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(71) Applicant: **R&D Project Sp. z o.o.**

92-318 Lodz (PL)

(72) Inventor: **Kecerski, Tomasz**

92-432 Lodz (PL)

(74) Representative: **Pawlowski, Adam**

Eupatent.PL

ul. Zeligowskiego 3/5

90-752 Lodz (PL)

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(54) **A method for manufacturing of cardboard boxes and a cardboard box**

(57) A method for manufacturing of cardboard boxes from at least two cardboard sheets, comprising the steps of laminating the sheets on one side with pre-printed paper sheets having a smoothness higher than the smoothness of the surface of the cardboard sheet, die-cutting the sheets to a desired shape of die-cut pieces, joining the folded flaps (21) of the die-cuts, thus forming a box

in a flat form. Before joining the die-cuts with glue using a gluer, the flaps of the die-cuts are perforated using a rotary perforating head (11) equipped with a rotatable mandrel (14) having an adjustable height, on which there are replaceably mounted rotary toothed cutting blades (12), wherein the height of the mandrel is adjusted to a value resulting in the depth of the cuts from 10% to 90% of the thickness of the laminated cardboard.

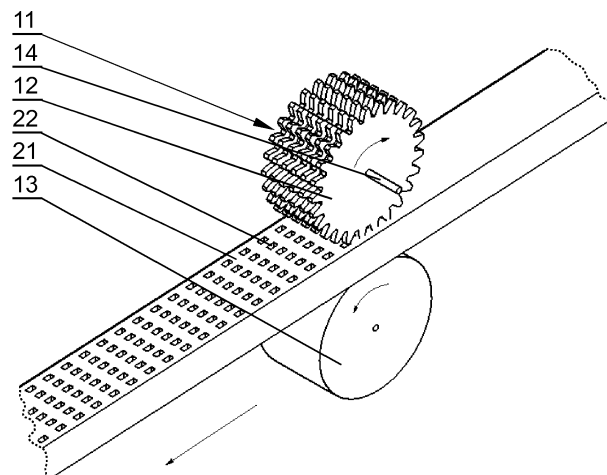


Fig. 4

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Description

[0001] The invention relates to a method for manufacturing of cardboard boxes and to a cardboard box.

[0002] A typical process of manufacturing cardboard boxes as packaging for various objects covers basic steps such as designing the box, preparing die structure, laminating cardboard with pre-printed paper, die-cutting the cardboard and connecting formed die-cuts with the flat profile of the box. Laminating is a necessary process and it usually takes place when an object put inside a box is exhibited for sales; in this case laminated box is visually more attractive than unlaminated one and thus it serves marketing purpose. Large size boxes, which after unfolding are bigger than the largest die-cuts available at the disposal of the box producer, must be produced by joining at least two die-cuts. As far as unlaminated boxes are concerned, their die-cuts are generally connected by gluing. However, gluing laminated boxes may be difficult, due to the high smoothness of pre-printed paper, which is hardly adhesive for a glue, thus necessitating the use of more expensive glues or making use of a special technique, e.g. hot melt. One can also use mechanical binding techniques, for example with staples, which guarantee firm and durable binding of sheets, but at the same time introduce a non-paper component to the package, which impedes the packaging recycling.

[0003] The aim of the invention is to develop environmentally friendly method of manufacturing cardboard boxes from at least two die-cuts of slippery external surface, which guarantees the durability of die-cut binding.

[0004] The object of the invention is a method for manufacturing of cardboard boxes from at least two cardboard sheets, comprising the steps of laminating the sheets on one side with pre-printed paper sheets having a smoothness higher than the smoothness of the surface of the cardboard sheet, die-cutting the sheets to a desired shape of die-cut pieces, joining the folded flaps of the die-cuts, thus forming a box in a flat form. Before joining the die-cuts with glue using a gluer, the flaps of the die-cuts are perforated using a rotary perforating head equipped with a rotatable mandrel having an adjustable height, on which there are replaceably mounted rotary toothed cutting blades, wherein the height of the mandrel is adjusted to a value resulting in the depth of the cuts from 10% to 90% of the thickness of the laminated cardboard.

