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(71) Applicant: NEOPOST TECHNOLOGIES [FR/FR]; 113,
rue Jean-Marín Naudin, F-92220 Bagneux (FR).

(72) Inventor: HUIZINGA, Erik; Wester Es 6, NL-8426 BK
Applescha (NL).

(74) Agent: CBDL PATENTANWÄLTE; Königstraße 57,
47051 Duisburg (DE).

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(57) Abstract: An apparatus for rigidifying cardboard (10) having at least one fold (12), comprising creasing means for forming indentations (14) on at least one side of said cardboard (10), said creasing means being adapted to form said indentations (14) such that at least some of said indentations (14) intersect said at least one fold (12).



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APPARATUS AND METHOD FOR RIGIDIFYING CARDBOARD,
SYSTEM AND METHOD FOR AUTOMATICALLY FORMING PACKAGING BOXES
USING SAID APPARATUS AND SAID METHOD FOR
RIGIDIFYING CARDBOARD

5

TECHNICAL FIELD OF THE INVENTION

10 The invention relates to an apparatus and a method for rigidifying cardboard having at least one fold. The invention also relates to a system and a method for automatically forming packaging boxes employing said apparatus respectively said method for rigidifying cardboard.

15

BACKGROUND OF THE INVENTION

In recent years, mail ordering has become increasingly common. In order to cope with the increased need for packaging mail ordered items, different systems and methods for automatically forming packaging boxes have been proposed. US 2008/0020916 A1
20 discloses a box-making machine, which executes creasing and cutting steps to obtain a cardboard blank, which is then folded to obtain a packaging box from the blank. The invention may be advantageously used in this type and similar types of machines.

For making cardboard blanks to be used in box-making machines, usually a long web
25 of cardboard is fed to such machine either from a roll of corrugated cardboard or from a stack, in which the web is zigzag folded into panels. Corrugated cardboard from a roll is flexible in one direction. Without special measures or treatment, it is not well suited for making packaging boxes.

30 Zigzag folded cardboard has the disadvantage that there are transversal folds in the source material at the positions where the panels are connected. These folds are usually not at positions where folds are needed in a blank that is to be cut from the source material. This is especially the case, when the sizes of the blanks to be cut vary while the panels in a stack of cardboard have a fixed size. Avoiding that a fold in the

source material will appear in the blank limits the maximum blank size (namely to the distance between two folds), and causes an undesired amount of waste material.

When such folds are present in a blank that is used to fold a packaging such as a box, there is a risk that the blank will not be folded at the intended crease lines, but at the folds that were already present in the source material. This may cause undesired effects during or after the fold process and may cause crashes and/or damage to the packaging and/or articles being packed or result in an undesired appearance of the packaging and/or insufficient protection of the articles inside the packaging.

DISCLOSURE OF THE INVENTION

It is an object of the invention to disclose an apparatus and a method that allow rigidifying cardboard having at least one fold in an easy manner.

It is an object of the invention to facilitate obtaining packaging material with increased stiffness from a cardboard stack that is formed by zigzag folding a cardboard web into panels connected via transverse folds, thereby reducing waste when forming e.g. blanks for boxes from said material and making the blank size independent of the distance between folds connecting the panels.

It is an object of the invention to improve production of cardboard boxes using cardboard from a stack of a zigzag folded cardboard web with transverse folds in respect of preciseness and/or stability of the cardboard boxes.

These and other objects are achieved by an apparatus for rigidifying cardboard having at least one fold comprising creasing means for forming indentations, which are preferably line-shaped, on at least one side of said cardboard, wherein at least some of said indentations intersect said at least one fold. These objects are likewise achieved by a corresponding method comprising a step of conveying cardboard having at least one fold through an apparatus according to the invention and forming preferably line-shaped indentations on at least one side of said cardboard, wherein at least some of said indentations intersect said at least one fold.

It has turned out that by making indentations crossing a fold in a cardboard, the tendency of the cardboard to bend at said fold can be stopped. Hence, when a blank for a box or any other item is formed from said cardboard by cutting and by providing crease lines, the risk that upon automated folding of such blank the blank will bend at undesired positions, namely at the folds resulting in particular from zigzag folding said cardboard for transportation purposes, can be minimized. Cardboard is thus obtained wherein the stiffness of the cardboard is improved at least locally around the fold.

It should be noted that although a typical use of the invention will be in forming boxes from cardboard web having been zigzag folded for transportation purposes, the invention is not limited to such applications. It can be used whenever the tendency of cardboard to bend at a fold shall be minimized.

It should also be noted that if the cardboard shall be cut and/or folded, the indentations can be made before or after cutting the cardboard, e.g. before or after cutting out a blank or any other item from the cardboard, and before or after providing the cardboard with crease lines, at which the cardboard shall be folded, but of course the indentations have to be made before actually folding the cardboard. The invention allows that new crease lines can be made in cardboard even very close to a fold, if before making such new crease lines indentations crossing the fold are made.

It should also be noted that the term "line-shaped" is to be understood as an expert in the art would do and is not limited to straight lines, although in most embodiments the lines will be straight as such lines can easily be made on the fly when conveying cardboard through an apparatus according to the invention. The indentations may intersect the fold substantially perpendicular. For conveying cardboard, the apparatus may comprise suitable conveying means such as driven rollers, belts or the like.

In one embodiment, the creasing means are movable between an idle position, in which they cannot form indentations on the cardboard, and an operating position, in which they can form indentions on the cardboard. This is one option to achieve that indentations are only made at certain positions in the cardboard, which in most cases will be desired, i.e. only locally around a fold. It should be noted that the creasing means generally will comprise an indentation part that actually indents (or in other

words impresses or creases) the cardboard and a supporting part that forces the cardboard towards the indentation part. Such supporting part can be in the form of a simple rigid guiding table, along which the cardboard can slide. In a preferred embodiment, the supporting part will be in the form of at least one press roll that can be driven and hence also function as a means for conveying the cardboard through the apparatus. The supporting part, in particular a press roll, can be made of a material allowing some compression in order to compensate certain variations in the thickness of the cardboard that may occur. Generally, the distance between the indentation part and the supporting part may be adjustable.

To further automate the process of rigidifying cardboard, the apparatus may comprise means for automatically detecting a fold in cardboard fed to or through the apparatus. This would allow bringing the creasing means automatically in an operating position at locations where indentations should be made. Such detecting means may comprise a thickness sensor.

