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(54) **Machine for the automatic and continuous opening of foldable boxes by means of a vertical movement and the corresponding unfolding procedure**

(57) Machine for the automatic and continuous opening of foldable boxes by means of a vertical movement and the corresponding unfolding procedure, which is divided into different stations: box feeding by means of an input conveyor (1), de-stacking (2), unfolding (3), verification (4) that the box (6) has been correctly unfolded, and rejection (5), where the de-stacking station (2) has the means to raise the stack of boxes with the exception

of the box at the bottom of the stack, which is sent to the unfolding station (3) where it is raised, and which, in its continuous ascension run, meets two blade sets, one that acts first (12) and a second one that acts afterwards (14); and with a conveyor gravitational ramp (16) at the end of the line that transports the box (6) that has been rejected and another belt (17) for correctly unfolded boxes (6).

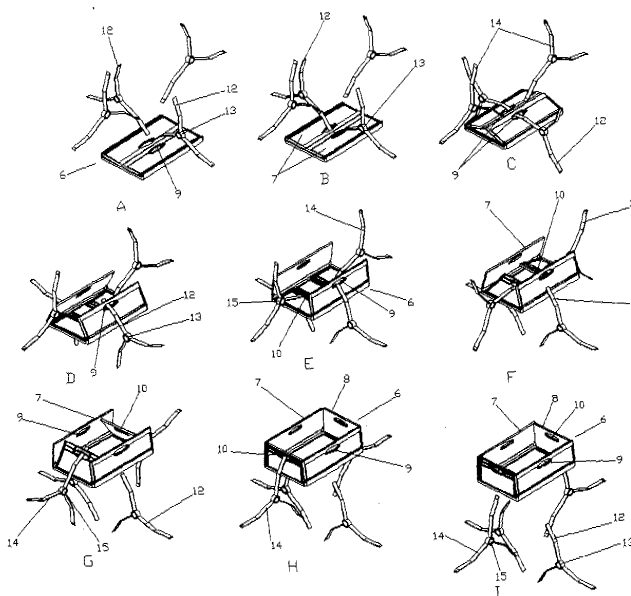


FIG. 2

## Description

### Purpose of the invention

[0001] This invention describes a new machine for automatically and continuously opening foldable boxes by means of a vertical movement and the corresponding unfolding procedure; it includes a structure that imposes a vertical movement on the box so that, after the box leaves the stack of boxes during its ascension, it meets some revolving blades that cause its sides to twist until the box is fully open, in such a way that all mechanisms are static and it is the box itself that activates them with its own movement, which allows carrying out two functions, opening and verification, with just one actor and with no motorization of the blades mentioned above, thus obtaining a simple and reduced consumption device that requires minimum maintenance.

[0002] Its application field is the foldable boxes unfolding machinery manufacture industry.

### Background of the invention

[0003] Unfolding boxes, normally made of plastic, were introduced in the market in order to reduce transportation costs related to their return to factories where they are loaded with mass consumption products. They are usually folded by mall personnel who receive the boxed products, after emptying the box contents.

[0004] A folded box occupies between 20 and 30% of the volume of an unfolded box, which is a remarkable advantage for return transportation. Upon reaching the factory, boxes must be unfolded in order to be filled with the corresponding products; for this purpose, machines capable of unfolding thousands of boxes per hour must be used, depending on the requirements of the process.

[0005] Sometimes unfolding tasks are carried out manually, which is tedious when there is a large quantity of boxes, and the person in charge of such task is usually affected by fatigue and discomfort that may in turn cause an incorrect opening and maintenance of the box due to an improper use of side fixing mechanisms, since performance and quality vary with time and effort.

[0006] Currently, some authors have developed automatic machines to carry out these operations without human intervention. One of such machines is described by invention patent E 95942178.5, "Unfolding device for recipients folded together," which describes and claims an unfolding machine that applies a vertical movement and which has a series of articulated and synchronized arms that hold the sides of the box to unfold and, by means of suitable motorization mechanisms, fully unfold said box.

[0007] On the other hand, the invention described in the previous paragraph moves the boxes in a vertical direction following phases or stages, in such a way that boxes are unfolded while they are not moving (still), since the rotation axis of the corresponding unfolding arms must be on the same plane as the rotation axis of the

hinge of the side that is to be unfolded.

