the contact time in the mill must be sufficient to insure loosening and freeing the major percentage of the bran coverings from the kernels, initial testing is desirable to determine the treatment time. From two to three minutes will serve as a lower limit, while up to twenty to twenty-five minutes constitutes the upper limit of the treatment time.

After treatment in the mill, the discharging mass is diluted and passed to the subsequent separation stage of the operation. The extent of dilution may be varied and usually three to four

parts water to one part grain will insure good results.

In this example, the treatment at the separation stage consists in feeding the dilute mass or pulp onto an ordinary concentrating table, such as the well-known "Wilfley tables" or "Deister tables." On these tables the kernels of grain which have been wetted in the conditioning treatment sink and are caught between the riffles and pass to the concentrate end of the table where they are discharged.

The bran particles, together with the contaminating matter, are maintained in a dispersed condition under the action of the reagent and kept from forming flocs which might tend to sink and also are kept from depositing on the grain surfaces with which they come in contact, as might otherwise occur if they were not responding to the action of the reagent.

As a consequence, this matter because of its lighter specific gravity forms an overlying stratum and remains in a state of semi-suspension in the water or wetting medium flowing across the deck of the table and is carried thereby over what is normally considered the tailing side.

As a result of this series of treatments, the grain discharged at the concentrates end of the table is in a substantially clean condition and free from any appreciable quantity of its original bran content. The bran removal also serves to effectively separate contaminants of mineral, vegetable and animal origin, and, as a consequence, the final grain concentrate is a substantially pure product possessing high food value.

While the treatment hereinbefore described is well suited for the treatment of what may be broadly classified as cereal grains, it has particular application to the treatment of wheat, barley, rye, corn and oats.

The wetting medium of the treatment preferably consists of water, but may be any other liquid or solution possessing the desired wetting qualities which will not have a contaminating or injurious effect on the grains.

In another treatment, it was desired to retain the bran in the grain and merely subject the grain to a cleaning operation for the removal of contaminants.

As an extended period of conditioning with the reagent will loosen the skin, it its necessary in such an operation to hold the conditioning time to a minimum, as well as to avoid a pronounced attrition action. Therefore, the mass subjected to the agitation in the tumbling action is passed through the treatment in from two to three minutes, which serves to provide the desired differential wetting action.

In this connection, it will be understood that the liquid content in the conditioning operation may be increased, and thereafter less additional dilution will be necessary to properly prepare the material for the hydraulic classification.

Furthermore, while it is preferable to initially condition the material in a tumble mill, any other form of mixing which will serve to bring the reagent into contact with the solids content to be removed by the classification may be substituted therefor. For example, a conditioning tank provided with rotary agitators may be used.

After the conditioning treatment, the product is diluted as required and subjected to the final separation by feeding it to a concentrating table where the grain tending to sink because of its wetted condition passes across the concentrates discharge while chaff, insects, dirt and the like, due to their dispersed condition, remain at the surface and pass across the tailings discharge.

Other types of hydraulic classification may be employed in place of table concentration. Jigs and hindered settling classifiers are cited as other types of equipment which may be used.

Another use of the present invention is to grade the constituents of a cereal grain according to variations in its protein content. In such an operation, the grain which preferably is a precleaned product, is introduced into the tumble mill in the presence of the wetting medium and subjected to a conditioning operation of not to exceed four minutes. The grain of high protein content which has the best food value wets first, while the low protein content which has the best seed value wets last. The discharge of the conditioning treatment is diluted sufficiently to form a free-flowing pulp and subjected to stratifying classification.

Due to the differences in the wetting properties, the high protein content will sink and be held in the riffles to pass to the concentrates discharge, while the low protein content forms an overlying stratum which moves across the riffles to the tailings discharge where it may be collected as a second valuable constituent of the operation.

It will be understood that all the foregoing treatments will not depend upon the use of a reagent, as the materials to be separated possess different wetting characteristics which permit a satisfactory recovery by the use of hydraulic classification.

However, the use of a dispersing agent serves to keep certain fractions of the contaminant matter from depositing on grain surfaces and from gathering in flocs which might tend to sink or might become entrapped with the grain content.

The accompanying flow sheet represents an operation well suited to attain the objects of any of the aforesaid operations. In this treatment grain after an initial screening operation to remove oversize foreign matter, passes into a conditioning stage to obtain the differential wetting and, if continued for a sufficient interval, to remove the outer skins from the grain kernels.

