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(54) Title: PULP BALE PRESS FOR COMPRESSING PULP BALES AND METHOD OF COMPRESSING

(57) Abstract: Described are a pulp bale press (1, 101), a method of pulp bale pressing and a pulp bale production line or system. The pulp bale press (1, 101) is for compressing pulp bales (12, 14) and comprises a base (2, 102); a top (4, 104) positioned opposite the base (2, 102) and connected to the base (2, 102); and a movable pressing element (6, 106, 506, 706) configured to move between the base (2, 102) and the top (4, 104), wherein the pulp bale press (1, 101) is configured to compress a first pulp bale (12) to be compressed between the base (2, 102) and the movable pressing element (6, 106, 506, 706), wherein the pulp bale press (1, 101) is further configured to compress a second pulp bale (14) to be compressed between the top (4, 104) and the movable pressing element (6, 106, 506, 706).

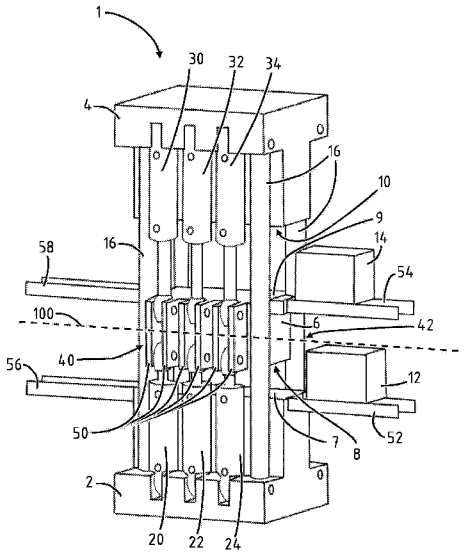

FIG. 1

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PULP BALE PRESS FOR COMPRESSING PULP BALES AND METHOD OF COMPRESSING

The present patent disclosure concerns a pulp bale press, a method of pulp bale pressing and a pulp bale production line or system.

Pulp is a material prepared by chemical or mechanical means from various materials (such as wood or rags) for use in, among others, making paper and cellulose products. Pulp comprises lignocellulosic fibers and can be used for producing paper. When pulp is produced, it can either be directly used in paper production on-site, or pulp can be packaged for shipment to produce paper elsewhere.

Often, the pulp is formed into sheets which are cut and stacked into bales. To reduce the volume of the fluffy pulp, the bales are compressed in a pulp bale press to reduce the volume of the pulp bales and thereafter packaged for shipment. As pulp production is typically a continuous process, the pulp bale press is part of the pulp production line. In a production line, the number of pulp bales to be compressed by the press may be, for instance, as high as 300 pulp bales per hour.

A pulp bale press may comprise a base comprising a conveyor, such as a conveyor belt, which positions the incoming pulp bale to be compressed below a movable pressing element or ram. Once the pulp bale to be compressed is in position, the movable pressing element is pushed downwards towards the base to compress the pulp bale with a certain force, for instance 15,000 kN. This force is, for instance, suitable for a pulp bale weighing 250 kg. The downwards force of the movable pressing element is usually applied using a hydraulic cylinder arranged above the movable pressing element. Often a relatively large hydraulic cylinder is used in order to apply the above noted force. An example of such a pulp bale press is the Valmet RoboPress PR-15.

Once the movable pressing element is at a point where the required force is applied, it will have to be lifted back upwards. This upward movement includes retracting the large hydraulic cylinder using additional smaller cylinders, often referred to as pre-pressing cylinders. In addition, one or more slave cylinders are employed which help to take out the hydraulic oil from the large hydraulic cylinder. In addition, the compressed bale is output of the pulp pale press and thereafter a new, not yet compressed and thus higher, pulp bale to be compressed is input into the pulp bale press. These necessary steps set a boundary for the number of pulp bales to be compressed by these pulp bale presses.

It is an object, among objects, to provide an improved pulp bale press.

To this end, a pulp bale press for compressing pulp bales is provided, wherein the pulp bale press comprises a base; a top positioned opposite the base and connected to the base; and a movable pressing element configured to move between the base and the top, wherein the pulp bale press is configured to compress a first pulp bale to be compressed between the base and the movable pressing element, wherein the pulp bale press is further configured to compress a second pulp bale to be compressed between the top and the movable pressing element.

In this pulp bale press, since the movable pressing element presses a pulp bale both in a downward direction and thereafter in an upward direction, the number of pulp bales produced per unit of time is greatly increased. In practice, an increased output compared to the single bale press of about 140% can be achieved.

In an embodiment, the pulp bale press is configured for use in a pulp production line. The pulp bale having an increased number of pulp bales produced per unit of time is particularly useful when used in a pulp production line, such that the production output is enhanced.

In an embodiment, the base comprises a first pressing surface, the movable pressing element comprises a second pressing surface facing the first pressing surface and a third pressing surface facing the top, the top comprises a fourth pressing surface facing the third pressing surface, and the pulp bale press is configured to receive the first bale to be compressed between the first pressing surface and the second pressing surface, compress the first bale by movement of the movable pressing element towards the base, receive the second bale to be compressed between the third pressing surface and the fourth pressing surface, and compress the second bale by movement of the movable pressing element towards the top. Preferably, the first and second pressing surfaces are substantially parallel and the third and fourth pressing surfaces are substantially parallel.

In yet another embodiment, the movable pressing element comprises a conveyor along the third pressing surface for positioning the second bale, wherein the conveyor may be a belt conveyor. The upper part of the conveyor belt comprises the third pressing surface. The conveyor is configured to allow for receiving an input bale from a first side, positioning the bale into a position in which it can be pressed against the top and thereafter output the bale to the other side of the press, opposite the first side. Beneficially, a belt conveyor, being flat, allows for compressing the bale while the bale is on the conveyor belt.

Optionally, the belt conveyor comprises two parallel belts that can be individually controlled such that the bale can also be rotated for positioning while on the movable pressing element.

The movable pressing element may further comprise a pressing base to which the conveyor is attached at a top facing side thereof. The pressing base may comprise a solid portion configured for pressing the (upper and lower) bales. The solid portion is thus configured to apply the required pressing force towards the base and the top.

The conveyor belt may be implemented such that the belt slides along itself in two directions along the upper side of the movable pressing element.

In still another embodiment, comprising one or more controllers configured to control the movement of the movable pressing element. Advantageously, the one or more controllers can automate the bale press so that the bale pressing speed of the bale press can be increased.

Preferably, the one or more controllers are configured to allow input of the second bale onto the movable pressing element when the movable pressing element is in a first position in which the top and the movable pressing element are sufficiently distanced to receive the second pulp bale to be compressed. Once an opening between the movable pressing element and the top is large enough, the second bale may be input.

The first position of the movable pressing element may be a position in which, when the first bale is present between the base and the movable pressing element, the first bale would be at least partially compressed. In this way, the number of bales compressed by the bale press is increased, since the feeding of the second bale is done during the compressing of the first bale. In an embodiment, the bale press may comprise a feeding mechanism configured for allowing the second bale to be fed while the movable pressing element is moving, for instance in a direction towards the base when pressing, or moving to press, the first bale.

In an embodiment, the top is connected to the base by one or more connecting elements, wherein the pulp bale press is configured such that the movable pressing element is guided along the one or more connecting elements. The connecting elements may be implemented as pillars or columns.

In another embodiment, the pulp bale press is a hydraulic pulp bale press. The movable pressing element may be movably attached to the base via a first plurality of hydraulic cylinders, and the

movable pressing element is movably attached to the top via a second plurality of hydraulic cylinders. The use of multiple hydraulic cylinders allows the size of each cylinder to be reduced. In addition, the cylinders may have similar or identical hydraulic volumes. This makes maintenance more effective, efficient, and less costly. In addition, the hydraulic pump can be placed on ground or floor level or lower so that the amount of noise experienced by workers in the space where the press is located is reduced. This is in particular the case when the hydraulic cylinders are placed laterally onto the press, holding the movable pressing element. The hydraulic cylinders together supply the total force required.

To aid the lifting upwards of the movable pressing element of presses having less (e.g. a single) larger hydraulic cylinders additional hydraulic cylinders such as pre-pressing cylinders and slave cylinders are employed, as described above. These additional hydraulic cylinders require, among others, hydraulic connections, pumps, valves and additional hydraulic oil, and thus increase the number of parts and complexity of the hydraulic system. By using the multiple hydraulic cylinders, as in embodiments of pulp bale presses of the present patent disclosure, this problem is resolved, since for the moving up and down of the movable pressing element when no or a low force is applied, a number of hydraulic cylinders of the first and/or second pluralities of hydraulic cylinders less than the total number of hydraulic cylinders can be used.

In an embodiment, the first plurality of hydraulic cylinders comprises an even number of hydraulic cylinders, and the second plurality of hydraulic cylinders comprises an even number of hydraulic cylinders. The hydraulic cylinders of each the first and second pluralities of hydraulic cylinders are equally divided over two lateral sides of the pulp bale press. This provides for a stable press structure by having a generally equal amount of force on each side of the movable pressing element.

The first plurality of hydraulic cylinders may have a total first volume and the second plurality of hydraulic cylinders may have a total second volume, wherein the total first volume may be substantially equal to the total second volume. In this way, the hydraulic fluid used by each hydraulic cylinder is equal.

In an embodiment, the first plurality of hydraulic cylinders comprises at least four hydraulic cylinders and the second plurality of hydraulic cylinders comprises an equal number of hydraulic cylinders as the first plurality of hydraulic cylinders.

In an embodiment, the first plurality of hydraulic cylinders comprises at least two hydraulic cylinders and the second plurality of hydraulic cylinders comprises an equal number of hydraulic cylinders as the first plurality of hydraulic cylinders.

The bale press may comprise a hydraulic system supplying hydraulic fluid to the first and second pluralities of hydraulic cylinders. The hydraulic system may comprise a pump hydraulically connected to the first and second pluralities of hydraulic cylinders, a hydraulic fluid reservoir hydraulically connected to the pump and valves configured to selectably supply hydraulics to the one or more of the first and second pluralities of hydraulic cylinders. The one or more controllers may be configured to control the hydraulic system. The hydraulic system may alternatively comprise dedicated one or more controllers.