In a preferred embodiment, the creasing means are adapted to form a plurality of indentations simultaneously. Typically, the method and the apparatus of the invention will be used to reinforce zigzag folded cardboard along the transverse folds that were made when a cardboard web was zigzag folded. Typically, to reinforce such fold indentations will be made having a "pitch" (a distance from one to the other along the fold) in the region of a few millimeters to several centimeters, wherein the expert advantageously can choose the pitch according to the properties of the respective cardboard. If the cardboard is rather stiff, a greater pitch and hence fewer indentations may be sufficient to reinforce the cardboard in the region of a fold. The indentations typically have a length of about 1 to 10 cm each, preferably of about 2 to 5 cm and/or a width of about 1 to 5 mm each, preferably of about 1 to 3 mm. The maximum depth of each indentation is typically between 0.5 and 1.5 times the maximum depth of said at least one fold.

In one embodiment, the creasing means are arranged to form a plurality of indentations from two opposite sides of cardboard at substantially matching positions. For example, depending on the properties of the cardboard to be rigidified, it may be advantageous to provide along a transverse fold numerous parallel indentations from

both sides of the cardboard at matching positions, i.e. such that an indentation on one side of the cardboard has a corresponding indentation on the other side of the cardboard. In another embodiment, the creasing means are arranged to form a plurality of indentations from two opposite sides of cardboard at shifted positions. For example, it may be desired to provide indentations always only from the side, on which a fold to be reinforced is actually impressed in the cardboard, if folds are impressed from different sides of the cardboard. In a zigzag folded cardboard web, it may be foreseen that those folds are alternatingly impressed on both sides of the cardboard web. Typically, a fold will be provided on both sides of a cardboard at matching positions, i.e. two transverse grooves will be noticeable in the cardboard. However, after folding the cardboard web along said folds, usually one of the grooves will be more pronounced than the other. Hence, it may be desired to be able to make one row of parallel indentations along a first fold in the cardboard from one side of the cardboard followed by a second row of parallel indentations along a second fold in the cardboard from the opposite side of the cardboard. Advantageously, the apparatus according to the invention may be designed such that creasing means on both sides of the transport path of cardboard fed through the apparatus are provided in an adjustable manner, such that the creasing means can be operated simultaneously to make indentations simultaneously from both sides of a cardboard fed through the apparatus or alternating on opposite sides of such cardboard.

The creasing means may comprise a plurality of cams arranged on at least one shaft. Such at least one shaft may be rotatably mounted in order to bring the cams in an operating position and in an idle position. In a preferred embodiment, two shafts each bearing a plurality of cams are provided to form preferably line-shaped indentations on two opposite sides of cardboard. If cams are provided, a cam drive mechanism may be activated to make indentations starting slightly before the location of the fold to be stabilized, and ending slightly after this fold, so that indentations with a length of a few centimeters in the direction of transport (preferably perpendicular to the fold line) will be made on the cardboard. The cams may be rotated e.g. by a stepper motor or via a clutch mechanism into an idle position, in which the cams do not contact cardboard fed through the apparatus.

Additionally or as an alternative, the creasing means may also comprise at least one pusher and/or at least one roller having a protrusion to form indentations on the cardboard.

5 The invention also relates to a system for automatically forming packaging boxes from cardboard having at least one fold, wherein the system comprises an apparatus according to the invention. Such system will typically comprise numerous stations like a station for cutting out blanks, which may be customized individually, a station for providing a blank with crease lines and a station for folding a box from said blank.

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The invention also relates to a method for automatically forming packaging boxes from cardboard having at least one fold, wherein the method comprises a step of rigidifying said cardboard by forming indentations crossing said fold.

15 Further objects, features and advantages of the invention will become apparent from the following non-limiting description of preferred embodiments in conjunction with the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1A shows a top view onto a cardboard section before processing it according to the invention.

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Figs. 1B shows a sectional view of the cardboard section shown in Fig. 1A.

Fig. 2A shows a top view onto the cardboard section shown in Fig. 1A after being processed according to the invention.

30

Fig. 2B shows a sectional view along the cut line B-B shown in Fig. 2A.

Fig. 2C shows a sectional view along the cut line C-C shown in Fig. 2B.

Fig. 3 shows schematically a first arrangement of cams in an embodiment of the invention.

Fig. 4 shows schematically a second arrangement of cams in another embodiment of the invention.

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Fig. 5 shows schematically a view onto a face side of a pair of the cams shown in Fig. 3 and Fig. 4, respectively.

Fig. 6 shows schematically a third arrangement of cams in another embodiment of the invention.

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Fig. 7 shows schematically a view onto a face side of a pair of the cams shown in Fig. 6.

Fig. 8 shows schematically a fourth arrangement of cams in another embodiment of the invention.

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Fig. 9 shows schematically a view onto a face side of a pair of the cams shown in Fig. 8.

20

Fig. 10 shows schematically a system according to the invention.

Fig. 11 shows schematically the use of a pusher for making an indentation on a cardboard.

25

Fig. 12 shows another example of a pusher.

Fig. 13 shows schematically different shapes of cross sections of cams or pushers in the region of contact with cardboard.

30

Fig. 14 shows schematically a pattern of indentations formed over a fold in a cardboard.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figures 1A and 1B show schematically and for the purpose of facilitating understanding of the invention only a section 10 of a cardboard with a transverse fold 12 being formed by two elongated grooves on corresponding positions on each side of the cardboard. It should be noted that as is common in the art, the cardboard is referred to as having a first and a second side, which are opposite to each other, while of course there are slim sides surrounding each cardboard section. However, as generally the cardboard is a thin sheet-like item having two main surfaces, only these surfaces are denoted as "sides".

Typically, the cardboard section 10 shown in Figures 1A and 1B will be a section of a long cardboard web that has been zigzag folded into a stack of panels for transportation purposes, as is schematically indicated in Fig. 10, which will be explained later. Obviously, a cardboard section 10 having a fold 12 will always have a tendency to bend at fold 12.

Figures 2A, 2B and 2C schematically show the situation of a cardboard section 10 having a fold 12 after having been processed according to the invention and hence after having been provided with numerous, in this case substantially parallel line-shaped indentations 14 crossing the fold 12. As will be apparent for an expert in the art, Figures 2A, 2B and 2C are again only rather schematic drawings not drawn to scale.

Typically, a cardboard web processed in an apparatus according to the invention will have a width in the region of 1 m and a length in the region of about 100 or more meters being zigzag folded into panels each having a length in the region of about 1 to 1.5 m. A typical fold that runs traverse such cardboard web to facilitate zigzag folding may have a width in the region of about 1 or 2 mm. The indentations 14 provided in the shown embodiment such that they cross the fold 12 on one side of the cardboard section 10 only will have a width indicated between the lines 16 of about 1 or 2 mm and a length of several centimeters, for example a length in the region of about 5 cm. The indentations 14 are spaced apart by a distance 18 (usually called "pitch") in the

region of several centimeters. The maximum depth of each indentation 14 will typically be in the region between 0.5 and 1.5 times the maximum depth of the fold 12.

