United States Patent [19]

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[45] **Nov. 27, 1973**

[54] **CASE PACKING MACHINE**

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[52] **U.S. Cl.** ..... **214/1 BT,** 214/1 BB
[51] **Int. Cl.** **B65g 57/04**
[58] **Field of Search** ..... 214/1 BT, 1 BB; 294/87 A

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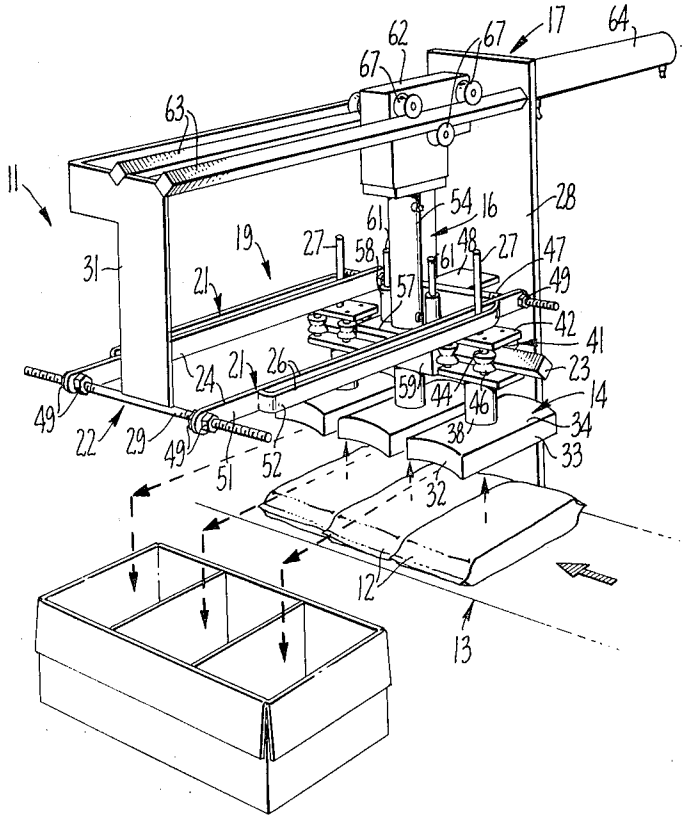
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[57] **ABSTRACT**

A manipulating machine for removing a plurality of bags of loosely particulate material from a conveyor and placing them in a carton, using vacuum pickup heads which seize most of the top area of the relatively flat bags on the conveyor. The mechanism moves the pickup heads toward and away from the top surfaces of the bags on the conveyor, and transports the picked-up bags transversely to the conveyor to a waiting carton. A quick-dumping valve relieves the vacuum to drop the bags. An adjustable spacing mechanism spaces the bags apart by moving the heads apart after the bags are picked up, so that the bags may clear the separators in the carton. A cycle timer controls the pneumatic actuators which move the parts of the machine. Stop members in the pickup heads limit excursion of the bag into the head, and the contour of the head is curved to approximate the contour of the top of the bag. A modified form is shown in which the bags are released onto a receiving platform and shoved sideways in a stack by a transfer mechanism into the carton.

12 Claims, 11 Drawing Figures



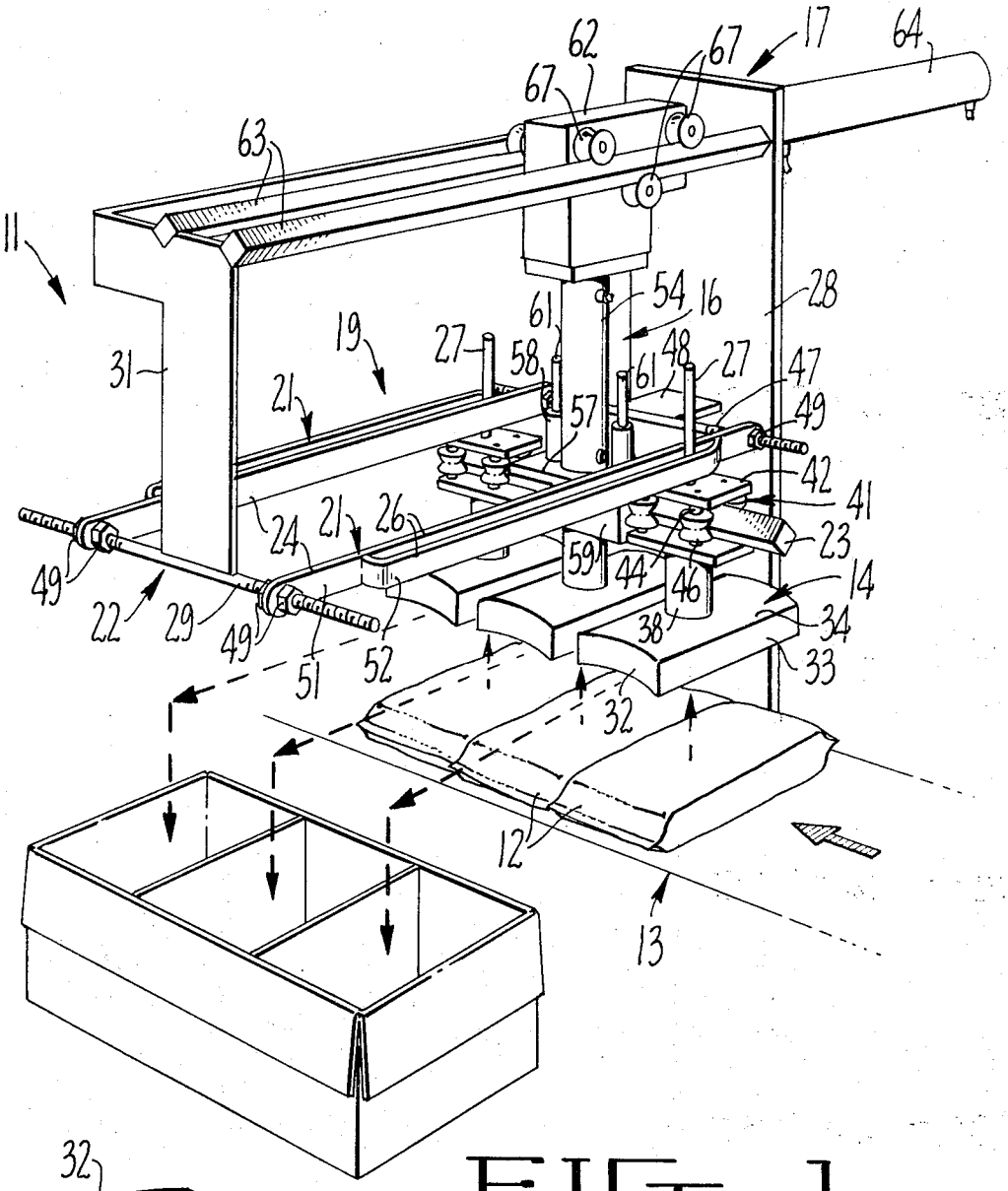


FIG. 1.

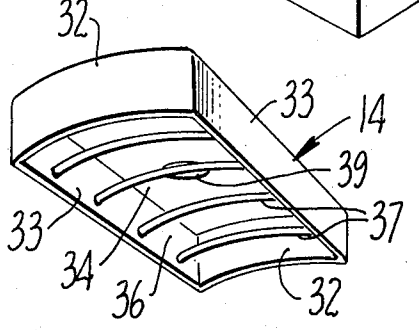


FIG. 2.