The first plurality and second plurality of hydraulic cylinders may be hydraulically connected via one or more valves. Each of the hydraulic cylinders may comprise a cylinder barrel and a piston which is movably arranged. The piston comprises a piston rod extending from the cylinder barrel. The barrel may be closed on one end by the cylinder end (or bottom or cap) and at the other end by a cylinder head out from which the piston head extends. The hydraulic cylinders each comprise a first hydraulic fluid chamber and a second hydraulic fluid chamber, the first hydraulic fluid chamber being in the barrel between the piston and the cylinder end and the second hydraulic fluid chamber being in the barrel between the piston and the cylinder head. Each of the hydraulic cylinders may comprise a first hydraulic fluid port for allow hydraulic fluid to flow into and out of the first hydraulic fluid chamber. Each of the hydraulic cylinders may comprise a second hydraulic fluid port for allowing hydraulic fluid to flow into and out of the second hydraulic fluid chamber.

In order to push the piston rod in an outward direction relative to the barrel, the (pressurized) hydraulic fluid is input into the first hydraulic fluid chamber. It will be apparent that the first hydraulic fluid chamber then increases in size, and that the second hydraulic fluid chamber reduces in size. In order to push back the piston rod into the barrel, the (pressurized) hydraulic fluid is input into the second hydraulic fluid chamber. Now, the first hydraulic fluid chamber reduces in size, and the second hydraulic fluid chamber increases in size.

The movable pressing element may be attached to outer ends of the respective piston rods of the hydraulic cylinders of the first and second plurality of hydraulic cylinders. The respective barrels of the first plurality of hydraulic cylinders are connected to the base of the bale press. The respective barrels of the second plurality of hydraulic cylinders are connected to the top of the bale press. By extending and contracting the piston rods, the movable pressing element is

moved from and towards the top (i.e. towards and from the base respectively). It will be understood that the movable pressing element could alternatively be attached to the barrels of the hydraulic cylinders instead of the piston rods. It is most practical, however, to connect the movable pressing element to the piston rods.

The bale press may be configured such that first respective one or more hydraulic cylinders of the first plurality of hydraulic cylinders is controllably hydraulically connected to second respective one or more hydraulic cylinders of the second plurality of hydraulic cylinders such that hydraulic fluid flowing out of the first respective one or more hydraulic cylinders flows into the second one or more hydraulic cylinders, and that hydraulic fluid flowing out of the second respective one or more hydraulic cylinders flows into the first one or more hydraulic cylinders. It will be understood that two hydraulic cylinders would be connected such that fluid flowing from the first hydraulic fluid chamber of one hydraulic cylinder (which thus contracts its piston rod) can flow towards the first hydraulic fluid chamber of the other hydraulic cylinder (which thus extends its piston rod), and fluid flowing from the second hydraulic fluid chamber of one hydraulic cylinder (which thus extends its piston rod) can flow towards the second hydraulic fluid chamber of the other hydraulic cylinder (which thus contracts its piston rod). The controllable hydraulic connection can be achieved by using one or more controllable valves. These valves can be controlled by the one or more controllers. The above can be seen as a hydraulic “short circuiting” mode of selected number of hydraulic cylinders so that they move freely.

In view of the above, beneficially, the volume of required hydraulic oil can be reduced. Also, there is no or less need to use the additional pre-pressingcylinders as described above, because a reduced number of hydraulic cylinders can be used in a pre-pressing cylinder function, while the other hydraulic cylinders are moving freely.

In a further embodiment, the movable pressing element is configured to receive the second bale along a first axis thereof; the movable pressing element comprises first and second lateral sides extending parallel to the first axis; an equal number of the first plurality of hydraulic cylinders is attached the movable pressing element to each of the first and second lateral sides; and an equal number of the second plurality of hydraulic cylinders is attached the movable pressing element to each of the first and the second lateral sides.

In yet another embodiment, the pulp bale press is configured to apply a force to the first bale and the second bale in the range of 2,000 to 40,000 kN (equal to about 200 to 4000 metric tons). The pulp bale press may, for example, be configured to apply a force to the first bale and the

second bale in the range of 5,000 to 2,5000 kN, such as 6,000, 7,000, 8,000, 9,000, 10,000, 11,000, 12,000, 13,000, 14,000, 15,000, 16,000, 17,000, 18,000, 19,000, 20,000, 21,000, 22,000, 23,000, and 24,000 kN or any range therebetween. It will be understood that the size of the hydraulic cylinders is chosen depending on the wanted number of hydraulic cylinders and the above noted force ranges. For instance, when the first and second pluralities of hydraulic cylinders in total comprise twelve hydraulic cylinders, each hydraulic cylinder may be configured to apply one twelfth of any one of the above-mentioned forces and/or force ranges, when retracting and/or extending their respective piston rods.

When using the described multiple hydraulic cylinders, the size of the hydraulic cylinders may be chosen depending on the wanted number of hydraulic cylinders and the above noted force ranges. For instance, when the first and second pluralities of hydraulic cylinders in total comprise twelve hydraulic cylinders, each hydraulic cylinder may be configured to apply one twelfth of any one of the above-mentioned forces and/or force ranges, when retracting and/or extending their respective piston rods.

It will be apparent that in the present disclosure concerning the bale press, the top is stationary relative to the base. The top may be attached to the base via fixing members, for instance embodied as four pillars or columns.

In general, an uncompressed pulp bale is a bundle of pulp. This may be a stack of pulp sheets. Often, a bale, when seen from the top, has a rectangular shape.

According to a second aspect, there is provided a pulp bale production system or line configured to produce pulp bales from a cellulose containing raw material, the pulp bale production system comprising the pulp bale press according to the first aspect. Beneficially, when used in a pulp bale production system or line, the use of the faster pulp bale press allows for an increased output of compressed pulp bales.

According to a third aspect, there is provided a method of compressing pulp bales in a pulp bale press, the method comprising; inputting the first bale to be compressed between the base and the movable pressing element; compressing the first bale by moving the movable pressing element towards the base; when the movable pressing element has moved to a first position in which the top and the movable pressing element are sufficiently distanced to receive the second pulp bale, inputting the second bale to be compressed between the movable pressing element and the top; and compressing the second bale by moving the movable pressing element towards the top.

The pulp bale press used in the method may be a pulp bale press according to the first aspect or the method may be in a pulp bale production system as per the second aspect.

In an embodiment, the inputting the first bale comprises inputting the first bale between the first pressing surface and the second pressing surface; and the inputting the second bale comprises, when the movable pressing element has moved to a first position in which the third pressing surface and the fourth pressing surface are sufficiently distanced to receive a second pulp bale, inputting the second bale to be compressed onto the third pressing surface.

In an embodiment, the pulp bale press comprises an input aligning mechanism and an output aligning mechanism, wherein the input aligning mechanism is configured to input a pulp bale to be compressed onto the movable pressing element while the movable pressing element is moving, wherein the output aligning mechanism is configured to output a pulp bale to be compressed onto the movable pressing element while the movable pressing element is moving.

Preferably, the pulp bale press comprises or is configured to work together with an input conveyor, wherein input aligning mechanism comprises an extendable arm and a complementary fork which have overlapping positions along the first axis when the extendable arm is in an extended position, wherein the input aligning mechanism is configured such that the movable pressing element receives a pulp bale to be compressed when moving upwards towards to the top when the extendable arm is in the extended position and a pulp bale is positioned within the overlapping positions along the first axis.

Alternatively, the pulp bale press comprises or is configured to work together with a rotatable pulp bale input conveyor configured to work, wherein a position of the movable pressing element facing edge of the rotatable pulp bale input conveyor is aligned with the rotatable input conveyor facing upper outer edge of the movable pressing element. In this case, the input aligning mechanism comprises the rotatable pulp bale input conveyor.

In this way, the pulp bales to be compressed can be fed onto movable pressing element while it is moving, thus increasing the compressed pulp bale output speed.

Similar configurations are provided for a rotatable pulp bale output conveyor, of which a position of the movable pressing element facing bale output edge of the rotatable output conveyor is aligned with the rotatable output conveyor facing upper outer edge of the movable pressing element.

The method may further comprise, when the movable pressing element has moved to a second position in which the second pressing surface is not in contact with the compressed first pulp bale, outputting the compressed first bale from the first pressing surface.

In another embodiment, the method further comprises, when during or after outputting the compressed first bale from the first pressing surface the movable pressing element has moved to a third position in which the first pressing surface and the second pressing surface are sufficiently distanced to receive a third pulp bale to be compressed, inputting the third bale to be compressed between the first pressing surface and the second pressing surface.

In yet another embodiment, the method further comprises, when the movable pressing element has moved to a fourth position in which the fourth pressing surface is not in contact with the compressed second pulp bale, output the compressed second bale from the third pressing surface; and when during or after outputting the compressed second bale from the fourth pressing surface the movable pressing element has moved to a fourth position in which the third pressing surface and the fourth pressing surface are sufficiently distanced to receive a fourth pulp bale to be compressed, input the fourth bale to be compressed between the third pressing surface and the fourth pressing surface.

In still another embodiment, in the steps of inputting the first, second and third pulp bales the first, second and third pulp bales are input on respective input sides of the pulp bale press, wherein in the steps of outputting the first, second and third pulp bales the first, second and third pulp bales are output on respective output sides of the pulp bale press, wherein the input sides are opposite the corresponding output sides.

It will be understood that technical advantages and effects associated with features and/or embodiments of one aspect, apply to the corresponding, similar or equivalent features and/or embodiments the other aspects. It will also be apparent that the features of the various aspects and/or embodiments thereof may be applied to the other aspects and/or embodiments thereof.

Brief Description of the Drawings

The accompanying drawings are used to illustrate presently preferred non-limiting exemplary embodiments of devices of the present disclosure. The above and other advantages of the features and objects of the disclosure will become more apparent, and the aspects and embodiments will be better understood from the following detailed description when read in conjunction with the accompanying drawings, in which:

Fig. 1 illustrates a schematic perspective view of a pulp bale press according to an embodiment of the present patent disclosure;

Fig. 2 illustrates a schematic perspective view of a pulp bale press according to an embodiment of the present patent disclosure;

Fig. 3 illustrates a schematic cross section of the pulp bale press of Fig. 2, wherein the cross section is indicated in Fig. 2;

Figs. 4A-4H illustrate respective schematic side views of the pulp bale press according to the present patent disclosure, showing the feeding in and out and pressing of pulp bales in the pulp bale press;

Figs. 5A-5D illustrate respective schematic side views of a pulp bale press according to the present patent disclosure, showing a particular configuration of feeding in and out and pressing of pulp bales in the pulp bale press;

Figs. 6A-6E illustrate respective schematic top of the movable pressing element and (parts of) the in- and output structure of the pulp bale press of Figs. 5A-5D; and

Figs. 7A-7C illustrate respective sides views of a movable pressing element and in- and output structure for feeding in pulp bales onto the movable pressing element while it is moving.