Advantageously, the invention allows the expert to choose the number and the pitch of indentations and the length, the width and the depth of each indentation according to the material properties of the cardboard to be processed. For example, if the cardboard is rather stiff per se, fewer indentations may provide sufficient stability to prevent the cardboard to bend at the fold. If the cardboard is rather thick, the indentations will typically be deeper than in cases where the cardboard is thin. It should also be noted that the term "line-shaped" does not only comprise straight lines, but comprises many different forms of lines such as wave lines or zigzag lines. For certain applications, it may even be appropriate to use indentations having rectangular or oval or other forms.

To form the indentations, an apparatus according to the invention comprises creasing means. Figures 3 to 9 show four different arrangements of cams provided on driven shafts, wherein each cam functions as a creasing means to form an indentation. In the embodiments schematically shown in Figures 3 to 9, a first row of in this case substantially parallel cams 20 is provided on a first rotatably driven shaft 22. A second row of substantially parallel cams 24 is provided on a second rotatably driven shaft 26. Throughout the Figures 3 to 9, the dashed line on each cam 20, 22 indicates, where in respect of the transport path of cardboard fed through an apparatus provided with such cams, the cams would end if turned in an idle position. As will be clear for an expert in the art, turning the cams from the operating positions shown for example in Figures 5 to 7 to an idle position will increase the free space between the cams arranged on shaft 22 and the cams arranged on shaft 26 so that cardboard could pass between those cams without being indented. It should also be noted that the space between adjacent cams 20 on shaft 22 respectively between adjacent cams 24 (or 28) on shaft 26 can be filled up about the height of the respective dashed lines with material forming press rollers which may function as supporting parts forcing cardboard towards cams on the opposite shaft. Suitable material for such press rollers may have a certain resiliency to allow cardboard having deviations in thickness to pass through. The distance between the shafts 22 and 26 may be adjustable. It should be noted that the mutual distance or pitch between the cams on each shaft may also be adjustable.

Figures 3 and 4 show arrangements of cams 20 and 24 on shafts 22 and 26 for simultaneously making indentations from both sides of a cardboard. In Fig. 3, the indentations made with the cams 20 will be shifted with respect to the positions of indentations made by the cams 24. With arrangements shown in Fig. 4, the
5 indentations made on both sides will match, i.e. for each indentation on one side of the cardboard a corresponding indentation will be made from the opposite side. A side view of the arrangements shown in Fig. 3 and Fig. 4 will in both cases lead to a view like the schematic view shown in Fig. 5.

10 Figures 6 and 7 show another arrangement of cams 20 and 28 on two shafts 22 and 26, the cams 28 being adapted to make thinner indentations than the cams 20 on shaft 22. Each cam 20 is associated with two cams 28 on shaft 26. Hence, on one side of cardboard fed through an apparatus equipped with such arrangement thicker but fewer indentations will be produced while and on the opposite side of said cardboard more
15 and thinner indentations will be produced.

In Figures 8 and 9, an arrangement of cams 20 on shaft 22 and cams 24 on shaft 26 is shown, which arrangement is adapted for making alternating indentations on opposite sides of cardboard fed through an apparatus equipment with such arrangement. In the
20 position shown in Figures 8 and 9, the upper cams 20 are in the working or operating position, whereas the lower cams 24 are in the idle position. Preferably, the cams are made of a relatively hard material like metal.

It will easily be understood for an expert in the art that by rotating one of the shafts 22
25 or 26 as shown in Fig. 4 and Fig. 8, one and the same apparatus can be configured to produce indentations on opposite sides of a cardboard at matching or shifted locations.

Fig. 10 shows very schematically a typical system for producing custom sized boxes of cardboard 10, which is fed as indicated by arrow 32 from a stack 30 of zigzag folded
30 cardboards into different stations 36, 40, 42 of said system. At station 36, an apparatus according to the invention is provided for rigidifying the cardboard at least locally in the region of the folds 46 (of which only one is denoted in the drawing) in the cardboard. The system comprises suitable conveying means such as rollers or belts for conveying said cardboard through the system. A detection device for detecting folds can be

provided such that the creasing means of the apparatus provided in station 36 can be automatically activated. In this embodiment, the system further comprises cutting and creasing station 40, in which blanks are formed from the cardboard, which then enter a folding station 42, which automatically folds and outputs custom sized boxed 44. In this
5 embodiment, cutting and creasing is done after rigidifying, but as explained above, the order of these steps can be different. Such system may be equipped with means for automatically packaging items into boxes.

In Fig. 11, a pusher 50 for making indentations in the region of a fold 12 in cardboard
10 is shown. To bring this pusher 50 into an operating position, it is movable between an idle position and an operating position as indicated by arrow 52. Fig. 12 shows a similar, but slightly different shaped pusher 54.

Fig. 13 shows very schematically three advantageous shapes A, B and C of the edges
15 of pushers 50 and 54 respectively of the edges of cams 20, 24 and 28 that come into contact with cardboard for making indentations.

Fig. 14 shows schematically a pattern of indentations 14', of which only some are provided with reference numbers and which have been formed over a fold 12 in a
20 cardboard. These indentions 14' too are considered "line-shaped" in the sense of the invention as described above and can be regarded as one long V-shaped line. Practically, each of such indentation 14' may either be formed by two separate cams slightly slated towards each other and provided on separate shafts, or by pushers having a corresponding shape or by a roller having a V-shaped protrusion.

CLAIMS

1. Apparatus for rigidifying cardboard (10) having at least one fold (12),
comprising
 - 5 - creasing means (20, 24, 28; 50; 54) for forming indentations (14) on at least one side of said cardboard (10),
 - said creasing means (20, 24, 28; 50; 54) being adapted to form said indentations (14) such that at least some of said indentations (14) intersect said at least one fold (12).
- 10 2. Apparatus according to claim 1, characterized in that said creasing means (20, 24, 28; 50; 54) are movable between an idle position and an operating position.
- 15 3. Apparatus according to claim 1 or 2, characterized in that said creasing means (20, 24, 28; 50; 54) are adapted to form a plurality of parallel indentations simultaneously.
- 20 4. Apparatus according to one of claims 1 to 3, characterized in that said creasing means (20, 24, 28; 50; 54) are adapted to form said indentations (14) such that the indentations each have a length of about 1 to 10 cm, preferably of about 2 to 5 cm and/or a width of about 1 to 5 mm, preferably of about 1 to 3 mm.
- 25 5. Apparatus according to one of claims 1 to 4, characterized in that said creasing means (20, 24, 28; 50; 54) are adapted to form said indentations (14) such that at least some of said indentations (14) intersect said at least one fold (12) substantially perpendicular.
- 30 6. Apparatus according to one of claims 1 to 5, characterized in that said creasing means comprise a plurality of cams (20, 24, 28) arranged on at least one shaft (22; 26).
7. Apparatus according to claim 6, characterized in that said at least one shaft (22; 26) is rotatably mounted.

