

AUTOMATIC MECHANISM FOR THE FEEDING OF FOIL BAGS IN BOX

Manoj Khatana [1]

¹M Tech, Department of Mechanical Engineering, CBS Group of Institution Jhajjar, Haryana, India

Abstract - Due to an Industry's pressing need to automate the process of packaging Silver foil bags into the boxes and decrease operating costs, I decided to design a machine that would place the foil bags silver coming out of the x-ray machine into the box. With very few pre-existing designs for automated packaging/loading of these types of bags into the moving boxes without making the conveyor carrying boxes to stop, I essentially had to come up with a design from scratch. To make my machine as simple as possible, I decided to make it primarily conveyor system based. Using both the graphical and analytical methods for conveyor linkage synthesis and with the aid of computer aided design software such as Factory I/O, Solidworks; I was able to determine the details of my system to be designed.

The basic concept behind my work was the use of potential energy stored inside the bags as I started my design by conveying those bags from the x-ray machine to an appropriate height and then the 90° rotation of those bags is also done by carrying the bags from first conveyor to the second conveyor placed at the right angle to the first conveyor.

Similar operations are performed two times to make the horizontally placed bags into the longitudinal position so that they can easily be dropped into their respective moving boxes placed vertically and moving horizontally.

The synchronization of dropping of bags right into the boxes is done with the help of adjusting the speed of the conveyor system along with the pneumatically operated shutter employed onto the chute conveyor.

As a controller for its Prototype mechanism I have used SIMATIC S7-300 PLC along with some of the solenoid valves, Proximity Induced sensors and Geared motors rated as 2kg-cm torque and 60 rpm.

My results were encouraging; the speed of machine is almost same as that of the actual speed of the boxes coming out of the machine to be filled in by the bags in the industry. I found this process should be automated because it is a series of repeated actions and motions.

If my work is continued and my machine is made more efficient, this could be a breakthrough for packaging because it doesn't require the aid of a human at any point during the packaging phase.

Key Words: Automatic feeding, Automation, Automatic packaging, Foil bags in box, Automatic foil packaging

1. INTRODUCTION

1.1 Need for This Study

A renowned FMCG packages the milk powder packets into their respective boxes manually. This work is done in the mid-care area by two workers standing near to the conveyer carrying bags coming out of the X-ray machine from the high care area .Both the hands of each worker are employed as they pick the packet from the first conveyor and place them into their respective boxes .Each adjacent box is getting filled by different workers as they place the packets in the box alternatively. After the box get filled in by the bags they are moved further on the conveyor to be filled in by the spoon and canister pack and then after their flaps being closed they are placed into a carton containing a total of 20 boxes. The same line and concept is used to pack the 4 different types of bags with time and each type varies in dimension very slightly and all are similar in shape. The most common dimension of boxes is 250 mm *180mm*100mm. So the company was in an urgent need to automate this process to save the time and cost. Also the fatigue to the workers may also be reduced. The picture below shows the type of box used.



Figure 1.1-Type of Box Used

Table 1.1-The Basic System

Speed of bags	63-90 bags/min moving
Placed Horizontally w.r.t worker	Left to right w.r.t worker
Speed of box	63-90 box/min moving
Placed Vertically in front of the worker	Right to left w.r.t worker
Distance between the two conveyors	250 mm

1.2 Basic System Installed at the site

In the Basic system of the site there is present a compact machine in which box are fed in their closed state and the machine automatically picks the boxes one by one and opens it to its proper shape and paste the flaps from its bottom. When the box is ready to move further with its upper portion open to fill the bags, these boxes are send to the conveyor which carry these boxes from the Right hand side towards the Left of the worker standing beside the conveyor. Similarly a bag packing machine is employed in the High care area of the site where the bags are being packed according to the required size and after that they are moved out of the High care area into the Medium care area just through a window. After coming into the medium care area the bags are passed through an X-ray machine to check for any metallic part being packed into the bag. At the other side the X-ray machine opens to a conveyor which carries these bags from the Left hand side to the Right hand side of the worker standing to fill these bags into the box. The distance between the two conveyors carrying bags & boxes is around 250 mm. The speed at which bags and box moves in the opposite direction to each other is the same i.e. 63-90 items/min.