Detailed Description of Preferred Embodiments

Although the present invention has been described with reference to specific embodiments, also shown in the appended drawings, it will be apparent to those skilled in the art that many variations and modifications can be done within the scope of the invention as described in the specification and defined with reference to the claims below.

The bale press 1 comprises a base 2 which is connected to the top 4 via pillars or columns 16, which extend from the base to the top. The pillars or columns 16 are an embodiment of the one or more connecting elements. Between the pillars 16 are openings for in- and outputting the first pulp bale 12 and the second pulp bale 14. The bale press 1 comprises a movable pressing element 6, which is here embodied as ram 6. Alternatively, the ram can be referred to as a stamp. The ram 6 is movable arranged and is guided along the pillars 16, for instance using bearings. The ram 6 comprises a first lateral side 40 and a second lateral side 42 opposite the first lateral side, both lateral sides extending parallel to first axis 100. The ram 6 comprises a plurality of fastening portions 50 at the first 40 and second 42 lateral sides. The fastening portions 50 are here embodied as a plurality of plates extending from the ram 6. The ram 6 is attached to the base 2 at the plurality of fastening portions via a first plurality of hydraulic cylinders, which comprises a first 20, a second 22 and a third 24 hydraulic cylinder, visible in

Fig. 1. The first plurality of hydraulic cylinders further comprises fourth to sixth hydraulic cylinders on the opposite side of the bale press 1, not visible in Fig. 1.

The ram 6 is attached to the top 4 at the plurality of fastening portions via a second plurality of hydraulic cylinders, which comprises a seventh 30, an eighth 32 and a ninth 34 hydraulic cylinder, visible in Fig. 1. The second plurality of hydraulic cylinders further comprises tenth to twelfth hydraulic cylinders on the opposite side of the bale press 1, not visible in Fig. 1.

Each of the hydraulic cylinders of the first and second pluralities of hydraulic cylinders comprise a barrel and a piston rod. The ram 6 is attached via the piston rods to the hydraulic cylinders. The barrels of the first to sixth hydraulic cylinders are attached to the base 2. The barrels of the seventh to twelfth hydraulic cylinders are attached to the top 4. The hydraulic cylinders work together to move the ram 6 up and down, the ram 6 being guided along the pillars 16.

The first to twelfth hydraulic cylinders are configured and/or sized such that a force to the first bale 12 and the second bale 14 can be applied in the range of 2,000 to 40,000 kN, such as 5,000 to 25,000 kN. For instance, a force of 15,000 kN (about 1500 metric tons) may be applied in total by the first to twelfth hydraulic cylinders.

A force of 15,000 kN is suitable for bales of about 250 kg, when having a footprint of about 0.5 or 0.6 m^2 (for instance 80 cm long and 70 cm wide bales). In this example, the height of the bale will compress by about a factor of two thirds (about 0.66), from 60 cm to 40 cm. Due to the compressing, air is pressed out of the pulp bales.

The base 2 comprises a first pressing surface 7. The ram 6 comprises a second pressing surface 8 facing the first pressing surface 7. In addition, the ram 6 comprises a third pressing surface 9 facing the top 4. The top 4 comprises a fourth pressing surface 10 facing the third pressing surface 9.

The ram 6, top 4 and base 2 are made from materials and are configured such that they are suitable for applying the pressures mentioned above and below to the pulp bales. Suitable materials may comprise steel. A suitable configuration for the base 2 may be that it comprises a solid base part underneath at least the first pressing surface 7. A suitable configuration for the ram 6 may be that it comprises a solid ram part underneath the second pressing surface 8 and underneath the third pressing surface 9. A suitable configuration for the top 2 may be that it comprises a solid top part underneath the fourth pressing surface 10.

The pulp bale press 1 is configured to receive the first bale 12 to be compressed between the first pressing surface 7 and the second pressing surface 8. Here, the first chain conveyor 52 moves the first bale 12 towards the first pressing surface 7. The base 2 comprises a first positioner, such as a conveyor belt, for positioning the pulp bales on the first pressing surface 7. The first bale 12, when positioned onto the first pressing surface 7 underneath the ram 6, is compressed by movement of ram 6 towards the base 2.

The pulp bale press 1 is further configured to receive the second bale 14 to be compressed between the third pressing surface 9 and the fourth pressing surface 10. The ram 6 comprises a second positioner, such as a conveyor belt, for positioning the pulp bales on the third pressing surface 9. The second bale 14, when positioned onto the third pressing surface 9 underneath the top 4, is compressed by movement of the movable pressing element 6 towards the top 4.

The above configuration, in other words, provides for two bale pressing levels in the pulp bale press 1. A first pressing level is between the base 2 and the ram 6. A second pressing level is between the ram 6 and the top 4. The functioning of this two-level pulp bale press is further described below. Although the described functioning of the pulp bale press is not limited to starting up the press, it is noted that starting up of the pulp bale press 1 may be performed by feeding a pulp bale to the first pressing level first or to the second pressing level first.

The first 7 and second 8 pressing surfaces are substantially parallel and the third 9 and fourth 10 pressing surfaces are substantially parallel. The second 8 and fourth 10 pressing surfaces may comprise various protrusions, grooves, and/or notches or the like, depending on the needs of the pulp bale producer.

The pulp bale press 1 comprises a first chain conveyor 52 and a second chain conveyor 54. These first 52 and second 54 chain conveyors are an implementation of respective input transporters. The input transporters are for inputting the first 12 and second 14 pulp bales to be compressed into the pulp press 1. The pulp bale press 1 further comprises a third chain conveyor 56 and a fourth chain conveyor 58. These third 56 and fourth 58 chain conveyors are an implementation of respective output transporters for outputting compressed bales. These third 56 and fourth 58 chain conveyors are an implementation of respective output transporters.

A pulp bale press 101 according to another embodiment is shown in Fig. 2. The features/components of the pulp bale press 101 corresponding to the features of the pulp bale press 1 have the same function as in the pulp bale press 1 as described above. The corresponding

features have reference numerals with 100 added to the reference numerals in Fig. 1. Features not explicitly indicated with reference numerals may still be present in the press 101 like in the press 1. If not mentioned otherwise, the features and functioning of the pulp bale press 101 are the same as of the pulp bale press 1. The pulp bale press 101 shows particular implementations of the first and second positioners described above. A cross section showing the implementations of the positioners is indicated in Fig. 2 and can be seen in Fig. 3.

The pulp bale press 101 comprises a base 102 which is connected to the top 104 via pillars or columns 116, which extend from the base to the top. The pillars or columns 116 are an embodiment of the one or more connecting elements. Between the pillars 116 are openings for in- and outputting the first pulp bale 112 and the second pulp bale 114. The bale press 101 comprises a movable pressing element 106, herein further referred to as ram 106. The ram 106 is movable arranged and is guided along the pillars 116, for instance using bearings. The ram 106 comprises a first lateral side 140 and a second lateral side 142 opposite the first lateral side, both lateral sides extending parallel to first axis 100. The ram 106 comprises a plurality of fastening portions at the first 40 and second 42 lateral sides. The fastening portions are here embodied on an inner side of the ram 106 and are therefore not visible. The ram 106 is attached to the base 102 at the plurality of fastening portions via a first plurality of hydraulic cylinders, which comprises a first 120, a second 122 and a third 124 hydraulic cylinder, visible in Fig. 2. The first plurality of hydraulic cylinders further comprises fourth to sixth hydraulic cylinders on the opposite side of the bale press 101, not indicated with reference numerals in Fig. 2.

The ram 106 is attached to the top 104 at the plurality of fastening portions via a second plurality of hydraulic cylinders, which comprises a seventh 130, an eighth 132 and a ninth 134 hydraulic cylinder, visible in Fig. 2. The second plurality of hydraulic cylinders further comprises tenth to twelfth hydraulic cylinders on the opposite side of the bale press 101, of which only the tenth hydraulic cylinder 136 is visible in Fig. 2. The press 101 comprises entry openings 150, which provide access to fasteners used to fasten the first to third and seventh to ninth hydraulic cylinders to the ram 106 at its fastening portions. Further openings are present at the lateral side 142 for providing access to fasteners used to fasten the fourth to sixth and tenth to twelfth hydraulic cylinders.

The base 102 comprises a first pressing surface 107. The ram 106 comprises a second pressing surface 108 facing the first pressing surface 107. In addition, the ram 106 comprises a third pressing surface 109 facing the top 104. The top 104 comprises a fourth pressing surface 110 facing the third pressing surface 109.

The cross section of Fig. 3 shows the first pulp bale 12 in a position on the base 102 such that it can be compressed by the ram 106. The second pulp bale 14 has in this figure been compressed. The base 102 comprises the belt conveyor 160, which is an implementation of a conveyor. The belt conveyor 160 comprises a belt 162, upper rollers 164 and 166 and lower rollers 168 and 170. The belt 162 in this embodiment goes around a solid base part 103 of the base 102. The solid base part is arranged such that the pulp bale 12 is compressed. The belt 162 moves along an upper surface of the solid base part 103. The belt 162 thus remains between the pulp bale 12 and the solid base part 103. In other words, an upper or outer surface of the belt 162 represents the first pressing surface 107. The belt conveyor 160 can be drive by one or more electrical motors which are controlled by one or more controllers (not shown). An advantage of using a belt is that it complements the upper surface of the solid base part 103 and thus allows the bale to be pressed with the belt between the solid base part 103 and the bale 12.

