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(54) **BOOKBINDING SYSTEM WITH ALTERNATIVE FEEDING OF BOOK BLOCKS FROM DIFFERENT MACHINES**

(57) A bookbinding system (100;400) is proposed comprising a finishing machine (105) for finishing book blocks in succession, a plurality of supplying machines (110a-110c,410b) each for supplying part of the book blocks in succession, a feeding apparatus (115) for feeding the book blocks in succession from the supplying machines (110a-110c,410b) to the finishing machine (105), wherein the feeding apparatus (115) comprises one or more feeding modules (115a-115c) in sequence each comprising a conveyor (205a-205c) for conveying corresponding book blocks in succession having a plurality of entrances (220a-220c,225a-225c,425b-425c), comprising a main entrance (220a-220c) and one or more secondary entrances (225a-225c,425b-425c), for receiving corresponding book blocks in succession into an input section (210a-210c) of the conveyor (205a-205c) being common to the entrances (220a-220c,225a-225c,

425b-425c) and an exit (230a-230c) for providing the corresponding book blocks in succession, the main entrance (220b-220c) of each of the feeding modules (115b-115c) different from a first one (115a) of the feeding modules (115a-115c) being coupled with the exit (230a-230b) of a previous one (115a-115b) of the feeding modules (115-115c), the exit (230c) of a last one (115c) of the feeding modules (115c-115c) being coupled with the finishing machine (115) and each of supplying machines (110a-110c,410b) being coupled with a corresponding one of the secondary entrances (225a-225c,425b), and wherein the bookbinding system (100;400) comprises a control device (145) for enabling alternately, in each of the feeding modules (115a-115c), one of the entrances (220a-220c,225a-225c,425b-425c) and/or the exit (230a-230c).

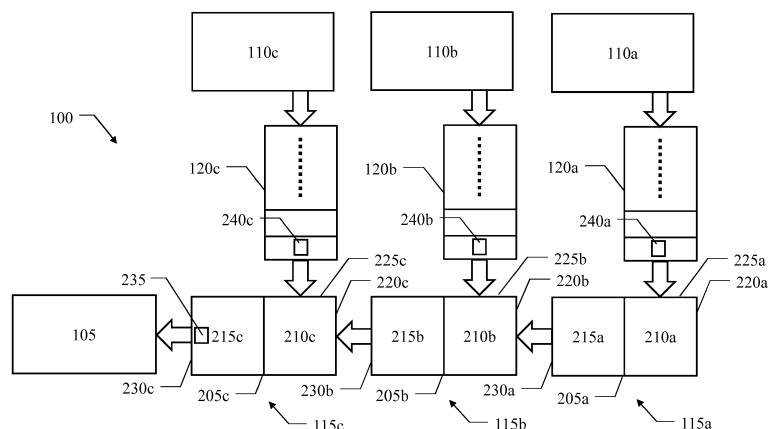


FIG.2

Description

Technical field

[0001] The present invention relates to the bookbinding field. More specifically, this invention relates to the feeding of book blocks.

Technological context

[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 disclosure.

[0003] The production of books at industrial level generally involves the finishing of corresponding (semi-finished) book blocks in bookbinding plants. For example, the book blocks are made in (bookbinding) sewing machines, which sew signatures of corresponding blocks to each other. In turn, the blocks of signatures are formed in (bookbinding) gathering machines. Typically, each gathering machine comprises a series of hoppers arranged along a conveyor; signatures of the same type are provided continuously by each hopper to corresponding sections of the conveyor, so as to be stacked together to form the blocks of signatures. The book blocks are provided from the sewing machines to further machines that finish them for making the corresponding books; for example, (bookbinding) perfect-binding machines glue a fastening lining and/or a soft cover to the book blocks (which are then cut in three-knife trimming machines).

[0004] The book blocks may be transferred manually from the sewing machines to the perfect-binding machines; for this purpose, operators collect the book blocks made by the sewing machines onto pallets, transport the pallets to the perfect-binding machines and pick up the book blocks from the pallets for loading them into the perfect-binding machines. However, these operations significantly increase the production times and costs of the books.

[0005] Therefore, feeding apparatuses are generally used for feeding the book blocks automatically. In general, each feeding apparatus is of single type, with a conveyor that conveys the book blocks provided by a sewing machine to a corresponding perfect-binding machine. Feeding apparatuses of double type are also available. In particular, (double) feeding apparatuses of simultaneous type are used to compose books with inserts (for example, special signatures or different objects, such as envelopes with CDs). For this purpose, the conveyor comprises two separate channels or a channel divided into two parts by a separator for providing the book blocks and the inserts continuously; the two channels or the two parts of the channel converge into a common channel where the inserts are added to the corresponding book

blocks.

[0006] In a different context relating to the formation of book blocks with internal pages glued in pairs, WO-A-2014/006483 instead describes a (double) feeding apparatus of sequential type, which is used to compensate for a different speed of the corresponding bookbinding machines. In particular, two groups each comprising a scoring module, a folding module and a gluing module are provided for feeding folded sheets continuously with a layer of glue applied onto their upper surface (with the exception of a first one of each book). The folded sheets coming from the two groups are provided to corresponding consecutive sections of a conveyor belt, so as to be combined into a double flow of folded sheets. The conveyor belt then feeds the folded sheets to a coupling/pressing module. The coupling/pressing module receives the folded sheets horizontally into pockets (open tangentially) of a rotating drum; the folded sheets are then extracted from the drum vertically onto a table, so as to be coupled and pressed to each other.

[0007] However, the traditional feeding devices are ineffective in case of stops of the bookbinding machines. Indeed, in a feeding apparatus (either single or double of simultaneous type) each stop of the sewing machine implies the missing feeding of the book blocks to the perfect-binding machine, and then its stop; moreover, in the case of the feeding apparatus (double of sequential type) of the document WO-A-2014/006483 each stop of one of the groups involves an intermittent feeding of the folded sheets that compromises their coupling and pressing in the coupling/pressing module and then involves its stop.

[0008] In any case, such feeding apparatuses are hardly suitable to cope with the requests of versatility of the modern production processes of the books. Indeed, nowadays the requests are more and more frequent of small production batches of the books, for example, each formed by 1-10 items. In this context, all the traditional feeding apparatuses involve recurring relatively long waiting times at every change of production batch for the configuration of the corresponding bookbinding machines.

[0009] Moreover, the bookbinding systems based on the same feeding apparatuses are not scalable, so that they may not be updated easily in case of increases of the workload.

Summary

[0010] A simplified summary of the present disclosure 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 disclosure 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.

[0011] In general terms, the present disclosure is based on the idea of providing an alternate feeding of

the book blocks from different machines.

[0012] Particularly, an aspect provides a bookbinding system comprising a finishing machine for finishing book blocks in succession, a plurality of supplying machines each for supplying part of the book blocks in succession and a feeding apparatus for feeding the book blocks in succession from the supplying machines to the finishing machine, wherein the feeding apparatus comprises one or more feeding modules each having a main entrance and an exit for coupling them in sequence with the finishing machine and one or more secondary entrances with which the supplying machines are coupled, and wherein in each of the feeding modules one of the entrances and/or the exit are enabled alternately.

[0013] A further aspect provides a feeding apparatus for use in this bookbinding system.

[0014] A further aspect provides a feeding module for use in this feeding apparatus.

[0015] A further aspect provides a corresponding method.

[0016] A further aspect provides a software program for implementing the method.

[0017] A further aspect provides a corresponding software program product.

[0018] More specifically, one or more aspects of the present disclosure 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 disclosure, 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, like 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. Particularly:

FIG.1 shows a schematic representation in plan view of a bookbinding system according to an embodiment of the present invention,
FIG.2 shows a representation at logic level of the bookbinding system according to an embodiment of the present invention,

FIG.3 shows a state diagram describing the functional logic of a feeding apparatus of this bookbinding system according to an embodiment of the present invention, and

FIG.4 shows a schematic representation in plan view of a bookbinding system according to a further embodiment of the present invention.

Detailed description

[0020] With reference in particular to FIG.1, a schematic representation in plan view is shown of a bookbinding system 100 according to an embodiment of the present invention.

[0021] The bookbinding system 100 comprises a (bookbinding) finishing machine for finishing book blocks in succession (not shown in the figure). In the example at issue, the finishing machine is a (bookbinding) perfect-binding machine 105 for gluing a fastening lining and/or a soft cover to each book block, formed by a block of signatures sewn to each other in the case of sewn books or loose in the case of glued books (with each signature that is formed in turn by a sheet of paper folded one or more times); the perfect-binding machine 105 has a modular structure, with several stations that may be enabled selectively for performing corresponding finishing operations onto the book blocks. For example, it is possible to mill the book blocks for glued books; in any case (both for the sewn books and for the glued books), it is possible to apply a soft cover or a lining for the next application of a hard cover.

[0022] Moreover, the bookbinding system 100 comprises a plurality of (bookbinding) supplying machines each for supplying part of the book blocks in succession. In the example at issue, the supply machines are three (bookbinding) sewing machines 110a, 110b and 110c, which sew blocks of signatures to each other for forming corresponding book blocks (for example, with the signatures that come from offset, reel or digital printers).