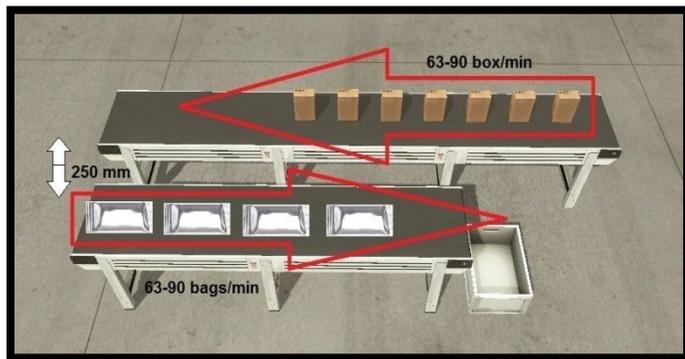


Figure Error! No text of specified style in document..1- Dimensions of Basic System

Time Estimation

As the Aluminum foil bags are coming out of the x ray machine in a Horizontal position there are several motions which the bag has to perform according to the designed system in order to come in the final state of being ready to be dropped inside its box. The various motions to be performed by the bag are as follows:-

1. Lifting of bag to a certain height
2. 90° Rotation of the bag in horizontal plane
3. 90° Rotation of the bag from Horizontal to Vertical plane

4. Dropping or movement of the bag into the box

So by considering the max speed of the bags moving over the conveyor the Time (T) taken by each bag can be calculated as follows:

$$T = \frac{\text{Total time taken}}{\text{No. of bags}}$$

$$T = \frac{60 \text{ seconds}}{90 \text{ bags}}$$

$$T = 0.66 \text{ Second/bag}$$

1.2 Designed System

The designed system may be subdivided into three individual systems as follows

1. Conveyor Unit
2. Pneumatic Unit
3. Sensing Unit

1.3.1 Conveyor Unit

The system designed consists of a number of conveyors arranged in different positions to ensure all the rotations of the bags needed to achieve the goal. All the conveyors' speed and the time of start and stop are controlled by PLC programming and the designed system is raised to a height above the basic system which provides us with following advantages:-

1. There is no need of extra space for a new mechanism
2. The requirement of providing potential energy to the bags is fulfilled
3. Each conveyor is individually controlled so the troubleshoot becomes easy

Conveyors require very little or no maintenance as the mechanism is simplest

1.3.2 Pneumatic Unit

Besides the above mechanism the system also consists of pneumatic circuit which is also controlled by the PLC programming simultaneously with the conveyors. This circuit is used for the following operations:-

To ensure the proper timing of the bags to be synchronized with the timing of the boxes moving from one point to another on conveyor

To open and close the paths for bags to move, operated by a sensing unit, to ensure that whether the box is available on the conveyor in which they will be dropped

1.3.3 Sensing Unit

The sensing unit acts like a brain for the whole designed mechanism. In this mechanism some of the proximity induced sensors are employed for the following works to be done:-

1. The sensing unit will calculate the actual time remaining for the box to reach just below the pneumatic shutter and accordingly the shutter will get opened to make the bag drop exactly into the moving box.
2. This unit will also sense the presence or absence of the box in which bags has to be dropped. If the boxes are not present for the bags then it will actuate an arm which will make the path open at one end and prevent the bags to move onto the pneumatic shutter.