8. Apparatus according to claim 6 or 7, characterized in that two shafts (22; 26) each bearing a plurality of cams (20, 24, 28) are provided to form line-shaped indentations on two opposite sides of cardboard (10).
- 5 9. Apparatus according to claim 8, characterized in that the distance between the two shafts (22, 26) is adjustable.
- 10 10. Apparatus according to one of claims 6 to 9, characterized in that the space between adjacent cams (20, 24, 28) on a shaft (22, 26) are filled with material forming press rollers.
- 15 11. Apparatus according to one of claims 1 to 10, characterized in that said creasing means comprise at least one roller having a protrusion to form an indentation on cardboard.
12. Apparatus according to one of claims 1 to 10, characterized in that said creasing means comprise at least one pusher (50, 54) to form an indentation on cardboard.
- 20 13. Apparatus according to one of claims 1 to 12, characterized in that said creasing means are arranged to form a plurality of indentations from two opposite sides of cardboard at substantially matching positions.
- 25 14. Apparatus according to one of claims 1 to 13, characterized in that said creasing means are arranged to form a plurality of indentations from two opposite sides of cardboard at shifted positions.
- 30 15. Apparatus according to one of claims 1 to 14, characterized in that the maximum depth of each indentation is between 0.5 and 1.5 times the maximum depth of said at least one fold.
16. Apparatus according to one of claims 1 to 15, further comprising means for automatically detecting a fold in said cardboard.

17. Apparatus according to one of claims 1 to 16, characterized in that the mutual distance or pitch between individual creasing means is adjustable.

5 18. Method for rigidifying cardboard comprising conveying cardboard having at least one fold into an apparatus according to one of claims 1 to 17 and forming indentations on at least one side of said cardboard, wherein at least some of said indentations intersect said at least one fold.

10 19. System for automatically forming packaging boxes from cardboard having at least one fold comprising an apparatus according to claims 1 to 17.

20. Method for automatically forming packaging boxes from cardboard having at least one fold comprising a step of rigidifying said cardboard according to claim 18.

