(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 266 814 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.12.2010 Bulletin 2010/52

(21) Application number: **10167101.4**

(22) Date of filing: **23.06.2010**

(51) Int Cl.:
B42C 19/00 *(2006.01)* ***B42C 7/00*** *(2006.01)*
B65H 31/30 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
BA ME RS

(30) Priority: **23.06.2009 IT TO20090478**

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(54) **System for manufacturing books on demand**

(57) A system (22) for manufacturing books on demand, comprising a cover forming equipment (39) for forming pre-shaped covers (32) from respective cover sheets (31) and a binding machine (31) for gluing a rib of a book block (36p, 36l) with a spine of a pre-shaped cover (32), and in which the binding machine receives the pre-shaped covers from a cover input "IC" in a predefined pre-assembling configuration and feeding along an assembling direction, parallel to the spine. The cover forming equipment further comprises a feeding mechanism (46) for moving the cover sheets (31) along a direction of shaping (FD) transversal to the direction of the spine of the cover. A cover trimming mechanism (49) and a marking mechanism (48a, 48b) execute a trimming and markings on the cover sheets transversally to the direction of shaping, while a diverting station (99) arranges the pre-shaped cover (32) in a position associated to the pre-assembling configuration.

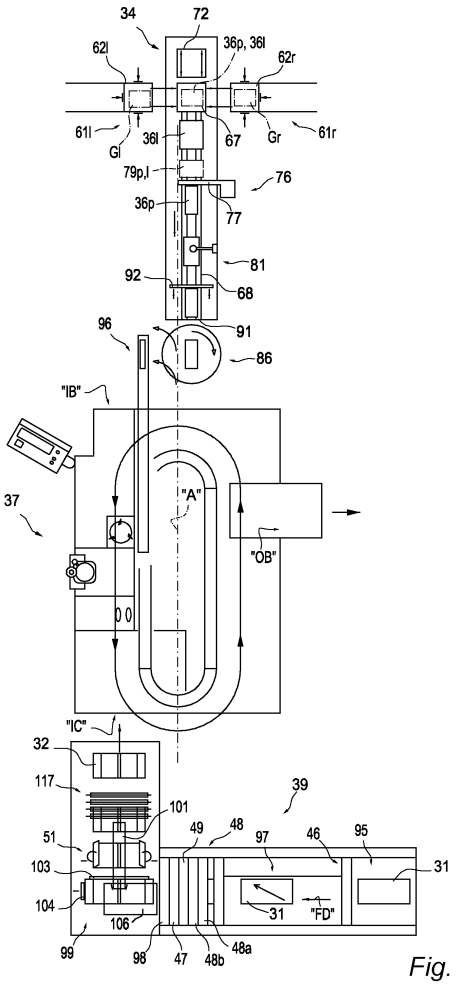


Fig. 4

EP 2 266 814 A2

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a system for manufacturing books on demand.

[0002] More specifically, the invention relates to a system for manufacturing books on demand according to the introductory portions of the main claim.

BACKGROUND OF THE INVENTION

[0003] Typically, a book comprises a plurality of sheets with pages of text stacked one upon the other and which constitute a book block, and a cover overlaying the first sheet, the last sheet and the rib of the book block. The pages are generally printed in black and white, whereas the cover is typically printed in color and on paper which may be thicker and of higher quality. Between the sheets with the pages of text, there can be interposed, as inserts, sheets with illustrations, also with paper of different quality. In non-bound or *brossure* books, the assembling of the book blocks with the respective covers is effected by automatic binders set for the mass gluing the ribs of the book blocks with the backs of the spines of the covers.

[0004] For reasons for economy and velocity, books are generally mass produced by offset printing, but it has as a result that, for each title, the publishing industry must print a large number of copies, hundreds, but more commonly, thousands. The produced books are supplied to the distributors and from these to the bookstores. Apart the discards of processing, the printing house produces not only the required number of components, but also excess components. Consequently, at least a part of the production go to waste. Moreover, since the demand for a book is very hard to estimate, large number of books go to waste when they are not sold. It has the effects to increase the intrinsic cost of the book and makes not economically convenient the industrial production of books with limited circulation and the reprint of books of exhausted editions and limited demand.

[0005] In recent years, with progress in the techniques of laser printing or ink jet and the use of binders with flexible setting, the printing of books has been rendered possible "on demand", allowing the production, with limited costs, of books in very limited quantity. The productions "on demand" they have nevertheless limits in the typology of the printable books, are relatively slow and require a significant use of manpower. In fact, so far book blocks and covers are produced separately and manually inserted into a binder for binding. Therefore the cost of production of the single copies results very greater with respect to the cost of copies obtained by productions of traditional type.

SUMMARY OF THE INVENTION

[0006] An object of the invention is to provide a system for manufacturing books on demand having costs similar to the one of the productions of mass either for large quantities of identical books, or for orders from clients regarding limited quantity of books having different title and format to be set up on the basis of the demand.

[0007] According to this object, the system for manufacturing of books on demand comprises at least a block book input and forming equipment, a cover forming equipment for forming pre-shaped covers from respective cover sheets and a binding machine for gluing a rib of the book block with a spine of a pre-shaped cover, and in which the binding machine receives the pre-shaped covers from a cover input in a pre-defined pre-assembling configuration and feeding along an assembling direction, parallel to the spine. The cover forming equipment further comprises a feeding mechanism for entering and moving the cover sheets along a direction of shaping transversal to the direction of the spine of the cover to be accomplished, a cover trimming mechanism, actuatable for executing the trimming of the cover sheets to define an edge of the pre-shaped cover transversally to the direction of shaping and a marking mechanism, actuatable for executing bending markings on the cover sheets for the spine of the cover transversally to the direction of shaping, according to the characterizing portion of the main claims.

[0008] This structure allows a high productive flexibility with minimum need of manpower and using of commercial binding machines.

[0009] The characteristics of the invention will become clear from the following description given purely by way of non-limiting example, with reference to the appended drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 represents a schematic plan view of a system for manufacturing books on demand according to the invention;

Fig. 2 shows, in enlarged scale, a partial schematic view in plant of some components of the system for manufacturing books of Fg. 1;

Figs. 3a-3l schematically show different operative conditions of some details of the components of Fig. 2;

Fig. 4 shows, on an enlarged scale, a partial schematic view in plant of components of the system represented in Fig. 1;

Figs. 5a-5d show schematically different operative conditions of some details of the components of Fig. 4;

Fig. 6 represents, on an enlarged scale, a partial schematic view in plant of other components of the system represented in Fig. 1;

Figs. 7a and 7b are schematic views of covers of a book in course of manufacturing by the system of

Fig. 1;
Fig. 8 represents schematically different operative conditions of one of the components of Fig. 6;
Fig. 9 is a partial schematic front view of some components of Fig. 6;
Fig. 10 is a partial schematic lateral view of some components of Fig. 6;
Figs. 11 and 12 show diagrams representative of different formats of books manufactured by the system according to the invention;
Fig. 13 shows some details of pages for formats of books of the Figs. 11 and 12;
Figs. 14 and 15 represent diagrams of pages in course of manufacturing by the system of the invention; and
Figs. 16 and 17 represent diagrams of covers in course of manufacturing..

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] With reference to the figures 1-4, is represented with 22 a system for manufacturing books on demand. The system 22 manufactures books 23 formed with book sheets 24 stacked one upon the other and covers 26 and uses a pair of spools 27r and 271 of paper strips 28r and 281 for the book sheets and the cover sheets 31 for the respective covers. The pairs of pages which form the sheets 24 are printed on the opposite faces of the paper strips 28r and 281 and are separated as basic sheets 29r and 291. The covers 26 are printed on cover sheets 31 or, in alternative, on respective sections of a paper cover strip unwinding from a spool not shown in the figures. The covers of the manufactured book can be provided of one or two flaps or devoid of flaps and are directly derived from basic pre-shaped covers 32, which are separated by cutting and trimming from the cover sheets 31 or the respective sections of the cover strip.

[0012] In extreme synthesis, the system 22 includes two sheet input and forming equipments 33r and 331 for separating and stacking the basic sheets 29r and 291, a collecting device 34 for forming a book block in vertical format (portrait) 36p, or in horizontal format (landscape) 361, a bookbinding machine or binder 37 for binding and gluing the book block 36p, 361 with the pre-shaped cover 32, an interconnecting group 38 between the collecting device 34 and the binder 37, a cover pre-forming equipment 39 for forming the pre-shaped covers 32, finishing equipments 41 and an electronic control equipment 42.

[0013] The binder 37 includes a series of pneumatic clamps, mounted on an elliptic chain, in which the book blocks 36p, 361 to be bound are inserted and which transports the book blocks for the whole sequence of binding. In sequence, a vibrating surface lines up the basic sheets, a miller, shown not, grinds ribs 43 of the book blocks, while rollers and blades smear the glue on the ribs 43. In a known manner, a cover feeder positions each pre-shaped cover 32 in registering with the rib 43, while a cover press and a folding device cause the back of a spine 44 of the pre-shaped cover to be forced against the rib and adjacent edges of the block book, and an output mechanism provides to the output of the glued books.

[0014] In a plan view, the binder 37 is extended longitudinally according to an axis "A". The system 22 has a "T" like arrangement of the sheet input and forming equipments 33r and 331 and the interconnecting group 38, with respect to the axis "A" of the binder 37. The cover pre-forming equipment 39 has an "L" like arrangement, while the finishing equipments are arranged in correspondence of an output of the binder 37, transversally to the axis "A"

[0015] The binder 37, of commercial type, is, for instance, as described in PCT Patent Application WO 01/85466. As for the present invention, the binder 37 requires that the book block 36p, 361 is positioned at a sheet input "IB" with a pre-assembling configuration having the faces parallel to the axis "A" and the rib 43 arranged downwardly with horizontal asset. In turn, the pre-shaped covers 32 must be positioned at a cover input "IC" with a pre-assembling configuration having the face horizontal and the spine 44 parallel to the axis "A", while the book block and the cover approach each the other for the assembling parallel to the axis "A".

[0016] The cover sheets 31 define a front edge "FE", reference edge "RE" and an end edge "EE" associated, respectively, to the top edge and a lateral end edge of flapped or un-flapped pre-shaped covers. The cover pre-forming equipment 39 comprises a feeding mechanism 46 for the cover sheets 31, a trimming mechanism 47 for trimming, in the cover sheet, a reference lateral edge "LE" of the flapped or un-flapped pre-shaped covers, opposite to the end edge "EE", a marking mechanism 48 for executing on the pre-shaped cover markings for the spine 44, easy opening of the cover and possible flaps and a cutting mechanism 49 for cutting an edge "OE" associated with the bottom edge of the pre-shaped cover, opposite to the reference edge "RE". Further, the equipment 39 comprises a flap folding mechanism 51 actuatable for folding, by overlapping, a possible front flap 52a, and/or a back flap 52b of the pre-shaped covers 32 and forming a flap or flaps of the cover. Specifically, the finishing equipments 41 comprise a drying group 53, a trilateral cutting equipment 54 and a flap opening and book cutting equipment 56.

[0017] The drying group 53, has a tower conveyor of spiral shape: it receives the books assembled by the binder 37 and provides to the drying of the glued areas; the trilateral cutting equipment 54 is actuatable for executing the finish trimming on the upper, lower and frontal edges of the books devoid of cover flaps, or the sole finish trimming on the upper and lower edges of the books with flapped cover. Suitably, the flap opening and book cutting equipment 56 is actuatable for opening the flapped covers with and executing the trimming on the side of the book opposite to the spine. The drying group 53, the tri-

lateral cutting equipment 54 and the flap opening and book cutting equipment 56 are of commercial type and the description is herein omitted. Nevertheless, some components of interface and of control are modified for being in agreement with the other components of the system 22 and the respective manufacturing method.

[0018] According to the invention, each of the input and forming equipments 33r and 33l includes, respectively: an unwinding device or unwinder 57l, 57r for the spool 27r, 27l, a longitudinal cutting and overlying device or "merger" 58l, 58r and a double cutter 59r, 59l for separating the basic sheets 29r and 29l from the strip 28r, 28l. The equipments 33r, 33l, further includes a group forming mechanism 61 r, 61l having an area of stacking 62r, 62l for the basic sheets 29r and 29l and output toward the collecting device 34 and in which the areas of stacking 62r and 62l are arranged at the right and the left of the axis "A".

[0019] The unwinding device 571, 57r unwinds the spool 27r, 271, while the merger 58r, 581 provides to longitudinally cut in half the strip 28r and 281 and preset the overly of the longitudinal sections of the strip 28r and 281 according to the "two-up" technique with constant mean feed velocity, servoized to information from the other equipments of the system. The merger 58r, 581 receives the strip 28r and 281 from the unwinding device 571, 57r through a loop 63r, 631, while the double cutter 59r, 591 receives the strip 28r and 281 from the merger 58r, 581 through a loop 64r, 641.