[0005] Preferably, the method involves selecting the cutting blades according to the desired pattern and width of the perforation cuts.

[0006] Preferably, the method involves adjusting the spacing of the cutting blades on the mandrel by spacers according to the desired distance between the perforation cuts.

[0007] Preferably, the method involves adjusting the number of the cutting blades on the mandrel according to the desired width of the perforation.

[0008] Another object of the present invention is a

glued cardboard box manufactured by the method according to the invention.

[0009] The advantage of the invention is that the method of manufacturing cardboard boxes, based on binding die-cuts by gluing them at the point of perforated glue flaps allows to produce boxes with firm and durable binding of die-cuts, which are at the same time environmentally friendly, especially during recycling. The method based on the invention is suitable for offset printing boxes and boxes with slippery external surface obtained from laminating the cardboard with high smoothness and/or gloss.

[0010] The present invention is shown by means of exemplary embodiment on a drawing, in which:

Fig. 1 presents the diagram of technological line for manufacturing cardboard boxes.

Fig. 2 presents the diagram of technological process for manufacturing cardboard boxes.

Fig. 3 presents the joint gluer for joining die-cuts together.

Fig. 4 presents perforation head of the gluer.

Fig. 5 presents example die-cuts, from which cardboard box is made.

Fig. 6A presents the method of folding die-cut glue flaps on a gluer.

Fig. 6B presents the view of joint die-cuts in vertical cross-section, obtained from the gluer.

[0011] Fig. 1 presents the diagram of technological line for manufacturing cardboard boxes, whilst Fig. 2 presents the diagram of the subsequent steps of technological process of their production. The first stage 201 involves designing of packaging using a computer design system; then, after determining its shape, dimensions as well as the number and shape of the die-cuts from which the packaging will be assembled, the second step 202 features the preparation of the die structure. In order to enhance visual and marketing quality of the final packaging, the cardboard sheets are laminated, i.e. covered with thin paper, preferably pre-printed. For this purpose, paper sheets need to be prepared before laminating. For this sheets a preview of the graphics placed on packaging is created as the step 203, using the design system 101. After that, by using the plotter 102, a prototype of the packaging for the review of graphic design can be produced. After the review, a printing form is produced using CTP technology, in order to prepare the printing process (CTP- Computer- to- Plate) . In the CTP technology the graphics on a computer is saved as postscript files, from which a printing form (offset plate) is exposed using an imagesetter 103 and laser beams. Thus prepared printing form is ready to print. In the next step 204, paper sheets are printed using the printer 104, and then (step 205) these printed paper sheets are used to laminate the cardboard sheets in the laminating machine 105. After the paper has been permanently merged with cardboard, usually after twelve hours, the laminated sheets are cut

in the step 206 on the automatic die 106 to form desired die- cut profiles 20A, 20B. The ready die- cuts 20A, 20B are taken to the joint gluer 107, the instruction to which is presented in Fig. 3. For example, in the case of boxes produced from two die- cuts, the die- cuts 20A, 20B are placed in the gluer 107 by laying the first die- cut 20A on the feeder 14A and the second die- cut 20B- on the feeder 14B located under the feeder 14A. The die- cuts 20A, 20B may preferably be of identical shape, as presented in Fig. 5. It is vital that the die- cuts 20A, 20B are placed on the feeders 14A, 14B in such a way that the unlaminated sides of cardboard sheets are facing each other. It is also important that the glue flaps 21A, 21 B, with which the die- cuts are joined, face the direction of side edges 18, 19 of the gluer 107 alternately, i.e. so that the glue flap 21A of the first sheet 20A faces the first side edge 18 of the gluer 107, and the glue flap 21 B of the second sheet 20B faces the second side edge 19 of the gluer 107. The die- cuts placed on the feeder are then transported on the conveyor belt of the gluer 107 and through the perforation unit (step 208) , presented in more detail in Fig. 4.

