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(54) **A process used to sort out lots of goods loaded in bulk on conveyor systems according to a specific order, item by item**

(57) The present invention relates to a process used to sort out a lot of items loaded in bulk on a conveyor system according to a predefined order. This process is basically characterised by the fact that it includes two different phases to separate the items thanks to the presence on the conveyor system of two groups of exits;

it being provided, in particular, that the first separation phase carried out with the first group of exits is preliminary to the second and final separation phase carried out with the second group of exits, that is the phase that allows to sort out the items according to the predefined order.

**Description**

**[0001]** The present patent application for industrial invention relates to a process used to sort out lots of goods loaded in bulk on conveyor systems according to a specific order, item by item.

**[0002]** The system according to the present invention refers to a specific technical sector that offers conveyor systems capable of sorting out items loaded in bulk.

**[0003]** A first type of these systems is represented by the so-called sorting systems.

**[0004]** These systems include a supply line and various exits used to separate the items. According to their operative principle, the first item that enters the system is usually the first item that exits from it, thus allowing to sort out the items in various groups. In these systems the number of exits is defined according to the number of groups to be created.

**[0005]** This type of system comprise a loading station, an identification station, a unidirectional transportation line and multiple exits with automatically controlled exchanges, one for each destination.

**[0006]** The major advantage of this type of systems is represented by fast operation, since unloading occurs together with loading and various items are managed in a parallel, simultaneous way, since no pre-defined positions are necessary.

**[0007]** These systems, however, cannot be used if the separation level of the items is high. As a matter of fact, in order to obtain a certain order in the exit of the items, it would be necessary to provide as many exits as the number of arriving items, and this is not possible for reasons related to space and costs.

**[0008]** Cascade systems are sometimes realised to obtain a higher level of separation. In these systems, the downstream installation receives a lot of items from one of the destinations directed to the upstream installation. For illustrative purposes, we could mention that a shipping system includes a first machine that sorts out the items by courier and a second machine that takes the items of a specific courier and sorts them out by client.

**[0009]** However, whenever a specific exit order is required, item by item, the number of machines and exits is always very high.

**[0010]** A second type of conveyor systems is represented by the so-called ordering systems. The applicant of this patent application has been operating in this field as manufacturer for a long time.

**[0011]** The ordering systems include multiple co-operating machines that receive the items and unload them, one by one, in the desired exit order; it being provided that the exit order is not related to the entrance order.

**[0012]** The major advantage of this type of systems is the capability of ordering the items according to any predefined order, since they include a search phase, item by item, inside the structure of a temporary stock with a different time schedule compared to the reception phase.

**[0013]** These systems are therefore extremely practical and efficient, since they provide for high separation of the unloading lists or, in any case, for the possibility of providing a high separation level.

**[0014]** The weak point of this type of systems is the reduced speed of reordering operations, since unloading does not take place together with loading. For this reason, in order to search for a specific item in the stored lot it is necessary to repeat the positioning for each item.

**[0015]** Once implemented on a conveyor system, the process according to the present invention allows for combining the specific advantages of the two types of systems mentioned above, without their disadvantages. More precisely, the process according to the present invention provides for the same performance, in terms of separation level, as the ordering systems, while maintaining the typical advantages of sorting out systems, related - as mentioned earlier - to limited costs and volumes, to the capability of respecting any exit order, item by item, and to the limited number of exits.

**[0016]** In particular, according to the new process, the items are subjected to two different separation phases: the first, preliminary phase realises the predefined order of the items during the second, final separation phase.

**[0017]** In consideration of a maximum number of items, the implementation of the process according to the present invention requires the realisation of a system with two groups of exits, each group with a number of exits equal to the square root of the maximum number of items in the lot, rounded up. To sort out a lot of max. 100 items, it will be therefore necessary to have a system with two groups of exits, with ten exits defined as A1, A2 up to A10 and other ten exits defined as B1, B2 up to B10.

**[0018]** Based on the process according to the present invention, the identification codes of the items loaded on the system must be known, as well as the desired unloading order, item by item. The positions of the items along exits B1, B2 ... B10 are booked according to this order, based on a logic principle by which the first item to be unloaded will book the first position of exit B1, the second item will book the second position of the same exit B1, and so on, until the maximum quantity of items that can be positioned on line B1 has been booked, which corresponds to the number of exits for each group (ten in this example).

**[0019]** The first item after the items that have booked the ten positions of exit B1 (that is the 11<sup>th</sup> item) will book the first position of exit B2; likewise, the first item after the items that have booked the ten positions of exit B2 will book the first position of exit B3, and so on, until the ten positions of exit B10 have been booked.