[0020] The double cutter 59r, 591 executes transversal cuts f on the strips 28r and 281 or the separation of the basic sheets 29r and 291 and moves the sheets along directions Fr and Fl of input for the of group forming mechanisms 61 r, 61l. Here, the basic sheets 29r and 291 are received and stacked on the area of stacking 62r, 621 forming a respective group of basic sheets Gr, Gl as component of the book block 36p, 361. The collecting device 34 has a receipting area 67 for receiving the groups Gr, Gl whereby forming the book block 36p, 361, while the interconnecting group 38 includes a conveyor belt 68.

[0021] The unwinding device 571, 57r, the merger 58r, 581 and the double cutter 59r, 591 are of commercial type and their description is herein omitted.

[0022] Optionally, a longitudinally rotating mechanism, not shown in the figures, can be inserted between the loop 63r, 631 and the double cutter 59r, 591, for longitudinally rotating of 180° one of the two longitudinal sections of the strip 28r and 281. Thus, the basic sheets emerging from the cutter will have a longitudinal bending, by pairs, congruent and opposite with respect to the bending of the strip in the spool of origin 27r, 271. It to the end of preventing that the groups Gr, Gl can have a given bending to be transferred to the manufactured book.

[0023] The sheet input and forming equipments 33r and 331 also include respective input pushers 71 r, 71l actuatable for pushing the first sheet group Gr and the second sheet group Gl from the respective areas of stacking 62r, 621 toward the receipting area 67 or on a sheet group Gl or Gr already stacked on the receipting area.

[0024] In particular, the conveyor belt 68 is parallel to the axis "A" of the binder, while the receipting area 67 is defined by an initial section of the conveyor belt: The collecting device 34 includes a platform 72 arranged above the receipting area 67, between the areas of stacking 62r, 621, for receiving temporarily the sheet group Gr and the sheet group Gl. The platform 72 is quickly shiftable parallel to the axis of the conveyor belt for leaving the sheet group Gr or Gl to fall on the underlying receipting area, as represented in the sequences of the Figs. 3c, Fig. 3l, without substantial lateral shifting.

[0025] The group forming mechanism 61 r, 61l comprises an arresting shovel 73r, 731 with lower edge tangent to the area of stacking 62r, 621 and having possibility of horizontal shifting along the directions Fr and Fl and of vertical shifting with respect to the area of stacking by means of corresponding, not shown, actuators. The arresting shovel 73r, 731, in a depressed position, is adapted to hold back the sheet group Gr, Gl during the stacking on the area of stacking 62r, 621 while, in the lifted position, allows the input pushers 71 r, 71l to shift the sheet group Gr, Gl from the area 62r, 621 to the platform 72. The group forming mechanism 61 r, 61l also comprises a lateral vibrating leveller, shown only schematically in the drawings.

[0026] The collecting device 34 also comprises an arresting wall 74 with lower edge tangent to the platform 72, which is actuatable for being shifted along the directions Fr and Fl from a central position to a position "LP" of left margin and a position "RP" of right margin of the platform 72 (Figs. 3b and 3d) for allowing the exact positioning of the sheet group Gr, Gl on the same platform 72.

[0027] As represented in the Figs. 3a-3l, the basic sheets 29r, 291, progressively separated from the double cutter 59r, 591, are stacked on the area 62r, 621, arrested by the shovel 73r, 731 in the depressed position, and form the group Gr, Gl, which is levelled. Thereafter, after lifting of the shovel 73r, 731 and shifting of the arresting wall 74 on the position "LP", "RP", the input pusher 71 r, 71l shifts the group Gr, Gl on the platform 72 in a centered position. Now, the platform 72 is quickly moved, allowing the group Gr, Gl to fall on the receipting area 67 constituted by the initial portion of the conveyor belt 68.

[0028] The two sheet input and forming equipments 33r and 331 can receive and pre-form the group Gr, Gl of basic sheets as component of the book block 36p, 361, with function of buffer and independently of one another, with "merge" or "tandem" processing. The input pushers 71 r, 71l can shift, respectively, a first sheet group Gr, Gl from one of the equipments 33r, 331 and/or a second sheet group Gl, Gr from the other equipment 331, 33r to the collecting device 34 for the formation of the book block 36p, 361. The conveyor belt 68 can remove the book block 36p, 361 from the collecting device functionally to the transfer of the book block to the binder 37. Moreover,

while an equipment of input 33r, 331 forms a group Gr, Gl, the other equipment 331, 33r shifts the group Gl, Gr to the collecting device 34, with possible transfer of the book block 36p, 361 to the binder 37.

[0029] In the "merge" processing, the second sheet group Gl represents an insert of the first sheet group Gr and the input pusher 71l of the equipment of input 331 shifts the second group Gl to the collecting device 34 as insert to the first sheet group Gr. After the insertion of the group Gl, the equipment of input 33r can shift another group of sheet group Gr to the collecting device 34 above the group Gl and so on, up to the complete forming of the book block 36p, 361 for the requested book 23.

[0030] In the "tandem" processing, the input pusher 71 r of the equipment 33r shifts the first sheet group Gr to the collecting device 34 for forming a first book block 36p, 361 only with the first sheet group Gr for a first required book 23', while the input pusher 71l of the equipment 331, after the removal of the first book block 36p, 361, shifts the second sheet group Gl to the collecting device 34 for forming a second book block 36p, 361 for a second requested book 23.

[0031] Therefore, this structure of the system 22 allows the possibility of using different qualities of printing and supports for the sheets of the pages of text and for the inserts: moreover, the system 22 substantially doubles the productivity in the case in which the sheet groups Gr and Gl represent the only component of the book block 36p, 361.

[0032] Along the conveyor belt 68 is arranged an inserting device 76 (Fig. 4), including a liftable arm 77 with a stop wall 78. This inserting device is provided for allowing the manual positioning of a book block "portrait" 79p, or "landscape" 791 on the conveyor belt upstream from the arm 77; in the case of assembling independent from the equipments 33r and 331. The stop wall of the arm 77 is liftable on request to release the book block 79p, 791, with the start of the conveyor belt 68 from an exact reference position, as defined by the stop wall, for a controlled transferring of the manually inserted book block to the binder 37.

[0033] Downstream from the inserting device 76, a thickness measurement device 81 of the book block 36p, 361 or 79p, 791 is provided. The measurement device 81 comprises, for instance, a probe 82, which can be depressed to bear on the book block laying on the conveyor belt 68 and a respective transducer for supplying corresponding information of thickness "TI". This information is used by the cover pre-forming equipment 39 and the binder 37 for executing with precision the pre formation of the spine 44 of the cover 32 and the assembling of the cover with the book block 36p, 361 or 79p, 791. Conveniently a sensor, not shown, supplies a control signal to the electronic control equipment 42 for arresting the conveyor belt when the presence of the block underneath the probe 82 has been revealed.

[0034] A manipulating device or rotator 86 is mounted between the conveyor belt 68 and the binder 37. This rotator is actuatable for arranging the book block 36p, 361 or 79p, 791 in a reference position and with a predefined orientation for the pre-assembling configuration. In detail, the rotator 86 (Figs. 5° and 5d) comprises a surface of support 87 for the book block 36p, 361 or 79p, 791 at the output of the conveyor belt 68, a pushing member 88 and a common support 89 for the surface of support 87 and for the pushing member 88. The conveyor belt presents a terminal portion 91, while a transferring pusher 92 (see Fig. 4) is provided, which is normally arranged above the terminal portion, and is actuatable to be lowered and pushing the book block up to the surface 87.

[0035] The pushing member 88 is provided for being shifted between an acceptance or release position for the book block 36p, 361 or 79p, 791 and a taken position in which it presses the book block against the surface of support 87. The common support 89 is provided for a transfer rotation around an axis 93 parallel to the conveyor belt 68 between a rest position and a transfer position.

[0036] In the rest position of the support 89 (see Fig. 5b), the surface of support 87 is adjacent and substantially coplanar with respect to the conveyor belt 68, while, in the trasfer position of the support 89 (see. Fig. 5c), the surface of support is perpendicular to the surface of the conveyor belt 68. The support 89 is also designed for an orientation rotation around an axis 94 parallel to a transversal shaft of the conveyor belt 68. It for rotating the book block 36p, 361 or 79p, 791, with positioning of an edge opposite to the trailing edge arranged according to the reference orientation required by the binder (see Fig. 5c). Thus, through the rotations around the axis 93 and eventually around the axis 94, the support 89 positions the rib 43 of the book block downwardly and with orientation parallel to the axis "A" of the binder 37, as requested for the perfect binding.

[0037] Moreover, jointly to the position of release of the pushing member 88, movement pliers carried by catenary, not shown, are provided for engaging the book block 36p, 361 or 79p, 791 in an area of the book block opposite to the rib 43 for transferring the book block on the input "IB" of the binder 37 in the provided pre-assembling configuration.

[0038] As above summarized, for gluing the back of the spines 44 of the pre-shaped covers 32 with the respective ribs 43 of the book blocks, the bookbinding machine or binder 37 provides the feeding of the covers 32 along a direction of assembling parallel to the spines 44, along the axis "A".

[0039] For the use of cover sheets 31, the cover preforming equipment 39 (Figs. 6, 9 and 10) comprises a store 95 for the cover sheets, and an equalizing device 97. The feeding mechanism 46 causes the cover sheets to singularly advance from the store 95 to the equalizing device 97. For instance, the feeding mechanism 46 includes motorized suckers "Sc", first motor rollers 96a, and further motor rollers 96b. The suckers "Sc" take sin-

gularly the cover sheets 31 from the store 95 for the engagement with the first motor rollers 96a toward the equalizing device 97. The equalizing device 97 is actuatable for aligning the reference edge (RE) and the lateral front edge (FE) of each cover sheet 31 s with an alignment member 97a and the further motor rollers 96b for a given positioning of the cover sheet 31 of starting for the following operations of marking, trimming and cutting. After the alignment, the feeding mechanism 46, by means of the further motor rollers 96b, causes the cover sheets 31 to singularly advance from the device 97 along a direction of formation "FD" for the pre-shaped covers transversal to the direction of the spine to be executed for the following operations of marking, trimming and cutting.

[0040] In the case of covers 26 obtained from a paper cover strip, the respective sections for the cover sheets are separated from the strip and transferred to the further motor rollers 96b for the following processing, also along the direction of formation "FD".

[0041] The marking mechanism 48 has two sections: a section 48a for folding markings in the sense of the face of the cover sheet 31 and a section 48b for spine markings in the sense of the back of the sheet 31. The sections 48a, and 48b, respectively, execute the folding markings facilitating the folding of the cover during the turn over operations of the bound book, while the spine markings facilitate the folding of the spine 44 during the binding of the book. The section 48b also executes flap markings requested for a front flap 52a, and/or back flap 52b, when present, of the pre-shaped cover. The trimming mechanism 47 is provided for trimming, in the cover sheet, the reference lateral edge "LE" of the pre-shaped cover, perpendicular to the reference edge "RE". This reference edge "LE" will constitute one of the lateral edges of the pre-shaped covers 31 of the front flap 52a (Fig. 7a), when present, or a given lateral edges for the pre-shaped covers devoid of flaps (Fig. 7b) or having a sole flap 52b. In turn, the end edge "EE" will constitute the lateral edges of the back flap 52b for the pre-shaped covers having the back flap 52b or the other lateral edges of the pre-shaped covers devoid of flaps or having the sole flap 52a.

[0042] Suitably, the cover pre-forming equipment 39 can include a heating device, not shown in the figures, to facilitate the marking of plasticized covers.

[0043] According to the invention, the trimming mechanism 47 and the marking mechanism 48 operate on the cover sheet 31 transversally to the direction of formation "FD" and the direction of the spine 44 in agreement with the dimensions of the book block, the thickness of the book block and the dimensions of the cover flaps, when present. For example, the trimming mechanism 47 provides an actuatable knife of guillotine type, while the marking mechanism 48 provides actuatable transversal punches of suitable shape. The cutting mechanism 49 is provided for cutting the cover sheet perpendicularly to the direction of the spine so as to define the lower edge "OE" of the pre-shaped cover opposed to the reference edge "RE". This mechanism 49 can provide conventional cutting disks and counter disks positionable perpendicularly to the direction "FD". A diverting device 98 provides to deviate the discards from the cutting mechanism and the trimming mechanism toward a, not shown, lower container.

[0044] The cover pre-forming equipment 39 comprises, upstream from the flap folding mechanism 51, an intermediate diverting station 99 and a taking and transferring mechanism 101. The station 99 arranges a marked and cut cover sheet 31 entered along the direction of formation "FD" in a starting position for the binding associated to a pre-assembling configuration, with a predefined position of the spine with respect to the input cover "IC" of the binder 27 and for being shifted along a direction of assembling of the binder parallel to the axis "A".

