

July 15, 1969

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3,455,446

APPARATUS AND METHOD FOR ADVANCING OBJECTS TO GAUGING SLOTS

Filed Sept. 5, 1967

3 Sheets-Sheet 2

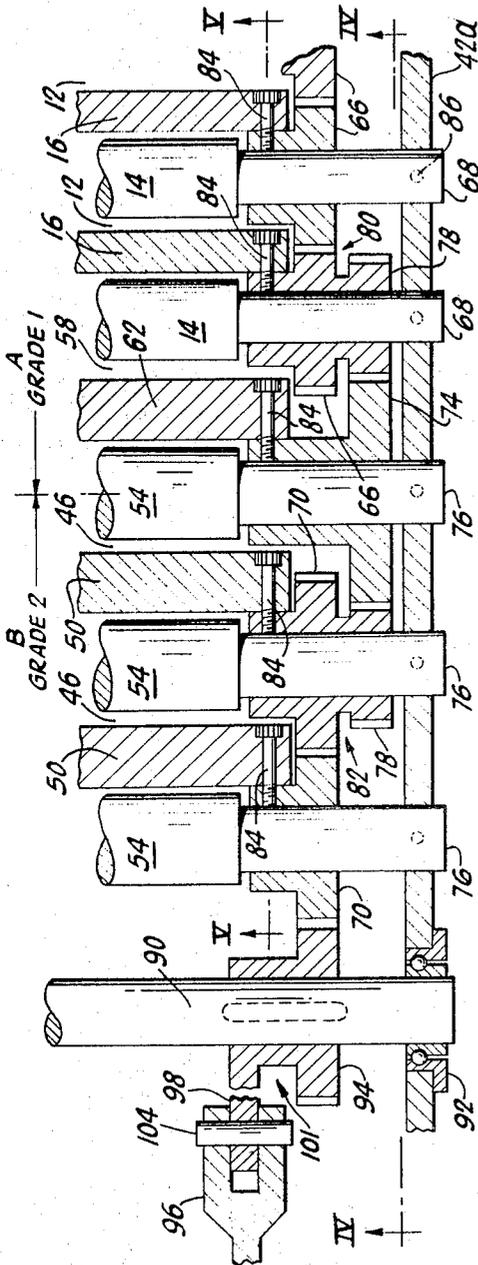


FIG. 3

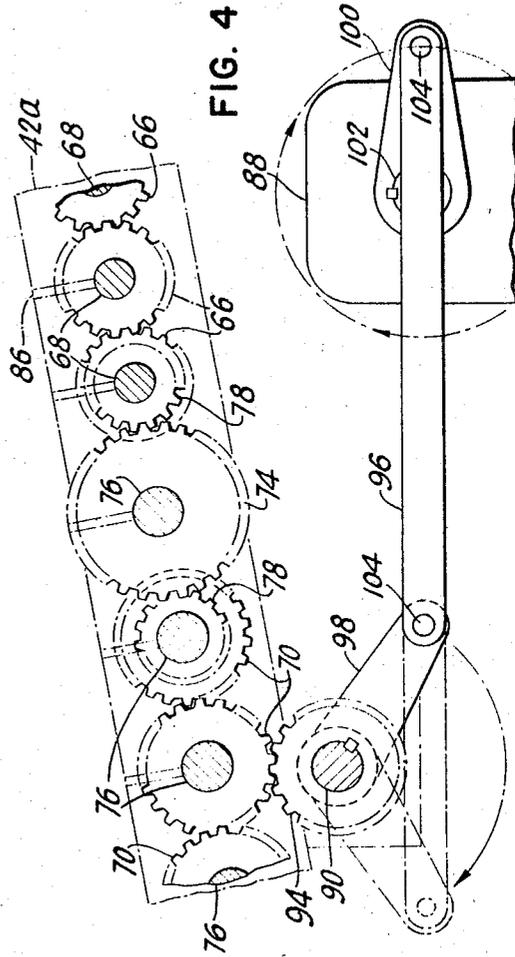


FIG. 4

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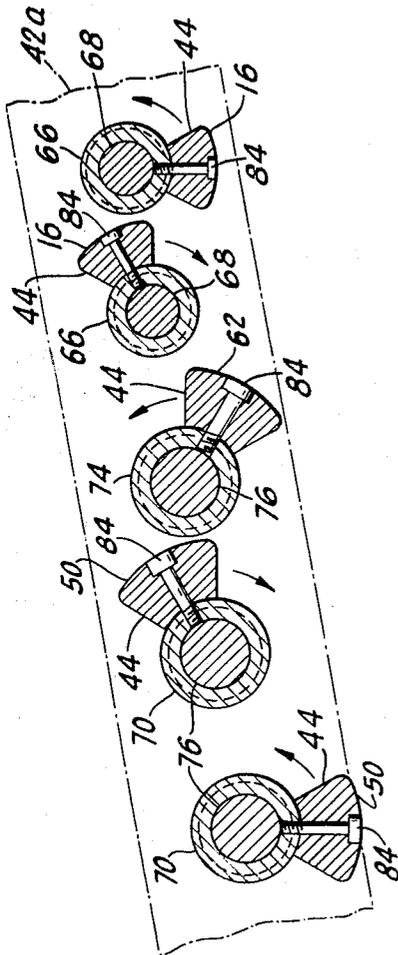