2. LITERATURE REVIEW

2.1 Packaging Machine

Patent Number: 4,524,566

In this packaging machine, the bags are held in shape of a magazine compartment into which it falls. Since the lower portion of the magazine is formed by the boxes, a free fall of the packets does not take place once the magazine is fully filled; and after that during lowering of the storage box, the individual packages slide, due to the gravity force in one of the magazine compartments on the bottom of the storage box because of which the danger of disorganizing of the organized bags is removed. Along with this a special closing mechanism is also not required as the magazine closes the bottom flap of the box along with its own and helps in keeping the design of the machine truly simple. The movement between the magazine and the feed mechanism should be in such a way that the compartments are filled alternatively. A curved end piece is used in the feed mechanism which ensures the favorable sliding of the bags into the magazine compartments due to which the individual packages are not stressed. The lifting of the individual packages on an inclined plane mechanism is purely avoided as the centrifugal forces produced are counteracted by the gravity force during the deflection and this inclined plane is very easy to make by

Besides the above advantages a shaping mechanism is also used in this machine which allows the flexible bags to take the shapes as desired such as uniform distribution of entire

content over the length of the bag. The best possible way to achieve this is by using a shaping roller. The provision of varying the shape or size of the bag with the help of a shaping mechanism benefits us by quickly opening the path in case of breakdowns or by its size according to the different conditions.

The two similar operating mechanisms moving in synchronization has an advantage that one may be lowered to empty the magazine while the other will be getting filled and the process can be carried out without any interruptions. This mechanism is however not essential if the interruptions such as the time between emptying a magazine and placing an empty storage box over it can be taken care of by suitable devices such as the arrangement of its storage in the feed mechanism only.

This arrangement results in the division of the box support. The filling of empty box and the retrieval of the filled boxes can be done simultaneously without moving the supports with the magazine.

Moreover it results into the position where these boxes are placed over the support without being lifted. It may be achieved by making a movable arrangement along with a pneumatic cylinder to lift .The design will be the simplest and also inexpensive with an efficient working.

The design for moving the empty storage boxes over an inclined plane till a support which also stops the next box at the time when the box support is lifted to a height results in the best mechanism to solve this problem as no extra control is required to empty the filled boxes and hence the angular arrangement of the machine can be used further[1].

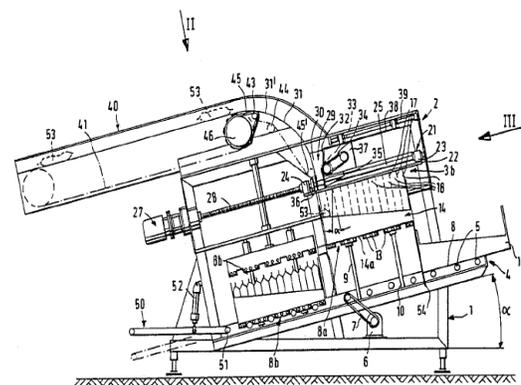


Figure Error! No text of specified style in document..2- Packaging Machine

2.2 Device for packing filled bags into boxes

Patent Number: 4,611,458

This project describes a machine for the packing of bags filled with potato chips.

These bags filled with chips are packaged manually as the proper mechanical or pneumatic handling of these bags is a not possible due to their very light weight. At the time of picking up these bags there is a significant chance of their fall as there is a problem in lifting one or more bags in a row due their light weight.

The machine designed consists of a suction box with a number of suction cups able to move horizontally between pickup and delivery position. The former position is maintained above a mechanism used for the forming a row of bags and the latter is maintained above a mechanism used for lifting the row formed onto the suction cups.

This lifting is employed to due to the reason that if once the row is formed by the bags then it is practically impossible to lift from a stationery position but can easily be pushed above towards the suction cup as it does not generally happens that the bags are left behind or get fallen from the suction cup.

The bags move in stages to form a row which gets deposited on a conveyor. A set of adjacent conveyor belts named as feeding mechanism for the bags to make rows with some spaces between them is provided. This mechanism is provided to protect the conveyor from being lifted as a whole with the suction cups .The conveyor carrying the bags can be moved up to a height towards the suction cups. The partition developed between the conveyor belts is vertically movable between the place of its rest on conveyor and the point on which it arrives to push the bags. The suction box is made to move in vertical position with the help of pneumatic-hydraulic piston cylinder arrangement which is the utmost requirement for aligning the bags in the specific rows.

