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(54) A BANKNOTE TRANSPORT ARRANGEMENT, A CASH PACKAGING APPARATUS AND A CASH PACKAGE

(57) The disclosure relates to a banknote transport arrangement (100) comprising: a banknote holding device (110) configured to hold a stack of banknotes (10), and a displacing arrangement (140) configured to displace the banknote holding device (110) along a displacement path (DP) from a first position (P1) to a second position (P2), wherein the first position (P1) and the second position (P2) are located in relation to each other such that a portion (P) of the displacement path (DP) extends coaxially through at least a part of an elongated bore (321), wherein the banknote holding device (110) is configured so as to force the stack of banknotes (10) to be bent into a curved shape when the banknote holding device (110) is in a closed configuration (C2) holding the stack of banknotes (10). The disclosure further relates to a cash packaging apparatus (400) comprising a banknote transport arrangement (100) according to the disclosure, and a cash package (900) obtainable by the cash packaging apparatus (400).

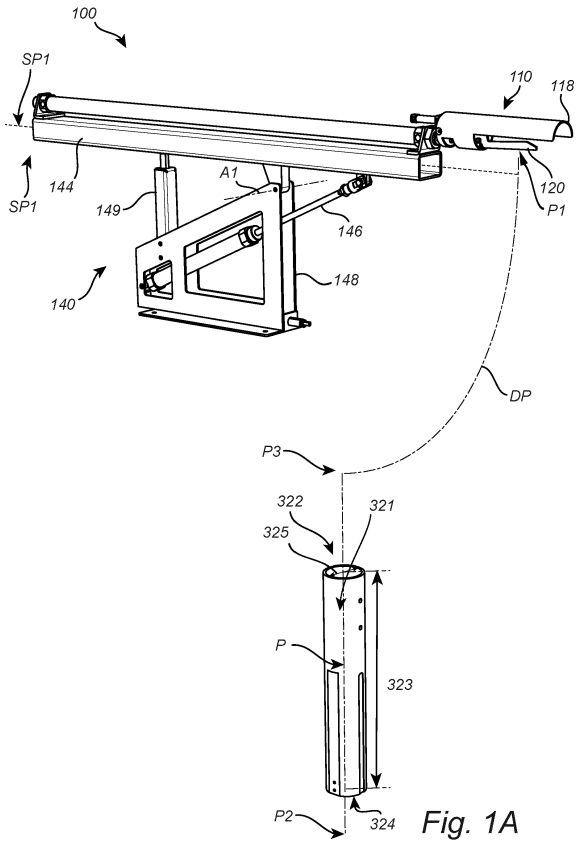

Fig. 1A

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Description

Field of the invention

[0001] The present invention relates to a banknote transport arrangement, a cash packaging apparatus, a method for manufacturing a cash package and a cash package obtainable from said method.

Background art

[0002] Transport of banknotes are well known in the art. Often, banknotes are transported one by one, such as within ATM machines or other kinds of banknote handling machines. There are also known solutions for transporting bundles or stacks of banknotes between different positions within such machines. A drawback of the solutions in the art is that they are not suitable for transporting banknotes to awkwardly accessible locations, such as an interior part of an elongated recess, or an elongated bore. A particular need for such a banknote transport arrangement is for transporting stacks of banknotes for packaging purposes, in particular a kind of packaging aiming to manufacture banknote cash bags, or sachets. These kind of cash bags are typically used to transport coins or banknotes to stores to be used at a point of sale. Whereas technical solutions do exist for automatically packaging coins in such cash bags, packaging banknotes, and in particular stacks of banknotes in such cash bags is not as trivial. There is thus a need in the art for an improved banknote transport arrangement.

Summary

[0003] It is an object to mitigate, alleviate or eliminate one or more of the above-identified deficiencies in the art and disadvantages singly or in any combination and solve at least the above-mentioned disadvantage in the art.

[0004] According to a first aspect there is provided a banknote transport arrangement comprising:

a banknote holding device presenting a first clamping interface and a second clamping interface, said first and second clamping interfaces being displaceable with respect to each other between an open configuration at which the banknote holding device is configured to receive a stack of banknotes in a gap formed between the first clamping interface and the second clamping interface, and a closed configuration at which the banknote holding device is configured to clamp the stack of banknotes between the first clamping interface and the second clamping interface, and

a displacing arrangement configured to displace the banknote holding device along a displacement path from a first position to a second position, wherein the first position and the second position are located in relation to each other such that a portion of the displacement path extends coaxially through at least a part of an elongated bore,

wherein the first clamping interface and the second clamping interface are configured so as to force the stack of banknotes to be bent into a curved shape when the banknote holding device is in the closed configuration.

[0005] The banknote transport arrangement may be advantageous as it allows for selectively transporting a stack of banknotes into remotely and awkwardly accessible locations. Specifically, the displacing arrangement is designed to be able to insert the stack of banknotes into an elongated bore. Such an elongated bore is defined e.g. on an inside of a vertically arranged product delivery cylinder of a vertical form, fill and seal machine - a machine suitable for manufacturing cash packages of the sachet type. In such machines, a flexible material is wrapped around an exterior surface of the product delivery cylinder, and sealed along edges thereof, so as to form, at a lower output opening thereof, an empty top-open sachet ready to receive an item to be packaged. Using the banknote transport arrangement of the disclosure, a stack of banknotes may be actively positioned directly into the top-open sachet without having to rely on gravity, which is the principle otherwise governing positioning of items to be packaged in sachets in vertical form, fill and seal machines. A further advantage of the banknote transport arrangement is that it keeps the stack of banknotes in order during transport by forcing the stack of banknotes to be bent into a curved shape. This effectively prevents banknotes of the stack from mutually spreading with respect to each other during transport, which could risk damaging one or more banknotes of the stack and/or risk jamming the banknote transport arrangement. The banknote transport arrangement may be advantageous also for other use than described above. The banknote transport arrangement may for example be used for transporting stacks of banknotes into individual receptacles or containers, into individual bays of a cash handling machine, or the like. The banknote transport arrangement is configured to transport wrapped as well as non-wrapped stacks of banknotes. The banknote transport arrangement may further be used for other flexible items than banknotes, such as e. g. postcards or paper material. Thus, the banknote transport arrangement is versatile and may be useful also for other applications than banknote handling.

[0006] The displacement path may be linear but may alternatively be non-linear. However, at least the portion of the displacement path which extends coaxially through the elongated bore is linear or substantially linear.

[0007] The term "elongated bore" should be construed as a hole or opening having a longitudinal extension which is longer than its cross-sectional diameter. This implies that the bore is elongated in its longitudinal, or axial, dimension. Typically, the longitudinal extension of

the bore is several times longer than its cross-sectional diameter, for example 3 times longer, 5 times longer, 7 times longer or 10 times longer. The longitudinal extension of the elongated bore is linear, or substantially linear. The elongated bore may have one opening only, such as for a receptacle, a container or a bay. Alternatively, the elongated bore may have two opposite openings, such as for the product cylinder of a vertical form, fill and seal machine. Thus, the elongated bore may be an elongated through-bore.

[0008] The second position may be located within the elongated bore. This implies that the portion of the displacement path may extend coaxially through only a part of the elongated bore. The portion of the displacement path may extend over at least 50% of the longitudinal extension of the elongated bore. The portion of the displacement path may extend over at least 75% of the longitudinal extension of the elongated bore. The portion of the displacement path may extend over at least 90% of the longitudinal extension of the elongated bore. Alternatively, the second position may be located outside of the elongated bore. This implies that said portion of the displacement path may extend coaxially through the whole elongated bore. In the latter example, the second position is located on an opposite side of the elongated bore, which is a through-bore.

[0009] The term "bent shape" should be construed as any non-planar shape. However, preferably the stack of banknotes is forced to be bent along one bending dimension only, as this minimizes the risk of damaging the stacks of banknotes.

[0010] According to some embodiments, the banknote holding device comprises a first clamping element which presents the first clamping interface and a second clamping element which presents the second clamping interface, and wherein the first and second clamping elements are arranged in relation to each other so as to allow free access to the gap from a front end and from opposite lateral sides of the banknote holding device.

[0011] This may be advantageous as it allows the banknote holding device to receive or dispense the stack of banknotes both in a forward direction and from directions transverse to the forward direction.

[0012] The first clamping element may be arranged so as to be on top of the second clamping element when the banknote holding device is in the first position. The banknote holding device may be arranged in relation to the displacing arrangement such that the front end faces a forward direction of the banknote holding device during the displacement along the portion of the displacement path which extends coaxially through the at least a part of the elongated bore.

[0013] According to some embodiments, the second clamping element is pivotably arranged with respect to the first clamping element. This implies that the first and second clamping interfaces are displaceable in relation to each other in response to a rotation of the first and second clamping element in relation to each other.

[0014] According to some embodiments, the first clamping element comprises a hollow cylinder sector and the first clamping interface is defined by an inner surface thereof. The hollow cylinder sector may have a sector angle of 180 degree. For such embodiments the hollow cylinder sector if a hollow half cylinder. Alternatively, the hollow cylinder sector may have a sector angle being less than, or larger than 180 degrees. Preferably, the cylinder sector has a sector angle being within the range 90 to 220 degrees.

[0015] This may be advantageous as it achieves a safe and efficient way to provide a clamping interface which may serve as an engagement surface onto which the stacks of banknote may be forced into the bent shape. Moreover, the cylindrical geometry allows for the exterior shape of the banknote holding device to be suitably fitted to enter the elongated bore.

[0016] The hollow cylinder sector may be configured such that the first clamping interface is larger than an area of a banknote of the stack of banknotes. This enables the banknote holding device to shield and protect the stack of banknotes during transport. Thus, for the example embodiment, the stack of banknotes may be prevented from protruding outside of the banknote holding device.

[0017] According to some embodiments, the second clamping element comprises an elongated portion which is connected to the banknote holding device at a first end thereof and presents the second clamping interface at a second end thereof.

[0018] The elongated portion may have a smaller cross-sectional area than a cross-sectional area of the hollow cylinder sector. This implies that the second clamping interface may have a smaller interface area than an interface area of the first clamping interface.

[0019] According to some embodiments, the displacing arrangement is configured:

to displace the banknote holding device between the first position which is distanced from the elongated bore, and a third position which is located at an entrance opening of the elongated bore; and
to linearly displace the banknote holding device from the third position, through the entrance opening of the elongated bore, and to the second position. In other words, the displacing arrangement is configured to perform two different displacements. The first displacement which encompasses the displacement from the first position to the third position may follow any conceivable path, such as a curvilinear path. The second displacement, which encompasses the displacement from the third position to the second position is a linear, or at least substantially linear, displacement.

[0020] According to some embodiments, the displacing arrangement comprises a linear actuator which carries the banknote holding device, the linear actuator be-

ing configured to linearly displace the banknote holding device from the third position, through the entrance opening of the elongated bore, and to the second position. The linear actuator may be any type of linear actuator such as e.g. a pneumatic linear actuator, a hydraulic linear actuator or a mechanical linear actuator such as a rack and pinion based linear actuator.

[0021] According to some embodiments, the displacing arrangement further comprises a support beam which carries the linear actuator, wherein the support beam is pivotable between a first support beam position at which the banknote holding device is allowed to reach the first position, and a second support beam position, at which the banknote holding device is allowed to reach the second position.

[0022] According to some embodiments, the banknote transport arrangement further comprises a further banknote holding device and a further displacing arrangement wherein the further displacing arrangement is configured to displace the further banknote holding device from a fourth position to the first position so as to provide the stack of banknotes in the gap of the banknote holding device to be received by the banknote holding device.

[0023] The banknote transport arrangement may be configured to receive the stack of banknotes from a banknote dispenser, such as e.g. an ATM machine.

[0024] The further banknote holding device and the further displacing arrangement may allow transporting banknotes from remote locations so as to be within the reach of the banknote holding device. Moreover, the use of two different banknote holding devices allows for configuring each banknote holding device for a specific purpose. The banknote holding device is intended to operate efficiently and reliably during a displacement through the elongated bore. Thus, the banknote holding device may be less suited for receiving banknotes from a banknote dispenser. The further banknote holding device may, however, be configured differently so as to be better suited for this purpose. A banknote dispenser typically outputs a stack of banknotes with its long stack side facing outwardly. The further banknote holding device may be configured to receive, hold and transport the stack of notes from the banknote dispenser in a reliably way. This may be achieved by the following features and functions.

[0025] The further banknote holding device may be configured to receive the stack of banknotes from a lateral side thereof.

[0026] The further banknote holding device may comprise a first clamping element and a second clamping element. The first clamping element may present a substantially planar surface adapted to support a stack of banknotes received by the further banknote holding device. The second clamping element may be arranged at a displaceable end of a linear actuator which may be arranged in the reference frame of the first clamping element. The linear actuator may be configured to displace the second clamping element between an open configuration at which a stack of banknotes may be received in a gap formed between the first and second clamping elements, and a closed configuration at which the further banknote holding device is configured to clamp the stack of banknotes between the first clamping element and the second clamping element. The second clamping element may have a rounded or circular cross section presenting a rounded or circular clamping interface.

[0027] The second clamping element may be arranged on the further banknote holding device such that the stack of banknotes is clamped at or close to a short stack side thereof leaving the opposite side of the stack of banknotes unclamped. The second clamping element may be arranged on the further banknote holding device such that the unclamped side of the stack of banknotes faces the banknote holding device when the further banknote holding device hands over the stack of banknotes to the banknote holding device at the first position.

[0028] The first clamping element may present an inwardly projecting elongated opening which protrudes into the first clamping element at a front end thereof. The elongated opening may allow the second clamping element of the banknote holding device to access the space defined by the gap of the further banknote holding device so as to clamp the stack of banknotes while the stack of banknotes is still residing in the gap of the further banknote holding device. This effectively allows for handing over the stack of banknotes from the further banknote holding device to the banknote holding device.

[0029] The further displacing arrangement may comprise a support beam which is rotationally arranged on the banknote transport arrangement by means of a rotational actuator. The support beam may be rotatable in a horizontal plane along a pivot axis. The support beam may carry the further banknote holding device at a movable end thereof.

[0030] According to a second aspect there is provided a cash packaging apparatus comprising:

a vertical form, fill and seal machine comprising:
a vertically arranged product delivery cylinder having an entrance opening for receiving items to be packaged, such as a mass of coins or a stack of banknotes, and an output opening for allowing said items to leave the product delivery cylinder, said entrance and output openings being interconnected by an elongated bore;
a flexible sheet forming and sealing arrangement configured:

to provide, from a flexible sheet material, a top-open sachet at the output opening of the product delivery cylinder for receiving items to be packaged from the product delivery cylinder, and
to, in response to having received items to be packaged in the top-open sachet, seal a top end thereof so as to form a sealed sachet containing the items; and

a banknote transport arrangement configured to transport a stack of banknotes through the entrance opening, via the elongated bore of the product transport cylinder and into the top-open sachet provided by the flexible sheet forming and sealing arrangement

wherein the cash packaging apparatus is configured to manufacture a cash package comprising the sealed sachet containing the stack of banknotes.

[0031] The cash packaging apparatus may be advantageous as it allows using a standard vertical form, fill and seal machine for packaging items which do not easily and reliably manage to enter the top-open sachet by gravity. Thus, by incorporating a banknote transport arrangement, the standard vertical form, fill and seal machine may package also items such as banknotes and/or other thin flexible objects. This allows for manufacturing cash packages containing banknotes in a convenient and flexible way. Specifically, the foot-print of the cash packaging apparatus, i.e. the physical area required by the apparatus when being deployed e.g. at a coin handling facility, may be significantly reduced compared to alternative cash packaging apparatuses based on alternative packaging principles, such as for example horizontal sachet filling machines.

[0032] The cash packaging apparatus may share one or more features in common with the banknote transport arrangement of the first aspect. The cash packaging apparatus may further share one or more features in common with disclosed embodiments of the banknote transport arrangement of the first aspect. According to some embodiments, the cash packaging apparatus shares all features in common with the banknote transport arrangement of the first aspect and/or disclosed embodiments thereof. In particular, the banknote transport arrangement of the cash packaging apparatus may comprise a banknote holding device being configured to clamp the stack of banknotes between a first clamping interface and a second clamping interface. The first clamping interface and the second clamping interface may be configured to force the stack of banknotes to be bent into a curved shape.

[0033] Some embodiments of the cash packaging apparatus of the disclosure may be suitable for manufacturing a cash package which, in addition to the sealed sachet containing the stack of banknotes, further comprises a further sealed sachet containing the mass of coins, wherein the sealed sachet and the further sealed sachet are interconnected to each other.

[0034] According to some embodiments, the cash packaging apparatus further comprises:

a coin dispensing arrangement configured to provide a mass of coins to the entrance opening of the product delivery cylinder so as to allow the mass of coins to be guided, by gravity, through the elongated bore of the product delivery cylinder and into the top-open sachet provided by the flexible sheet forming and sealing arrangement,

wherein the cash packaging apparatus is configured to manufacture a cash package which further comprises the further sealed sachet containing the mass of coins, wherein the sealed sachet and the further sealed sachet are interconnected to each other.

[0035] Such a cash packaging apparatus may be advantageous as it allows manufacturing cash packages containing both coins and banknotes at a single product line. Also, the cash packaging apparatus may be located at one location. Sometimes, local security regulations do not allow handling banknotes and coins in the same area. In such a case, the cash packaging apparatus may nevertheless be utilized, since e.g. the coin dispensing arrangement may be located remotely from the rest of the cash packaging apparatus in a first area having security clearance for handling coins, whereas the vertical form, fill and seal machine, the banknote transport arrangement and the banknote dispenser may be located in a second area having security clearance for handling banknotes. Coins may then be transported between the two areas through an opening or the like.

[0036] According to some embodiments, the cash packaging apparatus is configured to provide a perforation on the flexible sheet material such that the sealed sachet comprises a perforation extending from a bottom end of the sealed sachet to a top end of the sealed sachet on at least one side of the sealed sachet.