[0008] Even though this machine has a series of advantages with regard to manual operation, the use of all these arms that move with several freedom degrees and their respective motorization implies a certain complexity regarding machine synchronization, space, feeding, and maintenance, which in turn increases costs.

[0009] Additionally, since the machine must not be moving to carry out unfolding tasks, i.e., the vertical movement must be stopped, production is therefore delayed.

### Description of the invention

[0010] The aim of the machine for automatically and continuously opening foldable boxes by means of a vertical movement, described by the present invention, is to solve the problems described above; to this end, a mechanical structure is used as a support for the other components, among which there is an input conveyor to feed first stacks of boxes to the de-stacking station, and then individual boxes to the unfolding station. In this case, a roller conveyor is used.

[0011] There is also a de-sacking station that includes a mechanism for feeding one box from the stack at a time. There is a photocell that detects the stack of boxes as it enters the machine and causes a pneumatic movement that raises all boxes except for the one at the bottom of the stack. When the upper boxes are unlocked, the remaining box is transported by the input conveyor towards the unfolding station. As it moves forwards, the photocell is uncovered, which in turn causes the upper boxes to come down and repeat the cycle. There is another photocell that detects the second box and which, upon "losing sight" of this box, allows the entrance of a new stack of boxes.

[0012] When the boxes coming from the de-stacking station reach the unfolding station, there are some vertical guides that stop them and block a photocell, which starts a vertical conveyor that raises the box towards an area with revolving blades.

[0013] These revolving blades are mounted on a shaft that allows them to rotate with only one degree of freedom. The machine has preferably two sets of such revolving blades - one set of "long" blades for the long sides of the boxes to be unfolded, and one set of "short" blades for the short sides of the boxes to be unfolded; these names, however, do not refer to the physical length of the blades.

[0014] These revolving blades have devices mounted on the shaft to ensure an accurate angular position upon arrival of the boxes. Each blade has a shape that is suitable for its function.

[0015] During its ascending movement, the box encounters the blades and, as the box moves up linearly, the blades are forced to perform a twisting movement that interferes with the sides of the box and causes it to open.

**[0016]** Therefore, the machine herein advocated avoids the use of motorized arms, thus simplifying the entire mechanism that acts on the sides of the boxes, with the corresponding reduction of investment and maintenance costs. On the other hand, since box sides are unfolded continuously, idle times, some run ends, detectors and task synchronizers, etc., are avoided, thus favoring a higher production at a lower cost.

**[0017]** The machine also has a verification station located at the exit of the unfolding station; its purpose is checking that the boxes have been correctly unfolded. This station has a series of levers that exert a controlled pressure on each end of the short sides of the boxes; if this pressure is resisted, it means that the tabs are properly locked, otherwise the lever pushes the side of the box causing a small elastic deformation on it that is detected by a photocell that in turn triggers a rejection signal.

**[0018]** Finally, at the end of the ascending path there is a rejection station for separating the boxes verified in the previous station. It includes a pneumatic ramp that sends the boxes to one of two levels depending on whether they were accepted or rejected.

**[0019]** The novelty of this machine is that all of its mechanisms are static and it is the box itself that activates them with its own movement as it moves forward, thus making its opening possible.

**[0020]** All mechanisms (revolving blades, cams, etc.) simulate the opening process as carried out by human operators: picking up the boxes from their handles and, at the correct moment, pushing them to activate the mechanism that closes them.

### **Description of the drawings**

**[0021]** As a complement to the description herein included, and in order to help better understand the characteristics of the invention, a series of descriptive but not limiting figures have been attached to this descriptive summary as an integral part of it, showing the following:

Figure 1.- Upper side perspective view of a practical development of the unfolding machine described by this invention.

Figure 2.- Schematic sequence of 9 drawings to show the action of the sets of blades on the boxes as they move upwards, from the initial folded position up to the final, fully unfolded one: A: Start; B: Opening of long sides 1; C: Opening of long sides 2; D: Opening of long sides 3; E: End of opening of long sides; F: Opening of short sides 1; G: Opening of short sides 2; H: Opening of short sides 3; I: End of opening of short sides.

Figure 3.- Representation of a stopping system for the blades.

### **Preferred materialization of the invention**

**[0022]** As shown in the figures attached, there is a machine body that can be divided into several stations - there is an input conveyor (1) through which boxes are fed (6) and that carries the boxes to a de-stacking station (2) and then to an unfolding station (3), a verification station (4), and a rejection station (5). These boxes (6) can be folded as a parallelepiped that has two long sides (7) and two short sides (8) with their corresponding handles (9, 10).