When the suction box is at its lowest position provisions are made to break the vacuum automatically. To prevent the bags from being floated away at the time of breaking the vacuum the stroke of the piston cylinder units should be made at a time when the suction box is moving downwards. A suction pipe is also provided with an opening leading to the suction box being totally sealed resulting in an easy breaking of the vacuum or the suction effect. If the bags in a row and the rows themselves both are in a position that they are slightly overlapping on one another then only it is possible to fill the box totally full.

If the bags are arranged in a row with the help of a feeding mechanism one by one then only their overlapping position

is achieved in the box and a photoelectric cell is also used to provide the preferred movement of these belts for a predefined distance which has to be less than the width of the bags ensuring the overlapping of the bags in each and every row.

Some sensors and switches are also employed in the horizontal track of the suction box for the overlapping of the rows layer by layer. These sensors control the movement of the suction box according to the predefined distances so that whole rows coming into the packing box should overlap with each other[2]

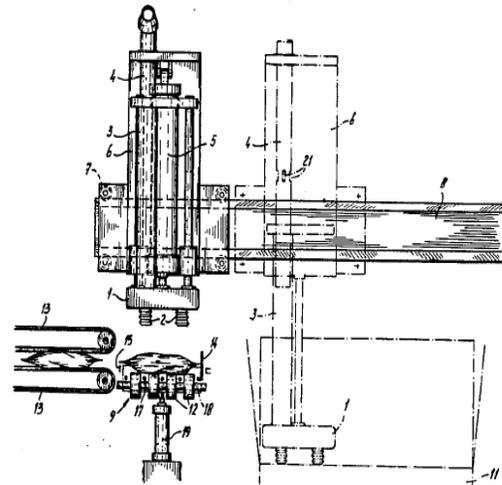


Figure Error! No text of specified style in document..3-Device for packing filled bags into boxes

2.3 Process for the automatic insertion of box-shaped bags

Patent Number: - 4,687,462

This project produces the process for the automatic feeding of bags made of some material which is flexible, into the containers having the shape of large box. The liquids are poured gradually into the containers made of box shaped with some hard material like paperboard or some metals. For the prevention of these liquids a protective covering of plastic material is applied onto these boxes. This covering is made up of a malleable material which in turn is applied over the boxes.

This type of packaging is used to prevent the packaged goods to come in contact with the material used to make the container. So for the feeding of these bags into small boxes an automatic mechanism is designed which produces a lot of this type of containers with bags made of malleable material fed into them. The machines of this type are very exorbitant and also they are not used for the large bags made of

malleable material being fed into the large box shaped containers. The large box containers have a volume of 100 to 200 liters.

A very good use of this type of large box containers is in the depositing and compressing of fiber tows. It is imperative to feed the bags made of malleable material to put into the large box containers made of metallic materials for the support and are of the similar size. Fiber tows are firstly pressed and then deposited onto these metallic support containers. When the filled metallic supporting container reaches to a final press, the support container is taken away and the already pressed box shaped bags are taken for the final pressing to form a bundled shape.

So the project claims an automatic process of feeding bags made of malleable material into the large box containers for the deposition and compression of fiber tow or staple fibers having a side walls and a flat bottom wall. This process includes the following steps:

1. Vertical suspension of the box containers with two extended side faces and the bottom of the bag folded with the other two side faces.
2. A number of such bags are suspended adjacent to each other.
3. Each suspended bag is transported to a bag transfer station.
4. The bags are then partially opened at the transfer station.
5. A device is then inserted into the partially opened bag to spread the bag.
6. Then the partially opened and spread bags are taken onto the container.
7. The side faces of the bags are then spread to engage with the inside walls and the flat bottom wall of the box container.
8. The bag is then held strongly inside the box container and after the collapse, the spreading device is removed and the bag is transferred to the container.
9. In the end each corner of the bag is partially cut from the top and bottom to form the side flaps to make the movement easy from the top of the bags.

Also the project claims the further steps of movement of the bags into the box with cut side flaps in a horizontal position

resulting in ease of the insertion of the bags from the top of the container[3].

