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(54) UNLOADING SYSTEM OF STACKS OF BOOKBINDING ITEMS WITH STACKING ZONES SEPARATE FROM TRANSIT ZONES

SYSTEM ZUM ENTLADEN VON STAPELN VON BUCHBINDEELEMENTEN MIT VON TRANSITBEREICHEN GETRENNTEN STAPELBEREICHEN

SYSTÈME DE DÉCHARGEMENT DE PILES D'ARTICLES DE RELIURE AVEC DES ZONES D'EMPILEMENT SÉPARÉES À PARTIR DE ZONES DE TRANSIT

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Description

Technical field

[0001] The present invention relates to the bookbinding field. More specifically, this invention relates to the unloading of bookbinding items into stacks.

Background

[0002] The background of the present invention is hereinafter introduced with the discussion of techniques relating to its context. However, even when this discussion refers to documents, acts, artifacts and the like, it does not suggest or represent that the discussed techniques are part of the prior art or are common general knowledge in the field relevant to the present invention.

[0003] The production of books on an industrial scale in corresponding bookbinding plants involves a series of operations that are performed by corresponding bookbinding machines. For example, (bookbinding) sewing machines sew signatures together into book blocks; the book blocks are then supplied to further bookbinding machines, which complete the production of the corresponding books, such as (bookbinding) perfect-binding machines that glue a lining and/or a soft cover to the book blocks.

[0004] The book blocks may be transferred manually among the different bookbinding machines, *i.e.*, from the sewing machines to the perfect-binding machines in the example at issue. For this purpose, operators of the bookbinding system unload the book blocks supplied by the sewing machines onto pallets, which are then transported to the perfect-binding machines for being loaded therein.

[0005] Stacking machines, or simply stackers, are available to facilitate the unloading of the book blocks onto the pallets. Each stacker stacks the book blocks supplied in succession by a corresponding sewing machine into stacks, so as to make their positioning onto the pallets easier for the operators. For this purpose, the stacker drops the book blocks in succession into a stacking zone, wherein they put on top of each other; as soon as a stack is completed, it is pushed from the stacking zone onto an (unloading) conveyor, such as a motorized roller conveyor, which conveys the stacks to an unloading zone thereof onto the pallets.

[0006] In the case of bookbinding plants with several sewing machines, an (automatic) unloading system may be provided, which connects the corresponding stackers in succession among them for conveying all the stacks towards a single unloading zone thereof onto the pallets. In this case, a (transit) conveyor is connected between each pair of successive stackers in the sequence. For each stacker following the first one in the sequence, a stop element is arranged in the transit conveyor upstream of the stacker (just before the stacking zone) for stopping the stacks coming from the previous stacker while a (new)

stack is under formation in the stacking zone. As soon as this stack is completed and frees the stacking zone, the stop element is disabled for allowing the transit of a stack coming from the previous stacker through the stacking zone.

[0007] However, any stop of the sewing machines (other than the one associated with the first stacker), such as for a change of its configuration, affects the entire unloading system. For example, if one of these sewing machines is stopped while a corresponding stack is under formation in the stacking zone of the corresponding stacker, this stack blocks the transit through the stacking zone. Therefore, all the stacks provided by the previous stackers in the sequence are stopped upstream of the stacking zone of the stacker of the stopped sewing machine. Consequently, once the transit conveyor downstream of each previous stacker is saturated, the corresponding (previous) sewing machine stops as well.

[0008] This prevents the supply to the unloading zone of the stacks of the book blocks which might instead be supplied by the sewing machines preceding to the stopped one, which are working normally.

[0009] This situation may persist for a relatively long time, as long as the stopped sewing machine is not restarted.

[0010] The above has a negative impact on the performance of the entire bookbinding plant, and therefore on the final cost of the corresponding books.

[0011] Moreover, in bookbinding plants based on digital printing the books are generally produced in very small batches (down to of a single book). As a result, the needs have increased of sorting the book blocks of the different production batches of the books individually according to their type. However, in this case the above-mentioned unloading system is inefficient, since by conveying all the book blocks to the single unloading zone it requires their subsequent separation.

[0012] US 2016/318730 A1 discloses the preamble of claim 1.

Summary

[0013] A simplified summary of the present invention is herein presented in order to provide a basic understanding thereof; however, the sole purpose of this summary is to introduce some concepts of the invention in a simplified form as a prelude to its following more detailed description, and it is not to be interpreted as an identification of its key elements nor as a delineation of its scope.

[0014] In general terms, the present invention is based on the idea of stacking binding items without interfering with their transit.

[0015] Particularly, an aspect provides an unloading system for unloading bookbinding items into stacks. The unloading system comprises a sequence of stackers. Each stacker following the first one comprises a stacking zone for stacking the bookbinding items supplied by a corresponding bookbinding machine above a transit

zone of corresponding stacks, thereby not interfering with their transit.

[0016] A further aspect provides a bookbinding plant comprising this unloading system.

[0017] A further aspect provides a corresponding method for unloading bookbinding items into stacks.

[0018] More specifically, one or more aspects of the present invention are set out in the independent claims and advantageous features thereof are set out in the dependent claims, with the wording of all the claims that is herein incorporated *verbatim* by reference (with any advantageous feature provided with reference to any specific aspect that applies *mutatis mutandis* to every other aspect).

Brief description of the drawings

[0019] The solution of the present invention, as well as further features and the advantages thereof, will be best understood with reference to the following detailed description thereof, given purely by way of a non-restrictive indication, to be read in conjunction with the accompanying drawings (wherein, for the sake of simplicity, corresponding elements are denoted with equal or similar references and their explanation is not repeated, and the name of each entity is generally used to denote both its type and its attributes, such as value, content and representation). In this respect, it is expressly intended that the drawings are not necessarily drawn to scale (with some details that may be exaggerated and/or simplified) and that, unless otherwise indicated, they are merely used to illustrate the structures and procedures described herein conceptually. In addition, orientations and related position references (such as upper, lower, lateral and so on) are to be understood in relation to a condition of use of the corresponding entities. Particularly:

FIG. 1 shows an illustrative representation of a bookbinding plant wherein the solution according to an embodiment of the present invention may be used, FIG.2 shows an illustrative representation of a portion of an unloading system of this bookbinding plant according to an embodiment of the present invention,

FIG.3 shows a schematic representation of this portion of the unloading system according to an embodiment of the present invention,

FIG.4 shows an illustrative representation of a bookbinding plant wherein the solution according to a further embodiment of the present invention may be used,

FIG.5 shows an illustrative representation of a portion of an unloading system of this bookbinding plant according to an embodiment of the present invention,

FIG.6 shows a schematic representation of this portion of the unloading system according to an embodiment of the present invention, and

FIG.7A-FIG.7B show a flow chart relating to an implementation of the solution according to an embodiment of the present invention.

Detailed description

[0020] With reference in particular to FIG. 1, an illustrative representation is shown of a bookbinding plant 100 wherein the solution according to an embodiment of the present invention may be used.

[0021] The bookbinding plant 100 is used to produce books on an industrial scale (or at least to perform some operations of the corresponding production process). For this purpose, the bookbinding plant 100 comprises the following components.

[0022] A plurality of bookbinding machines supply bookbinding items in succession. In the example at issue, the bookbinding machines are three (bookbinding) sewing machines 105a, 105b and 105c, which sew blocks of signatures together to form corresponding book blocks (not shown in the figure). Particularly, the sewing machines 105a-105c are of traditional type, *i.e.*, they open the signatures to be sewn being provided already ready (by folding a printed sheet one or more times); these sewing machines 105a-105c are typically used in the context of offset printing, wherein books are produced in very big batches (for productions of books in large runs in an economical way). In this case, the signatures (the same for all the sewing machines 105a-105c) are supplied on pallets 110. An operator 115 takes the signatures from the pallets 110 and loads them into a gathering machine 120. The gathering machine 120 gathers the signatures in succession from a series of hoppers thereof (each loaded with signatures of the same type) into the signature blocks. A feeding system 125 feeds the signature blocks to the sewing machines 105a-105c. An unloading system 130 (automatically) unloads the book blocks supplied by the sewing machines 105a-105c into stacks (each formed by one or more book blocks). The unloading system 130 comprises a plurality of stackers 135a, 135b and 135c corresponding to the sewing machines 105a, 105b and 105c, respectively (three in the example at issue), which are connected in sequence to convey the stacks towards a (common) unloading zone 140 (for example, close to the gathering machine 120 wherein the same operator 115 is located). For this purpose, a (transit) conveyor 145ab, 145bc conveys the corresponding stacks between each pair of (previous) stacker 135a, 135b and (successive) stacker 135b, 135c in the sequence. An (unloading) conveyor 145c conveys all the stacks from the last stacker 135c in the sequence to the unloading zone 140. In the solution according to an embodiment of the invention, the stackers 135b, 135c (following the first one) are configured to stack the book blocks without interfering with their transit (as described in detail below); the first stacker 135a may be both standard or similar to the successive stackers 135b, 135c but used in a standard way. In the unloading zone 140, the operator 115 picks up the

stacks supplied by the unloading system 130 and unloads them onto further pallets 150; the pallets 150 are then used to transport the book blocks to further book-binding machines (not shown in the figure), which complete the production of the corresponding books (for example, perfect-binding machines). Alternatively (not shown in the figure), the conveyor 145c conveys the stacks directly to these bookbinding machines. A corresponding control system 155a, 155b and 155c (for example, an industrial PC) controls each sewing machine 105a, 105b and 105c, respectively, and its stacker 135a, 135b and 135c, respectively. For example, each control system 155a-155c comprises several units that are connected to each other via a bus structure (not shown in the figure), and particularly a microprocessor that provides the logic capability of the control system 155a-155c, a non-volatile memory (ROM) that contains basic code for a bootstrap of the control system 155a-155c, a volatile memory (RAM) that is used as a working memory by the microprocessor, a mass memory for storing programs and data (for example, a Solid State Drive, SSD) and several controllers for corresponding peripherals, such as a control panel (for example, of touch-screen type) and a driver for removable memory devices (such as USB memory sticks).

[0023] With reference now to FIG.2, an illustrative representation is shown of a portion of the unloading system of this bookbinding plant according to an embodiment of the present invention.

[0024] Particularly, the portion of the unloading system relates to a generic successive stacker 135b, 135c.

[0025] A transit zone 205 is provided for a (common) transit of the stacks formed by the stacker 135b, 135c or coming from the previous stackers in the sequence (not shown in the figure); particularly, the stacks transit through the transit zone 205 from an infeed thereof 205i to an outfeed thereof 205o (aligned with each other), along a (transit) direction indicated by the arrows in the figure. A (stacking) conveyor 210 conveys the book blocks supplied by the corresponding sewing machine (not shown in the figure) to a stacking zone 215, wherein they are stacked into the corresponding stacks; the stacking zone 215 is arranged above the transit zone 205, so as not to occupy it during the formation of the stacks and therefore to allow the transit of any other stacks. For this purpose, the book blocks are dropped one on top of the other onto a support element, for example, a trapdoor 220, which may be opened to make each stack fall from the stacking zone 215 into the transit zone 205. A condition detector 225 detects a condition of the stacking zone 215, defined according to the book blocks already stacked at the moment. The conveyor 145ab, 145bc is connected to the infeed 205i for conveying the stacks provided by the previous stackers to the transit zone 205, along the same transit direction. A stop element 230 is used to stop the stacks supplied by the conveyor 145ab, 145bc upstream of the transit zone 205 along the transit direction. A presence detector 235 detects the

presence of each stack stopped by the stop element 230. The conveyor 145bc, 145c is connected to the outfeed 205o for conveying the stacks along the same transit direction.

[0026] In the above-mentioned solution, any stop of the sewing machines does not affect the rest of the unloading system. In fact, if one of these sewing machines is stopped even while a corresponding stack is under formation in its stacker, this does not block the transit through the corresponding transit zone.

[0027] Therefore, all the stacks supplied by the previous stackers in the sequence may continue transiting towards the unloading zone. As a consequence, the stopped sewing machine does not impact the sewing machines of the previous stackers in any way, which sewing machines may continue working normally.

[0028] All of the above has a positive effect on the performance of the entire bookbinding plant, and therefore on the final cost of the corresponding books.

