Nov. 8, 1932. O. H. HANSEN 1,887,239

QUALITY GRADER

Filed June 7, 1928 3 Sheets-Sheet 1

FIG. 2.

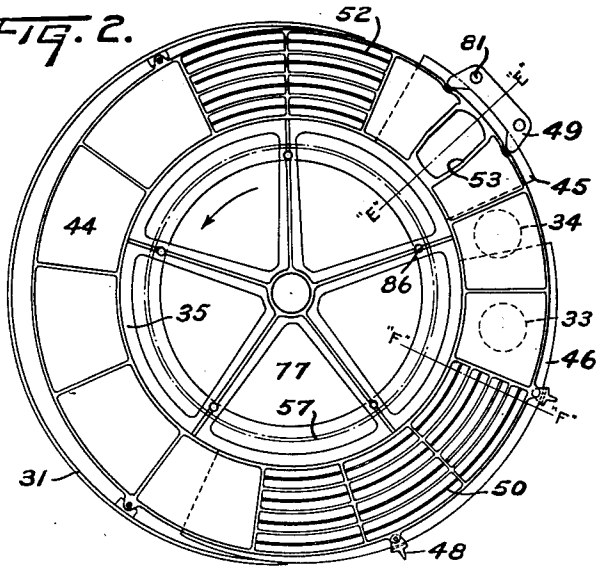


FIG. 5.

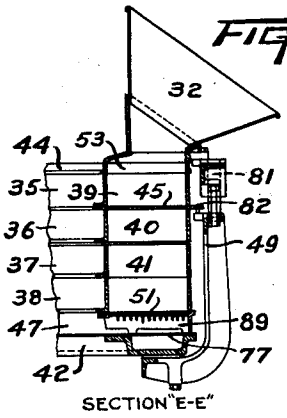
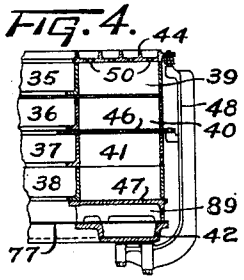


FIG. 4.



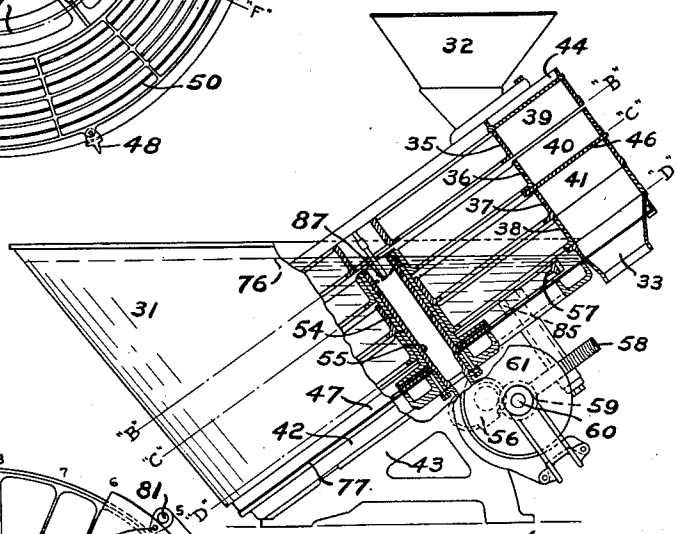


FIG. 1.

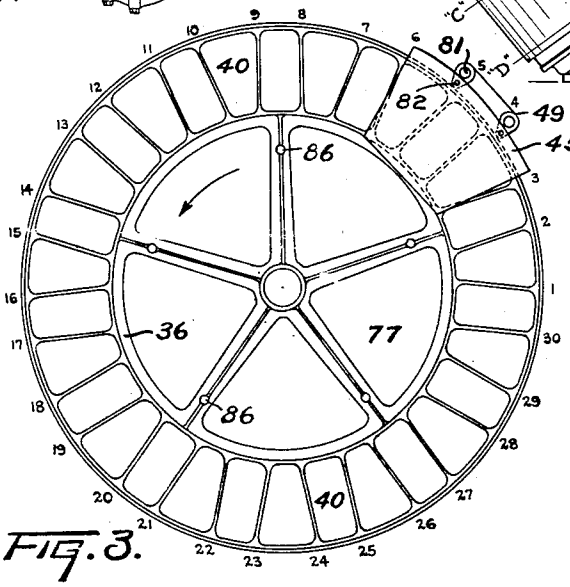


FIG. 3.