[0045] To this end, the intermediate station 99 comprises a support surface 102, a fixed front bank 103, a motorized lateral bank 104 and an alignment device 106. The alignment device is of known type with strip of transport and small alignment balls and provides to shift the cover sheet 31 so as to arrest the reference edge "RE" against the fixed bank 103 and the lateral edge "LE" against the motorized bank 104. The bank 104 is shiftable by program, along the direction of formation covers "FD", according to the thickness of the book block, for arresting the edge "LE" so as to arrange the pre-shaped cover in its starting position.

[0046] The taking and transferring mechanism 101 (Fig. 10) comprises a carriage 107 shiftable along guides 108 parallel to the axis "A" and includes three exhausting taking mouths or suckers 109, for lifting the cover sheet 31 from the support surface 102 of the station 99 and exactly positioning the cover sheet on the flap folding mechanism 51 and, in sequence and without transversal shifting with respect to the direction of assembling, toward the input cover "IC". The folding mechanism 51 is actuatable for folding by overlying the possible flaps 52a, 52b, whereby accomplishing the flaps of the pre-shaped cover 32 in association with the moving of the cover 32 along the direction of assembling.

[0047] In detail, the folding mechanism 51 comprises a central support surface 111, two contrast wings 112r and 112l and two bending wings 113r and 113l (see Fig. 8), symmetrical each the other, arranged parallel to the direction of assemblage. By program, the contrast wings and the bending wings have possibility of transversal shifting with respect to the assembling direction, up to position the contrast wings 112r and 112l in alignment with the markings regarding the flaps 52a, 52b (Fig. 8, fase1). The contrast wings 112r and 112l remain coplanar with the upper surface of the cover sheet and operate as contrast for the bending wings 113r and 113l which rotate, whereby folding the flaps 52a, 52b (Fig. 8, steps 2 and 3) around the markings for an angle of over 90°. Then, the wings 112r and 112l and the wings 113r and 113l are withdrawn from the effected folding (Fig. 8, step

4).

[0048] Now, the taking and transferring mechanism 101 moves the cover between a pair of upper shaped plates 114r and 114l and lower plates 116r and 116l, which provide progressively to further fold the flaps 52a, 52b up to the overlying on the back of the cover. Moreover, the transferring mechanism 101 puts the cover in engagement with a moving mechanism including counter-rotating rolls 117, having the function of advancing the pre-shaped covers along the direction of assembling up to the input cover "IC" of the binder 37 and consolidating the folding of the flaps.

[0049] According to the invention, the paper strips 281, 28r used in the system 22 have standardized format, of width such to allow the printing, side by side (two-up), with different orientations, of basic sheets of the main dimensional format of books, with minimum waste. As shown in the Figs. 11, 12 and 13, with a maximum width of 440÷460 mm, there can be printed basic sheets for book blocks 36p having vertical orientation (P) of notebook or "portrait" format, and book blocks 361 having horizontal orientation (L) of album or "landscape" format. The obtainable formats are substantially the ones most generally used in the book industry, varying from 105X180 mm to 210x295mm, and with the additional areas or "abundances" necessary for the finishing trimming.

[0050] As represented in the Figs. 14 and 15, in the strip 28r, the sheet groups Gr of the books 23, are arranged in longitudinal sections "LS", while the strip 281 provides longitudinal sections "LL" for the sheet groups Gl as inserts between the sheet groups Gr, but in which the groups Gr and the groups Gl can constitute the sole components of the books 23.

[0051] The pages 24 of each book 23 are sequentially printed on the two faces of the longitudinal section "LS", "LL" of the strip 281, 28r provided for the required book and according to the respective orientation. In association with the longitudinal section "LS", "LL" for the required book, there is printed a book code 121 and, in association with each basic sheet 29r, 291 is printed a respective sheet code 122. The book codes and the sheet codes are machine-readable. Further, in association with each cover sheet 31, is printed a cover code 123, also machine-readable and associated with the required book, while the cover sheet 31 for the cover devoid of flaps include a further service code 126 similar to the code 123.

[0052] The input and forming equipments 33r and 331 with cutting and stacking function, respond to information of the book codes 121 and the sheet codes 122 for the transversal separation from the sheet strip or strips of the basic sheets and the stacking of the basic sheets 29r, 291 with formation of the book blocks 36.

[0053] The cover pre-forming equipment 39 responds to cover data from the cover code 123 for pre-forming the pre-shaped covers 32 from the respective cover sheets 32 The finishing equipments 41 for the bonded books include the trilateral cutting equipment 54 and the flap opening and book cutting device 56 for trimming the basic sheets of the book block and the cover according to finishing data from the code 123/126 and/or the book code 121.

[0054] The manipulating device 86 provides to orientate the book blocks 36 for a predetermined operative position of input of the book block in the binding machine 37 in dependence of orientation data from the book code 121, while the binding machine proceeds to gluing the book block 36 with the respective pre-shaped cover 32 in dependence of agreement of book identifying data from the book code 121 with book identifying data from the cover code 123.

[0055] The method for manufacturing a book 23 provides the followings steps:

a) printing the basic sheets 29r, 291 for each book 23 in the respective longitudinal section "LS" of the paper strip 28r, 281 provided for the requested book and according to the orientation (P, L) of the book;

b) providing the printing of a book code 121 and of sheet codes 122, in which the book code121 is associated with the longitudinal section "LS" of the book and includes data of the required book, while the sheet codes 122 are associated with the basic sheets 29r, 291 and relate to the process of formation of the book;

c) providing the printing of a cover code 123 (Ved. Figs. 7, 16 and 17) in association with each sheet cover 31 and including data regarding the cover;

d) activating, on the basis of the data of the book code121 and/or the sheet code 122, the sheet input and forming equipments 33r and 331 and, respectively, the collecting device 34 for the separation from the paper strip and the stacking of the basic sheets 29r and 291 and the formation of the book block 36p, 361;

e) providing the measurement of the thickness of the book blocks 36p, 361 and activating, on the basis of the cover code 123, and of information of thickness on the book block 36p, 361, the equipment for the pre-formation of covers so as to pre-form the pre-shaped cover 32 from a respective cover sheet 31;

f) providing the binder 37 for gluing a rib 43 of the book block 36p, 361 with the back of a spine 44 of the respective pre-shaped cover 32, in dependence on the information of thickness;

g) orientating the book block 36p, 361 and arranging the pre-shaped cover 32 for respective predetermined operative positions of input of the binder, in dependence on the book code 121 and/or, respectively, the cover codes 123;

h) activating the binder 37 for assembling and gluing the rib 43 of the book block 36p, 361 with the back of the spine 44 of the respective pre-shaped cover 32; and

i) activating, on the basis of the data of the book

code121 and/or the sheet code 122, the finishing equipments 41 for the trimming of the basic sheets and the cover according to the data from the code cover 123.

[0056] The book code 121, the sheet codes 122 and the cover code 123 are of a type known as Datamatrix: of rectangular format for the book code 121 and the sheet codes 122, and of square format for the cover codes 123. These codes are printed by program on the basic sheets and the cover sheet on a conventional upper surface and/or the conventional lower surface thereof, jointly with the printing of the sheets and the cover in the "abundances" provided to be removed upon the trimming in the finishing equipments. The codes are read by appropriate code readers of the various equipments for supplying information for the execution of the respective functions, while the electronic control equipment 42 has function of general coordination and control and supplies the sequence of activation for the same equipments.

[0057] The book code 121 is arranged at an initial portion of each longitudinal section "LS" of the paper strip 28r, 281 for the required book, which will correspond to the first page of the book block 36. This book code 121 contains data essential for the identification and the characteristics of the book. In turn, the codes sheets 122 are printed beside the basic sheets and contain data necessary for processing the formation of the book. Synchronism strokes or "marker" 124 are also printed on the longitudinal section "LS" in correspondence of the pairs of basic sheets as signals of synchronism for the double cutter 49 and as signals of definition for the transversal cutting for the same pair of sheets.

[0058] The book code121 and the cover code 123 have the following data:

A) - Data regarding the batch of the books and progressive, also identifying the required book and regarding the client;
B) - Dimensional data regarding the sheet on which the printing is effected;
C) - Data regarding the height and to the width, including the abundance, of the book;
D) - Data regarding the presence of the front flap 56a, and/or the back flap 56b and, in positive case, the respective dimensions;
I) - Dimensional data regarding the distance of the folding marking, the upper abundance and the lateral abundance; and
F) - Finishing data regarding the height and the width of the finished book.

[0059] In turn, the sheet codes 122 have the following data:

P) - Data regarding the absolute number of pages of the book, which decrements naturally sheet by sheet and keeps in count the real number of he sheets considering the groups Gr, Gl which composes the book;
G) - The number of the current sheet of the group Gr, Gl, which decreases from the total of the pages of the current group;
H) - Data regarding the height of the page and it is repeated on each page;
L) - Data regarding the identification odf the batch of books;
I) - Data regarding the beginning of the book or the group Gr, Gl;
R) - Data regarding to the rotation to effected by the book block by the manipulating device; and
S) - Data of status regarding further information, for instance the thickness of the block book.

[0060] The book 23 always begins with a pair of sheets. A white sheet is left in the book block or discarded off line. For each book, the two branches of the strips 28r, 281 are equalized by managing the discards, if necessary.

[0061] As for the cover sheets 31, the cover code 123 (Figs. 7a and 7b) is printed on an code area of each cover sheet having a given relationship with respect to the reference edge (RE) and the lateral front edge (FE), for instance near to the corner between these edges. Further, a draw or marker 127 is printed adjacent to the lateral front edge (FE) of each cover sheet. The service 126 (Fig. 7b) is printed on an code area of each cover sheet devoid of flaps having a given relationship with respect to the reference edge (RE) and the lateral end edge (EE), for instance near to the corner between these edges.

[0062] Specifically, the cutters 59r, 591 have respective Datamatrix readers DRCra, DRCrb; DRCla DRClb for the sheet codes 122, while specific sheet marker sensors recognize the "marker" 124 for controlling the exact positions of the cuts for the basic sheets.

[0063] In the use, the readers DRCra, DRCrb; DRCla DRClb of the cutters 59r, 59l read the value P on the strips 28r and 28r, beginning from a cutter master. As function of the read numbers, the program sets the sheet input and forming equipment 33r, 331 for the insertion of groups if the current book has or not respective groups. For instance, if the program recognizes the equality of the value of P with the value of G, indicative of absence of groups. In the case of G <P, it is indicative that the book includes at least a group Gr, Gl to be inserted by the other equipment 33r, 331 in the concurrent cutter.

[0064] The cutter 59r, 591 which starts the work continues the separation of the sheets up to exhaustion of the parameter G (0-1); at this point, it leaves again the control to the other cutter 591, 59r for a following group. When the counter P has reached value 1 and the last sheet has entered the receipting area 67, it is indicative that the book block 36p, 361, has been completed. Now, the program causes the start of the conveyor belt 68 toward the binder with stop when the book block is in front of the thickness measurement device 81.

[0065] Thereafter, the program starts for the manufacturing of a following book. The progressive number is checked for overcoming conditions of anomaly and restoring the activities after a possible breakup of the strip 28r and 28r and the restarting. When the work restarts in front of an anomaly, the remaining book is composed up to the end but, at the arrival of the code on a start binder reader DRB the program verifies that the progressive code has been wrongly composed and alerts the operator to remove the book block and the respective cover.

[0066] Downstream from the receipting area 67, the interconnecting group 38 provides a Datamatrix reader DRB for reading the book code 121 of the book blocks 36p, 361 in transit. Further, on the feeding mechanism 46, a Datamatrix reader DRC reads the cover code 123 regarding the cover sheets 31, while a specific cover marker sensors 128 recognize the "marker" 127 for controlling the exact positions of the trimmings and markings for the cover sheets. The control equipment 42 compares the book identifying data from the book code read by the reader DRB with the book identifying data from the cover code read by the reader DRB. In the case of agreement the equipment 42 enables the binder 37 for the binding of the book block with the respective pre-shaped cover.

[0067] As for the finishing equipments, a Datamatrix reader DRT and, respectively, a Datamatrix reader DRFs are provided, upstream from the trilateral trimming mechanism 54 and the flap opening and book cutting equipment 56. In particular, for the trimming information, the reader DRT reads the book code 123 from the first page of the bound book having flapped covers, which is visible in view of the fact that the edge of the book block opposite to the spine projects from the edge of the folded flaps. On the contrary, for bound book having covers devoid of flap, the reader DRT reads the service code 126. Finally, the Datamatrix reader DRF is provided for reading the book code 123 from the first page of the bound book.

[0068] The data of beginning of the book and beginning of a group, are also used for controlling the correct proceeding of the work. At the beginning, if a white page is present and it is decided that it must be discarded it will be discarded, for going to an equalized condition of processing. The un-equalized conditions of sheets, during the manufacturing of the book are not recovered; it will be made at the end: the discard is signalled on the first page of the group which contains the discard but it will be executed at the end of the group. Conveniently, a diverter can be provided downstream of the cutter to discard such sheets.

[0069] Naturally, the principle of the invention remaining the same, the embodiments and the details of construction can broadly be varied with respect to what has been described and illustrated, by way of non-limitative example, without by this departing from the ambit of the present invention.