The ram 106 comprises the belt conveyor 180, which is an implementation of a conveyor. The belt conveyor 180 comprises a belt 182, and rollers 188 and 190. The belt 182 comprises outer belt section 184 and inner belt section 186, which thus means that the belt 182 in this case runs along itself along the upper surface of the solid ram part 105. The third pressing surface 109 is here represented by the outer belt section 184. One advantage of this belt configuration is that the second bale 14 can be moved along the ram 106 even when the ram 106 is pressing the first bale 12. Use of a conveyor belt further results in a compress conveyor. Fig. 3 is merely schematically indicating the functioning of the conveyors. For instance, sharp edges may be visible, and spacing between the belt(s) and other parts of the press 101, that in practice would not be present. These sharp edges may be rounded and/or may include further rollers of so needed for instance to reduce wear of the belt.

The belts conveyors 162 and 180 may be split into two separate belt conveyors each (not shown), for instance parallel to the axis 100, so that these separate belts may be controlled separately so that the respective bales can also be rotated on the first 107 and third 109 pressing surfaces.

The pulp bale press 1 comprises one or more controllers configured to control the movement of the ram 6. The one or more controllers may be configured to allow input of the second bale 14 onto the ram 6 when the ram 6 is in a first position in which the top 2 and the ram 6 are sufficiently distanced to receive the second pulp bale 14 to be compressed. This is further explained with reference to Figs. 4, 5 and 6.

Referring to Figs. 4A-4H, a method of compressing pulp bales in the pulp bale press 1 or 101 comprises inputting S200 the first bale 12 to be compressed between the base 2 and the ram 6. Fig. 4B shows the first bale 12 in a position wherein it is between the base 2 and the ram 6. After the step S200 of inputting the first bale, the method comprises the step S202 of compressing the first bale 12 by moving the ram 6 towards the base 2 (Fig. 4C). When the ram 6 has moved to a first position in which the top 2 and the ram 6 are sufficiently distanced to receive the second pulp bale 14, the method includes the step S204 of inputting the second bale 14 to be compressed between the ram 6 and the top 4. Thereafter, the step S206 of compressing the second bale 14 by moving the ram 6 towards the top 4 is performed.

The method includes, when the ram 6 has moved to a second position in which the second pressing surface 8 is not in contact with the compressed first pulp bale 12, the step S208 of outputting the compressed first bale 12 from the first pressing surface 7. When during or after outputting S208 the compressed first bale 12 from the first pressing surface 7 the ram 6 has moved to a third position in which the first pressing surface 7 and the second pressing surface 8 are sufficiently distanced to receive a third pulp bale 13 to be compressed, a step of inputting the third pulp bale 13 to be compressed between the first pressing surface 7 and the second pressing surface 8.

The method further comprises, when the ram 6 has moved to a fourth position in which the fourth pressing surface 10 is not in contact with the compressed second pulp bale 14, outputting S212 the compressed second bale 14 from the third pressing surface 9 of the ram 6.
When during or after outputting S212 the compressed second pulp bale 14 from the fourth pressing surface 10 the ram 6 has moved to a fourth position in which the third pressing surface 9 and the fourth pressing surface 10 are sufficiently distanced to receive a fourth pulp bale 15 to be compressed, the step of inputting the fourth pulp bale 15 to be compressed between the third pressing surface 9 and the fourth pressing surface 10.

In order to allow the pulp bale press 1 or 101 to press more bales per unit of time, it is beneficial to feed the pulp bales onto the ram 6 while it is moving. Figs 5, 6 and 7 show configurations of the pulp bale press that allow for this feeding while ram 6 is moving.

In Figs. 5 and 6, the ram 506 comprises a ram base part 505, a first ram extension 507 extending towards input conveyor 540 and a second ram extension 508 extending towards output conveyor 581. In other words, the first 507 and second 508 ram extension extend parallel to the axis 100. The input conveyor 540 is fed by the chain conveyor 539. The input 540 and output 581 conveyor are here implemented as chain conveyors. The first and second ram

extensions comprise conveyors, which are here implemented as chain conveyors. The ram base part 505 comprises a belt conveyor along its upper surface as shown in Fig. 2.

The output conveyor 581 comprises a second extendable arm 582. In the position of Fig. 5A, the second extendable arm 582, which is indicated with a dashed line, is in its extended position, similar to the position shown in the top view of Fig. 6D. The second extendable arm 582 is configured to extend such that its extended position overlaps with the second ram extension 508 of the ram 506 when viewed along the axis 100, which is in a horizontal direction in the Figs. 5A-5D. The second extendable arm 582 and the second ram extension 508 are complementarily shaped such that when the ram 506 moves up towards the top 4 or down towards the base 2, the first extendable arm 541 and the first ram extension 507 can pass each other without blocking each other. In this embodiment, the second ram extension 508 is fork shaped, and the second extendable arm 582 extends between the space between the fork shape of the second ram extension 508 (Fig. 6D).

In Fig. 5A, the compressed pulp bale 515 is positioned on the second ram extension 508 when the ram 506 is in an upward position in which it is pressing the pulp bale 14. The second extendable arm 582 is in its extended position underneath the second ram extension 508 and the pulp bale 515. After the pressing of the pulp bale 14 is finished, the ram 506 moves down (Fig. 5B) and the pulp bale 515 is held up by the second extendable arm 582. Thereafter, the second extendable arm 582 retracts (Fig. 5C) such that the compressed pulp bale 515 can be transported along the conveyor 584. The conveyor 584 is separate from the output conveyor 581, so that their respective conveying means, such as chains, can be individually operated.

The input conveyor 540 comprises a first extendable arm 541. The first extendable arm 541 is configured to extend such that its extended position overlaps with the first extension 507 of the ram 506 when viewed along the axis 100, which is in a horizontal direction in the Figs. 5A-5D. The first extendable arm 541 and the first ram extension 507 are complementarily shaped such that when the ram 506 moves up towards the top 4 or down towards the base 2, the first extendable arm 541 and the first ram extension 507 can pass each other without blocking each other. In this embodiment, the first ram extension 507 is fork shaped, and the first extendable arm 541 extends between the space between the fork shape of the second ram extension (Fig. 6B).

In Fig. 5A, pulp bale to be compressed 516 is positioned onto the first conveyor 540. A similar position is shown in Fig. 6A. Once the pulp bale 15 has moved away from the first ram extension 507 such that it is in a position on the ram 506 to be compressed, and the ram 506 is

in a downward or lower position (Fig. 5C) the first extendable arm 541 extends towards the ram 506, taking pulp bale 516 with it (Fig. 6B). Then, once the ram 506 moves upwards again to press the pulp bale 15, the first ram extension 507 takes the pulp bale 516 with in an upward direction towards the top 4. Thereafter the first extendable arm 541 retracts again (Fig. 6C). The pulp bale to be compressed 517' then takes position onto the input conveyor 540.

Once the pulp bale 516 is compressed, it is moved onto the second ram extension 508 (Fig. 6C). The second extendable arm 582 extends underneath the ram 506 and the pulp bale 516 (Fig. 6D), and once the ram 506 moves down again towards the base, the pulp bale 516 is held upward by the second extendable arm 582. Thereafter, the second extendable arm 582 retracts so that the pulp bale 516 can be transported away by the output conveyor 581 towards the conveyor 584.

The first additional chain conveyor 551 holds several pulp bales waiting to be compressed 513. The first chain conveyor 52 is then fed by the first additional conveyor 551. The first chain conveyor 52 and the first additional chain conveyor 551 are separated in order to show that these conveyors have individual sets of chains, so that the first chain conveyor 52 can feed the base 2 with a pulp bale independently of the first additional chain conveyor 551. The same holds for the input conveyor 540 and the additional input conveyor 539.

The first additional chain conveyor 551 and the additional input conveyor 539 are both fed with additional pulp bales 511 by the lift conveyor 550, which is configured to move between a first position in which it can feed the first additional chain conveyor 551 with pulp bales to be compressed and a second position in which it can feed the additional input conveyor 539 with pulp bales to be compressed. Alternatively, there may be first and second fixed chain conveyors, of which the first moves half of the pulp bales to be compressed towards the first additional chain conveyor 551 and the second moves the other half of pulp bales to be compressed towards the additional input conveyor 539.

It will be understood that alternatively the extendable arms could be implemented on the ram, and the fork shaped part on the in- and output conveyors. For sake of stability of the pulp bales, however, the ram may comprise the fork shaped extensions. Moreover, the extendable arms can be implemented as forks as well, such that the two fork shapes fit into each other. Any fork shape mentioned here may have two or more arms.

An alternative configuration to allow in- and outputting of the ram with pulp bales to be compressed while moving is shown in Figs. 7A-7C. A rotatable input conveyor 740 is rotatably

fixed by hinge 741. The rotatable input conveyor 740 is further fixed at a ram 706 facing end thereof by an elastic body, here embodied as a spring 742. The spring 742 is fixed to the rotatable input conveyor 740 at one end thereof and fixed to a stationary fixation point at the other end thereof. The rotatable input conveyor 740 comprises a first extension 743 at the ram 706 facing part thereof. The ram 706 in turn comprises a second extension 708 extending towards the rotatable input conveyor 740. In a resting position, the rotatable input conveyor 740 is positioned similar to the second chain conveyor 54. The ram 706 is an embodiment of the ram of the pulp bale presses according to the invention and is thus positioned between the top 4 and the base 2. The other features and functioning not mentioned in relation to Figs. 7A-7C are the same as for the other embodiments described above.

The first 743 and second 708 extensions are positioned complementarily such that the second extension 708 pushes down on the first extension 743 when the ram 706 moves in a downward direction towards the base 2 (not shown in Figs. 7A-7C) in order to compress a pulp bale positioned on the base 2. Then, the rotatable input conveyor 740 is pulled along with the ram 6 and remains aligned with an outer edge of the ram 706. The bale 14 can be feed onto the ram 708 independent of the vertical position of the ram 706, as long as there is sufficient space between the ram 706 and the top 4 to receive a pulp bale to be compressed, here pulp bale 14. A partially rotated or downward position is shown in Fig. 7B. A fully rotated or downward position is shown in Fig. 7C. When the ram 706 moves back up towards the top 4, the rotatable input conveyor 740 rotates back due to the upwards urge provided by the spring 742.

Alternative to the use of the first 743 and second 708 extensions, the rotation may be controlled by suitable hydraulic equipment or an electric motor. In general, the position of the ram facing bale input edge of the rotatable input conveyor is aligned with the rotatable input conveyor facing upper outer edge of the ram 706.