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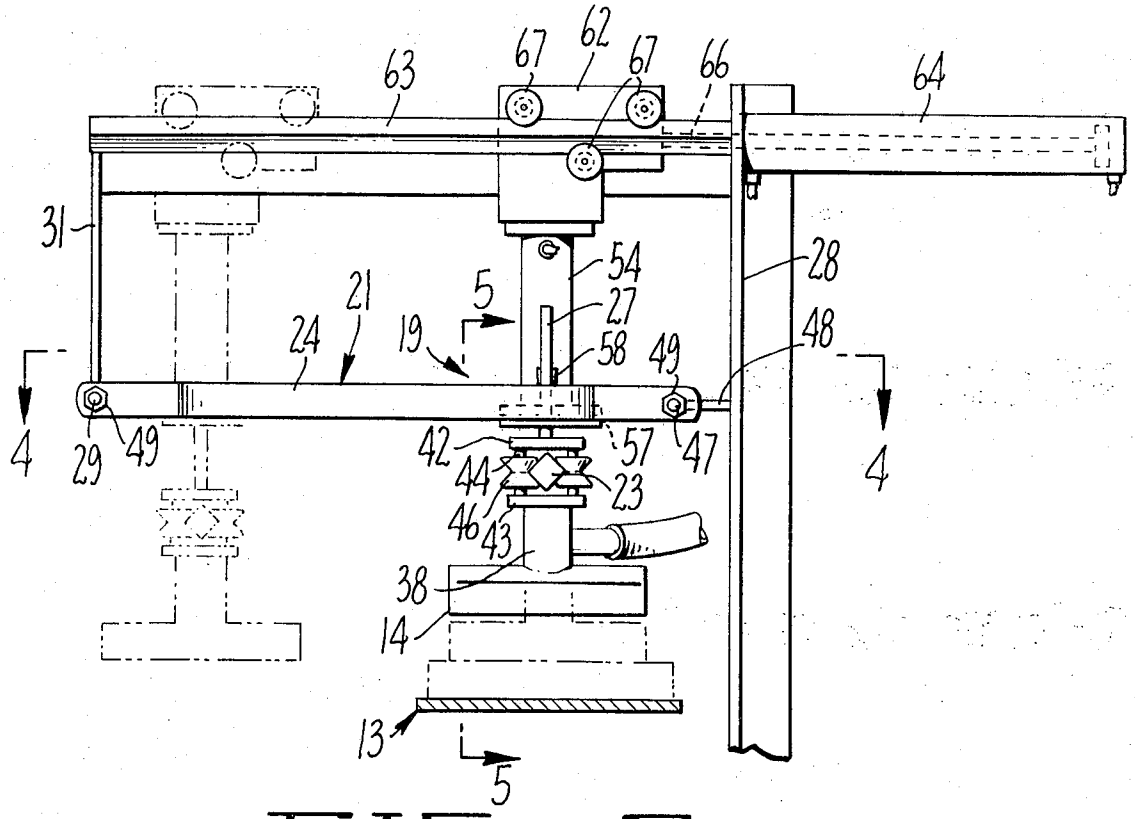


FIG. 3.

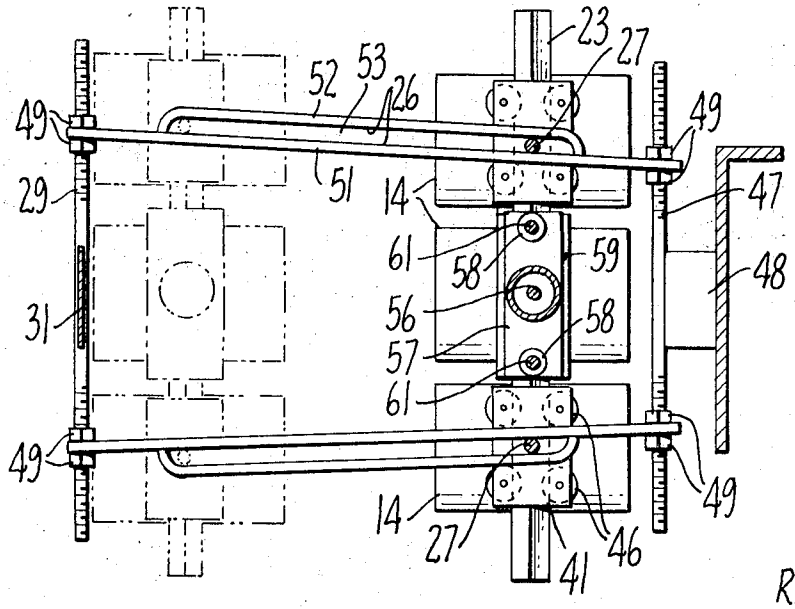


FIG. 4.

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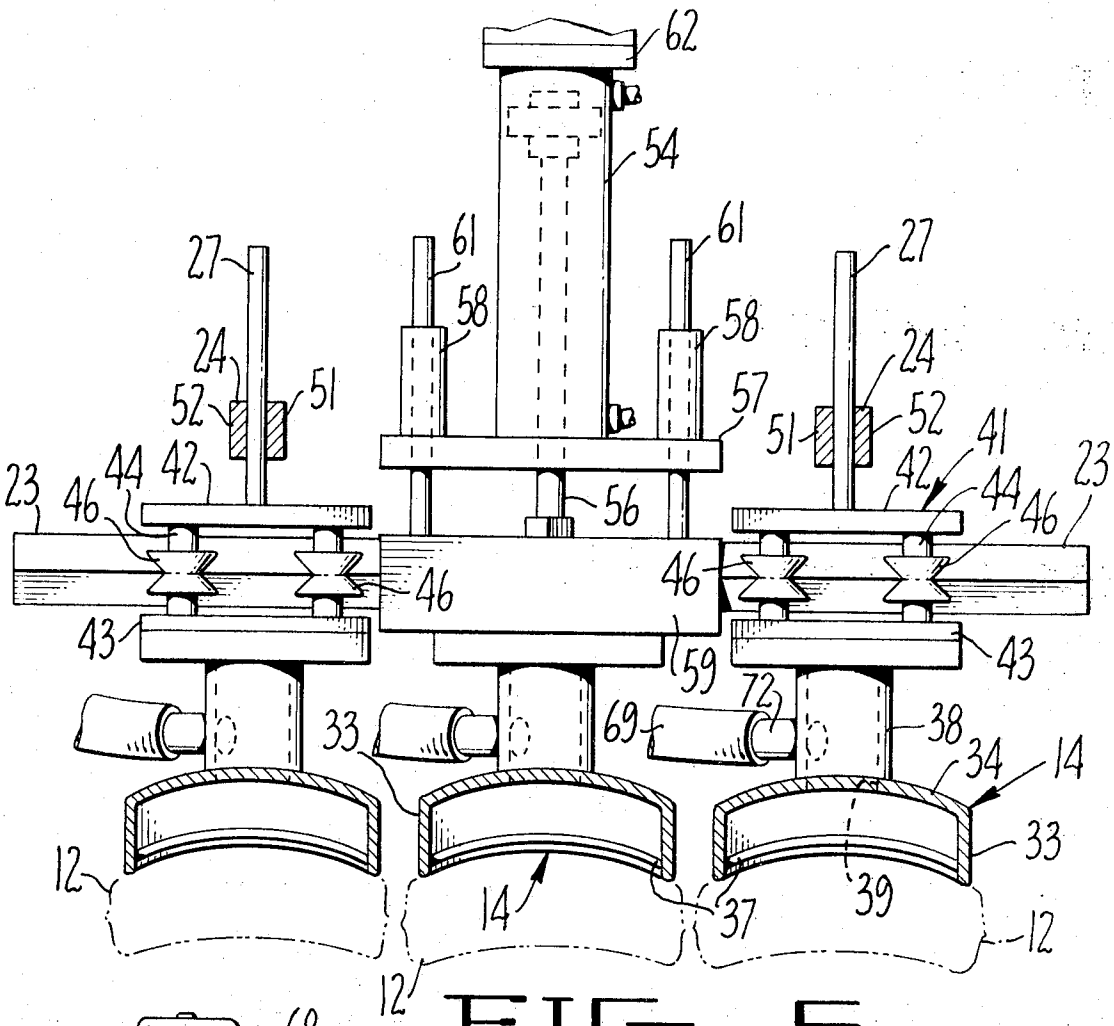


FIG. 5.