[0029] With reference now to FIG.3, a schematic representation is shown of this portion of the unloading system according to an embodiment of the present invention,

[0030] In the specific implementation of the figure, the transit zone 205 of the stacker 135a, 135b is defined by a (motorized) roller conveyor that conveys the stacks through it, from the infeed 205i to the outfeed 205o. The conveyor 210 supplies the book blocks coming from the sewing machine (not shown in the figure) to the stacking zone 215, wherein they put one on top of the other onto the trapdoor 220 (which book blocks, two in the figure, are indicated with the reference 305). The condition detector 225 is implemented via a passage detector (for example, a photocell) that detects each book block 305 being added to a (new) stack under formation and sends an addition signal to the corresponding control system (not shown in the figure), which updates a counter of the book blocks 305 of the stack under formation accordingly. The trapdoor 220 is located at a height from the transit zone 205 higher than a thickness of the stacks, so as to allow their transit through it (between the roller conveyor of the transit zone 205 and the trap door 220). Normally, the trap door 220 is closed (as shown in solid line in the figure), so as to support the book blocks 305 that are stacked thereon during the formation of each stack; the trapdoor is open (as shown in dashed line in the figure), so as to cause the stack being completed thereon (not present in the figure) to fall by force of gravity onto the roller conveyor of the transit zone 205. The conveyor 145ab, 145bc comprises a (motorized) roller conveyor that pushes the stacks of the book blocks supplied by the previous stackers (not shown in the figure). The stop element 230 comprises a retractable rake; when the rake is raised above the roller conveyor of the conveyor 145ab, 145bc it stops the stacks upstream of the transit zone 205 (only one shown in the figure, indicated with the reference 310), whereas when the rake is lowered inside the roller conveyor of the conveyor 145ab, 145bc it lets these stacks 310 to pass. The presence detector

235 comprises a sensor (for example, of the optical type), which is intercepted by the possible stack 310 being stopped by the stop element 230. The conveyor 145bc, 145c as well comprises a (motorized) roller conveyor that pushes the stacks towards the next stacker or the unloading zone (not shown in the figure).

[0031] Referring now to FIG. 4, an illustrative representation is shown of a bookbinding plant 400 wherein the solution according to a further embodiment of the present invention may be used.

[0032] The bookbinding plant 400 differs from the one of FIG. 1 in that it comprises different sewing machines 405a, 405a and 405c (again three in the example at issue), which are now of flat sheet type, *i.e.*, forming the signatures to be sewn by folding corresponding (flat) sheets; these sewing machines 405a-405c are typically used in the context of digital printing, wherein books are produced in very small batches, down to of a single book (for productions of books on request in a flexible way). In this case, the corresponding sheets (not shown in the figure) are supplied directly to each sewing machine 405a-405c individually (without gathering machine and feeding system) by one or more operators (not shown in the figure). Furthermore, a different unloading system 430 is provided. The unloading system 430 comprises a plurality of different stackers 435a, 435b and 435c corresponding to the sewing machines 405a, 405b and 405c, respectively (three in the example at issue), which are connected in sequence for conveying the stacks towards a plurality of unloading zones, for example, the same unloading zone 140 as above and another unloading zone 440 (opposite the unloading zone 140 in this case). For this purpose, as above the conveyors 145ab and 145bc convey the corresponding stacks between the pairs of stackers 435a-435b and 435b-435c, respectively, and the conveyor 145c conveys all the stacks from the stacker 435c to the unloading zone 140. In addition, a further (unloading) conveyor 445a, 445b and 445c conveys the corresponding stacks from each stacker 435a, 435b and 435c, respectively, to a (collection) conveyor 445x, which conveys all these stacks to the unloading zone 440. As above, in the unloading zone 140 an operator (not shown in the figure) picks up the stacks supplied by the conveyor 145c and unloads them onto the pallets 150; similarly, in the unloading zone 440 the same operator or another operator (not shown in the figure) picks up the stacks supplied by the conveyor 445x and unloads them onto (further) pallets 450. The pallets 150 and 450 are then used to transport the book blocks to different bookbinding machines (not shown in the figure), which complete the production of the corresponding books (for example, perfect-binding machines and casing machines, respectively). Alternatively (not shown in the figure), the conveyor 145c and/or the conveyor 445x directly convey the stacks to such bookbinding machines or one of them unloads them into a waste container. Each sewing machine 405a, 405b and 405c is provided as above with a control system 455a, 455b and 455c, respectively,

which now controls the sewing machine 405a, 405b and 405c, respectively, its stacker 435a, 435b and 435c, respectively, and the entry as well of the corresponding conveyor 445a, 445b and 445c, respectively, onto the conveyor 445x.

[0033] With reference now to FIG. 5, an illustrative representation is shown of a portion of an unloading system of this bookbinding plant according to an embodiment of the present invention.

[0034] Particularly, the portion of the unloading system relates to a generic stacker 435a, 435b, 435c (with the corresponding conveyor 145ab and 145bc that is present only in the case of the successive stacker 435b and 435c, respectively, whereas it is absent in the case of the first stacker 435a). The stacker 435a, 435b, 435c differs from the one of FIG. 2 in that the transit zone 205 has an additional outfeed 505o, perpendicular to the outfeed 205o and to the infeed 205i. Furthermore, the transit zone 205 is provided with an exchange device for selectively sending the stacks (not shown in the figure) towards one of the two outfeeds 205o or 505o. The conveyor 445a, 445b, 445c is connected to the outfeed 505o for conveying the corresponding stacks along an (unloading) direction perpendicular to the transit direction of the conveyor 145ab, 145bc and of the conveyor 145ab, 145bc, 145c, as indicated by the corresponding arrows in the figure.

[0035] This implementation adds further flexibility to the bookbinding plant. Particularly, the proposed unloading system allows sorting the books directly, for example, for different next processing; this is particularly useful (such as in the context of digital printing) when the books are produced in different types in very small batches.

[0036] With reference now to FIG. 6, a schematic representation is shown of this portion of the unloading system according to an embodiment of the present invention.

[0037] In the specific implementation of the figure, the exchange device of the stacker 435a, 435b, 435c, indicated with the reference 605, is implemented via a series of (motorized) rolls that are interposed between the (motorized) rolls of the transit zone 205; the rolls of the exchange device 605 are oriented to act along the unloading direction of the conveyor 445a, 445b, 445c, perpendicularly to the transit direction of the conveyor 145ab, 145bc and of the conveyor 145ab, 145bc, 145c. The rolls of the exchange device 605 are movable between a lowered condition and a raised condition. In the lowered condition (as shown in solid line in the figure), the rolls of the exchange device 605 are recessed into the rolls of the transit zone 205, so that they remain spaced apart from each stack 310 present therein; therefore, the rolls of the transit zone 205 push the stack 310 towards the conveyor 145ab, 145bc, 145c. In the raised condition (as shown in dashed line in the figure), the rolls of the exchange device 605 instead protrude above the rolls of the transit zone 205, so that they lift each stack 310 present therein; therefore, the rolls of the exchange device 605 push the stack 310 towards the conveyor

445ab,445bc,445c.

[0038] A stop element 630 (for example, a similar retractable rake) is used to stop the stacks supplied by the conveyor 445ab,445bc,445c upstream of the conveyor 445x along the unloading direction. A presence detector 635 (for example, of optical type) detects the presence of each stack being stopped by the stop element 630. Likewise, a stop element 640 (for example, a similar retractable rake) is used to stop the stacks supplied by the conveyor 445x upstream of the conveyor 445ab,445bc,445c along a (collection) direction towards the corresponding unloading zone (not shown in the figure). A presence detector 645 (for example, of optical type) detects the presence of each stack being stopped by the stop element 640.

[0039] With reference now to FIG.7A-FIG.7B, a flow chart is shown relating to an implementation of the solution according to an embodiment of the present invention.

[0040] Particularly, the diagram represents an exemplary process that may be used to unload the book blocks into stacks (in the corresponding portion of the unloading system relating to each stacker) with a method 700. Each block of the diagram may correspond to one or more executable instructions for implementing the specified logical function by a control program running on the control system of the corresponding sewing machine. For this purpose, the control program reads a configuration repository, which contains configuration information of the sewing machine. Particularly, this configuration information comprises an indication of an operating speed of the sewing machine (for example, in terms of book blocks supplied per unit of time), a size of the stacks (for example, in terms of total number of book blocks) and a transit time of the stacks through the transit zone, whose configuration information is set by the operator via the touchscreen of the control system. The software components of above (control program and configuration repository) are typically stored in the mass memory and loaded (at least in part) into the working memory of the control system when the control program is running (in addition to an operating system and possible other application programs). The control program is initially installed onto the mass memory, for example, from removable storage units or from a network.

[0041] The process involves the continual execution of a verification loop. The loop begins at block 703, wherein the control program detects the (current) condition of the stacker. The condition of the stacker is defined by the number of book blocks being stacked therein, as indicated by the corresponding counter (which is initialized to zero and incremented in response to each addition signal provided by the passage detector). The flow of activities branches at block 706 according to the condition of the stacker; for this purpose, the control program compares the book blocks counter with the size of the stacks (read from the configuration repository). If the book blocks counter is equal to the size of the stacks, this means that a stack has been completed in the stack-

er. In this case, the control program differs at block 709 according to the type of the transit zone. If the transit zone has only a single outfeed the blocks 712-715 are executed, whereas if the transit zone has two outfeed the blocks 718-730 are executed. Considering now block 712 (single outfeed), the control program activates the trapdoor to make the stack fall into the transit zone (by opening the support element and then closing it for receiving the book blocks of a next stack); as a consequence, the control program resets the book blocks counter. In this way, at block 715 the roller conveyor of the transit zone conveys the stack up to reach the transit conveyor of the next stacker or the unloading conveyor. Considering instead block 718 (two outfeeds), the control program selects the outfeed to which the stack present in the stacker is to be sent. This selection may be performed on the basis of various criteria, for example, according to the type of the book blocks supplied by the sewing machine (as read from a bar code present on them by means of a corresponding reader upstream of the stacking zone or set by the operator via the touchscreen of the control system of the sewing machine at the beginning of each processing batch), according to a quality indicator of the book blocks of the stack (for example, determined by one or more corresponding sensors) and so on; in this way, it is possible to use different outfeeds for book blocks of different types (for example, of different sizes, for books with soft or hard cover, and the like), for book blocks subject to different next processing (for example, single book blocks to be sent directly to further bookbinding machines and stacks of multiple book blocks to be unloaded onto pallets), for book blocks being acceptable or to be discarded, and so on. In this case as well, the control program at block 721 activates the trapdoor to make the stack fall into the transit zone and resets the book blocks counter. The flow of activities then branches at block 724 according to the selected outfeed. If the selected outfeed is along the transit direction, as above at block 727 the roller conveyor of the transit zone conveys the stack up to reach the transit conveyor of the next stacker or the unloading conveyor. If instead the selected outfeed is perpendicular to the transit direction, the control program at block 730 activates the exchange device to divert the stack transversely (by lifting its rolls above the rolls of the transit zone), so as to convey the stack up to reach the corresponding (further) unloading conveyor.