[0012] The perforation unit comprises a rotary perforation head 11 and a platen roller 13. The perforation head 11 rotates in the direction opposite to the platen roller 13. The perforation head 11 is equipped with rotary driven mandrel 14 on which replaceable toothed rotary cutting blades are mounted. The height of the mandrel 14 can be preferably adjusted to a value guaranteeing the depth of cuts 10% to 90% of laminated cardboard thickness. The cut depth can also be set to a value equal to 100% of laminated cardboard thickness or higher. However, this requires using the platen roller with grooves for inserting cutting blades into, and apart from that the cuts formed this way 22 would be visible from the outside of the cardboard. The joint gluer is equipped with two perforation units located at both of its edges 18, 19, which allows one unit to conduct perforation on the first die-cut 20A and the other - on the second die-cut 20B. The perforation is performed on the glue flaps 21A, 21 B of the die-cuts, with which the die-cuts will be joined in the next step.

[0013] The depth of the cuts 22 done by the cutting blades 12 of the head 11 can be adjusted using the head 11 settings; this mostly depends on the number of cardboard layers and the type of flutes on corrugated cardboard. The mandrel 14 of the head can hold any number of cutting blades 12, depending on the width and desired perforation, therefore, as a result of reduction or adding new blades, the width of the head may change. By replacing the cutting blades, which vary in the shape of protruding teeth, the pattern and width of cuts can also be adjusted. It is also possible to separate the blades with spacers, which allow to regulate the density of cuts. The head can slide both vertically and horizontally, therefore, apart from height adjustment which determines the depth of cuts, the distance of cut from the edge of the die-cut can be also adjusted.

[0014] Perforating the glue flaps 21A, 21 B, i.e. at the binding point of the die-cuts 20A, 20B facilitates the joining of die-cuts using glue, as it allows for glue penetration into the cuts. Glue penetrates the porous structure of cardboard much more easily than in the case of the surface of pre-printed paper, which is smooth and glossy. One of the advantages is that the perforation process allows for permanent binding of the die-cuts 20A, 20B using glues with relatively low adhesion, i.e. less expensive. For example, it allows the use of glues for cold gluing, which is considerably cheaper than hot gluing, as it consumes less energy and makes use of cheaper glue.

[0015] The application of adjustable perforation unit facilitates perforation of glue flaps of many different die-cuts, which eliminates the need to use a separate perforation press die for each type of die-cut. Furthermore, it allows for perforation on the level below 100% of the box thickness, which would not be possible to achieve using typical press die.

[0016] After the perforation, the guiding elements 15 fold the glue flaps 21 A, 21 B to the inside (step 209), i.e. to the direction of the unlaminated side of the die-cuts 20A, 20B, after which glue applicators 16 apply a layer of glue onto the laminated side of the glue flaps 21A, 21 B (step 210). Then, in the step 211, the glue flaps are pressed against each other in the press area 17, so that the glue flap 21A of the first die-cut 20A from the laminated side stick to the surface adjacent to the edge 22B of the second die-cut 20B from the unlaminated side and correspondingly - so that the glue flap 21 B of the second die-cut 20B from the laminated side stick to the surface adjacent to the edge 22A of the first die-cut from the unlaminated side; this is presented in Fig. 6A and 6B. Joining the die-cuts by gluing them at the point of glue flaps allows to obtain boxes with firm and durable joint. At the same time, these boxes are environmentally friendly, especially during recycling, as they do not contain metal staples, which impede the recycling process.

[0017] It is preferable that the new method of joining die-cuts is suitable for boxes with offset printing and boxes with slippery external surface obtained as a result of laminating cardboard with paper of high smoothness and/or gloss, for example chalk paper, GD2, HK Liner, Q-Liner, as well as lacquered paper and any other paper which is difficult to glue using traditional methods.