**[0023]** The input conveyor station (1) is based on current devices available in the market that use motorized rollers and photoelectric cells that detect the presence of the box (6) until it reaches the de-stacking station (2), which is suited so as to raise the stack of boxes received from the conveyor, raising all boxes but the one at the bottom of the stack, which is sent to the unfolding station (3) where it is held from its sides (7, 8) in order to unfold it.

**[0024]** At the de-stacking station there is a box (6) elevator (11) that causes boxes to get in touch with two blade sets - one that is larger (12) and revolves around a fixed rotation shaft (13), and a second one that is smaller (14) and also revolves around a fixed rotation shaft (15). Both sets are located at different heights within the ascending path of the box (6), so that boxes meet first the set of blades that unfolds the upper part of the folded box.

**[0025]** The revolving movement of the blades (12, 14) is controlled by any known device, although this will preferably be a connecting rod set (18) that revolves around the same axis (13, 15), a roller (19) and a spring (20).

**[0026]** The verification station (4) checks that boxes (6) have been properly unfolded. To this end, it has a series of levers (22) that exert a controlled pressure on each end of the short sides (8) of the boxes; if this pressure is resisted, it means that the tabs are properly locked, otherwise the lever pushes the side (8) of the box causing an elastic deformation on it that is detected by a photocell that in turn triggers a rejection signal.

**[0027]** The rejection station (5) has a gravitational conveyor ramp (16) that carries the boxes (6) that have been rejected for being incorrectly unfolded. Boxes that have been correctly unfolded are transported by a band (17) towards the pick-up and storage or filling point.

**[0028]** Blade sets (12 and 14) are synchronized in such a way that the difference in height between them allows boxes to go up and open the folded upper sides.

**[0029]** The rotation shaft (13, 15) and its support are in principle common. At the end of this shaft there is a mechanism that performs different functions: it is a blade stopping and positioning mechanism (12, 14) that accommodates the blades in the correct position to wait for the box (6). By means of a cam mechanism (18) and a spring (20), at the right time and with the required force, it exerts an impulse on the blade that allows closing the box without damaging it.

**[0030]** The cam has three runs: first, it loads the spring

(20) with the impulse generated by the box (6) as it goes up, by means of a lever that supports a following wheel (19); then, the energy from the spring (20) speeds up the side being unfolded, producing a small impact at the end of the run that causes the tabs to lock; finally, it has a curve (21) whose radius is similar to that of the following wheel (19) to ensure that the mechanism stops at a certain point (with the help of a stopping system) so that the box is correctly positioned for the next blade.

[0031] Its application and operation is very simple - boxes are fed by any known method, according to the figures attached, by means of a conveyor (1) and a de-stacker (2), in order to place the folded box (6) from the bottom onto the de-coupler (3) and raise it by means of suitable mechanisms (11) at a preset speed.

[0032] On its ascending movement (figure 2, drawing 1), the box (6) meets the long blades (12), whose ends are inserted into the handle (9) of the longest folded side (7) (figure 2, drawing 2), in such a way that, as the box continues its movement in an upwards direction (figure 2, drawing 3), the inserted blade (12) revolves around its axis (13) causing the side to unfold around its corresponding hinge until reaching its final position (figure 2, drawing 4).

[0033] The box (6) continues to move upwards and meets the short blades (14) that hold the handles (10) of the short sides of the box (figure 2, drawing 6). Similarly, as the box continues moving upwards, it causes the shafts (15) to twist and this revolving movement of the blade unfolds the connected side (figure 2, drawings 7, 8), which in turn rotates around its hinge until its final position (figure 2, drawing 9), forcing the long sides (7) to a closing position with respect to the short sides (8).

[0034] Blade sets (12, 14) will include a number of blades such that, when one of the blades has finished its job and turned the corresponding angle, the following blade of the same set, following the direction of the rotation, will be positioned to connect with the following box (6). This ratio will be the parameter used to determine the number of blades per mill-like set.

[0035] Then, some levers (22) at the verification unit (4) check that the box (6) is properly unfolded and, if it is, it continues its run on the band (17) towards the filling or storage destination; otherwise, if its sides have not been correctly closed, such situation is detected by a photocell that triggers a command to send the box to the gravitational conveyor ramp (16) for revision.