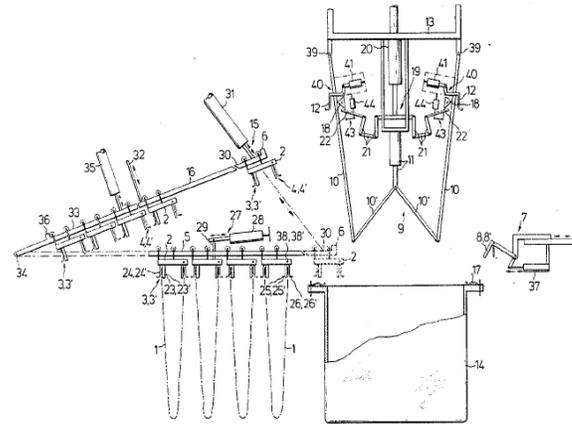


Figure Error! No text of specified style in document..4-
Device for the automatic insertion of box-shaped bags

2.4 Horizontal Pouch Packer

Patent number: - 4,800,703

The present invention contemplates an improved packing machine for pouches or other flexible containers which provides improved lifting and carrying means and more efficient use of space in packing. These objects are achieved by providing an indexable, on demand conveyor which positions the pouches for lifting, a vacuum head assembly which includes vacuum shrouds or vacuum cups, depending on the product, for lifting and nestling the pouches, and a means for varying the depth of placement of the pouches in the box by varying the stroke length of the vacuum head assembly.

In one embodiment of the invention, pouches are fed onto the indexable conveyor by means of a feed conveyor. The feed conveyor has a means for rejecting pouches which are too close together for the indexable conveyor to accept. Indexing or positioning means are also provided to control the stroke length and discharge position for the vacuum head assembly. In the illustrated embodiment, the length of stroke of the vacuum head assembly is determined using flags or other suitable signal means mounted on a shaft which moves with the head assembly and a photoelectric sensor for determining the number of flags which pass a given point, and therefore the depth achieved, on each stroke[4]

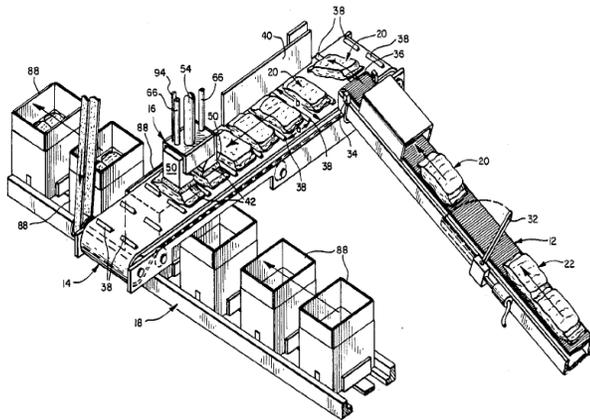


Figure Error! No text of specified style in document..5-
Horizontal Pouch Packer

2.5 System for loading packages into a box

Patent Number: - 5,588,285

A system for packing a plurality of packages into a container has according to the invention an input conveyor for delivering the packages one at a time at regular intervals and at a constant input speed to a transfer station and an output conveyor having a perforated lower belt and an upper belt together defining a path extending from an upstream end at the transfer station to a vertically displaceable downstream end at a loading station. A container conveyor extending past the loading station under the downstream end of the output conveyor can be advanced at a relatively high container speed and at a relatively low container speed for displacing a succession of the containers through the station. The downstream end of the output conveyor can be displaced between a lower position in a one of the containers in the loading station and an upper position out of the way of the containers passing on the container conveyor. The output conveyor can be displaced with any packages held by it at a relatively low stacking speed that is slower than the input speed and at a relatively high gapping speed that is higher than the input speed so that when the output conveyor is running at the slow stacking speed packages deposited on it by the input conveyor will overlap one another and when the output conveyor is running at the high gapping speed a space will be formed between packages on the output conveyor and packages deposited thereon by the input conveyor. A controller connected to a suction box underneath the lower belt in the transfer station and to all of the drives operates the output conveyor at the low stacking speed to form an overlapped group of the packages on the output conveyor while drawing air in through the lower belt to adhere the packages to the lower belt. It periodically switches the output conveyor from the low stacking speed to the high