[0018] Complete boxes in flat form are placed on pallets (step 212) in the station 108 and ready to stock in the storage 109 or transport (step 213).

Claims

1. A method for manufacturing of cardboard boxes from at least two cardboard sheets, comprising the steps of:

- laminating the sheets on one side with pre-printed paper sheets having a smoothness high-

er than the smoothness of the surface of the cardboard sheet,

- die-cutting the sheets to a desired shape of die-cut pieces (20A, 20B),
- joining the folded flaps (21A, 21 B) of the die-cuts(20A, 20B), thus forming a box in a flat form **characterized by:**
- before joining the die-cuts (20A, 20B) with glue using a gluer,
- perforating the flaps of the die-cuts using a rotary perforating head (11) equipped with a rotatable mandrel (14) having an adjustable height, on which there are replaceably mounted rotary toothed cutting blades (12),
- wherein the height of the mandrel (14) is adjusted to a value resulting in the depth of the cuts from 10% to 90% of the thickness of the laminated cardboard.

2. The method according to claim 1, **characterized by** selecting the cutting blades (12) according to the desired pattern and width of the perforation cuts.
3. The method according to claim 1, **characterized by** adjusting the spacing of the cutting blades (12) on the mandrel (14) by spacers according to the desired distance between the perforation cuts.
4. The method according to claim 1, **characterized by** adjusting the number of the cutting blades (12) on the mandrel (14) according to the desired width of the perforation.
5. A glued cardboard box manufactured by the method according to any of claims 1-4.

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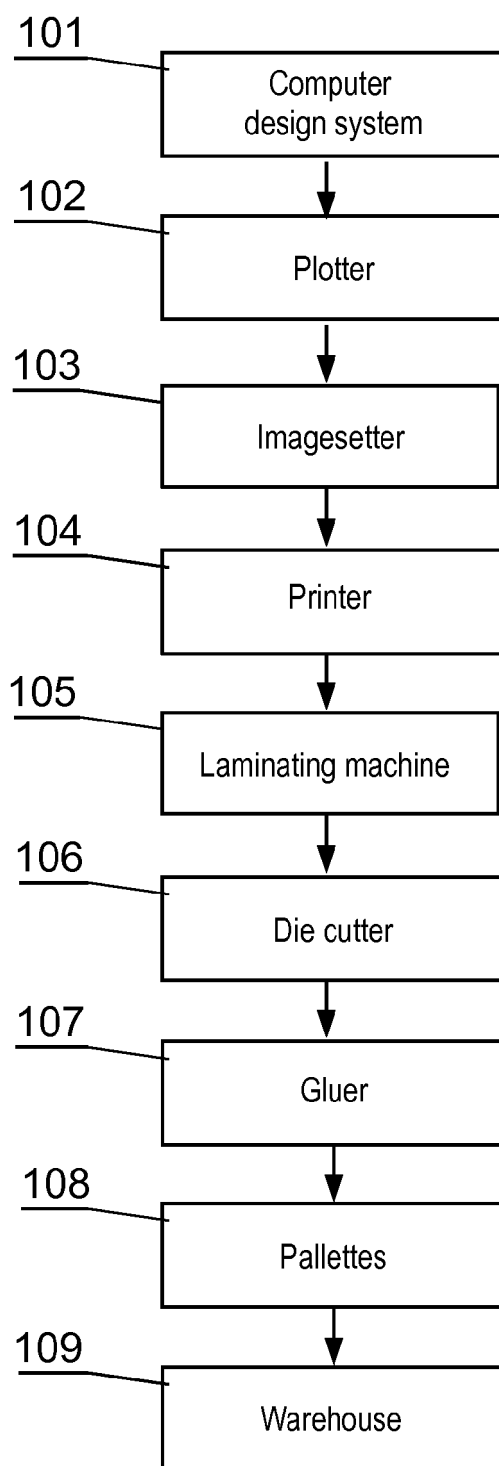