[0070] As alternative to the manipulator or rotator having three axes of rotation at the end of the transport belt, it can be provided a rotating device arranged immediately downstream of the cutters 59r and 591 or on the book block 36p, 361 of the platform 72 for orientating suitably the basic sheets or the book block.

[0071] An additional input can be provided for one or both the group forming mechanisms 61 r, 61l to the end of introducing groups of basic sheets independent of the spools strips 27r, 271. It can be accomplished by using a three channel cutter of the type described, as variant, in the European Patent Specification EP 1 741 653 in the name of the co-applicant Tecnau S.r.l.

[0072] In a simplified system, the formation of the book blocks can be effected through a single sheet input and forming equipment, with the possible addition of a three channels cutter.

[0073] In front of a reduced velocity, the system can use strips of half width with respect to the "standard" ones, such to allow the printing of a single column of sheets and technique "one up" of cutting and gathering. Further, the inserts for the book blocks can be obtained by other inputs and from equipments different from the one above described.

[0074] The employable codes for the control of the various components of the system can be different from the ones of Datamatrix type above described.

[0075] Further, the device of measure of the thickness of the basic stack of sheets for the control of the binder can be applied to an automatic system for manufacturing of book blocks different from the ones specific for "book on demand."

Claims

1. A system for manufacturing books on demand, comprising at least a block book input and forming equipment, a cover forming equipment for forming pre-shaped covers from respective cover sheets and a binding machine for gluing a rib of the book block with a spine of a pre-shaped cover, and in which the binding machine receives the pre-shaped covers from a cover input in a pre-defined pre-assembling configuration and feeding along an assembling direction, parallel to the spine, the said cover forming equipment being **characterized in that** it comprises
   a feeding mechanism for entering and moving the cover sheets along a direction of shaping transversal to the direction of the spine of the cover to be accomplished;
   a cover trimming mechanism, actuatable for executing the trimming of the cover sheets to define an edge of the pre-shaped cover transversally to the direction of shaping;
   a marking mechanism, actuatable for executing bending markings on the cover sheets for the spine of the cover transversally to the direction of shaping;
   a cover cutting mechanism, actuatable for executing on the cover sheets the cutting associated to the

height of the pre-shaped cover of the requested book; and
a diverting station for receiving the pre-shaped cover along the direction of shaping and arranging the pre-shaped cover in a position associated to the pre-assembling configuration;
a moving mechanism being provided for arranging the pre-shaped cover at the cover input of the binding machine.

2. System for manufacturing books on demand according to claim 1 **characterized in that** the cover forming equipment further comprises a store for the cover sheets, and an equalizing device, in which the feeding mechanism causes the cover sheets to singularly advance from the store to the equalizing device, while the equalizing device is provided for aligning a top reference edge (RE) and a lateral front edge (FE) of each cover sheet with respective alignment members for a given positioning of the cover sheet of starting for the following operations of marking, trimming and cutting and in which the feeding mechanism causes the cover sheets to singularly advance from the equalizing device with a given direction of formation (FD) transversal to the direction of the spine to be executed for the following operations of marking, trimming and cutting.

3. System for manufacturing books on demand according to claim 2 **characterized in that** the feeding mechanism includes motorized suckers, first motor rollers upstream from the equalizing device and further motor rollers downstream from the equalizing device, in which the suckers take singularly the cover sheets from the store for the engagement with the first rollers toward the equalizing device, while the further motor rollers singularly advance the equalized cover sheets along the given direction of formation (FD).

4. System for manufacturing books on demand according to any of the preceding claims **characterized in that** the cover trimming mechanism provides an actuatable knife of guillotine type, while the marking mechanism provides actuatable transversal punches of suitable shape.

5. System for manufacturing books on demand according to any of the preceding claims **characterized in that** the diverting station includes fixed arrest element for arresting a given reference edge of the pre-shaped cover and an adjustable arrest element for arresting a lateral reference edge of the pre-shaped cover, and in which the adjustable arrest element is shiftable along a direction of shaping according to the thickness of the book blocks, in order to arrange the pre-shaped cover in a position associated with said pre-assembling configuration.

6. System for manufacturing books on demand according to any of the preceding claims **characterized in that** the cover has one or two flaps, in which the marking mechanism is also actuatable for executing bending markings for the flap or flaps of the pre-shaped cover and in which the cover forming equipment further comprises a flap folding mechanism downstream from the diverting station actuatable for folding the flap or the flaps of the pre-shaped cover and overlying the flaps in association with the moving of the pre-shaped cover by the moving mechanism along a direction parallel to the assembling direction and in which a taken and transferring mechanism is provided for taken and moving the pre-shaped cover from the diverting station to the flap folding mechanism and the moving mechanism.

7. System for manufacturing books on demand according to claim 6 **characterized in that** the flap folding mechanism comprises a central support surface, two contrasts and two bending wings, symmetrical each the other, arranged parallel to the assembling direction, in which the contrast wings and the bending wings have possibility of transversal shifting with respect to the assembling direction, up to position the contrast wings in alignment with the markings regarding the flaps, the contrast wings remaining coplanar with the upper surface of the cover sheet and operating as contrast for the bending wings and folding the flaps around the markings for an angle of over 90° and in which the wings are withdrawn from the effected folding while the taking and transferring mechanism moves the cover between a pair of upper shaped plates and lower plates adjacent to the moving mechanism for further folding the flaps up to the overlying on the back of the cover.

8. System for manufacturing books on demand according to claim 6 or 7 **characterized in that** the taking and transferring mechanism comprises a carriage shiftable parallel to an assembling axis of the binding machine and includes suitable suckers, for lifting the cover sheet from a support surface of the diverting station and exactly positioning the cover sheet on the flap folding mechanism and, in sequence and without transversal shifting with respect to the direction of assembling, toward the moving mechanism.

9. System for manufacturing books on demand according to any of the preceding claims **characterized in that** said cover input and forming equipment comprises a device of heating for making easier the marking of plasticized covers.

10. System for manufacturing books on demand according to any of the preceding claims **characterized in that**, in association with each cover is printed a cover code, also machine-readable and associated with

the required book; the cover trimming mechanism, the marking mechanism and the cutting mechanism responding to cover data from the said cover code.

11. System for manufacturing books on demand according to claim 1 **characterized in that** the cover has one or two flaps, in which the marking mechanism is also actuatable for executing bending markings for the flap ore flaps of the pre-shaped cover and in which the cover forming equipment further comprises a flap folding mechanism downstream from the diverting station actuatable for folding the flap or the flaps of the pre-shaped cover and overlying the flaps in association with the moving of the pre-shaped cover by the moving mechanism, in which each of the cover sheets defines a reference edge (RE) associated to the top edge of the cover, a lateral front edge (FE), and an end edge "EE" associated to a lateral end edge of a cover devoid of flaps or a cover with flaps, in which the trimming mechanism is provided for trimming, a reference lateral edge (LE), opposite to the end edge (EE), constituting a reference lateral edge of a cover devoid of flaps or a cover with flaps of the pre-shaped cover, and in which a cutting mechanism is provided for cutting a bottom edge (OE) associated to the bottom edge of the cover, opposite to the reference edge (RE).

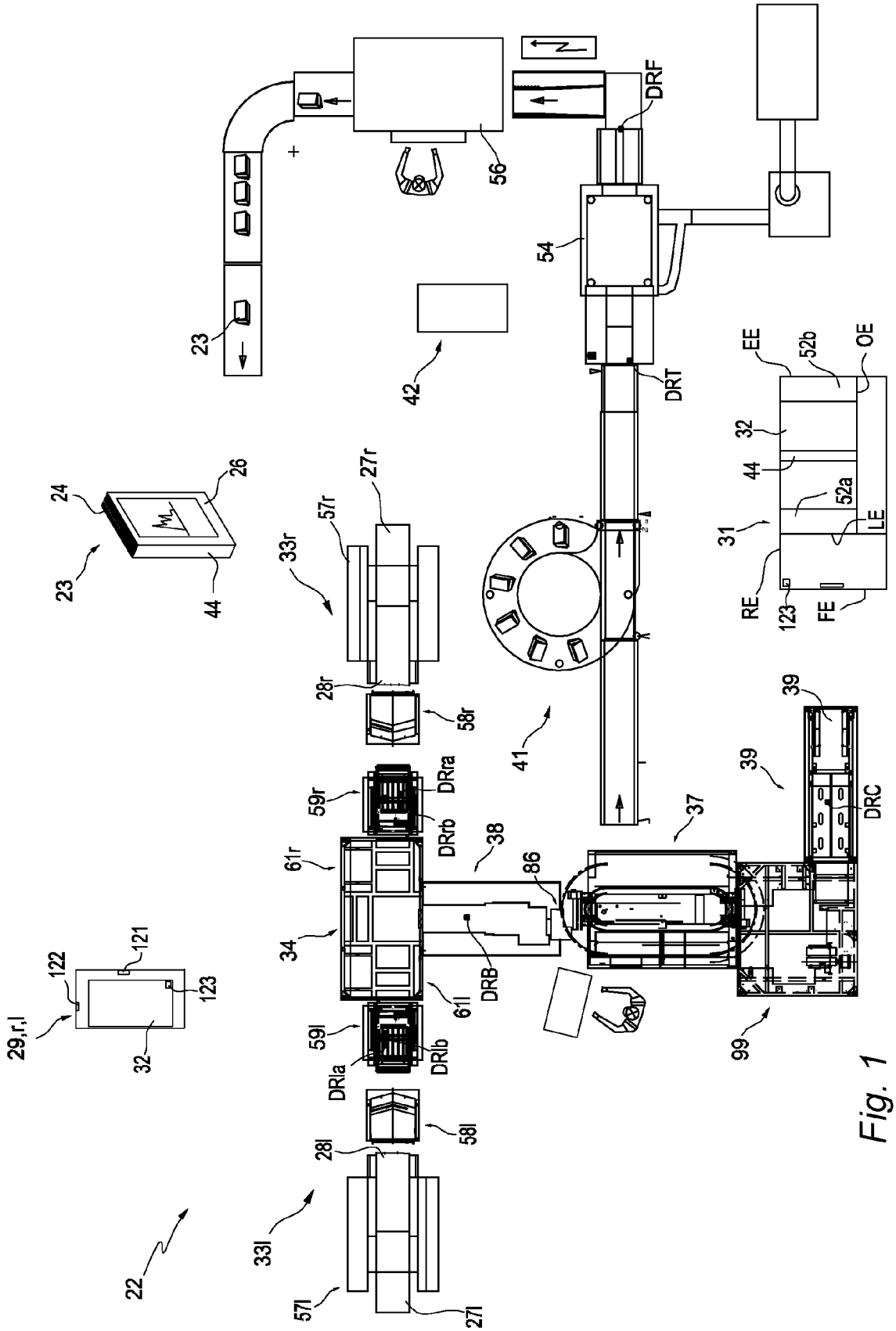
12. System for manufacturing books on demand according to claim 11 **characterized in that** a cover code is printed on an code area in a given relationship with respect to the reference edge (RE) and the lateral front edge (FE) of each cover sheet, in which a draw or marker is printed adjacent to the lateral front edge (FE) of each cover sheet and further comprising a code reader and a marker sensor for reading the cover code and revealing the draw or marker of a cover sheet for causing exact shifting of the cover sheet and the driving of the cover trimming mechanism, the marking mechanism and the cutting mechanism and the flap folding mechanism for flapped covers.

13. System for manufacturing books on demand according to claim 1, **characterized in that that** the covers has one or two flaps, said system further comprising a trilateral trimming mechanism for executing finishing cuttings on three edges of a bonded book devoid of flaps or finishing cuttings on two edges of a bonded book with a flap or flaps, a flap opening and book cutting equipment, actuatable for opening the covers with a flap or flaps and executing a cutting on the side of the book opposite to the spine of the cover; the trilateral trimming mechanism and the flap opening and book cutting equipment responding to the finishing data from the cover code or the book code.

14. System for manufacturing books on demand according to claim 13, **characterized in that that** a book code is printed on an abundance of a first page of the book code and a service code is printed on a given area of the cover sheet and in which, for trimming information, a code reader is provided upstream from the trilateral trimming mechanism for reading the book code from the first page of the bound book having flapped covers while, for bound book having covers devoid of flap, the code reader reads the service code or the repeated cover sheet, another code reader being provided upstream from the flap opening and book cutting equipment for receiving driving information by reading of the book code from the first page of the bound book.