Similar configurations are provided for a rotatable pulp bale output conveyor, of which a position of the ram facing bale output edge of the rotatable output conveyor is aligned with the rotatable output conveyor facing upper outer edge of the ram 706.

Mixtures of the embodiments of Figs. 5-6 and Fig. 7 are foreseen as well, for instance the in- or output side having the fork configuration of Figs. 5-6 and the other side having the configuration of Fig. 7.

Although the present invention has been described with reference to specific embodiments, also shown in the appended drawings, it will be apparent to those skilled in the art that many

variations and modifications can be done within the scope of the invention as described in the specification and defined with reference to the claims below.

CLAIMS

1. Pulp bale press (1, 101) for compressing pulp bales (12, 14) and configured for use in a pulp bale production line, comprising:

a base (2, 102);

a top (4, 104) positioned opposite the base (2, 102) and connected to the base (2, 102); and

a movable pressing element (6, 106, 506, 706) configured to move between the base (2, 102) and the top (4, 104), wherein the pulp bale press (1, 101) is configured to compress a first pulp bale (12) to be compressed between the base (2, 102) and the movable pressing element (6, 106, 506, 706),

characterized in that the pulp bale press (1, 101) is further configured to compress a second pulp bale (14) to be compressed between the top (4, 104) and the movable pressing element (6, 106, 506, 706).

2. Pulp bale press (1, 101) according to claim 1, wherein:

the base (2, 102) comprises a first pressing surface (7, 107),

the movable pressing element (6, 106, 506, 706) comprises a second pressing surface (8, 108) facing the first pressing surface (7, 107) and a third pressing surface (9, 109) facing the top (4, 104),

the top (4, 104) comprises a fourth pressing surface (10, 110) facing the third pressing surface (9, 109), and

the pulp bale press (1, 101) is configured to receive the first bale (12) to be compressed between the first pressing surface (7, 107) and the second pressing surface (8, 108), compress the first bale (12) by movement of the movable pressing element (6, 106, 506, 706) towards the base (2, 102), receive the second bale (14) to be compressed between the third pressing surface (9, 109) and the fourth pressing surface (10, 110), and compress the second bale (14) by movement of the movable pressing element (6, 106, 506, 706) towards the top (4, 104).

3. Pulp bale press (1, 101) according to claim 2, wherein the first (7, 107) and second (8, 108) pressing surfaces are substantially parallel and the third (9, 109) and fourth (10, 110) pressing surfaces are substantially parallel.

4. Pulp bale press (1, 101) according to claim 2 or 3, wherein the movable pressing element (6, 106, 506, 706) comprises a conveyor along the third pressing surface (9, 109) for positioning the second bale (14), wherein the conveyor is preferably a belt conveyor.

5. Pulp bale press (1, 101) according to any one of the preceding claims, comprising one or more controllers configured to control the movement of the movable pressing element (6, 106, 506, 706).

6. Pulp bale press (1, 101) according to claim 5, wherein the one or more controllers are configured to allow input of the second bale (14) onto the movable pressing element (6, 106, 506, 706) when the movable pressing element (6, 106, 506, 706) is in a first position in which the top (2, 102) and the movable pressing element (6, 106, 506, 706) are sufficiently distanced to receive the second pulp bale (14) to be compressed.

7. Pulp bale press (1, 101) according to claim 6, wherein the first position of the movable pressing element (6, 106, 506, 706) is a position in which, when the first bale (12) is present between the base (2, 102) and the movable pressing element (6, 106, 506, 706), the first bale (12) would be at least partially compressed.

8. Pulp bale press (1, 101) according to any one of the preceding claims, wherein the top (4, 104) is connected to the base (2, 102) by one or more connecting elements (16, 116), wherein the pulp bale press (1, 101) is configured such that the movable pressing element (6, 106, 506, 706) is guided along the one or more connecting elements (16, 116).

9. Pulp bale press (1, 101) according to anyone of the preceding claims, wherein:

the movable pressing element (6, 106, 506, 706) is movably attached to the base (2, 102) via a first plurality of hydraulic cylinders (20, 22, 24, 120, 122, 124), and

the movable pressing element (6, 106, 506, 706) is movably attached to the top (4, 104) via a second plurality of hydraulic cylinders (30, 32, 34, 130, 132, 134).

10. Pulp bale press (1, 101) according to claim 9, wherein the first plurality of hydraulic cylinders (20, 22, 24, 120, 122, 124) comprises at least two hydraulic cylinders and the second plurality of hydraulic cylinders (30, 32, 34, 130, 132, 134) comprises an equal number of hydraulic cylinders as the first plurality of hydraulic cylinders (20, 22, 24, 120, 122, 124).

11. Pulp bale press (1, 101) according to claim 9 or 10, wherein:

the movable pressing element (6, 106, 506, 706) is configured to receive the second bale along a first axis (100) thereof;

the movable pressing element (6, 106, 506, 706) comprises first (40) and second (42) lateral sides extending parallel to the first axis (100);

an equal number of the first plurality of hydraulic cylinders is attached the movable pressing element (6, 106, 506, 706) to each of the first (40) and second (42) lateral sides; and

an equal number of the second plurality of hydraulic cylinders (30, 32, 34, 130, 132, 134) is attached the movable pressing element (6, 106, 506, 706) to each of the first (40) and the second (42) lateral sides.

12. Pulp bale press (1, 101) according to any one of the preceding claims, configured to apply a force to the first bale (12) and the second bale (14) in the range of 2,000 to 40,000 kN, preferably 5,000 to 25,000 kN.

13. Pulp bale press (1, 101) according to any one of the preceding claims, wherein the pulp bale press (1, 101) comprises an input aligning mechanism and an output aligning mechanism, wherein the input aligning mechanism is configured to input a pulp bale (14) to be compressed onto the movable pressing element (506, 706) while the movable pressing element (506, 706) is moving, wherein the output aligning mechanism is configured to output a compressed pulp bale (14) onto the movable pressing element (506, 706) while the movable pressing element (506, 706) is moving.

14. Pulp bale production system configured to produce pulp bales from a cellulose containing raw material, the pulp bale production system comprising the pulp bale press (1, 101) according to any one of the preceding claims.

15. Method of compressing pulp bales in a pulp bale press according to any one of claims 1 to 13 or in a pulp bale production system according to claim 14, the method comprising:

inputting the first bale (12) to be compressed between the base (2, 102) and the movable pressing element (6, 106, 506, 706);

compressing the first bale (12) by moving the movable pressing element (6, 106, 506, 706) towards the base (2, 102);

when the movable pressing element (6, 106, 506, 706) has moved to a first position in which the top (2, 102) and the movable pressing element (6, 106, 506, 706) are sufficiently distanced to receive the second pulp bale (14), inputting the second bale (14) to be compressed between the movable pressing element (6, 106, 506, 706) and the top (4, 104); and

compressing the second bale (14) by moving the movable pressing element (6, 106, 506, 706) towards the top (4, 104).

16. Method according to claim 15, in dependence of at least claim 2, wherein:

the inputting the first bale (12) comprises inputting the first bale (12) between the first pressing surface (7, 107) and the second pressing surface (8, 108); and

the inputting the second bale (14) comprises, when the movable pressing element (6, 106, 506, 706) has moved to a first position in which the third pressing surface (9, 109) and the fourth pressing surface (10, 110) are sufficiently distanced to receive a second pulp bale (14), inputting the second bale (14) to be compressed onto the third pressing surface (9, 109).

17. Method of pulp bale pressing according to claim 15, further comprising:

when the movable pressing element (6, 106, 506, 706) has moved to a second position in which the second pressing surface (8, 108) is not in contact with the compressed first pulp bale (12), outputting the compressed first bale (12) from the first pressing surface (7, 107).

18. Method of pulp bale pressing according to claim 17, further comprising:

when during or after outputting the compressed first bale (12) from the first pressing surface (7, 107) the movable pressing element (6, 106, 506, 706) has moved to a third position in which the first pressing surface (7, 107) and the second pressing surface (8, 108) are sufficiently distanced to receive a third pulp bale (13) to be compressed, inputting the third bale (13) to be compressed between the first pressing surface (7, 107) and the second pressing surface (8, 108).

19. Method of pulp bale pressing according to claim 18, further comprising:

when the movable pressing element (6, 106, 506, 706) has moved to a fourth position in which the fourth pressing surface (10, 110) is not in contact with the compressed second pulp bale (14), outputting the compressed second bale (14) from the third pressing surface (9, 109); and

when during or after outputting the compressed second bale (14) from the fourth pressing surface (10, 110) the movable pressing element (6, 106, 506, 706) has moved to a fourth position in which the third pressing surface (9, 109) and the fourth pressing surface (10, 110) are sufficiently distanced to receive a fourth pulp bale to be compressed, inputting the fourth bale (15) to be compressed between the third pressing surface (9, 109) and the fourth pressing surface (10, 110).