15

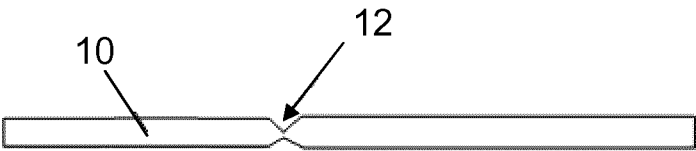


Fig. 1B

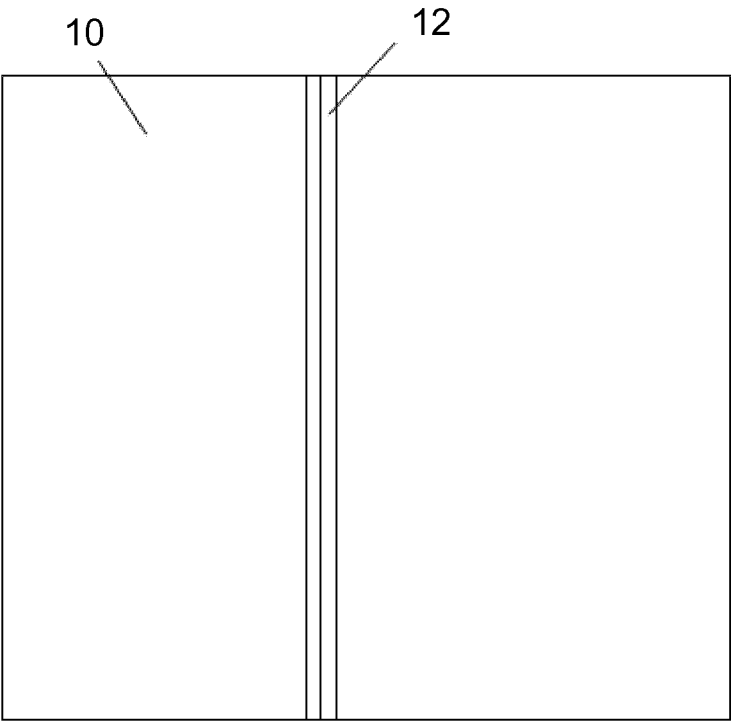


Fig. 1A

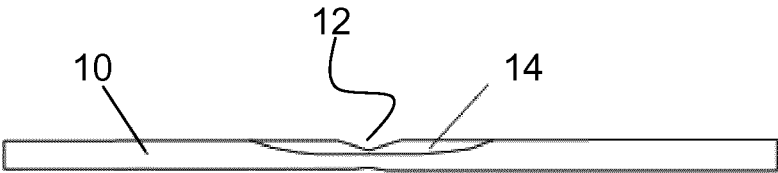


Fig. 2B

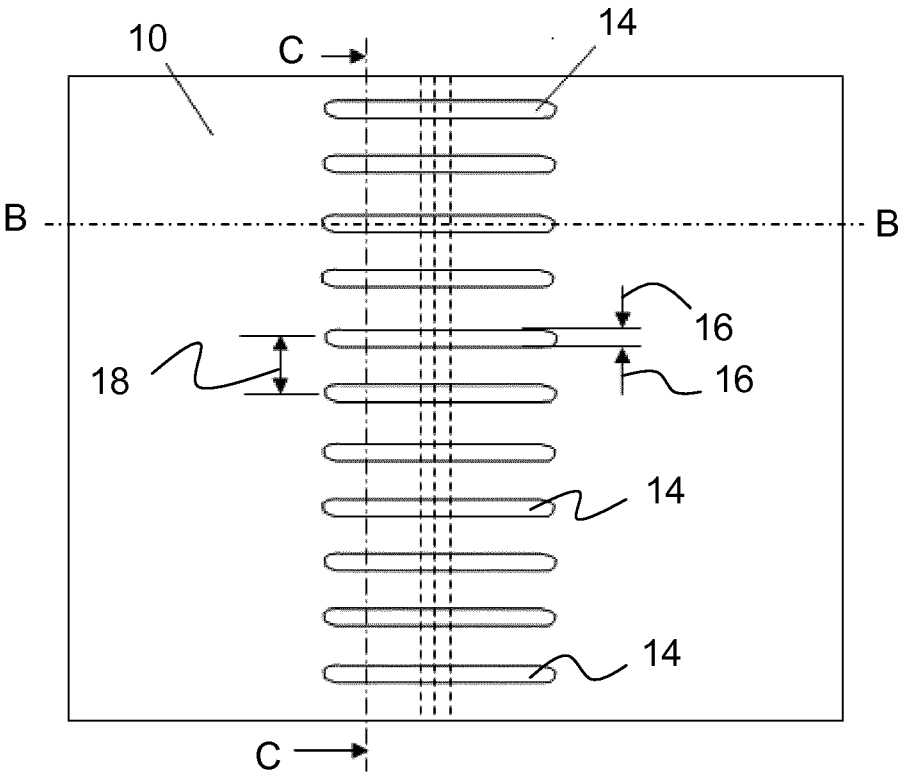


Fig. 2A

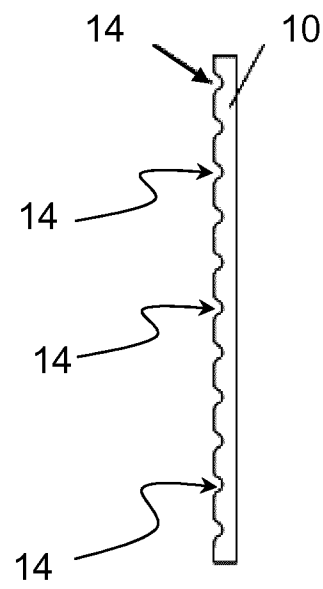


Fig. 2C

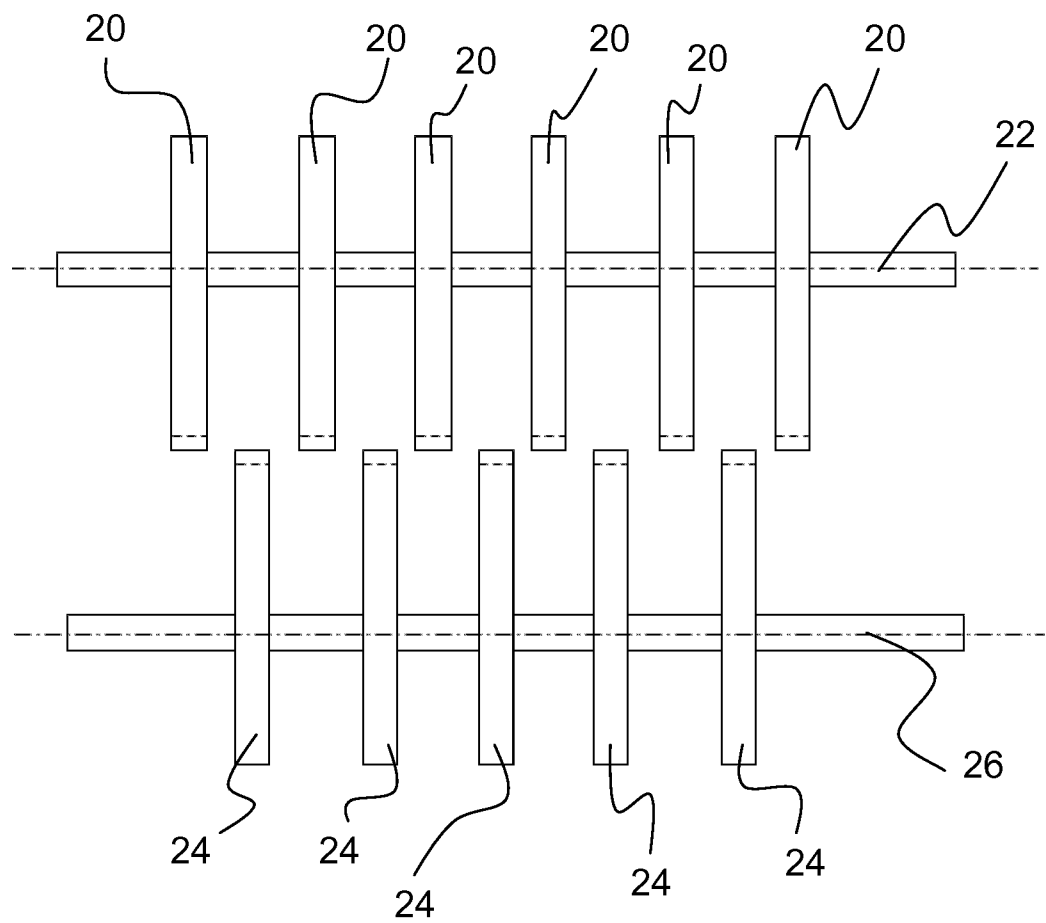


Fig. 3

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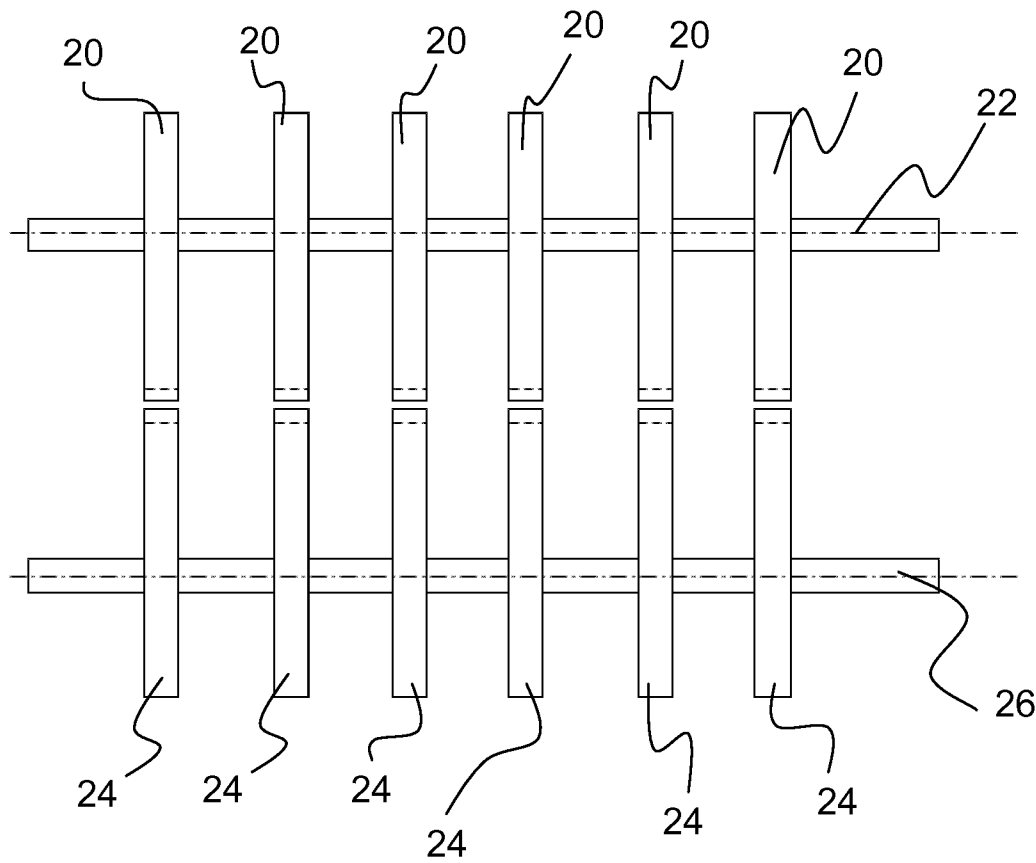