[0037] This may be advantageous as it allows more easy retrieval of the cash one the cash package arrives at the point of sale where the cash is to be deposited. The sachets may be opened by hand just by tearing up the sachet along the perforation. As each sachet contains only one specific denomination, this allows keeping denominations apart and selectively deposit them in order in e.g. a cash machine of a checkout counter.

[0038] This may be achieved by the flexible sheet forming and sealing arrangement before the flexible sheet material is formed and sealed. The perforation may be provided to the flexible sheet material by a perforation roller arranged to rotate as the flexible sheet material is fed towards the product delivery cylinder. The perforation roller may comprise a perforation wheel which extends transversely to a rotational axis of the perforation roller. The perforation wheel may be a toothed wheel. The perforation roller may be arranged in relation to the guide roller such that the perforation wheel faces and partly protrudes into the flexible sheet material so as to perforate the flexible sheet material. Adjacent the perforation roller on an opposite side of the flexible sheet material may be arranged a guide roller having a circumferentially arranged recess. The perforation roller may be arranged in relation to the guide roller such that the perforation wheel faces and partly protrudes into the circumferentially arranged recess of the guide roller. This way, a perforation will be automatically created in the flexible sheet

material which passes in between the guide roller and the perforation roller during off-winding of the flexible sheet material during operation of the vertical form, fill and seal machine.

[0039] Perforations may be achieved in other ways. Perforation may be achieved by stamping the flexible sheet material or the flexible tube before turning the same into a sachet. Alternatively, the flexible sheet material may be perforated before mounted on the cash packaging apparatus.

[0040] The cash packaging apparatus may further comprise a banknote dispenser configured to output the stack of banknotes to be received by the banknote transport arrangement. The banknote dispenser may be arranged in relation to the banknote transport arrangement such that the stack of banknotes is output to the first position to be received by the banknote holding device, or, alternatively, to the fourth position to be received by the further banknote holding device. The banknote dispenser may comprise a plurality of banknote storage units for storing banknotes e.g. of different denomination and/or currency. The banknote dispenser may include a banknote output unit configured to receive banknotes output from the plurality of banknote storage units, arrange the received banknotes in a stack configuration so as to form the stack of banknotes, and output the stack of banknotes from the banknote dispenser. A banknote dispenser could be e.g. an ATM machine.

[0041] The cash packaging apparatus may further comprise a control unit configured to control the banknote transport arrangement and the vertical form, fill and seal machine.

[0042] For example embodiments which includes a banknote dispenser, the control unit may be further configured to control said banknote dispenser. The control unit may be configured to send, to the banknote dispenser, banknote dispensing instructions including at least a number of banknotes to be packaged, wherein the banknote dispenser is configured to dispense a stack of banknotes corresponding to said banknote dispensing instructions. Optionally, the banknote dispensing instructions includes an associated number of banknotes for a respective one of two or more banknote denominations. This allows for the banknote dispenser to dispense a stack of banknotes including banknotes of different denomination.

[0043] The control unit may be configured to receive, or retrieve, cash packaging instructions pertaining to an individual cash package to be manufactured, wherein said cash packaging instructions include at least said banknote dispensing instructions. The cash packaging instructions may be received, or retrieved, from a database connected to the cash packaging apparatus. Alternatively, the cash packaging instructions may be provided to the cash packaging apparatus by user input.

[0044] The control unit may be further configured to control the banknote transport arrangement and/or the vertical form, fill and seal machine. The control unit may be further configured to send cash packaging instructions to the vertical form, fill and seal machine, said cash packaging instructions including a number of sachets intended for banknotes and a number of banknotes intended for coins.

[0045] For example embodiments which includes a coin dispensing arrangement, the control unit may be further configured to control said coin dispensing arrangement. The control unit may be configured to send, to the coin dispensing arrangement, coin dispensing instructions including at least a number of coins to be packaged in a sachet of the cash package, wherein the coin dispensing arrangement is configured to provide a mass of coins corresponding to said coin dispensing instructions. Optionally, the coin dispensing instructions may include an associated number of coins for a respective one of two or more coin denominations.

[0046] The control unit may be configured to send instructions to the vertical form, fill and seal machine pertaining to an associated length of each sachet of a cash package. This may allow the vertical form, fill and seal machine to provide an appropriate length of top-open sachets for each individual group of items to be packaged. Top-open sachets intended for a stack of banknotes may extend further downstream than top-open sachets intended for a mass of coins, such that the sealed sachet of the manufactured cash package has a longer distance between its top end and its bottom end than the corresponding distance of the further sealed sachet of the manufactured cash package.

[0047] As readily appreciated by the person skilled in the art, the control unit of the cash packaging apparatus may allow controlling all essential parts of the apparatus needed in order to manufacture individual cash packages having predefined properties. A first cash package may, for example, include 20 coins of three denominations and a stack of banknotes including altogether 20 banknotes of two denominations. A second cash package may, as another example, include 30 coins of five denominations and a stack of banknotes including altogether 30 banknotes of only one denomination. Thus, each manufactured cash package may be individually tailored for the intended end user. This may be especially useful for manufacturing cash packages as starting tills, as will be further discussed later. By providing cash packaging instructions including individual instructions for respective one of a plurality of individually tailored cash packages, the cash packaging machine of the disclosure may manufacture the plurality of individually tailored cash packages based on these instructions in a fully automatic mode without user intervention.

[0048] According to a third aspect there is provided a method for manufacturing a cash package comprising a sealed sachet containing a stack of banknotes, said method comprising:

(a) providing, from a flexible sheet material and by a vertical form, fill and seal machine, a top-open sa-

chet at an output opening of a vertically arranged product delivery cylinder of the vertical form, fill and seal machine;

(b) providing, by a banknote transport arrangement, a stack of banknotes through the entrance opening, via an elongated bore of the product transport cylinder and into the top-open sachet; and

(c) sealing, by the vertical form, fill and seal machine, a top end of the top-open sachet so as to form the sealed sachet containing the stack of banknotes.

[0049] According to some embodiments of the method, the cash package further comprises a further sealed sachet containing a mass of coins, wherein the sealed sachet and the further sealed sachet are interconnected to each other, the method further comprising:

(d) providing, from the flexible sheet material and by the vertical form, fill and seal machine, a further top-open sachet at the output opening of the vertically arranged product delivery cylinder of the vertical form, fill and seal machine;

(e) providing a mass of coins to be packaged to an entrance opening of the product delivery cylinder so as to allow the mass of coins to be guided, by gravity, through the elongated bore of the product delivery cylinder to be output through the output opening of the product delivery cylinder and received into the further top-open sachet;

(f) sealing, by the vertical form, fill and seal machine, a top end of the further top-open sachet so as to form the further sealed sachet containing the mass of coins.

[0050] According to a fourth aspect there is provided a cash package obtainable by the method according to the third aspect.

[0051] In other words, the cash package may comprise a sealed sachet containing a stack of banknotes and a further sealed sachet containing a mass of coins, wherein the sealed sachet and the further sealed sachet are interconnected to each other. The cash package may further comprise one or more further sealed sachets. The one or more further sealed sachets may contain an individual stack of banknotes and/or an individual mass of coins. The cash package thus formed will comprise a plurality of interconnected sachets. The plurality of interconnected sachets may form an array of interconnected sachets.

[0052] The cash package which comprises the mutually interconnected sealed sachet containing the stack of banknotes and the further sealed sachet containing the mass of coins may be advantageous for several reasons. Firstly, it reduces the number of individual packages needed for CIT personnel to ship to a site, such as a point of sale location. Instead of having to rely on separate processes for coins and banknotes, everything is handled in the same system and the end product is a single package. Packages may be tailored for specific point of sale locations and/or for specific stations at such point of sale locations, such as for a specific checkout counter. This may be especially useful for providing cash to tills at the start of a new working day, so called starting tills. Today, starting tills are usually provided by means of coin rolls and stacks of banknotes provided to the end user by CIT personnel. The manual process makes end-tailored delivery challenging. Instead, typically each end user at a specific facility, such as a mall or store, receives identical sets of coins and banknotes. To make sure cash will be enough, it is not uncommon to provide cash in excess. Also, coin rolls are supplied as multiples of, e.g. 25, 40 or 50 coins. This makes it further challenging to supply an appropriate number of coins for a specific starting till. The end result will be an unnecessary transporting of excess coins and banknotes, and especially for the coins, which are heavier than banknotes, this will lead to in increased cargo weight for the CIT vehicles leading to higher overall fuel consumption and consequently a higher environmental footprint. Furthermore, the increased weight may also negatively affect the health of CIT personnel when delivering the cash by hand to their customer's cite. The cash package of the invention allows for reducing the weight, since it allows for removing the excess coins and banknotes as compared to the prior art solutions. Another advantage of the cash package of the invention is that it provides a tamper-free solution for both coins and banknotes. Any attempt to access the cash will be easily identified since the sachets must be broken in order to access the cash. The cash package may also have an additional advantage of reducing the risk of theft of the cash package as compared to traditional solutions. The cash package combines banknotes which have a relatively high monetary value with coins which have a lower monetary value. At the same time, the coins are relatively heavy while the banknotes are relatively lightweight. From a perspective of a criminal, the cash package may be less interesting to steel as it is quite heavy. Where the banknotes make up most of the monetary value contained within the cash package, the coins provide a relatively large mass which must be carried around.

[0053] Each cash package may be provided with one or more lateral perforations arranged along interconnection regions formed between adjacent sealed sachets of the cash package. The lateral perforation may be arranged along, within or at least close to, a sealed portion defining a transition between two sealed sachets. The lateral perforation facilitates removal of one or more sachets from the cash package. This may for example allow separating banknotes from coins, or some denominations from other denominations. This may be advantageous especially for the end user, as it facilitates handling the cash package during refilling of a cash till. There are many ways in the art to provide such perforations. For example, a perforation wheel may be configured to displace laterally across the flexible tube. Alternatively, a stamping tool comprising a plurality of protrusions may

be used to stamp the flexible tube so as to form the perforation in one single operation.

[0054] Each sachet of the two or more interconnected sachets of the cash package may have an individual length as defined between its bottom end and its top end. An associated length of a sachet containing banknotes may be longer than an associated length of a sachet containing a mass of coins. An associated length of a sachet containing a first mass of coins may be different than an associated length of a sachet containing a second mass of coins.

[0055] The cash package may be made identifiable by providing identification means to the cash package. The identification means may comprise a unique code. The unique code may be provided as a visible code, such as e.g. a numerical code, a bar code, a QR code or the like. The visible code may be provided on a patch, or sticker attached to the cash package by means of an adhesive. Alternatively, the visible code may be printed directly onto the cash package.

[0056] Alternatively, identification means may comprise a flexible identification card configured to be provided to a sachet of the cash package during manufacture thereof by using the banknote transport arrangement. The flexible identification card may be arranged together with the stack of banknotes in a stacked configuration and provided to the top-open sachet by the banknote transport arrangement together with the stack of banknotes. Alternatively, the flexible identification card may be provided to the cash package into another sachet so as to be separated from the stack of banknotes. The flexible identification card may comprise a unique code. The unique code may be a visible code as already detailed herein. Alternatively, the unique code may be a digital code stored within the flexible identification card. The flexible identification card may comprise an RFID tag comprising the digital code. The flexible identification card may be advantageous as it may be provided to the cash package by the banknote transport arrangement of the cash packaging apparatus with little or no modification to the apparatus. For example, the flexible identification card may be provided on top of the stack of banknotes being provided to the banknote transport arrangement in the first position (or, alternatively, the fourth position). The banknote transport arrangement may thereby transport both the flexible identification card and the stack of banknotes to the top-open sachet.

[0057] It is also conceivable that the identification means is an identification badge. The identification badge may comprise a unique code. The unique code may be a visible code as already detailed herein. Alternatively, the unique code may be a digital code stored within the identification badge. The identification badge may comprise an RFID tag comprising the digital code. The identification badge may be configured to be provided to a sachet directly via the product delivery cylinder. This implies that the identification badge, during manufacturing of the cash package, will be guided, by gravity, through the elongated bore of the product delivery cylinder and into a top-open sachet provided by the flexible sheet forming and sealing arrangement. The identification badge may be advantageous as it may be provided to the cash package by the coin dispensing arrangement of the cash packaging apparatus with little or no modification to the apparatus. For example, the identification badge may be provided directly on the coin transport arrangement of the coin dispensing arrangement by a dedicated badge dispenser being a part of the coin dispensing arrangement. The identification badge may thereby be transported by the coin transport arrangement to the product delivery cylinder and provided to a top-open sachet either together with a mass of coins to be packaged therein, or in isolation in a dedicated top-open sachet.

[0058] The identification means may be advantageous as it allows keeping track of each cash package. When cash packages are manufactured, these may be packaged following different specifications dependent on end customer. Thus, each manufactured cash package may contain a different set of coins and/or banknotes. By providing the identification means, each manufactured cash package may be tracked, or traced, which allows for a correct end used receiving each package. As each cash package aims to cover the complete cash requirements for a specific station over a specific time period, it allows convenient follow up. Since a single apparatus, such as the cash packaging apparatus of the disclosure, packages both banknotes and coins, it allows to keep track of the number of coins and banknotes of each denomination which are packaged for a specific station. Thus, feedback information that for example a station severely lacks a specific denomination over time, may be used to automatically or manually change the specifications for that station, thus adding more coins or banknotes of that specific denomination for upcoming cash packages shipped to that station.

[0059] Effects and features of the second and third aspects are largely analogous to those described above in connection with the first aspect. Embodiments mentioned in relation to the first aspect are largely compatible with the second aspect and third aspects. It is further noted that the inventive concepts relate to all possible combinations of features unless explicitly stated otherwise.

[0060] A further scope of applicability of the present invention will become apparent from the detailed description given below. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the scope of the invention will become apparent to those skilled in the art from this detailed description.

[0061] Hence, it is to be understood that this invention is not limited to the particular component parts of the device described or steps of the methods described as such device and method may vary. It is also to be under-

stood that the terminology used herein is for purpose of describing particular embodiments only, and is not intended to be limiting. It must be noted that, as used in the specification and the appended claim, the articles "a", "an", "the", and "said" are intended to mean that there are one or more of the elements unless the context clearly dictates otherwise. Thus, for example, reference to "a unit" or "the unit" may include several devices, and the like. Furthermore, the words "comprising", "including", "containing" and similar wordings does not exclude other elements or steps.

Brief descriptions of the drawings

[0062] The invention will by way of example be described in more detail with reference to the appended [schematic] drawings, which shows presently preferred embodiments of the invention.

Figure 1A shows a perspective view of a banknote transport arrangement according to an embodiment of the present disclosure. In Fig. 1A, the banknote holding device is in a first position.

Figure 1B shows a perspective view of the banknote transport arrangement of Fig. 1A when the banknote holding device is in a third position.

Figure 1C shows a perspective view of the banknote transport arrangement of Fig. 1A when the banknote holding device is in a second position.

Figure 2A shows a perspective view of the banknote holding device of the banknote transport arrangement of Figs 1A-C when the banknote holding device is in an open configuration.

Figure 2B shows a perspective view of the banknote holding device of the banknote transport arrangement of Figs 1A-C when the banknote holding device is in a closed configuration.

Figure 3A shows a perspective view of a banknote transport arrangement according to another embodiment of the present disclosure. In Fig. 3A, a stack of banknotes is received by a further banknote holding device of the banknote transport arrangement in a fourth position.

Figure 3B shows a perspective view of the banknote transport arrangement according to Fig. 3A, where the stack of banknotes has been transported by the further banknote holding device from the fourth position to the first position.

Figure 3C shows a perspective view of the banknote transport arrangement according to Fig. 3A, when the stack of banknotes is handed over from the further banknote holding device to the banknote holding device.

Figure 3D shows a perspective view of the banknote transport arrangement according to Fig. 3A, as the further banknote holding device is removed so as to allow transporting the stack of banknotes away from the first position by means of the banknote holding device.

Figure 4A shows a perspective view of a cash packaging apparatus comprising a vertical form, fill and seal machine according to an embodiment of the disclosure.

Figure 4B shows a perspective view of a part of a flexible sheet forming and sealing arrangement of the cash packaging apparatus of Fig. 4A as the stack of banknotes is transported through a transport cylinder of the vertical form, fill and seal machine so as to reach the second position located within a top-open sachet.

Figure 4C shows a perspective view of the part of the flexible sheet forming and sealing arrangement Fig. 4A as the vertical form, fill and seal machine feeds forward the top open sachet containing the stack of banknotes.

Figure 4D shows a perspective view of the part of the flexible sheet forming and sealing arrangement Fig. 4A as the vertical form, fill and seal machine seals the top open sachet so as to form a sealed sachet containing the stack of banknotes.

Figure 4E shows a perspective view of another part of the flexible sheet forming and sealing arrangement of Fig. 4A.

Figure 5A shows a perspective view of a cash packaging apparatus comprising a vertical form, fill and seal machine according to another embodiment of the disclosure.

Figure 5B shows a perspective view of the part of the flexible sheet forming and sealing arrangement Fig. 4A as the vertical form, fill and seal machine has sealed a further top-open sachet containing a mass of coins.

Figure 6A shows a flow chart of a method for manufacturing a cash package according to an embodiment of the disclosure.

Figure 6B shows a flow chart of a method for manufacturing a cash package according to an alternative embodiment of the disclosure.

Figure 7A shows a perspective view of a cash package according to an embodiment of the disclosure.

Figure 7B shows a perspective view of a serial cash package according to an embodiment of the disclosure.

Figure 7C shows a perspective view of a serial cash package according to another embodiment of the disclosure.

Figure 7D schematically illustrates three alternative example embodiments of an identification means of the disclosure.

Detailed description

[0063] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the invention are shown. This invention may, however,

be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided for thoroughness and completeness, and fully convey the scope of the invention to the skilled person.

[0064] Figure 1A-D and 2A and B shows a banknote transport arrangement 100 according to an example embodiment. The banknote transport arrangement 100 is configured to transport a stack of banknotes 10 between different positions in space in a way which will be further disclosed hereinbelow.