15. A system for manufacturing books on demand, comprising a collecting device for a book block formed with basic sheets, and a binding machine for the manufacturing of the required book, said system being **characterized in that** it comprises:

two book sheet input and forming equipments, each one having a stacking area for receiving and pre-shaping a respective group of the basic sheets as component of the book block; and
a transferring mechanism for transferring the book block from the collecting device toward the binding machine;
in which the collecting device includes a receiving area for receiving the groups of basic sheets forming the book block; and
in which the stacking areas of the two book sheet input and forming equipments are arranged side by side with respect to the receiving area of the collecting device;
the book sheet input and forming equipments including respective input pushers, actuatable for pushing the first group of sheets and the second group of sheets from the respective stacking areas toward the receiving area or on a group of sheets stacked on the receiving area; and
the transferring mechanism being actuatable for transferring the book block from the collecting device toward the binding machine.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DRra
DRrb
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DRB
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29,r,l
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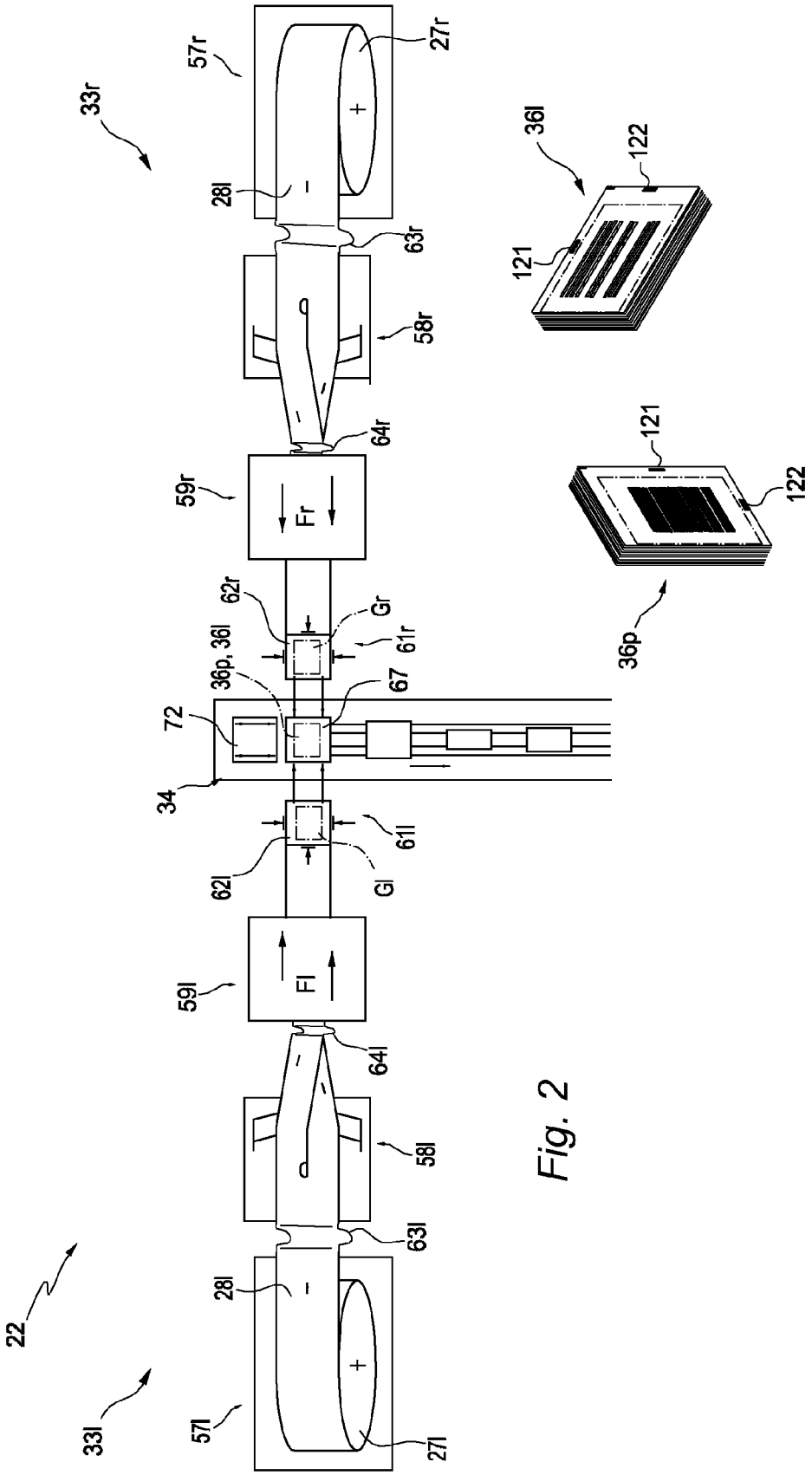
123
32

Fig. 1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62l
Gl
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36p