Fig. 4

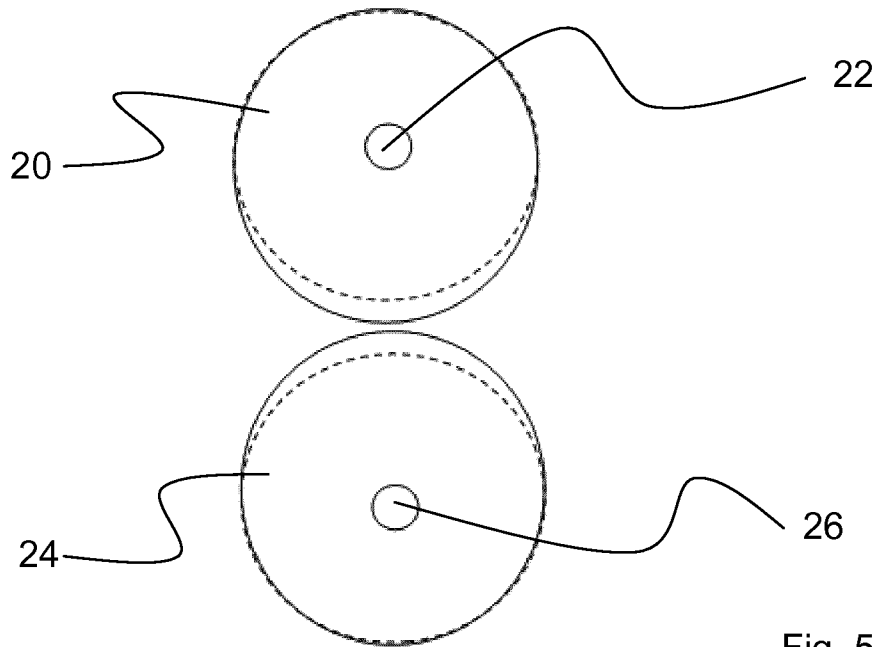


Fig. 5

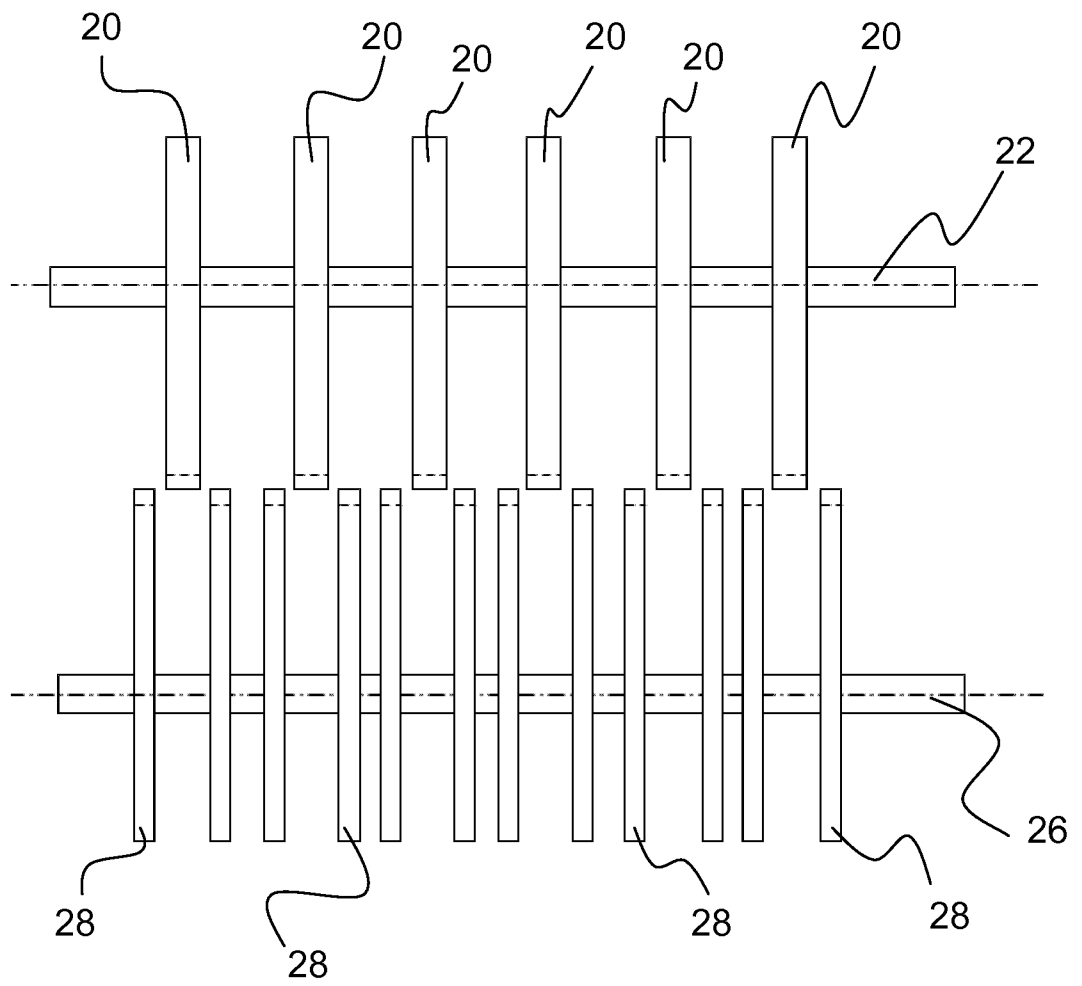


Fig. 6

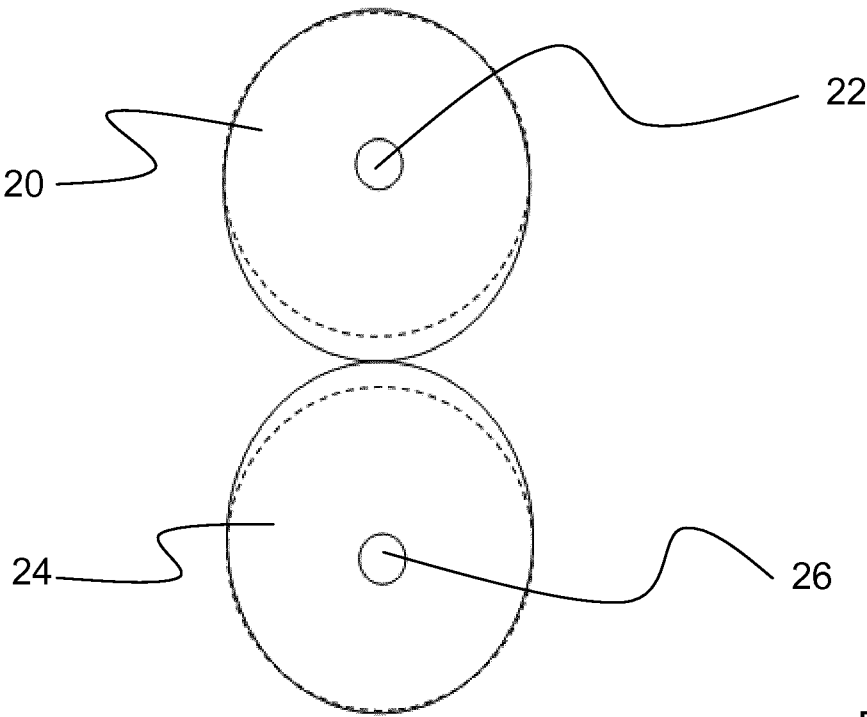