[0065] The banknote transport arrangement 100 comprises a banknote holding device 110 which presents a first clamping interface 112 and a second clamping interface 114. The banknote holding device 110 is best illustrated in Figs 2A and B. The first 112 and second 114 clamping interfaces are displaceable with respect to each other between an open configuration C1 (see Fig. 2A) at which the banknote holding device 110 is configured to receive a stack of banknotes 10 in a gap 116 formed between the first clamping interface 112 and the second clamping interface 114, and a closed configuration C2 (see Fig. 2B) at which the banknote holding device 110 is configured to clamp the stack of banknotes 10 between the first clamping interface 112 and the second clamping interface 114.

[0066] The banknote holding device 110 comprises a first clamping element 118 which presents the first clamping interface 112 and a second clamping element 120 which presents the second clamping interface 114.

[0067] The first clamping element 118 comprises a hollow cylinder sector 119 having a sector angle of 180 degrees (also termed hollow half cylinder) and the first clamping interface 112 is defined by an inner surface 117 thereof. The rounded surface thus provided is of importance as it aids shaping the stack of banknotes 10 in a particular way, as will be further described later. The second clamping element 120 comprises an elongated portion 121 which is connected to the banknote holding device 110 at a first end 121a thereof and presents the second clamping interface 114 at a second end 121b thereof. The second clamping element 120 is pivotably arranged with respect to the first clamping element 118. In the example embodiment, this is realized by the second clamping element 120 being rotationally attached to the first clamping element 118 at a pivot axis A1. The second clamping element 120 further comprises a lever portion 122 which extends radially out from the pivot axis A1 at a first end 122a thereof to a second end 122b thereof. The movement of the second clamping element 120 is controlled by a clamping actuator 124 arranged in the structure of the first clamping element 118. The clamping actuator 124, which is a linear actuator, connects its displaceable end to the second end 122b of the lever portion 122 of the second clamping element 120.

[0068] The first 118 and second 120 clamping elements are arranged in relation to each other so as to allow free access to the gap 116 from a front end 111 and from opposite lateral sides 115a, 115b of the banknote holding device 110. Thus, a stack of banknotes 10 may be provided to the banknote holding device 110 along three orthogonal directions in a plane. The combination of the cylindrical surface defined by the first clamping interface 112 and the second end 121b of the elongated portion 121 of the second clamping element 120 defining the second clamping interface 114 allows for bending the stack of banknotes 10 when the second clamping element 120 is moved towards the first clamping element 118 so as to reach the closed configuration C2 to close the gap 116. This is illustrated in Fig. 2B. In other words, the first clamping interface 112 and the second clamping interface 114 are configured so as to force the stack of banknotes 10 to be bent into a curved shape when the banknote holding device 110 is in the closed configuration C2. This effectively prevents banknotes of the stack from mutually spreading with respect to each other. As readily appreciated by the person skilled in the art, the banknote holding device 110 will also provide a shielding protection to the stack of banknotes 10 during transport, since the stack of banknotes 10 will always be held on the inside of the first clamping element 118, which element 118 thus acts as a protective shield. In other words, the dimensions of the hollow cylinder sector 119 (in the example: the hollow half cylinder) is such that the first clamping interface 112 is larger than an area of a banknote of the stack of banknotes 10 (See Fig. 2B). This enables the banknote holding device to shield and protect the stack of banknotes during transport.

[0069] The banknote transport arrangement 100 further comprises a supporting frame 148 and a displacing arrangement 140. The displacing arrangement 140 is best illustrated in Figs 1A-C.

[0070] The displacing arrangement 140 is configured to displace the banknote holding device 110 along a displacement path DP from a first position P1 to a second position P2, wherein the first position P1 and the second position P2 are located in relation to each other such that a portion P of the displacement path DP extends coaxially through at least a part of an elongated bore 321. The elongated bore has a longitudinal extension 323 and a cross sectional diameter 325. The longitudinal extension 323 of the elongated bore 321 is several times longer than its cross-sectional diameter 325. In the example, the longitudinal extension 323 of the elongated bore 321 is 6 times longer than its cross-sectional diameter 325. The longitudinal extension 323 of the elongated bore 321 is linear. In the example embodiment, the second position P2 is located just below the elongated bore 321. In Fig. 1A, the banknote holding device 110 is located in the first position P1, ready to receive a stack of banknotes 10 to be transported. The displacing arrangement 140 is configured to displace the banknote holding device 110 between the first position P1 which is distanced from the elongated bore 321, and a third position P3 which is located at an entrance opening 322 of the elongated bore 321 (see Fig. 1B). Finally, the displacing arrangement

140 is configured to linearly displace the banknote holding device 110 from the third position P3, through the entrance opening 322 of the elongated bore 321, through an output opening 324 of the elongated bore 321 and to the second position P2 located just below the elongated bore 321 (Fig. 1C).

[0071] The displacing arrangement 140 comprises a linear actuator 142 which carries the banknote holding device 110. The linear actuator 142 is configured to linearly displace the banknote holding device 110 from the third position P3, through the entrance opening of the elongated bore 321, to the second position P2. The linear actuator 142 of the example embodiment is pneumatically operated, but alternative solutions such as rack and pinion-based actuators are conceivable.

[0072] The displacing arrangement 140 further comprises a support beam 144 which carries the linear actuator 142. The support beam 144 is pivotable between a first support beam position SP1 at which the banknote holding device 110 is allowed to reach the first position P1, and a second support beam position SP2, at which the banknote holding device 110 is allowed to reach the second position P2. The support beam 144 is pivotable by means of a further linear actuator 146. When located in the first support beam position SP1, the support beam 144 is in abutment with a damper 147 arranged on support 149. The damper 147 acts to reduce the impact of the support beam 144 when the support beam 144 reaches the support beam position SP1. In the example embodiment, the linear actuator 142 and the further linear actuator 148 are pneumatically operated.

[0073] Figure 3A-D discloses a banknote transport arrangement 200 according to an alternative example embodiment. As can be seen in Fig. 3A, the banknote transport arrangement 200 shares several features in common with the banknote transport arrangement 100 but differs in that the banknote transport arrangement 200 further comprises a further banknote holding device 250 and a further displacing arrangement 260 wherein the further displacing arrangement 260 is configured to displace the further banknote holding device 250 from a fourth position P4 to the first position P1 so as to provide the stack of banknotes 10 in the gap 116 of the banknote holding device 110 to be received by the banknote holding device 110.

[0074] The further banknote holding device 250 comprises a first clamping element 252 and a second clamping element 253. As best illustrated in Figs 3C and D, the first clamping element 252 presents a substantially planar surface defining a first clamping interface 112 for the stack of banknotes 10. The second clamping element 253 is arranged at a displaceable end of a linear actuator 251 which is arranged in the reference frame of the first clamping element 253. The linear actuator 251 is configured to displace the second clamping element 253 between an open configuration K1 (illustrated in Figs 3A, C and D) at which a stack of banknotes 10 may be received in a gap 255 formed between the first 252 and second 253 clamping elements, and a closed configuration K2 (illustrated in Fig. 3B) at which the further banknote holding device 250 is configured to clamp the stack of banknotes 10 between the first clamping element 252 and the second clamping element 253. The second clamping element 253 may have a rounded or circular cross section presenting a rounded or circular clamping interface.

[0075] As best illustrated in Figs 3B and C, the second clamping element 253 is arranged on the further banknote holding device 250 such that the stack of banknotes 10 is clamped at or close to a short stack side thereof leaving the opposite side of the stack of banknotes 10 unclamped. The second clamping element 253 may be arranged on the further banknote holding device 250 such that the unclamped side of the stack of banknotes 10 faces the further banknote holding device 250 when the further banknote holding device 250 hands over the stack of banknotes 10 to the banknote holding device 110 at the first position P1.

[0076] The first clamping element 252 presents an inwardly projecting elongated opening 254 which protrudes into the first clamping element 252 at a front end 256 thereof. As best illustrated in Figs 3C and D, the elongated opening 254 allows the second clamping element 120 of the banknote holding device 110 to access the space defined by the gap 255 of the further banknote holding device 250 so as to clamp the stack of banknotes 10 while the stack of banknotes 10 are still residing in the gap 255 of the further banknote holding device 250. This effectively allows for handing over the stack of banknotes 10 from the further banknote holding device 250 to the banknote holding device 110.

[0077] The further displacing arrangement 260 comprises a support beam 261 which is rotationally attached to a frame element 263 of the banknote transport arrangement 200 by means of a rotational actuator 262. As illustrated in Figs 3A and B, the support beam 261 is rotatable in a horizontal plane along a pivot axis A3. The support beam carries the further banknote holding device 250 at a movable end thereof.

[0078] A cash packaging apparatus 300 will now be described with reference to Figs 4A-E. The cash packaging apparatus 300 comprises a vertical form, fill and seal machine 310 which is configured to manufacture flexible bags, referred to here as sachets, from a flexible sheet material such as e.g. a plastic sheet material.

[0079] The vertical form, fill and seal machine 310 comprises a vertically arranged product delivery cylinder 320 having an entrance opening 322 for receiving items to be packaged, such as a mass of coins 20 or a stack of banknotes 10, and an output opening 324 for allowing said items to leave the product delivery cylinder 320. The inner space of the product delivery cylinder 320 defines an elongated bore 321. Thus, the elongated bore 321 interconnects the entrance opening 322 with the output opening 324.

[0080] The vertical form, fill and seal machine 310 fur-

ther comprises a flexible sheet forming and sealing arrangement 330 configured to provide, from a flexible sheet material 332, a top-open sachet 334a at the output opening 324 of the product delivery cylinder 320 for receiving items to be packaged from the product delivery cylinder 320. This is achieved by wrapping the flexible sheet material 332 around a tube former 392 and further around an exterior surface of the product delivery cylinder 320 such that the two opposite lateral edges 332a,332b of the flexible sheet material 332 meet and overlays each other at the outer surface of the product delivery cylinder 320. A first heat sealing system 370 of the vertical form, fill and seal machine 310 heats the two superimposed lateral edges 332a,332b of the flexible sheet material 332 so as to provide a flexible tube 334 which is displaceable along the outer surface of the product delivery cylinder 320. Beneath the output opening 324 of the product delivery cylinder 320, the flexible tube 334 extends freely from the product delivery cylinder 320. A second heat sealing system 380 is configured to seal the flexible tube 334 along a lateral dimension of the tube 334 so as to form a top-open sachet 334a having a sealed bottom end 335a (see Fig. 4B). Items to be packaged in the top-open sachet 334a (in Figs 4B and C: a stack of banknotes 10) are provided to the top-open sachet 334a via the product delivery cylinder 320. Once the items to be packaged has been provided, a feeding arrangement 385 of the vertical form, fill and seal machine 310 allows for feeding the flexible sheet material 332, or more specifically the flexible tube 334 made therefrom, downwards so as to make room for a new top-open sachet to be filled. However, the flexible sheet forming and sealing arrangement 330 are first configured to, in response to having received items to be packaged in the top-open sachet 334a, seal a top end 336a thereof so as to form a sealed sachet 338a having a sealed bottom end 339a and a sealed top end 340a containing the items (see Fig. 4D).

[0081] The cash packaging apparatus 300 further comprises a banknote transport arrangement configured to transport a stack of banknotes 10 through the entrance opening, via the product transport cylinder 320 and into a top-open sachet 334 provided by the flexible sheet forming and sealing arrangement 330. In the example embodiment, the banknote transport arrangement is the banknote transport arrangement 200 previously described in detail herein. However, the cash packaging apparatus of the disclosure is not limited to this particular example embodiment, which is used here for mere example only. The banknote transport arrangement 100 allows providing a stack of banknotes 10 to the top-open sachet 334a provided by the vertical form, fill and seal machine 310 at the second position P2. Thus, the stack of banknotes 10 is actively placed in the second position P2 in the top-open sachet 334a and does not have to rely on gravity to end up in the correct position. Thus, the cash packaging apparatus 300 is suitable for packaging both wrapped and non-wrapped stacks of banknotes. The cash packaging apparatus 300 is also suitable for packaging single banknotes and/or other kind of flexible sheet material such as paper, post cards or the like.

[0082] The cash packaging apparatus 300 may further comprise a banknote dispenser 30 configured to output the stack of banknotes 10 to be received by the banknote transport arrangement 200. Thus, for the example embodiment, the banknote dispenser 30 is arranged in relation to the banknote transport arrangement 200 such that the stack of banknotes 10 is output to the fourth position P4 to be received by the further banknote holding device 250. The banknote dispenser 30 may comprise a plurality of banknote storage units 35a-e for storing banknotes e.g. of different denomination and/or currency. The banknote dispenser 30 further includes a banknote output unit 36 configured to receive banknotes output from the plurality of banknote storage units 35a-e, arrange the received banknotes in a stack configuration so as to form the stack of banknotes 10, and output the stack of banknotes 10 from the banknote dispenser 30. The banknote dispenser 30 could be e.g. an ATM machine.

[0083] The cash packaging apparatus 300 further comprises a control unit 40 configured to control the banknote transport arrangement 100 and the vertical form, fill and seal machine 310. The control unit 40 is further configured to control the banknote dispenser 30. The control unit 40 is configured to send, to the banknote dispenser 30, banknote dispensing instructions including at least a number of banknotes to be packaged, wherein the banknote dispenser 30 is configured to dispense a stack of banknotes 10 corresponding to said banknote dispensing instructions. Optionally, the banknote dispensing instructions includes an associated number of banknotes for a respective one of two or more banknote denominations. This allows for the banknote dispenser 30 to dispense a stack of banknotes 10 including banknotes of different denomination.

[0084] The control unit 40 is configured to receive, or retrieve, cash packaging instructions pertaining to an individual cash package to be manufactured, wherein said cash packaging instructions include at least said banknote dispensing instructions. The cash packaging instructions may be received, or retrieved, from a database connected to the cash packaging apparatus. Alternatively, the cash packaging instructions may be provided to the cash packaging apparatus by user input.

[0085] The control unit 40 is further configured to control the banknote transport arrangement and/or the vertical form, fill and seal machine 310. The control unit 40 is further configured to send cash packaging instructions to the vertical form, fill and seal machine 310, said cash packaging instructions including a number of sachets intended for banknotes and a number of banknotes intended for coins.

[0086] Figure 4E illustrates another part of the flexible sheet forming and sealing arrangement 330 of the vertical form, fill and seal machine 310. The cash packaging apparatus 300 is configured to provide a perforation 333 on the flexible sheet material 332 such that each sealed

sachet 338a will present a perforation 333 extending from a bottom end 339a of the sealed sachet 338a to a top end 340a of the sealed sachet 338a on at least one side of the sealed sachet 338a. For the example embodiment, this is provided by a pair of rollers, as will be further described below.

[0087] The flexible sheet material 332 is stored on a storage roll 331 and is provided to the tube former 392 by means of a plurality of guide rollers 350. As illustrated in Fig. 4C, one of these guide rollers, guide roller 351 has a circumferentially arranged recess 352. Adjacent guide roller 351 a perforation roller 353 is arranged. The perforation roller 353 is arranged to rotate counter clockwise to guide roller 351. The perforation roller 353 comprises a perforation wheel 354 which extends transversely to a rotational axis of the perforation roller 353. The perforation roller 353 is arranged in relation to the guide roller 351 such that the perforation wheel 354 faces and partly protrudes into the circumferentially arranged recess 352 of the guide roller 351. This way, a perforation 333 will be automatically created in the flexible sheet material 332 which passes in between the guide roller 351 and the perforation roller 353 during of-winding of the flexible sheet material 332 during operation of the vertical form, fill and seal machine 310.

[0088] A cash packaging apparatus 400 will now be described with reference to Figs 5A and B. The cash packaging apparatus 400 shares all features of the cash packaging apparatus 300 already described with reference to Figs 4A-E. Thus, the cash packaging apparatus 400 is also configured to manufacture sealed sachets comprising stacks of banknotes. However, in addition to these features and functions, the cash packaging apparatus 400 is further configured to manufacture sealed sachets comprising coins of one or more denominations. For this purpose the cash packaging apparatus 400 further comprises a coin dispensing arrangement 440 configured to provide a mass of coins 20 to the entrance opening 322 of the product delivery cylinder 320 so as to allow the mass of coins 20 to be guided, by gravity, through the elongated bore 321 of the product delivery cylinder 320 and into a top-open sachet 334a provided by the flexible sheet forming and sealing arrangement 330. The coin dispensing arrangement 440 comprises one or more coin dispensers 442. In the example embodiment of Fig. 5, there are altogether eight coin dispensers in the coin dispensing arrangement 440. The eight coin dispensers are arranged in two rows on opposite sides of a coin transport arrangement 444 which includes a conveyor belt (not shown). The coin transport arrangement 444 extends out to the product delivery cylinder 320 of the vertical form, fill and seal machine 310, where a coin dispensing chute 448 connects the coin transport arrangement 444 with the product delivery cylinder 320 such as to allow coins leaving the coin transport system 444 to enter through the entrance opening 322 of the product delivery cylinder 320. This allows for providing a mass of coins 20 to a further top-open sachet 334b which is on top of, and interconnected with, the top-open sachet 338a containing the stack of banknotes 10. As illustrated in Figs 4D and 5B, the further top-open sachet 334b may thereby be sealed so as to form a further sealed sachet 338b containing the mass of coins 20.

[0089] The control unit 40' of the cash packaging apparatus 400 shares the features of the control unit 40 of the cash packaging apparatus 300. However, the control unit 40' is further configured to control the coin dispensing arrangement 440. The control unit 40' is configured to send, to the coin dispensing arrangement 440, coin dispensing instructions including at least a number of coins to be packaged in a sachet of the cash package, wherein the coin dispensing arrangement 440 is configured to provide a mass of coins 20 corresponding to said coin dispensing instructions. Optionally, the coin dispensing instructions may include an associated number of coins for a respective one of two or more coin denominations.