Fig. 1

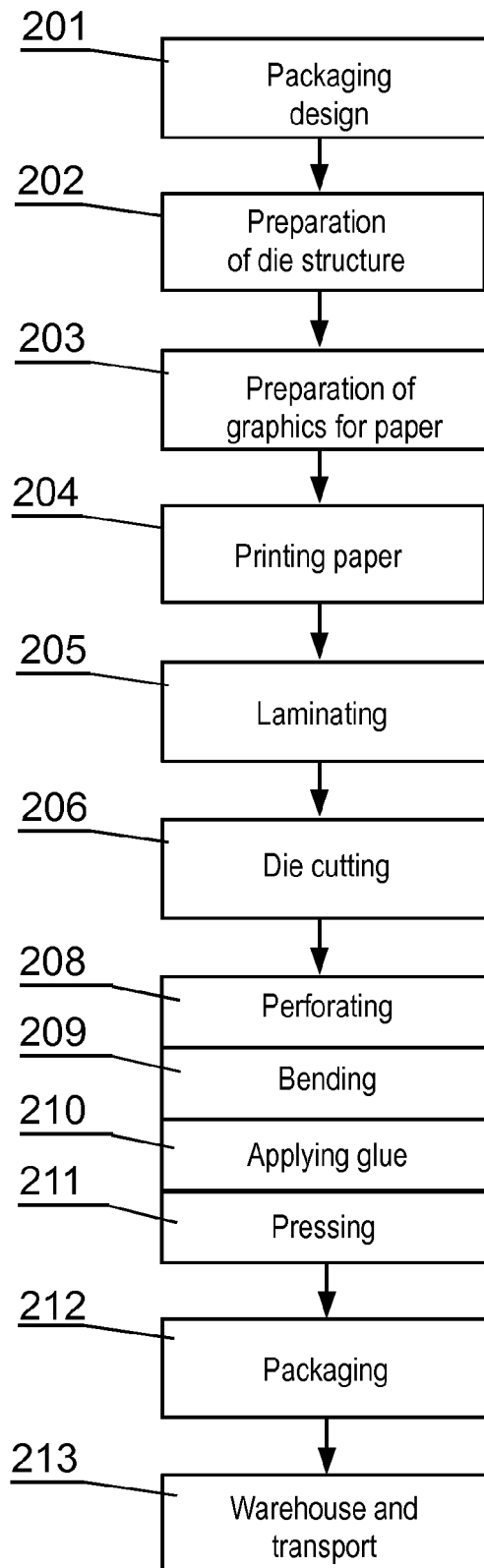


Fig. 2