Fig. 7

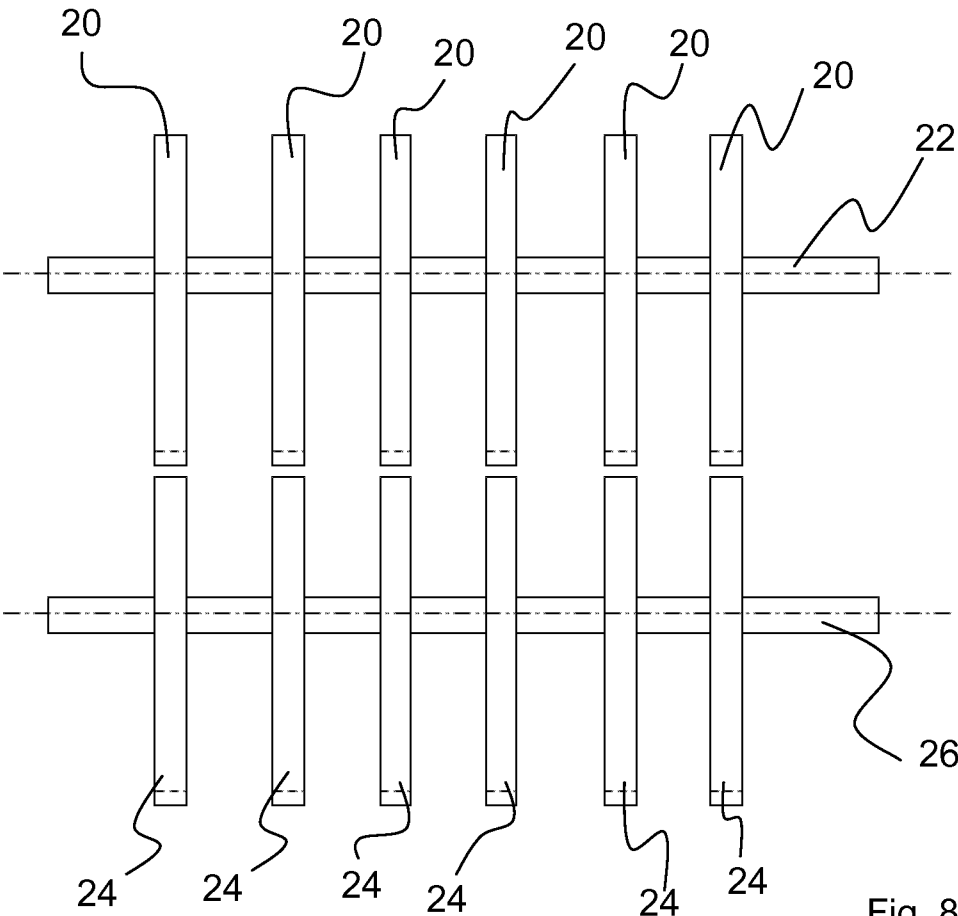


Fig. 8

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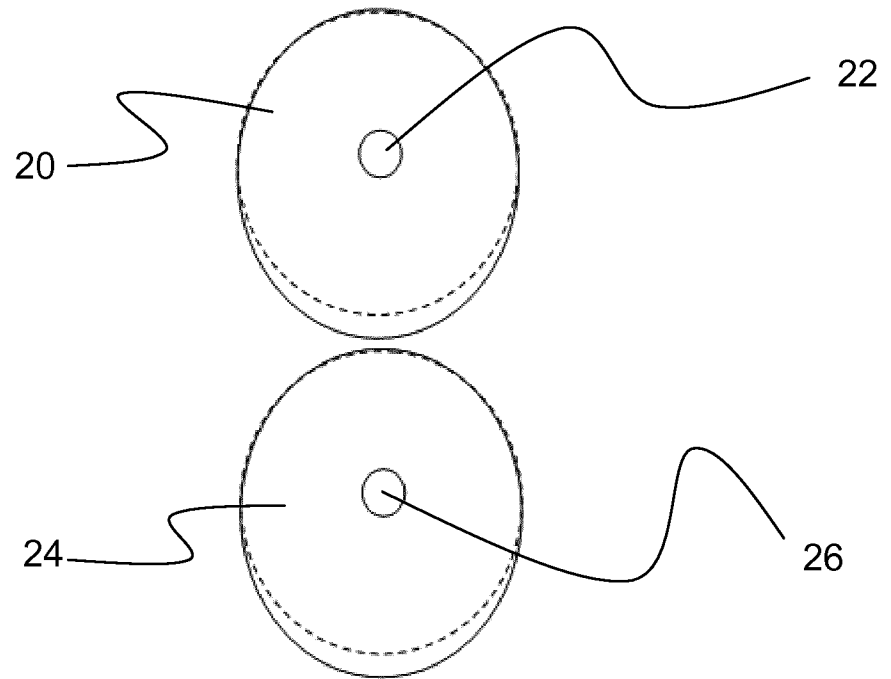