[0090] The control unit 40' is further configured to send instructions to the vertical form, fill and seal machine 310 pertaining to an associated length of each sachet of a cash package. This may allow the vertical form, fill and seal machine 310 to provide an appropriate length of top-open sachets for each individual group of items to be packaged. This is used for cash package 900 of Fig. 7C (to be further discussed later). During the manufacture process, the top-open sachet 334a intended for the stack of banknotes 10 may extend further downstream than the further top-open sachet 334b intended for a mass of coins 20, such that the sealed sachet 338a of the manufactured cash package has a longer distance between its top end 340a and its bottom end 339a than the corresponding distance of the further sealed sachet 338b of the manufactured cash package.

[0091] A method 500 will now be describer with reference to Fig. 6A. The method is directed to manufacturing a cash package which comprises a sealed sachet 338a containing a stack of banknotes 10. Examples of this kind of cash package are cash packages 500 and 600 illustrated in Figs 7A and B and which will be further discussed below. The method comprises providing S502, from a flexible sheet material 332 and by a vertical form, fill and seal machine 310, a top-open sachet 334a at an output opening 324 of a vertically arranged product delivery cylinder 320 of the vertical form, fill and seal machine 310. The method further comprises providing S504, by a banknote transport arrangement 100, a stack of banknotes 10 through the entrance opening 322, via an elongated bore 321 of the product transport cylinder 320 and into the top-open sachet 334a. The method further comprises sealing S506, by the vertical form, fill and seal machine 310, a top end 336a of the top-open sachet 334a so as to form the sealed sachet 338a containing the stack of banknotes 10.

[0092] As readily understood by the person skilled in the art, the method 500 is suitable for use with either the cash packaging apparatus 300 or the cash packaging apparatus 400 of the disclosure. Dependent on the

needs, different embodiments of a cash package may be manufactured by the method. Two examples are provided in Figs 7A and B.

[0093] Cash package 700 of Fig. 7A is defined by the sealed sachet 338a containing the stack of banknotes 10. The cash package 700 is formed once separated from the remaining parts of the flexible sheet material by a sachet separating unit (not shown) of the vertical form, fill and seal machine 310. Such sachet separating units are well known in the art and may be based in e.g. horizontally displaceable knife edge or the like.

[0094] Cash package 800 of Fig. 7B is defined by two or more interconnected sachets 810 which in the example includes the sealed sachet 338a containing the stack of banknotes (i.e. the same as in cash package 700). However, cash package 800 further includes another sealed sachet 338a' which is interconnected with the sealed sachet 338a. The sealed sachet 338a' contains another stack of banknotes 10'. As illustrated in Fig. 7B, the stack of banknotes 10 and the stack of banknotes 10' have different denominations. Thus, using the method 500, cash packages including a series of different denominations may be manufactured. This allows for supplying customers, e.g. at a point of sale, with custom-made cash packages best suited for the particular store.

[0095] However, there may also be a need for supplying coins. For this purpose, the method 600 may be used. The method 600 will be described with reference to Fig. 6B. The method is directed to manufacturing a cash package 900 which comprises a sealed sachet 338a containing a stack of banknotes 10 and a further sealed sachet 338b containing a mass of coins 20, wherein the sealed sachet 338a and the further sealed sachet 338b are interconnected to each other. An example of such a cash package is illustrated in Figs 7C. The first method steps S502, S504 and S506 are identical to the ones discussed earlier for the method 500 and will thus not be repeated here. In addition to these steps the method 600 further comprises Providing S508, from the flexible sheet material 332 and by the vertical form, fill and seal machine 310, a further top-open sachet 334b at the output opening 324 of the vertically arranged product delivery cylinder 320 of the vertical form, fill and seal machine 310. The method 600 further comprises providing S510 a mass of coins 20 to be packaged to an entrance opening 322 of the product delivery cylinder 320 so as to allow the mass of coins 20 to be guided, by gravity, through the elongated bore 321 of the product delivery cylinder 320 to be output through the output opening 324 of the product delivery cylinder 320 and received into the further top-open sachet 334b. The method 600 further comprises sealing S512, by the vertical form, fill and seal machine 310, a top end 336b of the further top-open sachet 334b so as to form a further sealed sachet 338b containing the mass of coins 10.

[0096] As readily understood by the person skilled in the art, the method 600 may be suitable for use with cash packaging apparatus 400 of the disclosure, which has capacity to package both coins and banknotes. Dependent on the needs, different embodiments of a cash package may be manufactured by the method.

[0097] Cash package 900 of Fig. 7C is defined by two or more interconnected sachets 910 which in the example includes the sealed sachet 338a containing the stack of banknotes (i.e. the same as in cash package 700 and 800). Cash package 900 further includes the further sealed sachet 338b containing the mass of coins 20. The sealed sachet 338a and the further sealed sachet 338b are interconnected with each other. As illustrated in Fig. 7C, the cash package 900 further comprises one or more further sealed sachets 338b',338b",338b'". The sachets of the one or more further sealed sachets 338b',338b",338b'" each contain an individual mass of coins 20', 20", 20'" with denominations mutually different from each other and from the denomination of the mass of coins 20. Thus, using the method 600, cash packages including a series of different denominations of both banknotes and coins may be manufactured. This allows for supplying customers, e.g. at a point of sale, with custom-made cash packages best suited for the particular store.

[0098] Cash package 900 is provided with lateral perforations 920 arranged along interconnection regions formed between adjacent sealed sachets of the cash package 900. Such a lateral perforation 920 may be arranged along, within or at least close to, a sealed portion defining a transition between two sealed sachets. The lateral perforation 920 facilitates removal of one or more sachets from the cash package 900. This may for example allow separating banknotes from coins, or some denominations from other denominations. This may be advantageous especially for the end user, as it facilitates handling the cash package 900 during refilling of a cash till. The lateral perforations 920 may be provided to the cash package 900 by the cash packaging apparatus according to the disclosure. There are many ways in the art to provide such perforations. For example, a perforation wheel, similar to previously disclosed perforation wheel 354, may be configured to displace laterally across the flexible tube. Alternatively, a stamping tool comprising a plurality of protrusions may be used to stamp the perforation 920 in one single operation.

[0099] The cash package 900 may be made identifiable by providing identification means to the cash package. The identification means may comprise a unique code. The unique code may be provided as a visible code, such as e.g. a numerical code, a bar code, a QR code or the like. The visible code may be provided on a patch, or sticker attached to the cash package by means of an adhesive. This is illustrated in Fig. 7D according to an example embodiment. The sticker 940 comprises a bar code 942. Stickers, such as the sticker 940, may be attached to the cash package 900 manually or automatically.

[0100] Alternatively, as illustrated in Fig. 7D, identification means may comprise a flexible identification card 950 configured to be provided to a sachet of the cash

package 900 during manufacture thereof by using the banknote transport arrangement 100. The flexible identification card 950 may be arranged together with the stack of banknotes 10 in a stacked configuration (not shown) and provided to the top-open sachet 334a by the banknote transport arrangement 100 together with the stack of banknotes 10. Alternatively, the flexible identification card 950 may be provided to the cash package 900 into another sachet so as to be separated from the stack of banknotes 10 (not shown). The flexible identification 950 card may comprise a unique code. The unique code may be a visible code as already detailed herein. Alternatively, the unique code may be a digital code stored within the flexible identification card. The flexible identification card 950 of the example embodiment comprises an RFID tag 952 which comprises a digital code.

[0101] It is also conceivable that the identification means is an identification badge 960 as illustrated in Fig. 7D. The identification badge 960 may comprise a unique code. The unique code may be a visible code as already detailed herein. Alternatively, the unique code may be a digital code stored within the identification badge 960. The identification badge 960 of the example embodiment comprises an RFID tag 962 which comprises a digital code. The identification badge 960 is configured to be provided to a sachet directly via the product delivery cylinder 320. This implies that the identification badge 960, during manufacturing of the cash package 900, will be guided, by gravity, through the elongated bore 321 of the product delivery cylinder 320 and into a top-open sachet 334a provided by the flexible sheet forming and sealing arrangement 330.

[0102] The person skilled in the art realizes that the present invention by no means is limited to the preferred embodiments described above. On the contrary, many modifications and variations are possible within the scope of the appended claims. Additionally, variations to the disclosed embodiments can be understood and effected by the skilled person in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims.

Claims

1. A banknote transport arrangement (100) comprising:

a banknote holding device (110) presenting a first clamping interface (112) and a second clamping interface (114), said first and second clamping interfaces being displaceable with respect to each other between an open configuration (C1) at which the banknote holding device is configured to receive a stack of banknotes (10) in a gap (116) formed between the first clamping interface (112) and the second clamping interface (114), and a closed configuration (C2) at which the banknote holding device is configured to clamp the stack of banknotes (10) between the first clamping interface (112) and the second clamping interface (114), and

a displacing arrangement (140) configured to displace the banknote holding device (110) along a displacement path (DP) from a first position (P1) to a second position (P2), wherein the first position (P1) and the second position (P2) are located in relation to each other such that a portion (P) of the displacement path (DP) extends coaxially through at least a part of an elongated bore (321),

wherein the first clamping interface (112) and the second clamping interface (114) are configured so as to force the stack of banknotes (10) to be bent into a curved shape when the banknote holding device (110) is in the closed configuration (C2).

2. The banknote transport arrangement (100) according to claim 1, wherein the banknote holding device comprises a first clamping element (118) which presents the first clamping interface (112) and a second clamping element (120) which presents the second clamping interface (114), and wherein the first and second clamping elements are arranged in relation to each other so as to allow free access to the gap (116) from a front end (111) and from opposite lateral sides (115a, 115b) of the banknote holding device.

3. The banknote transport arrangement (100) according to claim 2, wherein the second clamping element (120) is pivotably arranged with respect to the first clamping element (118).

4. The banknote transport arrangement (100) according to claim 2 or 3, wherein the first clamping element (118) comprises a hollow cylinder sector (119) and the first clamping interface (112) is defined by an inner surface (117) thereof.

5. The banknote transport arrangement (100) according to claim 4, wherein the second clamping element (120) comprises an elongated portion (121) which is connected to the banknote holding device (100) at a first end (121a) thereof and presents the second clamping interface (114) at a second end (121b) thereof.

6. The banknote transport arrangement (100) according to any one of claim 1 to 5, wherein the displacing arrangement (140) is configured:

to displace the banknote holding device (110) between the first position (P1) which is distanced from the elongated bore (321), and a third position (P3) which is located at an entrance opening

(322) of the elongated bore (321); and
to linearly displace the banknote holding device (110) from the third position (P3), through the entrance opening (322) of the elongated bore (321), and to the second position (P2).

7. The banknote transport arrangement (100) according to claim 6, wherein the displacing arrangement (140) comprises a linear actuator (142) which carries the banknote holding device (110), the linear actuator (142) being configured to linearly displace the banknote holding device (110) from the third position (P3), through the entrance opening (322) of the elongated bore (321), and to the second position (P2).

8. The banknote transport arrangement (100) according to claim 7, wherein the displacing arrangement (140) further comprises a support beam (144) which carries the linear actuator (142), wherein the support beam (144) is pivotable between a first support beam position (SP1) at which the banknote holding device (110) is allowed to reach the first position (P1), and a second support beam position (SP2), at which the banknote holding device (110) is allowed to reach the second position (P2).

9. The banknote transport arrangement (200) according to any one of the claims 1 to 8, wherein the banknote transport arrangement further comprises a further banknote holding device (250) and a further displacing arrangement (260) wherein the further displacing arrangement (260) is configured to displace the further banknote holding device (250) from a fourth position (P4) to the first position (P1) so as to provide the stack of banknotes (10) in the gap (116) of the banknote holding device (110) to be received by the banknote holding device (110).

10. A cash packaging apparatus (300) for manufacturing a cash package (700,800) comprising:

a vertical form, fill and seal machine (310) comprising:

a vertically arranged product delivery cylinder (320) having an entrance opening (322) for receiving items to be packaged, such as a mass of coins (20) or a stack of banknotes (10), and an output opening (324) for allowing said items to leave the product delivery cylinder (320), said entrance and output openings being interconnected by an elongated bore (321);
a flexible sheet forming and sealing arrangement (330) configured:

to provide, from a flexible sheet material (332), a top-open sachet (334a) at the output opening (324) of the product delivery cylinder (320) for receiving items to be packaged from the product delivery cylinder (320), and
to, in response to having received items to be packaged in the top-open sachet (334a), seal a top end (336a) thereof so as to form a sealed sachet (338a) containing the items; and

a banknote transport arrangement (100) configured to transport a stack of banknotes (10) through the entrance opening, via the elongated bore (321) of the product transport cylinder (320) and into the top-open sachet (334a) provided by the flexible sheet forming and sealing arrangement (330),
wherein the cash packaging apparatus (300) is configured to manufacture a cash package (700,800) comprising the sealed sachet (338a) containing the stack of banknotes (10).

11. The cash packaging apparatus (400) for manufacturing a cash package (900) according to claim 10, wherein the cash packaging apparatus (400) further comprises:

a coin dispensing arrangement (440) configured to provide a mass of coins (20) to the entrance opening (322) of the product delivery cylinder (320) so as to allow the mass of coins (20) to be guided, by gravity, through the elongated bore (321) of the product delivery cylinder (320) and into the top-open sachet (334a) provided by the flexible sheet forming and sealing arrangement (330),
wherein the cash packaging apparatus (400) is configured to manufacture a cash package (900) which further comprises the further sealed sachet (338b) containing the mass of coins (20),
wherein the sealed sachet (338a) and the further sealed sachet (338b) are interconnected to each other.

12. The cash packaging apparatus (300,400) according to claim 10 or 11, wherein the banknote transport arrangement (100) comprises a banknote holding device (110) being configured to clamp the stack of banknotes (10) between a first clamping interface (112) and a second clamping interface (114), wherein the first clamping interface (112) and the second clamping interface (114) are configured to force the stack of banknotes (10) to be bent into a curved shape.

13. The cash packaging apparatus (300,400) according to any one of claim 10 to 12, wherein the cash packaging apparatus (300,400) is configured to provide

a perforation (333) on the flexible sheet material (332) such that the sealed sachet (338a) comprises a perforation (333) extending from a bottom end (339a) of the sealed sachet (338a) to a top end (340a) of the sealed sachet (338a) on at least one side of the sealed sachet (338a).

14. A method (500) for manufacturing a cash package (700,800) comprising a sealed sachet (338a) containing a stack of banknotes (10), said method comprising:

(a) providing (S502), from a flexible sheet material (332) and by a vertical form, fill and seal machine (310), a top-open sachet (334a) at an output opening (324) of a vertically arranged product delivery cylinder (320) of the vertical form, fill and seal machine (310);
(b) providing (S504), by a banknote transport arrangement (100), a stack of banknotes (10) through the entrance opening (322), via an elongated bore (321) of the product transport cylinder (320) and into the top-open sachet (334a); and
(c) sealing (S506), by the vertical form, fill and seal machine (310), a top end (336a) of the top-open sachet (334a) so as to form the sealed sachet (338a) containing the stack of banknotes (10).

15. The method (600) for manufacturing a cash package (900) according to claim 14, wherein the cash package (900) further comprises a further sealed sachet (338b) containing a mass of coins (20), wherein the sealed sachet (338a) and the further sealed sachet (338b) are interconnected to each other, the method further comprising:

(d) providing (S508), from the flexible sheet material (332) and by the vertical form, fill and seal machine (310), a further top-open sachet (334b) at the output opening (324) of the vertically arranged product delivery cylinder (320) of the vertical form, fill and seal machine (310);
(e) providing (S510) a mass of coins (20) to be packaged to an entrance opening (322) of the product delivery cylinder (320) so as to allow the mass of coins (20) to be guided, by gravity, through the elongated bore (321) of the product delivery cylinder (320) to be output through the output opening (324) of the product delivery cylinder (320) and received into the further top-open sachet (334b);
(f) sealing (S512), by the vertical form, fill and seal machine (310), a top end (336b) of the further top-open sachet (334b) so as to form the further sealed sachet (338b) containing the mass of coins (10).