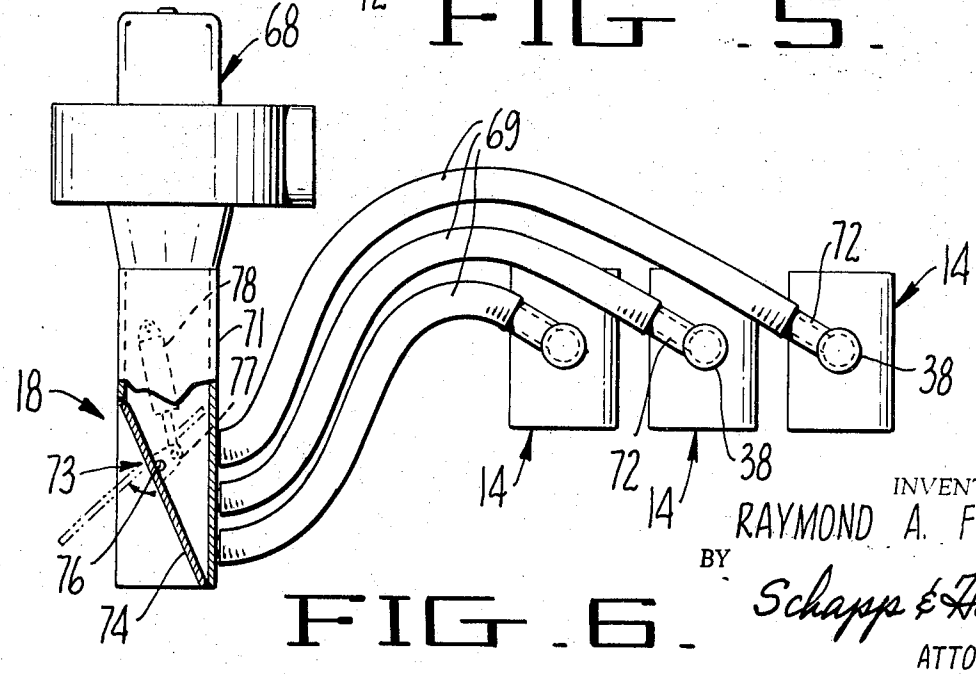


FIG. 6.

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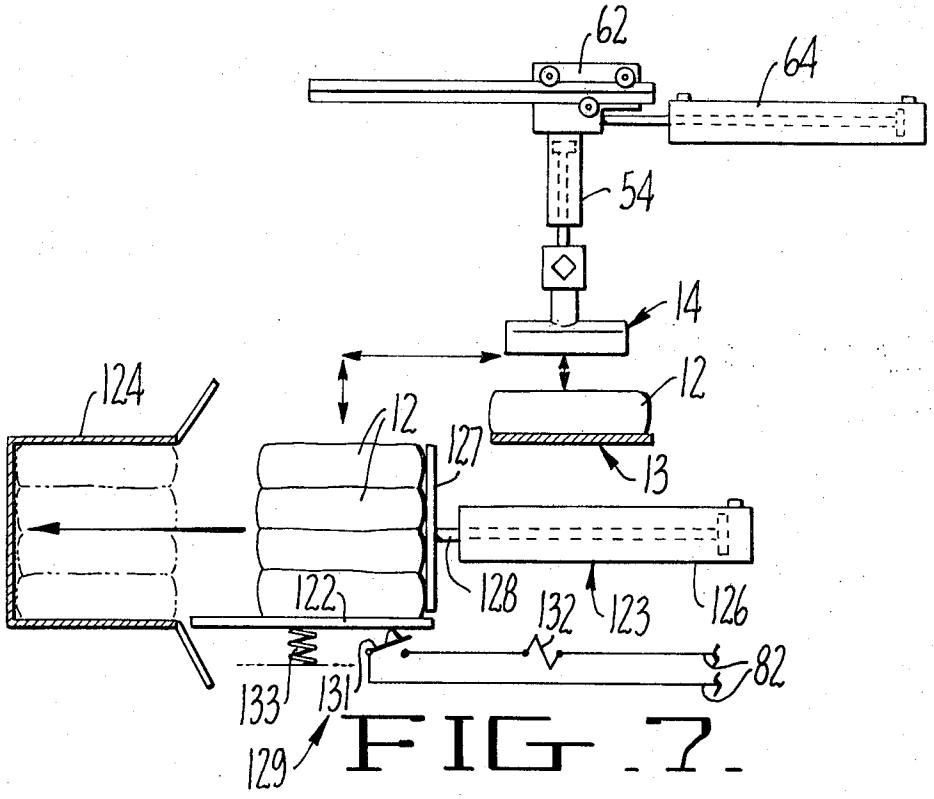


FIG. 7.

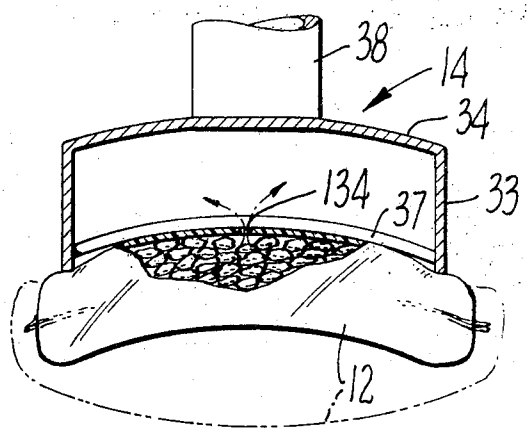


FIG. 8.

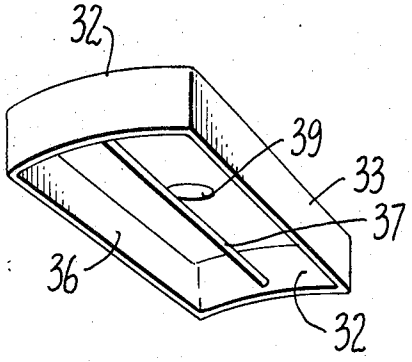


FIG. 9.