gapping speed when a predetermined number of the packages have been deposited on the output conveyor by the input conveyor to form a space on the output conveyor between succeeding groups of packages and it operates the container conveyor at the low speed and simultaneously moves the output-conveyor downstream end into the lower position dipped into a one of the containers in the loading station to deposit the group of the packages into the container in the loading station. The container conveyor is subsequently operated at the high speed and simultaneously the output-conveyor downstream end is moved into the upper position clear of the container in the loading station to displace a full container out of the loading station.

Thus with this system a single output conveyor serves not only for forming the necessary gaps between succeeding groups formed on itself, but also for loading these groups into respective containers. This eliminates the need for the prior-art transfer conveyor, thereby substantially simplifying the apparatus. The use of a suction box at the stacking or transfer station ensures that the packages deposited on the lower belt will not shift, but will stay solidly in place so that the output belt can move at high speed. Thus there are no transverse forces that can create product jams in the machine. The machine of this invention can normally pack twice as fast as the above-described prior-art system. The suction box at the same time does not crush the packages, which can contain fragile materials like breakfast cereal or potato chips.

According to this invention the upper belt has an upstream end at a downstream end of the suction box. Thus the upper belt does not cover the lower belt above the suction box, allowing the packages to be sucked down into position before they are gripped between the two belts.

Another suction box is provided underneath the container conveyor at the loading station. The controller applies suction to this box in the loading station during loading of a group of packages therein to stabilize the container. This further ensures that dropping the packages into the container will not shift the container and jam the machine.

The controller according to this invention has a sensor for counting the number of packages deposited by the input conveyor at the upstream end of the output conveyor for switching the output conveyor to the high gapping speed whenever a predetermined number of the packages have been deposited. Thus the entire operation can be automated. The controller switches the container conveyor between its high and low speeds synchronously with switching of the output conveyor between its gapping and stacking speeds. This ensures that the packages are laid in a uniform layer in the container which is moved synchronously with the

packages emerging from the downstream end of the output conveyor[5].

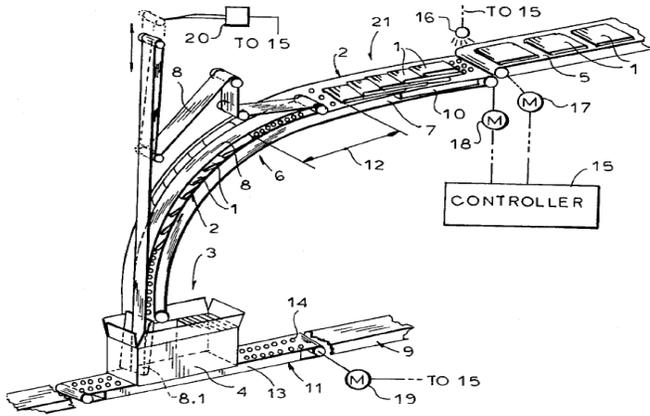


Figure Error! No text of specified style in document..6- System for loading packages into a box

2.6 Device for packing filled bags in cases

The invention relates to a device for packing filled bags in cases, comprising: means for placing the bags in a row in such a way that they overlap each other, a suction box provided with suction cups for retaining the filled bags, which suction box can be moved between a pick-up position above the above mentioned means for forming a row and a delivery position above a case or device for feeding in a case, and means for pushing a formed row of bags up against the suction cups of the suction box, The suction box of this device is suitable for picking up, moving horizontally and delivering a single row of overlap ping bags. In order to deposit two rows of bags in a case, the suction box has to move back and forth twice between the pick-up and the delivery position, which means a relatively long cycle time. The bags are normally deposited in a case in such a way that the rows overlap each other at right angles to the lengthwise direction of the rows. This therefore means that the bags of a row overlap each other in two directions at right angles to each other. It has been found that there is a risk here that the bags of each layer will go into an upward slanting position at right angles to the lengthwise direction of the rows and that the various layers stacked on top of each other will not lay flat on top of each other. The object of the invention is to make a change in the design of the known device which leads to a shorter cycle time and to layers of bags being deposited lying at on top of each other in a case. For this purpose, the suction box according to the invention is provided with first and second rows of suction cups parallel with respect to the feed direction of the bags, the mouths of the first row or rows on the one hand being distanced in the vertical direction from the mouths of the second row or rows of suction cups by a vertical height