16. A cash package (700,800,900) obtainable by the method according to claim 14 or 15.

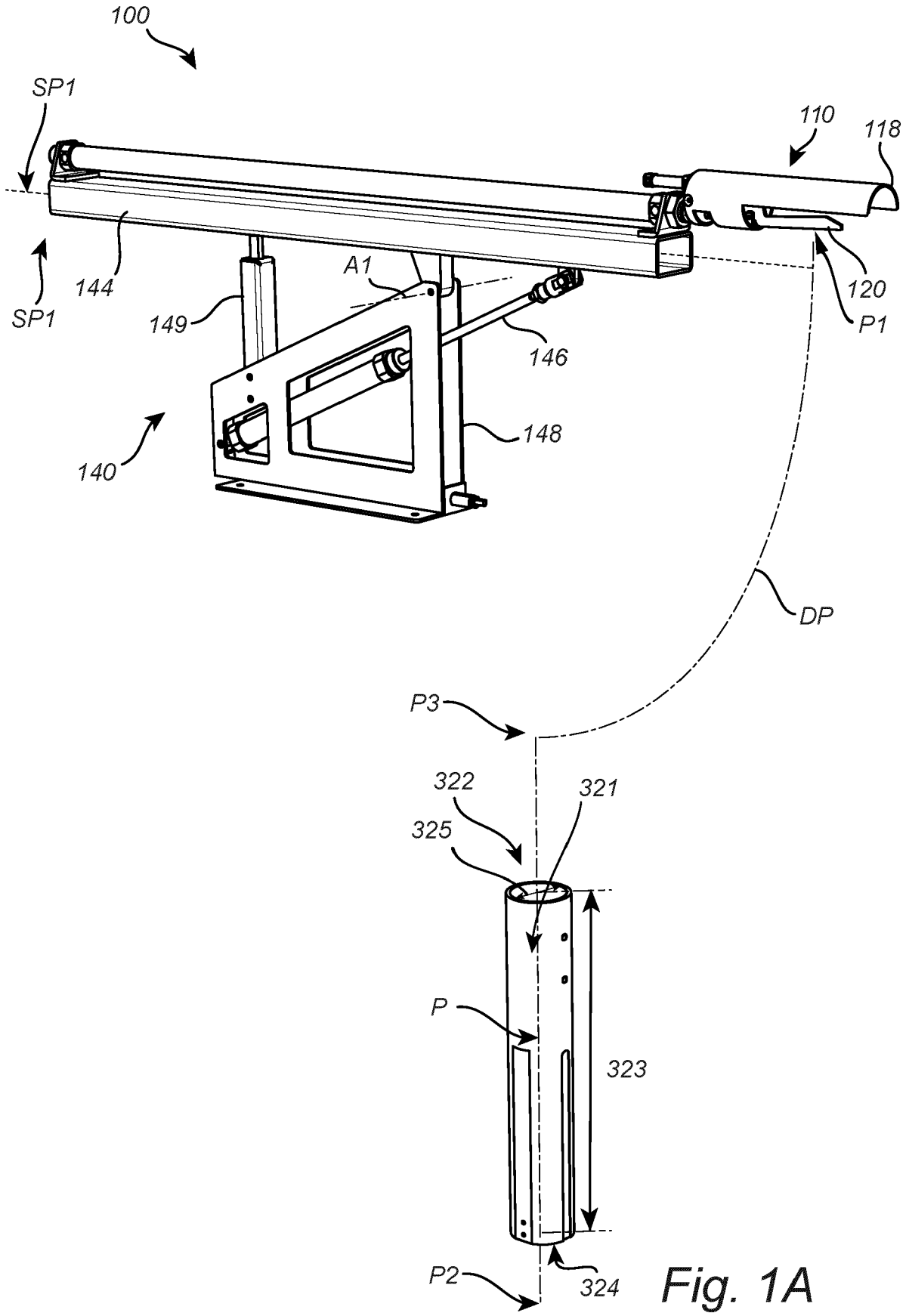

100
SP1
110
118
144
A1
120
SP1
149
P1
146
140
148
DP
P3
322
321
325
P
323
P2
324

Fig. 1A

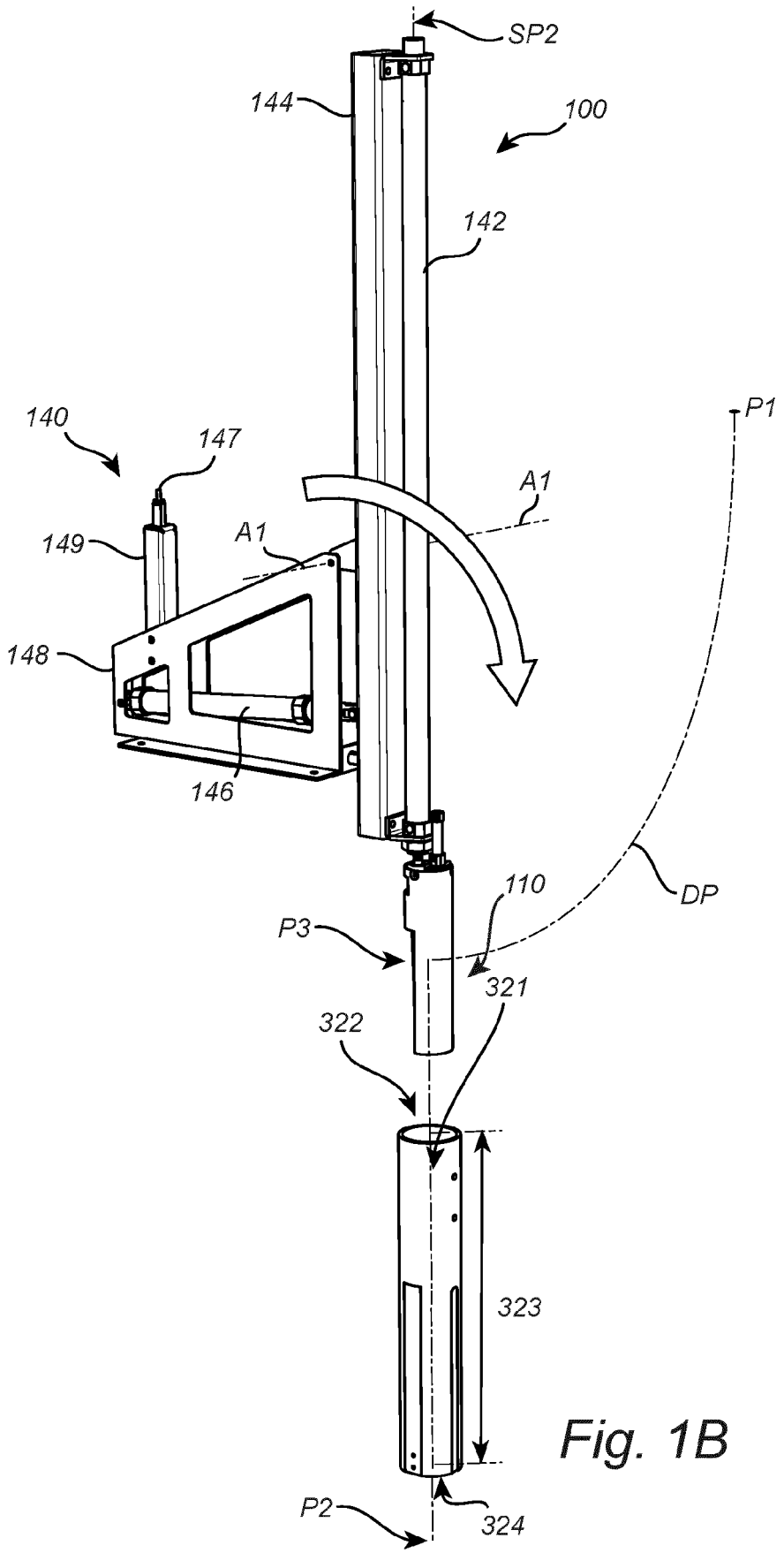

SP2
144
100
142
140
147
149
A1
A1
148
146
P1
DP
110
P3
321
322
323
P2
324

Fig. 1B

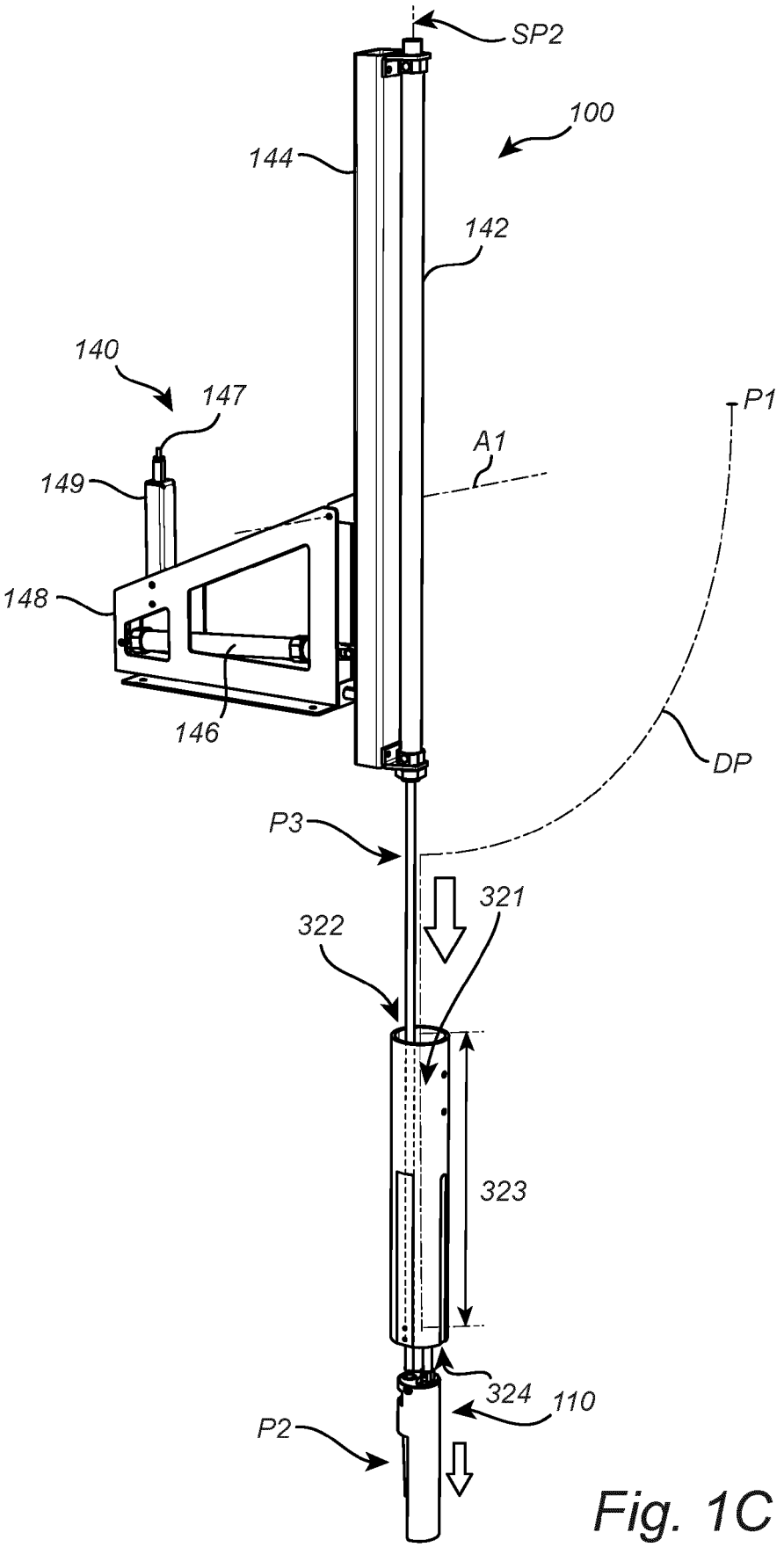

SP2
100
144
142
140
147
149
148
146
A1
P1
DP
P3
321
322
323
324
110
P2

Fig. 1C

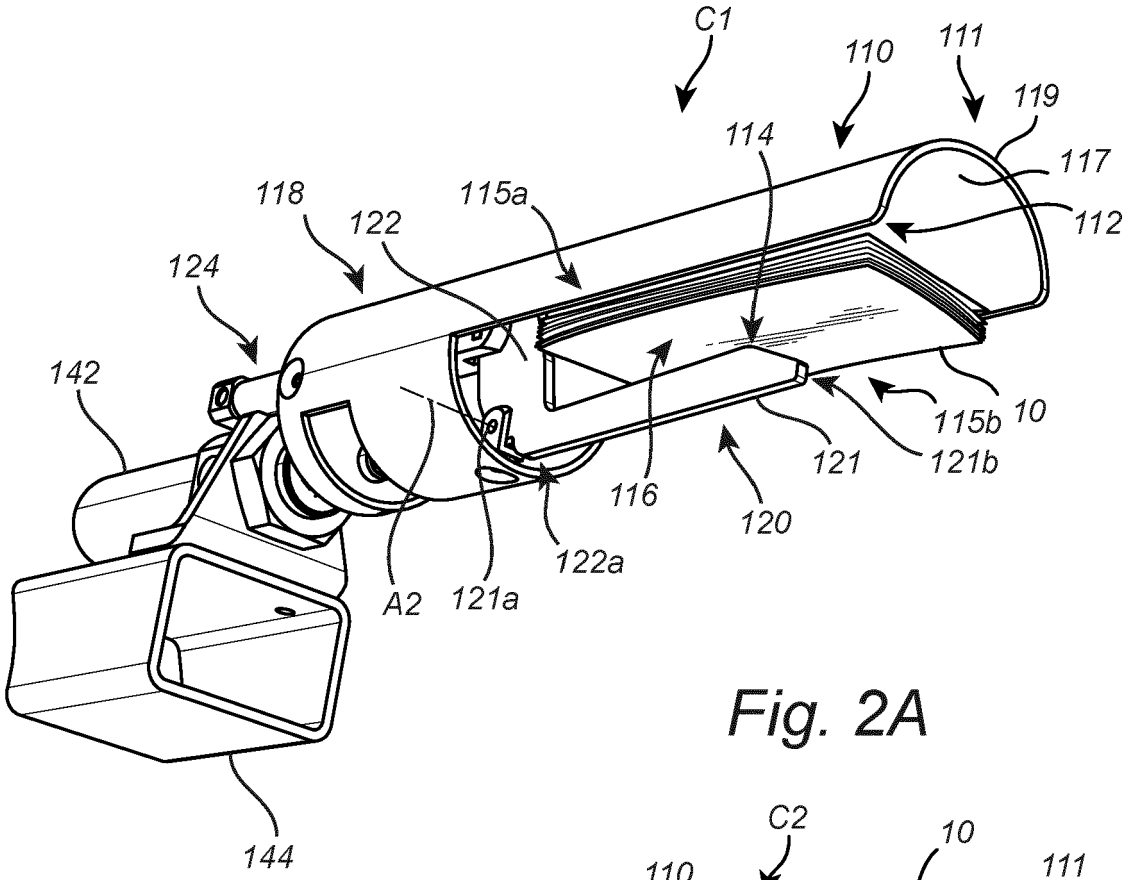
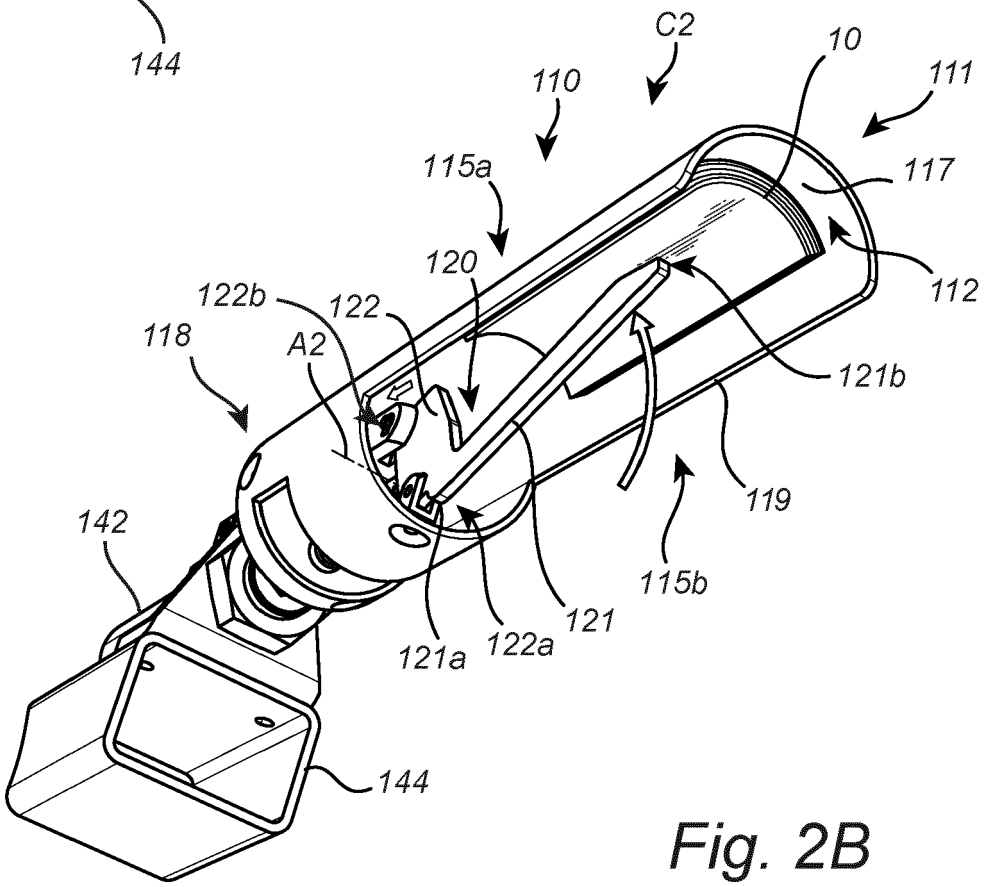

C1
110
111
119
114
117
118
122
115a
112
124
142
115b
10
121
121b
116
120
122a
A2
121a
144

Fig. 2A


C2
10
110
111
115a
117
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122b
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A2
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142
115b
121
121a
122a
144

