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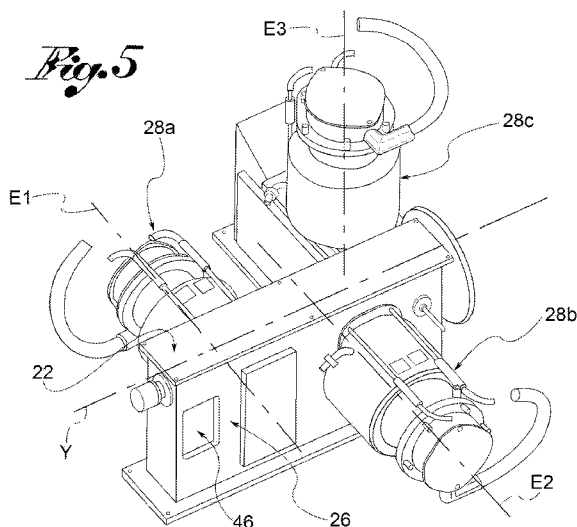
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(54) Title: STERILISATION DEVICE WITH ELECTRON BEAMS FOR THIN WALLED CONTAINERS AND STERILISATION METHOD



(57) Abstract: A sterilisation device (1) with electron beams for thin walled containers (C) comprises a sterilisation chamber provided with a first electron cannon (28a) positioned horizontally and a further electron cannon (28c) positioned vertically, to strike the container from different angles.

**"STERILISATION DEVICE WITH ELECTRON BEAMS FOR THIN WALLED
CONTAINERS AND STERILISATION METHOD"**

DESCRIPTION

[0001] The present invention relates to a device for
5 sterilising thin-walled containers, in particular
flexible containers, such as those for containing dense
fluids, especially foods such as creams, yoghurt, honey,
fruit juices or medicines and the like.

[0002] In the food industry, the sterilisation of
10 containers is extremely important for preventing
infections and preserving the food contained therein
correctly.

[0003] Sometimes, chemical sterilisation is performed,
during which the container is washed with disinfectants,
15 such as hydrogen peroxide, and then dried, before being
sent for subsequent filling operations.

[0004] However, chemical sterilisation has some drawbacks
such as for instance the presence of residues of the
chemical disinfectant in the dry container or the
20 presence of areas which have not been disinfected on
account of complicated or irregular geometries of the
container. Such drawback is particularly felt in the
field of thin-walled flexible containers.

[0005] Electron beam sterilisation is becoming increasingly
25 widespread.

[0006] Initially, the performance of electron beam sterilisation was restricted to specialised centres, which the containers to be treated had to be sent to and from which the sterilised containers were picked up, with
5 a considerable increase in transport costs and logistics. In such centres high powered (500 kV-10mV) electron cannons were usually utilised, with all the relative consequences on operator safety and environmental pollution.

10 [0007] Recently, electron beam sterilisation is becoming increasingly popular, thanks to the creation of particularly compact electron cannons functioning efficiently even at low voltages (80 - 150 kV). Such cannons permit the performance of electron beam
15 sterilisation directly in the container production plant, with notable economic savings.

[0008] The purpose of the present invention is to make a low voltage electron beam sterilisation device particularly suitable for treating thin-walled, flexible
20 containers.

[0009] The characteristics and advantages of the sterilisation device according to the present invention will be evident from the following description, made by way of a non-limiting example, with reference to the
25 attached drawings, wherein:

[0010] - figures 1 and 2 show a specimen of a flexible, thin-walled container, respectively full and empty;

[0011] - figure 3 shows an overall view of the sterilisation device according to the present invention,
5 according to one embodiment;

[0012] - figure 4 is a scheme diagram of a layout of the sterilisation device in figure 3;

[0013] - figure 5 shows a sterilisation group of the sterilisation device in figure 3;

10 [0014] - figure 5a shows a diagram of the reference planes and the emission planes defined for the present invention;

[0015] - figure 6 shows an input unit of the sterilisation device in figure 3;

15 [0016] - figure 7 shows a horizontal cross-section view of the input unit in figure 6;

[0017] - figure 8 shows a longitudinal cross-section view of the input unit in figure 6, along the section plane VIII-VIII in figure 7;

20 [0018] - figure 9 shows a pre-sterilisation chamber of the device in figure 3;

[0019] - figure 10 shows a main chamber of the sterilisation group in figure 5, at the point of the input unit;

25 [0020] - figure 11 shows a secondary chamber of the

sterilisation group in figure 5;

[0021] - figures 12a and 12b show an example of embodiment of the sterilisation system, fitted with an external, anti-radiation casing, in a closed and open configuration
5 respectively.

[0022] According to the drawings, reference numeral 1 globally denotes a low voltage electron beam sterilisation device for thin-walled, flexible containers.

10 [0023] In particular, the device 1 is suitable for sterilising containers C consisting of a body B formed of two B', B'' or more walls of flexible film, facing one another and joined, for example welded along the edges, if required with gusset side walls G, and provided with a
15 straw A in rigid material, fitted in a section of the edge of the body B, usually between the side walls. The straw A projects from the body along a straw axis and may be coupled to a cap, also in rigid material.

[0024] When the flexible container is just made and empty,
20 the body is particularly thin (figure 2), while it appears to bulge when filled (figure 1).