being substantially equal to or larger than the thickness of a filled bag, and on the other being distanced in the horizontal direction by a length smaller than the width of a filled bag as seen perpendicular to a row of collected bags, that the suction box is connected to a part which is movable between a first pick-up position and a second pick-up position, the distance between the first and second pick-up positions substantially corresponding to the horizontal distance between the first and second rows of suction cups so as to provide a densely packed layer of bags which overlap each other in two directions perpendicular to each other. The distance between the first and second pickup position should be slightly smaller than the width of a bag, so that successive rows of bags hanging from the suction box overlap each other. Two rows of bags, for example, are always deposited overlapping each other in the crosswise direction in a case, and it has been found that, although those bags overlap each other in a case in two directions at right angles to each other, the layers still lie flat on top of each other. The invention therefore leads to a gain in time and again in space in the outers[6].

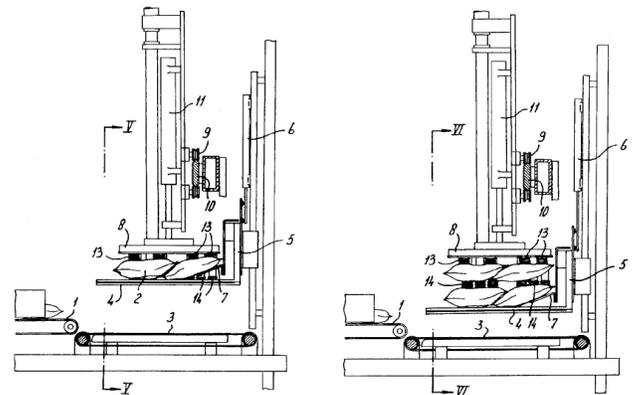


Figure Error! No text of specified style in document..7- Device for packing filled bags in cases

2.7 Automatic sequential bagging machine with constant feed and method of operation

Patent number: - 5,813,196

It is a feature of the present invention to provide a method and a machine for automatically bagging a pre-determined number of articles into a bag and in a sequential and uninterrupted manner from an article feeding device carrying a plurality of spaced articles. Another feature of the present invention is to provide a method and a machine for placing at least two articles in a bag in a sequential and uninterrupted manner from an article feeding device carrying a plurality of spaced articles and Wherein an article support means is moved in a last one of compartments being loaded Where a succeeding article is discharged

immediately after the last article of the preceding group. Another feature of the present invention is that the new sequence provides for a smoother operation with reduced noise and vibration. The new packing sequence reduces the number of strokes of the air cylinders controlling the hinged gates, thereby reducing Wear and tear and maintenance costs and longer machine life.

According to the above features, from a broad aspect, the present invention provides an automatic article bagging machine for placing at least two articles in a bag from an article receiving housing having at least two compartments loaded in alternating sequence from an article feeding device carrying a plurality of spaced articles. The housing receives the articles therein in an uninterrupted manner. The housing has at least two compartments and a hinged gate to guide a first one of the articles from the article feeding device to a first one of the compartments. A further one of the articles is discharged in a further one of the compartments with the hinged gate moved to a non-obstructing open position With respect to the further one of the compartments. The housing has a discharge gate at a lower end thereof. Bag support means is provided for holding a bag under the compartments in a position to receive the at least two articles When the hinged gate is moved to a discharge open position. Detection means is provided to sense the presence of the first and second articles as they enter the first and further compartments. Control means is provided for receiving signals from the detection means. Article support means is displaceable movable in and out of a lower section of each of the compartments above the discharge gate and actuate by the control means to momentarily enter its associated compartment to support a succeeding article being discharged in a last loaded one of the compartments moments after the discharge gate is moved to the discharge position Where the articles in the compartments are released from a bottom open end of the housing and With the hinged gate remaining in the non-obstructing open position to accept a first article of a next group of the at least two articles in the further one of the compartments.