FIG. 5

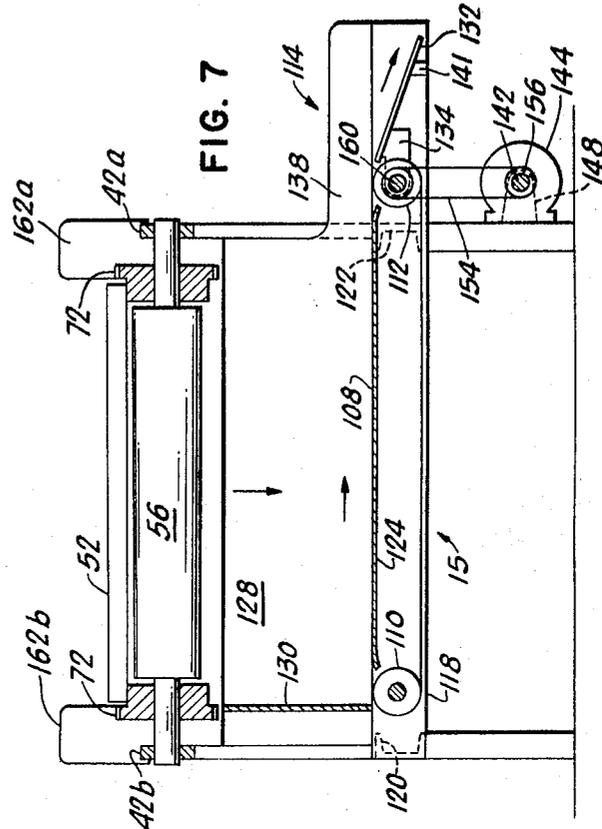


FIG. 7

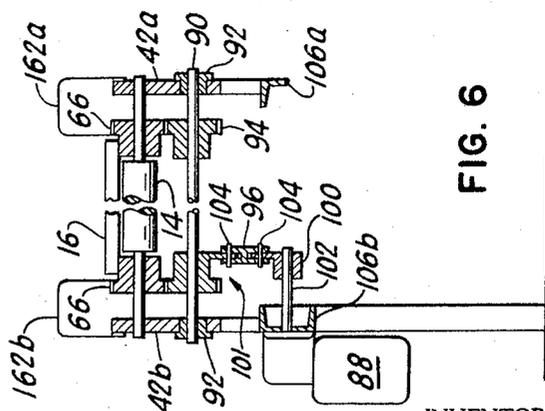


FIG. 6

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APPARATUS AND METHOD FOR ADVANCING OBJECTS TO GAUGING SLOTS

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U.S. Cl. 209—98

18 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for sorting substantially symmetrical objects according to size comprising an inclined sorting table provided with several gauging stations for sorting the objects into successively larger sizes downstream from a supply; each of said stations having a plurality of gauging slots defined by a pair of stationary rolls in spaced apart relationship through which objects of the same or lesser size may pass, each slot having an advancing member reciprocally rotatable in an arc through the gauging slot with alternate members reciprocating at 180° out of phase with respect to the other members for dislodging and advancing those objects larger than the gauging slot to the adjacent downstream slot; the apparatus preferably having laterally driven conveyor belts underlying each station for removing the objects sorted by the stations.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates generally to the classifying, separating, and assorting of solids and more particularly to the assorting of solids by gauging slots provided with bars and rollers.

Description of the prior art

Prior art devices are of many types, depending mostly on the kind of article to be sorted. Insofar as they are pertinent to the present invention, it can be said that they are generally provided with a plurality of gauging pockets or slots of varying sizes through which articles of the same or smaller size are caused to pass. The pockets are generally defined by a succession of rotating parallel grooved rollers, subsequent pairs of which have increasingly larger grooves through which the increasingly larger objects pass. Stockdale Patent No. 2,244,546 illustrates this type of apparatus.

Gauging slots are usually defined by a plurality of ungrooved rollers spaced parallel to each other at increasingly greater distances to provide wider gauging slots downstream from a supply of the objects to be sorted.

Generally the rollers forming the pockets or slots are rotatably driven as a means of advancing the objects to the subsequently larger gauging openings. Some devices are provided with elaborate devices for removing objects too large for the gauging pocket and advancing them to the next larger pocket as, for example, illustrated in Adams Patent No. 1,183,156 and Laase Patent No. 2,830,703. Of the ones using rotating rollers for advancing the objects, some of them have subsequent downstream rollers rotating faster in the same direction than the preceding roll to help advance the object and to prevent pinching of the object between the rollers. Apparatus of this type is illustrated in Hodecker Patent No. 2,370,539.