[0023] A feeding apparatus 115 is provided for feeding the book blocks in succession from the sewing machines 110a-110c to the perfect-binding machine 105. In the solution according to an embodiment of the present invention, the feeding apparatus 115 comprises one or more feeding modules, three in the example at issue denoted with the references 115a, 115b and 115c. The feeding modules 115a-115c are coupled to each other in sequence with the perfect-binding machine 105. Moreover, each of the sewing machines 110a-110c is coupled with a corresponding one of the feeding modules 115a-115c; particularly, the sewing machines 110a, 110b and 110c are coupled with the feeding modules 115a, 115b and 115c, respectively, via corresponding connection holders 120a, 120b and 120c.

[0024] Dedicated electric motors drive the members of the different components of the bookbinding system 100; particularly, the perfect-binding machine 105 is provided with a motor 130, each of the sewing machines 110a,

110b and 110c is provided with a motor 135a, 135b and 135c, respectively, and each of the feeding modules 115a, 115b and 115c is provided with a motor 140a, 140b and 140c, respectively. A control device 145 controls operation of the perfect-binding machine 105 and of the feeding apparatus 115; particularly, as described in detail in the following, the control device 145 is capable of controlling each feeding module 115a-115c individually by enabling its entrances and/or exit alternately. Further control devices 150a, 150b and 150c control operation of the sewing machines 110a, 110b and 110c, respectively. Each control device 145, 150a-150c (for example, based on an industrial PC) is provided with one or more microprocessors, a volatile working memory (RAM), a non-volatile memory (for example, an E²PROM) for storing programs and data, and several input-output units, for example, a USB port for reading/writing removable memory devices such as a pen drive and a control panel, for example, of touch-screen type.

[0025] The above-described bookbinding system 100 is very versatile. Indeed, different production batches of books may proceed in parallel on the different sewing machines 110a-110c (with the corresponding book blocks that are supplied alternately to the perfect-binding machine 105 for their finishing).

[0026] In any case, during each stop of part of the sewing machines 110a-110c, the feeding apparatus 115 automatically compensates for the missing receipt of their book blocks by receiving more book blocks from the other sewing machines 110a-110c; in this way, it is possible to maintain the feeding of the perfect-binding machine 105 substantially uniform (by limiting the length of the possible periods of lack of book blocks), thus without significantly compromising its operation.

[0027] All of the above is particularly advantageous in modern production processes of the books based on small production batches (for example, each formed by 1-10 items). Indeed, while corresponding operators configure one or more (stopped) sewing machines 110a-110c for their changes of production batches, the other sewing machines 110a-110c may continue the processing of their production batches (with this processing that proceeds faster because of the higher availability of the feeding apparatus 115, so that the changes of production batches are substantially opaque to the yield of the bookbinding system 100).

[0028] Moreover, the feeding apparatus 115 has a modular structure that makes the bookbinding system 100 scalable; particularly, it is possible to add one or more further feeding modules upstream the first feeding module 115a in a simple and fast way (without requiring any modification of the feeding modules 115a-115c already present), and then to add corresponding further sewing machines. As a consequence, the bookbinding system 100 may adapt to increases of the workload gradually (with a spreading of the corresponding economic investment over time).

[0029] With reference now to FIG.2, a representation

at logic level is shown of the bookbinding system 100 according to an embodiment of the present invention.

[0030] The feeding modules 115a, 115b and 115c comprise respective conveyors 205a, 205b and 205c for conveying corresponding book blocks (not shown in the figure) in succession. For example, each conveyor 205a-205c comprises a transport channel of the book in vertical, with two sidewalls that are adjustable (via a corresponding kinematic system) according to a thickness of the book blocks, and a chain with push pegs (not shown in the figure). Each of the conveyors 205a, 205b and 205c is divided into an input section 210a, 210b and 210c, respectively, and a buffer section 215a, 215b and 215c, respectively, with the buffer section 215a-215c that follows the input section 210a-210c along a conveying direction of the book blocks by the conveyor 205a-205c (from the right to the left in the figure). The (input and buffer) sections 210a-210c and 215a-215c are defined by the push pegs of the corresponding chain; particularly, in a rest condition of the conveyor 205a-205c (not driven by the corresponding motor) a push peg is arranged behind the input section 210a-210c and a next push peg is arranged behind the buffer section 215a-215c.

[0031] Each of the conveyors 205a, 205b and 205c has a main entrance 220a, 220b and 220c, respectively, opened into the transport channel for receiving corresponding book blocks along the conveying direction (from the right to the figure); moreover, each of the conveyors 205a, 205b and 205c has a secondary entrance 225a, 225b and 225c, respectively, for receiving corresponding book blocks falling into the transport channel transversely to the conveying direction (from above in the figure). In each feeding module 115a-115c, both the (main and secondary) entrances 220a-220c and 225a-225c receive the book blocks alternately into the same input section 210a-210c. Each of the conveyors 205a, 205b and 205c has an exit 230a, 230b and 230c, respectively, opened into the transport channel for providing the book blocks in succession (to the left in the figure).

[0032] The main entrance 220b and 220c of each feeding module 115b and 115c (different from the first feeding module 110a along the conveying direction) is joined to the exit 230a and 230b of the previous feeding module 115a and 115b, respectively (along the conveying direction); the main entrance 220a of the first feeding module 110a is instead left free. The exit 230c of the last feeding module 115c (along the conveying direction) is joined to a loading channel of the book blocks in vertical of the perfect-binding machine 105 (not shown in the figure). Each sewing machine 110a-110c is coupled with the secondary entrance 225a-225c of the corresponding feeding module 115a-115c via its connection holder 120a-120c; particularly, a discharge belt of the book blocks in horizontal of each sewing machine 110a-110c (not shown in the figure) is joined to the connection holder 120a-120c, which in turn is joined to the secondary entrance 225a-225c. Each connecting belt 120a-120c (for example, implemented with a conveyor belt) is capable of queuing

the book blocks provided by the sewing machine 110a-110c in front of the secondary entrance 225a-225c (in a number corresponding to its length).

[0033] The conveyor 205c (of the last feeding module 115c) is provided with a thickness sensor 235 arranged in correspondence to its buffer section 215c (for example, implemented with a wheel probe), which measures a thickness of each book block present therein. Each connection holder 120a, 120b and 120c is provided with a presence sensor 240a, 240b and 240c, respectively (for example, implemented with a photocell) that detects the presence of a book block at an exit thereof (in front of the secondary entrance 225a-225c).

[0034] In the rest condition of each conveyor 205a-205c, the secondary entrance 225a-225c may be enabled when a book block is present at the exit of the connecting belt 120a-120c (as detected by the presence sensor 240a-240c); the secondary entrance 225a-225c is enabled by driving the connecting belt 120a-120c, so that the book block present at its exit is provided to the input section 210a-210c by falling vertically into the transport channel (with the connecting belt 120a-120c that remains in motion until a next book block reaches its exit, as detected by the presence sensor 240a-240c). The conveyors 205a-205c have a step-by-step operation independent to each other (with each step defined by their push pegs). Each conveyor 205a-205c may be enabled (for a step) thereby advancing each book block present thereon by one position (defined by the sections 210a-210c and 215a-215c); as a consequence, a possible book block present in the buffer section 215a, 215b and 215c is provided to the input section 210b of the next feeding module 110b, to the input section 210c of the next feeding module 110c and to the perfect-binding machine 105, respectively; at the same time, a possible book block present in the input section 210a-210c is brought into the buffer section 215a-215c. When a book block is present in the buffer section 215a-215c, the enabling of the conveyor 205a-205c also enables the exit 230a-230c; for each feeding module 115a-115b (other than the last feeding module 115c), this is possible only when the input section 210b-210c of the next feeding module 115b-115c is free and thus capable of receiving the corresponding book block, whereas for the last feeding module 115c this is normally possible unless the perfect-binding machine 105 is not capable of receiving the corresponding book block (for example, if it is stopped).

[0035] The buffer sections 215a-215c reduce the dependency among the different feeding modules 115a-115c. Indeed, in each feeding module 115a-115c this increases the possibility of clearing the input section 210a-210c (even when the exit 230a-230c may not be enabled) and then of receiving the book blocks therein (with a consequent reduction of the risk of missing feeding of the perfect-binding machine 105).

[0036] With reference now to FIG.3, a state diagram 300 is shown describing the functional logic of a feeding apparatus according to an embodiment of the present

invention.

[0037] Particularly, the functional logic of the feeding apparatus is based on a round-robin policy for the enabling of the (main and secondary) entrances of each feeding module, so as to avoid starvation situations of the sewing machines; at the same time, the functional logic of the feeding apparatus is aimed at conveying the book blocks towards the perfect-binding machine as soon as possible, so as to maintain the perfect-binding machine fed and the feeding apparatus free for receiving the book blocks from the sewing machines.

[0038] The functional logic of each feeding module is described by a finite state (abstract) machine through its states and transitions among them; the state machine may evolve among its states at every operating cycle of the feeding module, common for the whole feeding apparatus and synchronous with the perfect-binding machine. For this purpose, before each operating cycle the control device of the perfect-binding machine determines the actions to be performed into the feeding modules in the same operating cycle. For this purpose, the feeding modules are analyzed in succession, starting from the last one; indeed, the last feeding module is constrained only by the perfect-binding machine (since the enabling of its exit is normally possible unless the perfect-binding machine is not capable of receiving a possible book block present in its buffer section), whereas each previous feeding module is constrained by the next feeding module (since the enabling of its exit is possible only if the next feeding module is capable of receiving the corresponding book block into its input section).