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QUALITY GRADER

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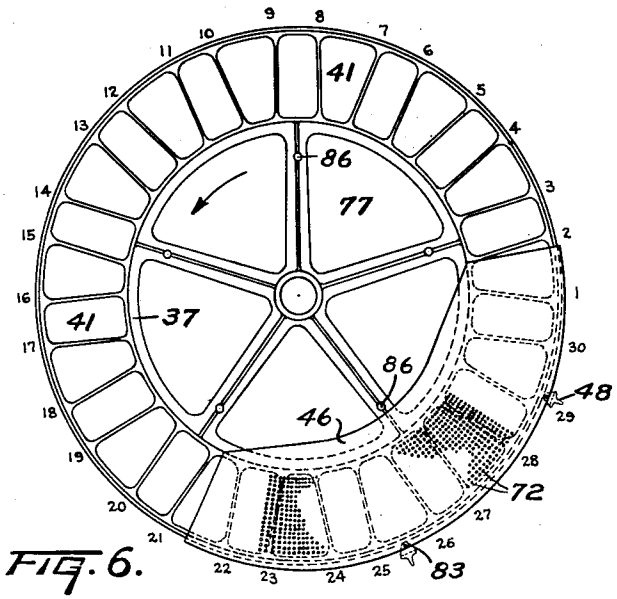

FIG. 6.

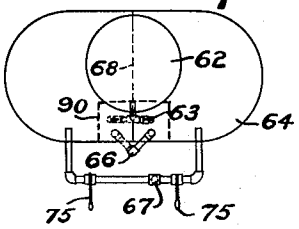

FIG. 9.

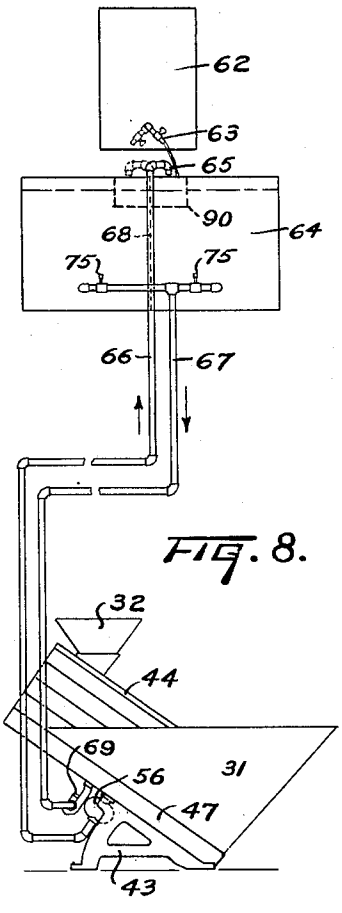

FIG. 8.

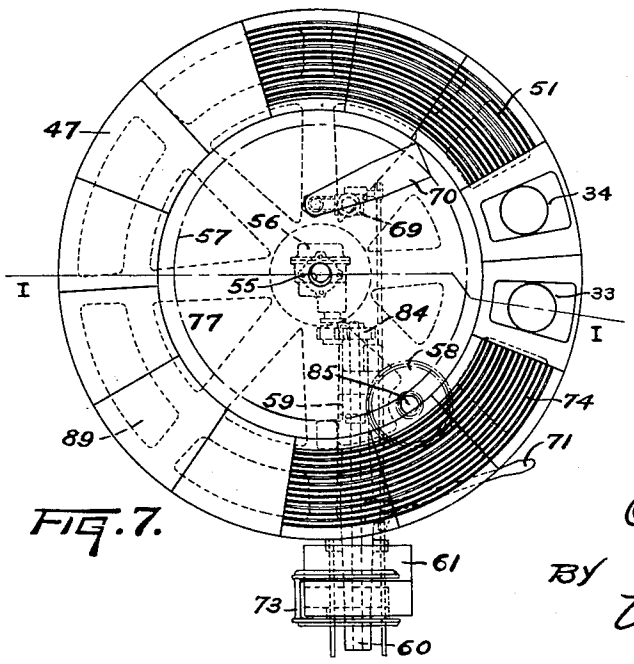

FIG. 7.

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QUALITY GRADER

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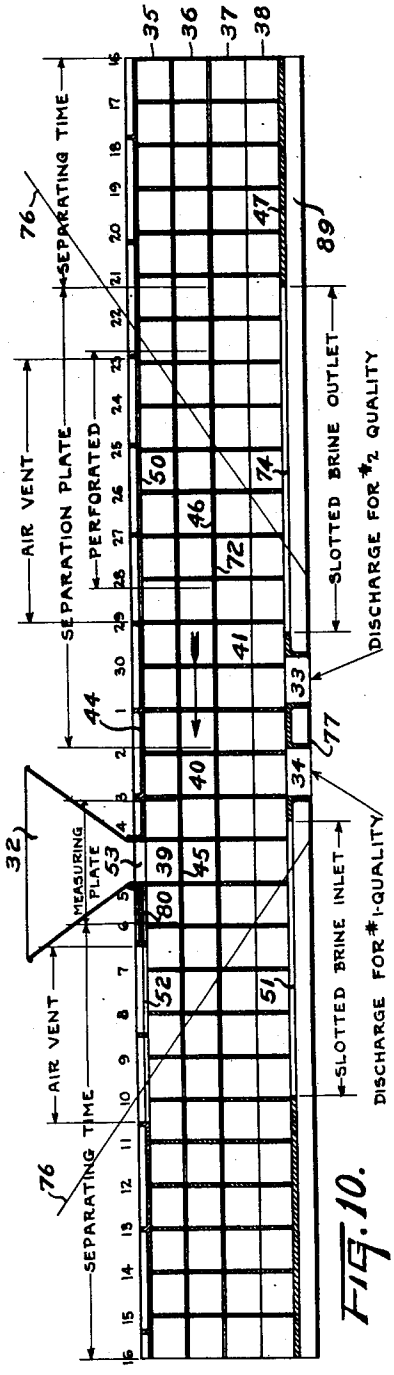

FIG. 10.