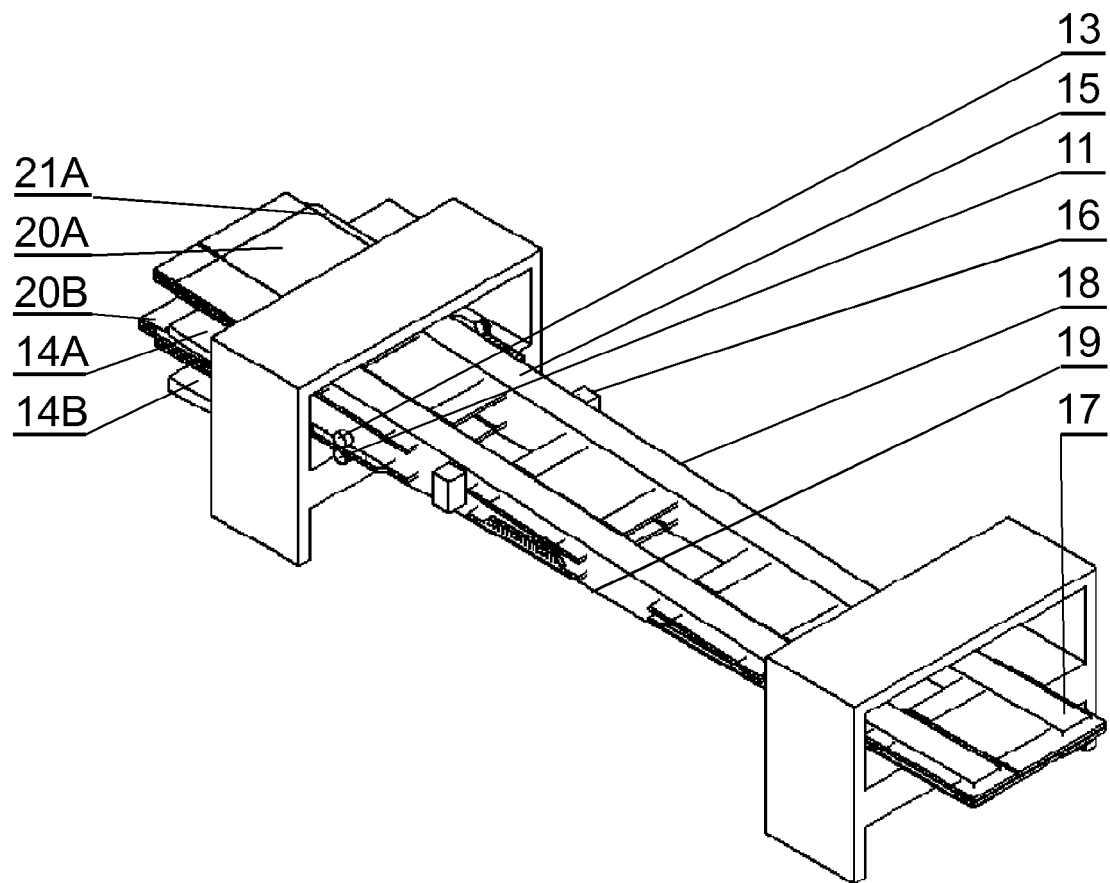


Fig. 3

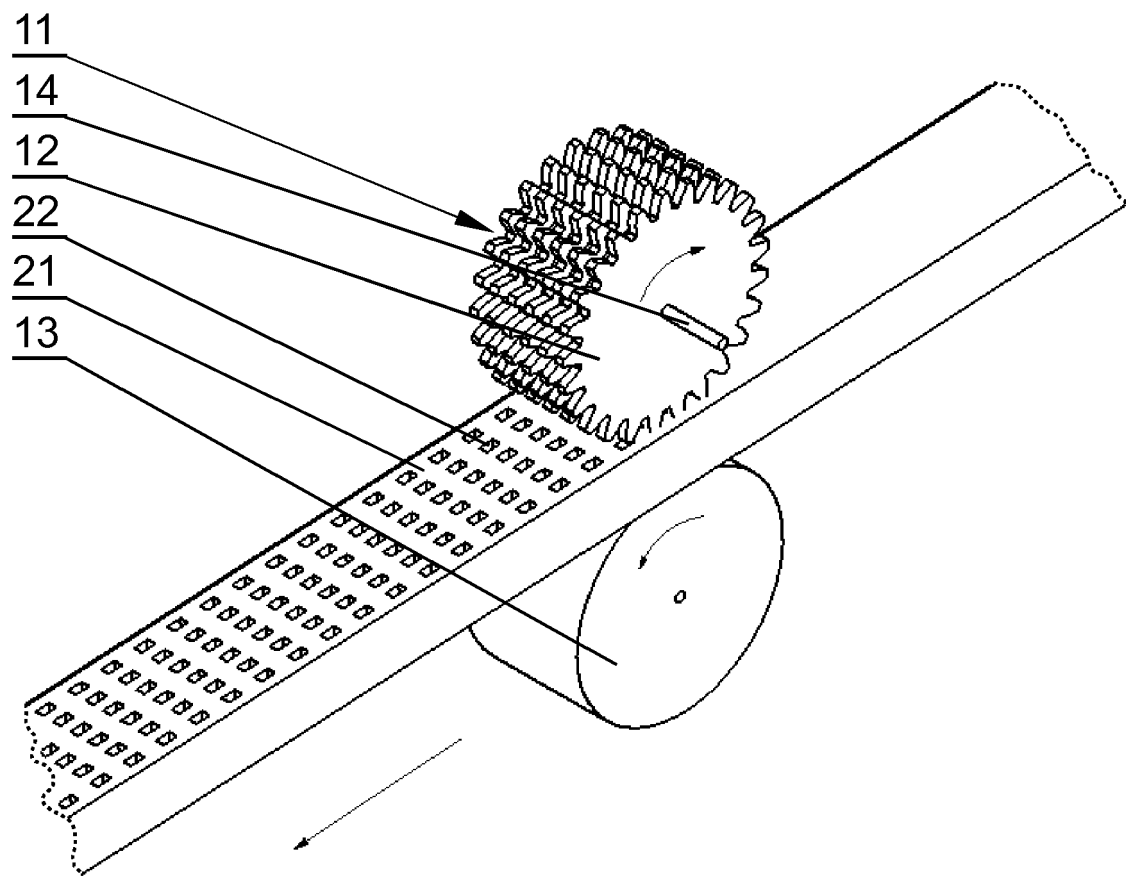