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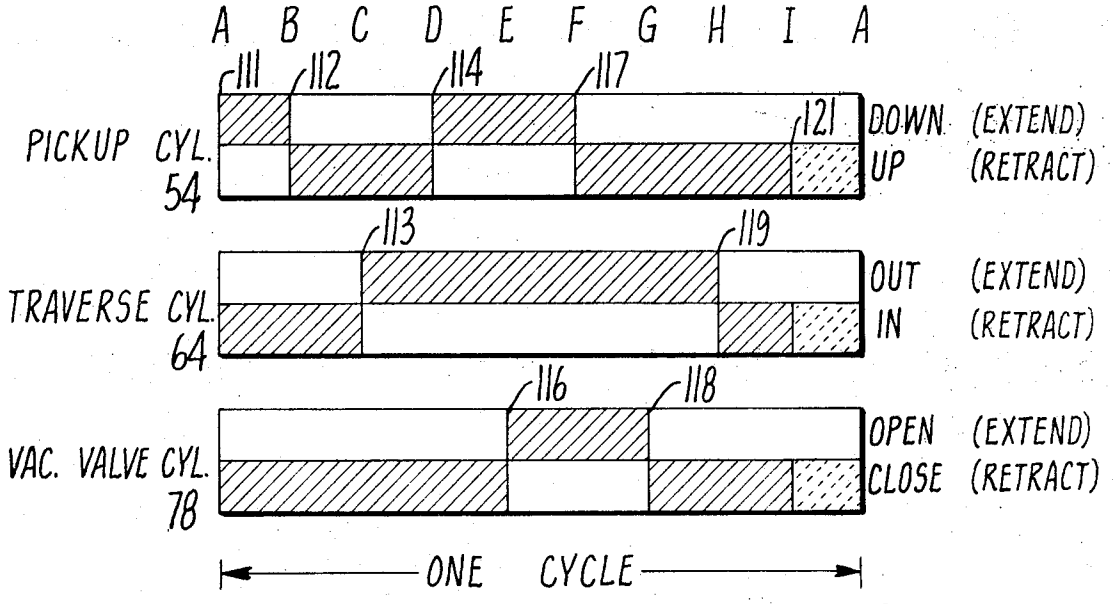


FIG. 11.

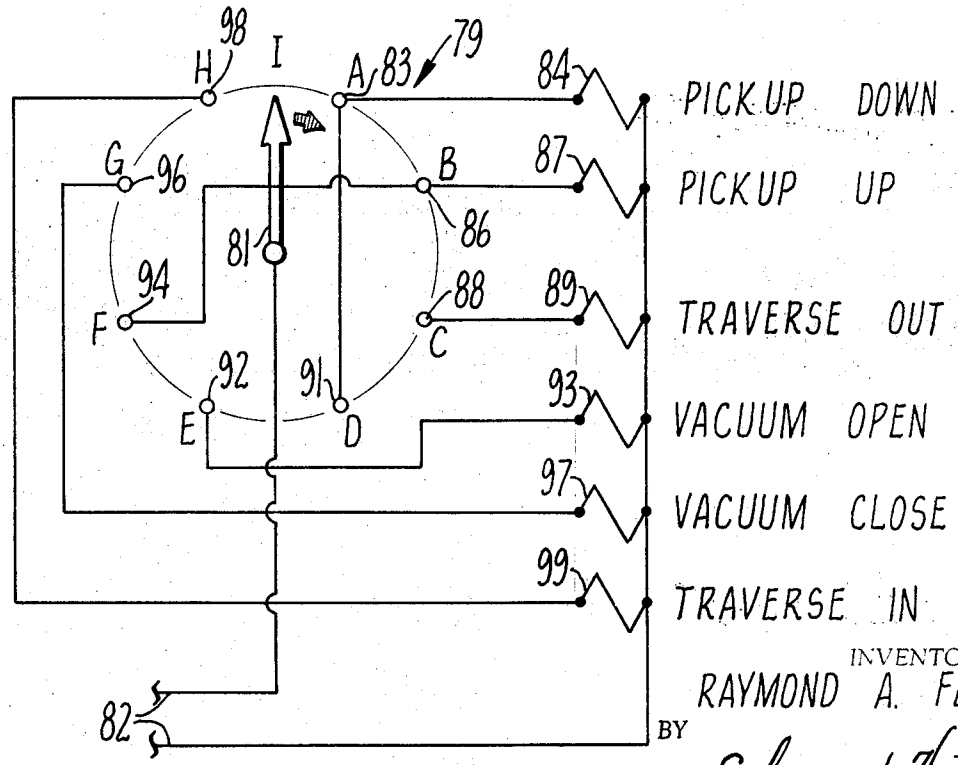


FIG. 10.

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CASE PACKING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to a CASE PACKING MACHINE, and more particularly to a manipulator for vacuum pickup of bagged loose material from a line conveyor and inserting it into cartons.

Prior case-packing machinery has encountered difficulty in packing bags of loose material which could flow about within the bag when the bag was picked up, reducing the compactness of the packing within the carton by distorting the bag from its most compact shape. Bags of such material also tend to be difficult to grip and manipulate, due to their flexibility and the relative fragility of common bag materials.

Difficulty has also previously been encountered in packing more than one such bag into a carton simultaneously, where it is necessary to space the bags apart to clear a separator within the carton. Further problems have been encountered in designing a machine capable of packing such loose bags sideways into a carton so that when the carton is turned with the open end upward, the bags are oriented to stand on their sides or ends rather than lie flat. Further, as in most packaging machinery, speed is a much sought-after feature, and many prior case packers have been able to achieve acceptable speed only at the expense of gentleness of handling the bag.

SUMMARY OF THE INVENTION

The case packer of the present invention uses a low-vacuum pickup head having an area approaching the area of the upper surface of the bag, so that the holding force is distributed over a wide area of bag material. Since most of the top surface of the bag is gripped, the shifting of loose matter within the bag is reduced, and distortion of the bag shape minimized.

Gripping of the amorphously shaped bag is also aided by the curved contour of the pickup head, so that a rapid yet reliable seal of the head to the bag is obtained without need of excessively high vacuum. Release is likewise rapid, through action of a fast, high-volume vacuum-dumping valve.

Applications of the case packer generally call for a speed of action which makes it advisable to handle more than one bag at once. When two or more bags are picked up at once, however, it becomes necessary to adjust their spacing from each other so as to fit within the carton in a desired pattern, such as to clear a separator in the carton. A spacing mechanism in the present machine allows adjustable control of that spacing. Where it is desired to pack a carton sideways, so that when the carton is righted, the bags stand on their ends or sides, the present case packer loads the bags into one or more stacks alongside the conveyor, and the stacks are then shifted sideways for insertion into the carton. Problems of bunching up are thereby eliminated and insertion of bags sideways into the carton is eased.

Accordingly, it is a principal object of the present invention to provide a case-packing machine of the character described capable of rapidly and gently transferring bags of loose material from a conveyor into a carton.

Another principal object of the present invention is to provide a case-packing machine of the character described capable of smoothly and rapidly gripping and releasing a non-rigid bag of flowable material.

A further principal object of the present invention is to provide a case-packing machine of the character described which is capable of picking up a plurality of bags at once and adjustably altering their separation from each other before releasing them.

Yet another object of the present invention is to provide a case-packing machine of the character described which is capable of loading bags sideways into a carton so that the bags are on an edge when the carton is righted.

A still further object of the present invention is to provide a case-packing machine of the character described which limits excursion of the bag into the pickup head and distributes the vacuum over a substantial portion of the top surface of the bag. Still another object of the present invention is to provide a case-packing machine of the character described which reduces bag volume while picking up the bag.

Further objects and advantages of the present invention will become apparent as the specification progresses, and the new and useful features thereof will be fully defined in the claims attached hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred form of the present invention is illustrated in the accompanying drawings, forming part of this specification, in which:

FIG. 1 is a perspective view of the manipulator or case-packing machine of the present invention;

FIG. 2 is a perspective view from below of one of the vacuum pickup heads used in the manipulator of the present invention;

FIG. 3 is an end elevation of a portion of the machine of the present invention taken approximately along a plane transverse to the conveyor;

FIG. 4 is a plan view partially in section with portion shown broken away for clarity, taken approximately along the plane of lines 4—4 of FIG. 3;

FIG. 5 is a partial side elevational view partially in cross-section, taken approximately along the plane of lines 5—5 of FIG. 3;

FIG. 6 is a semi-schematic plan view of the vacuum system of the manipulator of the present invention, with portions shown broken away for clarity;

FIG. 7 is a semi-schematic and elevational view of a modified form of the manipulator of the present invention, with portions of the manipulator omitted for clarity;

FIG. 8 is a transverse cross-sectional view on an enlarged scale of the vacuum pickup head shown in FIG. 2, showing the evacuation of a bag;

FIG. 9 is a perspective view from below of an alternative embodiment of the vacuum pickup head of the present invention;

FIG. 10 is a schematic diagram of the circuit of the control mechanism of the present invention; and

FIG. 11 is a timing diagram of the sequence of operations of the present invention.