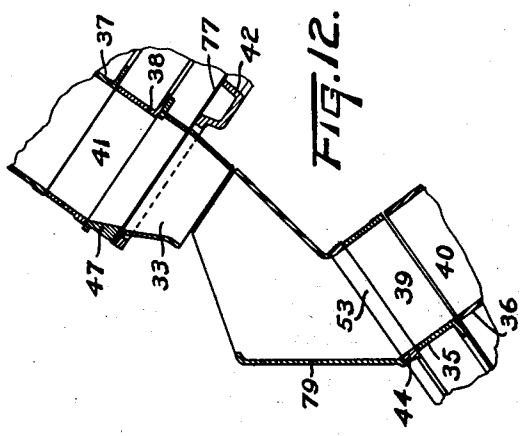

FIG. 12.

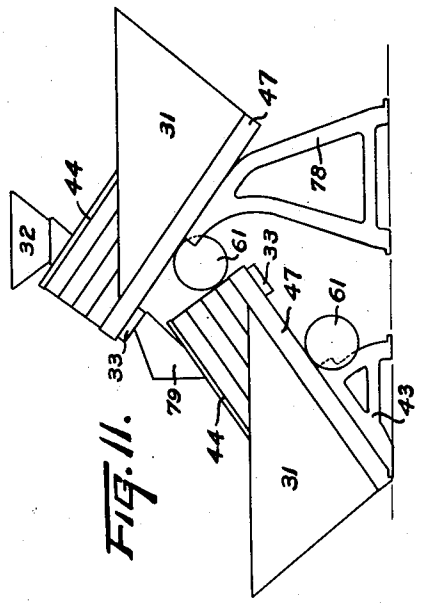

FIG. 11.

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1,887,239

UNITED STATES PATENT OFFICE

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QUALITY GRADER

Application filed June 7, 1928. Serial No. 283,500.

The present invention relates generally to improvements in the art of grading granular material such as peas, beans, berries and the like as to quality, and relates more specifically to an improved process of and apparatus for separating granular material into several distinct grades having different specific gravity.

A general object of the invention is to provide a novel method of commercially and effectively grading granular material such as peas, beans, cut beans, berries or the like as to quality. Another object of the invention is to provide simple, compact and highly efficient apparatus for automatically exploiting the improved process.

In accordance with a prior application Serial No. 148,814, filed November 17, 1926, patented June 3, 1930 No. 1,761,788 it has heretofore been proposed to grade granular material such as green peas, as to quality, by placing batches of the material into relatively quiescent basins of liquid of predetermined density, so as to effect separation of the granules in accordance with the specific gravity thereof.

During exploitation of this prior process, it has been discovered that the specific gravity of peas or beans is not dependent solely upon their hardness, and that there are frequently present extremely hard seeds that actually float in a solution wherein softer granules will sink. While the cause of this phenomenom has not been definitely determined, it has been found that practically all of the so-termed "hard floaters" have an air confining sac or space beneath the skin. The presence of these hard floaters is extremely objectionable since they have the characteristic of quickly decomposing and of producing foul odors thereby deteriorating a batch of wholesome peas with which they may be intermingled.

It has been found that the hard floaters together with the thistle buds, skins and other objectionable material, may be positively removed from the desirable or wholesome peas, by subjecting the mixed mass to treatment in a relatively weak brine solution. After such initial treatment for removal of objectionable material, the desirable granules may be separated into two or more quality grades by further treatment in brine solutions of higher density.

Another important fact concerning the grading of peas or the like, which has been ascertained from practical demonstration, is that if tender peas which will readily float in a brine solution of definite density, are permitted to remain in such solution for a relatively long period of time, they will absorb or accumulate sufficient of the brine constituents to cause them to sink. It is therefore extremely important in effecting quality grading, not to permit the seed to remain in a brine solution of predetermined density, beyond the saturation or accumulation period, if accurate quality grading is desired.

A further important factor which contributes materially to the success of quality grading, is the avoidance of violent agitation of the granules and liquid during separation. In order to eliminate objectionable agitation, the seed should not be thrown or precipitated into the liquid, but should in fact be gradually immersed therein. The presence of any perceptible amount of agitation will make accurate quality grading impossible.

Still another requirement which is essential for accurate specific gravity grading, is that the density of the grading liquid be maintained substantially constant throughout the entire period of separation, by replenishing the spent brine. It will be apparent that if the density of the liquid varies any appreciable amount, as it will if the same brine is used for too long a period, the quality of the several separated grades will naturally vary, thereby destroying the uniformity of the graded product.