Fig. 2B

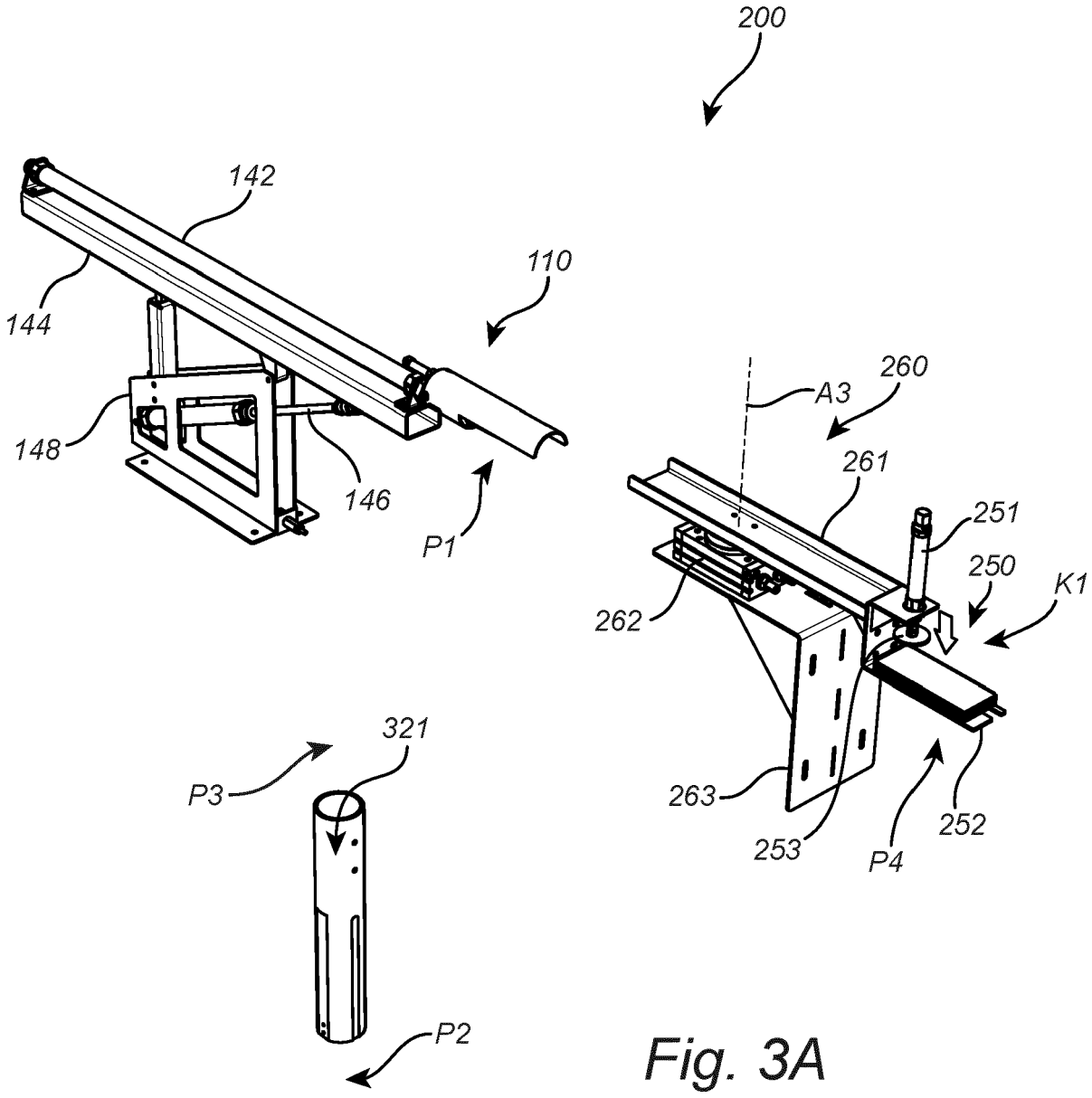

200
142
144
110
148
146
P1
260
A3
261
251
250
K1
262
263
253
P4
252
321
P3
P2

Fig. 3A

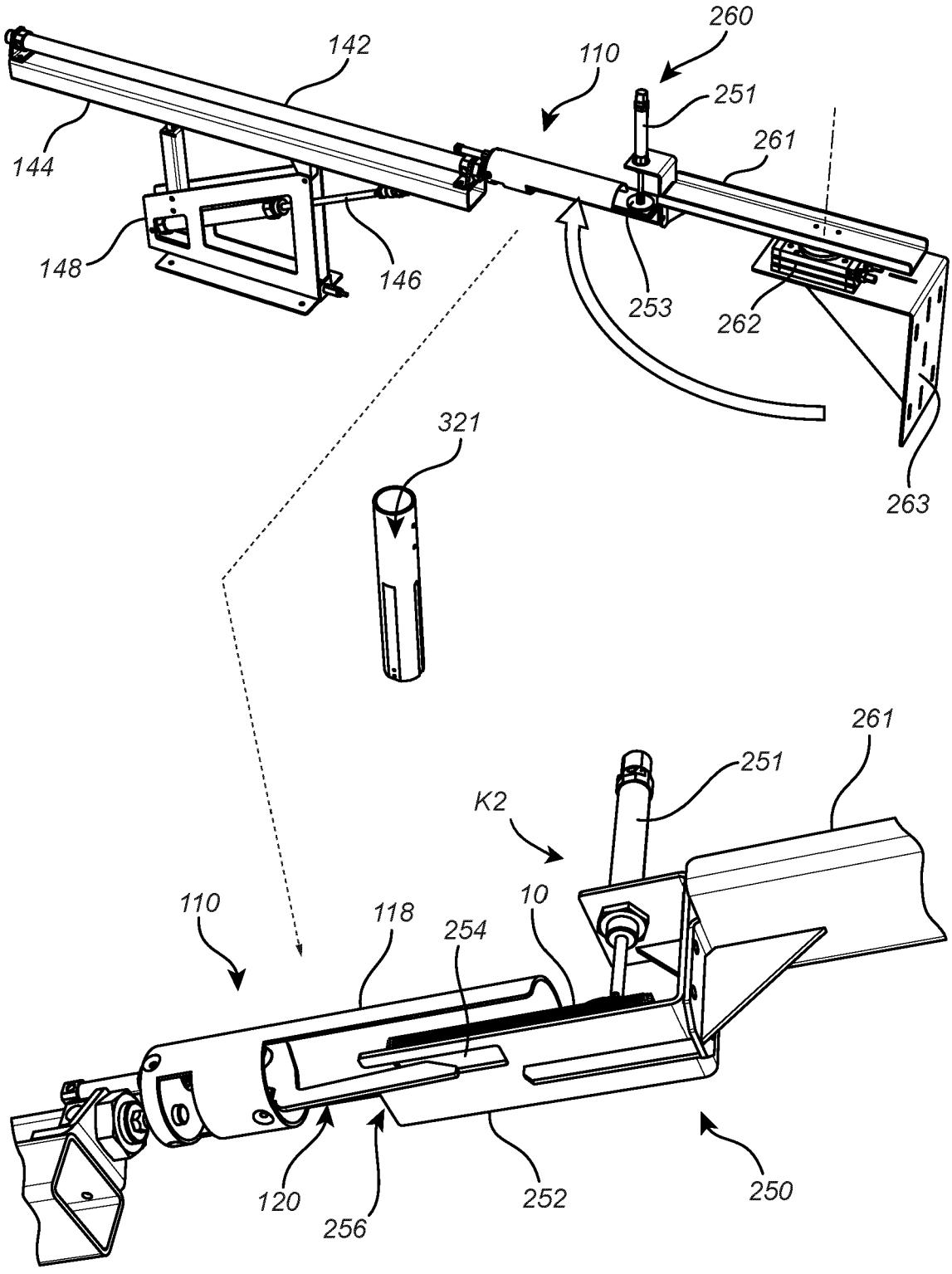
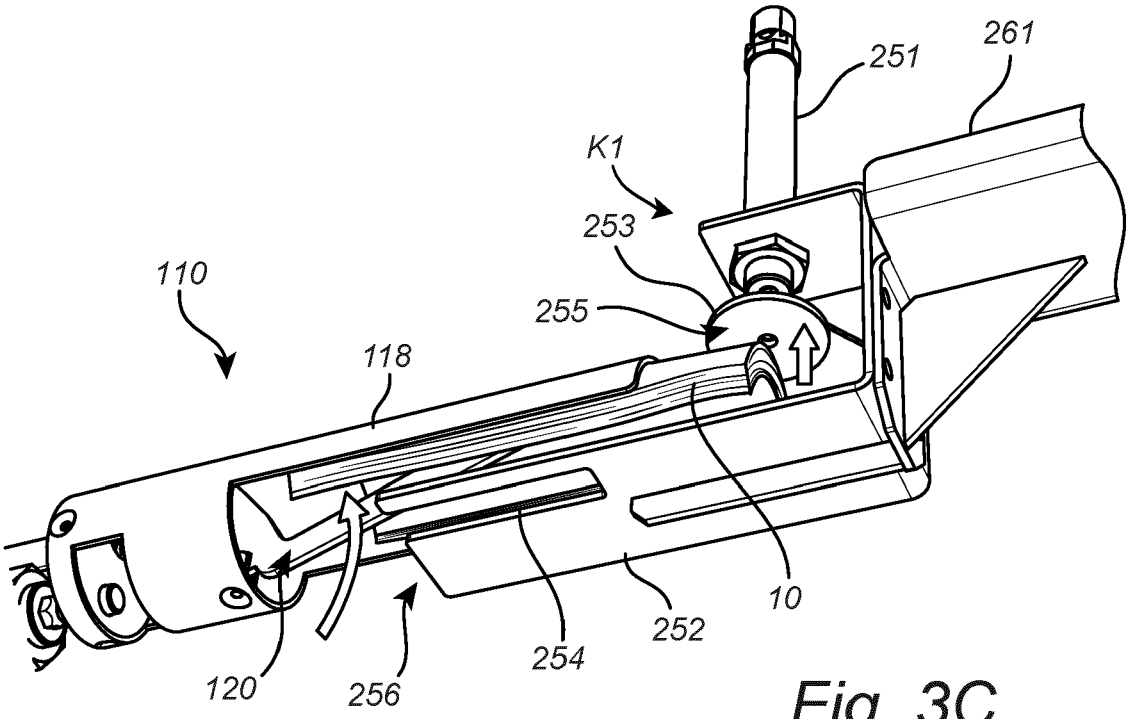

260
142
110
251
144
261
148
146
253
262
263
321
261
251
K2
110
118
254
10
120
256
252
250

Fig. 3B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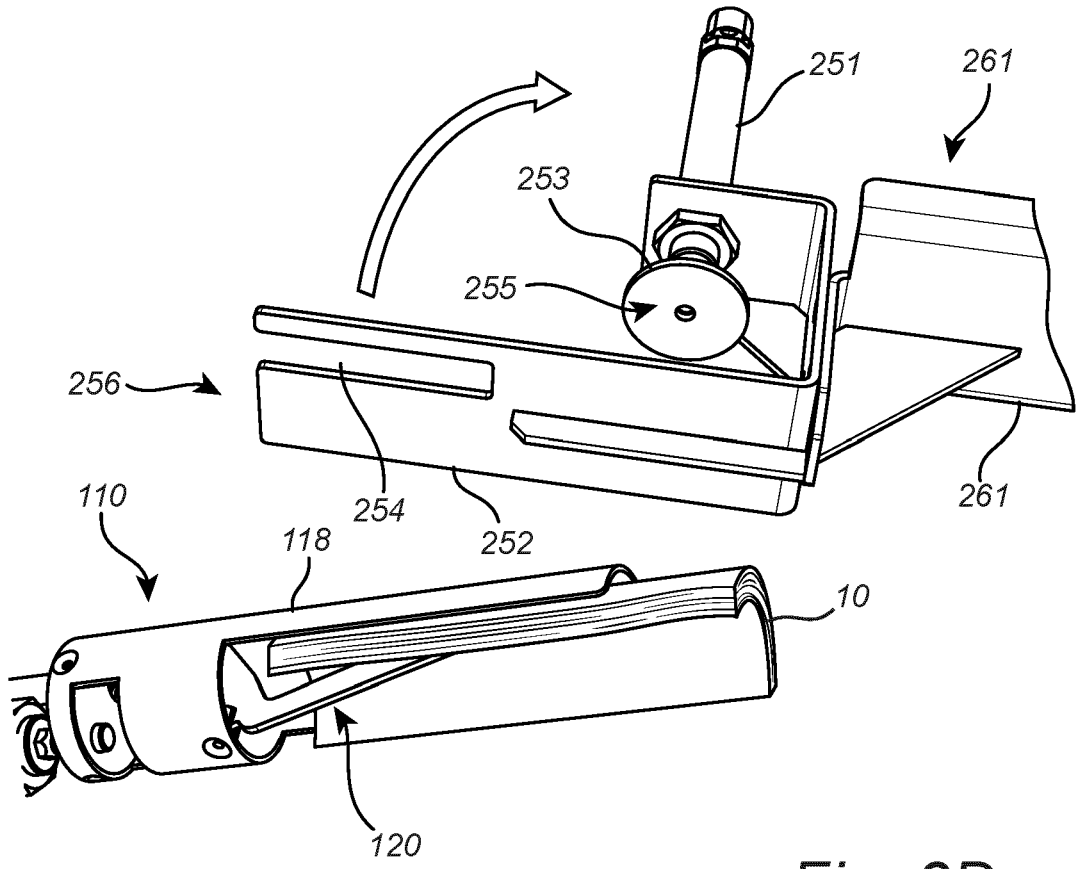
261
K1
253
110
255
118
10
252
254
120
256

Fig. 3C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261
110
118
10
120

Fig. 3D

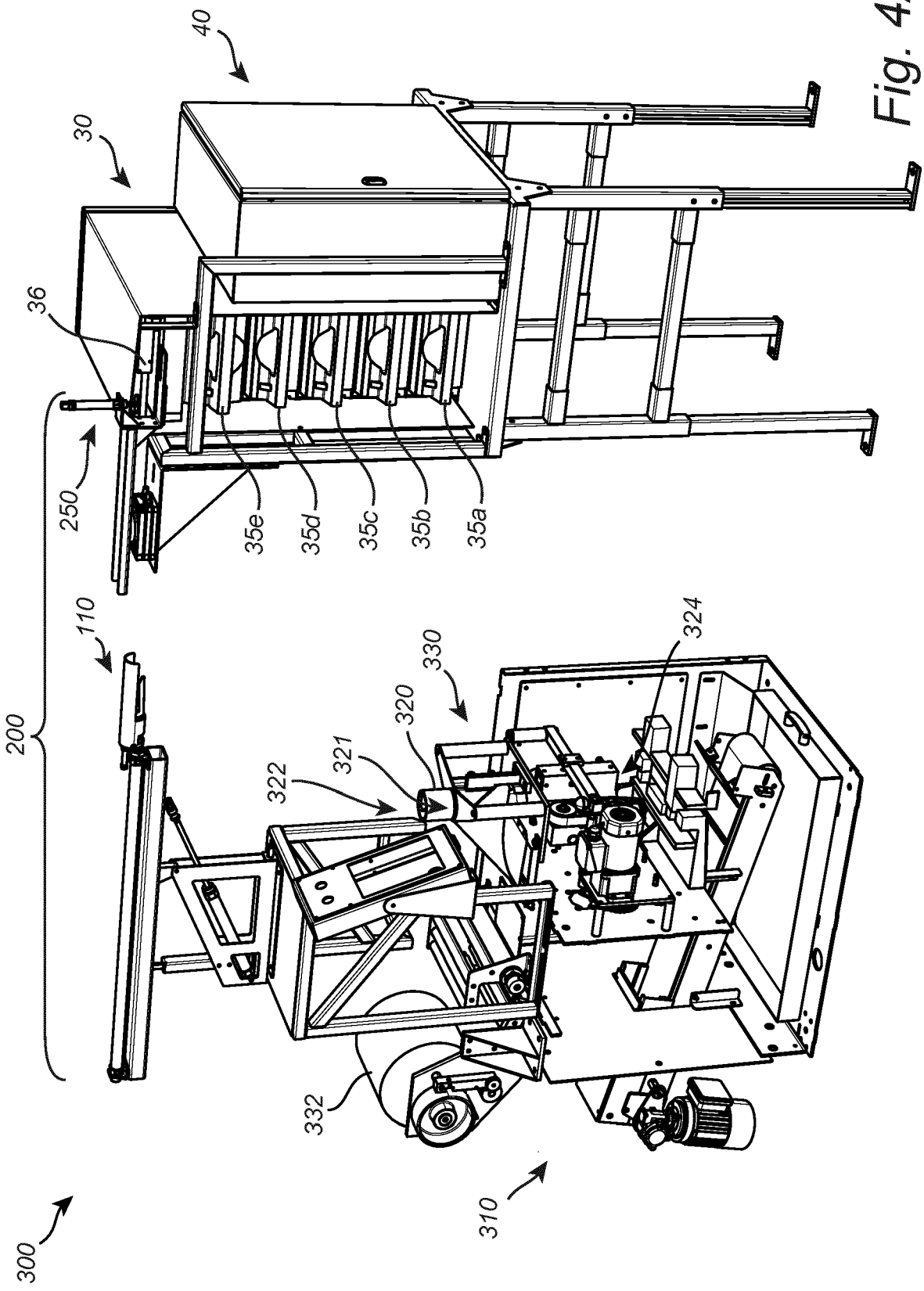
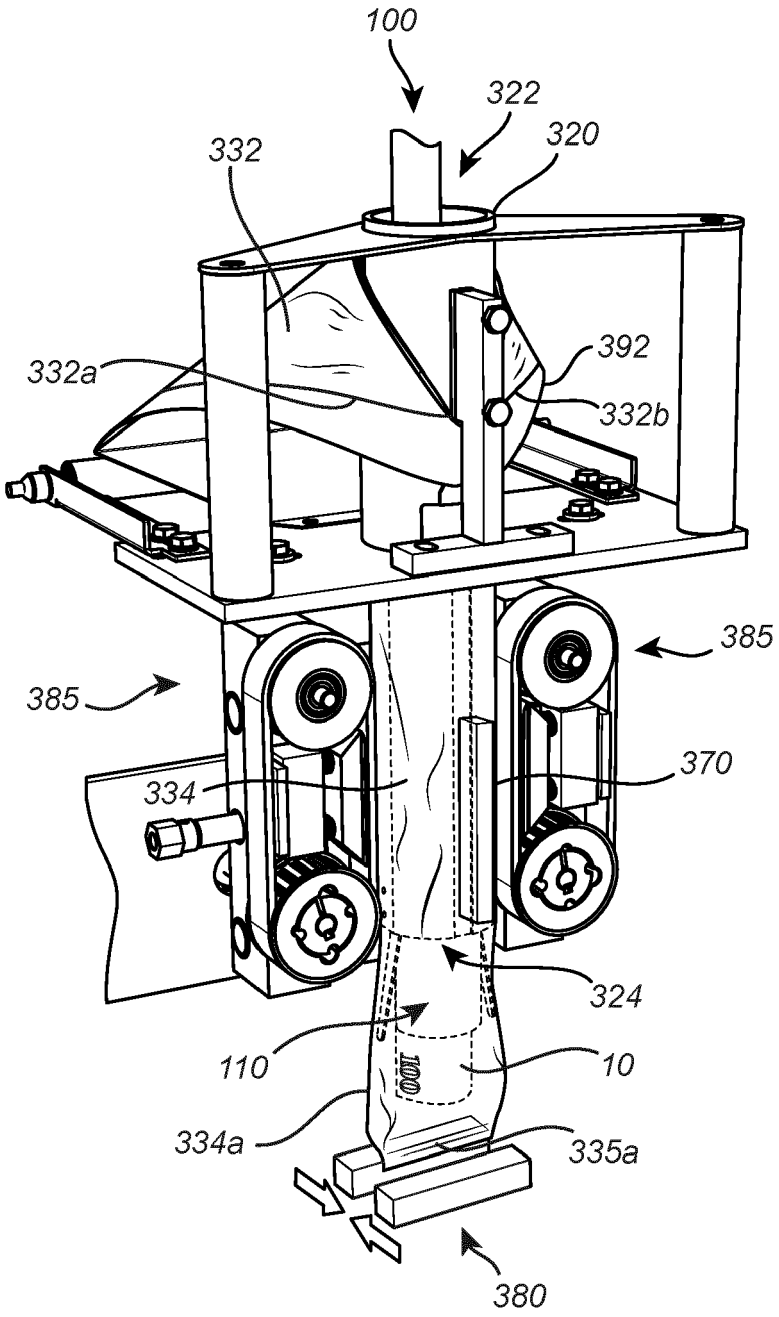