According to a still further broad aspect of the present invention the housing is provided with three compartments, with a central compartment being located between opposed end compartments. There are two hinge gates to direct the first and the second article to a first and a central compartment, respectively. A third compartment receives a third article. The article support means are associated with the first and third compartments which are the opposed end compartments. According to a further broad aspect of the present invention there is provided a method of automatically bagging at least two articles in a bag from an article receiving housing having at least two compartments loaded in alternating sequence from an article feeding

device carrying a plurality of spaced articles. The method comprises the steps of feeding by means of a hinge gate a first one of the articles in a first compartment of an article holding housing. The first article entering the first compartment is detected and a first hinge gate is displaced in non-obstruction open position With respect to a further compartment to accept a second article in the further compartment. The second article entering the further compartment is also detected whereupon the articles are discharged from a bottom end of the compartment through a hinged gate to release the articles into an open bag.

An article support means is actuated, a predetermined time after the hinge plate is actuated, and enters into the further compartment to obstruct an open bottom end of the further compartment to support a first article of the next group of articles being discharged in the further compartment While the hinged gate remains in the non-obstructing open position to accept the first article of the next group of two articles. Accordingly, the feed of articles to the compartments is uninterrupted[7].

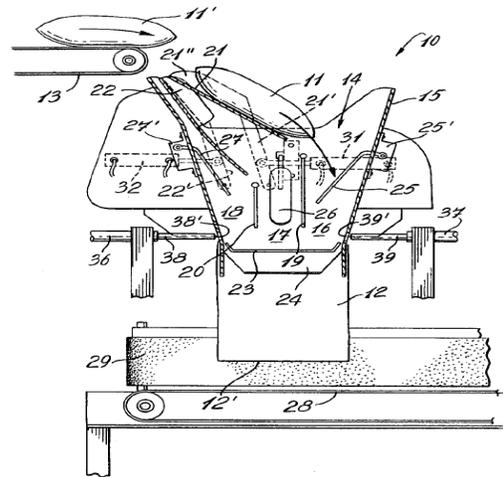


Figure Error! No text of specified style in document..8- Automatic sequential bagging machine

3. CONCLUSION

I have to conclude my project after the completion of the fabrication of mechanical system. So at the end of the completion of the project with each and every desired goals achieved it will be a big success and a new achievement in the automation industry as the project will prove to be the unique of its kind. The industry installing this project once our prototype testing gets over, will gain in various forms such as the dependency of the industry on the workers will become less, the productivity will be increased and the continuous packaging of the bags can be done without causing fatigue to the workers etc. so the different forms of

Gains to the industry as well as to the workers are listed below:-

1. Efficient Production.
2. Lower Expenses.
3. More Profit
4. Less Fatigue

REFERENCES

[1] N. Spiegel and S. Ivey, "Design of Automated Packaging Machine," 2006.

[2] B. Prakken, F. Application, and P. Data, "U . S . Patent Sep . 16 , 1986," 1986.

[3] R. Cited, S. Rewitzer, and H. Aktiengesellschaft, "U . S . Patent Aug . 18 , 1987 Sheet1of4," 1987.

[4] F. Application and P. Data, "Ulllted States Patent [19]," vol. 14, no. I, 2000.

[5] W. S. Rises and E. Suffers, "Miňđ áňđ máttřř: řřbřřř m. řápřřřřř," pp. 2-4, 2016.

[6] K. Street, "UllltBd States Patent [19]," 1992.

[7] T. J. Packard, R. Cited, U. S. P. Documents, J. Eloise, and J. J. Hohenshell, "Ulllted States Patent [19]," vol. 39, 1999.