[0039] In each (current) feeding module, the state machine initially enters (in response to a power-on of the bookbinding system) a state $00(M)$, wherein both the input section and the buffer section are free with a last book block that has been provided to the feeding module from the main entrance, considered as such by default (similar considerations apply to the opposite case). In the state $00(M)$, if a book block is available for the secondary entrance independently of the state of the main entrance ($S=1$), the control device (of the perfect-binding machine) enables the secondary entrance (S); in this way, the book block present at the exit of the connecting belt is provided to the input section. Accordingly, the state machine passes to a state $01(S)$, wherein the buffer section is free and the input section is busy with the last book block that has been provided to the feeding module from the secondary entrance. Still in the state $00(M)$, if no book block is available for the secondary entrance and at the same time a book block is available for the main entrance ($S=0 \vee M=1$), the control device enables (indirectly) the main entrance (M) by enabling the conveyor of the previous feeding module by one step and then its exit; in this way, the book block present in the buffer section of the previous feeding module is provided to the input section of the current feeding module. Accordingly, the state machine passes to a state $01(M)$, wherein the buffer section is free and the input section is busy with a last book block that has

been provided to the feeding module from the main entrance. Still in the state $00(M)$, if no book block is available for both the secondary entrance and the main entrance ($S=0 \vee M=0$), the control device takes no action and the state machine remains in the state $00(M)$.

[0040] In the state $01(S)$, if a book block is available for the main entrance independently of the state of the secondary entrance ($M=1$), the control device enables the conveyor by one step (T) and it enables (indirectly) the main entrance (M) by enabling the conveyor of the previous feeding module by one step and then its exit; in this way, the book block present in the input section is brought into the buffer section and the book block present in the buffer section of the previous feeding module is provided to the input section of the current feeding module. Accordingly, the state machine passes to a state $11(M)$, wherein both the buffer section and the input section are busy with a last book block that has been provided to the feeding module from the main entrance. Still in the state $01(S)$, if no book block is available for the main entrance independently of the state of the secondary entrance ($M=0$), the control device enables the conveyor by one step (T); in this way, the book block present in the input section is brought into the buffer section. Accordingly, the state machine passes to a state $10(S)$, wherein the buffer section is busy and the input section is free with a last book block that has been provided to the feeding module from the secondary entrance.

[0041] In the state $01(M)$, if a book block is available for the secondary entrance independently of the state of the main entrance or no book block is available for both the secondary entrance and the main entrance ($S=1 \wedge (S=0 \vee M=0)$), the control device enables the conveyor by one step (T); in this way, the book block present in the input section is brought into the buffer section. Accordingly, the state machine passes to a state $10(M)$, wherein the buffer section is busy and the input section is free with a last book block that has been provided to the feeding module from the main entrance. Still in the state $01(M)$, if no book block is available for the secondary entrance and at the same time a book block is available for the main entrance ($S=0 \vee M=1$), the control device enables the conveyor by one step (T) and it enables (indirectly) the main entrance (M) by enabling the conveyor of the previous feeding module by one step and then its exit; in this way, the book block present in the input section is brought into the buffer section and the book block present in the buffer section of the previous feeding module is provided to the input section of the current feeding module. Accordingly, the state machine passes to the state $11(M)$.

[0042] In state $11(M)$, if the exit is enabled and at the same time a book block is available for the secondary entrance or no book block is available for both the secondary entrance and the main entrance ($O \vee (S=1 \wedge (S=0 \vee M=0))$), the control device enables the conveyor by one step (T); in this way, the book block present in the buffer section is provided to the perfect-

binding machine (in the case of the last feeding module) or to the next feeding module (otherwise) and the book block present in the input section is brought into the buffer section. Accordingly, the state machine passes to the state $10(M)$. Still in the state $11(M)$, if the exit is enabled, no book block is available for the secondary entrance and at the same time a book block is available for the main entrance ($O \vee S=0 \vee M=1$), the control device enables the conveyor by one step (T) and it enables (indirectly) the main entrance (M) by enabling the conveyor of the previous feeding module by one step and then its exit; in this way, the book block present in the buffer section is provided to the perfect-binding machine (in the case of the last feeding module) or to the next feeding module (otherwise), the book block present in the input section is brought into the buffer section and the book block in the buffer section of the previous feeding module is provided to the input section of the current feeding module. Accordingly, the state machine remains in the same state $11(M)$. Still in the state $11(M)$, if the exit is not enabled ($\neg O$), the control device does not perform any action and the state machine remains in the state $11(M)$.

[0043] In the state $10(S)$, if the exit is enabled and at the same time a book block is available for the main entrance independently of the state of the secondary entrance ($O \vee M=1$), the control device enables the conveyor by one step (T) and it enables (indirectly) the main entrance (M) by enabling the conveyor of the previous feeding module by one step and then its exit; in this way, the book block present in the buffer section is provided to the perfect-binding machine (in the case of the last feeding module) or to the next feeding module (otherwise) and the book block present in the buffer section of the previous feeding module is provided to the input section of the current feeding module. Accordingly, the state machine passes to the state $01(M)$. Still in the state $10(S)$, if the exit is enabled and at the same time no book block is available for the main entrance independently of the state of the secondary entrance ($O \vee M=0$), the control device enables the conveyor by one step (T); in this way, the book block present in the buffer section is provided to the perfect-binding machine (in the case of the last feeding module) or to the next feeding module (otherwise). Accordingly, the state machine passes to a state $00(S)$, wherein both the buffer section and the input section are free with a last book block that has been provided to the feeding module from the secondary entrance. Still in the state $10(S)$, if the exit has not been enabled and at the same time a book block is available for the main entrance independently of the state of the secondary entrance ($\neg O \vee M=1$), the control device enables (indirectly) the main entrance (M) by enabling the conveyor of the previous feeding module by one step and then its exit; in this way, the book block present in the buffer section of the previous feeding module is provided to the input section of the current feeding module. Accordingly, the state machine changes to the state $11(M)$. Still in the state $10(S)$, if the exit has not been enabled, no book block is

available for the main entrance and at the same time a book block is available for the secondary entrance ($\neg O \vee M = 0 \vee S = 1$), the control device enables the secondary entrance (S); in this way, the book block present at the exit of the connecting belt is provided to the input section. Accordingly, the state machine passes to a state 11(S), wherein both the buffer section and the input section are busy with a last book block that has been provided to the feeding module from the secondary entrance. Still in the state 10(S), if the exit has not been enabled and at the same time no book block is available for both the main entrance and the secondary entrance ($\neg O \vee M = 0 \vee S = 0$), the control device takes no action and the state machine remains in the state 10(S).

[0044] In state 10(M), if the exit is enabled and at the same time a book block is available for the secondary entrance or no book block is available for both the secondary entrance and the main entrance ($O \vee (S = 1 \wedge (S = 0 \vee M = 0))$), the control device enables the conveyor by one step (T); in this way, the book block present in the buffer section is provided to the perfect-binding machine (in the case of the last feeding module) or to the next feeding module (otherwise). Accordingly, the state machine passes to the state 00(M). Still in the state 10(M), if the exit is enabled, no book block is available for the secondary entrance and at the same time a book block is available for the main entrance ($O \vee S = 0 \vee M = 1$), the control device enables the conveyor by one step (T) and it enables (indirectly) the main entrance (M) by enabling the conveyor of the previous feeding module by one step and then its exit; in this way, the book block present in the buffer section is provided to the perfect-binding machine (in the case of the last feeding module) or to the next feeding module (otherwise) and the book block present in the buffer section of the previous feeding module is provided to the input section of the current feeding module. As a result, the state machine passes to the state 01(M). Still in state 10(M) if the exit has not been enabled and at the same time a book block is available for the secondary entrance independently of the state of the main entrance ($\neg O \vee S = 1$), the control device enables the secondary entrance (S); in this way, the book block present at the exit of the connection holder is provided to the input section. Accordingly, the state machine passes to the state 11(S). Still in the state 10(M), if the exit has not been enabled, no book block is available for the secondary entrance and at the same time a book block is available for the main entrance ($\neg O \vee S = 0 \vee M = 1$), the control device (indirectly) enables the main entrance (M) by enabling the conveyor of the preceding feeding module by one step and the its exit; in this way, the book block present in the buffer section of the previous feeding module is provided to the input section of the current feeding module. Accordingly, the state machine passes to the state 11(M). Still in the state 10(M), if the exit has not been enabled and at the same time no book block is available for both the secondary entrance and the main entrance ($\neg O \vee S = 0 \vee M = 0$),

the control device does not perform any action and the state machine remains in the state 10(M).

[0045] In the state 00(S), if a book block is available for the main entrance independently of the state of the secondary entrance ($M = 1$), the control device enables (indirectly) the main entrance (M) by enabling the conveyor of the previous feeding module by one step and then its exit; in this way, the book block present in the buffer section of the previous feeding module is provided to the input section of the current feeding module. Accordingly, the state machine passes to the state 01(M). Still in the state 00(S), if no book block is available for the main entrance and at the same time a book block is available for the secondary entrance ($M = 0 \vee S = 1$), the control device enables the secondary entrance (S); in this way, the book block present at the exit of the connecting belt is provided to the input section. Accordingly, the state machine passes to the state 01(S). Still in the state 00(S), if no book block is available for both the main entrance and the secondary entrance ($M = 0 \vee S = 0$), the control device takes no action and the state machine remains in the state 00(S).