Fig. 9

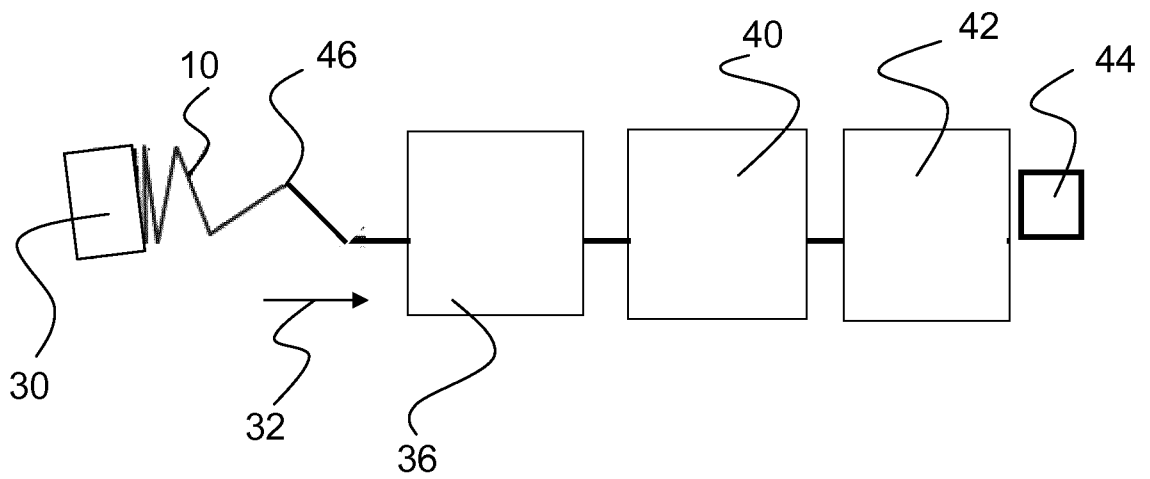


Fig. 10

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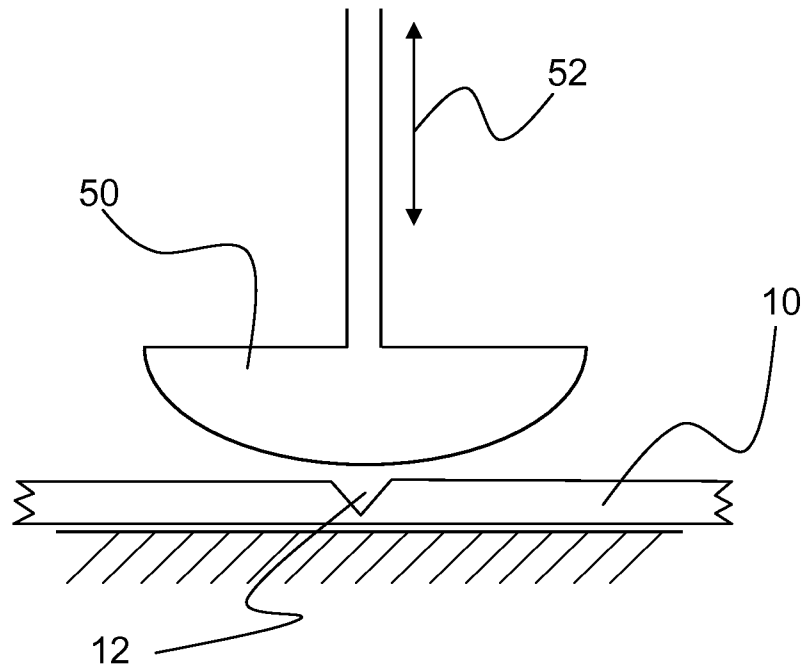


Fig. 11

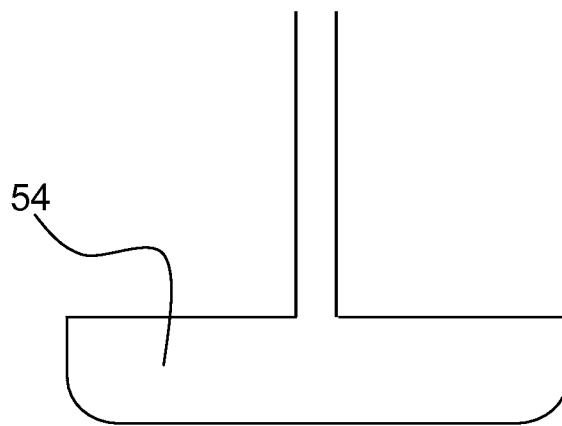


Fig. 12

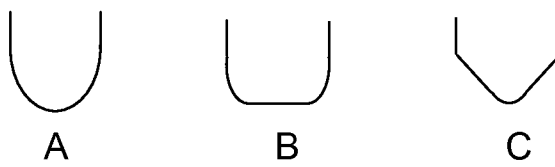


Fig. 13

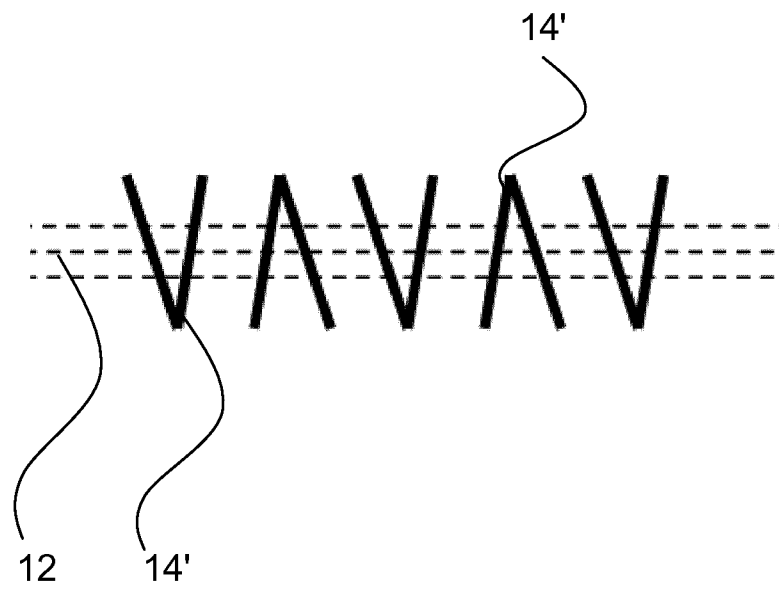


Fig. 14