This invention relates in general to a vacuum transfer device. More particularly, this invention relates to a bulk vacuum lifter for lifting eggs from a carton, tilting and spreading them, and setting them down on a conveyor.

Eggs received in an egg-packing plant for processing are normally packed vertically in multiecellular egg containers. These containers normally contain multiple rows of eggs, a common combination being five rows of six eggs each.

It is common to lead many different types of grading or processing machines with bulk-handling devices suited to transfer a complete container of eggs at one time. Some machines are adapted to convey eggs in a six-wide-pattern with spacing similar to that of a multiecellular egg flat. Other devices require that the eggs be conveyed with their major axes horizontal to allow for such steps as the rotation of the eggs for inspection of cleaning or for their removal at the end of a conveyor by a rolling action. A common type of conveyor for horizontal placement of the eggs is the roller type or the spool type. In either case a matrix of rolls or spools aligned parallel with their axes perpendicular to the movement of the conveyor is used to support and to rotate the eggs.

Since eggs are oblong in shape, more room is required in the lateral dimension of a conveyor to arrange eggs lying end-to-end on their sides than to place them vertically. Since the standard multiecellular package in which eggs are received achieves rather close spacing of the individual eggs, a problem is introduced in trying to load in bulk from such a package to a conveyor for horizontal alignment of the eggs.

In cases where it is desired automatically to package eggs moving on a rotating spool or roller conveyor it is necessary to insure correct orientation of the small end of the egg, since it is necessary that the small end eventually be placed point down in its package. If hand orientation in the packing plant is to be avoided, as well as the use of reorienting devices, it is necessary to preserve the original correct orientation of the eggs in their multiecellular package as received from the producer.

Since both hand and automatic reorientation are expensive in terms of broken eggs, as well as in labor and equipment cost, it is most desirable to retain the original orientation of the eggs. This is the case even where eggs are removed from the roll or spool conveyor by hand, since this will reduce the work load of the person removing the eggs.

A further problem is presented by the fact that eggs are of different sizes and, hence, if packed into a carton or filler flat the tops will not all lie in a single plane. Bulk vacuum lifters of the types which have heretofore been available have not been adjustable vertically except to the extent that a system of bellows used in connection with the cups may provide for temporary vertical adjustment of cup levels. But even these bellows-equipped lifters operate to lift each egg to a point where the topmost end of each egg is at the same level as the topmost end of each other egg lifted at that time. The result is that the lower ends of the eggs will be at different heights and, following release, will fall varying distances to a supporting surface, conveyor, carton, etc. The smaller eggs, the lowermost ends of which will be raised relatively higher, will be dropped a distance which may be sufficient to damage them. Hence some means is necessary to adjust vertically the individual lifters in accordance with the varying lengths of the eggs lifted and to maintain the lifters for individual eggs in such a vertically adjusted manner until such time as the eggs are released whereby to insure that the lowermost ends of the eggs are always at the same height from the surface to which they are to be dropped.

It is therefore an object of this invention to provide means for transferring eggs vertically oriented in a carrier to horizontal orientation on a second carrier.

A further object is to provide means for retaining the relative orientation of the small ends of eggs when transferred from a vertical to a horizontal position.

A further object is to provide for handling simultaneously multiple rows of eggs while increasing the spacing between adjacent rows so as to provide adequate spacing between the rows of eggs thereby to accommodate the major dimension of the eggs and thus permit their horizontal placement on a conveyor without breakage.

Still another object of this invention is to provide means for spreading eggs in an automatic fashion so that they may be removed from a filler flat wherein they are packed closely together and placed upon a second supporting surface in a differing spaced relationship.

Yet another object of this invention is to provide means for transferring eggs from one surface to another while maintaining the downwardly oriented surface of each egg at the same height as each other egg being transferred at the same moment.

Further objects and advantages of this invention, if not specifically set forth, will become apparent during the course of the description which follows.

In the drawings:

FIGURE 1 is a perspective view showing the egg handling machine of this invention;

FIGURE 2 is a side elevation of the transfer mechanism showing the device in the position assumed just prior to depositing eggs;

FIGURE 3 is a sectional side elevation taken on a vertical longitudinally oriented plane showing the cups and associated structure from the interior side, and illustrating the device in the position assumed just prior to picking up the eggs;

FIGURE 4 is an end elevational view showing the vacuum cups and associated structure as viewed from the left of FIGURE 1;

FIGURE 5 is a fragmentary side elevation partially in section showing a modification of this structure wherein means are provided for adjusting the level of the individual cups and locking such cups in an adjusted position;

FIGURE 6 is a side elevational view partially in section showing one of the two elements of FIGURE 5 in the position assumed just prior to depositing an egg.