[0046] In the state 11(S), if the exit is enabled and at the same time a book block is available for the main entrance independently of the state of the secondary entrance ($O \vee M = 1$), the control device enables the conveyor by one step (T) and it enables (indirectly) the main entrance (M) by enabling the conveyor of the previous feeding module by one step and then its exit; in this way, the book block present in the buffer section is provided to the perfect-binding machine (in the case of the last feeding module) or to the next feeding module (otherwise), the book block present in the input section is brought into the buffer section, and the book block present in the buffer section of the previous feeding module is provided to the input section of the current feeding module. Accordingly, the state machine passes to the state 11(M). Still in the state 11(S), if the exit is enabled and at the same time no book block is available for the main entrance independently of the state of the secondary entrance ($O \vee M = 0$), the control device enables the conveyor by one step (T); in this way, the book block present in the buffer section is provided to the perfect-binding machine (in the case of the last feeding module) or to the next feeding module (otherwise) and the book block present in the input section is brought into the buffer section. Accordingly, the state machine passes to state the 10(M). Always in the state 11(S), if the exit has not been enabled ($\neg O$) the control device takes no action and the state machine remains in the state 11(S).

[0047] The above-described bookbinding system may be used for processing a number of production batches of books of the same type. This provides a high yield of the bookbinding system.

[0048] For this purpose, for example, an operator (or more) prepares the perfect-binding machine and configures it, by entering various configuration parameters into the control panel of its control device (for example, by

selecting its modules to be enabled), according to the production batches of the books to be processed. The operator prepares each sewing machine and configures it, in this case as well by entering various configuration parameters into the control panel of its control device (for example, format of the book blocks, their number), according to a corresponding current production batch (with such operations that are repeated at every change of production batch). During each operating cycle, the control device of the perfect-binding machine controls the feeding modules to perform the operations determined as described above. In addition, the thickness sensor measures the thickness of the possible book block present in the buffer section of the last feeding module (with this measure that is null if it is free), and communicates it to the control device of the perfect-binding machine; in response thereto, the control device of the perfect-binding machine adjusts it accordingly for the correct finishing of the book block (for example, by varying a width of a transport channel thereof of the book block in vertical).

[0049] The same bookbinding system may also be used to process a series of production batches of books of different type (in case the application of different covers is not required or the perfect-binding machine is capable of feeding the covers selectively).

[0050] In the case of application of different covers, the perfect-binding machine is prepared by loading stacks of covers of different type (for the various production batches) into corresponding hoppers. The operator that configures each sewing machine for a new production batch also enters (into the control panel of its control device) an identification code of the production batch and an indication of the corresponding type of cover (among the ones of the covers loaded into the perfect-binding machine); the control device of the sewing machine transmits this information to the control device of the perfect-binding machine. The control device of the perfect-binding machine tracks a state of the feeding apparatus (according to its control thereof); for example, this state is defined by a feeding state table with two locations (for the input section and the buffer section) for each feeding module, each containing the identification code of the production batch of the possible book block present therein. Whenever a book block present in the buffer section of the last feeding module (as indicated in the corresponding location of the feeding state table) is going to be provided to the perfect-binding machine, the control device of the perfect-binding machine controls it for the application onto this book block of the cover of the type corresponding to its production batch (by enabling its hopper to provide it to the corresponding feeder).

[0051] In any case, during each operating cycle, the control device of the perfect-binding machine performs various operations for each feeding module whenever it is in a position to enable any one of its (main or secondary) entrances for providing a corresponding (new) book block with thickness different from that of the possible

book blocks that are currently present in the feeding module. Particularly, the control device of the perfect-binding machine indiscriminately brings all the book blocks present in the feeding module to the perfect-binding machine (for the last feeding module) or to the next feeding module (otherwise), in order to clear the feeding module. At this point, the control device of the perfect-binding machine adjusts the feeding module according to the new book block (for example, by varying the distance between the sidewalls of its transport channel according to the thickness of the new book block); the control device of the perfect-binding machine may then enable the entrance of the feeding module for providing the new book block to its input section.

[0052] The processing of different types of books provides a greater versatility of the bookbinding system.

[0053] With reference now to FIG.4, a schematic representation in plan view is shown of a bookbinding system 400 according to a further embodiment of the present invention.

[0054] The book binding system 400 differs from that described above for the following characteristics.

[0055] Particularly, one or more of the feeding modules has two secondary entrances (in addition to the main entrance) for receiving corresponding book blocks that fall into its transport channel transversely to the conveying direction from opposite sides (above and below in the figure); for example, the feeding module 115b has a further secondary entrance 425b in addition to the secondary entrance 225b and the feeding module 115c has a further secondary entrance 425c in addition to the secondary entrance 225c (whereas the feeding module 115a has remained unchanged). As above, in each feeding module 115a, 115b and 115c all the respective entrances 220a,225a, 220b,225b,425b and 220c,225c,425c provide the book blocks (alternately) into the same input section 210a, 210b and 210c, respectively.

[0056] A further sewing machine may be coupled with each of these additional secondary entrances 425b-425c; for example, in the case at issue a sewing machine 410b, provided with a motor 435b and a control device 450b as above, is coupled with the secondary entrance 425b of the feeding module 115b via an additional connection holder 420b.

[0057] In addition or in alternative, one or more of the secondary entrances 225a-225c,425b-425c may be used to provide corresponding book blocks manually; for example, in the case at issue a connecting belt 420c is coupled with the secondary entrance 425c of the feeding module 115c, with this connecting belt 420c that is left free for loading the book blocks thereon manually.

[0058] The functional logic of the feeding apparatus 115 is similar to the case described above, with the round-robin policy that applies to the enabling of all the (main and one/two secondary) entrances 220a,225a, 220b,225b,425b and 220c,225c,425c of each feeding module 115a, 115b e115c, respectively.

[0059] The availability of two secondary entrances

225b, 425b and 225c, 425c in one or more feeding modules 115b and 115c, respectively, accordingly increases the versatility of the bookbinding system 400.

[0060] In addition or in alternative, the use of one or more secondary entrances 425c for the manual feeding of the book blocks allows having a buffer of book blocks, which may be supplied to the feeding apparatus 115 in case of stop of one or more sewing machines 110a-110c, 410b for limiting a shortage of feeding of the perfect-binding machine 105.

[0061] In addition or in alternative, a sorting device 455 is coupled with an exit of the perfect-binding machine 105. For example, the sorting device 455 comprises a main belt 460 aligned with the exit of the perfect-binding machine 105 (for example, implemented with a conveyor belt of the books in horizontal). One or more lateral belts, four in the example at issue denoted with the references 465a, 465b, 465c and 465d (for example, each of them implemented with a roller conveyor with idle rollers for supporting the books horizontally), extend transversely to the main belt 460 (to the left in the figure). A diverter 470a, 470b, 470c, and 470d is arranged along the main belt 460 in correspondence to the lateral belt 465a, 465b, 465c and 465d, respectively; each diverter 470a-470d is movable between an inactive position, wherein it allows the passage of the book blocks along the main belt 460, and an active position, wherein it diverts the book blocks towards the lateral belt 465a-465d. A bar code reader 475 (for example, based on a camera) is arranged at the beginning of the main belt 460 (before the diverters 470a-470d).

[0062] The sorter 455 may be used to process books of different type. For this purpose, the control device (of the perfect-binding machine) 145 tracks a current state of the sorter 455 (based on its control thereof as described below); for example, this state is defined by a sorter state table with a location for each lateral belt 465a-465d, each of which contains the identification code of a possible production lot assigned thereto (all initialized to a null value at a power-on of the perfect-binding machine 105).

[0063] Particularly, in case the application of different covers is not required (and thus the control device 145 does not track the current state of the feeding apparatus 115), the barcode reader 475 reads a barcode printed on a top side of each (current) book, or more generally finished book block, which passes under it and communicates it to the control device 145. The control device 145 extracts the identification code of the corresponding production batch from the barcode. If the identification code relates to a new production batch (not comprised in the sorter state table), the control device 145 selects an available one of the lateral belts 465a-465d (for example, the first one whose location in the sorter state table contains the null value) and assigns the production batch thereto (by writing the corresponding identification code into its location of the sorter state table). In any case, the control device 145 controls the sorter 455 to

bring the diverter 470a-470d of the lateral belt 465a-465d assigned to the production batch of the book (as indicated in the sorter state table) into the active position at the passage of this book, so as to divert it towards the lateral belt 465a-465d. In addition, if the book is the last of its production batch, the control device 145 clears its lateral belt 465a-465d by writing the null value into the corresponding location of the sorter state table. Similar considerations apply when the application of different covers is provided; in this case, the control device 145 already knows the identification code of the production batch of each book block which is under finishing in the perfect-binding machine 105 (since it is extracted from the feeding state table for the selection of the corresponding cover), so that the same information may also be used for controlling the sorter 455 (without using the barcode reader 475 or by using it simply to verify the corresponding book).