**[0020]** Once the items have been loaded on the conveyor system operated by the logical principle according to the

present invention, the items are initially sorted out along the exits of series A1-A10, according to the position booked on the exits of series B1-B10. More precisely, all items designed to take the first positions of the exits B1-B10 will be conveyed towards exit A1 (that is the 1<sup>st</sup> item, the 11<sup>th</sup> item, the 21<sup>st</sup> item ... up to the 91<sup>st</sup> item); all items designed to take the second positions of the exits B1-B10 will be conveyed towards exit A2 (that is the 2<sup>nd</sup> item, the 12<sup>th</sup> item, the 22<sup>nd</sup> item ... up to the 92<sup>nd</sup> item) and so on, until all items designed to take the 10<sup>th</sup> positions of the exits B1-B10 will be conveyed towards exit A10 (that is the 10<sup>th</sup> item, the 20<sup>th</sup> item ... up to the 100<sup>th</sup> item).

**[0021]** Unloading starts once the reception of a lot has been completed and the lot has been divided along exits A1-A10, starting from exit A1 that unloads the ten items in the first positions of the ten exits B1-B10; likewise, exit A2 unloads the ten items in the second positions of the ten exits B1-B10, until the ten items located inside exit A10 have been unloaded in the 10<sup>th</sup> positions of the same exits B1-B10.

**[0022]** It must be noted that, in order to ensure the correct final selection inside exits B1-B10, the order in which the items are loaded inside each exit from A1 to A10 is not relevant.

**[0023]** Considering exit A1 for illustrative purposes, it can be said that the ten items designed for this exit can be loaded in a rigorous sequence (i.e. the 1<sup>st</sup>, the 11<sup>th</sup>, the 21<sup>st</sup> ... up to the 91<sup>st</sup>) like the sequence shown in the table below, but also, with the same efficacy, in a completely random sequence (i.e. the 21<sup>st</sup>, the 91<sup>st</sup>, the 1<sup>st</sup>, the 31<sup>st</sup>, the 41<sup>st</sup>, etc.) as long as all these items are the first items of their respective sub-lots of ten items each.

**[0024]** To better understand the logic principle of the process according to the present invention, reference is made to Table A below, which shows the sorting out of a 100-item lot.

**[0025]** The table is prepared before the arrival of the 100-item lot, by giving numbers from 1 to 100 to each of the identification codes of the items in the desired final order. Then the table is filled in, in horizontal direction from left to right, from up down.

**[0026]** The table is read horizontally for exits of group B and vertically for exits of group A. In practice, for each identification code, the destination during the separation phase for exits in group A corresponds to the column and the destination for exits in group B corresponds to the line.

**[0027]** It must be noted that the sorting out process with double cycle according to the present invention can be actuated by a sorting out system with two groups of exits as illustrated above, or by two independent systems arranged in cascade, each of them with a single group of exits, or by a single system provided with a single group of exits, as long as the exits can be divided in two parts and therefore used first as exits of series A and then as exits of series B, maintaining the items separated along the same line.

Table A

|     | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 |
|-----|----|----|----|----|----|----|----|----|----|-----|
| B1  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10  |
| B2  | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20  |
| B3  | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30  |
| B4  | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40  |
| B5  | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50  |
| B6  | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60  |
| B7  | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70  |
| B8  | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80  |
| B9  | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90  |
| B10 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |

**[0028]** For easier reference this description continues with a practical example of the operation of the process according to the present invention, with the help of some graphic symbols, with each symbol representing an item to be sorted out. For convenience reasons, this example refers to a lot of 16 items. It is understood, however, that the same logic principle can be used for lots with any number of items, as desired.

**[0029]** In view of the above, it can be understood that the 16 items can be sorted out by means of a system provided with two groups of exits, each of them including four exits, that is equal to the square root of the number (16) of items in the lot to be sorted out. In this example the items arrive to the system operated according to the present invention in the following random order:

|            |          |            |          |            |            |          |           |          |            |           |            |            |           |            |           |
|------------|----------|------------|----------|------------|------------|----------|-----------|----------|------------|-----------|------------|------------|-----------|------------|-----------|
| ↑          | ↙        | ↓          | ↘        | ←          | →          | ↗        | ☹         | ↘        | ☒          | ☆         | ☐          | ☑          | ☺         | ☒          | ✱         |
| $\alpha 4$ | $\chi 2$ | $\alpha 1$ | $\chi 3$ | $\alpha 2$ | $\alpha 3$ | $\chi 4$ | $\beta 3$ | $\chi 1$ | $\delta 1$ | $\beta 2$ | $\delta 4$ | $\delta 3$ | $\beta 4$ | $\delta 2$ | $\beta 1$ |