While only the preferred forms of the invention have been shown here, it should be understood that various changes or modifications may be made within the scope of the claims attached hereto without departing from the spirit of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in detail, it will be seen that

the manipulator, or case-packing machine 11 of the present invention is intended for removing bags 12 of material from a longitudinal conveyor 13 and placing the bags 12 into a desired array. The manipulator includes a vacuum pickup head 14 which is adapted to contact the top surface of one of the bags 12 on the conveyor 13, and a reciprocation means 16 for moving the pickup head 14 toward and away from the conveyor 13 for effecting the contact with the top surface of the bag 12 and lifting the bag from the conveyor 13. The manipulator also includes a translation means 17 for moving the pickup head 14 transversely of the conveyor 13 from a first position above the conveyor 13 to a second position alongside the conveyor 13, and a vacuum means 18 operative to create a vacuum in the pickup head 14 and to relieve the vacuum in the pickup head 14 at the second position for releasing the bag 12 at the second position.

In the preferred form of the present invention, the machine 11 is equpped with a plurality of the vacuum pickup heads 14, with each of the heads 14 attached to the reciprocation means 16 and the translation means 17. The machine 11 also includes a spacing means 19 operative to alter the spacing between the heads 14 during the travel of the heads 14 as moved by the reciprocation means 16 and the translation means 17, to change the relative spacing between the bags 12 from that present when they are on the conveyor 13.

A number of arrangements or configurations of the vacuum pickup heads 14 are possible, using more or fewer heads than shown in FIG. 1, and locating the heads in a pattern appropriate to the use desired. As shown in the preferred form in FIG. 1, however, the machine 11 has three vacuum pickup heads arrayed one after the other longitudinally of the conveyor 13, and the spacing means 19 operates to alter the longitudinal spacing between the heads 12 as they are in motion.

The spacing means 19 includes a guide member 21 disposed generally transversely of the conveyor 13 and associated with one of the vacuum pickup heads 14 to guide the motion of the head 14 along a path generally transverse to the conveyor 13, and an adjusting means generally indicated at 22 for adjusting the angle of the guide member with respect to a line perpendicular to the conveyor 13 in a generally horizontal plane. The spacing means 19 also includes a longitudinal track member 23 oriented generally longitudinally of the conveyor 13 and attached to the reciprocation means 16. The vacuum pickup heads 14 are borne on the longitudinal track member 23, with at least one of the heads 14 journalled on the track member 23 for longitudinal motion along the track member 23 with respect to another of the heads 14.

The guide member 21 includes a trackway 24 having a guide surface 26 extending longitudinally along the trackway 24, and the spacing means 19 also includes a follower pin 27 attached to one of the vacuum pickup heads 14 and engaged with the guide surface 26 to guide the head 14 along a path generally transverse to the conveyor 13. As shown in the present embodiment, spacing means 19 includes a plurality of the trackways 24 and a plurality of the follower pins 27, with each of the pins 27 attached one to each of a plurality of the heads 14, and each pin 27 engaging one guide surface 26 on one trackway 24. This arrangement enables the adjusting means 22 to adjust the angle of the trackways 24 with respect to each other in a generally horizontal plane.

The manipulator 11 also includes a stationary chassis 28 which supports the reciprocation means 16, the translation means 17, and the adjusting means 22. The trackways 24 are pivotally attached to the chassis 28 on one side of the conveyor 13 and extend transversely across the conveyor 13. The opposite or distal ends of the trackways 24 are engaged with a rod 29 which is attached to the chassis 28 by a bracket 31. The rod 29 is oriented generally parallel to the longitudinal direction of the conveyor 13 and the ends of the trackways 24 may be adjustably moved along the rod 29 to make the adjustment of the angle of the trackways 24 with respect to each other referred to above.

The vacuum pickup head 14 includes a pair of end walls 32, a pair of side walls 33 and top 34 which together define an open-sided chamber 36. The end walls 32 are arcuate in elevation, with the concave side down so that the pickup heads 14 will approximate the contour of a mound bag 12 on the conveyor 13. A stop member 37 is disposed approximately in the plane of the bottom of the pickup head 14 and extends from one of the walls 32 or 33 to the wall opposite to limit the excursion of the bag 12 into the chamber 36.

As shown in FIG. 2, the stop member 37 extends between the side walls 33 and is generally parallel with the end walls 32. The stop member 37 is also shown in this embodiment as being bowed in an arc approximating the arc of the end members 32. A plurality of the stop members 37 are shown, as is appropriate for pickup head 14 intended for use with relatively fragile packing materials in the bag 12, so that the degree of distortion of the film comprising the bag 12 is limited.

As shown in FIG. 9, the stop member 37 may alternatively extend between the end walls 32 and parallel with the side walls 33 as shown in FIG. 9. The single stop member 37 shown in FIG. 9 is used where the bags 12 to be lifted are made of a less fragile material which can be subjected to greater distortion. In either embodiment, a hollow sleeve 38 connects the top of the head 14 to the remainder of the machine 11 and also serves as the vacuum exhaust conduit by communicating with the chamber 36 through an aperture 39 in the top 34. The connection of the sleeve 38 to the vacuum system may be seen in FIG. 3.

The sleeve 38 is attached to the underside of a carriage member 41 which rolls along the longitudinal track member 23. The carriage member 41 includes upper and lower plate members 42 and 43 respectively which are joined by axles 44. Rollers 46 which are troughed in a generally V-shape are journalled on the axles 44 to bear on the longitudinal track member 23. The track member 23 is oriented to present one edge of a square cross-section downwardly so that the upper and lower faces on each side of the bar provide a V-shaped convex track engageable by the rollers 46. The sleeve 38 may most conveniently be attached to the lower plate member 43 while the follower pin 27 may conveniently be attached to the upper plate 42. With the three-headed arrangement shown here, only the outer two heads need be suspended in roller fashion from the track member 23, as the necessary relative spacing apart may be accomplished without any longitudinal movement of the center head 14 of the triplet.

The trackways 24 which serve as the guide members 21 are pivotally attached to the chassis 28 on the far

side of the conveyor 13 as seen in FIG. 1 through a threaded rod 47 and a bracket 48 similar to the threaded rod 29 and the bracket 31. Although the connection of the trackways 24 at the end adjacent the chassis 28 might be made a fixed-position pivotal connection, it has been found advantageous to be able to adjust the relative head spacing of the vacuum pickup heads 14 when they are in the position immediately over the conveyor 13, to accommodate different spacings and sizes of the bags 12 on the conveyor. As hereshown, therefore, both of the rods 29 and 47 have both of their ends threaded to receive at least one nut 49 on each end of each rod.