Broadly, the invention comprises a vacuum transfer device incorporating a plurality of suction cups having supports therefor and associated apparatus for varying the positions of all cups simultaneously. The supports and associated apparatus are hereinafter termed, for convenience, a "frame." The frame provides means whereby to change the spacing between the cups and to rotate the cups in a vertical plane so as to incline the articles (eggs) held in the cups. The frame includes a plurality of horizontal arm assemblies pivoted at the top which support vacuum manifolds from which depend a plurality of suction cups. Each manifold is journaled in bearing assemblies and so is rotatable about its major axis.
A second short arm mounted perpendicular to the horizontal manifold and associated means for applying pressure to the opposite end of each arm provides means for applying a turning moment to the horizontal manifold assembly. An arrangement of co-operating cams and followers is also provided for spreading the individual horizontal manifolds upon which the various suction cups are mounted. In the preferred embodiment of the invention means are provided for vertically adjusting each of the cup supports so that eggs of varying lengths may be picked up at one time and the lowermost ends of the eggs held all in a single plane just prior to being deposited.

In the drawings, wherein like characters refer to like parts throughout, a horizontal pneumatic or hydraulic cylinder 10 of conventional construction is mounted on the frame and provides means for shifting the entire structure in a longitudinal direction. A suitable source of pneumatic or hydraulic pressure and controls therefor, not shown, are provided. Perpendicularly secured to the piston rod 12 of cylinder 10 is a vertical cylinder 13, the piston rod 14 of which is secured to plate 15 from which the remaining portions of the structure depend. The two pairs of guide rods 16 and 17 which are secured at either end of the plate also serve as vacuum and pressure manifolds. Vacuum line 18 and pressure line 20 are provided for the appropriate manifold.

Depending from beneath plate 15 is another pneumatic cylinder 22. This cylinder is also provided with lines 24 and 26 mounted on the underside of cylinder 22 but having a hole at the center thereof for passage therethrough of the piston rod of cylinder 22, is a block 28 which supports the lifter assembly. Pivotally connected by a long rod 30, the horizontal line 32 and the vertical line 34, the side of one side of the frame 28 is provided with a pair of six rows of cups. Journalled at the far end of each is a vacuum manifold tube 32. These tubes receive pressure or vacuum through lines 34 and 36 respectively.

Depending from the underside of each manifold are the hollow supports 42 for the individual suction cups 44. These supports 42 also serve as vacuum and pressure lines. The cups themselves preferably incorporate a bellows arrangement so as to increase their flexibility but they may be of any conventional structure, and since many of the structures are known, no further detail will be set forth here.

The individual horizontal vacuum manifolds 32 are pivoted about their major axes by the action of crank arms 46 which, in turn, are driven by pivotally mounted rods 48 secured at the upper ends thereof to perpendicularly mounted pins 50 each of which is journaled at either end thereof in the inverted channel 52. The channel is secured on its upper face to the piston rod 23 of vertical cylinder 22.

U-shaped cam tracks 54 are secured on the inner faces of the vertical arms 50. Note that the angle of these cam tracks changes, being most displaced from the horizontal toward either end of the device. A fan-like structure is formed. On either side of channel 52 are mounted standard needle-bearing cam rollers 56 which travel in cam tracks 54.