and must be sorted out in the following order

|            |            |            |            |           |           |           |           |          |          |          |          |            |            |            |            |
|------------|------------|------------|------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|------------|------------|------------|------------|
| ↓          | ←          | →          | ↑          | ✱         | ☆         | ☹         | ☺         | ↘        | ↙        | ↘        | ↗        | ☒          | ☒          | ☑          | ☐          |
| $\alpha 1$ | $\alpha 2$ | $\alpha 3$ | $\alpha 4$ | $\beta 1$ | $\beta 2$ | $\beta 3$ | $\beta 4$ | $\chi 1$ | $\chi 2$ | $\chi 3$ | $\chi 4$ | $\delta 1$ | $\delta 2$ | $\delta 3$ | $\delta 4$ |

**[0030]** More precisely, as it can be seen from the alphanumerical codes associated to the various symbols, the final purpose is to sort out the items loaded in bulk according to a desired sequence of four different sub-lots, each of them with four items; it being provided that the four items of each sub-lot are ordered according to a predefined sequence.

**[0031]** With reference to the symbols and alphanumerical codes that identify the items, it can be stated that the final purpose of this demonstration is to create a sequence of four sub-lots as explained below:

- the first sub-lot with items  $\alpha 1$ ,  $\alpha 2$ ,  $\alpha 3$ ,  $\alpha 4$
- the second sub-lot with items  $\beta 1$ ,  $\beta 2$ ,  $\beta 3$ ,  $\beta 4$
- the third sub-lot with items  $\chi 1$ ,  $\chi 2$ ,  $\chi 3$ ,  $\chi 4$
- the fourth sub-lot with items  $\delta 1$ ,  $\delta 2$ ,  $\delta 3$ ,  $\delta 4$ .

**[0032]** To that end two consecutive separation phases will take place, each of them affecting one group of four exits. The four exits for the first separation phase (or initial division) are defined as A1, A2, A3 and A4 and the second group of exits for the second separation phase (or final division) as B1, B2, B3 and B4.

**[0033]** The description continues illustrating the arrangement of the items at the end of the second separation phase according to Table B below, which is filled in using the symbols of the items in the desired final order, from up down and from left to right.

**Table B**

|           | A1 | A2 | A3 | A4 |
|-----------|----|----|----|----|
| <b>B1</b> | ↓  | ←  | →  | ↑  |
| <b>B2</b> | ✱  | ☆  | ☹  | ☺  |
| <b>B3</b> | ↘  | ↙  | ↘  | ↗  |
| <b>B4</b> | ☒  | ☒  | ☑  | ☐  |

**[0034]** As shown in Table B, during the first separation phase, the items will be assigned to the exit that corresponds to the vertical line they belong to, then will be taken in the second separation phase step and directed to the exit that corresponds to the same horizontal line they belong to.

**[0035]** Therefore during the first separation phase step the items will be sorted out as follows:

- ↓ ✱ ↘ ☒ in exit A1
- ← ☆ ↙ ☒ in exit A2
- → ☹ ↘ ☑ in exit A3
- ↑ ☺ ↗ ☐ in exit A4

even if not necessarily in the correct order described above.

**[0036]** The essential condition for the first separation phase of the process is that the four specific items directed to a specific exit (A1-A4) must be deposited inside this specific exit, even if in random order.

**[0037]** For easier reference, it can be said that if exit A1 is necessarily the first destination of the items identified with  $\alpha 1$ ,  $\beta 1$ ,  $\chi 1$ ,  $\delta 1$ , these items can be deposited there in an ordered sequence, but also - as an alternative example - in

the sequence  $\chi_1, \alpha_1, \delta_1, \beta_1$  or in any other possible sequence.

[0038] Then the items positioned in exits A1, A2, A3 and A4 are taken starting from exit A1 to A4 and sent to the exits of group B. In this phase the items are sorted out to the destinations of group B as indicated below:

- $\downarrow \leftarrow \rightarrow \uparrow$  to destination B1
- $\star \star \odot \odot$  to destination B2
- $\nabla \triangleleft \triangleright \blacktriangle$  to destination B3
- $\boxtimes \boxtimes \boxtimes \boxtimes$  to destination B4.