The simplest adjustment arrangement, and that shown here, is for each end of each trackway 24 to be equipped with a hole which passes freely over the rod 29 or 47. A nut 49 is run up along the rod to the trackway 24 on each side of the trackway end to fix its position along the rod 29 or 47 in a "jam-nut" fashion. To change the spacing at either end of the trackways 24, the nuts 49 at the opposite end of the trackways 24 may be slightly loosened to permit pivotal motion, while the nuts 49 at the end at which the spacing change is desired are screwed along the threaded rod 29 or 47 to move the trackways 24 to their desired new spacing. The nuts 49 are then retightened to jam up against the ends of trackways 24 in the new location and hold the adjustment fixed.

Each of the trackways 24 is formed from a generally strap-like metal bar 51 oriented on edge vertically and having apertures at each end (not shown) as mentioned above for engagement with the rods 29 and 47. A second strap-like metal bar 52 runs parallel to the bar 51 and is attached to the bar 51 by having each end turned in toward the bar 51, so that the two bars 51 and 52 together form an elongate slot 53 having closed ends. The two vertical inner sides of the slot 53 form the guide surfaces 26 of the trackways 24. As the heads 14 are moved away from the conveyor 13 laterally, by the action of the translation means 17, described below, the engagement of the follower pins 27 with the guide surfaces 26 of the slot 53 will cause the outer two heads 14 of the triplet to be moved either toward or away from the center head 14 of the triplet, by rolling the carriage members 41 along the longitudinal track member 23. On the return movement of the heads 14 from the position outboard of the conveyor to a position again above the conveyor 13, the engagement of the follower pins 27 with the trackways 24 will roll the movable heads 14 along the longitudinal track member 23 to restore the heads 14 to the relative spacing between themselves appropriate for proper alignment with the bags of material 12 presented beneath them on the conveyor 13.

The reciprocation means 16 includes an actuating cylinder 54 connected between the translation means 17 and the longitudinal track member 23. The actuating cylinder 54 may be a hydraulic or pneumatic cylinder, and is a pneumatic cylinder in the preferred embodiment. As shown here, the body of the cylinder 54 is attached to the translation means 17 and a piston rod 56 of the actuator 54 (see FIG. 4) is attached to a block 59 which in turn bears the track member 23.

To prevent rotation of the track member 23 about a vertical axis, a plate 57 is fixed to the lower end of the actuating cylinder 54 and sleeves 58 are fixed to the plate 57. The block 59 on the end of the piston rod 56 has fastened to it in turn a pair of vertically oriented guide rods 61 which pass upward through appropriate apertures in the plate 57 and through the inside of the sleeves 58. The block 59 carries the center vacuum pickup head 14 of the triplet of heads 14 and also carries the longitudinal track member 23 projecting out to either side of the block 59. Since the plate 57 is fixed against rotation by being attached to the body of the cylinder 54, the engagement of the guide rods 61 with the sleeves 58 and the plate 57 prevents rotation of the block 59 and the track member 23 attached to the block 59.

It is to be noted that the length of the follower pins 27 and the guide rods 61 is such that during the downward extension of the block 59 by the action of the actuating cylinder 54 and the accompanying lowering of the vacuum pickup heads 14, they remain in engagement with the trackways 24 and the sleeves 58 respectively so that control of the position of the vacuum heads 14 is maintained. It may also be appreciated that while three vacuum pickup heads 14 are shown in the present embodiment, the apparatus may be extended to any desired number of pickup heads, by extending length of the longitudinal track member 23 and providing additional carriages 41 journalled on it. It may also be seen that bags 12 two or more abreast on the conveyor 13 may be picked up by a machine having a second longitudinal track member akin to the track member 23, parallel to the first one and attached to the block 59 and bearing additional carriage members 41 attached to additional vacuum pickup heads 14. If necessary, additional trackways 24 could be provided to engage the appropriate follower pins 27.

The translation means 17 includes a carriage member 62 engaged with a pair of guide rails 63 mounted on the chassis 28, and an actuating cylinder 64, hydraulic or pneumatic, mounted on the chassis 28 and having its piston rod 66 attached to the carriage member 62. The guide rails 63 are of a diamond-shaped configuration similar to the longitudinal track member 23, and the carriage member 62 is equipped on each side with a triplet of concave V-shaped rollers 67 similar to the rollers 46 on the carriages 41. The actuation of the cylinder 64 moves the carriage 62, and with it the cylinder 54, the block 59, the longitudinal track member 23, the carriages 41, and the three vacuum heads 14, from the position shown in solid in FIG. 3 to the position shown in phantom in that figure. On its retraction, it returns them all to the position shown in solid above the conveyor 13.

The actuating cylinders 54 and 64 have been shown here as the double-acting type, but it should be appreciated that a single-acting cylinder with an appropriate return spring could also be utilized. The use of double-acting cylinders simplifies the control circuitry, as described below.

The vacuum means 18 of the case packing machine 11 is schematically shown in FIG. 6 and includes a vacuum pump or exhauster 68, a vacuum manifold 71, and vacuum hoses 69 leading from the manifold 71 to nipple 72 attached to each of the sleeves 38 on each of the heads 14. The manifold 71 is attached to the intake of the vacuum pump 68 and may also be opened to the atmosphere by the vacuum relief means 18. A valve member 73, shown here as essentially a butterfly valve, is disposed in the manifold 71 so as to close off access of the manifold 71 to the atmosphere in one position,

thereby causing the current of air drawn by the exhaustor **68** to be drawn solely through the vacuum pickup head **14.**

To relieve the vacuum at the point along the path of travel of the head **14** at which it is desired to release the bag **12,** valve member **73** is moved to the position shown in phantom in FIG. **6,** in which the current of air into the intake of the exhauster **68** is drawn solely from the atmosphere and the ends of the vacuum hoses **69** where they connect to the manifold **71** are shielded by the butterfly valve **73** from that intake current of air to the exhauster **68.** It has been found particularly advantageous to block the vacuum hose ends as they enter the manifold **71** from the inrushing current of air to the exhaustor **68** so that a partial vacuum is not created in the hoses by the rush of air past the ends, in a Venturi-like effect.

The valve **73** is pivotally mounted in the manifold **71** and dimensioned so that in a closed position it closes off the access of the manifold **71** to the atmosphere. The valve member **73** pivots about a pin **76** and has attached to it a lever arm **77** in which in turn is pivotally attached the piston rod of an actuating cylinder **78.** As the actuating cylinder **78** has its body portion fixed with respect to the manifold **71,** its actuation moves the valve **73** between the position shown in solid in FIG. **6,** closing off the manifold from access to the atmosphere, to the position shown in phantom in FIG. **6,** opening the intake of the exhauster **68** to the atmosphere while shielding the ends of the vacuum hoses **69** from the intake air current.

The proper sequential operation of the case packing machine **11** is governed by a control circuit **79,** which may be a cycle timer as shown in FIG. **10.** It should be appreciated, however, that while a rotary-switch type of cycle timer is shown in FIG. **10,** the machine **11** may be also advantageously controlled by means of a sequential control circuit in which the completion of each phase of the operation triggers the beginning of the next phase of the operation. The machine **11** would thus be able to operate at the maximum speed, proceeding from each step to the next as soon as that step is completed. The desired relationship of the times of actuation of the actuating cylinders **54, 64** and **78** is shown in the timing diagram of FIG. **11.** It should be noted, however, that the phase relationships shown in FIG. **11** are only approximate, and are subject to adjustment for the optimum speed of operation and conditions of operation of the machine.

The cycle timer control circuit **79** shown in FIG. **10** is illustrated as a rotary switch having its rotor **81** connected to one side of a power supply line **82** and its switch points connected to the actuating coils of solenoid valves (not shown) controlling air flow into the actuating cylinders **54, 64** and **78.** The other side of the power line **82** is connected directly to the opposite terminals of all of the solenoid valves. The circuit **79** is shown arranged for use with double-acting pneumatic cylinders, which are positively driven from one position to another by air pressure controlled by solenoid valves.