Figures 5 and 6 show means for incorporating another operational feature into the structure. The modifications shown in these drawings provide means for adjusting and locking the level of the individual suction cups 44 thus making it possible for the device to accommodate eggs of different lengths while maintaining the lowermost surfaces of all eggs in a single plane. Thus, when the eggs are released from the apparatus all will be dropped the same distance to the table, conveyor, etc., making it possible for all eggs to be dropped a minimum distance. Referring specifically to FIGURE 5, there is shown a portion of the basic structure outlined earlier having certain modifications. The structure there incorporates the cups 44 described earlier and the support 42 therefor. The hollow cup support 42, which also here acts as the means for conveying the vacuum directly to the vacuum cups, passes through a box 90 having shelves at either end, the box in turn being located internally of the housing 92 which is secured at the lowermost end of the vertical supporting arm 30. The cup support 42 is slidable mounted in sleeves of the box 90 and spring 94 acts on its upper side against the box and on its lower side against a flange on the lowermost end of cup support 42. Spring 94 provides means to the vacuum cup support 42 sufficiently extended that the stop ring 96 will rest against the upper surface of the box 90. Gravity alone may be relied upon but the spring insures positive action. Within the box is a pneumatic line 98 (not shown) and a bellows arrangement of the type shown in Figures 5 and 6, one side of which, when not under pressure, approaches a side of cup support 42 but normally does not sufficiently fill the space within the box to impede vertical movement of the cup support. A valve and associated source of air pressure of conventional design (not shown) are provided means for distending the pneumatic tube and locking the support 42 and cup 44 in a raised position. FIGURE 6 shows the pneumatic tube 98 so distended. A single tube 98 serves to lock each corresponding support of each row to that a total of six tubes govern the action of the thirty supports of the preferred structure.

Considering now the operation of the device, a standard thirty KYS Filler Flat is placed on the surface at the left of the lifter assembly and cylinder 10 moves the assembly directly overhead the eggs. The cups are first arranged vertically by depressing channel 53 through the action of piston rod 23. The cam followers 56, riding cam tracks 54, act to cause the vertical arms 30 to swing inwardly to the maximum permissible extent. Channel 52 depresses rods 48 also so as to pivot crank arms 46 thereby rotating manifolds 32 in a counter-clockwise direction toward the vertical (as viewed in FIGURE 1). The cups are then contacted by the eggs in the filler flat through the action of cylinder 13 or by raising the flat to the egg cups. A vacuum is then applied to manifold 17 through the appropriate line fitted with a shut-off type valve, not shown. This vacuum is applied to manifolds 32 and the eggs are grasped by the lifter assembly is then raised and moved directly over a spool conveyor. Next, the eggs are brought as closely as possible to the conveyor. Thereafter, through the action of air cylinder 22, piston rod 23 and associated channel 52 are drawn upwardly. Followers 56, riding cam tracks 54, cause the vertical arms 30 to fan outwardly and simultaneously rods 48 rotate the crank arms 46 on a clockwise direction. This causes each manifold 52 to rotate in a clockwise direction in its respective bearing, thereby causing the eggs to assume the position shown in FIGURE 2. The vacuum is released and pressure applied via manifold 16 to assure immediate release of the eggs.

It is seen, therefore, that by the movement of channel 52, the individual manifolds simultaneously may be caused to pivot and fan or spread apart. This allows for the placement of eggs in a manner necessary and at the same time avoids contact of the eggs with one another. The individual cam tracks 54 should be adjustable so as to allow the device to be adjusted for use with spool-type conveyors of varying sizes. While it is apparent that the eggs are not placed in an entirely horizontal position at the cups, the rotation of the spools will cause the eggs to line up with their major axes as desired.

Both the horizontal and vertical movements of the lifter can be readily made automatic and controlled by the movement of the spool conveyor, thus permitting the
5 automatic removal of eggs from the multicellular package and their placement at the correct instant on the moving spool, as follows. The structures of FIGURES 5 and 6 allow for adjusting the lowermost level of each individual vacuum cup, depending upon the length of the egg, so that the lowermost surfaces of all of the eggs lifted at one time are in the same plane. The structure shown in FIGURES 5 and 6 may also utilize the manifold 32 shown in FIGURE 1 though this somewhat complicates the structure and it is preferred to supply individual lines to individual suction cups, such lines being connected to the source of pressure and vacuum described earlier at a point somewhat removed from the individual suction cups. As shown in FIGURES 5 and 6, the entire assembly lifter is moved down upon eggs held in a filler flat at a time where there is no substantial pressure within pneumatic line 98 and the vacuum cups 44 used must be of sufficient stiffness that a tall egg will cause the entire cup support 42 to be forced upwardly against the resistance of spring 94. See FIGURE 5 wherein eggs of different heights are shown. The left-hand lifter used of FIGURE 5 is shown contacting a small egg and hence the support 42 and its vacuum cup 44 are not forced upwardly to any substantial extent while the right-hand unit is raised by the larger egg. Vacuum is applied to cups 44 and pressure is applied internally of line 98 so that the line is distended as shown in FIGURE 6 thereby filling substantially the entirety of the box 90 and frictionally engaging one side of the support 42. This locks the entire lifter element in a raised position. The lowermost edges of all the eggs will then remain in a single plane throughout the transfer operation. The eggs are next lifted and spread in the fashion described earlier. When it is time to release the eggs, the vacuum is released and preferably sufficiently by pressure applied to insure a positive egg releasing action. Thereafter the pressure in pneumatic line 98 is released and supports 42 and associated cups 44 then are forced by spring 94 (or gravity) into a fully extended position. Obviously many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. In a vacuum-transfer device wherein a plurality of suction cups are provided for transferring articles from one position to another, the improvements comprising: a plurality of horizontal rod assemblies supporting said cups; means to provide communication between a source of vacuum and each of said cups; a reciprocating element mounted adjacent said horizontal rod assemblies; means operatively associated with said reciprocating element and said rod assemblies to translate said reciprocating element into a force acting to separate said horizontal rod assemblies.