[0064] 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 disclosure. More specifically, although this disclosure 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. Particularly, different embodiments of the present disclosure may even be practiced 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, it is expressly intended that specific elements and/or method steps described in connection with any embodiment of the present disclosure may be incorporated in any other embodiment as a matter of general design choice. In any case, each numerical value should be read as modified by the term about (unless already done) and each range of numerical values should be intended as expressly specifying any possible number along the *continuum* within the range (comprising its end points). Moreover, 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 and involve (and any forms thereof) 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 any forms thereof) 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.

[0065] For example, an embodiment provides a book-

binding system. However, the bookbinding system may be used in any application (for example, for producing any bookbinding articles such as books, booklets, brochures, albums).

[0066] In an embodiment, the bookbinding system comprises a finishing machine for finishing book blocks in succession. However, the finishing machine may be of any type (for example, a perfect-binding machine, a back-gluing machine, a case-in machine); the finishing machine may finish any book blocks (for example, formed by sewn, glued, loose signatures) in any way (for example, by applying linings, applying endpapers, pressing, milling, applying soft/hard covers or any combination thereof).

[0067] In an embodiment, the bookbinding system comprises a plurality of supplying machines each for supplying part of the book blocks in succession. However, the supplying machines may be in any number and of any type, for supplying semi-finished book blocks of any type (for example, sewing machines, folding machines, gluing machines of the signatures into the book blocks or any combination thereof).

[0068] In an embodiment, the bookbinding system comprises a feeding apparatus for feeding the book blocks in succession from the supplying machines to the finishing machine. However, the feeding apparatus may feed the book blocks in any way (for example, along a straight, curved path).

[0069] In an embodiment, the feeding apparatus comprises one or more feeding modules in sequence. However, the feeding modules may be in any number.

[0070] In an embodiment, each feeding module comprises a conveyor for conveying corresponding book blocks in succession. However, the conveyor may be of any type (for example, based on push pegs, drawers, tape, jaws for conveying the book blocks vertically/horizontally).

[0071] In an embodiment, the conveyor has a plurality of entrances comprising a main entrance and one or more secondary entrances. However, the entrances, and in particular the secondary entrances, may be in any number.

[0072] In an embodiment, the entrances are configured for receiving corresponding book blocks in succession into an input section of the conveyor being common to the entrances. However, the entrances may receive the book blocks in any way (for example, pushed, deposited) in any input section (for example, defined by the push pegs, by a position of the drawers, by a portion of the tape, by the jaws).

[0073] In an embodiment, the conveyor has an exit for providing the corresponding book blocks in succession. However, the exit may provide the book blocks in any way (for example, pushed, picked up).

[0074] In an embodiment, the main entrance of each of the feeding modules different from a first one of the feeding modules is coupled with the exit of a previous one of the feeding modules and the exit of a last one of

the feeding modules is coupled with the finishing machine. However, the feeding modules may be coupled to each other and to the finishing machine in any way (for example, by simply joining them, via a connecting interface for transferring the book blocks).

[0075] In an embodiment, each of supplying machines is coupled with a corresponding one of the secondary entrances. However, the supplying machines may be coupled with the secondary entrances in any way (for example, by means of corresponding connecting belts, directly).

[0076] In an embodiment, the bookbinding system comprises a control device. However, the control device may be of any type (for example, an industrial PC, a PLC or any other computing or data processing system) and implemented in any position (for example, in the finishing machine or stand-alone).

[0077] In an embodiment, the control device is configured for enabling alternately, in each of the feeding modules, one of the entrances and/or the exit. However, at any time it is possible to enable only one entrance, only the exit or an entrance and the exit of each feeding module; moreover, the entrances and the exit may be enabled in any way (for example, by operating the connecting belts for receiving the book blocks automatically at the secondary entrances, by operating the conveyor for providing the book blocks automatically to the exit and/or for receiving them automatically at the main entrance, by performing a specific action for receiving the book blocks at any entrance and for providing them to the exit, such as picking-up/depositing them, clearing their passage).

[0078] In an embodiment, in each of the feeding modules the main entrance is arranged for receiving the corresponding book blocks along a conveying direction of the book blocks by the conveyor. However, the possibility is not excluded of arranging the main entrance in any other way in one or more of the feeding modules (for example, transversely to the conveying direction to make a non-linear conveyor apparatus).

[0079] In an embodiment, the secondary entrances are arranged for receiving the corresponding book blocks transversely to the conveying direction. However, this result may be obtained by arranging the secondary entrances in any way (for example, laterally, above at one or more levels); in any case, the possibility is not excluded of having one of the secondary entrances along the conveying direction.

[0080] In an embodiment, in each of the feeding modules the conveyor comprises at least one buffer section in series to the input section for receiving the corresponding book blocks. However, the buffer sections may be in any number and of any type (either the same or different with respect to the input section); moreover, the buffer sections may be arranged in series with the input section in any way (for example, downstream and/or upstream).

[0081] In an embodiment, the control device is adapted to alternately enable, in each of the feeding modules, the conveyor, the conveyor with the main entrance and/or

the exit, or each of the secondary entrances. However, this result may be obtained in any way (for example, with the conveyor that is operated only when enabled, with the conveyor that is implemented with friction rollers always in rotation allowing the book blocks to pass only when enabled); in any case, different control modes of the feeding modules are possible (for example, by moving the book blocks individually).

[0082] In an embodiment, the feeding modules comprise corresponding motors each for driving the conveyor of the feeding module. However, the motors may be of any type (for example, brushless, stepper).

[0083] In an embodiment, the control device is adapted to control each of the motors individually. However, the individual control of the feeding modules may also be obtained in another way (for example, with one or more shared motors by operating corresponding transmission systems selectively).

[0084] In an embodiment, the control device is adapted to alternately enable, in each of the feeding modules, the entrances according to a round-robin policy. However, the feeding modules may be controlled according to a policy of any type (for example, according to different priorities of the sewing machines, either fixed according to their type or variable according to their production batches).

[0085] In an embodiment, at least one of the feeding modules has a plurality of secondary entrances. However, the feeding modules may have any number of secondary entrances, either the same or different to each other (comprised all one).

[0086] In an embodiment, at least one of the secondary entrances is coupled with a manual loader of the corresponding book blocks. However, the manual loaders may be in any number (comprising zero); moreover, each manual loader may be of any type (for example, a connecting belt, a loading window opened onto the conveyor).

[0087] In an embodiment, the feeding modules are a plurality. However, a basic implementation is not excluded with a single feeding module.

[0088] In an embodiment, at least the last feeding module comprises a thickness sensor for measuring a thickness of each of the book blocks. However, the thickness sensor may be of any type (for example, mechanical, optical) and it may be placed at any position (for example, in any feeding module, from only one to all, in any supplying machine, in the finishing machine or any combination thereof).

[0089] In an embodiment, the thickness sensor is coupled with the control device for providing an indication of the thickness of each of the book blocks. However, the thickness sensor may provide this information to the control device in any way (for example, via wired, wireless communication).

[0090] In an embodiment, the control device is adapted to configure the finishing machine for finishing each of the book blocks according to the thickness thereof. How-

ever, the finishing machine may be controlled in any way according to the thickness of the book blocks (for example, by adjusting its transport channel, the length of the fastening lining); in any case, this information may be provided in any other way, even without any thickness sensor (for example, by setting it manually) or it may be missing at all (for example, when the finishing machine is adjusted manually for a common thickness of the book blocks).

[0091] In an embodiment, the bookbinding system comprises means for providing an indication of a format of each of the book blocks to the control device. However, the format may be defined in any way (for example, width, length and/or thickness); moreover, the means for providing the format may be implemented in any way (for example, with this information that is provided via the control devices of the supplying machines or directly to the control device of the finishing machine) or they may also be missing at all (for example, when the feeding modules are adjusted manually for a common format of the book blocks).

[0092] In an embodiment, for each of the feeding modules the control device is adapted (in correspondence to the enabling of each of the entrances that are going to provide a new one of the corresponding book blocks with the format different from the format of any book blocks present in the feeding module) to clear the feeding module and to adjust the feeding module according to the new format of the book block. However, the feeding module may be adjusted in any way (for example, in width, height); moreover, it is possible to clear and to adjust the feeding module that is going to receive the book block only or all the possible other downstream feeding modules as well. In any case, this feature may also be omitted at all in a simpler implementation wherein only book blocks of the same format may be processed during each series of production batches.

[0093] In an embodiment, the bookbinding system comprises means for providing an indication of a type of cover of each of the book blocks to the control device. However, the means for providing the type of cover may be implemented in any way (for example, with this information that is provided via the control devices of the supplying machines or directly to the control device of the finishing machine) or they may also be missing at all (for example, when the perfect-binding machine is capable of feeding covers of the same type only).

[0094] In an embodiment, the control device is adapted (in correspondence to the enabling of the exit of the last feeding module that is going to provide a current one of the book blocks to the finishing machine) to control the finishing machine to apply a cover of the corresponding type to the current book block. However, the covers may be selected in any way (for example, by means of corresponding hoppers for a single feeder or by means of corresponding feeders); in any case, this feature may be omitted at all in a simpler implementation wherein only book blocks with covers of the same type may be proc-

essed during each series of production batches.

[0095] In an embodiment, the bookbinding system comprises means for providing an indication of a production batch of each of the book blocks to the control device. However, the means for providing the indication of the production batch may be implemented in any way (for example, with this information that is provided via the control devices of the supplying machines or directly to the control device of the finishing machine) or they may also be missing at all (for example, when books all equal to each other are processed during each series of production batches).