Another relatively important feature which contributes to the success of quality grading is the maintenance of uniform depth of the brine solution during admission of the peas thereto and removal of the grades therefrom. The depth of the grading solution should be retained constant irrespective of the quantity of granular material in the bath,

and the solution should be kept in circulation to an extent sufficient to maintain the density uniform throughout.

In view of the foregoing discoveries and facts, it is a more specific object of the present invention to provide a method of and apparatus for effectively removing objectionable material such as hard floaters, thistle buds, skins, broken granules, pods, stems, snips and the like, from the wholesome or desirable material, and for rapidly and precisely separating the desirable granules into accurately uniform quality grades. In accordance with the improvement, the granular material is subjected to the grading action of a properly maintained solution for only a sufficient length of time to insure thorough separation well within the accumulation period, and objectionable agitation is absolutely avoided. The invention further provides improved systems of depositing the granular material in the brine and of maintaining desirable uniformity of the brine density and depth, and also provides numerous improvements in the details of construction of grading machines whereby such devices may be readily manufactured and operated, and conveniently maintained in highly sanitary condition. These and other specific objects and advantages will be apparent from the following description.

A clear conception of embodiments of the numerous improved features and of the various steps constituting the new process of grading, may be had by referring to the drawings accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the various views.

Fig. 1 is a part sectional side elevation of one unit of an improved quality grader, showing the same completely assembled and with the section taken along the irregular line I—I of Fig. 7.

Fig. 2 is a top view of the improved quality grader with the supply hopper removed, the view being taken in the direction of the arrow "A" of Fig. 1.

Fig. 3 is a full top view of the upper intermediate pocket forming member and upper measuring plate of the machine, looking directly toward the plane B—B of Fig. 1.

Fig. 4 is a fragmentary radial section through the quality grader unit, the section being taken on the line F—F of Fig. 2.

Fig. 5 is a fragmentary radial section through the quality grader unit, the section being taken along the line E—E of Fig. 2.

Fig. 6 is a full top view of the lower pocket forming member and of the intermediate separating plate of the machine, looking directly toward the plane C—C of Fig. 1.

Fig. 7 is a top view looking in the direction of the arrow A of Fig. 1, of the lower cut off and discharge plate of the machine, showing the driving mechanism, the view being taken at the plane D—D of Fig. 1.

Fig. 8 is a diagram of the brine supply and control apparatus, showing the manner in which this apparatus is associated with a grader unit.

Fig. 9 is a diagrammatic top view of the brine supply and control apparatus.

Fig. 10 is a development of the grader pockets showing the relative disposition of the granular material inlet and discharge elements with respect to the pockets.

Fig. 11 is a diagrammatic side elevation of a two unit series quality grader.

Fig. 12 is an enlarged fragmentary radial section through the granular material transferring portion of the two unit quality grader.

While the invention is described herein as being specifically applied to the grading of green peas as to quality, it will be apparent that some of the features of novelty are more generally applicable to the quality grading of green beans, berries or the like, and to the separation of bean snips and stems from cut wax and green beans. The specific application is therefore made only for descriptive purposes and is not to be considered as an intentional limitation in scope.

Each unit of the improved quality grader comprises in general a brine confining bowl or basin 31 having an inclined plane bottom 77; a plurality of superimposed rotary members 35, 36, 37, 38 forming an annular series of grader pockets which are revolvable downwardly through the basin 31 about an inclined axis; mechanism for revolving the members and the pockets; means for delivering granular material to and from the grading pockets; and instrumentalities for effecting ingress and egress of the brine to and from the basin 31 and the grader pockets.

The bowl or basin 31 may be formed of sheet metal and is supported upon a lower stationary spider 42 which is mounted either upon a low frame 43 such as shown in Fig. 1, or upon a high frame 78 as shown in Fig. 11. Located slightly above the floor or bottom 77 of the basin 31, is a stationary sectional bottom plate 47 which provides an annular lower brine inlet and discharge space 89, this space also serving as an accumulation chamber for impurities gravitating through the brine. The bottom plate 47 forms the lower end of the separating pockets, being provided with adjoining sections having granular material discharge openings 33, 34 therein respectively, and also being provided with brine inlet and outlet grid sections 51, 74 respectively, located adjacent to the spout sections as shown in Fig. 7. The successive sections of the plate 47 are all formed of equal length, and the plane sections, the grid sections, and the outlet sections are identical in structure with those of a corresponding type, in order to facilitate construction and machining of

the sections while assembled in ring form. The center of the basin 31 is provided with a stationary tubular central brine discharge pipe 55 having an axis which is perpendicular to the plane of the upper surface of the plate 47 and to the basin bottom 77.