One common drawback to the use of the foregoing devices is that delicate objects are likely to be damaged by the rotating rollers such as by pinching or crushing them and, in the case of fruits and vegetables having skins, rupturing or removing the skins.

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SUMMARY OF THE INVENTION

Accordingly an object of the present invention is to provide a simplified assorting apparatus for sorting objects into groups of a desired size range without damaging the objects.

The present invention provides a plurality of non-rotating gauging rolls spaced to define successively larger gauging slots. By utilizing stationary rolls, damage to the objects being sorted, such as pinching, crushing, and skinning, is thereby avoided. Thus, there is no tendency for the objects to become wedged between the rolls and suffer damage thereby.

To advance objects too large to pass through one gauging slot downstream to a larger slot, advancing bars are provided which reciprocate in an arc through the gauging slots from a position beneath the gauging rolls to a position above the slots. Preferably, alternate ones of the advancing bars reciprocate in a forward or advancing motion as the others reciprocate backward from the advancing position. In this manner, the objects are presented to a first slot for gauging and, if too large for the slot, will be advanced to the next larger slot until it finally reaches a slot corresponding to its size. Because the advancing bars accelerate from a standstill, the possibility of impact damage is reduced.

Preferably, the gauging slots are arranged in groups of a given size to provide the production capacity required or to compensate for overfeeding. Thus, should more objects be presented to a first slot in a group than can pass therethrough during advancing cycles of the advancing bars, the remaining objects are merely advanced to the next downstream slot. The number of equal size slots in a group can be varied according to the type of object being sorted and the speed at which it is desirable for the machine to run.

A transversely extending conveyor under each group of gauging slots can be used to great advantage for removing the sorted objects to a position to the side of the machine where they can be easily handled. For example, the objects can thus be transported to containers at the ends of the conveyors or else to other conveyors leading to subsequent handling operations or packaging.

Depending on the nature of the objects to be sorted, the first group of gauging slots may be used to separate out objects too small for use or to separate dirt or debris fed to the machine along with the objects. If some objects larger than a given size are not useful or if it is not desirable to classify them, they can be passed out of the machine at the downstream end beyond the last group of gauging slots.

The present invention is particularly useful for sorting clams which are somewhat fragile in some respects. By way of example, the drawings and description refer to apparatus for sorting large numbers of clams as a preferred embodiment of the invention although the apparatus may be used, or be readily adapted for use, for sorting a variety of objects.

The above and further objects and novel features of the invention will appear more fully from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are not intended as a definition of the invention but are for the purpose of illustration only.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a side elevation of a preferred embodiment of the invention diagrammatically illustrating the gauging slots arranged in sorting groups and showing the relative positions of the advancing bars at one end of their reciprocating cycle as well as the transverse conveyor positioned under the sorting groups;

FIGURE 2 is a plan view of the invention of FIGURE 1;

FIGURE 3 is a section taken along the line III—III in FIGURE 1 illustrating the preferred gearing arrangement for reciprocating the advancing bars through the gauging slots;

FIGURE 4 is a section taken along the line IV—IV of FIGURE 3 illustrating the driving arrangement for the gears of the advancing bars;

FIGURE 5 is a section taken along the line V—V of FIGURE 3 showing the stationary rolls and advancing bars in greater detail;

FIGURE 6 is a partial cross-section diagrammatically illustrating the drive mounting and linkage for driving the machine; and

FIGURE 7 is a cross-section taken along the line VII—VII of FIGURE 1 diagrammatically illustrating the arrangement of the transverse conveyors.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGURE 1, the sorting apparatus for separating objects of a selected size from a supply of a mass of the objects comprises generally a sorting table having a plurality of laterally extending pairs of annular parallel stationary rolls that define gauging slots therebetween. The slots range in width, from a feed end of the table, from small to large. These slots correspond in width substantially to the thickness of the objects being sized which pass through the slots while the oversize objects remain supported by the rolls defining the slots. Advancing bars are provided for periodically extending through the slots for advancing downstream the oversize objects supported on the rolls. The advancing bars are rotated in an arc which passes from beneath the rolls, and through the slots to a position above the rolls. Motor means and gears are provided for cyclically operating alternate ones of the bars in a first direction and the remaining bars in an opposite direction. A discharge means is provided below the slots for receiving objects selectively separated from the mass by the gauging slots, which slots may be arranged in groups of the same size. The discharge means is preferably a driven transverse conveyor for carrying the graded objects beyond the side of the machine.

Referring now to FIGURE 1, more specifically, the sorting machine is divided into sorting groups A, B, C, and D for sorting a mass of objects such as clams into four grades. Feeding apparatus 10 is provided for feeding the mass into group A which separates those objects of a given size or smaller (grade 1) from the mass. Grade 1 objects pass through grading slots 12 defined by stationary rolls 14 and onto a transverse delivery conveyor assembly 15 which transports them outside the machine. The remainder of the mass is advanced to group B by advancing bars 16 which reciprocate about stationary rolls 14 in an arc through the grading slots 12 to the positions shown by the dotted lines. Arrows, shown only in group C, indicate the arc of travel of the advancing bars forward and backward through the grading slots. The other arrows indicate the travel of graded objects through the grading slots and onto and out of the conveyors as well as the advance of ungraded objects throughout the machine.