[0096] In an embodiment, the book binding system comprises a sorting device coupled with the finishing machine having a plurality of further exits that may be enabled selectively. However, the sorting device may have exits in any number and of any type (for example, lateral belts based on idle rollers, tape, table that extend transversely at one or more sides of a main belt based on idle rollers with push pegs, drawers, with an additional exit aligned with the main belt); moreover, the exits of the sorting device may be enabled in any way (for example, with a diverter, a pusher).

[0097] In an embodiment, the control device is adapted (in correspondence to an output of a finished one of the book blocks that has been finished by the finishing machine) to enable one of the further exits corresponding to the production batch of the finished book block. However, this feature may be omitted at all in a simpler implementation wherein only books of the same type may be processed during each series of production batches, or when the different finished book blocks are sorted manually or at a later time (downstream by other bookbinding machines capable of processing them selectively, for example, by reading corresponding barcodes).

[0098] An embodiment provides a feeding apparatus for feeding book blocks in succession from the supplying machines to the finishing machine of such bookbinding system. The feeding apparatus comprises one or more feeding modules in sequence. Each feeding module comprises a conveyor for conveying corresponding book blocks in succession. The conveyor has a plurality of entrances. The entrances comprise a main entrance and one or more secondary entrances. The entrances are configured for receiving corresponding book blocks in succession into an input section of the conveyor that is common to the entrances. The conveyor has an exit for providing the corresponding book blocks in succession. The main entrance of each of the feeding modules different from a first one of the feeding modules is coupled with the exit of a previous one of the feeding modules and the exit of a last one of the feeding modules may be coupled with the finishing machine. Each of the secondary entrances may be coupled with a corresponding one of the supplying machines. In each of the feeding modules, one of the entrances and/or the exit may be enabled alternately. However, the feeding apparatus may be implemented in different ways (see above); moreover, the

feeding apparatus may also be made and put on the market as a stand-alone product, to be used with pre-existing supplying/finishing machines.

[0099] An embodiment provides a feeding module for use in this feeding apparatus. The feeding module comprises a conveyor for conveying book blocks in succession. The conveyor has a plurality of entrances, comprising a main entrance and one or more secondary entrances. The entrances are configured for receiving corresponding book blocks in succession into an input section of the conveyor that is common to the entrances. The conveyor has an exit for providing the book blocks in succession. The feeding module comprises a motor for driving the conveyor. The main entrance may be coupled with the exit of a previous feeding module. The exit may be coupled with the main entrance of a next feeding module or with the finishing machine. Each of the secondary entrances may be coupled with a corresponding one of the supplying machines. One of the entrances and/or the exit may be enabled alternately. However, the feeding module may be implemented in different ways (see above); moreover, the feeding module may also be made and put on the market as a stand-alone product, to be used in pre-existing feeding apparatuses (to be appended to its feeding modules or to replace one of them).

[0100] Generally, similar considerations apply if the bookbinding system, the feeding apparatus and the feeding module each has a different structure or comprises equivalent components (for example, of different materials) or it has other operative characteristics. In any case, every component thereof may be separated into more elements, or two or more components may be combined together into a single element; moreover, each component may be replicated to support the execution of the corresponding operations in parallel. Moreover, unless specified otherwise, any interaction between different components generally does not need to be continuous, and it may be either direct or indirect through one or more intermediaries.

[0101] An embodiment provides a method of feeding the finishing machine by the supplying machines in the above-described bookbinding system. The method comprises alternately enabling one of the entrances and/or the exit in each of the feeding modules.

[0102] Generally, similar considerations apply if the same solution is implemented with an equivalent method (by using similar steps with the same functions of more steps or portions thereof, removing some non-essential steps or adding further optional steps); moreover, the steps may be performed in a different order, concurrently or in an interleaved way (at least in part).

[0103] An embodiment provides a software program configured for causing the control device of the bookbinding system here above to perform this method when the software program is executed on the control device. An embodiment provides a software program product comprising a computer readable storage medium embodying a software program, the software program being

loadable into a working memory of the control device of the bookbinding system thereby configuring the control device to perform the same method. However, the software program may be implemented as a stand-alone module, as a plug-in for a pre-existing software program (for example, a control program of the finishing machine), or even directly in the latter for running on any control device (see above). In any case, the program may take any form (for example, external or resident software, firmware, or microcode) and it may be provided on any tangible (storage) medium, and it may be downloaded to the control device from this medium or via a communication network. In any case, the solution according to an embodiment of the present disclosure lends itself to be implemented even with a hardware structure (for example, by electronic circuits integrated in one or more chips of semiconductor material), or with a combination of software and hardware suitably programmed or otherwise configured.

Claims

1. A bookbinding system (100;400) comprising a finishing machine (105) for finishing book blocks in succession, a plurality of supplying machines (110a-110c,410b) each for supplying part of the book blocks in succession, a feeding apparatus (115) for feeding the book blocks in succession from the supplying machines (110a-110c,410b) to the finishing machine (105), wherein the feeding apparatus (115) comprises one or more feeding modules (115a-115c) in sequence each comprising a conveyor (205a-205c) for conveying corresponding book blocks in succession having a plurality of entrances (220a-220c,225a-225c,425b-425c), comprising a main entrance (220a-220c) and one or more secondary entrances (225a-225c,425c-425b), for receiving corresponding book blocks in succession into an input section (210a-210c) of the conveyor (205a-205c) being common to the entrances (220a-220c,225a-225c, 425b-425c) and an exit (230a-230c) for providing the corresponding book blocks in succession, the main entrance (220b-220c) of each of the feeding modules (115b-115c) different from a first one (115a) of the feeding modules (115a-115c) being coupled with the exit (230a-230b) of a previous one (115a-115b) of the feeding modules (115-115c), the exit (230c) of a last one (115c) of the feeding modules (115c-115c) being coupled with the finishing machine (115) and each of the supplying machines (110a-110c,410b) being coupled with a corresponding one of the secondary entrances (225a-225c,425b), and wherein the bookbinding system (100;400) comprises a control device (145) for enabling alternately, in each of the feeding modules (115a-115c), one of the entrances (220a-220c,225a-225c,425b-425c) and/or the exit (230a-230c).
2. The bookbinding system (100;400) according to claim 1, wherein in each of the feeding modules (115a-115c) the main entrance (220a-220c) is arranged for receiving the corresponding book blocks along a conveying direction of the book blocks by the conveyor (205a-205c) and the secondary entrances (225a-225c, 425b-425c) are arranged for receiving the corresponding book blocks transversely to the conveying direction.
3. The bookbinding system (100;400) according to claim 1 or 2, wherein in each of the feeding modules (115a-115c) the conveyor (205a-205c) comprises at least one buffer section (215a-215c) in series to the input section (210a-210c).
4. The bookbinding system (100;400) according to claim 3, wherein the control device (145) is adapted to alternately enable, in each of the feeding modules (230b-230c), the conveyor (205a-205c), the conveyor (205a-205c) with the main entrance (220a-220c) and/or the exit (230a-230c), or each of the secondary entrances (225a-225c,425b-425c).
5. The bookbinding system (100;400) according to claim 4, wherein the feeding modules (115a-115c) comprise corresponding motors each for driving the conveyor (205a-205c) of the feeding module (115a-115c), the control device (145) being adapted to control each of the motors individually.
6. The bookbinding system (100;400) according to any claim from 1 to 5, wherein the control device (145) is adapted to alternately enable, in each of the feeding modules (115a,115c), the entrances (220a-220c,225a-225c,425c-425b) according to a round-robin policy.
7. The bookbinding system (400) according to any claim from 1 to 6, wherein at least one of the feeding modules (115b; 115c) has a plurality of secondary entrances (225b,425b;225c,425c).
8. The bookbinding system (100;400) according to any claim from 1 to 7, wherein at least one of the secondary entrances (425c) is coupled with a manual loader (420c) of the corresponding book blocks.
9. The bookbinding system (100;400) according to any claim from 1 to 8, wherein the feeding modules (115a-115c) are a plurality.
10. The bookbinding system (100;400) according to any claim from 1 to 9, wherein at least the last feeding module (115c) comprises a thickness sensor (325) for measuring a thickness of each of the book blocks,

the thickness sensor (325) being coupled with the control device (145) for providing an indication of the thickness of each of the book blocks, and wherein the control device (145) is adapted to configure the finishing machine (105) for finishing each of the book blocks according to the thickness thereof.

11. The bookbinding system (100;400) according to any claim from 1 to 10, wherein the bookbinding system (100;400) comprises means (150a-150c,450b) for providing an indication of a format of each of the book blocks to the control device (145), for each of the feeding modules (115a-115c) the control device (145) being adapted, in correspondence to the enabling of each of the entrances (220a-220c,225a-225c,425b-425c) being going to provide a new one of the corresponding book blocks with the format different from the format of any book blocks present in the feeding module (115a-115c), to clear the feeding module (115a-115c) and to adjust the feeding module (115a-115c) according to the new format of the book block.

12. The bookbinding system (100;400) according to any claim from 1 to 11, wherein the bookbinding system (100;400) comprises means (150a-150c,450b) for providing an indication of a type of cover of each of the book blocks to the control device (145), the control device (145) being adapted, in correspondence to the enabling of the exit (230a) of the last feeding module (11a) that is going to provide a current one of book blocks to the finishing machine (105), to control the finishing machine (105) to apply a cover of the corresponding type to the current book block.