Disposed directly above the top surface of the plate 47 and spaced slightly therefrom, is the lower pocket forming member 38 having a hub which is pressed upon a rotary central element 54. The element 54 is rotatable upon the discharge pipe 55 and also has a bearing upon the bottom 77 of the basin 31. The annular member 38 is provided with radiating arms to the lower portions of which a ring gear 57 is attached, and from the upper portions of which a series of parallel driving pins 86 extend, see Fig. 6. The peripheral portion of the member 38 is provided with an annular series of grader pocket portions which constitute the lower parts of the pockets 41. The upper portions of the pockets 41 are formed in the lower intermediate member 37 which rests upon and in intimate contact with the lower member 38. The annular member 37 is provided with a hub which is pressed upon the rotary element 54, and has radial arms provided with holes engaging the driving pins 86. By utilizing two members 37, 38 to form the lower pockets 41, these members may be of similar construction and the same pattern may be utilized in the formation of all of the pocket forming members 35, 36, 37, 38.

A stationary intermediate separating plate 46 coacts directly with the upper surface of the lower intermediate member 38, the plate 46 being held in place by means of fixed pins 83 associated with rigid brackets 48, and having therein a nest of drainage holes 72 as shown in Fig. 6. The upper intermediate pocket forming member 36 is spaced slightly from the top of the fixed separating plate 46, and is provided with an annular peripheral series of pockets 40 located in alinement with the lower pockets 41 of the members 37, 38. The member 36 also has a central hub embracing the rotary bearing element 54, and is likewise provided with radial arms having holes and spacing washers engaging the driving pins 86. Resting upon the upper intermediate member 37, is a stationary intermediate measuring plate 45 which is held in fixed position by means of parallel pins 82 rigidly secured to the supply hopper retaining bracket 49, as shown in Fig. 3. The upper pocket forming member 35 is spaced slightly from the top of the fixed measuring plate 45 and is provided with an annular peripheral series of pea measuring pockets 39 which are also located in alinement with the pockets 40, 41 of the members 36, 37, 38. The hub of the upper member 35 is spaced slightly from the hub of the upper intermediate member 36 and from the end of the rotary bearing element 54, to provide an annular brine discharge opening communicating with the overflow or discharge pipe 55 the upper end of which may if desired, be provided with a strainer 87.

Supported with slight clearance, above the upper rotary pocket forming member 35, is a stationary cover plate 44 which is fixed against rotation by means of stationary pins 82, 83. The cover plate 44 is of annular form, being provided with air inlet and exhaust vents 52, 50 respectively, shown in Fig. 2, and also being provided with a pea inlet opening 53 and with a recess 80 at the bottom thereof adjoining the inlet opening. Directly above the inlet opening 53 is located either a standard pea supply hopper 32, or a special supply hopper 79, the type of hopper employed depending upon the location of the unit and upon the mode of delivering the granular material thereto. If this material is supplied to the unit intermittently by means of baskets or the like, a standard hopper 32 having a relatively wide inlet opening may be used, whereas a special hopper 79 may be utilized when the said material is spouted to the unit. The supply hopper rests upon the stationary top plate 44 and is adjustably and detachably associated with parallel retaining pins 81 secured to the bracket 49.

The brine level 76 within the basin 31 is automatically maintained substantially constant by means of the central overflow pipe 55 which communicates with the suction opening of a gear pump 56. The discharge opening of the pump 56 communicates with a brine return pipe 66 extending upwardly in proximity to a brine tank 64 and having an end swing spout 65 for delivering brine into the tank 64 through the screen 90, on either side of the tank partition 68, see Fig. 8. The lower portions of the divisions of the tank 64 are communicable through flow control valves 75, with a brine feed pipe 67 which in turn communicates through a main brine control valve 69 with an inlet nozzle 70 located at the bottom of the basin 31. The discharge end of the nozzle 70 is spread laterally and is so directed that the incoming brine is most effectively distributed without objectionably agitating the charge of brine within the basin.

The density of the brine within the circulating system, may be maintained at the proper value, by means of a brine supply and conditioning tank 62 located above the brine circulating tank 64 and having a swingable faucet 63 for delivering brine to either division of the tank 64. Since the granular material passing through the basin 31, carries with it some of the liquid and also tends to reduce the density of the brine remaining in the circulating system, it is desirable to restore both the quantity and the

density thereof. This may be readily accomplished with the aid of the brine supply and conditioning tank 62 and by utilizing either of the divisions of the circulating tank 64 in the system.

The main brine control valve 69 is operable by means of a hand lever 71 shown in Fig. 7, which also controls the operation of the driving mechanism for the grader pockets. The lever 71 is connected to a belt shifter 73 which cooperates with a belt associated with either the driving or the idler pulley 61 carried by an end of the main driving shaft 60. The opposite end of the driving shaft 60 is operatively connected with the gear pump 56 by means of spur gearing 84, and the medial portion of the shaft 60 is provided with a worm 59 which meshes with a worm wheel 58 secured to the lower end of a counter shaft to the upper end of which a pinion 85 is attached. The pinion 85 meshes with the annular gear 57 located within the basin 31 and rigidly attached to the arms of the lower pocket forming member 38. The arrangement of the elements is such that when the lever 71 is shifted to one extreme position, the brine control valve 69 is closed and the machine is stopped, whereas shifting of the lever 71 to the opposite extreme position, opens the brine valve 69 and simultaneously sets the pump 56 and the gears 59, 58, 85, 57 in motion thereby causing the superimposed pocket forming members 38, 37, 36, 35 to revolve in unison about the axis of the central inclined overflow pipe 55.