40
30
36
250
35e
35d
35c
35b
35a
110
200
330
324
320
321
322
332
310
300

Fig. 4A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322
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332
392
332a
332b
385
385
370
334
324
110
10
334a
335a
380

Fig. 4B

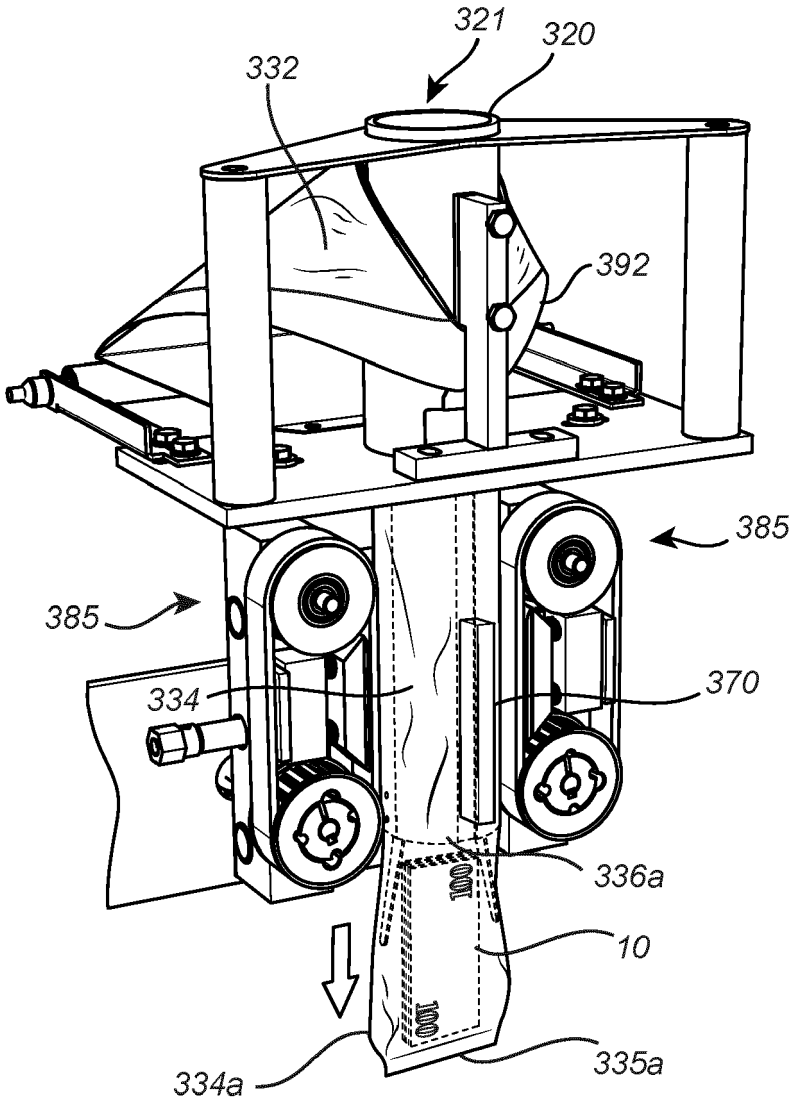


Fig. 4C

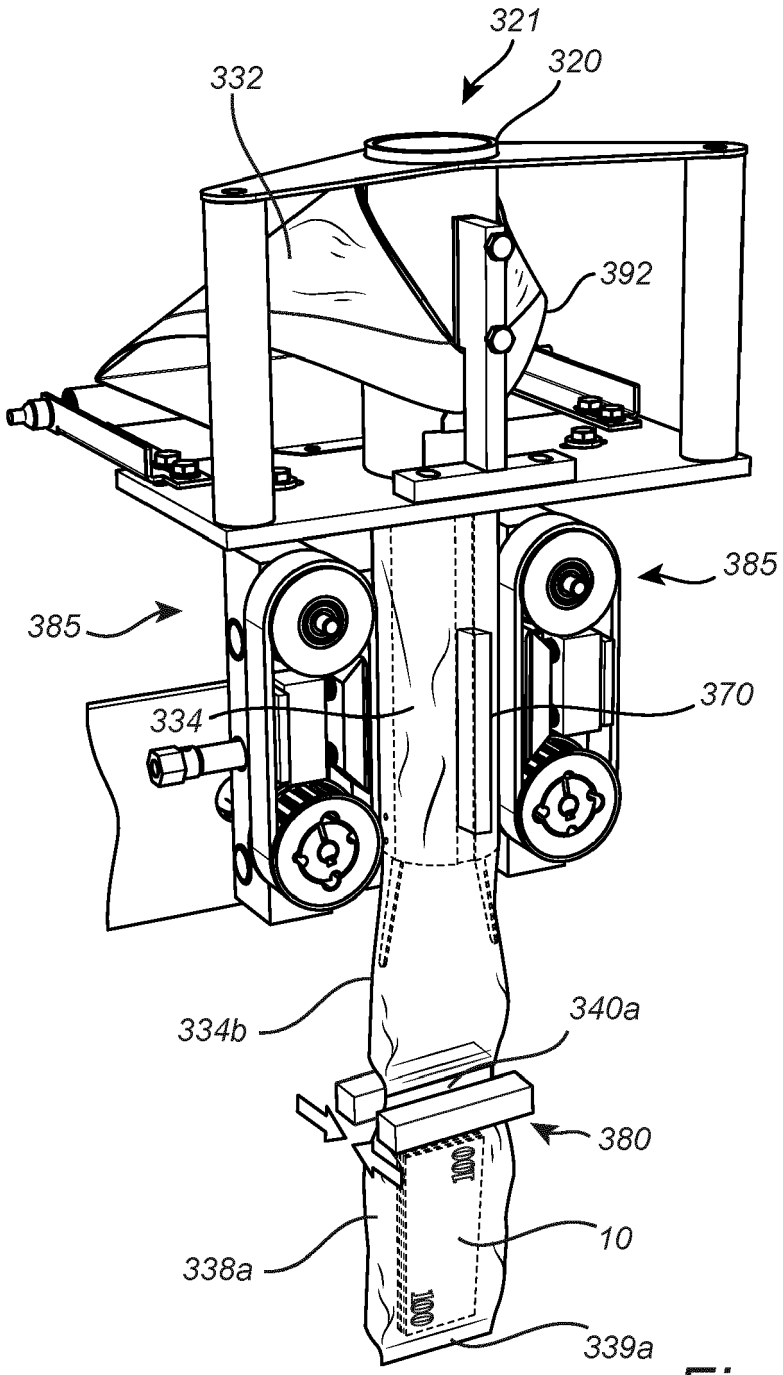
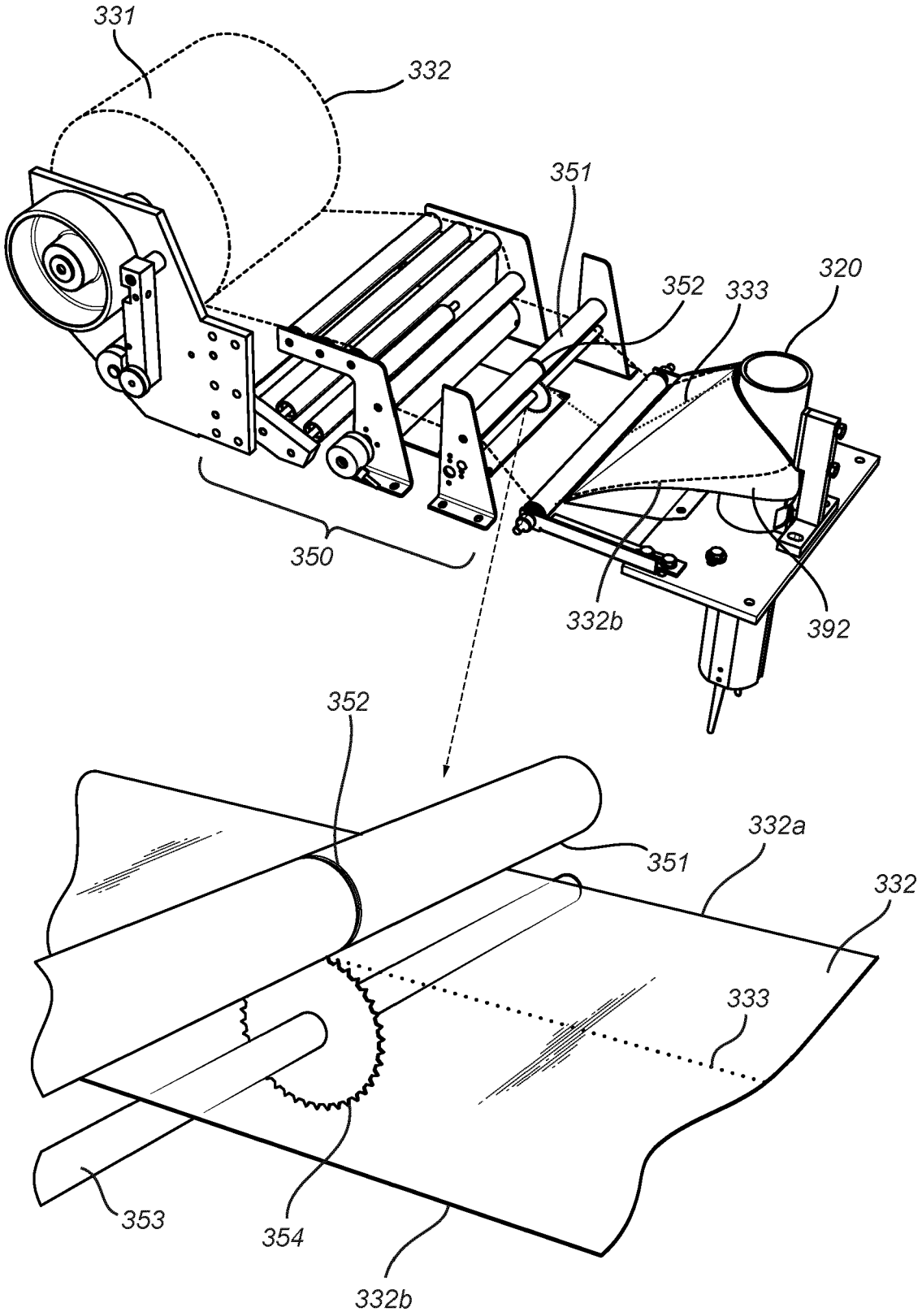


Fig. 4D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332
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333
320
350
332b
392
352
351
332a
332
333
353
354
332b

Fig. 4E

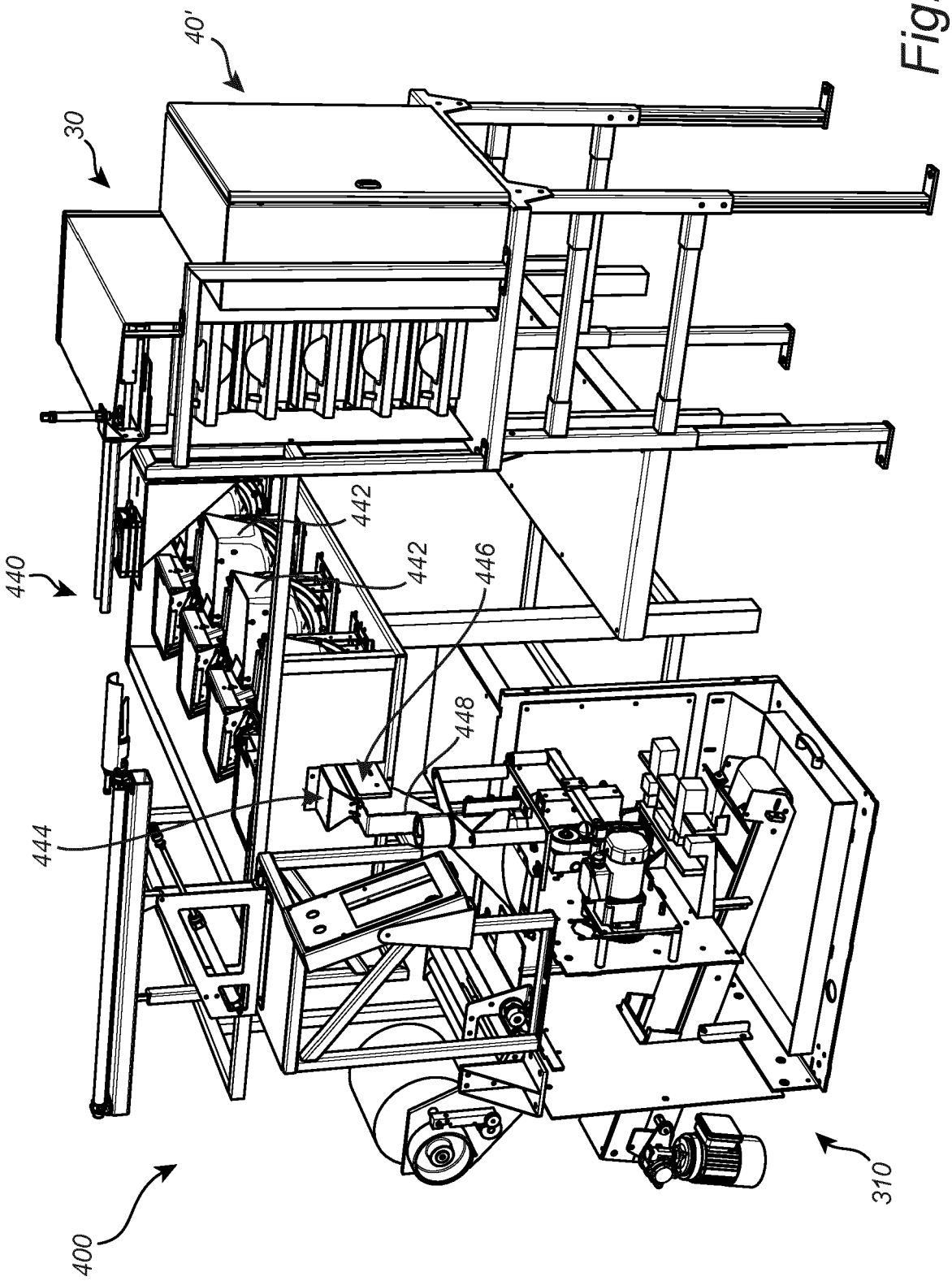
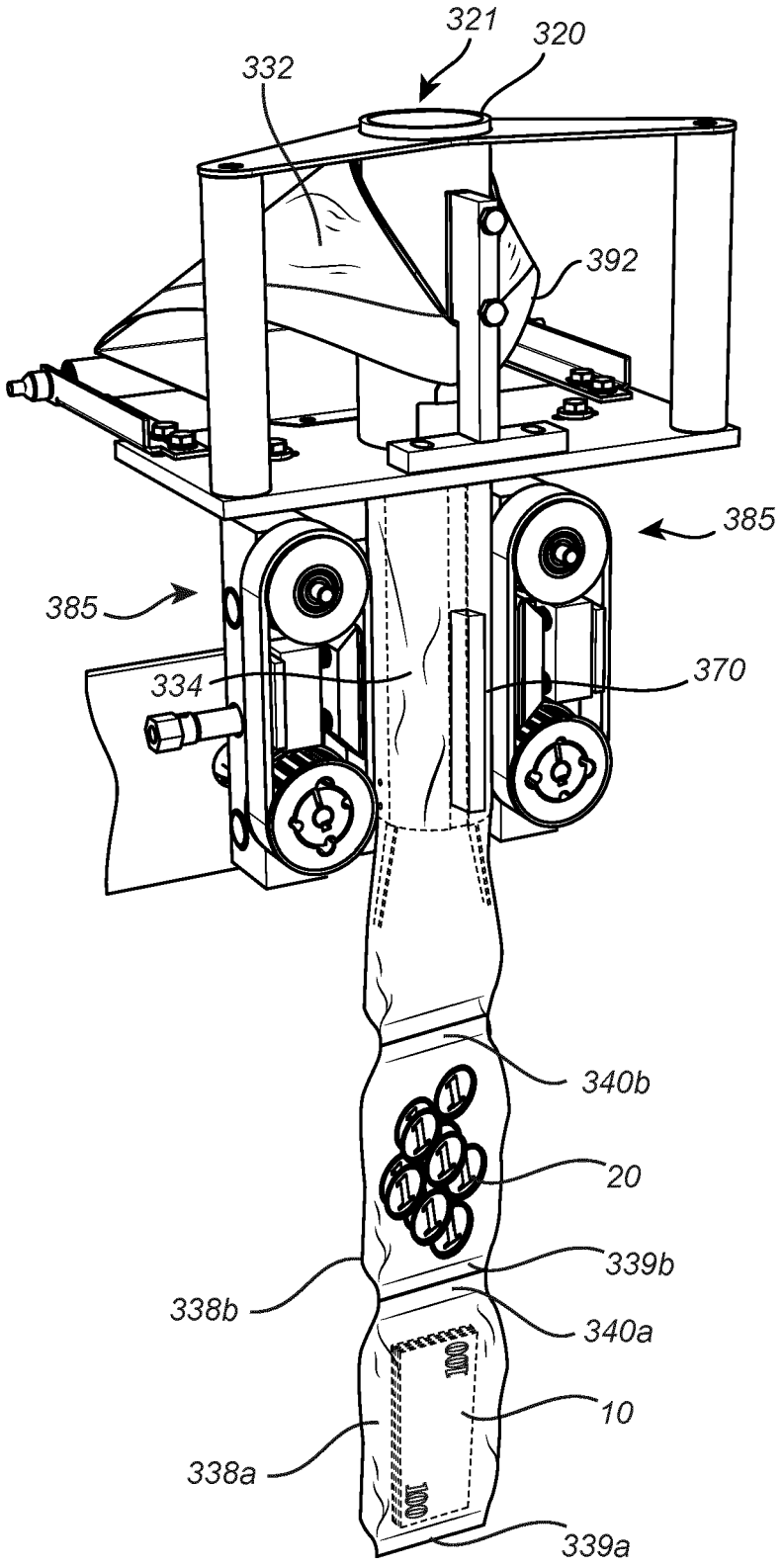