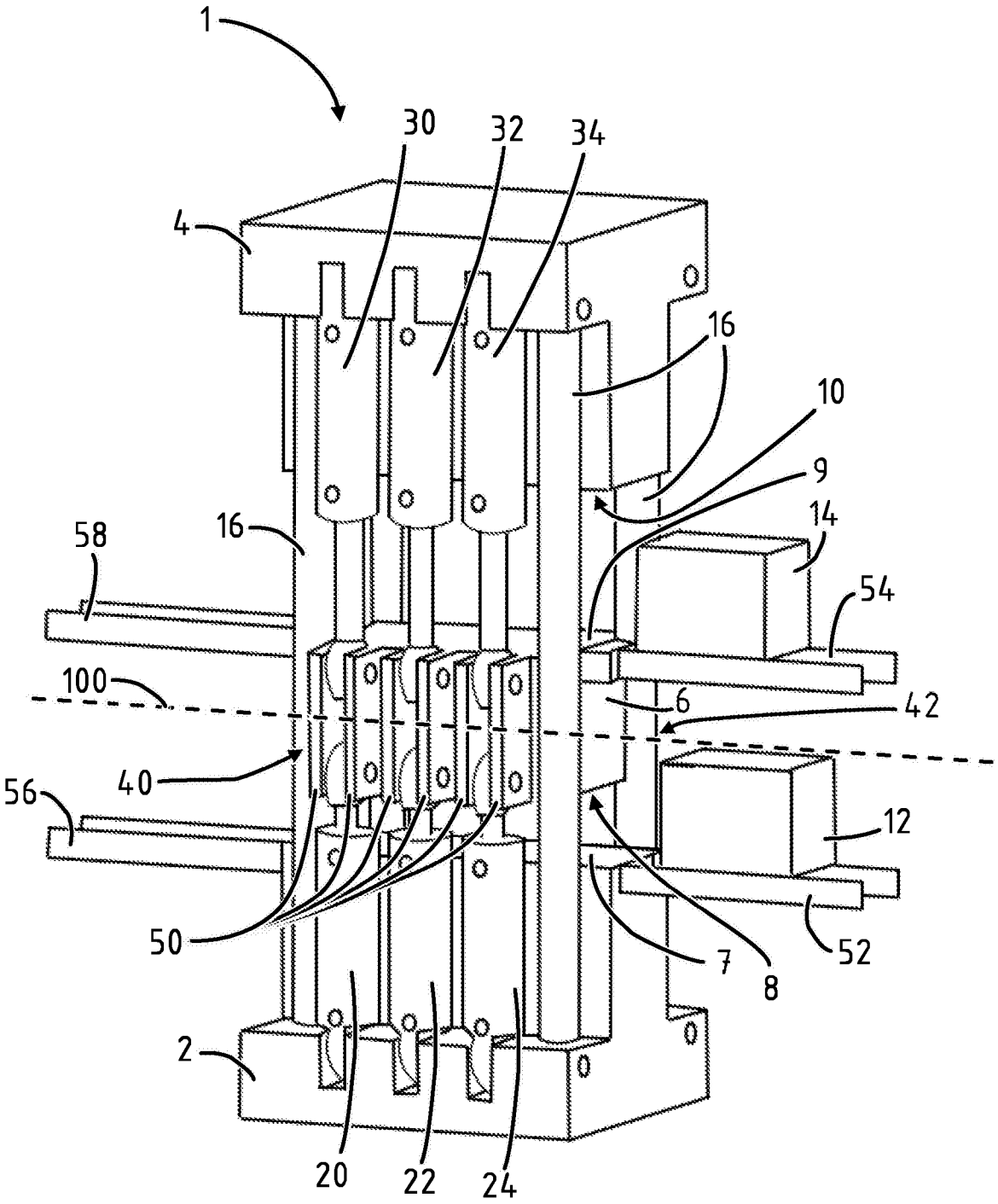
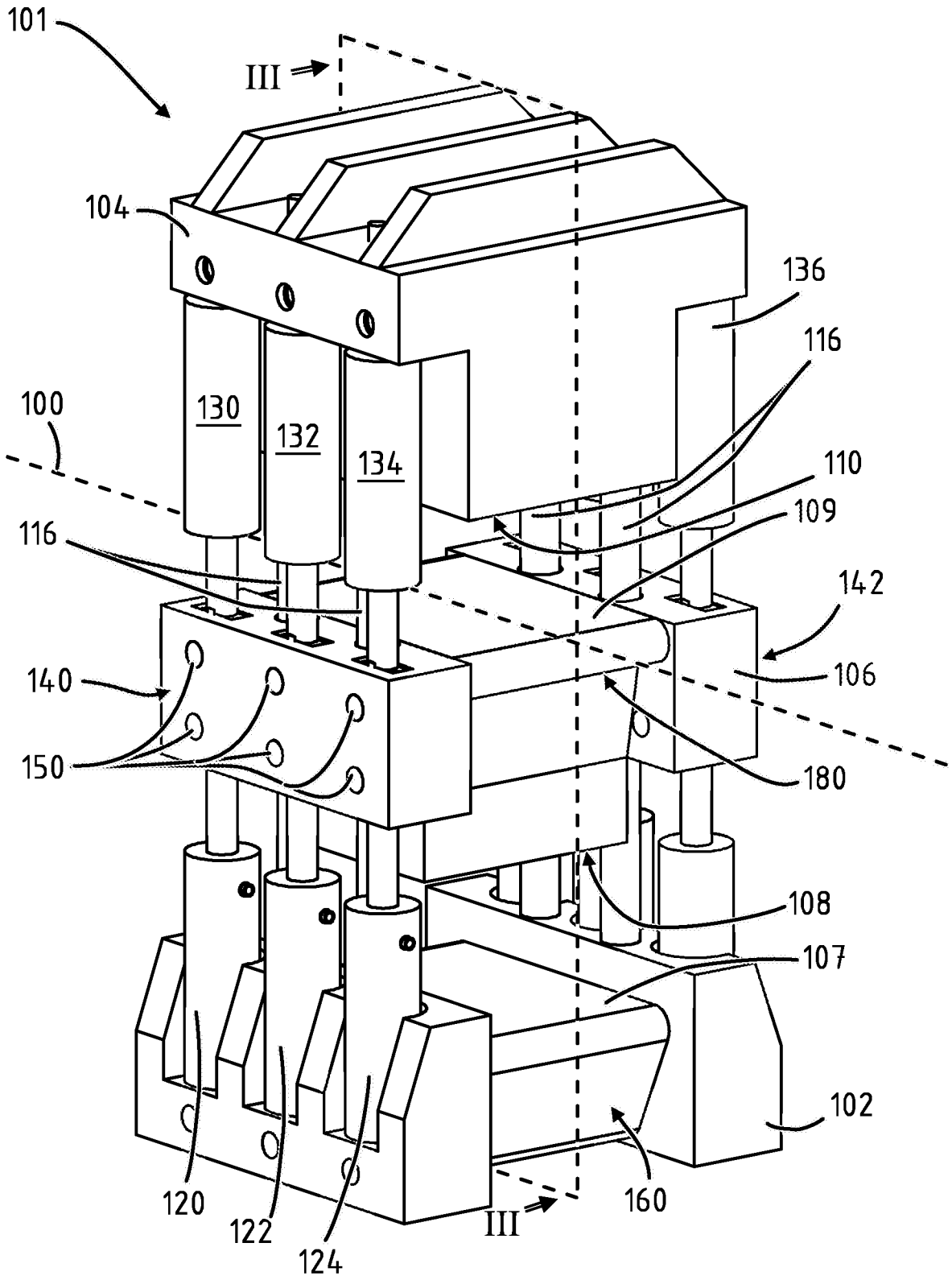


FIG. 1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116
100
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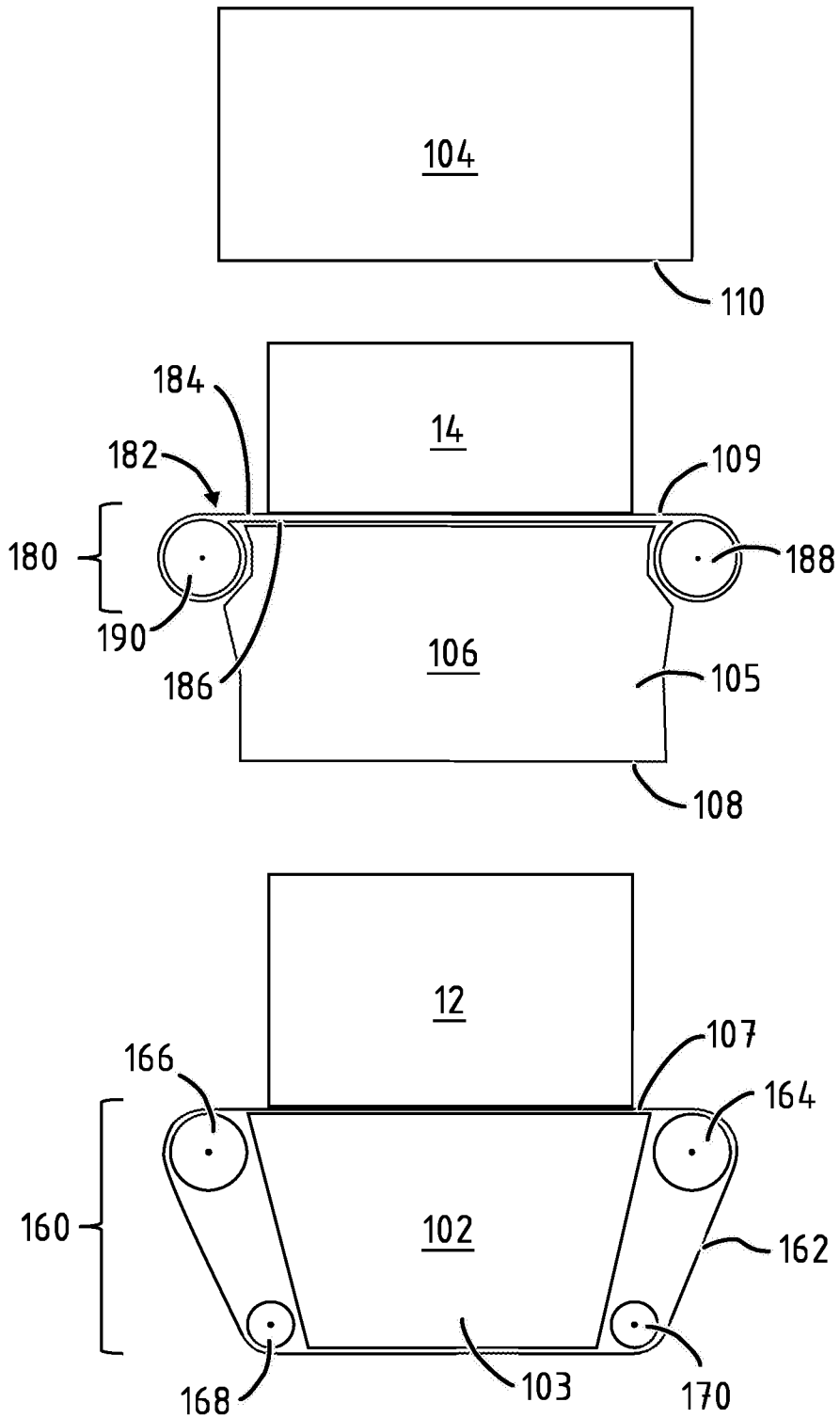
122
124
III
160

FIG. 2


104
110
184
14
182
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12
107
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102
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168
103
170