Objects of the next given size (grade 2) are separated from the mass in group B in a fashion similar to that described for group A. Thereafter, the remainder of the mass is likewise subjected to sorting in group C. Any objects larger than the grading slots of group C are advanced to the end of the machine where they may be collected under the discharge chute 18.

Feeding apparatus 10, FIGURES 1 and 2, comprises an endless conveyor 20 surrounding a pair of pulley shafts 22 and 24 each rotatably mounted in spaced side frame portions 26a, 26b in a conventional manner. Pulley shaft

24 is driven by a motor 28 through a drive belt 30 surrounding a pair of pulley wheels 32 and 34 secured to the motor 28 and pulley shaft 24 respectively. Motor 28 is conveniently mounted to frame 26b.

A hopper member 36 is secured to the frame members 26a, 26b by brackets (not shown) and extends across the upper run of conveyor 20 to prevent a mass of objects placed on the conveyor from falling. Side guides 38a, 38b are also provided along the lateral edges of conveyor 20 to retain the mass on the conveyor.

Bridge plate 40 spans the space between conveyor 20 and the first of stationary rolls 14, being secured to side frames 26a, 26b in any convenient manner. The mass is thereby introduced gently into sorting group A.

The sorting groups A, B and C are substantially identical except for the difference in size of the stationary rolls and advancing bars, so for the purpose of brevity, only group A will be described in detail.

Sorting group A for the grade 1 objects comprises, as illustrated herein, five rolls 14 supported between frame portions 42a and 42b. Rolls 14 are spaced substantially equidistant to define four grading slots 12 through which grade 1 objects may pass. The spacing is selected in accordance with the size of the objects desired to pass through grade 1 and slots 12 as grade 1 objects.

Advancing bars 16 are provided for each slot 12 and are arranged to reciprocate through slots 12 in an arc about their respective rolls 14 from a lower position to an upper position. Alternate ones of bars 16 are arranged to be in the lower position as the others are in the upper position as indicated in FIGURE 1. Grade 1 objects will fall through alternate slots 12 when the bars 16 associated with those slots are in the lower position. Objects too large to pass through slots 12 will remain supported in the upper portion of the slots by rolls 14. As bars 16 reciprocate or oscillate, the ones in the lowermost position will rise thereby lifting oversize objects out of slots 12 and advance them downstream. Simultaneously, the bars 16 in the uppermost position will rotate downward thereby opening the associated slot 12 to receive objects advanced from the preceding upstream slot.

Advancement of the objects is accomplished by rotating bars 16 in an arc about the upstream side of their associated rolls 14. Thus, the lifting surface 44 of each bar urges the oversize object in a downstream direction as it rises above the horizontal and continues to a point near the top of roll 14. Although not essential, it is helpful to incline frame portions 42a, 52b downwardly toward the downstream end of the machine at an angle of, for example, 10 degrees. Consequently, downstream advancement of the mass is aided by gravity.

Sorting groups B and C are similar in all respects to group A except that slots 46 of group B and slots 48 of group C (corresponding to slots 12 in group A) are larger to accommodate the larger selected grades 2 and 3. Obviously, the thickness of group B advancing bars 50 and group C advancing bars 52 should correspond to the greater widths of slots 46 and 48 respectively. Preferably, group B rolls 54 and group C rolls 56 are of successively larger diameter than rolls 14 of group A.

This is particularly desirable in machines for sorting clams since the bi-valve dimension of the clam is the one being gauged for sorting purposes. Thus, it is desirable to have the clam standing on edge in the gauging slot rather than bridging the slot. Obviously, the larger the roll diameter, the greater the distance between the vertical centerlines of the rolls. So as the horizontal spacing between centerlines exceeds the length of the clam, the less chance there is that bridging will occur. The shorter spacing at the beginning of the machine, because of the smaller rolls, is helpful in advancing the larger clams since they tend to bridge. In this manner, they skid across the smaller rolls instead of standing up in the slots with the need for dislodging by the advancing

bars. Of course, where the sorted objects are nearly round, the size of the roll bears no particular relation to the width of the gauging slot.

Sorting group D for grade 4 objects comprises only discharge chute 18 which guides all the objects larger than grade 3 into a container (not shown).

As illustrated in FIGURE 1, an intermediate slot 58 is provided between the last downstream roll 14 of group A and the first upstream roll 54 of group B. A similar slot 60 is provided between corresponding rolls of groups B and C. Advancing bars 62 and 64 associated with these slots are so arranged that their lowermost position fills the slots to prevent passage of objects therethrough. Upward travel of these bars advances the objects resting on their lifting surfaces 44 in the same manner as described for the other lifting bars. This feature is not essential but is provided as a convenience of manufacture to leave a space between the collection apparatus associated with the delivery conveyors 15 (to be subsequently described).