[0042] The process then continues to block 733 from block 715 or from block 730; the same point is also reached directly from block 706 if the book blocks counter is (strictly) lower than the size of the stacks, meaning that a stack is still under formation in the stacker (or it is empty). At this point, the control program verifies whether a stack is present on the transit conveyor, stopped upstream of the infeed of the transit zone (as indicated by the corresponding presence detector). The flow of activities branches at block 736 according to the outcome of this verification. In the affirmative case, the control pro-

gram at block 739 verifies a (current) operating condition of the sewing machine (for example, by querying it in this respect). The flow of activities further branches at block 742 according to the outcome of this verification. If the sewing machine responds to the control program that it is working, the control program at block 745 calculates a completion time that is expected at the very least for completing the stack under formation in the stacking zone. The completion time is given by:

$$T_c = \frac{Dp - Cb}{V_m},$$

where T_c is the completion time, Dp is the size of the stacks, Cb is the book blocks counter (and therefore $Dp - Cb$ is the number of book blocks being missing for completing the stack) and V_m is the operating speed of the sewing machine (read from the configuration repository). In this way, the completion time indicates the time required to complete the stack in the case the sewing machine continues working normally. The control program at block 748 compares the transit time (T_t) of the stacks through the transit zone (extracted from the configuration repository) with the completion time T_c of the stack under formation in the stacking zone. The flow of activities branches at block 751 according to the outcome of this comparison. If the transit time is (strictly) lower than the completion time, *i.e.*, $T_t < T_c$, the process continues to block 754. The same point is also reached directly from block 742 if the sewing machine responds to the control program that is not working (or it does not respond within a maximum time, such as 0.1-1.0s), so that at the moment it is unable to complete the stack under formation in the stacking zone. In both cases, this means that the stack present on the transit conveyor may pass through the transit zone before the stack under formation in the stacking zone is completed. At this point, as above the control program differs according to the type of the transit zone. If the transit zone has only a single outfeed the blocks 757-760 are executed, whereas if the transit zone has two outfeeds the blocks 763-775 are executed. Considering now block 757 (single outfeed), the control program commands the stop element of the transit conveyor to let the stack being stopped behind it to pass (lowering the rack into the roller conveyor and raising it as soon as the stack has passes beyond, so to stop any other stack being queued thereto). In this way, at block 760 the roller conveyor of the transit zone conveys the stack up to reach the transit conveyor of the successive stacker or the unloading conveyor. Considering instead block 763 (two outfeeds), the control program selects the outfeed to which the stack present on the transit conveyor is to be sent. This selection may be performed on the basis of several criteria in a similar way as above, for example, according to the type of book blocks supplied by the previous sewing machines (as read from a bar code present on them by means of a corresponding reader upstream of the stop element or set by the operator via the touch-

screen of the corresponding control systems at the beginning of each processing batch), according to a quality indicator of the book blocks of the stack (for example, determined by one or more corresponding sensors) and so on. In this case as well, the control program at block 766 commands the stop element of the transit conveyor to let the stack being stopped behind it to pass. The flow of activities then branches at block 769 according to the selected outfeed. As above, if the selected outfeed is along the transit direction, at block 772 the roller conveyor of the transit zone conveys the stack up to reach the transit conveyor of the next stacker or the unloading conveyor. If instead the selected outfeed is perpendicular to the transit direction, the control program at block 775 activates the exchange device to divert the stack transversely, so as to convey it up to reach the corresponding (further) unloading conveyor.

[0043] As a consequence, in the transit zone of each stacker, priority is given to the stacks formed in the corresponding stacking zone (since they are dropped into the transit zone as soon as possible after their completion). The stacks supplied by the previous stackers are instead allowed to pass towards the transit zone only when they may pass through it before the stack under formation in the stacking zone is completed, so that this has no impact on its operation and therefore on that of the corresponding sewing machine.

[0044] The process then continues to block 778 from block 760 or from block 775; the same point is also reached directly from block 736 if no stack is present on the transit conveyor being stopped upstream of the infeed of the transit zone or from block 751 if the transit time is equal to or higher than the completion time, *i.e.*, $T_t \geq T_c$. At this point, the control program again differs according to the type of the transit zone. If the transit zone has only one outfeed, the process returns to block 703 to repeat the same operations continually. If instead the transit zone has two outfeeds, the control program at block 781 verifies whether a stack is present on the unloading conveyor, being stopped upstream of the collection conveyor (as indicated by the corresponding presence detector). The flow of activities branches at block 784 according to the outcome of this verification. In the affirmative case, the control program at block 787 commands the stop element of the unloading conveyor to let the stack being stopped behind it to pass (lowering the rack into the roller conveyor and raising it as soon as the stack has passed beyond, so as to stop any other stack being queued thereto); in this way, the unloading conveyor conveys the stack up to reach the collection conveyor. The process then continues at block 790; the same point is also reached directly from block 784 if no stack is present on the unloading conveyor being stopped upstream of the collection conveyor. Likewise, the control program now verifies whether a stack is present on the collection conveyor, being stopped upstream of the unloading conveyor (as indicated by the corresponding presence detector). The flow of activities branches block 793 according to the

outcome of this verification. In the affirmative case, the control program at block 796 commands the stop element of the collection conveyor to let the stack being stopped behind it to pass (lowering the rack into the roller conveyor and raising it as soon as the stack has passed beyond, so as to stop any other stacks being queued thereto); in this way, the collection conveyor conveys the stack along it. The process returns to block 703 from block 796 (after the time necessary for the stack to pass beyond the unloading conveyor) or directly from block 796 (if no stack is present on the collection conveyor being stopped upstream of the unloading conveyor) for repeating the same operations continually.

Modifications

[0045] Naturally, in order to satisfy local and specific requirements, a person skilled in the art may apply many logical and/or physical modifications and alterations to the present invention. More specifically, although this invention has been described with a certain degree of particularity with reference to one or more embodiments thereof, it should be understood that various omissions, substitutions and changes in the form and details as well as other embodiments are possible inside the scope of the claims. Particularly, different embodiments of the present invention may be practiced even without the specific details (such as the numerical values) set forth in the preceding description to provide a more thorough understanding thereof; conversely, well-known features may have been omitted or simplified in order not to obscure the description with unnecessary particulars. Moreover, items presented in a same group and different embodiments, examples or alternatives are not to be construed as *de facto* equivalent to each other (but they are separate and autonomous entities). In any case, each numerical value should be read as modified according to applicable tolerances; particularly, unless otherwise indicated, the terms "substantially", "about", "approximately" and the like should be understood as within 10%, preferably 5% and still more preferably 1%. Moreover, each range of numerical values should be intended as expressly specifying any possible number along the *continuum* within the range (comprising its end points). Ordinal or other qualifiers are merely used as labels to distinguish elements with the same name but do not by themselves connote any priority, precedence or order. The terms include, comprise, have, contain, involve and the like should be intended with an open, non-exhaustive meaning (*i.e.*, not limited to the recited items), the terms based on, dependent on, according to, function of and the like should be intended as a non-exclusive relationship (*i.e.*, with possible further variables involved), the term a/an should be intended as one or more items (unless expressly indicated otherwise), and the term means for (or any means-plus-function formulation) should be intended as any structure adapted or configured for carrying out the relevant function.

[0046] The invention is defined in claim 1.

[0047] For example, an embodiment provides an unloading system for unloading bookbinding items into stacks (each comprising one or more of the bookbinding items). However, each stack may comprise any number of bookbinding items (down to a single one) of any type (for example, book blocks, signatures, sheets and so on).

[0048] In an embodiment, the unloading system comprises a sequence of a plurality of stackers for stacking the bookbinding items provided by corresponding bookbinding machines into corresponding stacks. However, the stackers may be in any number for use with bookbinding machines of any type (see below), and they may stack the bookbinding items in any way (for example, dropping, pushing, picking/depositing and so on the bookbinding items one on top of the other).

[0049] In an embodiment, each successive one of the stackers (different from a first one of the stackers in the sequence) comprises a transit zone for a transit of corresponding stacks. However, the transit zone may be of any type (for example, roller conveyor, belt, mat and so on) for the transit of the stacks in any way (for example, along a single direction, two or more directions, a single way or both ways along each direction, and so on). Furthermore, this transit zone may be implemented with a dedicated component of the stacker or simply with a corresponding portion of a conveyor being common to all the stackers.

[0050] In an embodiment, each successive stacker comprises a stacking zone of the corresponding bookbinding items in the corresponding stacks arranged above the transit zone in condition of use thereby not interfering with the transit of the stacks. However, the stacking zone may be arranged in any position above the transit zone (for example, at any height, in the center or at a side, and so on), with the first stacker that may have the stacking zone in the same position or in another position (even directly in the transit zone).

[0051] In an embodiment, each successive stacker comprises a support element that may be opened to drop each of the corresponding stacks from the stacking zone into the transit zone. However, this result may be achieved in any way (for example, through a trapdoor, a movable grate and so on).

[0052] In an embodiment, each successive stacker comprises a condition detector for detecting a condition of the stacking zone. However, the condition of the stacking zone may be defined in any way (for example, by the number of bookbinding items already stacked, the height of the stack under formation and so on) and it may be detected in any way (for example, detecting the passage of the bookbinding items by means of a sensor of optical, mechanical and the like type, measuring the height of the stack under formation by means of a sensor of mechanical, optical and the like type, calculating the number of bookbinding items in the stack under formation according to the operating speed of the bookbinding machine and so on).

[0053] In an embodiment, the unloading system further comprises corresponding one or more transit conveyors for the successive stackers, each for conveying corresponding stacks from a previous one of the stackers in the sequence to the transit zone of the corresponding successive stacker. However, each transit conveyor may convey the stacks in any way (for example, by roller conveyor, belt, mat and so on).

[0054] In an embodiment, the unloading system further comprises corresponding one or more stop elements for the transit conveyors, each for stopping the corresponding stacks on the corresponding transit conveyor upstream of the corresponding transit zone. However, the stacks may be stopped in any way (for example, through a mechanical element that prevents the stacks from advancing, such as a rake, a peg and the like, an electric command that stops the conveyor and so on) at any position upstream of the transit zone (for example, directly before, at any distance and so on).

[0055] In an embodiment, the unloading system further comprises corresponding one or more presence detectors for the stop elements, each for detecting a presence of the corresponding stacks being stopped by the corresponding stop element. However, the presence of the stacks may be defined in any way (for example, only by the one being stopped directly, by the total number of the stopped stacks and so on) and it may be detected in any way (for example, directly through a sensor of any type such as optical, mechanical and the like, indirectly based on operation of the previous stacker and on a time necessary for the stacks to pass along the transit conveyor, and so on).

[0056] In an embodiment, the unloading system further comprises an unloading conveyor for conveying the stacks from a last one of the stackers in the sequence to an unloading zone of the stacks. However, the unloading conveyor may be of any type (either the same or different with respect to the transit conveyors) and it may convey the stacks to an unloading zone of any type (for example, for the unloading of the stacks onto pallets, for their direct transport to other bookbinding machines and so on).

[0057] In an embodiment, the unloading system further comprises a control system. However, the control system may be of any type (for example, a computer, a microcontroller and the like of each bookbinding machine, of each stacker or unique for the entire unloading system, and so on).

[0058] In an embodiment, for each of the successive stackers the control system is configured to control the support element and the stop element according to the condition of the stacking zone, the presence of the corresponding stacks and a current operating speed of the corresponding bookbinding machine. However, the control system may perform this operation in any way (for example, with different priorities, techniques to avoid deadlocks and/or starvations, and so on) according to any definition of the condition of the stacking zone and of the presence of the stacks (see above) and of the

current operating speed of the bookbinding machine (for example, set operating speed and condition indicator, measured operating speed, set/measured operating speed defined by number of bookbinding items provided per unit of time, operation frequency and so on).

[0059] Further embodiments provide additional advantageous features, which may however be omitted at all in a basic implementation.

[0060] In an embodiment, for each of the successive stackers the control system is configured to determine a completion of each of the corresponding stacks in the stacking zone. However, the completion of the stack may be determined in any way (for example, when the number of bookbinding items reaches the size of the stacks, when the height of the stack reaches its value and so on).

[0061] In an embodiment, for each of the subsequent stackers the control system is configured to open the support element in response to the completion of each corresponding stack. However, this operation may be performed in any way (for example, synchronously during corresponding verification cycles, asynchronously in response to corresponding signals and so on).

[0062] In an embodiment, for each of the successive stackers the control system is configured to calculate a completion time of each of the corresponding stacks under formation in the stacking zone according to the condition of the stacking zone, a size of the corresponding stacks and the current operating speed of the corresponding bookbinding machine. However, the completion time may be calculated in any way (for example, based on the number of missing bookbinding items, based on the missing height and the size of the bookbinding items, and so on).

[0063] In an embodiment, for each of the successive stackers the control system is configured to control the stop element according to the completion time and to a transit time through the transit zone of the corresponding stacks. However, this operation may be performed in any way (for example, during corresponding verification cycles, continuously as long as the completion time remains lower than the transit time, either synchronously by querying the presence detector or asynchronously in response to the arrival of each stack at the stop element, and so on).

[0064] In an embodiment, for each of the successive stackers the control system is configured to control the stop element to let each of the corresponding stacks being stopped by the stop element to pass in response to its presence and to the transit time being lower than the completion time. However, the stopped stacks may be let to pass in any way (for example, a single one or all the possible ones for each verification cycle, and so on).