FIG. 3

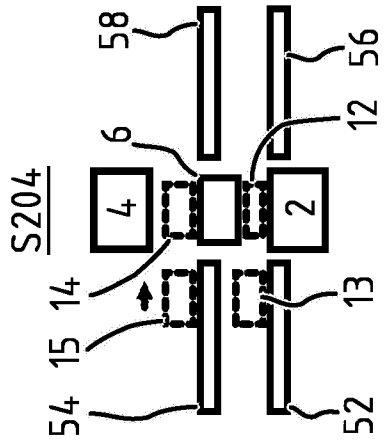


FIG. 4A

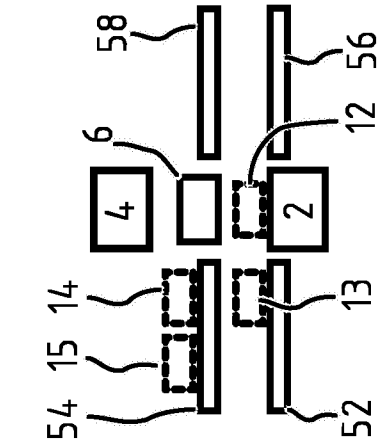


FIG. 4B

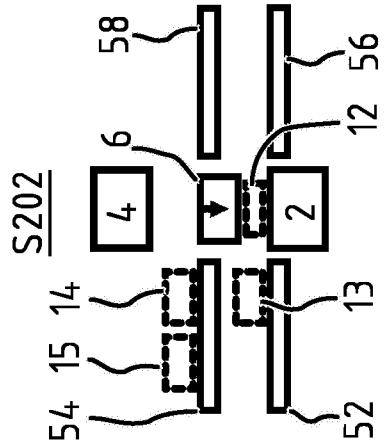


FIG. 4C

FIG. 4D

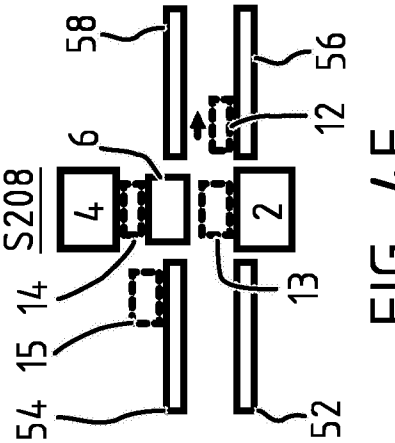


FIG. 4E

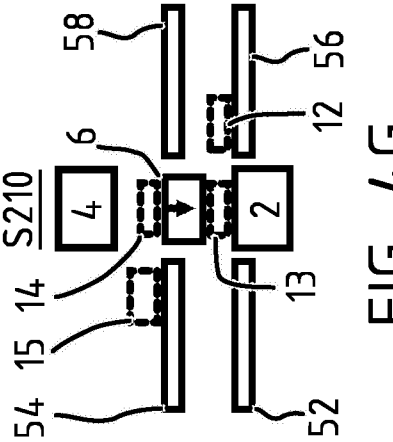


FIG. 4F

FIG. 4G

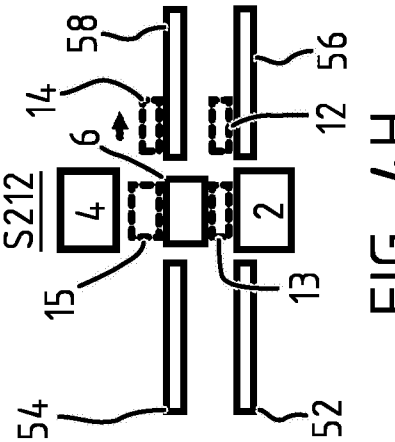
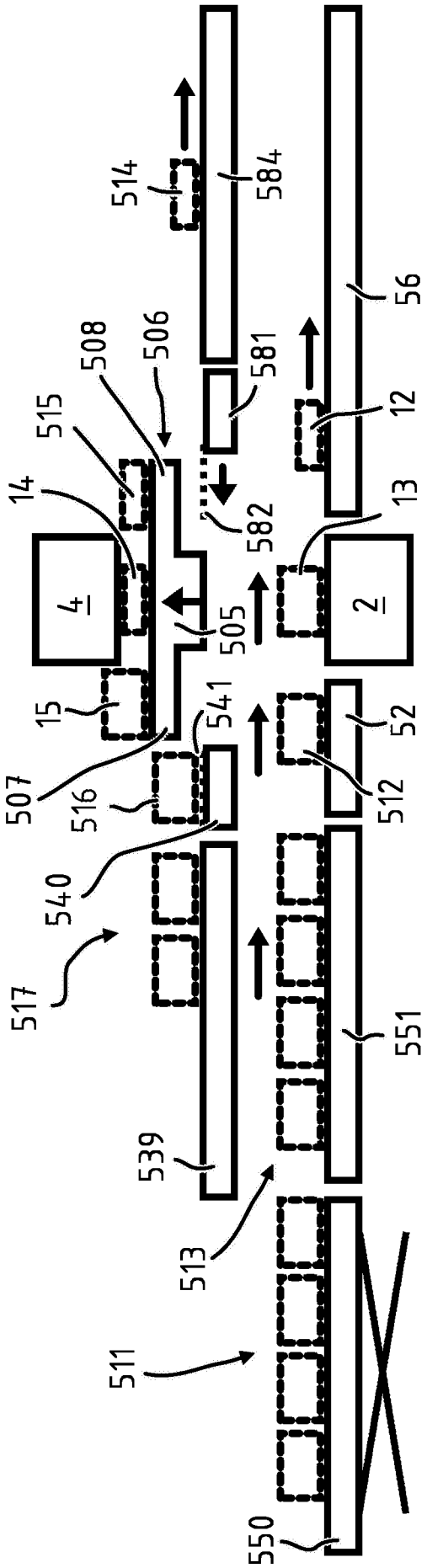


FIG. 4H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584
508
506
581
56
515
12
14
582
13
4
2
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15
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539
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511
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FIG. 5A

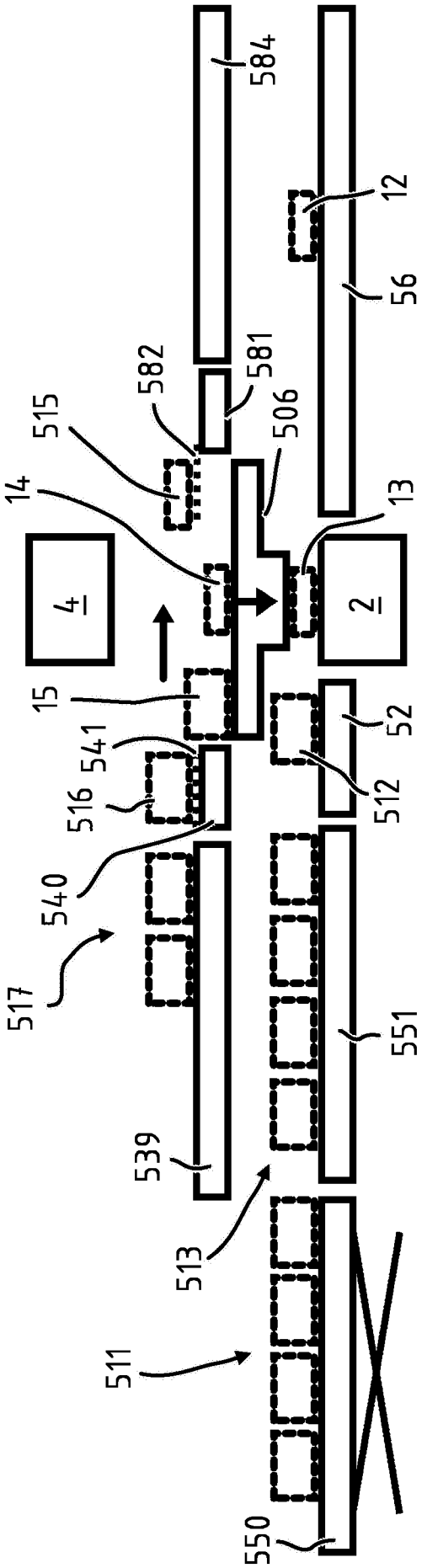
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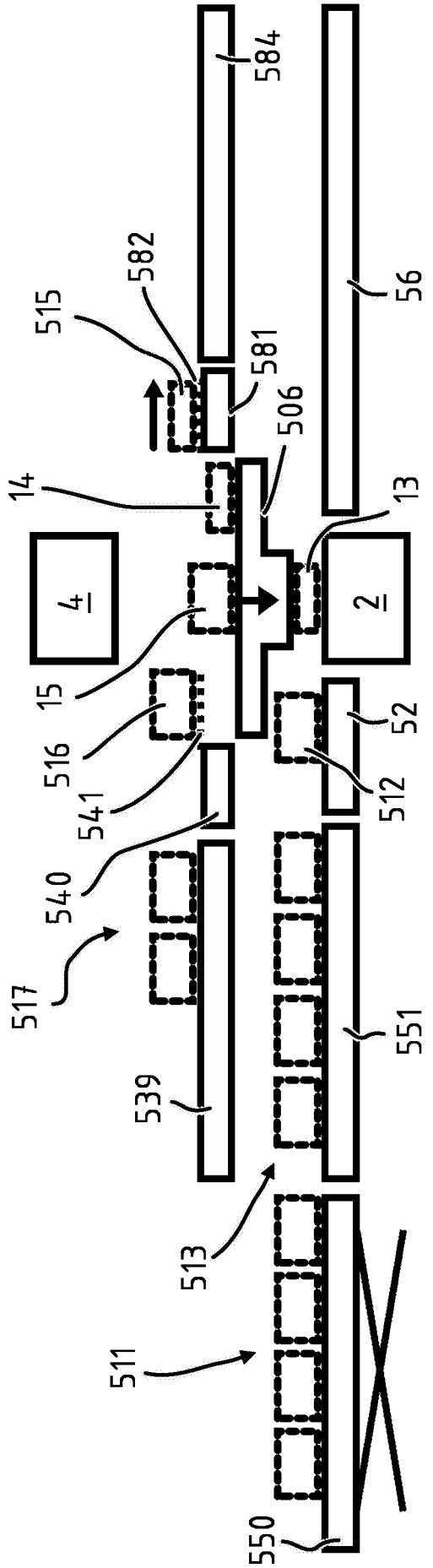
FIG. 5B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511
550