A preferred mounting and driving arrangement for the advancing bars is illustrated in FIGURES 3, 4, and 5. Conventional spur gears 66 are mounted for rotation about reduced diameter journal portions 68 on both ends of rolls 14 in group A for driving engagement with each other. Similar gears 70 and 72 (72 not shown) are similarly mounted to rolls 54 and 56 of groups B and C respectively. Gears 66 and 70 of adjoining groups A and B are engaged for rotation through intermediate gear 74, mounted for rotation about journal 76 of the first upstream roll 54 of group B, and gears 78 mounted for rotation about the respective journals of the adjacent rolls 14 and 54. Gears 78 and 66 may be conveniently made as an integral compound gear 80 and likewise gears 78 and 70 form compound gear 82.

It can be seen that the advancing bar 62 that passes through slot 58 is mounted to the same roll 54 that carries the gear 74. By making intermediate gear 74 approximately twice as large as the gear 78, it will accordingly reciprocate in an arc about half the length of the arc traversed by the other advancing bars. In this manner, the slot 58 is never fully opened as shown in FIGURE 1. Similar gears (not shown) are provided for connecting groups B and C for rotation and to reciprocate advancing bar 64 through slot 60 in a short arc so as not to fully open the slot.

Advancing bars 16 of group A are secured to gears 66 on both ends of rolls 14 such as by screws 84, passing through the bars and threaded into the gears as shown in FIGURE 3. Thus, reciprocation of the gears carries the advancing bars in an arc about their respective rolls. Rolls 14 are held against rotation in frame portions 42a, 42b by set-screws 86 threaded in the frame portions against journals 68. The rolls 54 and 56 of groups B and C are likewise held against rotation. Advancing bars 50, 52, 62, and 64 are secured to the respective gears of groups B and C in the manner described for group A.

A clearance, although not essential, is preferably provided between the advancing bars and the rolls by making the thickness of the bars slightly less than the spacing of the slots. Thus, wear of the rolls and bars is avoided such as might be caused by grit or other debris associated with the objects being sorted. When extremely fragile objects are being sorted, the advancing bars may have a coating of soft material, such as polyurethane, bonded, or otherwise applied, thereto. Any impact damage tending to occur from the lifting of oversize objects from the slots by the lifting bars can thus be damped. If preferred, the rolls also may be similarly covered.

As previously indicated, the advancing bars reciprocate in an arc through their respective slots. A conventional linkage arrangement, FIGURES 4 and 6, is provided to translate rotary motion from a motor 88 to reciprocating motion in the gears connecting the advancing bars for reciprocation. The linkage comprises a drive-shaft 90 supported in bearings 92 secured to frame portions 42a, 42b. Drive gears 94 are secured for rotation with the

shaft 90 and in engagement with gears 66 on each end of one of the rolls 14 of group A. (For convenience, FIGURE 4 shows drive gears 94 engaging gears 70 of group B. Obviously, the drive gears may be engaged to any of the gears in the train provided the proper proportions are maintained.) The drive-shaft 90 is reciprocated in an arc by a link 96 pivotably connected on its one end to an arm 98 secured to the drive-shaft and on its other end to an arm 100 secured to the motor output shaft 102. Arm 98 and one of the gears 94 may be used to connect the link 96 with the arms 98 and 100. Thus, it can be seen that as motor shaft 102 rotates, link 96 imparts reciprocating motion to arm 98, as shown by the dotted lines in FIGURE 4, which is translated to the gears 66 via drive-shaft 90 and drive gears 94.

FIGURE 5 shows the corresponding positions of the advancing bars 16, 62, and 50 of groups A and B and their respective directions of travel upon reciprocation of link 96 by motor 88. The bars 64 and bars 52 of group C operate in a similar fashion as illustrated in FIGURE 1.

As illustrated in FIGURE 6, gearmotor 88 may be flange-mounted to frame portion 106b so that its output shaft 102 extends inwardly through the frame portion for connection with link 96 via arm 100. The proportions of the arms and link are chosen in the known manner to achieve the length of arc travel desired for the advancing bars. For the present invention, an arc of approximately 160 degrees is satisfactory, being substantially evenly divided into an 80 degree travel above and below horizontal. The length of arc may vary depending on the type of objects being sorted. The gearmotor output speed is chosen to operate the machine at the desired speed, it being understood that the speed may necessarily vary depending upon the nature of the objects being sorted.

Although drive gears 94 are illustrated as being about the same size as gears 70, they are preferably about twice the size of gears 70. Thus, gears 70 will reciprocate in an arc about twice the length of that of gears 94. This permits the arc for lever 98 to be about half of that shown which is more efficient in the type drive linkage described.