[0065] In an embodiment, one or more multiple stackers of the stackers each comprises an outfeed and a further outfeed of the transit zone (the outfeed being connected to the unload conveyor in the case of the last stacker or to the transit conveyor of the corresponding successive stacker otherwise). However, the two out-

feeds may be arranged in any way (for example, with the outfeed aligned and the further outfeed perpendicular to the infeed, *vice-versa* and so on); moreover, the further outfeed may be provided in all the stackers, only in part of them or even in none of them.

[0066] In an embodiment, each multiple stacker comprises an exchange device for sending the corresponding stacks selectively to the outfeed or to the further outfeed. However, the exchange device may be of any type (for example, based on retractable motorized rolls, push rake, turntable and so on).

[0067] In an embodiment, the unloading system comprises one or more corresponding further unloading conveyors connected to the further outfeed of the multiple stackers for conveying corresponding stacks towards at least one further unloading zone. However, the further unloading conveyors may be in any number (according to the multiple conveyors) and of any type (either the same or different with respect to the other conveyors); moreover, each further unloading conveyor may be used to convey the corresponding stacks towards any further unloading zone (for example, an area being common to all the stackers through a collection conveyor, different areas for groups of stackers through corresponding collection conveyors, corresponding different areas for the stackers and so on).

[0068] In an embodiment, for each of the multiple stackers the control system is configured to control the exchange device according to a type of each of the corresponding stacks. However, this operation may be performed on the basis of any type of the stacks (for example, partial, different and/or additional ones with respect to those mentioned above).

[0069] In an embodiment, the unloading system comprises a collection conveyor for conveying the corresponding stacks from the further unloading conveyors to the further unloading zone. However, the collection conveyor may be of any type (either the same or different with respect to the other conveyors) or it may also be completely absent.

[0070] In an embodiment, the unloading system comprises corresponding one or more first further stop elements for the further unloading conveyors, each for stopping corresponding stacks on the corresponding further unloading conveyor upstream of the collection conveyor. However, the first further stop elements may be of any type (either the same or different with respect to the stop elements) for stopping the stacks at any position upstream of the collection conveyor (for example, directly before, at any distance and so on).

[0071] In an embodiment, the unloading system comprises corresponding one or more second additional stop elements for the further unloading conveyors, each for stopping corresponding stacks on the collection conveyor upstream of the corresponding further unloading conveyor. However, the second additional stop elements may be of any type (either the same or different with respect to the other stop elements) for stopping the

stacks at any position upstream of the corresponding further unloading conveyor (for example, directly before, at any distance and so on).

[0072] In an embodiment, the unloading system comprises corresponding one or more first further presence detectors for the first further stop elements, each for detecting a first further presence of the corresponding stacks being stopped by the corresponding first further stop element. However, the first further presence detectors may be of any type for detecting any first further presence of the stacks (either the same or different with respect to the presence detectors).

[0073] In an embodiment, the unloading system comprises corresponding one or more second further presence detectors for the second further stop elements, each for detecting a second further presence of the corresponding stacks being stopped by the corresponding second further stop element. However, the second further presence detectors may be of any type for detecting any second further presence of the stacks (either the same or different with respect to the other presence detectors).

[0074] In an embodiment, for each of the multiple stackers the control system is configured to control the first further stop element and the second further stop element according to the first further presence and to the second further presence of the corresponding stacks. However, this operation may be performed in any way (for example, with a round-robin policy, with different priorities, either fixed or variable according to the type of the stacks, and so on).

[0075] In an embodiment, the bookbinding machines are sewing machines. However, the sewing machines may be of any type (for example, of the traditional type and/or of flat sheets in the context of either offset or digital printing, which sew blocks of signatures with or without inserts, and so on).

[0076] In an embodiment, the bookbinding items are book blocks each comprising a plurality of signatures being sewn together. However, the book blocks may be of any type (for example, each formed by any number of signatures, which are opened and/or formed by flat sheets in the bookbinding machine, and so on).

[0077] An embodiment provides a stacker for use in this unloading system (wherein the stacker comprises the transit zone, the stacking zone, the support element and the condition detector). However, the stacker may also be put on the market as a stand-alone product.

[0078] An embodiment provides a bookbinding plant, which comprises the unloading system of above and the bookbinding machines for providing the corresponding bookbinding items. However, the bookbinding plant may be of any type inside the scope of claim 8 (for example, used in the context of offset and/or digital printing, with any further bookbinding machines upstream of the bookbinding machines, such as printers, folding machines, gathering machines and the like, and/or downstream of the unloading system, such as perfect-binding machines,

three-knife trimming machines, casing machines and the like, down to none); moreover, the bookbinding machines may be in any number and of any type (for example, sewing machines, folding machines, perfect-binding machines and so on).

[0079] An embodiment provides a method for unloading bookbinding items into stacks in the unloading system of above. In an embodiment, the method comprises detecting the condition of the stacking zone of each successive stacker via the corresponding condition detector. In an embodiment, the method comprises detecting the presence of the corresponding stacks being stopped by each stop element via the corresponding presence detector. In an embodiment, the method comprises controlling, for each successive stacker, the support element and the stop element according to the condition of the stacking zone, the presence of the corresponding stacks and the current operating speed of the corresponding bookbinding machine via the control system. However, the method may be performed in any way inside the scope of claim 9 (with the same considerations of above relating to the components of the unloading system that apply *mutatis mutandis* to the corresponding steps of the method).

[0080] An embodiment provides a computer program (not claimed) configured to cause the control system to perform the method of above when the computer program is executed on the control system. An embodiment provides a computer program product (not claimed) comprising one or more computer readable storage media having program instructions collectively stored in the readable storage media, the program instructions being readable by the control system to cause the control system to perform the same method. However, the program may be implemented as a stand-alone module, as an additional program (plug-in) for a pre-existing program (for example, a control program for each bookbinding machine) or even directly in the latter. In any case, similar considerations apply if the program is structured in a different way, or if additional modules or functions are provided; likewise, the memory structures may be of other types, or may be replaced with equivalent entities (not necessarily consisting of physical storage media). The program may take any form suitable to be used by the control system, thereby configuring the control system to perform the desired operations; particularly, the program may be in the form of external or resident software, firmware, or microcode (either in object code or in source code, for example, to be compiled or interpreted). Moreover, it is possible to provide the program on any computer readable storage medium; the storage medium is any tangible medium (different from transitory signals *per se*) that may retain and store instructions for use by the control system. For example, the storage medium may be of the electronic, magnetic, optical, electromagnetic, infrared or semiconductor type; examples of such storage medium are fixed disks (where the program may be pre-loaded), removable disks, memory keys (for exam-

ple, USB) and the like. The program may be downloaded to the control system from the storage medium or via a network (for example, the Internet, a wide area network and/or a local area network comprising transmission cables, optical fibers, wireless connections, network devices); a network adapter (or more) of the control system receives the program from the network and forwards it for storage into one or more storage devices of the control system. In any case, the solution according to an embodiment of the present invention lends itself to be implemented even with a hardware structure (for example, by electronic circuits integrated on one or more chips of semiconductor material), or with a combination of software and hardware suitably programmed or otherwise configured.

Claims

1. An unloading system (130;430) for unloading bookbinding items (305) into stacks (310) each comprising one or more of the bookbinding items (305), wherein the unloading system (130;430) comprises: a sequence of a plurality of stackers (135a-135c;435a-435c) for stacking the bookbinding items provided by corresponding bookbinding machines (105a-105c;405a-405c) into corresponding stacks (310), each successive one of the stackers (135b-135c;435b-435c) different from a first one of the stackers (145a;435a) in the sequence comprising:

a transit zone (205) for a transit of corresponding stacks (310),

a stacking zone (215) of the corresponding bookbinding items (305) in the corresponding stacks (310) arranged above the transit zone (205) in condition of use thereby not interfering with the transit of the stacks (310), and

a support element (220) openable to drop each of the corresponding stacks (310) from the stacking zone (215) into the transit zone (205), the unloading system being **characterised in that** each successive one of the stackers different from a first one of the stackers in the sequence further comprises

a condition detector (225) for detecting a condition of the stacking zone (215), and **in that** the unloading system (130;430) further comprises:

corresponding one or more transit conveyors (145ab-145bc) for the successive stackers (135b-135c;435b-435c), each for conveying corresponding stacks (310) from a previous one of the stackers (135a-135b;435a-435b) in the sequence to the transit zone (205) of the corresponding successive stacker (135b-135c;435b-435c), corresponding one or more stop elements

- (230) for the transit conveyors (145ab-145bc), each for stopping the corresponding stacks (310) on the corresponding transit conveyor (145ab-145bc) upstream of the corresponding transit zone (205),
 corresponding one or more presence detectors (235) for the stop elements (230), each for detecting a presence of the corresponding stacks (310) being stopped by the corresponding stop element (230),
 an unloading conveyor (145c) for conveying the stacks (310) from a last one of the stackers (135c;435c) in the sequence to an unloading zone (140) of the stacks (310), and
 a control system (155b-155c;455b-455c), for each of the successive stackers (135b-135c;435b-435c) the control system (155b-155c;455b-455c) being configured to control the support element (220) and the stop element (230) according to the condition of the stacking zone (215), the presence of the corresponding stacks (310) and a current operating speed of the corresponding bookbinding machine (105b-105c;405a-405c).
2. The unloading system (130;430) according to claim 1, wherein for each of the successive stackers (135b-135c;435b-435c) the control system (155b-155c;455b-455c) is configured to determine a completion of each of the corresponding stacks (310) in the stacking zone (215) and to open the support element (220) in response to the completion of each corresponding stack (310).
 3. The unloading system (130;430) according to claim 1 or 2, wherein for each of the successive stackers (135b-135c;435b-435c) the control system (155b-155c;455b-455c) is configured to calculate a completion time of each of the corresponding stacks (310) under formation in the stacking zone (215) according to the condition of the stacking zone (215), a size of the corresponding stacks (310) and the current operating speed of the corresponding bookbinding machine (105b-105c; 105a-105c), and is configured to control the stop element (230) according to the completion time and to a transit time through the transit zone (205) of the corresponding stacks (310).
 4. The unloading system (130;430) according to claim 3, wherein for each of the successive stackers (135b-135c;435b-435c) the control system (155b-155c;455b-455c) is configured to control the stop element (230) to let each of the corresponding stacks (310) being stopped by the stop element (230) to pass in response to the presence thereof and to the transit time being lower than the completion time.
 5. The unloading system (430) according to any claim
- from 1 to 4, wherein one or more multiple stackers of the stackers (435a-435c) each comprises an outfeed (205o) and a further outfeed (505o) of the transit zone (205), the outfeed (205o) being connected to the unloading conveyor (145c) in case of the last stacker (435c) or to the transit conveyor (145ab,145bc) of the corresponding successive stacker (435b,435c) otherwise, and an exchange device (605) for sending the corresponding stacks (310) selectively to the outfeed (205o) or to the further outfeed (505o), and wherein the unloading system (430) comprises one or more corresponding further unloading conveyors (445a-445c) connected to the further outfeed (505o) of the multiple stackers (435a-435c) for conveying corresponding stacks (310) towards at least one further unloading zone (440), for each of the multiple stackers (435a-435c) the control system (455a-455c) being configured to control the exchange device (605) according to a type of each of the corresponding stacks (310).
6. The unloading system (430) according to claim 5, wherein the unloading system (430) comprises a collection conveyor (445x) for conveying the corresponding stacks (310) from the further unloading conveyors (445a-445c) to the further unloading zone (440), corresponding one or more first further stop elements (630) for the further unloading conveyors (445a-445c), each for stopping corresponding stacks (310) on the corresponding further unloading conveyor (445a-445c) upstream of the collection conveyor (445x), corresponding one or more second further stop elements (640) for the further unloading conveyors (445a-445c), each for stopping corresponding stacks (310) on the collection conveyor (445x) upstream of the corresponding further unloading conveyor (445a-445c), corresponding one or more first further presence detectors (635) for the first further stop elements (630), each for detecting a first further presence of the corresponding stacks (310) being stopped by the corresponding first further stop element (630), and corresponding one or more second further presence detectors (645) for the second further stop elements (640), each for detecting a second further presence of the corresponding stacks (310) being stopped by the corresponding second further stop element (640), for each of the multiple stackers (435a-435c) the control system (455a-455c) being configured to control the first further stop element (630) and the second further stop element (640) according to the first further presence and to the second further presence of the corresponding stacks (310).
 7. The unloading system (130;430) according to any claim from 1 to 6, wherein the bookbinding machines (105b-105c;405a-405c) are sewing machines, the bookbinding items (305) being book blocks each

comprising a plurality of signatures being sewn together.