[0036] After describing in detail the nature of the present invention, as well as a possible practical application, all that remains to be stated is that both its shape and composing materials can be modified provided that such modifications do not substantially affect the characteristics claimed in the following section.

## Claims

1. Machine for the automatic and continuous opening

of foldable boxes by means of a vertical movement, from which folded boxes (6) are picked for the automatic unfolding of said folded boxes (6) as a parallelepiped that has two long sides (7) and two short sides (8) with their corresponding handles (9, 10), **characterized** because the machine body is divided into several stations - there is an input conveyor (1) through which boxes are fed (6) and that carries the boxes to a de-stacking station (2) and then to an unfolding station (3), a verification station (4) to check that the box (6) has been properly unfolded, and a rejection station (5); the de-stacking station (2) of the machine is suited so as to raise the stack of boxes received from the conveyor, raising all boxes but the one at the bottom of the stack, which is sent to the unfolding station (3) where it is held from its sides (7, 8) in order to unfold it so that at the de-stacking station there is a box (6) elevator (11) that causes boxes to get in touch with two blade sets - one that is larger (12) and a second one that is smaller (14) and whose rotation movements are controlled by a stopping system; and at the end of the line there is a conveyor gravitational ramp (16) that transports the box (6) that has been rejected and another belt (17) for correctly unfolded boxes (6).

2. Machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the first claim, **characterized by** the fact that each set of long blades (12) revolves around a fixed rotation shaft (13).

3. Machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the first claim, **characterized by** the fact that each set of short blades (14) revolves around their fixed rotation shaft (15).

4. Machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the previous claims, **characterized by** the fact that both sets of blades (12 and 14) are located at different heights along the ascending run of the box (6), so that the box meets first the set of blades that unfold the upper part of the folded box.

5. Machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the first claim, **characterized by** the fact that the stopping system of the blades (12, 14) uses a cam mechanism (18) and a spring (20) that, at the right time and with the required force, exerts an impulse on the blade that allows closing the box.

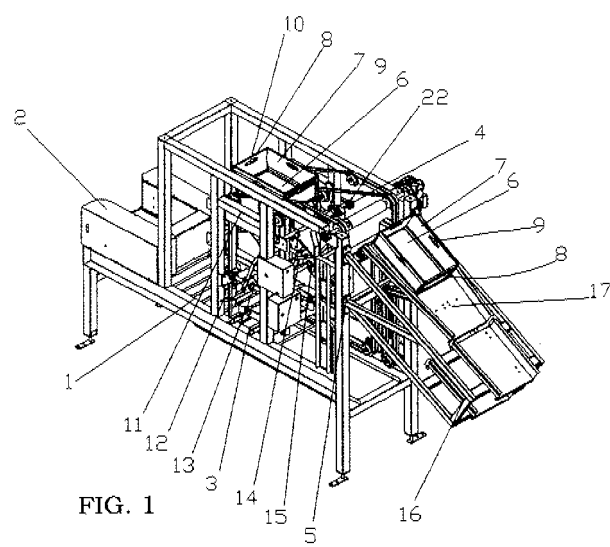
6. Machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the previous claim, **characterized by** the fact that the cam has three runs: first, it loads

the spring (20) with the impulse generated by the box (6) as it goes up, by means of a lever that supports a following wheel (19); then, the energy from the spring (20) speeds up the side being unfolded, producing a small impact at the end of the run that causes the tabs to lock; finally, it has a curve (21) whose radius is similar to that of the following wheel (19) to ensure that the mechanism stops at a certain point.

7. Machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the first claim, **characterized by** the fact that the verification station has a series of levers (22) that exert a controlled pressure on each end of the short sides (8) of the boxes so that if this pressure is resisted, it means that the tabs are properly locked, otherwise the lever pushes the side (8) of the box causing an elastic deformation on it that is detected by a photocell that in turn triggers a rejection signal.
8. Machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the first and previous claims, **characterized by** the fact that the rejection station (5) has a conveyor gravitational ramp (16) that transports the box (6) that has been rejected for being incorrectly unfolded. Boxes that have been correctly unfolded are transported by a band (17) towards the pick-up and storage or filling point.
9. Unfolding procedure of the machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the first to fourth claims, **characterized by** the fact that, during its ascending movement, the box (6) meets the long blades (12), whose ends are inserted into the handle (9) of the longest folded side (7), in such a way that, as the box continues its movement in an upwards direction, the inserted blade (12) revolves around its axis (13) causing the side to unfold around its corresponding hinge until reaching its final position.
10. Unfolding procedure of the machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the seventh claim, **characterized by** the fact that the box (6) continues to move upwards and meets the short blades (14) that hold the handles (10) of the short sides of the box and, similarly, as the box continues moving upwards, it causes the shafts (15) to twist and this revolving movement of the blade unfolds the connected side, which in turn rotates around its hinge until its final position.
11. Unfolding procedure of the machine for the automatic and continuous opening of foldable boxes by