The transverse delivery conveyor assemblies 15 are all of similar construction. Accordingly, the following description of the assembly beneath group C will suffice for all.

As viewed in FIGURES 2 and 7, grade 1 objects passing through grading slots 48 fall upon an endless conveyor belt 108 surrounding a pair of driven pulleys 110 and 112 and are carried thereby to a discharge chute assembly 114 outside the machine. Pulleys 110 and 112 are supported for rotation in a conventional manner between a pair of spaced rail members 116 and 118 which are secured to frame portions 120 and 122 with the rails extending beyond frame portion 122 to support pulley 112. A generally flat support member 124 extends between, and is joined to, the rails 116, 118 beneath the upper run of belt 108 to provide a rigid support for the upper run between the pulleys. A conventional belt tightener (not shown) may be employed to maintain tension in the belt if desired.

A delivery hopper comprising sloped side members 126 and 128, as illustrated in FIGURE 1, are provided for guiding the graded objects onto belt 108. These members may be suitably joined along their lower edges to the tops of rails 116 and 118 and their ends may likewise be joined to frame portions 120 and 122. An end member 130 is also provided to prevent spillage of the graded objects from the conveyor belt 108 near pulley 110. Member 130 is shaped to close the opening between side members 126 and 128 and is joined thereto in a suitable manner.

Discharge chute 114 comprises a pan 132 pivotably connected to pulley 112 by a pair of hinges 134 connected to the edges of pan 132 and surrounding pulley shaft 160 of pulley 112. Pan 132 slopes downward from the upper run of conveyor belt 108. The sides of chute 114 are

formed by the extending rails 116 and 118 and by extended portions 138 and 140 of side members 126 and 128 respectively.

Suitable stops 141 secured to rails 116 and 118 limit the downward slope of pan 132 to the position shown in FIGURE 7. However, the pan can be pivoted above horizontal to stop the flow of objects therefrom. This permits attendants collecting the graded objects to stop the flow of objects therefrom. This permits attendants collecting the graded objects to stop the flow of objects from the pan 132 so that empty collecting containers can be substituted for filled ones. In the event that more completely automatic operation is desired, the pan 132 may be raised by an air cylinder or the like (not shown) connected in a conventional manner to raise the pan when the collecting containers are filled. The air cylinder may be activated by an electric eye set to be tripped by the height of the objects in the container. Another means for activating the air cylinder would be to energize a weight-sensitive switch beneath the containers.

All of the conveyor assemblies 15 are driven by a line shaft 142 connected to an electric motor 144 mounted to frame portion 146. The line shaft 142 is supported by pillow block bearings 148 fastened to upstanding frame portions 150a, 150b, and 150c. The driven end of the shaft is preferably connected to motor 144 through a gear box 152 which reduces the speed of the motor to drive the conveyors at relatively slow speeds.

The pulleys 112 are driven from the line shaft 142 by roller chains 154 surrounding sprockets 156 mounted to shaft 142 and sprockets 158 mounted to the pulley shaft 160 of pulleys 112 which extend through rail 118.

As best illustrated in FIGURE 7, guide rails 162a and 162b are provided adjacent the ends of the various advancing bars to retain the mass along the sorting path. The guide rails 162a, 162b preferably are formed to cover the various gears to prevent contamination by foreign matter. The guide rails may be joined to the frame portions 42a, 42b by bolts or the like (not shown).

The discharge chute 18 for group D, previously mentioned, extends laterally across the width of the machine and is suitable secured to upstanding frame portions 150d. The chute preferably is sloped downward away from the last stationary roll 56 as shown.

OPERATION

To operate the machine, the feed motor 28, advancing bar motor 88, and conveyor motor 144 are all energized, from a suitable power source (not shown), thereby activating the feed conveyor 10, the advancing bars 16, 62, 50, 64, and 52, and the delivery conveyors 15. A mass of objects to be sorted is placed in front of hopper member 36 on the feed conveyor 20 which immediately advances the mass downstream where the objects slide over bridge plate 40 into the first grading slot 12. If the slot is open, those objects on the bottom of the mass having a width equal to or less than the width of the slot will fall through and be guided by side member 128 onto transverse conveyor belt 108.

If the first slot is fully closed by advancing bar 16, as indicated by the dotted lines in FIGURE 1, all or part of the mass will rest against the advancing bar and roll 14. If the mass is large, part of it may spill over the bar and into the next slot 12, which would then be open. When the first advancing bar moves to its lowermost position, the objects of proper size, as indicated above, will fall through the slot. Those objects larger than slot 12 will remain in or near the slot, being supported by the first and second of rolls 14. Thereafter, bar 16 will rise and thereby lift the oversize objects out of the slot and urge them in a downstream direction over the second of rolls 14 and into the second of slots 12. The grading of grade 1 objects will continue in a similar fashion throughout group A. By the time the mass reaches the last of slots 12, all of the grade 1 objects will have been graded, that

is, they will have fallen through the slots and onto conveyor belt 108.