Fig. 2

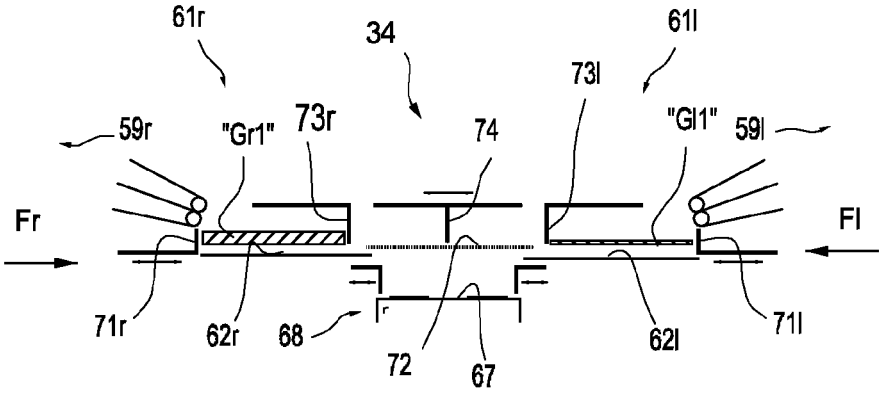


Fig. 3a

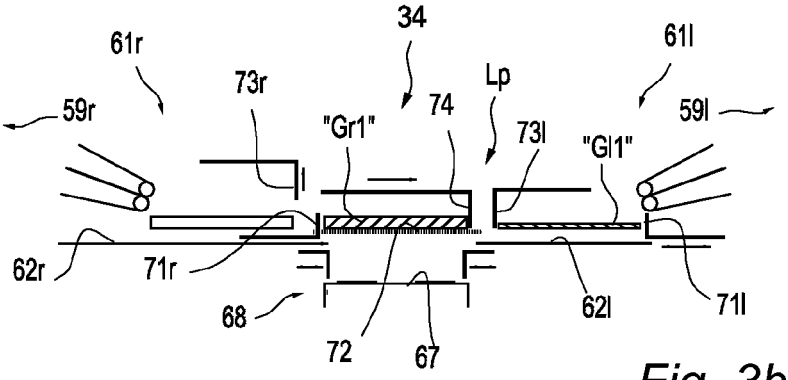


Fig. 3b

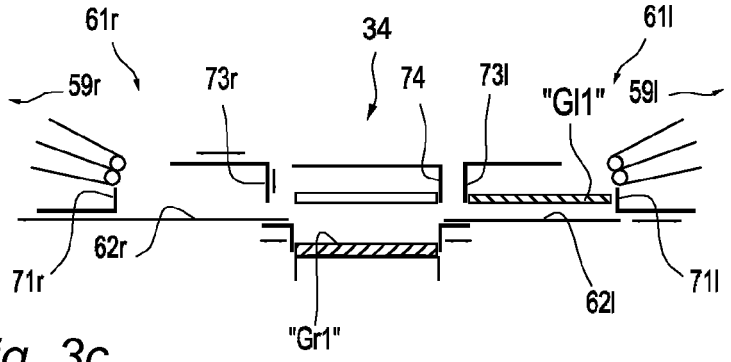


Fig. 3c

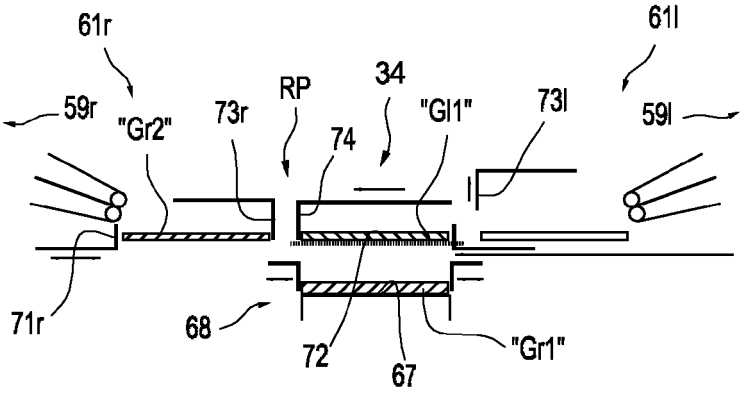


Fig. 3d

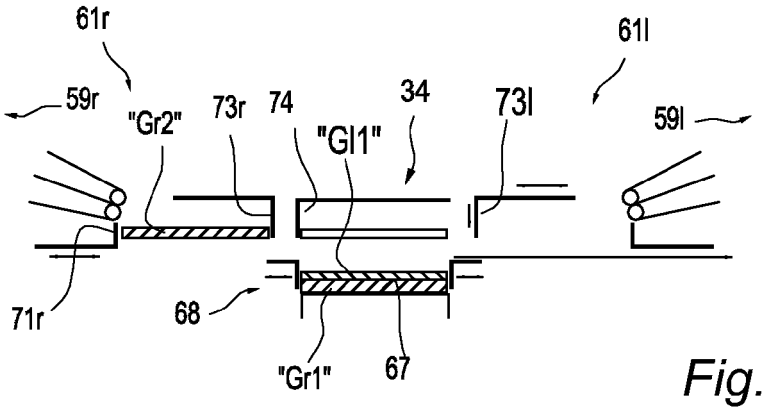


Fig. 3e

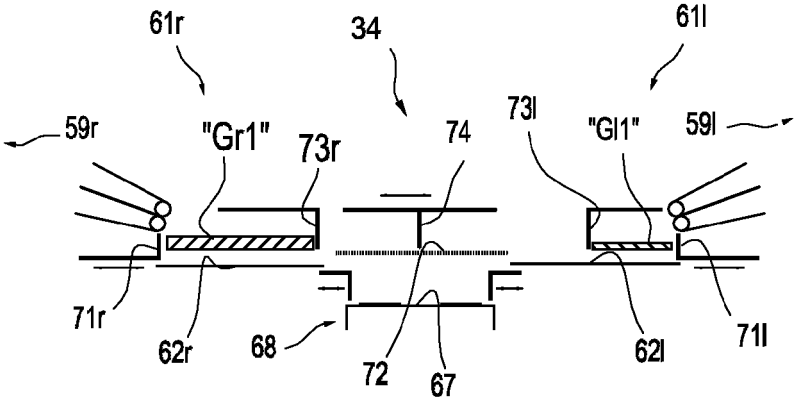


Fig. 3f

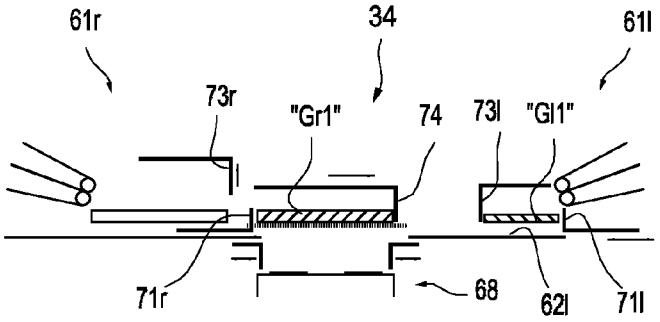


Fig. 3g

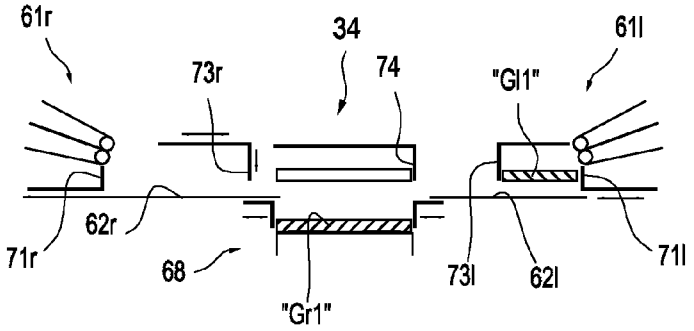


Fig. 3h

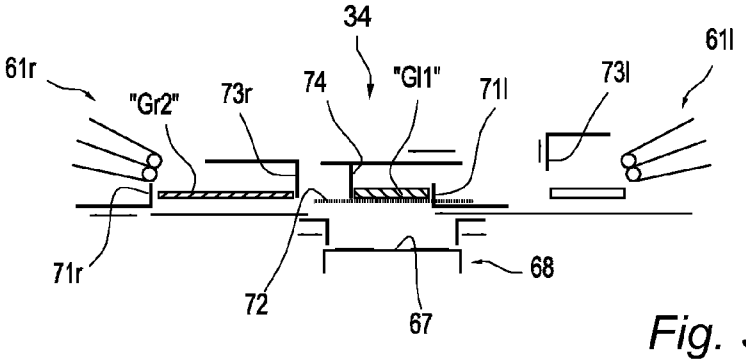


Fig. 3i

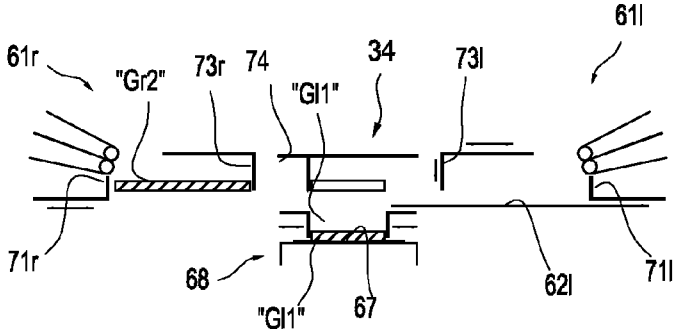
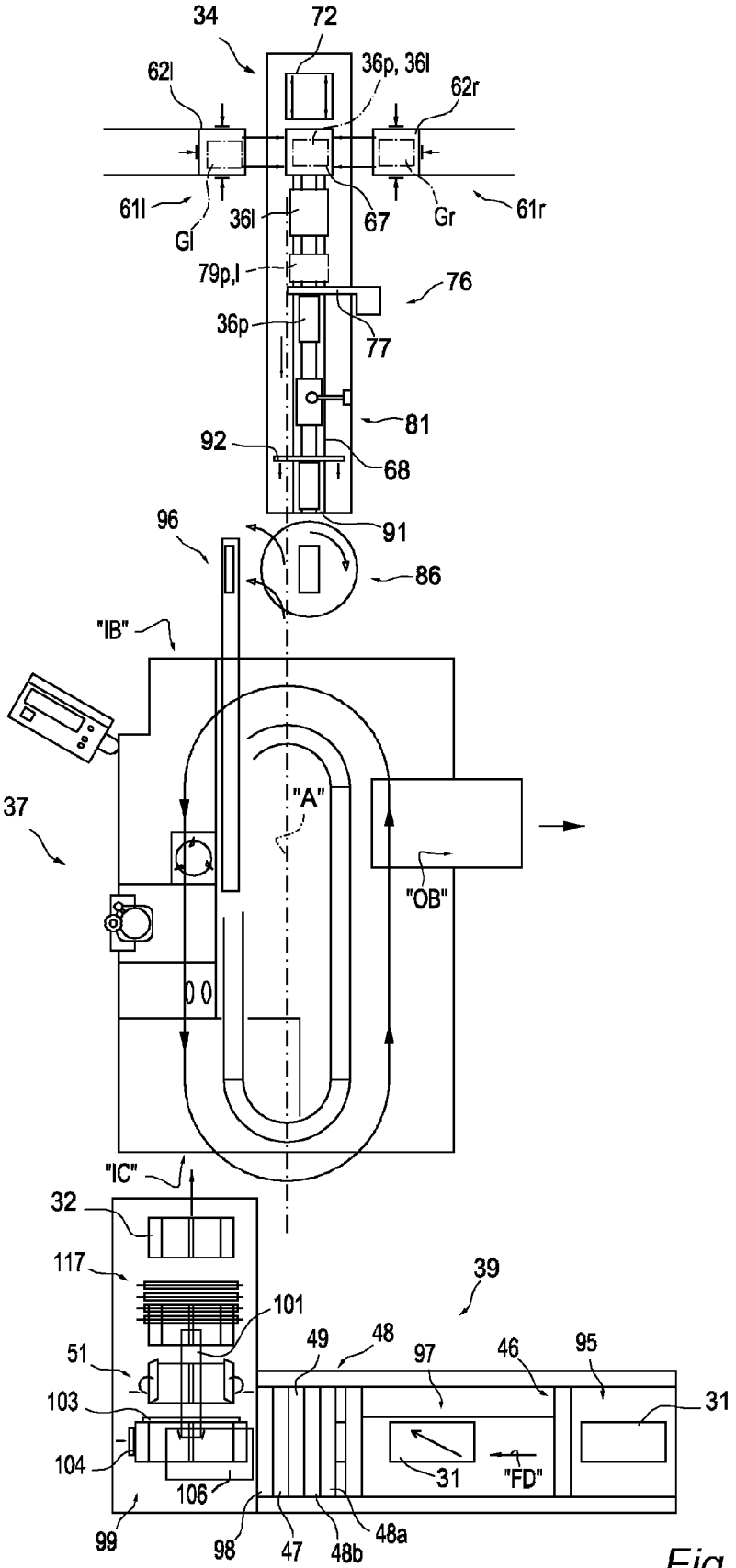


Fig. 3l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36l
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Gr
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79p,l
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96
91
86
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"A"
"OB"
"IC"
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48b
48a

Fig. 4

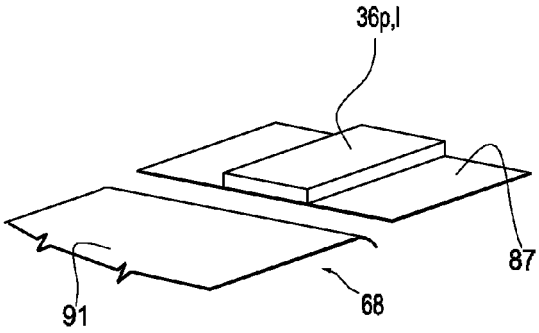


Fig. 5a

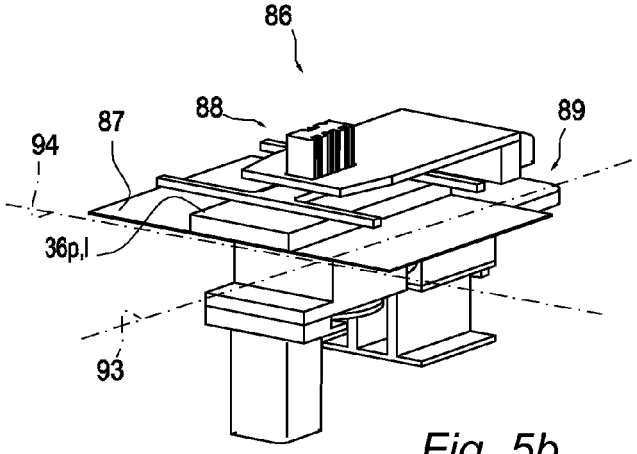


Fig. 5b

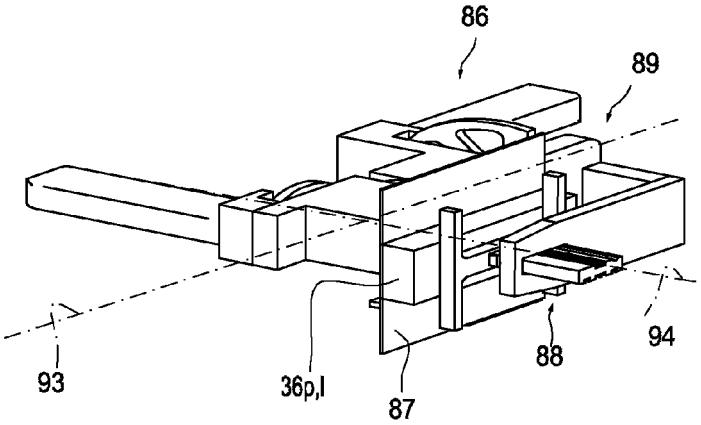


Fig. 5c

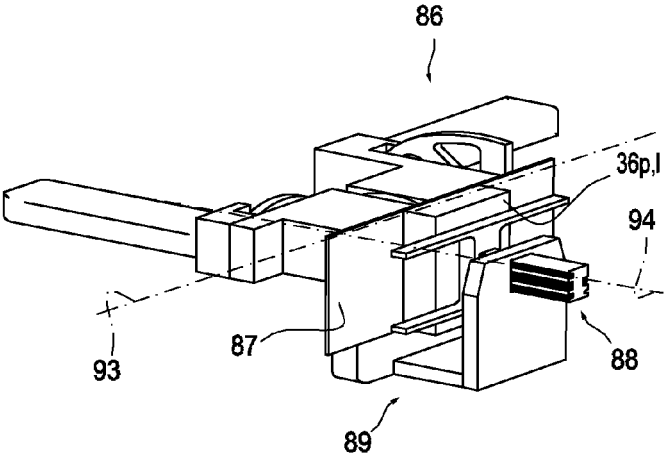
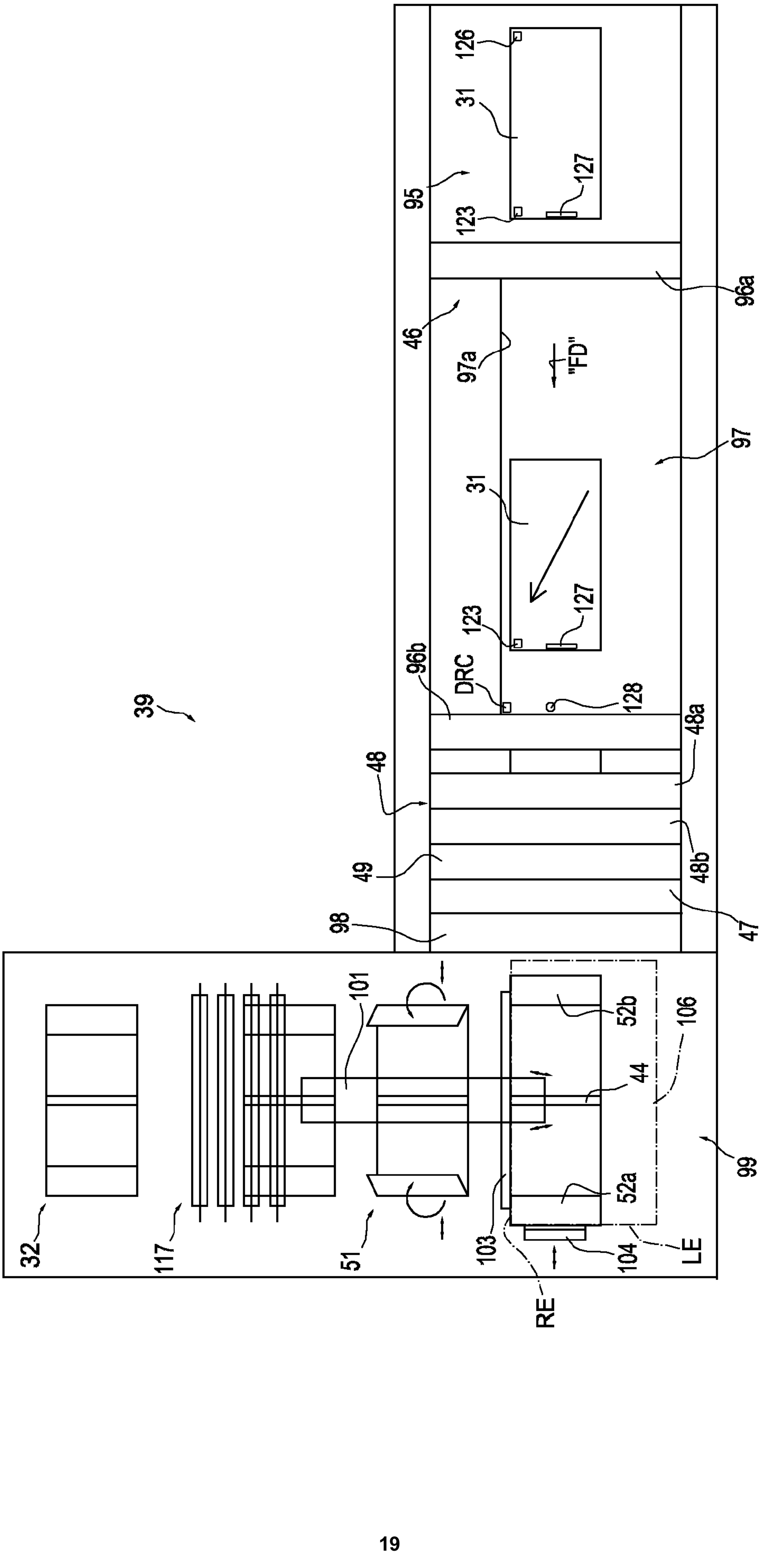