FIG. 5C

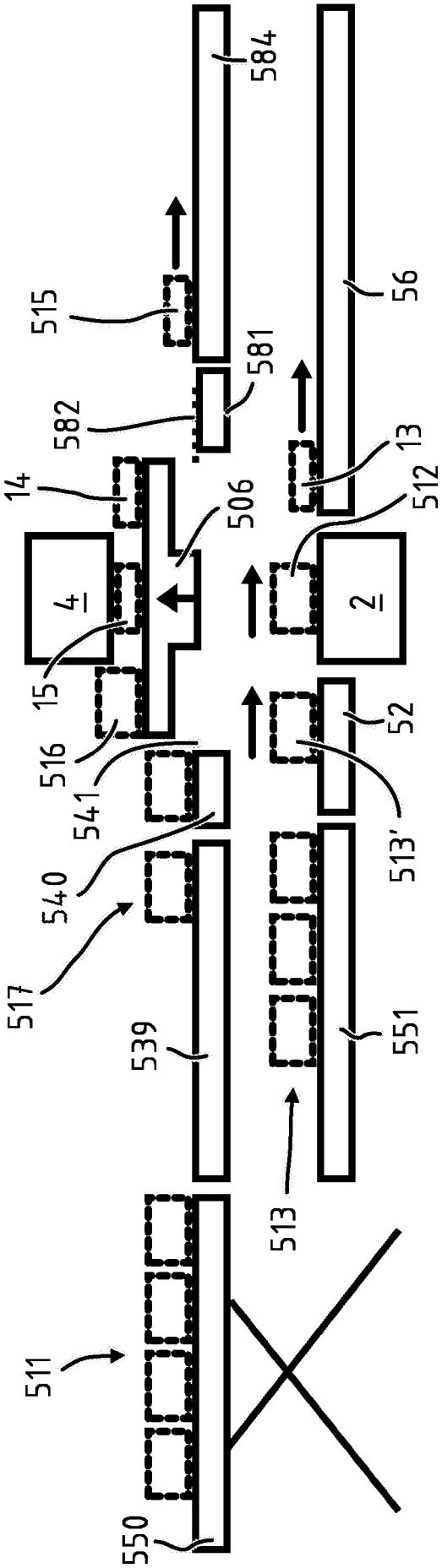
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FIG. 5D

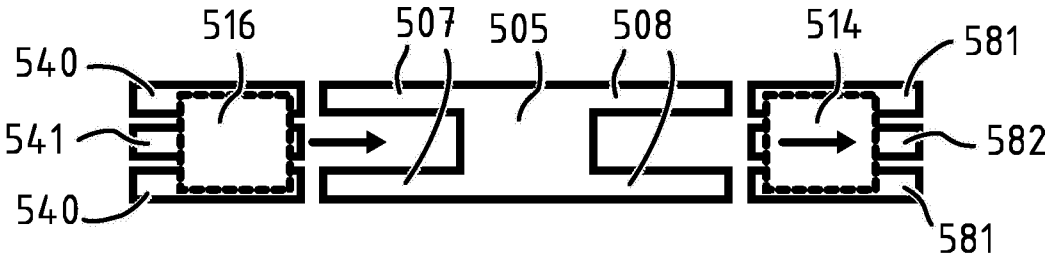

FIG. 6A

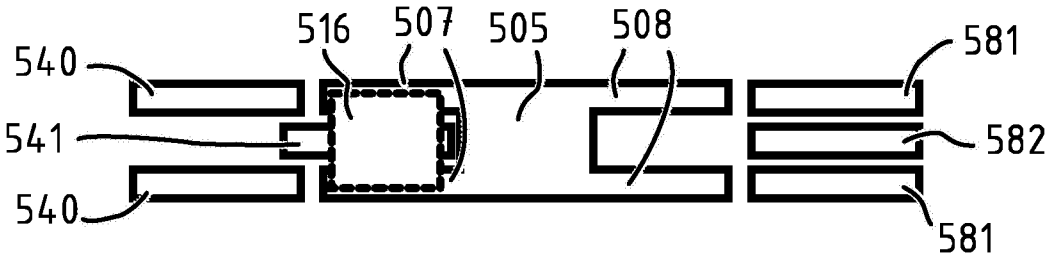

FIG. 6B

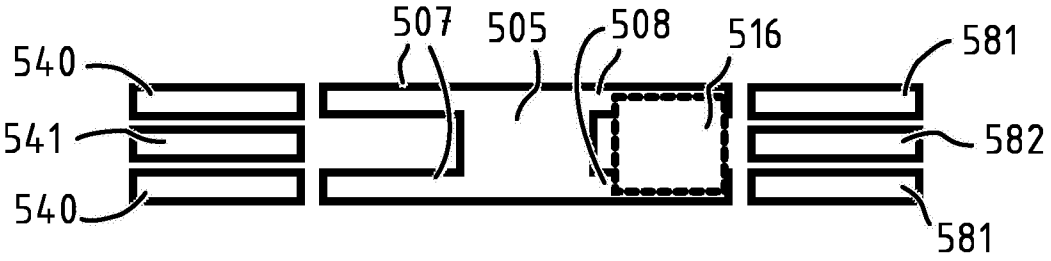

FIG. 6C

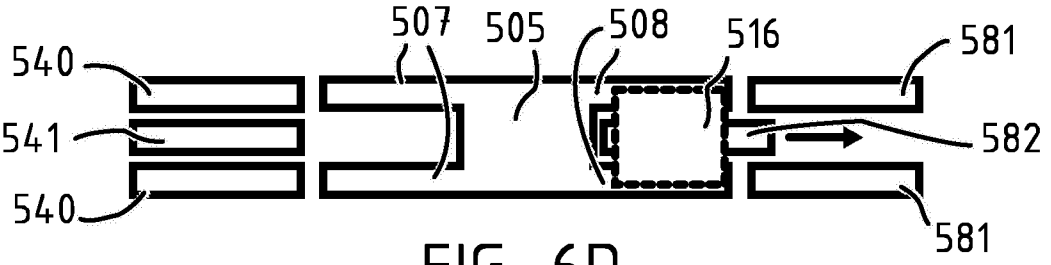

FIG. 6D

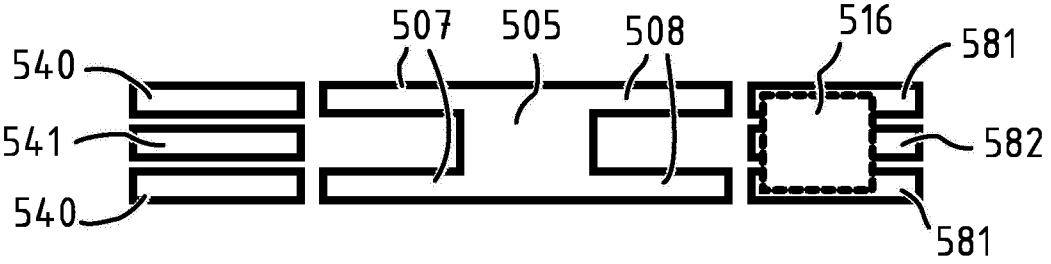

FIG. 6E

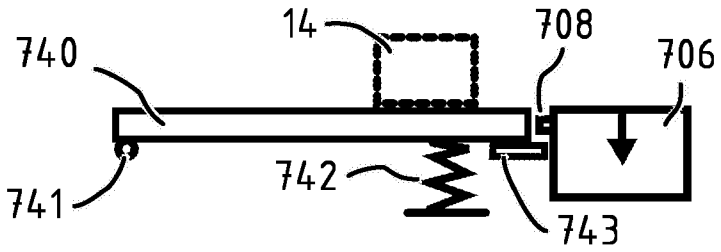

FIG. 7A

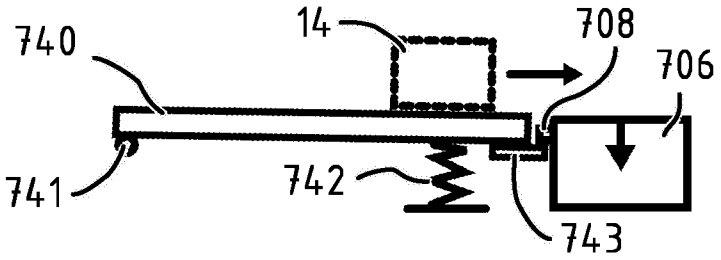

FIG. 7B

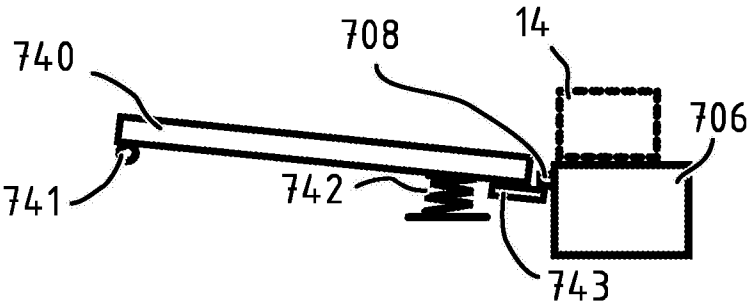

FIG. 7C

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2023/050937

A. CLASSIFICATION OF SUBJECT MATTER
INV. B30B9/30 B30B15/06 B30B1/32 B30B15/32
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B30B B31B B27N D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 441 877 A (PAGNONI GIORGIO [IT]) 10 April 1984 (1984-04-10)	1,5,6,8, 12
A	column 1 - column 2; figure 1	2-4,7, 9-11, 13-19

X	US 4 565 481 A (PAGNONI GIORGIO [IT]) 21 January 1986 (1986-01-21)	1,12
A	columns 1, 5; figures 1, 2	2-11, 13-19

A	US 2 159 779 A (CAVIN HAROLD D) 23 May 1939 (1939-05-23) column 1 - column 2; figure 1	1-19

A	US 3 824 058 A (AXER H ET AL) 16 July 1974 (1974-07-16) abstract; figures 1-7	1-19

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 December 2023	22/12/2023

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Real Cabrera, Rafael

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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