When the mass reaches slot 58, which is never fully opened, it merely rests in the slot until the bar 62 lifts the objects and urges them downstream in the same fashion as described above. When the mass enters group B, the grade 2 objects are graded in the same manner as those in group A. The remainder of the mass ungraded by group B will advance to group C where grade 3 objects are sorted out. Any of the objects larger than grade 3 will be advanced over the last of rolls 56 and down the chute 18. Obviously, all objects larger than grade 3 objects are classified as grade 4 objects.

As the various grades of the objects fall from the grading slots, they descend directly to the conveyor belts 108 or are guided onto it by side members 126 and 128. The belts 108 carry the objects outside the machine and discharge them into the discharge chute 114 where they will slide down pan 132 into suitable containers (not shown) provided for collecting the graded objects. One or more attendants can supply empty containers and remove the filled ones. As previously mentioned, the discharge of objects from pans 132 can be temporarily halted during the change of containers. The discharge from chute 18 can be handled in a like manner. If desired, additional conveyors may be positioned so as to receive the discharge of objects from pans 132 and carry them elsewhere for further processing.

Even though only the preferred construction of the invention has been described, various modifications will, of course, be obvious to those skilled in the art. For example, if a mass is to be graded into just two sizes, only one pair of rolls, e.g. rolls 14, would be required along with one appropriate advancing bar. A small mass, or a small mass fed slowly into the grading slot, could be separated in this manner. The number of grading groups is merely made commensurate with the number of grades desired. Similarly, the number of grading slots in the sorting group can be varied in accordance with the quantity and nature of objects to be sorted.

No integrally contained feed mechanism, such as feed apparatus 10, is required since the mass can be placed manually in the first sorting group. The mass can also be transported from a supply by a conveyor and discharged directly into the first sorting group.

While the intermediate slots 58 and 60 have been illustrated in the preferred embodiment, they are not essential. The mass can be advanced directly from one sorting group to the other. Suitably modified conveyor assemblies 15 will maintain separation of the graded objects.

The conveyor assemblies 15 are preferred since the removal of collecting containers from within the machine would otherwise be very difficult. If it is expedient, a simple inclined chute can be used in lieu of the conveyor assemblies. A water trough may replace the conveyor assemblies 15 to handle extra delicate objects such as tomatoes or other fruits.

As previously mentioned, the stationary rolls and advancing bars may be provided with a soft covering when so required by the objects to be graded. The side members 126 and 128 may likewise be covered as well as the various discharge chutes.

Should the objects being sorted require cleaning, as clams often do, it may be desirable to add a washing attachment above sorting group A. Such an attachment could comprise, for example, a laterally extending pipe having holes therein directed towards the mass for cascading water over the objects. In this event, the discharge conveyor assembly could be modified to catch the dirt and water with provision for draining the water. Steam cleaning can likewise be employed or air drying of wet objects fed to the machine.

Although the advancing bars have been illustrated as being driven by a motor through suitable gears, if desired, a linkage arrangement of easily calculated proportions

driven by a reciprocating hydraulic or air actuator can be satisfactorily employed.

As an example of the operation of this invention, the machine of the type disclosed in FIGURE 1 was used to sort clams. Previously, clams had to be sorted by hand which is a tedious and laborous operation. The machine used differed from the machine illustrated in FIGURE 1 in that, instead of the sorting groups illustrated, the machine used had five sorting groups, each having 5 grading slots for separating a mass into six grades. The effective width of the machine was approximately 60 inches. The speed of the feed belt was about 12 feet per minute with the advancing bars reciprocating at 20 cycles per minute. The discharge belts moved at 35 feet per minute. Under the above conditions, the machine sorted 75 bushels of assorted clams per hour with 3 attendants required to run the machine, one feeding the machine and two handling the sorted clams. To sort the same quantity of clams manually in one hour would require nine attendants. Thus, considerable savings in labor costs are realized by using the machine. It should be understood that the quantity sorted by both men and machine will vary according to the size range of clams being sorted. Where the majority of the mass is large, less time will be required per unit volume. Conversely, when the majority is smaller, more time will be required. The figures given are approximately average.

Having thus described the invention in its best embodiment and mode of operation, what is desired to be claimed by Letters Patent is:

I claim:

1. Sorting apparatus for separating objects of a selected size from an upstream supply of a mass of said objects, comprising:

a support;

a pair of parallel stationary members extending transversely across said support and spaced apart on said support a distance that defines an elongated gauging discharge slot whose width corresponds to the thickness of said objects of selected size so that said objects of selected size may pass therethrough and which has an entrance portion for supporting oversize objects;

advancing means for periodically extending through said slot toward said entrance portion for advancing said oversize objects downstream from said slot; and drive means for periodically operating said advancing means.

2. The apparatus of claim 1 wherein said advancing means comprises a member smaller than said slot that moves in an arc about one of said pair of parallel stationary members for moving said oversize objects downstream.