Fig. 5d



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LE
RE

Fig. 6

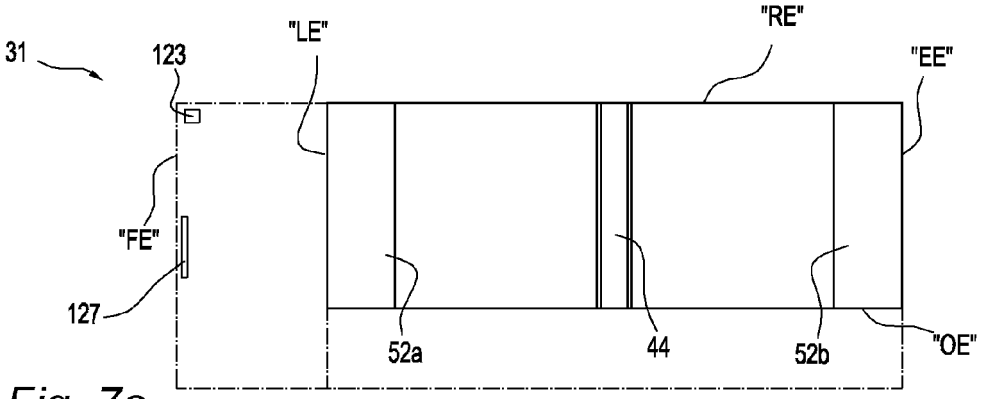


Fig. 7a

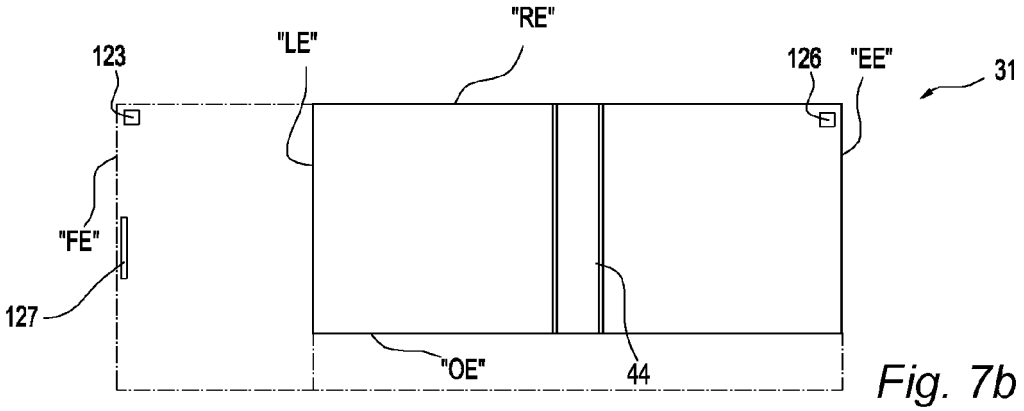


Fig. 7b

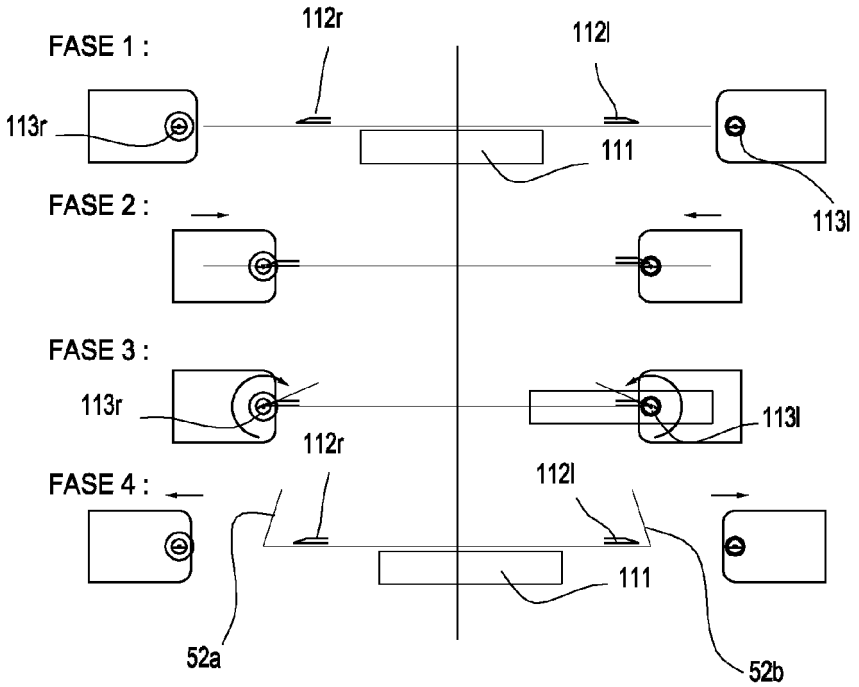


Fig. 8

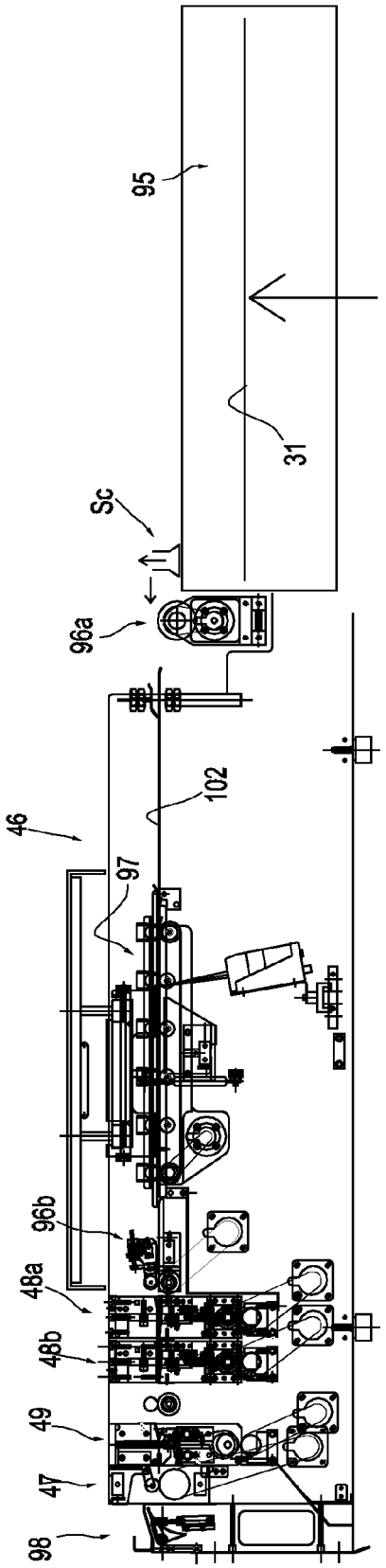

95
31
Sc
96a
102
46
97
96b
48a
48b
49
47
98

Fig. 9

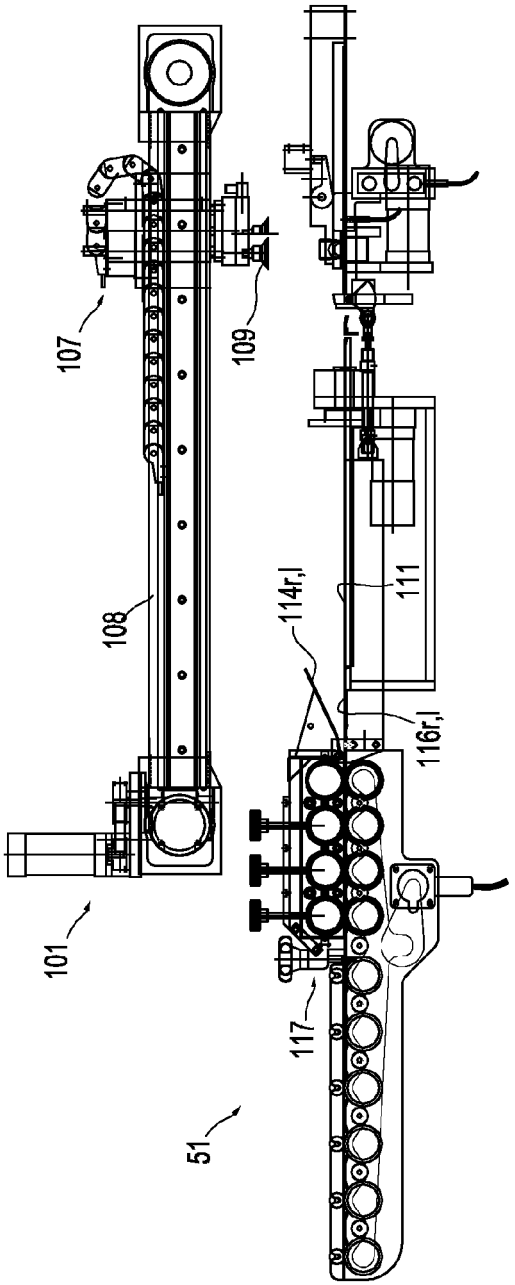

107
109
108
114r,l
111
116r,l
101
117
51

Fig. 10

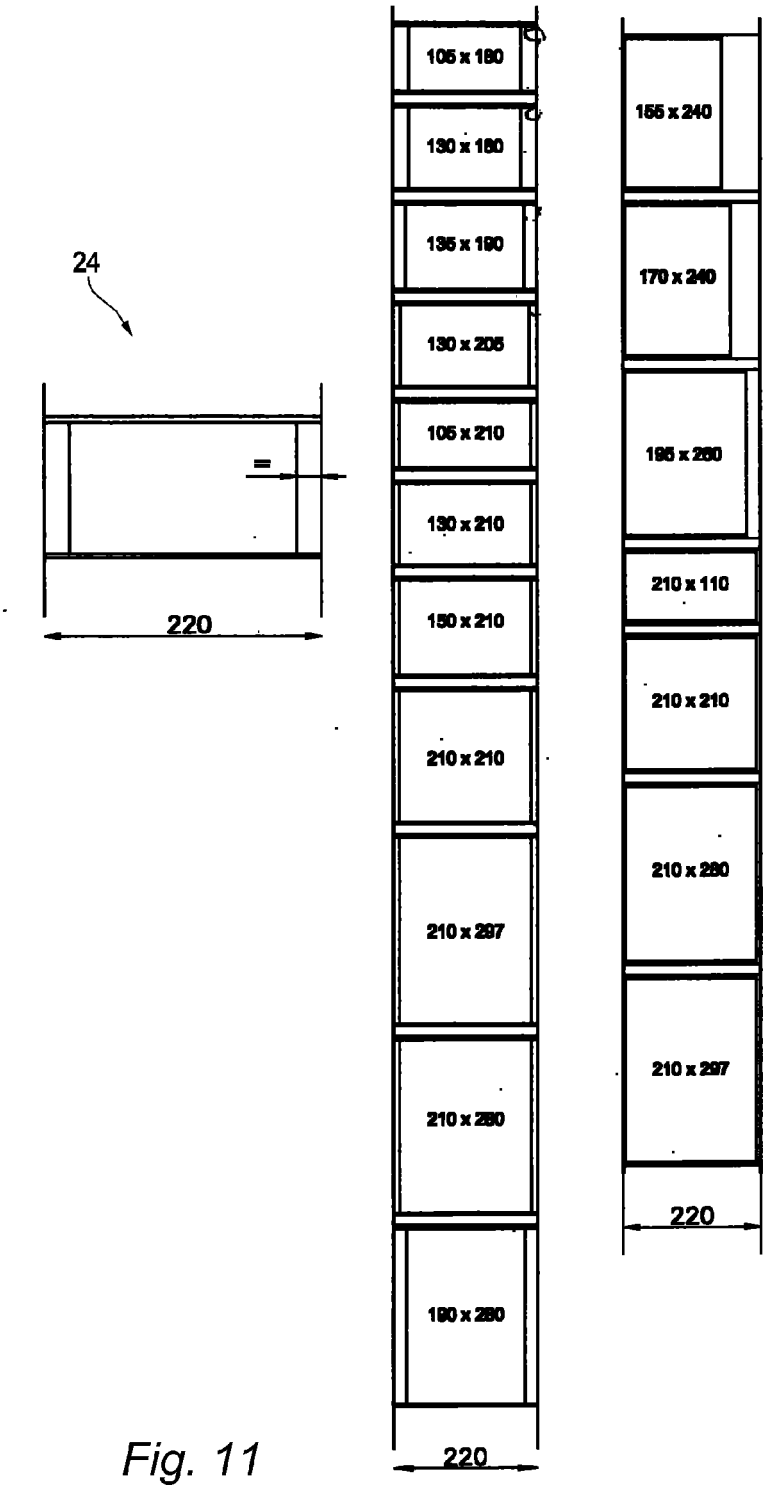
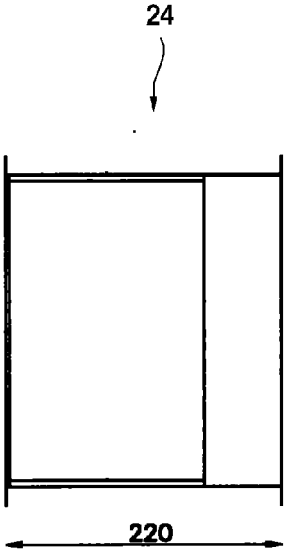

24
220
105 x 180
130 x 180
135 x 190
130 x 205
105 x 210
130 x 210
150 x 210
210 x 210
210 x 297
210 x 280
190 x 280
220
155 x 240
170 x 240
195 x 280
210 x 110
210 x 210
210 x 280
210 x 297
220