13. The book binding system (100;400) according to any claim from 1 to 12, wherein the bookbinding system (100;400) comprises means (150a-150c,450b) for providing an indication of a production batch of each of the book blocks to the control device (145) and a sorting device (455) coupled with the finishing machine (105) having a plurality of further exits (465a-465d) that may be enabled selectively, the control device (145) being adapted, in correspondence to an output of a finished one of the book blocks that has been finished by the finishing machine (105), to enable one of the further exits (465a-465d) corresponding to the production batch of the finished book block.

14. A feeding apparatus (115) for feeding book blocks in succession from the supplying machines (110a-110c,410b) to the finishing machine (105) of the bookbinding system (100;400) according to any claim from 1 to 13, wherein the feeding apparatus (115) comprises one or more feeding modules (115a-115c) in sequence each comprising a conveyor (205a-205c) for conveying corresponding book

blocks in succession having a plurality of entrances (220a-220c,225a-225c,425b-425c), comprising a main entrance (220a-220c) and one or more secondary entrances (225a-225c,425c-425b), for receiving corresponding book blocks in succession into an input section (210a-210c) of the conveyor (205a-205c) being common to the entrances (220a-220c,225a-225c, 425b-425c) and an exit (230a-230c) for providing the corresponding book blocks in succession, the main entrance (220b-220c) of each of the feeding modules (115b-115c) different from a first one (115a) of the feeding modules (115a-115c) being coupled with the exit (230a-230b) of a previous one (115a-115b) of the feeding modules (115-115c), the exit (230c) of a last one (115c) of the feeding modules (115c-115c) being couplable with the finishing machine (115) and each of the secondary entrances (225a-225c,425b) being couplable with a corresponding one of the supplying machines (110a-110c,410b), in each of the feeding modules (115a-115c) one of the entrances (220a-220c,225a-225c,425b-425c) and/or the exit (230a- 230c) being enableable alternately.

15. A feeding module (115a-115c) for use in the feeding apparatus (115) according to claim 14, wherein the feeding module (115a-115c) comprises a conveyor (205a-205c) for conveying book blocks in succession having a plurality of entrances (220a-220c,225a-225c,425b-425c), comprising a main entrance (220a-220c) and one or more secondary entrances (225a-225c,425c-425b), for receiving corresponding book blocks in succession into an input section (210a-210c) of the conveyor (205a-205c) being common to the entrances (220a-220c,225a-225c, 425b-425c) and an exit (230a-230c) for providing the book blocks in succession, and a motor for driving the conveyor (205a-205c), the main entrance (220b-220c) being couplable with the exit (230a-230b) of a previous feeding module (115a,115b), the exit (230a-230c) being couplable with the main entrance (220b-220c) of a next feeding module (115b-115c) or with the finishing machine (115) and each of the secondary entrances (225a-225c,425b) being couplable with a corresponding one of the supplying machines (110a-110c,410b), one of the entrances (220a-220c,225a-225c,425b-425c) and/or the exit (230a- 230c) being enableable alternately.