8. A bookbinding plant (100;400) comprising the unloading system (130;430) according to any claim from 1 to 7, and the bookbinding machines (105b-105c;405b-405c) for providing the corresponding bookbinding items (305). 5
9. A method (700) for unloading bookbinding items (305) into stacks (310) in the unloading system (130;430) according to any claim from 1 to 7, wherein the method (700) comprises: 10
 - detecting (703) the condition of the stacking zone (215) of each successive stacker (135b-135c;435b-435c) via the corresponding condition detector (225), 15
 - detecting (733) the presence of the corresponding stacks (310) being stopped by each stop element (320) via the corresponding presence detector (235), and 20
 - controlling (706-730,736-775), for each successive stacker (135b-135c;435b-435c), the support element (220) and the stop element (230) 25 according to the condition of the stacking zone, the presence of the corresponding stacks (310) and the current operating speed of the corresponding bookbinding machine (105b-105c;405a-405c) via the control system (155b-155c;455b-455c). 30

Patentansprüche

1. Entladesystem (130; 430) zum Entladen von Buchbindeartikeln (305) in Stapel (310), die jeweils einen oder mehrere der Buchbindeartikel (305) umfassen, wobei das Entladesystem (130; 430) umfasst: 35
 - eine Folge einer Mehrzahl von Stapler (135a-135c; 435a-435c) zum Stapeln der von entsprechenden Buchbindemaschinen (105a-105c; 405a-405c) bereitgestellten Buchbindeartikel in entsprechende Stapel (310), wobei sich jeder nachfolgende der Stapler (135b-135c;435b-435c) von einem ersten der Stapler (145a;435a) in der Folge unterscheidet und umfasst: 40
 - eine Transitzone (205) für einen Transitentsprechender Stapel (310), 45
 - eine Stapelzone (215) der entsprechenden Buchbindeartikel (305) im entsprechenden Stapel (310), die im Gebrauchszustand über der Transitzone (205) angeordnet sind, wodurch sie den Transit der Stapel (310) nicht behindern, und 50
 - ein Trägerelement (220), das geöffnet werden kann, um jeden der entsprechenden Stapel 55

(310) aus der Stapelzone (215) in die Transitzone (205) fallen zu lassen, wobei das Entladesystem **dadurch gekennzeichnet ist, dass** jeder nachfolgende der Stapler, der sich von einem ersten Stapler in der Folge unterscheidet, ferner einen Zustandsdetektor (225) zum Erkennen eines Zustands der Stapelzone (215) umfasst, und dadurch, dass das Entladesystem (130; 430) ferner umfasst:

entsprechend einen oder mehrere Transitzonenförderer (145ab-145bc) für die nachfolgenden Stapler (135b-135c; 435b-435c), jeweils zum Fördern entsprechender Stapel (310) von einem vorherigen der Stapler (135a-135b; 435a-435b) in der Folge zur Transitzone (205) des entsprechenden nachfolgenden Staplers (135b-135c; 435b-435c),
entsprechend ein oder mehrere Anhaltelemente (230) für die Transitzonenförderer (145ab-145bc), jeweils zum Anhalten der entsprechenden Stapel (310) auf dem entsprechenden Transitzonenförderer (145ab-145bc) vor der entsprechenden Transitzone (205),
entsprechend einen oder mehrere Anwesenheitsdetektoren (235) für die Anhaltelemente (230), jeweils zum Erkennen einer Anwesenheit der entsprechenden Stapel (310), die durch das entsprechende Anhaltelement (230) angehalten werden,
einen Entladeförderer (145c) zum Fördern der Stapel (310) von einem letzten der Stapler (135c; 435c) in der Folge zu einer Entladezone (140) der Stapel (310), und
ein Steuersystem (155b-155c; 455b-455c), wobei das Steuersystem (155b-155c; 455b-455c) für jeden der nachfolgenden Stapler (135b-135c; 435b-435c) eingerichtet ist, das Trägerelement (220) und das Anhaltelement (230) abhängig vom Zustand der Stapelzone (215), der Anwesenheit der entsprechenden Stapel (310) und einer aktuellen Betriebsgeschwindigkeit der entsprechenden Buchbindemaschine (105b-105c; 405a-405c) zu steuern.

2. Entladesystem (130; 430) nach Anspruch 1, wobei für jeden der nachfolgenden Stapler (135b-135c; 435b-435c) das Steuersystem (155b-155c; 455b-455c) eingerichtet ist, einen Abschluss von jedem der entsprechenden Stapel (310) in der Stapelzone (215) zu bestimmen und das Trägerelement (220) als Reaktion auf die Fertigstellung jedes entsprechenden Stapels (310) zu öffnen.
3. Entladesystem (130; 430) nach Anspruch 1 oder 2, wobei für jeden der nachfolgenden Stapler (135b-

- 135c; 435b-435c) das Steuersystem (155b-155c; 455b-455c) eingerichtet ist, eine Fertigstellungszeit jedes der entsprechenden Stapel (310), die sich in der Stapelzone (215) abhängig vom Zustand der Stapelzone (215) bilden, eine Größe der entsprechenden Stapel (310) und die aktuelle Betriebsgeschwindigkeit der entsprechenden Buchbindemaschine (105b-105c; 105a-105c) zu berechnen, und das eingerichtet ist, das Anhaltelement (230) abhängig von der Fertigstellungszeit und einer Transitzeit durch die Transitzone (205) der entsprechenden Stapel (310) zu steuern.
4. Entladesystem (130; 430) nach Anspruch 3, wobei für jeden der nachfolgenden Stapler (135b-135c; 435b-435c) das Steuersystem (155b-155c; 455b-455c) eingerichtet ist, das Anhaltelement (230) zu steuern, um jeden der entsprechenden Stapel (310), die durch das Anhaltelement (230) angehalten werden, als Reaktion auf deren Anwesenheit und dass die Transitzeit kürzer als die Fertigstellungszeit ist, passieren zu lassen.
5. Entladesystem (430) nach einem der Ansprüche 1 bis 4, wobei einer oder mehrere Mehrfachstapler der Stapler (435a-435c) jeweils eine Abgabe (205o) und eine weitere Abgabe (505o) der Transitzone (205) umfassen, wobei die Abgabe (205o) im Falle des letzten Staplers (435c) mit dem Entladeförderer (145c) oder andernfalls mit dem Transolförderer (145ab, 145bc) des entsprechenden nachfolgenden Staplers (435b, 435c) verbunden ist, und eine Austauschvorrichtung (605) zum Versenden der entsprechenden Stapel (310) wahlweise zur Abgabe (205o) oder zur weiteren Abgabe (505o), und wobei das Entladesystem (430) einen oder mehrere entsprechende weitere Entladeförderer (445a-445c) umfasst, verbunden mit der weiteren Abgabe (505o) der Mehrfachstapler (435a-435c) zum Fördern entsprechender Stapel (310) in Richtung mindestens einer weiteren Entladezone (440), wobei das Steuersystem (455a-455c) für jeden der Mehrfachstapler (435a-435c) eingerichtet ist, die Austauschvorrichtung (605) entsprechend einem Typ jedes der entsprechenden Stapel (310) zu steuern.
6. Entladesystem (430) nach Anspruch 5, wobei das Entladesystem (430) einen Sammelförderer (445x) zum Fördern der entsprechenden Stapel (310) von den weiteren Entladeförderern (445a-445c) zur weiteren Entladezone umfasst (440), entsprechende ein oder mehrere erste weitere Anhaltelemente (630) für die weiteren Entladeförderer (445a-445c), jeweils zum Anhalten entsprechender Stapel (310) auf dem entsprechenden weiteren Entladeförderer (445a-445c) vor dem Sammelförderer (445x), entsprechende ein oder mehrere zweite weitere Anhaltelemente (640) für die weiteren Entladeförderer (445a-445c), jeweils zum Anhalten entsprechender Stapel (310) auf dem Sammelförderer (445x) vor dem entsprechenden weiteren Entladeförderer (445a-445c), entsprechend einem oder mehreren ersten weiteren Anwesenheitsdetektoren (635) für die ersten weiteren Anhaltelemente (630), jeweils zum Erkennen einer ersten weiteren Anwesenheit der entsprechenden Stapel (310), die durch das entsprechende erste weitere Anhaltelement (630) angehalten werden, und entsprechende einen oder mehrere zweite weitere Anwesenheitsdetektoren (645) für die zweiten weiteren Anhaltelemente (640), jeweils zum Erkennen einer zweiten weiteren Anwesenheit des entsprechenden Stapels (310), die durch das entsprechende zweite weitere Anhaltelement (640) angehalten werden, wobei das Steuersystem (455a-455c) für jeden der Mehrfachstapler (435a-435c) eingerichtet ist, das erste weitere Anhaltelement (630) und das zweite weitere Anhaltelement (640) entsprechend der ersten weiteren Anwesenheit und der zweiten weiteren Anwesenheit der entsprechenden Stapel (310) zu steuern.
7. Entladesystem (130; 430) nach einem der Ansprüche 1 bis 6, wobei die Buchbindemaschinen (105b-105c; 405a-405c) Nähmaschinen sind und die Buchbindeartikel (305) Buchblöcke sind, die jeweils eine Mehrzahl von Druckbögen umfassen, die zusammengeheftet werden.
8. Buchbindeanlage (100; 400), umfassend das Entladesystem (130; 430) nach einem der Ansprüche 1 bis 7 und die Buchbindemaschinen (105b-105c; 405b-405c) zum Bereitstellen der entsprechenden Buchbindeartikel (305).
9. Verfahren (700) zum Entladen von Buchbindeartikeln (305) in Stapel (310) im Entladesystem (130; 430) nach einem der Ansprüche 1 bis 7, wobei das Verfahren (700) umfasst:
- Erkennen (703) des Zustands der Stapelzone (215) jedes nachfolgenden Staplers (135b-135c; 435b-435c) über den entsprechenden Zustandsdetektor (225),
- Erkennen (733) der Anwesenheit der entsprechenden Stapel (310), die von jedem Anhaltelement (320) über den entsprechenden Anwesenheitsdetektor (235) angehalten werden, und Steuern (706-730, 736-775) des Trägerelements (220) und des Anhaltelements (230) für jeden nachfolgenden Stapler (135b-135c; 435b-435c) entsprechend dem Zustand der Stapelzone, der Anwesenheit des entsprechenden Stapel (310) und der aktuellen Betriebsgeschwindigkeit der entsprechenden Buchbindemaschine (105b-105c; 405a-405c) über das Steuersystem (155b-155c; 455b-455c).