Starting clockwise from the top of the diagram, the first switch point **83** is connected to supply power to the actuating coil **84** of a solenoid valve (not shown) which controls the supply of air pressure to that side of the actuating cylinder **54** which causes it to extend. Actuation of the solenoid valve operated by the coil **84** thus causes the cylinder **54** to extend and move the vacuum pickup head **14** downward toward the top surfaces of the longitudinal conveyor **13.** The next switch point **86** is connected to the actuating coil **87** of a solenoid valve (not shown) which supplies air pressure to that side of the cylinder **54** which causes the cylinder piston rod **56** to retract and raise the vacuum pickup head **14** away from the conveyor surface.

The next switch point **88** is connected to the actuating coil **89** of a solenoid valve (not shown) which controls the supply of air pressure to that side of the actuating cylinder **64** which causes its piston rod **66** to extend and move the carriage member **62** transversely away from the conveyor **13.** The next switch point **91** is connected in common with the switch point **83** to again supply power to the actuating coil **84** of the solenoid valve which supplies air pressure to that side of the actuating cylinder **54** which causes its poston rod **56** to extend and lower the vacuum pickup head. The next switch point **92** is connected to the actuating coil **93** of a solenoid valve (not shown) which controls the supply of air pressure to the actuating cylinder **78** to cause its piston rod to extend and open the vacuum relief valve **18.** By this actuation, the vacuum in vacuum pickup head **14** is dumped to the atmosphere and the bag **12** held by the pickup head **14** is released.

The next switch point **94** is connected in common with the switch point **86** to again supply power to the actuating coil **87** of the solenoid valve which controls the supply of air pressure to that side of the actuating cylinder **54** which causes the piston rod **56** of that cylinder to retract and move the vacuum pickup head upwards again. The next switch point **96** is connected to the actuating coil **97** of the solenoid valve (not shown) which controls the supply of air pressure to that side of the actuating cylinder **78** which causes retraction of the piston rod of that cylinder, closing the vacuum relief valve **18** to reestablish the vacuum in the pickup heads **14.**

The final switch point **98** of the cycle is connected to the actuating coil **99** of a solenoid valve which controls the supply of air pressure to that side of the actuating cylinder **64** which causes its piston rod **66** to retract and pull the carriage member **62** back into position above the conveyor **13.** The machine **11** has thus completed one entire cycle of moving the vacuum pickup head **14** down to contact the bag **12** on the conveyor **13,** moving the vacuum pickup head back upward away from the conveyor **13** with the bag seized by the vacuum in the pickup head **14,** moving the carriage member **62** transversely away from the conveyor **13** and then once again extending the vacuum heads **14** downward to place the bag in the vicinity of the delivery station. The vacuum relief means **73** is then opened to cause the vacuum pickup head **14** to drop the bag **12,** and the vacuum pickup head with the vacuum relieved is then retracted upward by the cylinder **54,** the vacuum re-established by closure of the vacuum relief valve **73** by the extension of the actuating cylinder **78,** and then the transverse actuating cylinder **64** is retracted to bring the carriage transversely across back above the conveyor **13** ready to begin a new cycle.

The control circuit **79** has been illustrated in a very schematic fashion in FIG. **10,** and should be appreciated that in practice the actual mechanism of the rotary switch might be formed of a group of adjustable-dwell cams ganged on a common shaft rotated by a timing

motor, with each of the cams having a follower which actuates in turn a switch corresponding to each of the switch points of the rotary switch 79. The arrangement of such a cam actuated switch is a technique well known in the art and is thus not described in full here. The adjustability of the dwell periods of the cams in such a rotary cam actuated switch could be used to tailor the operating cycle of the machine 11 to the various production situations encountered in practice.

As pointed out above, the operation of the machine could also be controlled in a feedback sequential fashion in which the movement of the various parts of the machine by extension and retraction of the actuating cylinders would be sensed at the termination of each movement by the appropriate sensors, such as minature switches, magnetic reed relays or photosensitive devices. Such sequential control allows the machine to run at the maximum speed with which each mechanical operation may be completed, without unnecessary waiting periods for the completion of a time cycle.

The time relationship of the periods of extension and retraction of the three actuating cylinders is shown in approximate fashion in the schematic timing diagram of FIG. 11. In the diagram of FIG. 11, the times of extension and retraction of the actuating cylinder 54 are shown respectively in the upper and lower portions of the first time line on the graph. The periods of extension and retraction respectively of the actuating cylinder 64 are shown in the middle time line on the graph, and the periods of extension and retraction of the actuating cylinder 78 are shown in the bottom time line of the graph.

The point 111 on the top time line of the graph corresponds to the switch point 83 of the rotary switch shown in FIG. 10, the point 112 on that time line corresponds to the switch point 86, the point 113 on the middle time line corresponds to the switch point 88 and the point 114 on the top time line corresponds to the switch point 91. The point 116 on the bottom time line of the graph corresponds to the switch point 92, the point 117 on the top time line of the graph corresponds to the switch point 94, the point 118 on the bottom time line of the graph corresponds to the switch point 96, and the point 119 on the middle time line of the graph corresponds to the switch point 98. The point 121 on the top time line would correspond with the point 111 on the top time line as being the beginning of a new cycle in the situation where no dwell time is required between cycles to get the bags 12 into position on the conveyor beneath the pickup heads 14. Where such a dwell period was required, the point 121 would represent the beginning of a dwell period with the cylinder 54 remaining retracted. This dwell is not shown in FIG. 10, but would lie between the switch points 98 and 83.

FIG. 7 illustrates an alternative embodiment of the case packing machine 11 of the present invention, in which the bags 12 are not loaded directly into an awaiting carton as illustrated in FIG. 1, but are instead loaded onto a receiving platform 122 adjacent to the conveyor 13 at the second, or release, position. The receiving platform 122 is adapted to receive bags 12 one atop another on the platform, and a translocating mechanism generally indicated at 123 is located adjacent to the receiving platform 122 and is formed to move a stack of the bags 12 off the platform 122 in a generally horizontal direction into the waiting carton, indicated generally at 124.

The translocating mechanism 123 includes an actuating cylinder 126 having a plate member 127 attached to the piston rod 128 of the cylinder 126. The plate member 127 is generally vertically oriented in a plane running approximately parallel to one side of the stack of bags 12 on the platform 122. A control mechanism generally indicated at 129 actuates the cylinder 126 once a full stack of bags 12 has been placed on the platform 122.

In its simplest form, the control mechanism 129 includes a weight-actuated single-pole switch 131 connected in series to supply power to the actuating coil 132 of a solenoid valve (not shown) which in turn regulates the supply of air pressure to the actuating cylinder 126. A compression spring 133 has been schematically indicated beneath the platform 122 to indicate the weight sensitivity of the switch 131. The switching arrangement shown is that appropriate to use with a single-acting cylinder 126 having a spring bias for return to the retracted position.

The amount of weight of bags 12 necessary on the platform 122 to actuate the switch 131 is selected to be just that characterized by the requisite number of bags desired to be stacked on the platform before actuation of the translocating mechanism 123. When the last bag 12 to make that weight is placed on the platform 122, the switch 131 closes to supply power from the power lines 82 to the actuating coil 132, which then opens a solenoid valve (not shown) to supply air to the cylinder 126. The piston rod 128 then extends to move the plate member 127 to the left as shown in FIG. 7, shoving the stack of bags 12 off the platform 122 into the waiting carton 124. After the stack of bags is removed from the platform 122, the switch 131 opens to allow spring-biased retraction of the cylinder 126 and the return of the plate member 127 to the position shown in FIG. 7.