2. In a vacuum-transfer device wherein a plurality of suction cups are provided for transferring articles from one position to another, the improvements comprising: a plurality of horizontal rod assemblies supporting said cups and serving as vacuum manifolds therefor; a crank arm mounted perpendicularly upon each of said horizontal rod assemblies; means to apply a turning moment to each of said horizontal arms through each of said crank arms simultaneously; and means to change the spacing between each said horizontal rod assemblies while maintaining said rod assemblies equidistantly spaced along the same line.

3. In a vacuum-transfer device wherein a plurality of suction cups are provided for transferring articles from one position to another, the improvements comprising: a plurality of horizontal rod assemblies supporting said cups and serving as vacuum manifolds therefor; a crank arm mounted perpendicularly upon each of said horizontal rod assemblies; means to apply a turning moment to each of said horizontal arms through each of said crank arms simultaneously; and means to change the spacing between each said horizontal rod assemblies while maintaining said rod assemblies equidistantly spaced along the same line.

4. In a vacuum-transfer device wherein a plurality of suction cups are provided for transferring articles from one position to another, the improvements comprising: a frame; a plurality of horizontal rod assemblies supporting said cups; a plurality of vertical arms supporting said horizontal rod assemblies; means for pivoting said horizontal rods held by said vertical arms about the major axes of said horizontal rods, said vertical arms being pivotally mounted on the upper ends thereof to said frame; and means for forcing said vertical arms away from one another at the lower ends thereof simultaneously applying a turning moment to said horizontal rod assemblies.

5. In a vacuum-transfer device wherein a plurality of suction cups are provided for transferring articles from one position to another, the improvements comprising: a frame; a plurality of horizontal rod assemblies supporting said cups; a plurality of vertical arms supporting said horizontal rod assemblies, each of said horizontal rod assemblies being pivotally mounted at the lowermost end of two opposed vertical arms, said vertical arms being pivotally mounted at the upper ends thereof to the frame of said device; cam tracks fixed on each of said vertical arms; a cam roller mounted adjacent and cooperating with each of said cam tracks, said cam tracks being so positioned that the application of pressure in one direction to said cam rollers will cause said pivotally vertical arms to pivot in an outwardly direction, each of said cam rollers being fixedly secured to a reciprocating member; a crank arm perpendicularly mounted upon each of said horizontal rod assemblies; and a rod pivotally mounted at one end upon each of said crank arms and pivotally secured at the opposite end thereof to said reciprocating member whereby to provide means for applying a turning moment to each of said horizontal rod assemblies simultaneously.

6. In a vacuum-transfer device wherein a plurality of suction cups are provided for transferring articles from one position to another, the improvements comprising: a frame, a plurality of horizontal rod assemblies supporting said cups and journaled in bearing assemblies; vertical arms supporting said bearing assemblies pivotable at the upper ends thereof from said frame, said arms being arranged in opposed pairs; a cam track mounted on the inner side of each of said opposed vertical arms, said cam tracks generally describing a fan when viewed as a group from one side thereof; a plurality of cam followers cooperating with said cam tracks; a reciprocating member supporting said followers; a crank shaft perpendicularly mounted upon each of said horizontal rod assemblies; and a rod pivot at the far end of each of said crank arms and pivotally attached to said reciprocating member supporting said cam followers whereby downward movement of said reciprocating member will simultaneously force said pivotally mounted vertical arms together at the lowermost ends thereof and cause a turning moment to said horizontal rod assemblies whereby to align each of said cups in a vertical fashion and whereby upward motion of said member supporting said cam followers simultaneously will spread each of said pivotally mounted vertical arms at the lower ends thereof and apply a turning moment to each of said horizontal rod assemblies whereby to cause said cups to rotate to assume an orientation displaced from the vertical.