During normal operation of the improved quality grader to effect commercial exploitation of the new process, the main brine control valve 69 is open and the gear pump 56 as well as the members 35, 36, 37, 38 are operating as previously referred to. The spout 65 is positioned to deliver the brine discharged by the pump 56 to the effective division of the tank 64, the discharge valve 75 of which is opened for the delivery of brine to the return pipe 67. The peas which are to be graded, are deposited into the supply hopper and are delivered by gravity into the successive advancing pocket portions 39 of the upper member 35, filling the same and measuring the peas into successive substantially equal batches, see Fig. 10 wherein the successive pockets have been numbered from 1 to 30 in conformity with the numbering of the corresponding pockets in Figs. 3 and 6. As the filled pocket portions 39 proceed down the incline and beyond the edge of the measuring plate 45 (see pocket 6 of Fig. 10), the measured batches of peas are precipitated into the lower pocket portions 41 whereupon the advancing pockets enter the brine in the basin 31. During the subsequent movement of the pockets (see pockets 7 to 10), the brine rises upwardly through the charges of peas therein, through the inlet grid 51, and elevates the floaters away from the sinkers, simultaneously expelling the air through the air vent 52. The pockets are subsequently completely immersed in the brine for a short period of time during which complete separation of the several quality grades is insured. When the floaters have been thus separated from the sinkers, the successive pockets are advanced up the incline to a position wherein the separating plate 46 becomes effective to divide each pocket into segregated upper and lower portions, the former of which contains the floaters and the latter of which has the sinkers confined therein, (see pockets 21 to 28). During the next period of advancement of the pockets, the brine is withdrawn through the outlet grid 74 and air simultaneously enters the pockets through the air vent 50, while the floaters are being deposited upon and slid along the plate 46 and the separated sinkers are likewise deposited and slid along the bottom plate 47. When the successive pockets reach the position of the pockets 29, 30 of Fig. 10, the sinkers are delivered by gravity from the pocket portions 41 through the discharge opening 33, while the floaters are retained within the upper pocket portions. As the successive pockets reach the position of the pocket 2 of Fig. 10, the floaters are delivered by gravity from the upper pocket portions 40 through the lower portions 41 and the discharge opening 34. The foregoing separating cycle is automatically applied to each of the successive batches of granular material passing through the unit thus continuously and effectively separating the product into two quality grades.

When it is desired to separate only the hard floaters, thistle buds, skins, split peas, stems and other unwholesome material from the good peas, the material may be treated by a single passage thereof through the improved unit, and the wholesome product will be delivered through the discharge opening 33 while the rejected material will pass through the discharge opening 34. Such separation may be effectively accomplished by employing a relatively weak brine solution registering 1.02, since the hard floaters as well as the other objectionable materials mentioned, will float in a solution of such density whereas the wholesome peas will sink therein irrespective of their size and maturity.

When it is desired to separate the unwholesome materials from the edible peas and to additionally separate the good peas into several quality grades, two or more of the separating units may be employed in series as shown in Figs. 11 and 12. With the units thus arranged, several distinct modes of operation are possible, depending upon the will of the operator. Assuming that three final

quality grades are to be produced with three units wherein brine densities of 1.02, 1.07 and 1.08 are maintained, the several methods employed may be as follows:—

Method A.—The peas may be initially passed through the 1.02 brine in order to separate the hard floaters and other undesirable material from the wholesome peas. The mixed wholesome peas may be subsequently passed through the 1.07 brine to separate the fancy grade which will float in such brine, from the mixture of standard and sub-standard grades which will sink in this solution. The mixture of standard, sub-standard, and hard sinker peas may then be finally passed through the 1.08 brine to separate the standard grade which will float in this brine mixture, from the sub-standard and hard sinker grades which will sink therein.

Method B.—The peas may be initially passed through the 1.08 brine to separate the sub-standard and hard sinker grades which alone sink therein, from the standard and fancy grades and the unwholesome floating material. The mixture of standard and fancy grades and other floating material may subsequently be passed through the 1.07 brine to separate the standard grade which sinks in such brine, from the mixture of fancy peas and unwholesome floating material which float thereon. The mixture of fancy peas and undesirable floaters may finally be passed through the 1.02 brine to separate the fancy grade which sinks in such brine, from the unwholesome floatable material.

Method C.—The peas may be initially passed through the 1.07 brine to separate the mixed fancy peas and the hard floaters etc., which will float therein, from the mixture of standard, sub-standard and hard sinkers which will sink in such solution. The mixture of fancy peas and hard floaters may then be passed through the 1.02 brine to segregate the former from the latter, and the mixture of standard, sub-standard and hard sinkers may be passed through the 1.08 brine to separate the standard grade from the sub-standard peas and hard sinkers.