Following this conditioning operation, the grain is subjected to hindered settling in an air-free liquid. The grain, or grain of high protein content, sinks in the liquid, while chaff, foreign matter and other contaminants pass to the surface and are removed.

The cleaned grain is then subjected to the action of a centrifuge and passed to a drier from which it is discharged as a dried and cleaned final product.

"Air-free liquid" as used in the description and claims is intended to designate a liquid containing no gas other than the normal amount of oxygen present by reason of surface absorption.

It is also possible to use the same treatment operations in conjunction with an agglomerating separation by the use of suitable agglomerating agents. Features of the agglomerating action described but not claimed herein have been made the subjects matter of claims in my co-pending application of even date, Serial No. 378,317, entitled Agglomeration of cereal grains.

Changes and modifications may be availed of within the spirit and scope of the invention as defined in the hereunto appended claims.

What I claim and desire to secure by Letters Patent is:

1. In a process of separating grain kernels from the outer skins of their natural formation, the steps of treating cereal grain in an aqueous carrier vehicle, and during said treatment agitating the grain submerged in said vehicle for an interval sufficient to loosen the outer skins and differentially wet the grain kernels and said skins without substantially reducing the grain kernels, subjecting said skins upon loosening to the influence of a dispersing reagent, causing said loosened skins while subject to the dispersing influences of the reagent to collect in suspension at or near the surface of the liquid in overlying relation to said grain kernels by subjecting the submerged solids to a vibrating table treatment capable of exerting a suspending influence on said skins, and recovering the solids so separated at separate points of discharge from the treatment.

2. In a process of separating grain kernels from the outer skins of their natural formation, the steps of treating cereal grain in an aqueous carrier vehicle, and during said treatment agitating the grain submerged in said vehicle for an interval sufficient to loosen the outer skins and differentially wet the grain kernels and said skins without substantially reducing the grain kernels, subjecting said skins upon loosening to the influence of a dispersing reagent, causing said loosened skins while subject to the dispersing influences of the reagent to collect in suspension at or near the surface of the liquid in overlying relation to said grain kernels by subjecting the submerged solids to a jigging treatment capable of exerting a suspending influence on said skins, and recovering the solids so separated at separate points of discharge from the treatment.

3. In a process of separating grain kernels from the outer skins of their natural formation, the steps of treating cereal grain in an aqueous carrier vehicle, and during said treatment maintaining the grain submerged in said vehicle, initially subjecting the immersed grain to attrition in a tumbling action for an interval sufficient to loosen the outer skins and differentially wet the grain kernels and said skins, subjecting said skins after loosening to the influence of a dispersing reagent, then causing said loosened skins while subject to the dispersing influences of the reagent to collect in suspension at or near the surface of the liquid in overlying relation to said grain kernels by subjecting the submerged solids to a classification treatment capable of exerting a suspending influence on said skins, and recovering the solids so separated at separate points of discharge from the treatment.

4. In a process of separating grain kernels from the outer skins of their natural formation, the steps of treating cereal grain in an aqueous carrier vehicle, and during said treatment maintaining the grain submerged in said vehicle, initially subjecting the immersed grain to attrition in a tumbling action for an interval sufficient to loosen the outer skins and differentially wet the grain kernels and said skins, diluting the product of the attrition action, subjecting said skins after loosening to the influence of a dispersing reagent, then causing said loosened skins while subject to the dispersing influences of the reagent to collect in suspension at or near the surface of the liquid in overlying relation to said grain kernels by subjecting the submerged solids to a classification treatment capable of exerting a suspending influence on said skins, and recovering the solids so separated at separate points of discharge from the treatment.

5. In a process of separating grain kernels from the outer skins of their natural formation, the steps of treating cereal grain in an aqueous carrier vehicle, and during said treatment maintaining the grain submerged in said vehicle, initially mixing the cereal grain with a sufficient quantity of the carrier vehicle to make a semi-fluid mass, subjecting the semi-fluid mass to attrition in a tumbling action for an interval sufficient to loosen the outer skins and differentially wet the grain kernels and said skins, diluting the product of the attrition action, subjecting said skins after loosening to the influence of a dispersing reagent, then causing said loosened skins while subject to the dispersing influences of the reagent to collect in suspension at or near the surface of the liquid in overlying relation to said grain kernels by subjecting the submerged solids to a classification treatment capable of exerting a suspending influence on said skins, and recovering the solids so separated at separate points of discharge from the treatment.

6. A treatment according to claim 5 in which the semi-fluid mass is subjected to attrition for an interval of from two to twenty-five minutes.

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