Fig. 4

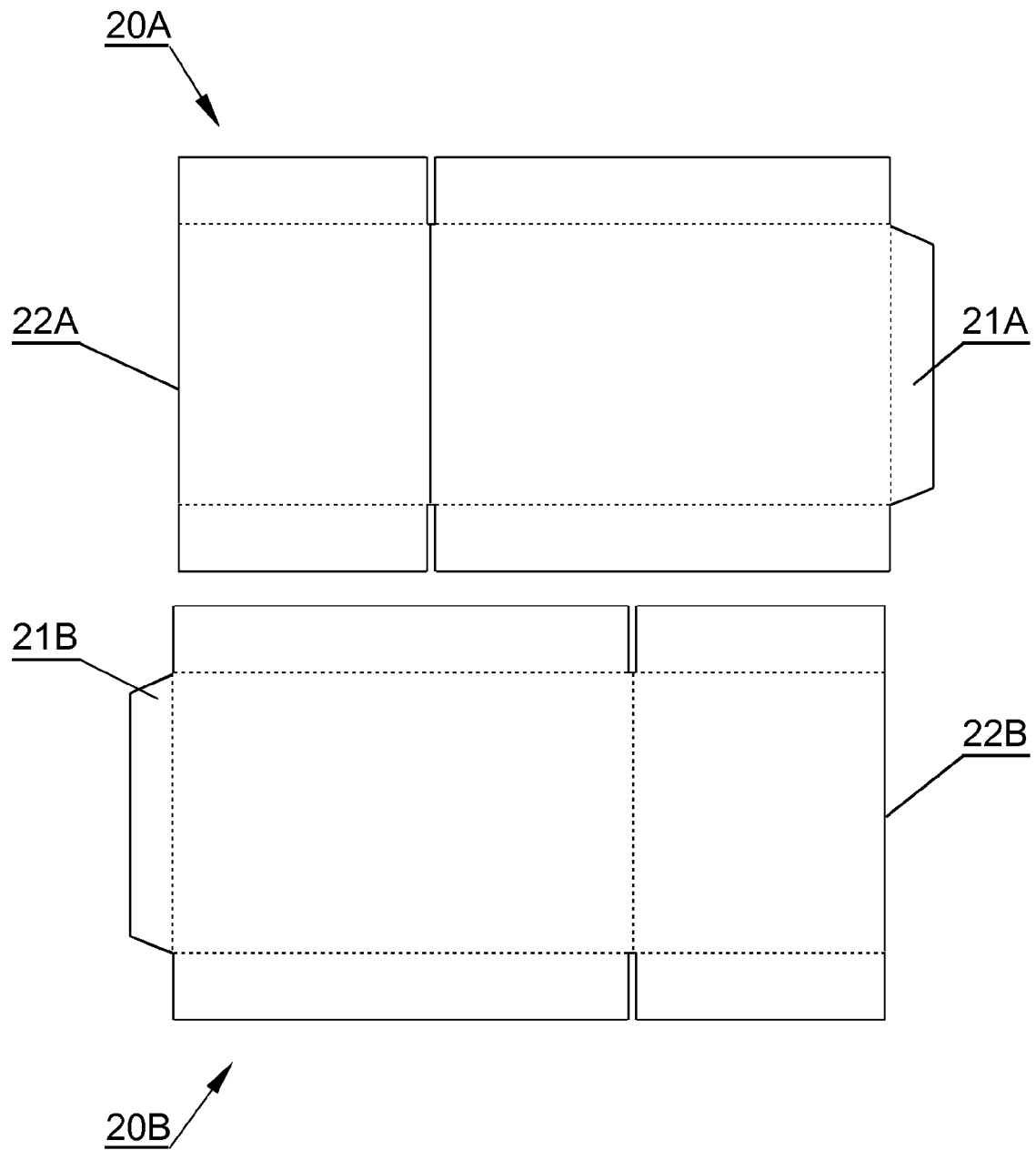


Fig. 5

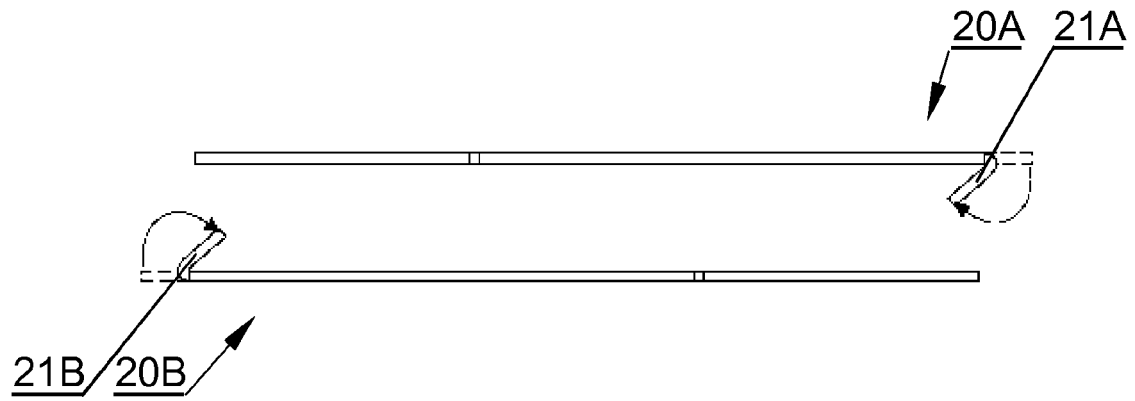


Fig. 6A

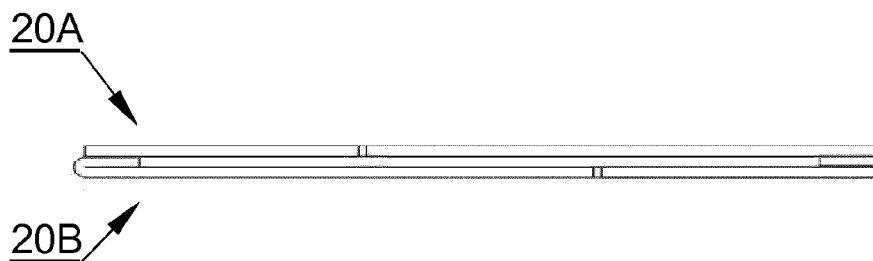


Fig. 6B