It will therefore be apparent that various sequences of separation are possible, and that any desired number of distinct quality grades may be produced. Each of the several separating units must, however, be operated at such speed, that the separating period or time indicated in Fig. 10, does not exceed the accumulation period of the floaters, if accurate grading is desired. The accumulation period for green peas is ordinarily less than one minute, but may vary throughout a considerable range for other granular materials. If the separated materials are not segregated within the accumulation period, the floating product will eventually sink, thus destroying the accuracy of the grading.

It is also extremely important when accurate quality grading is desired, that the depth and density of the solution be maintained constant, and that objectionable agitation be avoided. In the improved separating unit, the overflow pipe 55 establishes a definite depth of brine 76 in the basin 31, and the pump 56 cooperates with the supply tank 64 to constantly cause brine to enter the basin 31 through the nozzle 70 and to overflow at the top of the pipe 55. The screen 90 facilitates the removal of impurities from the brine, and the quantity and density of the brine in each circulating system, may be maintained constant by admitting brine of proper density to the tank 64 from the conditioning tank 62. If the brine level 76 is permitted to drop below a fixed level, the cut-off plates 45, 72 will not become effective at the proper time and the separated grades will not be segregated properly. If the brine level 76 rises too high, brine will be wasted by overflowing at the edge of the basin 31. With the improved circulating system, the level 76 of the brine will always remain constant irrespective of the quantity of peas admitted to the basin 31.

When the brine in one of the circulating systems becomes excessively dirty, the division of the tank 64 containing the impure brine may be cut out by closing its control valve 75, and the other division of this tank containing pure brine, may be cut into the system. The location and formation of the inlet nozzle 70, insures proper circulation of the fresh brine throughout the basin 31, without undesirably agitating the solution within the basin, thus insuring maintenance of the proper depth and density of the brine without violent agitation thereof.

Agitation of the materials within the separating pockets is also minimized by dropping the peas into the empty pockets and gradually immersing the measured batches of peas therein, in the brine, and by permitting the brine to gradually but quickly rise through the confined batches of peas to thereby elevate the floaters from the sinkers. By measuring the successive batches which are treated, overloading of the pockets is avoided and complete and accurate separation of the several grades, is assured. In this connection, attention is directed to the cut away portion 80 of the top plate 44, which during loading of the upper pocket portions, positively prevents cutting of the peas. This cut away portion extends circumferentially beyond the delivery edge of the measuring plate 45 and the peas begin to drop from the measuring portions 39 of the pockets before they reach the end of the recessed portion 80.

The clearances between the stationary plates 45, 72 and the adjacent pocket forming members are sufficient to permit these fixed plates to float between these members while rotating, without introducing excessive fric-

tion losses and without introducing agitation of the material in the advancing pockets. The alternate pockets of the series are formed as shown for structural reasons, and construction of the machine is also facilitated by forming the base plate 47 of equal segments, and by forming the several members 35, 36, 37, 38 of equal height and diameter.

The common operating lever 71 simultaneously controls both the brine supply valve 69 and the belt shifter 73, but when operating the units in series, the uppermost unit of the series should be stopped first in order to prevent overloading of the intermediate hopper 79 which supplies the next machine. The same power shaft 60 which drives the pump 56, also actuates the gears 59, 58, 85, 57 and thereby positively rotates the pocket forming members about the inclined overflow pipe 55. The pins 86, besides serving to transmit the rotating motion from the lower member 38 to the upper members 37, 36, 35, also provide for convenient removal of these members from each other and from the centering sleeve 54.

When it is desired to dismantle one of the improved units, the power should be shut off and the brine should be removed from the basin 31 by removal of a drain plug located at the lowest portion of the basin. The hopper 32 may then be slipped from its retaining pins 81 whereupon the stationary top plate 44 may be likewise removed from the pins 83. When the hopper and the top plate have been withdrawn, the members 35, 36, 37 may be freely removed in succession from the driving pins 86 and from the centering sleeve 54. After removal of the upper member 35, the stationary measuring plate 45 may be withdrawn from the pins 82, and the fixed separating plate 46 may be likewise removed from the pins 83 after the member 36 has been withdrawn. When these various elements have been removed, the lower member 38 is freely removable with the ring gear 57, thereby permitting removal of sediment from the collecting chamber 89 beneath the bottom plate 47 and also enabling thorough cleansing of the removed parts. The mode of assembling the structure will be readily understood from the foregoing description and it will be noted that the various elements are retained in normal position by gravity. This arrangement provides a separating unit, which, while being extremely simple and compact in construction and thereby occupying minimum floor space, has enormous capacity as a grader.

From the foregoing detailed description, it will be apparent that the invention not only provides a simple and highly efficient method of removing objectionable materials such as hard floaters and the like from wholesome materials but it also provides a method of accurately grading materials of different specific gravity. The granular material is in fact subjected to the grading action of a solution of uniform density and depth, for only a sufficient length of time to insure thorough separation, and objectionable agitation is absolutely avoided while maintaining a sufficient circulation of the brine to insure uniformity in its consistancy. The improved unit may be readily manufactured and operated at minimum cost, and has proven highly successful in commercial operation.