Revendications

1. Système de déchargement (130 ; 430) pour décharger des éléments de reliure de (305) en piles (310) comprenant chacune un ou plusieurs des éléments de reliure (305), dans lequel le système de déchargement (130 ; 430) comprend :
 - une séquence de plusieurs empileurs (135a-135c ; 435a-435c) pour empiler les éléments de reliure fournis par les machines à relier correspondantes (105a-105c ; 405a-405c) en piles correspondantes (310), chacun des empileurs successifs (135b-135c ; 435b-435c) différent d'un premier des empileurs (145a ; 435a) dans la séquence comprenant :
 - une zone de transit (205) pour un transit de piles correspondantes (310),
 - une zone d'empilement (215) des éléments de reliure correspondants (305) dans les piles correspondantes (310) disposées au-dessus de la zone de transit (205) en condition d'utilisation n'interférant ainsi pas avec le transit des piles (310), et
 - un élément de support (220) pouvant être ouvert pour déposer chacune des piles correspondantes (310) de la zone d'empilement (215) dans la zone de transit (205), le système de déchargement étant **caractérisé en ce que** chacun des empileurs successifs différent d'un premier des empileurs dans la séquence comprend
 - un détecteur de condition (225) pour détecter une condition de la zone d'empilement (215), et
 - en ce que** le système de déchargement (130 ; 430) comprend en outre :
 - un ou plusieurs convoyeurs de transit correspondants (145ab-145bc) pour les empileurs successifs (135b-135c ; 435b-435c), chacun pour transporter des piles correspondantes (310) à partir d'un précédent des empileurs (135a-135b ; 435a-435b) dans la séquence vers la zone de transit (205) de l'empileur successif correspondant (135b-135c ; 435b-435c),
 - un ou plusieurs éléments d'arrêt correspondants (230) pour les convoyeurs de transit (145ab-145bc), chacun pour arrêter les piles correspondantes (310) sur le convoyeur de transit correspondant (145ab-145bc) en amont de la zone de transit correspondante (205),
 - un ou plusieurs détecteurs de présence correspondants (235) pour les éléments d'arrêt (230), chacun pour détecter une présence des piles correspondantes (310) qui sont arrêtées par l'élément d'arrêt correspondant (230),
 - un convoyeur de déchargement (145c) pour
2. Système de déchargement (130 ; 430) selon la revendication 1, dans lequel, pour chacun des empileurs successifs (135b-135c ; 435b-435c), le système de commande (155b-155c ; 455b-455c) est configuré pour déterminer un achèvement de chacune des piles correspondantes (310) dans la zone d'empilement (215) et pour ouvrir l'élément de support (220) en réponse à l'achèvement de chaque pile correspondante (310).
3. Système de déchargement (130 ; 430) selon la revendication 1 ou 2, dans lequel, pour chacun des empileurs successifs (135b-135c ; 435b-435c), le système de commande (155b-155c ; 455b-455c) est configuré pour calculer un temps d'achèvement de chacune des piles correspondantes (310) en cours de formation dans la zone d'empilage (215) selon l'état de la zone d'empilage (215), une taille des piles correspondantes (310) et la vitesse de fonctionnement courante de la machine à relier correspondante (105b-105c ; 405a-405c), et est configuré pour commander l'élément d'arrêt (230) en fonction du temps d'achèvement et d'un temps de transit à travers la zone de transit (205) des piles correspondantes (310).
4. Système de déchargement (130 ; 430) selon la revendication 3, dans lequel, pour chacun des empileurs successifs (135b-135c ; 435b-435c) le système de contrôle (155b-155c ; 455b-455c) est configuré pour commander l'élément d'arrêt (230) pour laisser passer chacune des piles (310) correspondantes arrêtées par l'élément d'arrêt (230) en réponse à sa présence et à un temps de transit inférieur au temps d'achèvement.
5. Système de déchargement (430) selon l'une quelconque des revendications 1 à 4, dans lequel un ou plusieurs empileurs multiples des empileurs (435a-435c) comprennent chacun une sortie (205o) et une autre sortie (505c) de la zone de transit (205), la sortie (205c) étant reliée au convoyeur de déchar-

gement (145c) dans le cas du dernier empileur (435c) ou au convoyeur de transit (145ab, 145bc) de l'empileur successif correspondant (435b, 435c) dans le cas contraire, et un dispositif d'échange (605) pour envoyer les piles correspondantes (310) sélectivement vers la sortie (205o) ou vers l'autre sortie (505o), et dans lequel le système de déchargement (430) comprend un ou plusieurs autres convoyeurs de déchargement correspondants (445a-445c) connectés à l'autre sortie (505c) des multiples empileurs (435a-435c) pour transporter les piles correspondantes (310) vers au moins une autre zone de déchargement (440), le système de commande (455a-455c) étant configuré, pour chacun des multiples empileurs (435a-435c), pour commander le dispositif d'échange (605) selon un type de chacune des piles correspondantes (310).

6. Système de déchargement (430) selon la revendication 5, dans lequel le système de déchargement (430) comprend un convoyeur de collecte (445x) pour transporter les piles correspondantes (310) des autres convoyeurs de déchargement (445a-445c) vers l'autre zone de déchargement (440), un ou plusieurs autres premiers éléments d'arrêt correspondants (630) pour les autres convoyeurs de déchargement (445a-445c), chacun pour arrêter des piles correspondantes (310) sur l'autre convoyeur de déchargement correspondant (445a-445c) en amont du convoyeur de collecte (445x), un ou plusieurs seconds éléments d'arrêt supplémentaires correspondants (640) pour les autres convoyeurs de déchargement (445a-445c), chacun pour arrêter des piles correspondantes (310) sur le convoyeur de collecte (445x) en amont de l'autre convoyeur de déchargement correspondant (445a-445c), un ou plusieurs premiers autres détecteurs de présence correspondants (635) pour les premiers autres éléments d'arrêt (630), chacun pour détecter une première autre présence des piles correspondantes (310) arrêtées par le premier autre élément d'arrêt correspondant (630), et un ou plusieurs deuxièmes autres détecteurs de présence correspondants (645) pour les deuxièmes autres éléments d'arrêt (640), chacun pour détecter une deuxième autre présence des piles correspondantes (310) arrêtées par le deuxième autre élément d'arrêt correspondant (640), pour chacun des multiples empileurs (435a-435c), le système de commande (455a-455c) étant configuré pour commander le premier élément d'arrêt supplémentaire (630) et le deuxième élément d'arrêt supplémentaire (640) en fonction de la première présence supplémentaire et de la deuxième autre présence des empilements correspondants (310).
7. Système de déchargement (130 ; 430) selon l'une quelconque des revendications 1 à 6, dans lequel les machines à relier (105b-105c ; 405a-405c) sont

des machines à coudre, les éléments de reliure (305) étant des blocs de livre comprenant chacun une pluralité de cahiers cousus ensemble.

8. Installation de reliure (100 ; 400) comprenant le système de déchargement (130 ; 430) selon l'une quelconque des revendications 1 à 7, et les machines à relier (105b-105c ; 405b-405c) pour fournir les éléments de reliure correspondants (305).

9. Procédé (700) pour décharger des éléments de reliure (305) en piles (310) dans le système de déchargement (130 ; 430) selon l'une quelconque des revendications 1 à 7, dans lequel le procédé (700) comprend :

la détection (703) de l'état de la zone d'empilement (215) de chaque empileur successif (135b-135c ; 435b-435c) via le détecteur d'état correspondant (225),
la détection (733) de la présence des piles correspondantes (310) arrêtées par chaque élément d'arrêt (320) via le détecteur de présence correspondant (235), et
la commande (706-730, 736-775), pour chaque empileur successif (135b-135c ; 435b-435c), de l'élément de support (220) et de l'élément d'arrêt (230) en fonction de l'état de la zone d'empilement, de la présence des piles correspondantes (310) et de la vitesse de fonctionnement courante de la machine à relier correspondante (105b-105c ; 405a-405c) via le système de commande (155b-155c ; 455b-455c) .