[0039] Taking the items from the exits of group B, starting from B1 to B4, the desired order can be obtained, as shown below:

|              |              |               |            |           |           |           |           |          |                 |                  |                  |             |             |             |             |
|--------------|--------------|---------------|------------|-----------|-----------|-----------|-----------|----------|-----------------|------------------|------------------|-------------|-------------|-------------|-------------|
| $\downarrow$ | $\leftarrow$ | $\rightarrow$ | $\uparrow$ | $\star$   | $\star$   | $\odot$   | $\odot$   | $\nabla$ | $\triangleleft$ | $\triangleright$ | $\blacktriangle$ | $\boxtimes$ | $\boxtimes$ | $\boxtimes$ | $\boxtimes$ |
| $\alpha_1$   | $\alpha_2$   | $\alpha_3$    | $\alpha_4$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ | $\chi_1$ | $\chi_2$        | $\chi_3$         | $\chi_4$         | $\delta_1$  | $\delta_2$  | $\delta_3$  | $\delta_4$  |

[0040] Finally, it must be noted that for the practical implementation of the process according to the present invention, the sorting system used for this purpose must be assisted by an electronic control unit (capable of managing and controlling the entire process) and a reader capable of identifying the items loaded on the system and transferring the identification results to the electronic control unit.

## Claims

1. A process used to sort out lots of goods loaded in bulk on conveyor systems according to a specific order, item by item, **characterised by** the fact that it is implemented on a sorting system with two different, but identical in number, groups of exits ( $A_1-A_n/B_1-B_n$ ), according to which, when items are loaded in bulk on the system, the identification codes of each item are known, as well as the order in which the items have to be unloaded, item by item; it being provided that according to the predefined order of unloading, the various items entering the system are automatically associated - using a suitable processor - with the position they occupy in the second group of exits ( $B_1-B_n$ ), based on the logic principle that the first item to be unloaded must be assigned to the first position of the first exit ( $B_1$ ), the second item to be unloaded must be assigned to the second position of the first exit ( $B_1$ ), up to the last item to be unloaded that must be assigned to the last position of the last exit ( $B_n$ ); it being provided that initially the items are assigned to the first group of exits ( $A_1-A_n$ ), according to the logic principle that all items assigned to the first positions in the exits of the second group ( $B_1-B_n$ ) must be conveyed to the first exit ( $A_1$ ), all items assigned to the second positions of the exits of the second group ( $B_1-B_n$ ) must be conveyed to the second exit ( $A_2$ ), up to the last exit of the first group ( $A_n$ ) in which all items assigned to the last position of the exits of the second group ( $B_1-B_n$ ) must be conveyed; it being additionally provided that the items are transferred according to an ordered sequence from the first group of exits ( $A_1-A_n$ ) to the second group of exits ( $B_1-B_n$ ) according to the logic principle that the items contained in the first exit ( $A_1$ ) of the first group are unloaded, one by one, into the exits of the second group ( $B_1-B_n$ ) so that they always occupy the first positions, the items contained in the second exit ( $A_2$ ) of the first group are unloaded, one by one, into the exits of the second group ( $B_1-B_n$ ) so that they always occupy the second positions, up to the items contained in the last exit ( $A_n$ ) of the first group that are unloaded, one by one, into the exits of the second group ( $B_1-B_n$ ) so that they always occupy the last positions.
2. A process according to claim 1, **characterised by** the fact that the items loaded in each exit of the first group of exits ( $A_1-A_n$ ) are arranged according to a predefined order based on the position they must occupy in the corresponding exit ( $B_1-B_n$ ) of the second group; it being provided that the first position of the first exit ( $A_1$ ) is occupied by the first item assigned to the first exit ( $B_1$ ) of the second group, that the second position of the first exit ( $A_1$ ) is occupied by the first item assigned to the second exit ( $B_2$ ) of the second group, that the third position of the first exit ( $A_1$ ) is occupied by the first item assigned to the third exit ( $B_3$ ) of the second group and so on, just like the first position of the second exit ( $A_2$ ) of the first group is occupied by the second item assigned to the first exit ( $B_1$ ) of the second group, the second position of the second exit ( $A_2$ ) of the first group is occupied by the second item assigned to the second exit ( $B_2$ ) of the second group, the third position of the second exit ( $A_2$ ) of the first group is occupied by the second item assigned to the third exit ( $B_3$ ) and so on.



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Application Number  
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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                                                             |                                              |
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| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                  |                                                             |                                              |
| Place of search<br><b>MUNICH</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                  | Date of completion of the search<br><b>3 September 2001</b> | Examiner<br><b>Hillebrand, A</b>             |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                  |                                                             |                                              |

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