If the use of a double-acting cylinder for cylinder 126 is desired, the switch 131 may be made a single-pole double-throw switch which in the light condition of the platform closes a contact energizing a solenoid valve (not shown) to supply air to that side of the cylinder 126 which causes its retraction. In the heavy condition of the platform 122, the switch would close a contact to supply power to the actuating coil 132. The same contacts or additional contacts on the weight-actuated switch 131 could be employed in a fashion well known in the art to interrupt the further cycling of the machine by the control circuit 79 until the cylinder 126 has had time to clear the platform 122 by extending and retracting to a position ready to receive more bags 12 on the platform 122.

FIG. 8 illustrates a method of evacuating the bags 12 to cause a reduction in their volume during the packing process. In this method, one or more apertures 134 are formed in the material of the bag 12 in that surface of the bag which confronts the vacuum pickup head 14. As the vacuum pickup head 14 seizes the bag on conveyor 13, it not only picks up the bag 12 and its contents but also exhausts any excess air within the bag 12 through the apertures 134 and out the sleeve 38 to the exhauster 68. It is contemplated that the apertures 34 could be made small enough to exclude pests and vermin from the bag 12 and yet of sufficient capacity to permit the exhaustion of the bag 12 through the apertures 134.

If necessary, a fairly large number of such apertures **134** could be formed in the bag at some convenient location, such as abutting a seam in the bag **12**. The apertures could then be quite small without seriously impeding the ability of trapped air to flow out of the bag **12** into the vacuum pickup head **14**. The bag **12** could thus be reduced as schematically shown in FIG. **8** from the volume indicated in the phantom outline to a volume such as that indicated in solid in that Figure.

Particular problems are encountered in lifting, transporting and packing bags of flowable material which can shift about and distort the bag from its most compact or desired shape. This problem is particularly acute where the bags are loosely filled with particulate materials, such as raisins, peanuts, etc., and the contents tend to remain in the shape assumed when the bag is picked up. The present invention is particularly suited to keep the bags in the desired shape by forming the vacuum pickup heads **14** to cover a large percentage of the upper surface of the bags **12**.

This structural relationship produces several additional advantages. In the first place, the large horizontal area of the pickup heads **14** makes it possible to pick up and transport relatively heavy bags with only a small pressure drop across the vacuum head, so that the thin and relatively fragile material of the bag will not be ruptured. Secondly, precise registration with the apertures **134** is not required where the bag is to be evacuated while being lifted. Also, the broad support area makes the bags more stable during high speed lifting and transporting.

In accordance with the invention, the vacuum pump or exhauster **68** is of a type capable of quickly exhausting relatively large volumes of air from the vacuum pickup heads **14** and associated conduits. Preferably, the exhauster **68** is of the blower type capable of rapidly moving large quantities of air, and is controlled to provide the relatively low pressure drop. This facilitates rapid pickup and dropping of the bags and permits rapid cycling. Moreover, the large volumetric capacity facilitates the evacuation of the bags through apertures **134**, where desired, and insures that peripheral leaks between the rim of pickup head **14** and the bag, as by reason of a fold or pucker, do not break the vacuum and allow the bag to drop prematurely.

From the foregoing it may be seen that a case packing machine has been provided which gently and rapidly grips and releases bags of loose material to transfer them from a conveyor to a carton, with an altered spacing between the bags. The machine holds the bag smoothly without risk of breakage by distributing the vacuum over a large portion of the bag surface and by limiting the drawing up of the bag into the pickup head. The machine can also pack bags sideways into a carton, and reduce bag volume while picking up the bag.

I claim:

1. A manipulator for removing bags of material from a longitudinal conveyor and placing them in a desired array, comprising

a plurality of vacuum pickup heads adapted to contact the top surfaces of separate bags on the conveyor and wherein at least two of said heads are arrayed one after the other longitudinally of said conveyor,

reciprocation means for moving said pickup heads toward and away from the conveyor for effecting said contact with the top surfaces of the bag and lifting the bags from the conveyor,

translation means for moving said pickup heads transversely of a conveyor from a first position above said conveyor to a second position alongside said conveyor,

vacuum means operative to create a vacuum in said pickup heads and to relieve the vacuum in said pickup heads at said second position for releasing the bags thereat, each of said heads being attached to said reciprocation and said translation means,

spacing means operative to alter the spacing between said heads during the travel thereof whereby the relative spacing between said bags while on the conveyor will be changed as they are removed from the conveyor , said spacing means comprising

a guide member disposed generally transversely of said conveyor and associated with one of said heads to guide motion of said heads generally transverse to said conveyor, and

adjusting means for adjusting the angle of said guide member with respect to a line perpendicular to said conveyor in a generally horizontal plane.

2. A manipulator for bags as described in claim **1** and wherein said spacing means further comprises a longitudinal track member oriented generally longitudinally of said conveyor, attached to said reciprocation means, and bearing one of said heads thereon, said one of said heads heing journalled on said track member for longitudinal motion therealong with respect to another of said heads.

3. A manipulator for bags as described in claim **2** and wherein said guide member comprises a trackway having a guide surface extending longitudinally thereof, and said spacing means further comprises a follower pin attached to said head and engaged with said guide surface for guidance of said head thereby along a path generally transverse to said conveyor.

4. A manipulator for bags as described in claim **3** and wherein said spacing means comprises a plurality of said trackways and a plurality of said pins attached one to each of a plurality of said heads, each pin engaging one guide surface on one trackway, and said adjusting means adjusts the angle of said trackways with respect to each other in a generally horizontal plane.

5. A manipulator for bags as described in claim **4** and wherein said manipulator further comprises a stationary chassis and said trackways are attached to said chassis on one side of said conveyor with freedom for pivotal motion in a horizontal plane, and extend transversely across said conveyor, said adjusting means further comprising a rod attached to said chassis on the side opposite said first-named attachment and oriented generally parallel to the longitudinal direction of said conveyor, said rod being engaged with the distal ends of said trackways for adjustable motion of said distal ends along said rod.

6. A manipulator for bags as described in claim **5** and wherein said manipulator further comprises a second adjusting means for adjusting the spacing between said trackways in a horizontal plane for that portion of said trackways lying directly above said conveyor.

7. A manipulator for bags as described in claim **6** and wherein said second adjusting means comprises a rod attached to said chassis on the side of said conveyor opposite said second position and oriented generally parallel to the longitudinal direction of said conveyor, said

second-named rod being engaged with the pivotal ends of said trackways for adjustable motion of said pivotal ends along said rod.

8. A manipulator as described in claim **1** and wherein said vacuum pickup head comprises a pair of end walls, a pair of side walls, and a top, defining an open-sided chamber, said end walls being arcuate in elevation with the concave side down, said open side of said chamber being the lower side, whereby the pickup head will approximate the contour of a mounded bag on said conveyor.

9. A manipulator as described in claim **8** and wherein a stop member is disposed approximately in the plane of the bottom of said pickup head and extends from one of said walls to another of said walls for limiting excursion of the bag into said chamber.

10. A manipulator as described in claim **9** and wherein said stop member extends between one of said side walls and the side wall opposite and is parallel with said end walls, said stop member being bowed in an arc approximating the arc of said ends members.

11. A manipulator as described in claim **9** and wherein a plurality of said stop members extend from one of said walls to the wall opposite.

12. A manipulator as described in claim **9** and wherein said stop member extends between said end walls and is parallel with said side walls.

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