Fig. 11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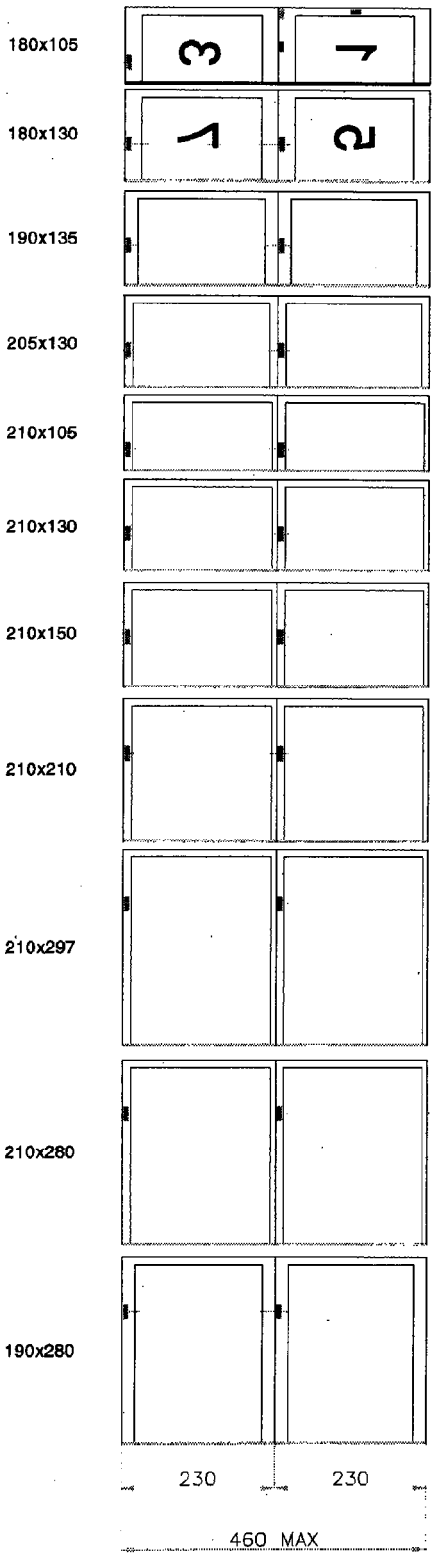
220

Fig. 12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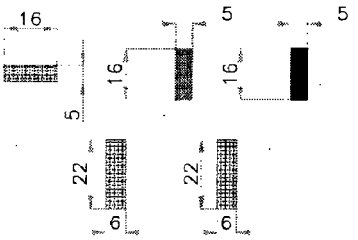
180x130
190x135
205x130
210x105
210x130
210x150
210x210
210x297
210x260
190x280
3
1
1
2
230
230
460 MAX


16
5
16
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16
5
22
6
22
6

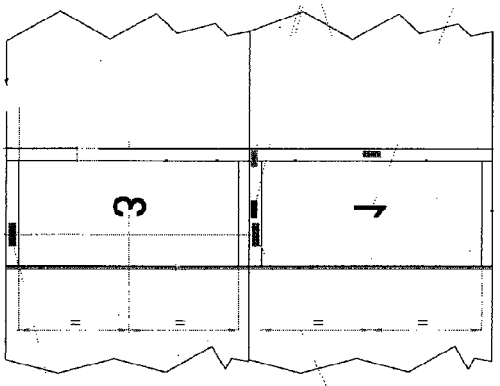
3
1

Fig. 13

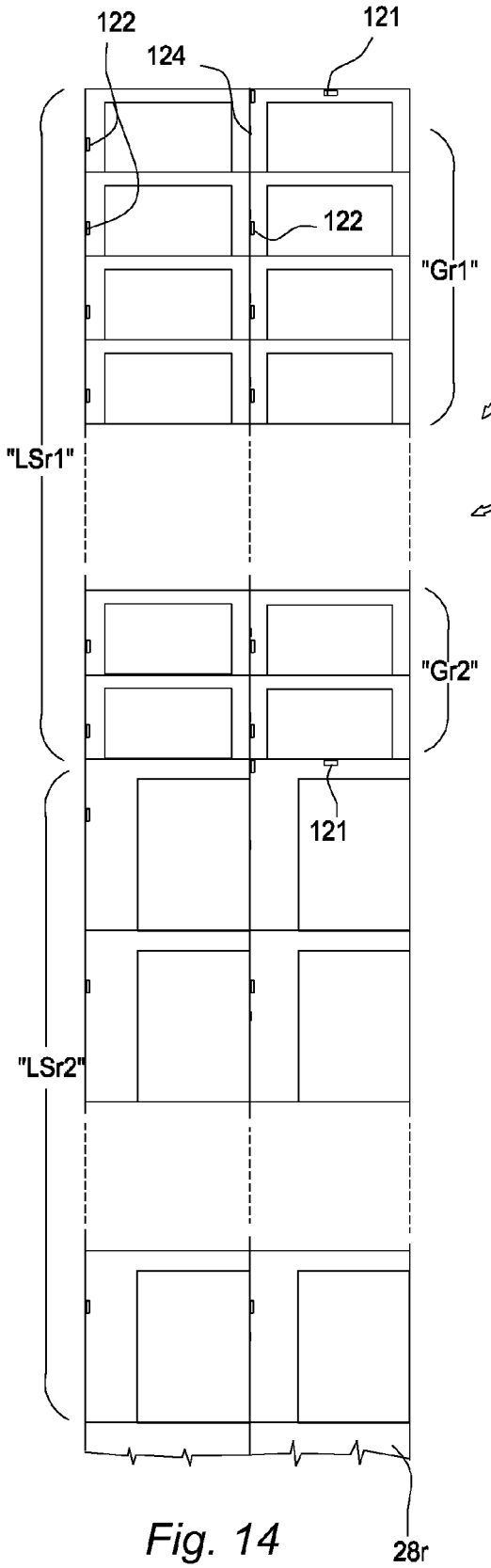
122
121
124
122
"Gr1"
"LSr1"
"Gr2"
121
"LSr2"
28r

Fig. 14

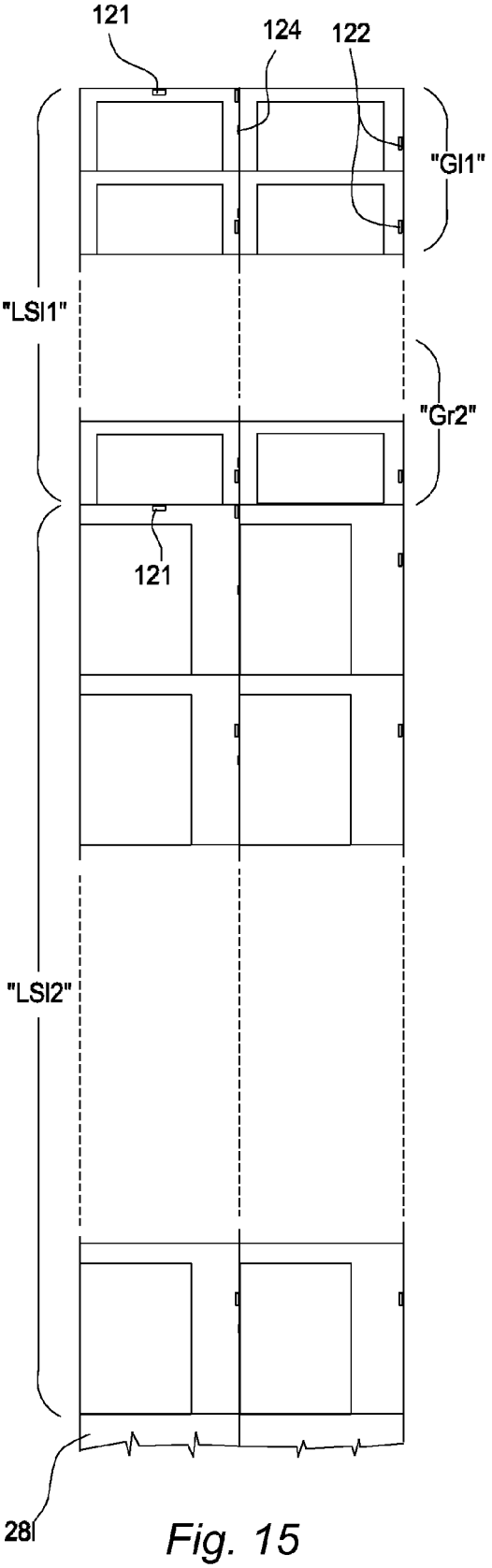
121
124
122
"Gl1"
"LSl1"
"Gr2"
121
"LSl2"
28l

Fig. 15

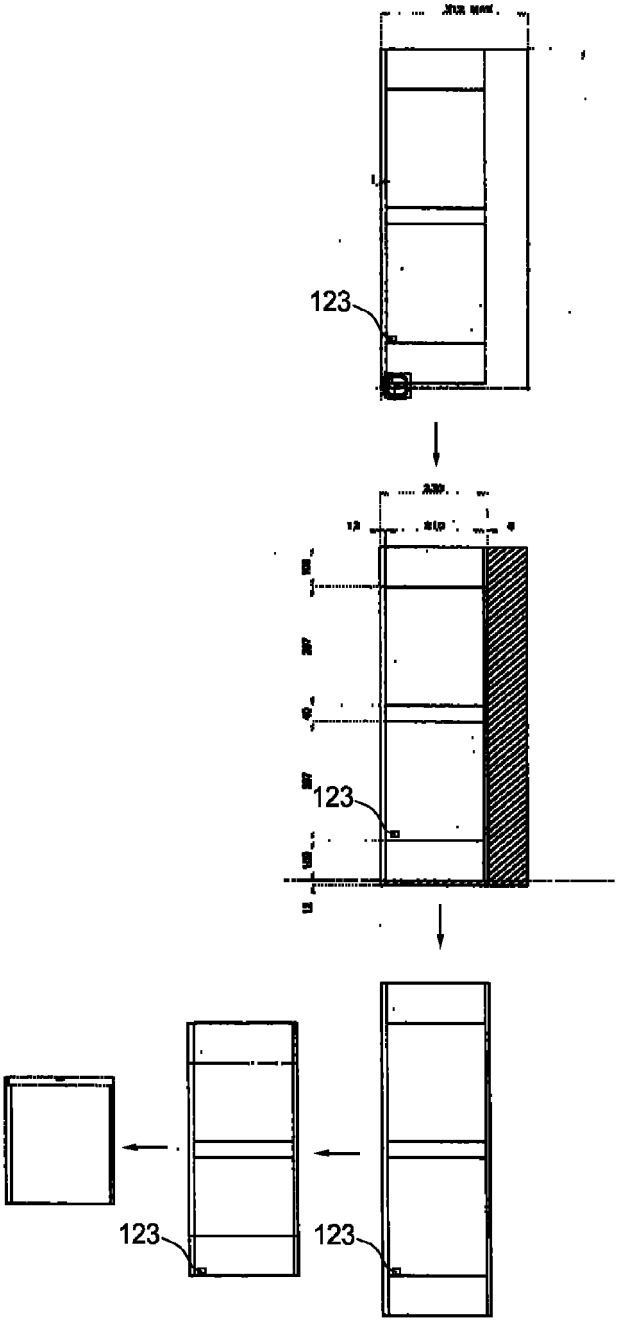

Fig. 16

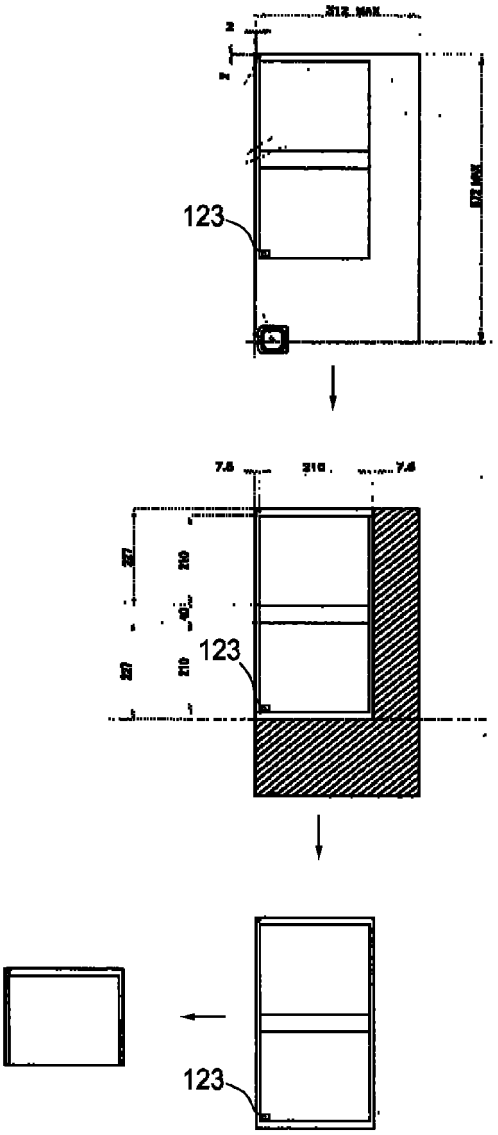

Fig. 17

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 0185466 A **[0015]**
- EP 1741653 A **[0071]**