3. The apparatus of claim 2, and in addition:

a plurality of said parallel stationary stationary members arranged parallel to each other in operative sequence to provide a plurality of gauging slots the width of which becomes progressively larger downstream from said supply for forming sizing groups for separating progressively larger selected sizes of said objects from said mass; and an advancing means for each of said gauging slots.

4. The apparatus of claim 3 wherein each of said sizing groups has a plurality of said slots of equal size with corresponding advancing means whereby larger quantities of each of said selected sizes may be separated from said mass.

5. The apparatus of claim 3 including an intermediate pair of said stationary members for providing an intermediate gauging slot for separating one sizing group from the other and an intermediate advancing means within said intermediate slot periodically operative to extend into said entrance portion for advancing objects supported in said entrance portion,

whereby said mass is advanced progressively downstream from sizing group to sizing group.

6. The apparatus of claim 5 wherein cyclic means are provided for cyclically operating said advancing means and said intermediate advancing means with alternate ones of such means rising toward said entrance portions as the remaining ones descend toward said discharge portions,

said cyclic means including a spur gear on each of said advancing means and said intermediate advancing means in operative engagement with spur gears on adjacent advancing and intermediate advancing means,

said intermediate advancing means gears being approximately twice the diameter of said advancing means gears whereby said intermediate advancing means travel through an arc approximately half the distance traveled by said advancing means so that said intermediate slots are not fully opened to prevent said objects from passing therethrough; and

motor means operatively connected to one of said gears for cyclically operating alternate ones of said gears in a first direction and the others of said gears in an opposite direction.

7. The apparatus of claim 3 wherein cyclic means are provided for cyclically operating said advancing means members through said slots with alternate ones of said advancing means rising toward said entrance portions as the remaining ones descend toward said discharge portions,

whereby oversize objects supported by said entrance portions are advanced downstream from alternate slots toward succeeding slots being opened to receive said objects.

8. The apparatus of claim 7, and in addition:

a feed means adjacent the most upstream of said sizing groups for feeding a mass of said objects placed thereon toward said sizing groups.

9. The apparatus of claim 8, and in addition:

discharge means for receiving objects selectively separated from said mass by said sizing groups.

10. The apparatus of claim 9 wherein said discharge means comprises a transverse conveyor beneath each of said sizing groups operative to carry said selectively separated objects to a place adjacent a side of said apparatus.

11. The apparatus of claim 10 wherein said transverse conveyor includes a discharge chute for receiving said selectively separated objects from said conveyor.

12. The apparatus of claim 7 wherein each of said cyclic means includes a spur gear in operative engagement with spur gears on adjacent upstream and downstream advancing means members and motors means operatively connected to one of said gears for cyclically operating alternate ones of said gears in a first direction and the others of said gears in an opposite direction.

13. The apparatus of claim 12 wherein said advancing means members cyclically operate through an arc of approximately 160 degrees.

14. Apparatus for sorting objects according to size, comprising:

a sorting table having a plurality of laterally extending stationary gauging slots that range in width from small to large from a feed end of said table

whereby objects of smaller size than said slots tend to pass through said slots whereas objects larger than said slots do not pass therethrough;

ejecting means movable between said slots for ejecting from said slots those objects that do not pass therebetween; and

means for supplying said objects to said feed end of said table.

15. The apparatus of claim 14 wherein said table is inclined downward from said feed end of said table.

16. The apparatus of claim 15 wherein said slots are defined by pairs of annular parallel stationary members providing entrance portions for said slots for supporting

objects too large to pass through said slots and said ejecting means comprises an advancing member for each slot periodically operative to extend through said slots for advancing downstream said objects supported in said entrance portions.

17. Apparatus for sorting objects according to size comprising:

an elongated support having an upstream end and a downstream end,

a feed at the upstream end for feeding said objects to said support,

a plurality of sizing groups spaced between said ends for removing objects of selected size,

each of said sizing groups including

at least one pair of stationary members extending transversely across said support, said stationary members being substantially circular in cross-section and being spaced apart a distance to define a slot corresponding to the desired size of the portion of objects to be sorted, whereby objects having the desired or smaller size fall through said slot whereas objects larger than the desired size tend to bridge said slot and remain on said stationary members,

an advancing bar rotatable through an arc about the downstream one of said pair of stationary members and through the slot between said stationary members for advancing objects tending to remain on said stationary members downstream, and

means for rotating said advancing bar through said arc,

each of said groups also including means below said slot for receiving the objects of desired size that pass through said slot.

18. A method for sorting objects according to size which comprises:

supplying said objects to the feed-end of a sorting zone which has a plurality of laterally extending stationary gauging slots that range in width from small to large from said feed-end of said zone;

passing said objects through said zone whereby objects having a size smaller than an initial slot in said zone tend to pass through the slot whereas objects larger than said initial slot tend to bridge said slot; and

ejecting through said slots in a downstream direction the objects which bridge said slots, whereby such objects move downstream to the next adjacent slot.

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