Fig. 5A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320
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392
385
385
334
370
340b
20
339b
338b
340a
10
338a
339a

Fig. 5B

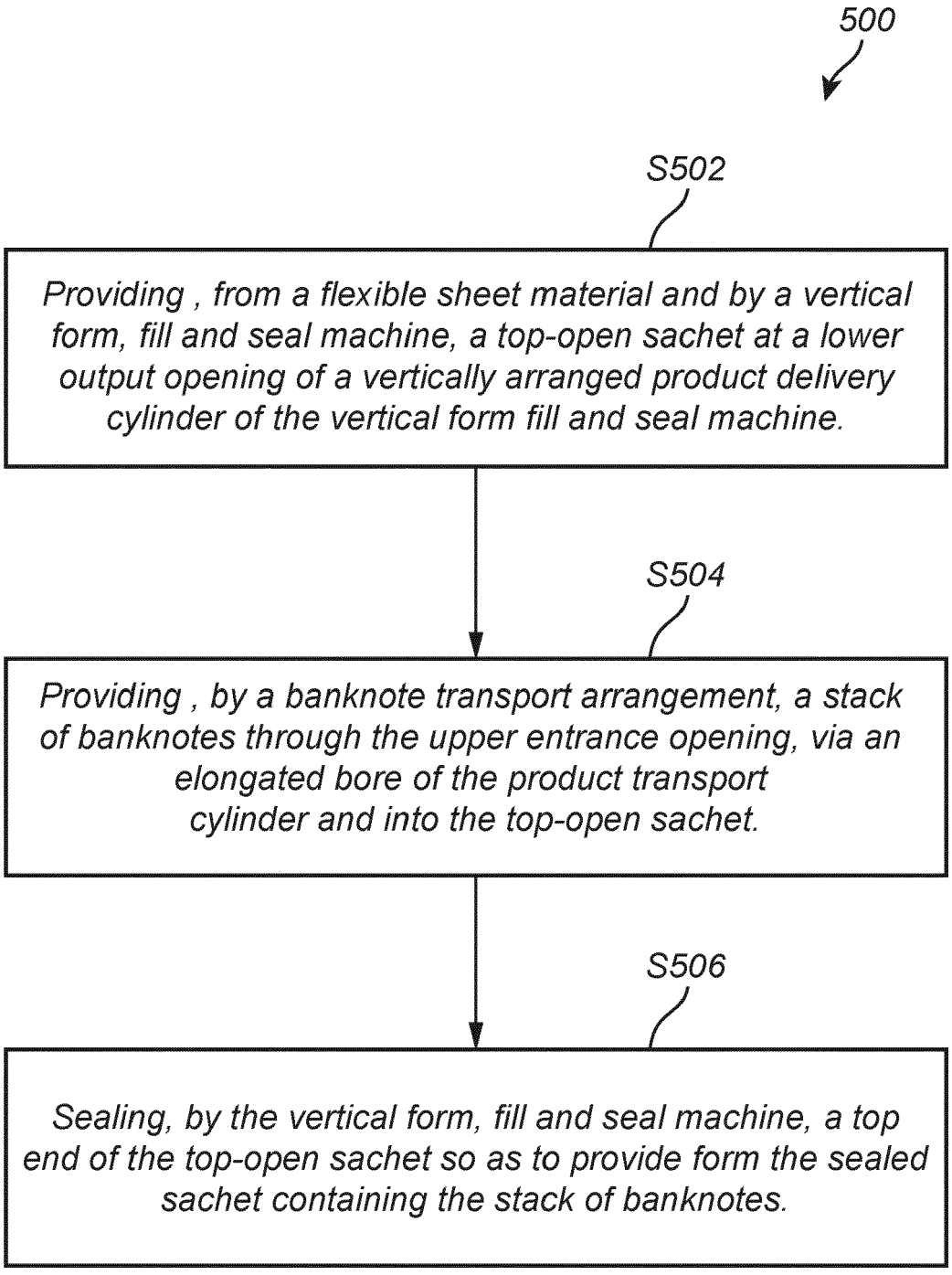
500
S502
Providing , from a flexible sheet material and by a vertical form, fill and seal machine, a top-open sachet at a lower output opening of a vertically arranged product delivery cylinder of the vertical form fill and seal machine.
S504
Providing , by a banknote transport arrangement, a stack of banknotes through the upper entrance opening, via an elongated bore of the product transport cylinder and into the top-open sachet.
S506
Sealing, by the vertical form, fill and seal machine, a top end of the top-open sachet so as to provide form the sealed sachet containing the stack of banknotes.

Fig. 6A

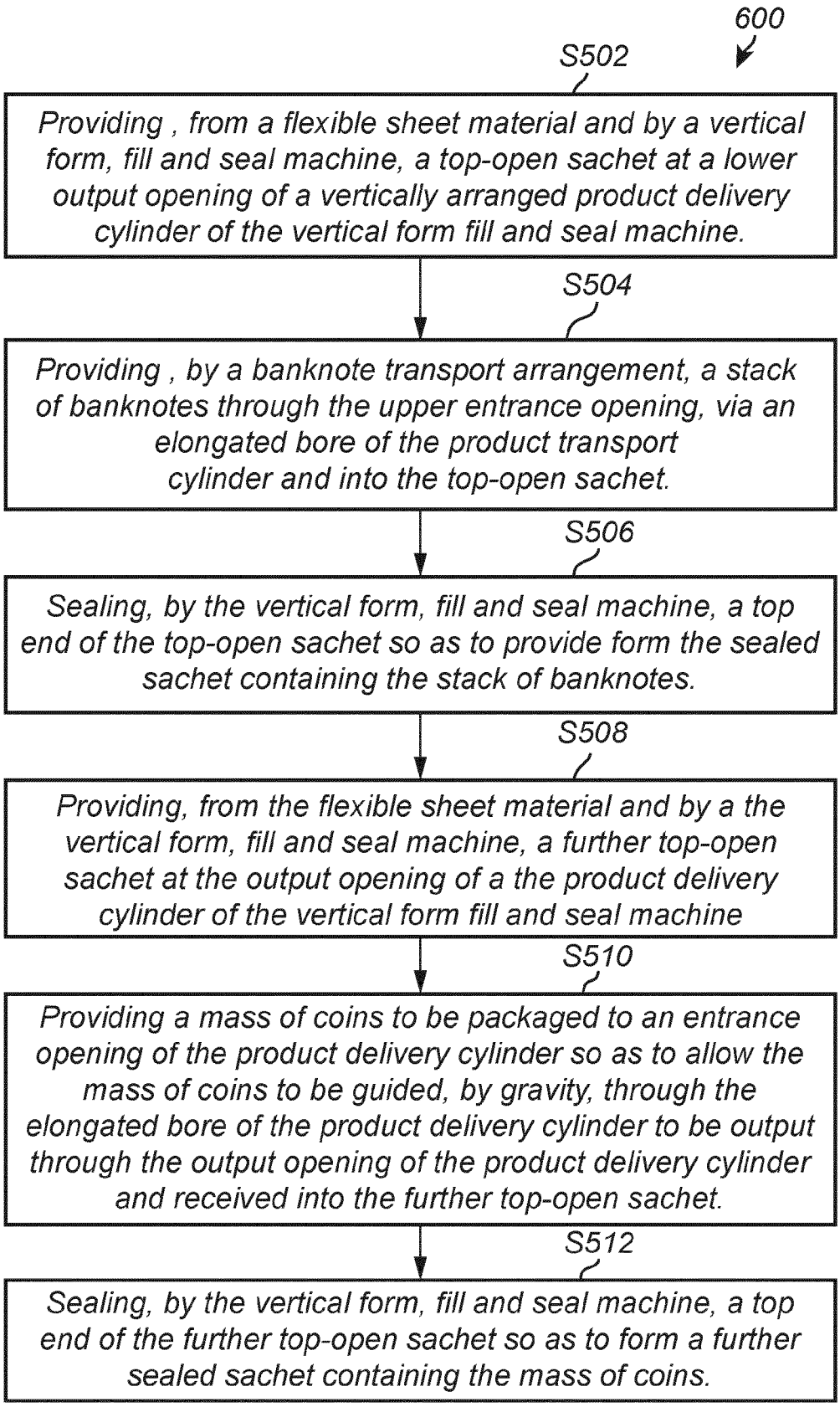
600
S502
Providing , from a flexible sheet material and by a vertical form, fill and seal machine, a top-open sachet at a lower output opening of a vertically arranged product delivery cylinder of the vertical form fill and seal machine.
S504
Providing , by a banknote transport arrangement, a stack of banknotes through the upper entrance opening, via an elongated bore of the product transport cylinder and into the top-open sachet.
S506
Sealing, by the vertical form, fill and seal machine, a top end of the top-open sachet so as to provide form the sealed sachet containing the stack of banknotes.
S508
Providing, from the flexible sheet material and by a the vertical form, fill and seal machine, a further top-open sachet at the output opening of a the product delivery cylinder of the vertical form fill and seal machine
S510
Providing a mass of coins to be packaged to an entrance opening of the product delivery cylinder so as to allow the mass of coins to be guided, by gravity, through the elongated bore of the product delivery cylinder to be output through the output opening of the product delivery cylinder and received into the further top-open sachet.
S512
Sealing, by the vertical form, fill and seal machine, a top end of the further top-open sachet so as to form a further sealed sachet containing the mass of coins.

Fig. 6B

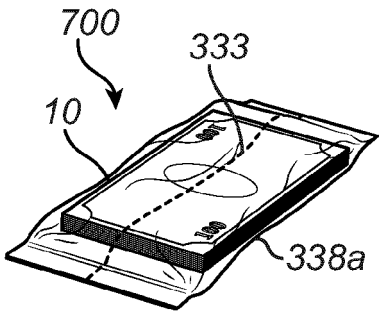

Fig. 7A

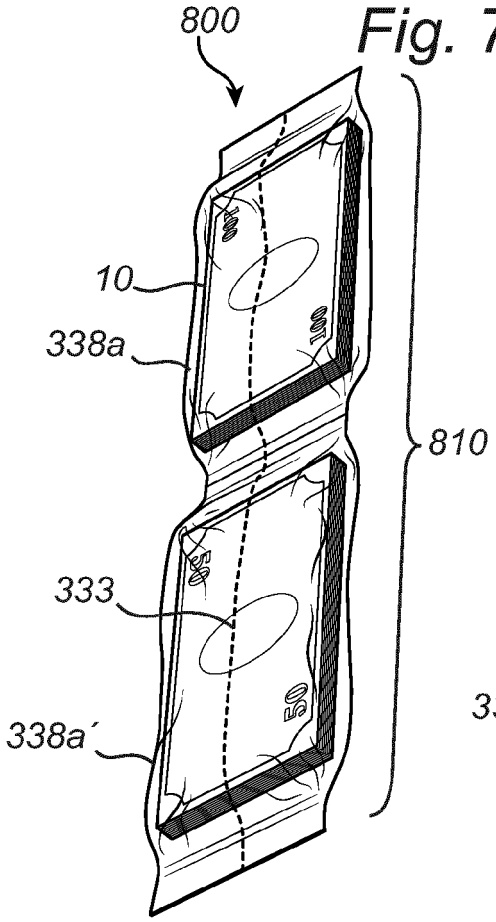

Fig. 7B

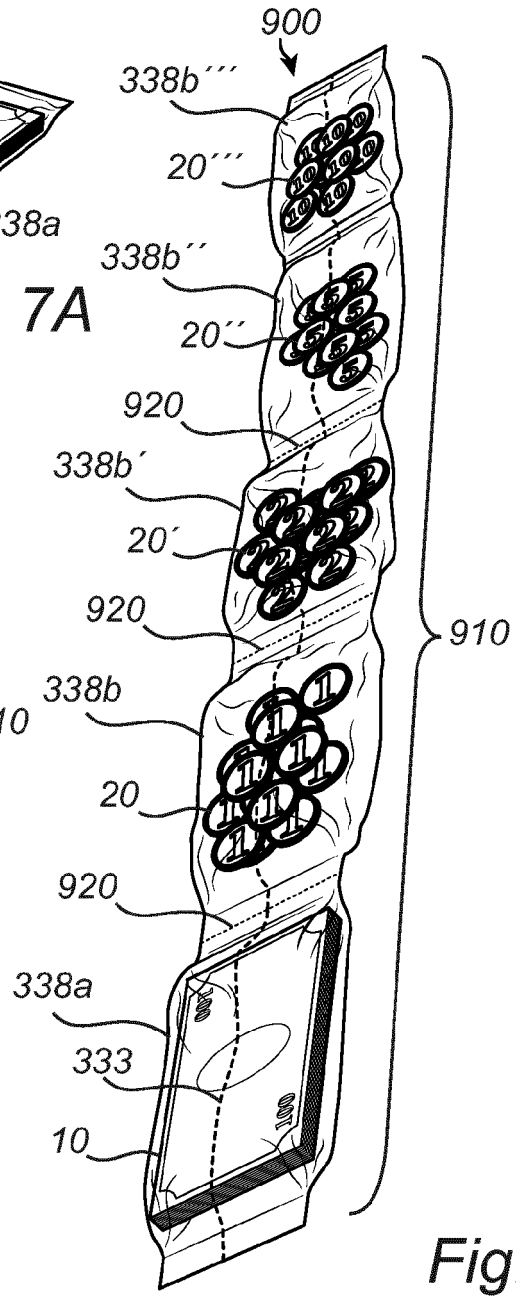

Fig. 7C

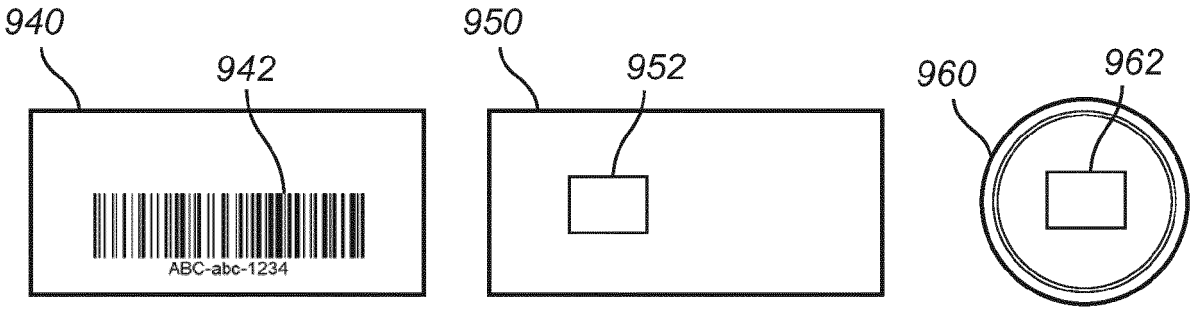

Fig. 7D

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 15 6962

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2007/034683 A1 (EASTMAN JEFFREY [US] ET AL) 15 February 2007 (2007-02-15)	1-9	INV. G07D1/00
A	* figures 27-40 * * paragraph [0175] - paragraph [0207] *	10-16	G07D9/00 G07D9/06 G07D11/00
X	US 2003/173402 A1 (OGAWA HIROSHI [JP] ET AL) 18 September 2003 (2003-09-18)	1-9	G07D11/12 G07D11/18
A	* paragraph [0075] - paragraph [0083] * * paragraph [0148] - paragraph [0153] * * figures 9,17-21,23-27 *	10-16	G07D11/14
X	US 2018/057290 A1 (KURODA TOSHIYUKI [JP] ET AL) 1 March 2018 (2018-03-01)	1-9	
A	* paragraph [0040] - paragraph [0057] * * figures 2-8 *	10-16	
X	US 2018/276932 A1 (DIETZ OLIVER [DE]) 27 September 2018 (2018-09-27)	1-9	
A	* paragraph [0006] * * paragraph [0027] - paragraph [0070] * * paragraph [0081] - paragraph [0086] * * figures 1-7 *	10-16	
X	US 3 809 217 A (HARRISON B) 7 May 1974 (1974-05-07)	10,11, 13-16	TECHNICAL FIELDS SEARCHED (IPC) G07D
A	* column 2, line 11 - column 3, line 65 * * figure 2 *	1-9,12	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 July 2020	Seifi, Mozhdeh

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 15 6962

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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30-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007034683 A1	15-02-2007	NONE	
US 2003173402 A1	18-09-2003	AU 6427501 A	24-12-2001
		CN 1436342 A	13-08-2003
		KR 20030010688 A	05-02-2003
		TW 571258 B	11-01-2004
		US 2003173402 A1	18-09-2003
		WO 0197181 A1	20-12-2001
US 2018057290 A1	01-03-2018	EP 3270359 A1	17-01-2018
		JP 2016169076 A	23-09-2016
		US 2018057290 A1	01-03-2018
		WO 2016143555 A1	15-09-2016
US 2018276932 A1	27-09-2018	CN 108629921 A	09-10-2018
		EP 3379503 A1	26-09-2018
		US 2018276932 A1	27-09-2018
US 3809217 A	07-05-1974	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82