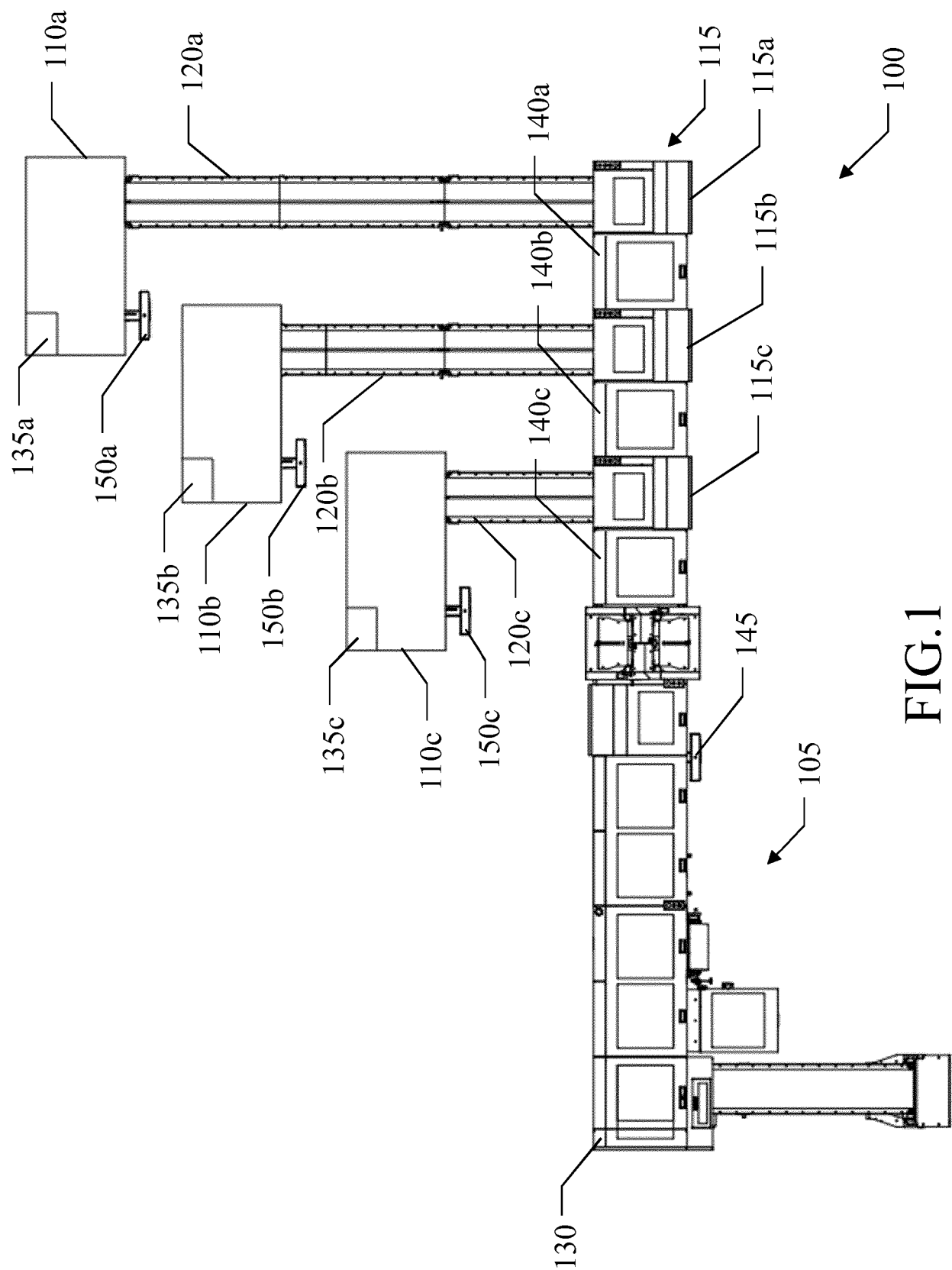


FIG.1

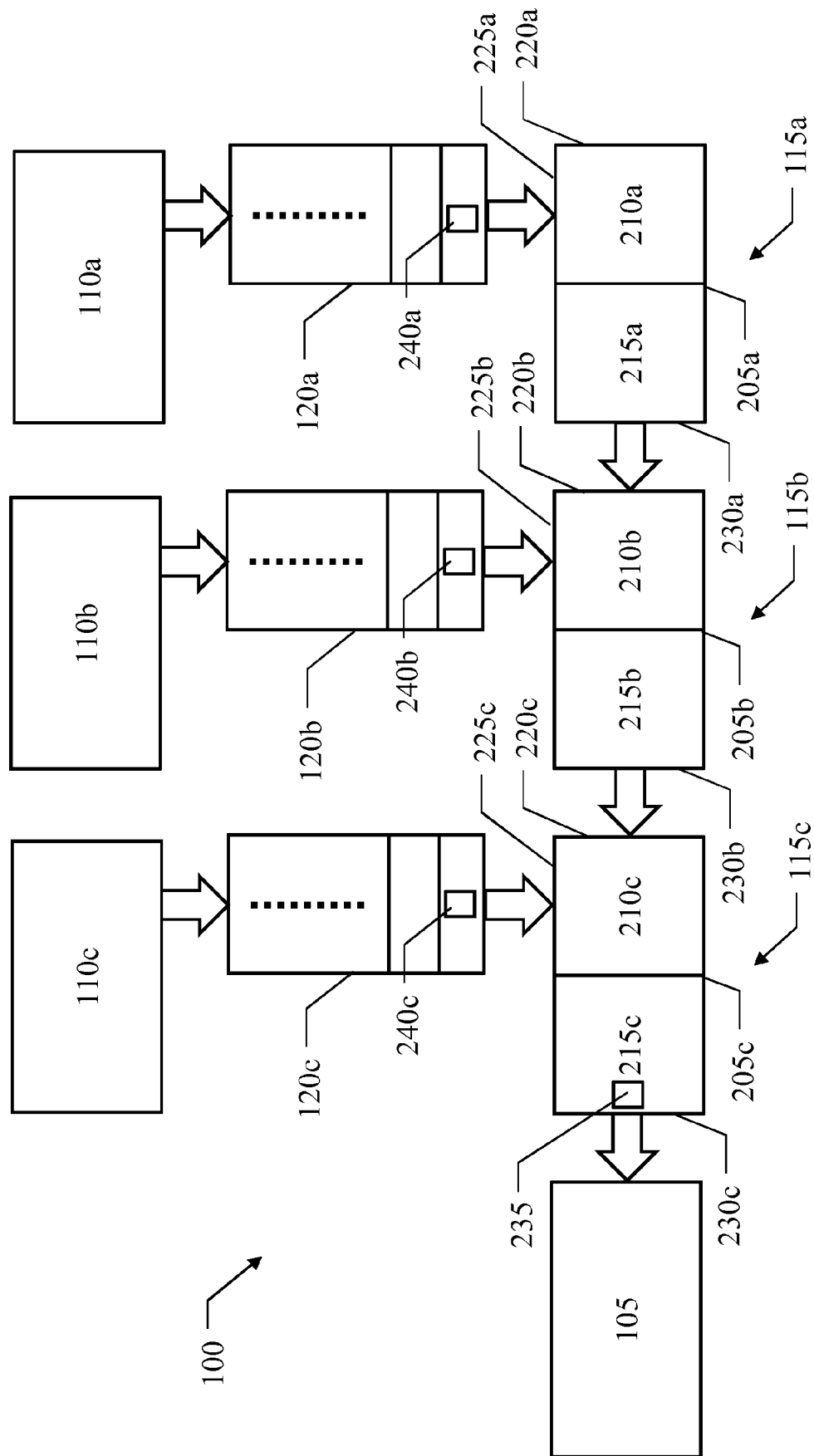


FIG.2

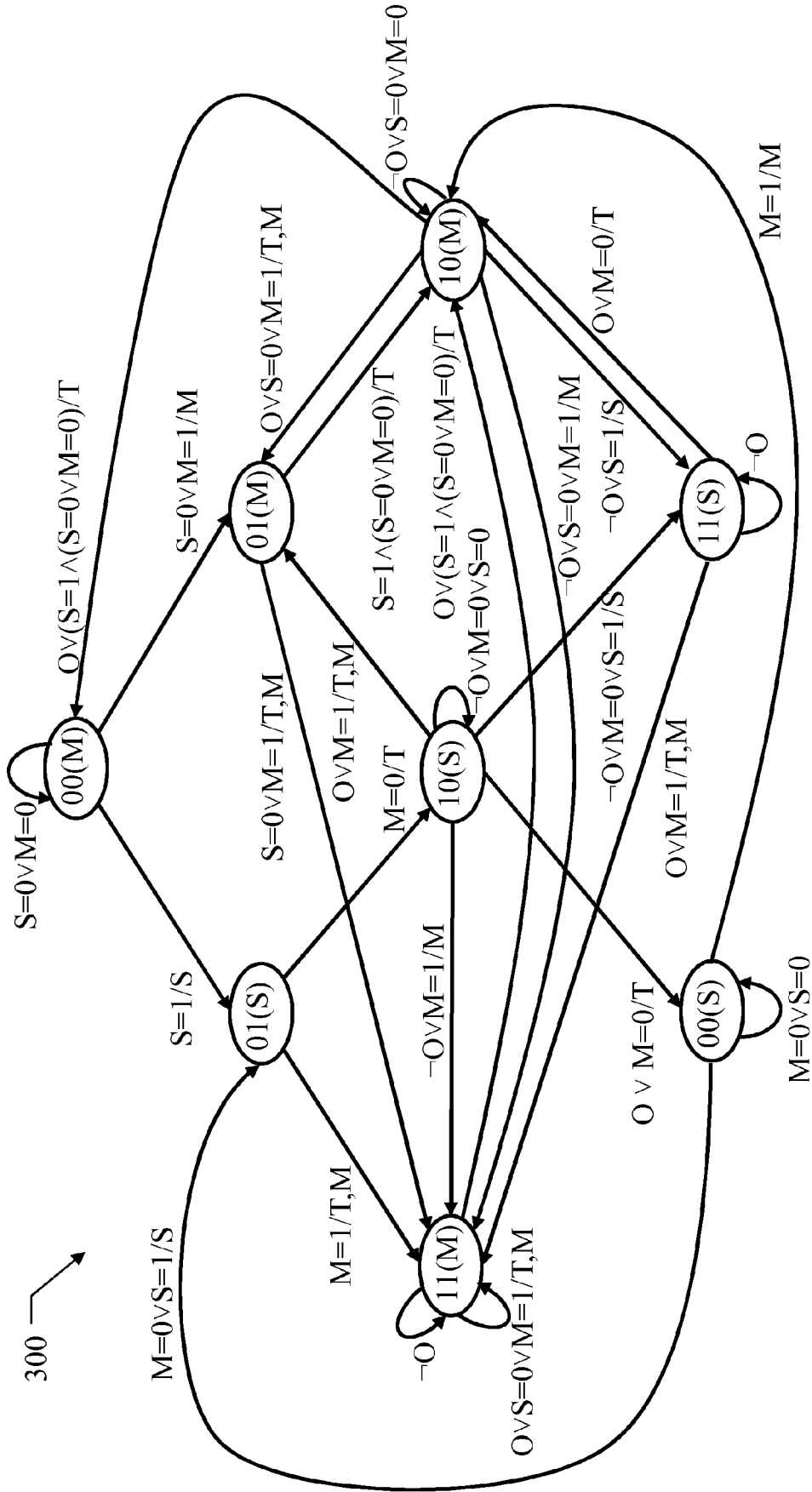
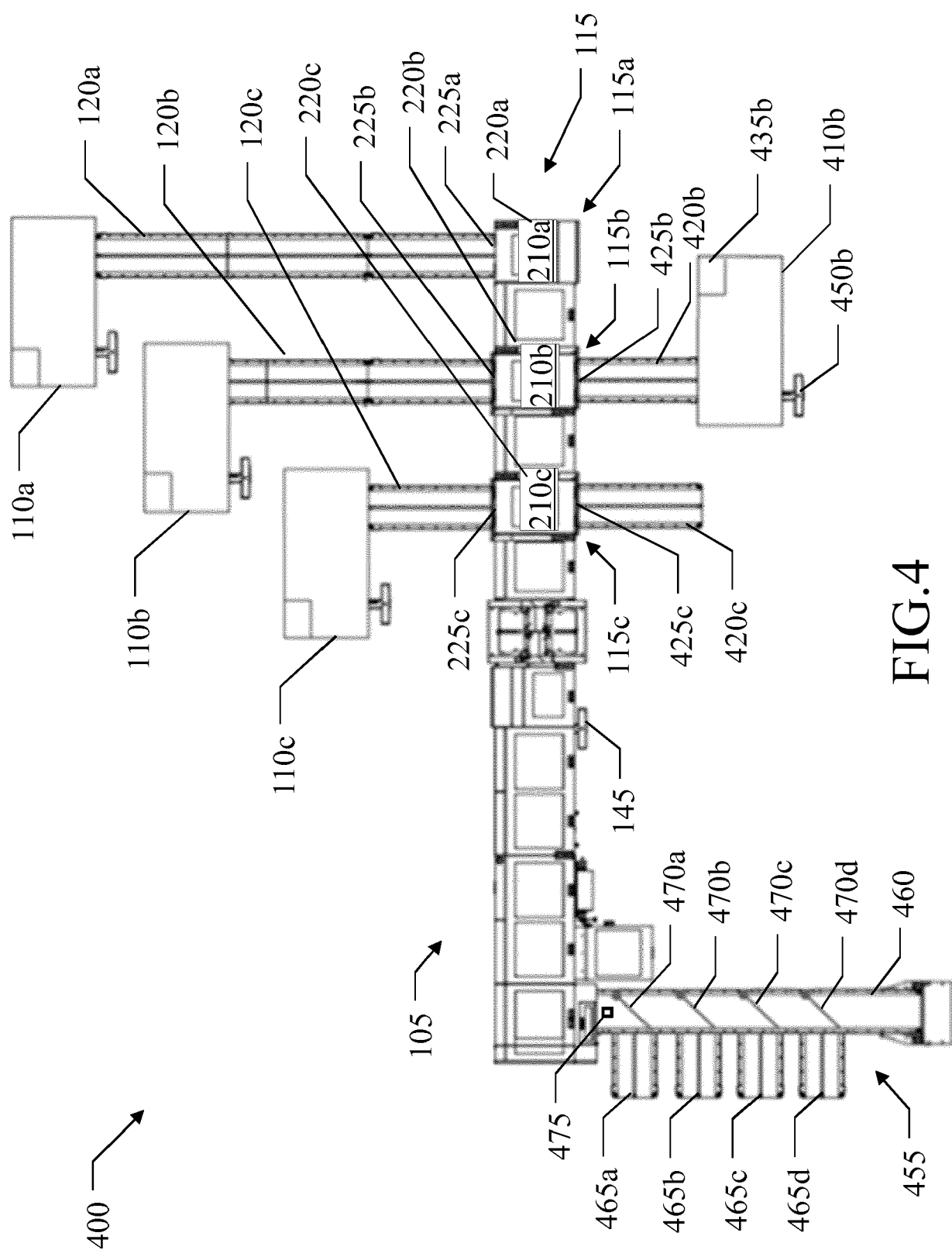


FIG.3





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