means of a vertical movement, as described in the previous claim, **characterized by** the fact that the last revolving movement of the blades (14) forces the long sides (7) to a closing position with respect to the short sides (8).

12. Unfolding procedure of the machine for the automatic and continuous opening of foldable boxes by means of a vertical movement, as described in the seventh claim, **characterized by** the fact that the sets of blades (12, 14) include a number of blades such that, when one of the blades has finished its job and turned the corresponding angle, the following blade of the same set, following the direction of the rotation, is positioned to connect with the following box (6).



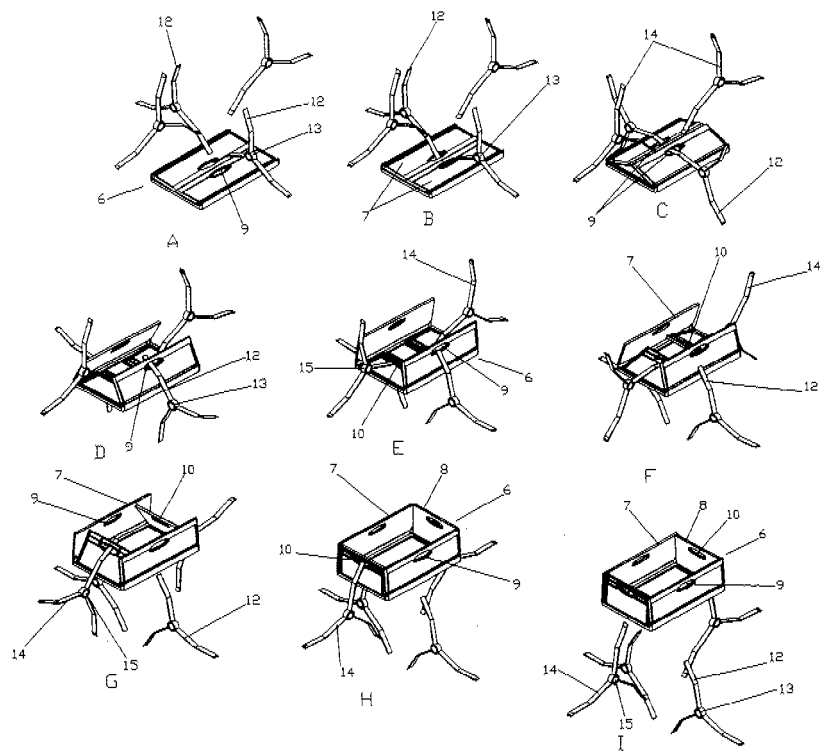


FIG. 2

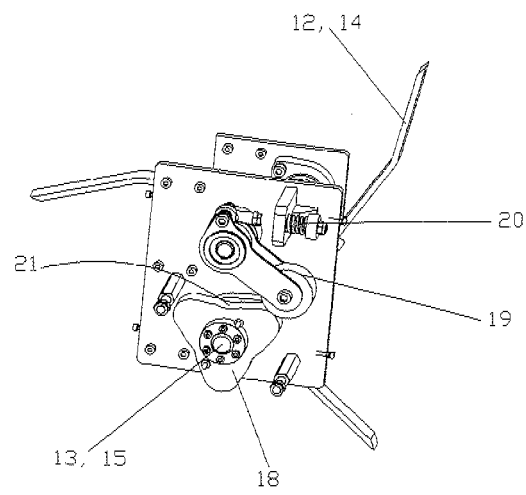


FIG. 3





European Patent  
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## EUROPEAN SEARCH REPORT

Application Number  
EP 07 38 0341

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			B31B B65B
Place of search		Date of completion of the search	Examiner
Munich		8 April 2008	Johne, Olaf
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 38 0341

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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