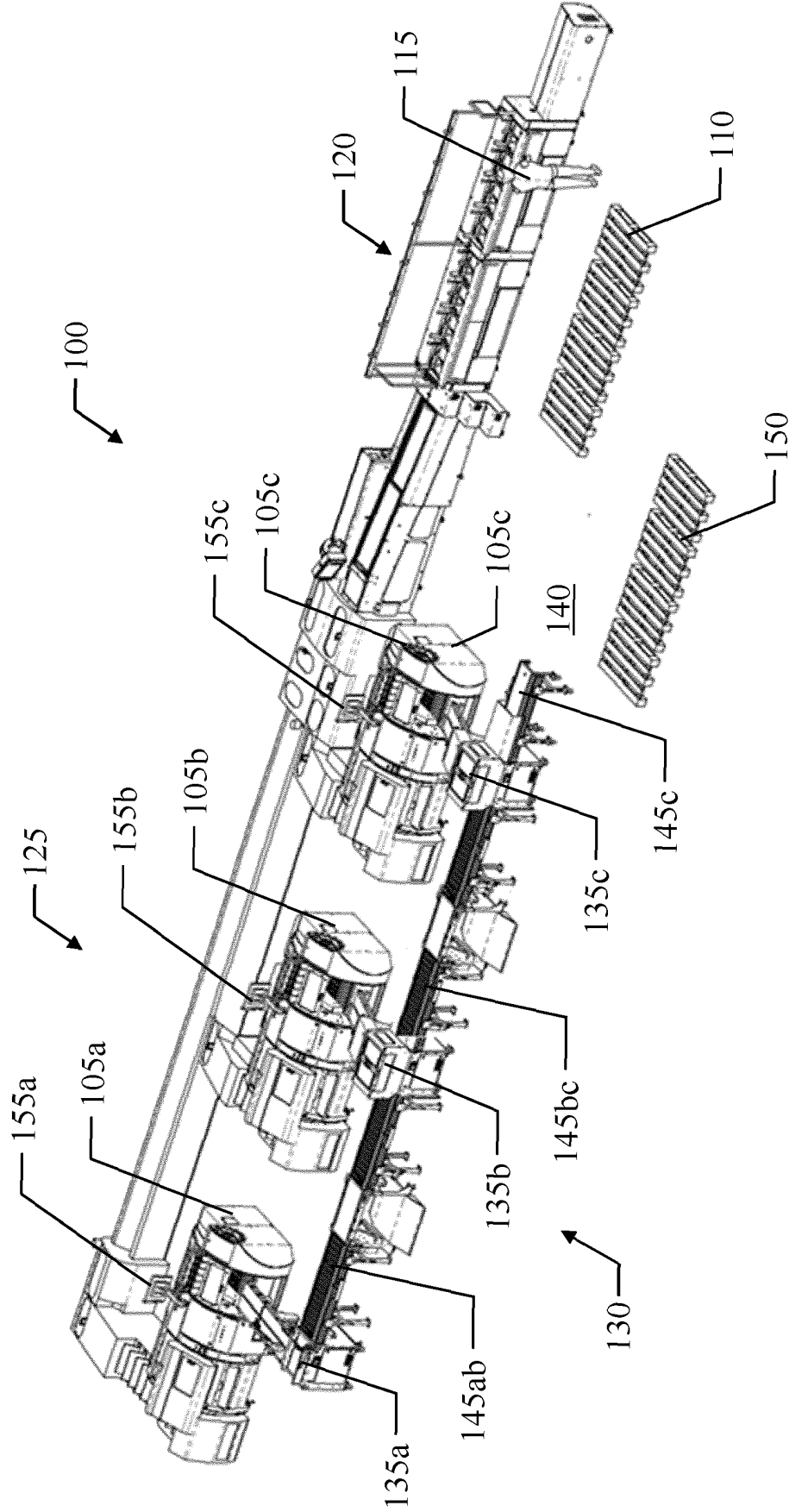


FIG.1

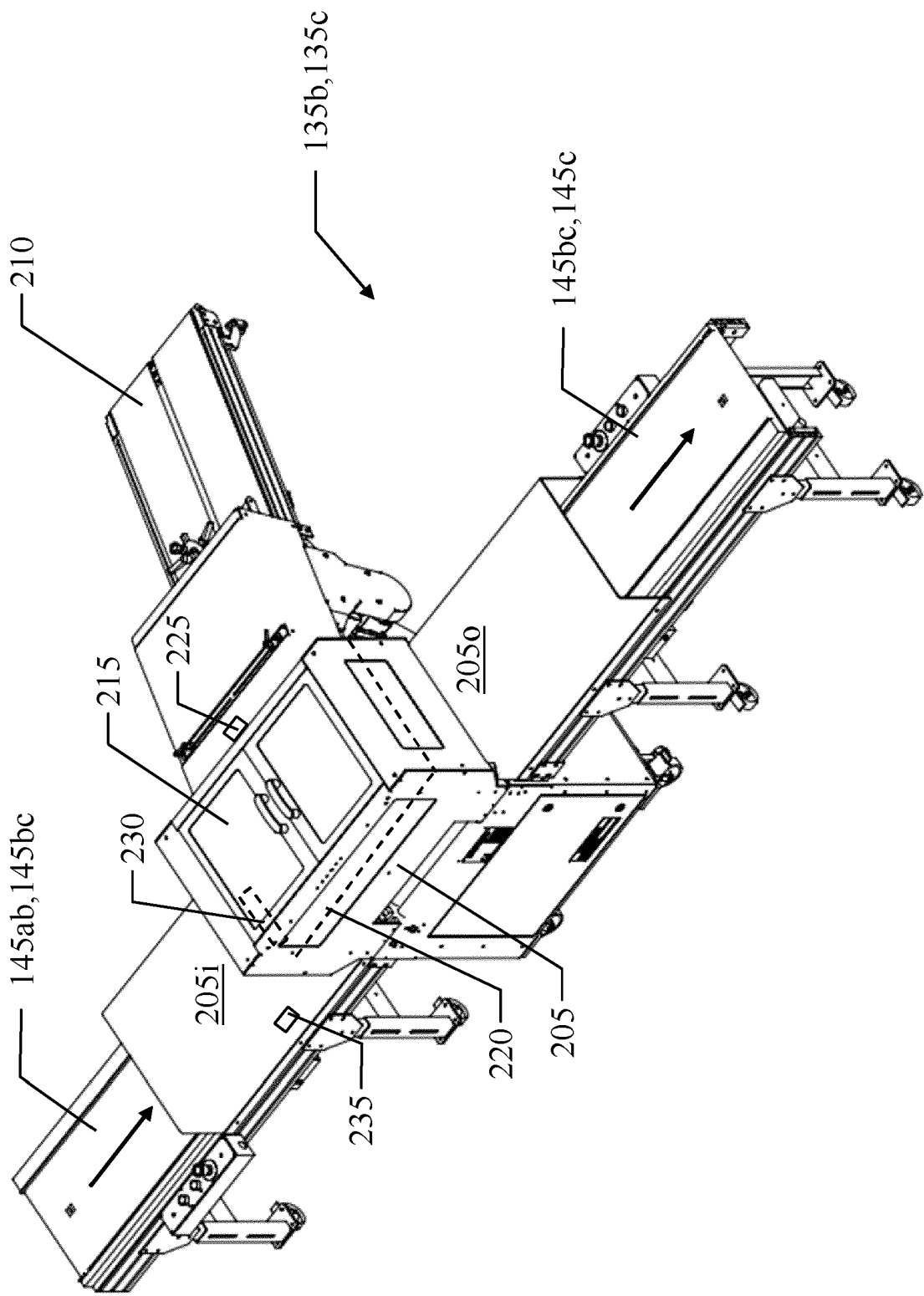


FIG.2

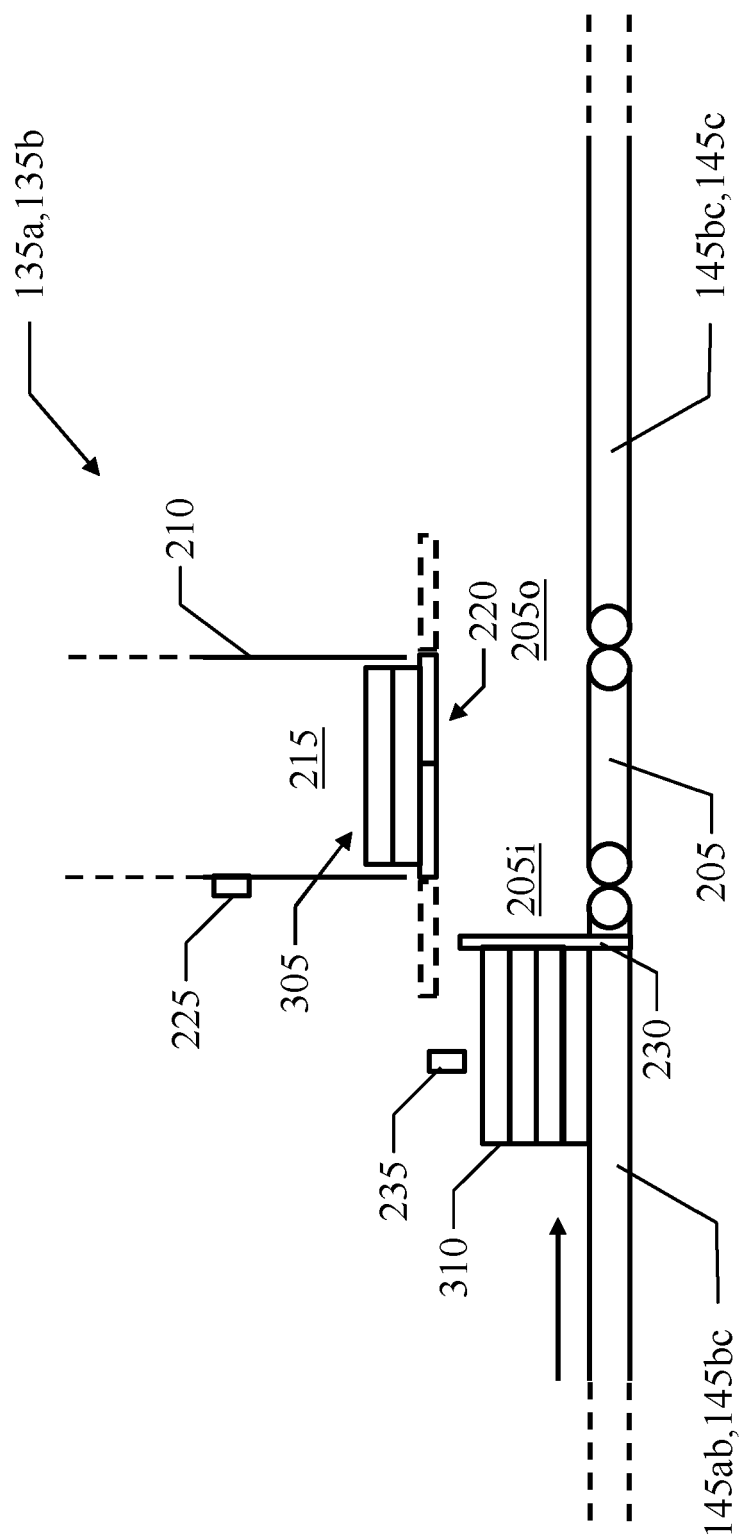


FIG. 3

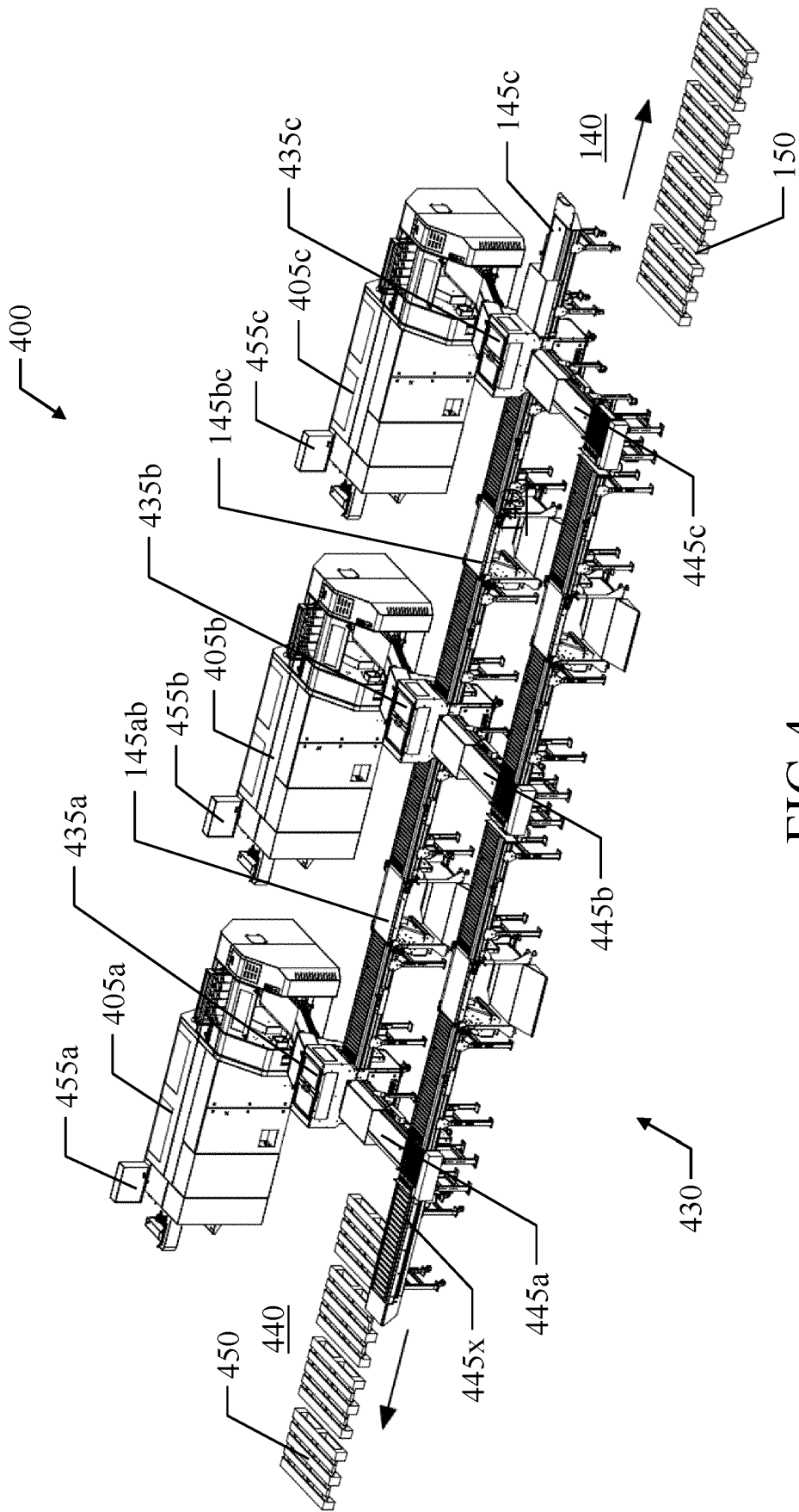


FIG. 4

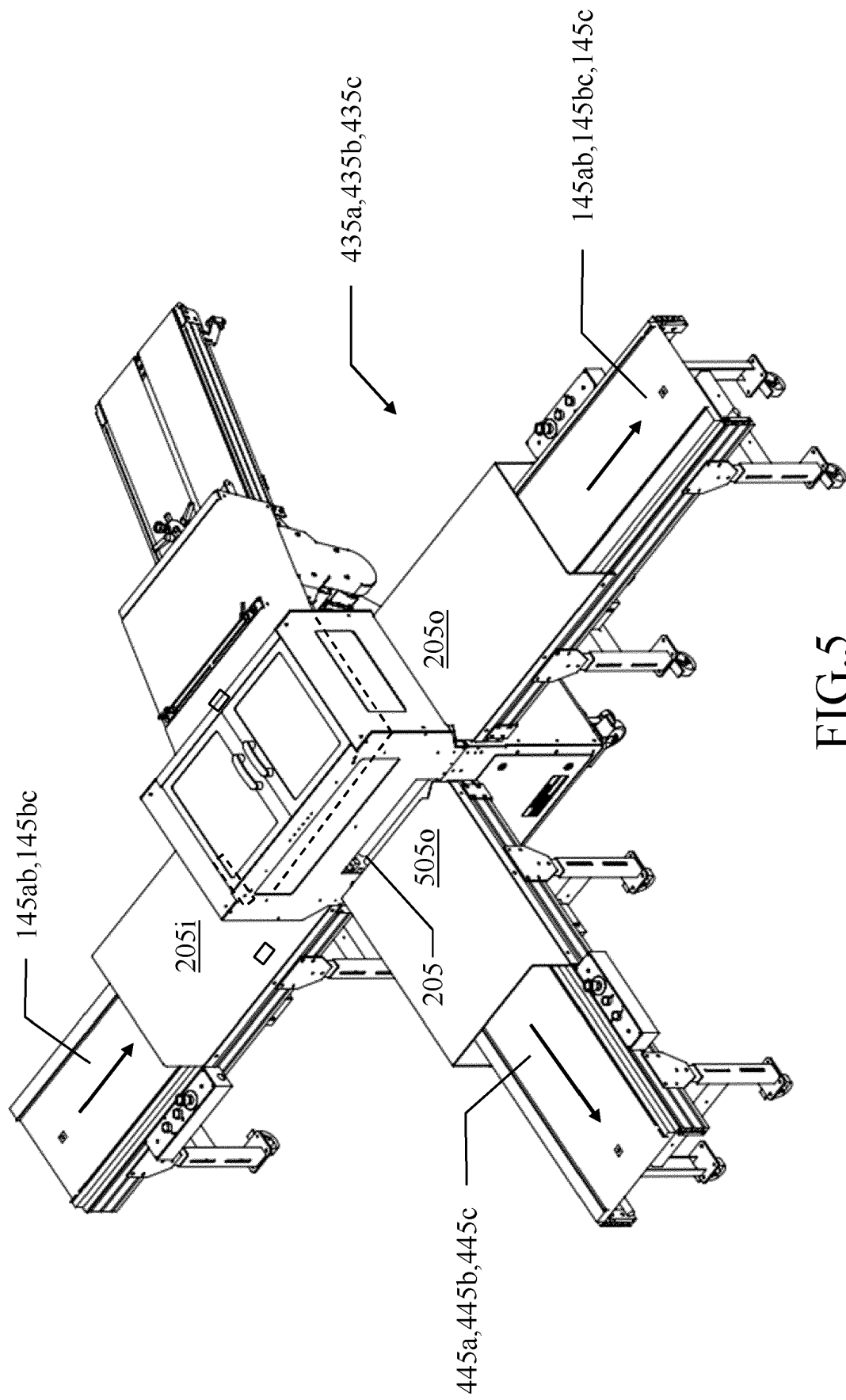


FIG. 5