It should be understood that it is not desired to limit the invention to the exact steps of the method and to the precise details of construction of the apparatus herein shown and described, for various modifications within the scope of the appended claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:—

1. In combination, a movable pocket, means for delivering peas into said pocket while in motion, means for admitting liquid upwardly through said pocket while in motion to separate the floating peas from the sinkers, and stationary means for segregating said pocket into upper and lower divisions to prevent commingling of the separated materials.

2. In combination, means forming a bath of liquid, a series of pockets movable downwardly into said bath, means for delivering peas into said pockets while in motion, means for admitting liquid from said bath upwardly through said pockets during movement thereof into said bath to separate the floating peas from the sinkers, and stationary means for independently removing the separated materials from said pockets in succession.

3. In combination, an annular series of pockets rotatable about an axis, means for delivering batches of peas into the successive pockets of said series while in motion, means for admitting liquid upwardly through the successive loaded pockets to separate the floating peas from the sinkers, and common means for segregating the successive pockets into upper and lower divisions and for independently removing the materials from the said divisions.

4. In combination, a liquid basin, an annular series of pockets rotatable about an inclined axis so as to cause the successive pockets to pass through the liquid of said basin, means for delivering peas to the successive pockets prior to immersion thereof in said liquid, and means for dividing each of said pockets into upper and lower portions while leaving said liquid.

5. In combination, an annular series of pockets each having superimposed divisions, means for filling the uppermost division of each pocket with peas to produce a measured batch of the material, means for subsequently effecting precipitation of the measured batches into the lower divisions of said pockets, means for subsequently admitting liquid to

said pockets to separate the floating peas from the sinkers, and means for finally removing the floaters from the upper pocket divisions and the sinkers from the lower pocket divisions.

6. In combination, a plurality of superimposed members forming an annular series of pockets each having several divisions, a measuring plate interposed between the uppermost of said members and a lower member to periodically provide upper measuring portions within said pockets, and a separating plate interposed between several of said members for periodically segregating said pockets into grade separating portions.

7. In combination, a plurality of superimposed members forming an annular series of measuring pockets revolvable about an inclined axis, means for positively revolving one of said members, and a detachable driving connection between each of said members and an adjoining member whereby the successive members may be freely removed and assembled in series.

8. In combination, a liquid basin, a plurality of pockets periodically movable through said basin to hydraulically grade material confined in said pockets, a plurality of independent liquid tanks, common means for independently maintaining predetermined density of the liquid in each of said tanks, and a pump for continuously circulating liquid through said basin and a selected tank of said plurality.

9. In combination, a liquid basin, a pocket periodically movable into said basin to admit liquid from said basin upwardly to said pocket, means for admitting granular material to said pocket while in motion prior to entry thereof to said basin, and stationary means for segregating said pocket into upper and lower divisions while said pocket is being withdrawn from said basin.

10. In combination, a liquid basin, a series of pockets successively movable into said basin to admit liquid from said basin upwardly to said pockets, means for admitting granular material to the successive pockets of said series prior to entry thereof to said basin, and common means for segregating the successive pockets of said series into upper and lower divisions while leaving said basin.

11. In combination, a pocket movable along a definite path, means for delivering granular material into the upper end of said pocket, means for admitting liquid to said pocket through the lower end thereof, and stationary means for segregating said pocket into upper and lower divisions while the liquid is being removed therefrom.

12. In combination, a series of pockets continuously revolvable about an inclined fixed axis, means for admitting granular material to each of said pockets while in its uppermost position, means for admitting liquid to each of said pockets during its downward travel, and means for subsequently segregating each pocket into upper and lower divisions while the liquid is being removed therefrom.

13. In combination, a series of pockets continuously revolvable about an inclined fixed axis, means for admitting granular material to each of said pockets while in its uppermost position, means for submerging each of said pockets in a liquid while in its lowermost position, and means for segregating each pocket into upper and lower divisions during removal thereof from the liquid.

14. In combination, a plurality of superimposed members forming an annular series of measuring pockets revolvable about an axis, means for positively revolving the lower of said members, a detachable driving connection between said members whereby the successive members may be freely removed and assembled in series, and a series of plates disposed between said members and cooperable therewith to segregate the successive pockets into upper and lower divisions during revolution thereof.

15. In combination, a plurality of loosely superimposed annular members forming a series of pockets revolvable about an axis, means for positively revolving one of said members, a detachable driving connection between said driven member and the other of said members, and a detachable stationary plate extending between two of said members, said plate being formed to segregate the successive pockets into upper and lower divisions during revolution thereof about said axis.

16. In combination, a plurality of superimposed members forming an annular series of pockets revolvable about an axis, a perforated plate providing a support for said members and forming a closure for the lower pocket ends, and a stationary plate extending between said members and resting directly upon a lower member.

In testimony whereof, the signature of the inventor is affixed hereto.

OSWALD H. HANSEN.