7. In a vacuum-transfer device wherein a plurality of vacuum cups are provided for transferring articles from
one position to another, the improvements comprising: an individual downwardly extending supporting element for each of said cups, each of said supporting elements being mounted for reciprocating movement whereby to provide for varying the height of individual cups relative to one another; means operative at a predetermined instant for locking all of said individual supporting elements simultaneously irrespective of the height of said individual cups at said instant whereby said cups may be locked at varying heights and means for spreading the lowermost ends of said supporting elements from one another whereby to spread said cups.

6. In a vacuum-transfer device wherein a plurality of vacuum cups are provided for transferring articles from one position to another, the improvements comprising: an individual downwardly extending supporting element for each of said cups, said supporting elements being arranged in straight rows whereby said cups are arranged in straight rows, each of said supporting elements being mounted for reciprocating movement whereby to provide for varying the height of individual cups relative to one another; means operative at a predetermined instant for locking all of said individual supporting elements simultaneously irrespective of the height of each said cup, at said instant whereby said cups may be locked at varying heights; means for spreading the lowermost ends of said supporting elements from one another whereby to spread said cups; and means for pivoting said cups while maintaining a parallel orientation of the major normally vertical axes of said cups while maintaining all cups in a single row thereof equidistantly spaced at all times.

9. In a vacuum-transfer device wherein a plurality of vacuum cups are provided for transferring articles from one position to another, the improvements comprising: an individual vertical supporting element for each of said cups, each of said supporting elements being slidably mounted for reciprocating movement; means for locking each of said vertical supporting elements against reciprocating movement, said locking means comprising an inflatable resilient tube positioned adjacent said slidably mounted supporting element; and means for applying a fluid pressure internally of said tube to distend said tube whereby a side of said tube will fractionally engage said slidably mounted supporting element.

10. In a vacuum-transfer device wherein a plurality of vacuum cups are provided for transferring articles from one position to another, the improvements comprising: an individual vertical supporting element for each of said cups, each of said supporting elements being slidably mounted for reciprocating movement; means for locking each of said vertical supporting elements against reciprocating movement, said locking means comprising an inflatable resilient tube positioned adjacent said slidably mounted supporting element; means for applying a fluid pressure internally of said tube to distend said tube; and means responsive to said tube whereby said distention of said tube causes said slidably mounted supporting element to be engaged.

11. In a vacuum-transfer device wherein a plurality of vacuum cups are provided for transferring articles from one position to another, the improvements comprising: an individual downwardly extending supporting element for each of said cups, each of said supporting elements being mounted for reciprocating movement whereby to provide for varying the height of individual cups relative to one another; and means operative at a predetermined instant for locking all of said individual supporting elements simultaneously irrespective of the height of the said cups at said instant whereby said cups may be locked at varying heights.

12. In a vacuum-transfer device wherein a plurality of suction cups are provided for transferring eggs from a given spaced relationship wherein said eggs are positioned substantially vertically to a second position wherein said eggs are in a further spaced relationship and tilted into an orientation which is at an angle to the vertical, the improvements comprising:

(a) means for supporting a plurality of cups in a first horizontal row;

(b) additional means spaced on either side of the last-mentioned means for supporting additional spaced cups in additional individual straight horizontal rows, each cup being aligned with all adjacent cups whereby each of said cups falls into two straight, parallel horizontal rows, each of the said two straight, parallel horizontal rows being at right angles to one another and in a single horizontal plane;

(c) means for applying a turning moment simultaneously to each of the said supporting means for the said cups whereby to tilt said eggs in the same direction while maintaining said cups in a single horizontal plane;

(d) means to change the horizontal spacing between said first-mentioned single row of cups and said additional spaced rows of cups and thereby increase the spacing between said eggs while maintaining all of the said cups in a single one of said rows equidistantly spaced at all times; and

(e) means to apply a vacuum to the interior of each of the said cups.

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