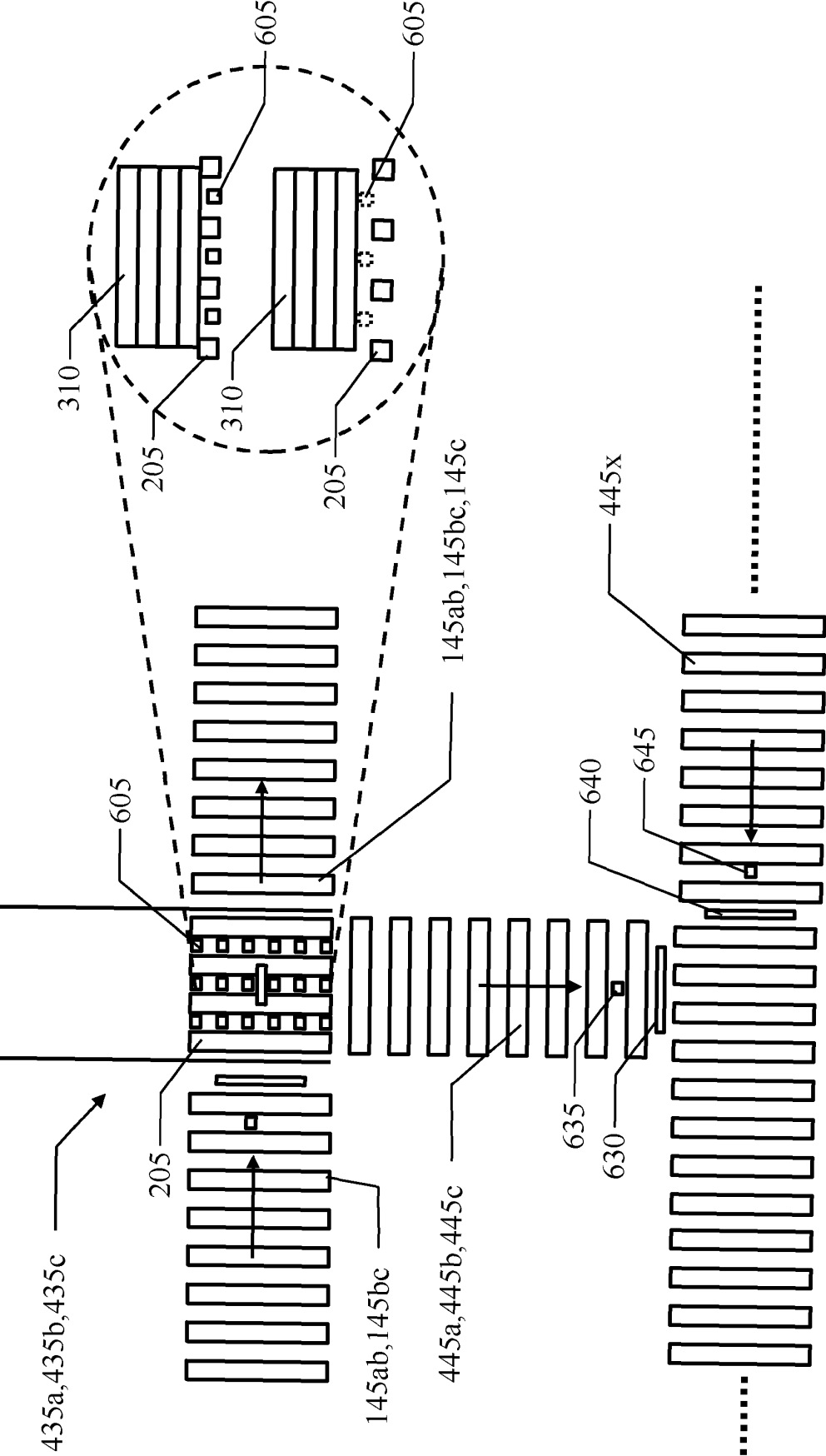


FIG.6

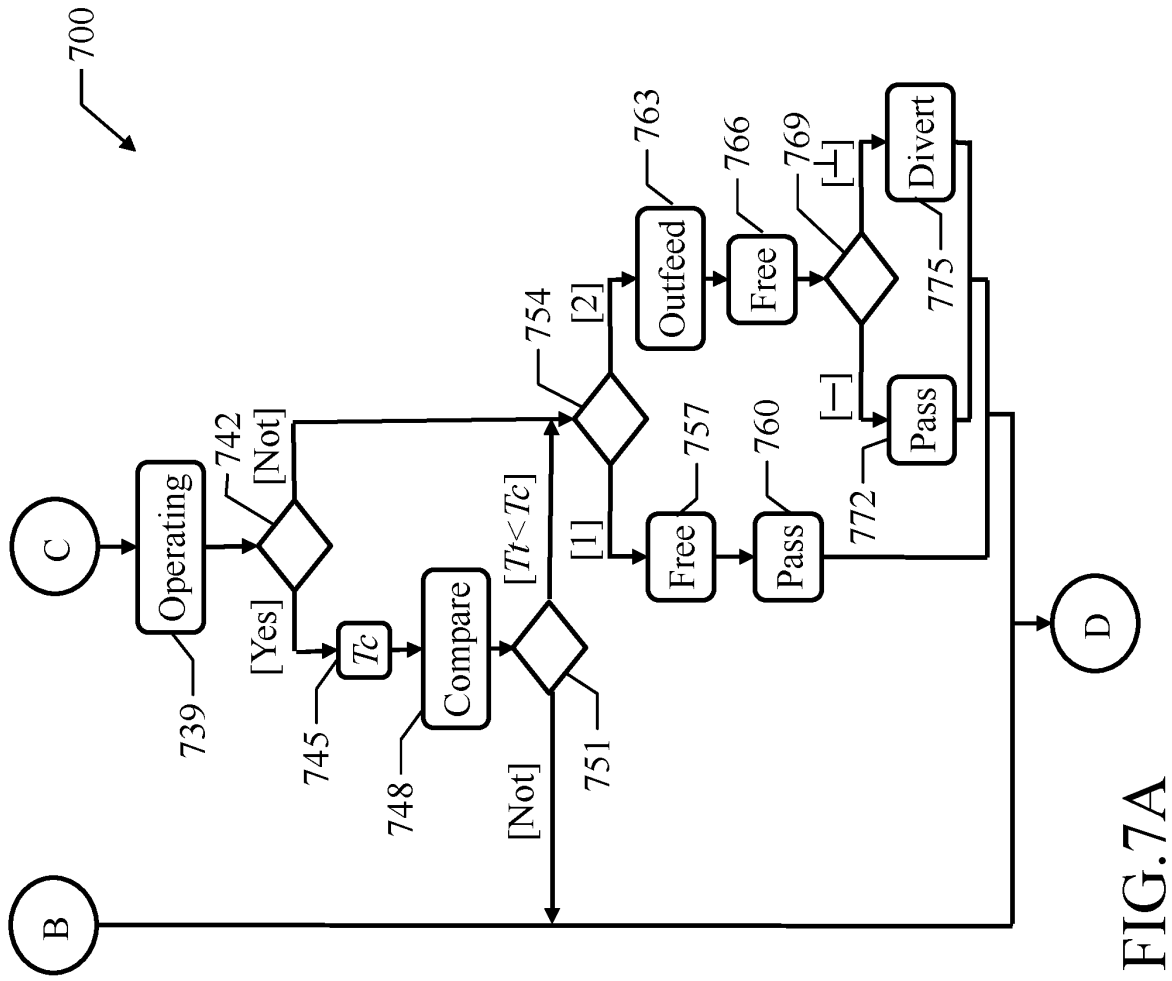
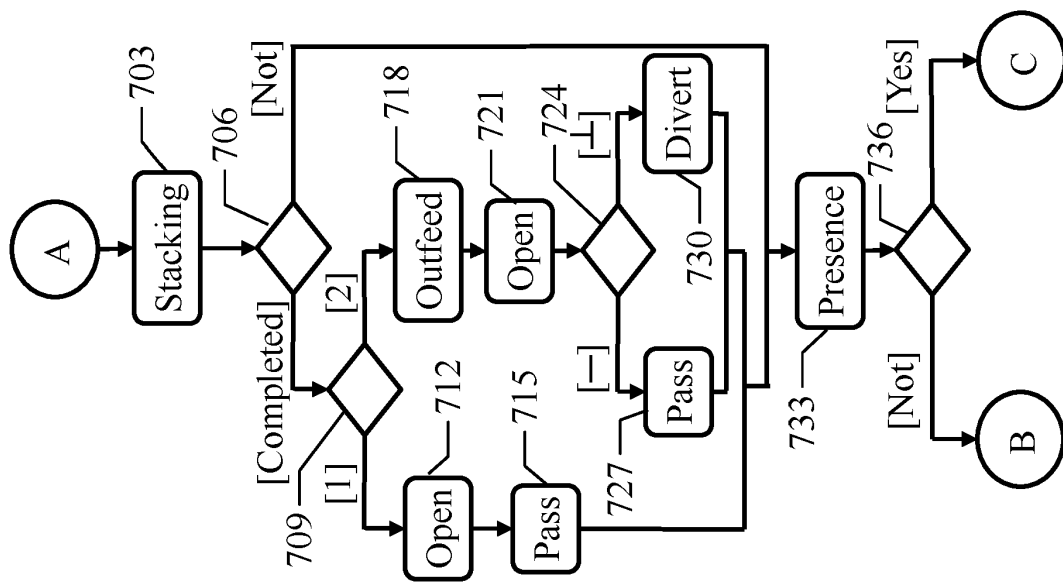


FIG.7A



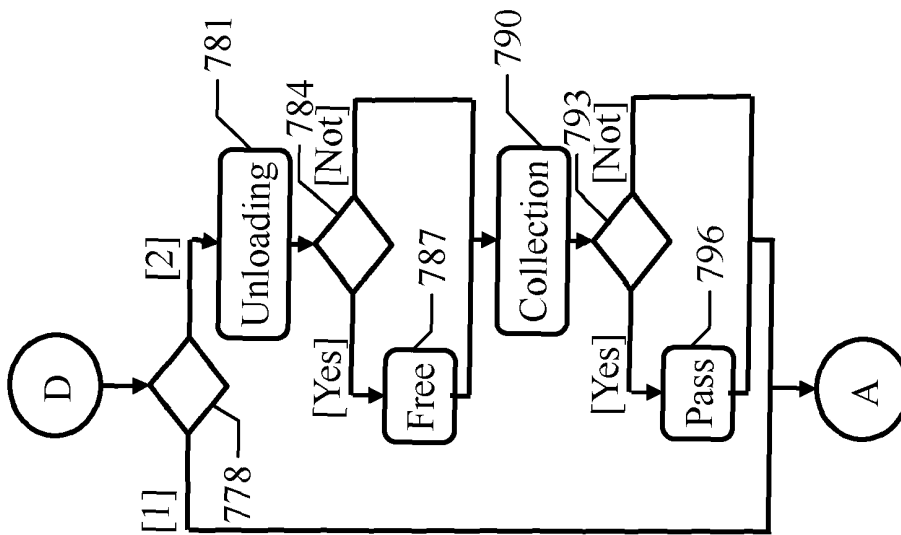


FIG. 7B

REFERENCES CITED IN THE DESCRIPTION

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