[0025] For the empty containers C, a height H is defined along the straw axis, a width W transversal to the height H, and a thickness T of the thin wall.

25 [0026] One embodiment example of such containers is shown

in documents EP-A1-1538105 and US-D-552,483, in the Applicant's name; one embodiment example of a straw with cap is shown in the document WO-A1-2008-050361, also in the Applicant's name.

5 [0027] The sterilisation device 1 comprises a sterilisation group 20, in which the sterilisation by means of low voltage electron beams takes place, an input unit 40 for the introducing the containers to be treated in the sterilisation group 20 and an output unit 60 for the exit
10 of the treated containers from the sterilisation group 20.

[0028] Said input unit 40 and said output unit 60 also form an obstacle to the leakage of radioactive emissions, and in particular of the X-rays produced by the electron beam
15 inside the sterilisation group 20, at its input and output.

[0029] The input unit 40 comprises an outer casing 42 provided with a front wall 44a which an entrance 46a is made in for the entrance of the containers C to be
20 treated, coming from machines upstream of the sterilisation device 1.

[0030] Similarly, the outer casing 42 is provided with a back wall 44b which an exit 46b is made in for the entrance of the containers C to be treated in the
25 sterilisation group 20.

[0031] The outer casing 42 further comprises a bottom 48 and a cover 50, preferably fitted with a removable lid 52 for access to the inside of the casing.

[0032] The outer casing 42 further comprises side walls 54,
5 preferably polygonal-shaped.

[0033] The input unit 40 further comprises a swivelling body 56, housed at least partially in the compartment inside the casing 42, swivelling on command in alternate directions or always in the same direction, around a
10 rotation axis K.

[0034] To such purpose, the input unit 40 is fitted with drive means, such as an electric motor 58, preferably of the brushless type connected to the swivelling body 56, preferably positioned under the bottom 48 of the casing
15 42. For example, the motor 58 is connected to the swivelling body 56 by means of a shaft 60 which crosses the bottom 48 of the outer casing.

[0035] The swivelling body 56 has at least one loading seat suitable for receiving at least one container to be
20 treated. In particular, the loading seat can be aligned with the entrance 46 of the casing 42 to enable the loading of containers to be treated.

[0036] Preferably the swivelling body 56 has two loading seats 58, for example diametrically opposite each other,
25 which can be alternately aligned with the entrance 46a.

[0037] Moreover, by rotation on command, the loading seat 58 can be aligned with the exit 46b of the casing for dropping the containers to be treated into the sterilisation group 20.

5 [0038] Preferably when one loading seat is aligned with the exit 46b, another loading seat is aligned with the entrance 46a, so that the loading of containers to be treated from the entrance 46a can take place simultaneously with the emptying of other containers from
10 the exit 46b.

[0039] The swivelling body 56 further presents filling portions, outside the loading seats, which occupy the operating area of the swivelling body rotating in the casing, so as to prevent or limit as far as possible the
15 presence of leaks from inside the sterilisation group 20 outwards through the input unit 40.

[0040] For example, the swivelling body 56 is a solid cylindrical body in which loadings seats 58 are made, generally diametrically opposite each other, having a
20 radial extension from the periphery towards the inside of the cylindrical body, so as to determine solid portions of operating space in the form of cylindrical segments, which brush the surface of the inner compartment of the casing 42.

25 [0041] The containers to be treated pass into the

sterilisation group 20 from the input unit 40.

[0042] To such purpose, the sterilisation device 1 comprises extraction means, suitable for extracting the containers housed in the loading seat 58 facing the exit
5 46b of the input unit 40.

[0043] According to a preferred embodiment, the extraction means comprise an extraction guide, for example formed of an extraction rail 140, which extends in an input direction X.

10 [0044] For example, the input direction X comes out of the loading seat 58 when aligned with the exit 46b, and preferably, is a rectilinear direction.

[0045] The containers are suspended from the extraction rail 140 by means of the respective straws A and the
15 extraction means are suitable for pushing the straws along the input direction X, in a direction of advancement IN.

[0046] To such purpose, for example, the extraction means comprise a pair of pushers provided with fingers 142
20 positioned on both sides of the extraction rail 140, spaced out along the input direction X, staggered along said input direction.

[0047] Preferably the pushers are driven by brushless motors.

25 [0048] The pushers are suitable for moving the fingers 142

in translation along the input direction X in the direction of advancement IN so as to engage and push the straws, for example corresponding to a group of containers.

5 [0049] Moreover, the pushers are provided with a lifting and return movement, which is implemented when a pusher has completed its forward stroke, so as to pass over the row of hanging containers and go back, to extract further containers housed in the loading seat 58 of the loading
10 unit 40 and make them advance.

[0050] In short, according to the embodiment illustrated said extraction means perform a "jumping" movement in which the fingers of the two pushers alternate in pushing each group of containers along the input
15 direction X. ,

[0051] According to a preferred embodiment, the device 1 comprises a pre-sterilisation chamber 50, shielded from the leakage of X-rays, extending in an input direction X, positioned downstream of the loading unit 40 and upstream
20 of the sterilisation group 20.

[0052] For example, the extraction means are housed in the pre-sterilisation chamber.

[0053] The sterilisation group 20 comprise an outer casing 22 which internally defines a sterilisation chamber, comprising a main chamber 24. In particular, a side wall
25

26 of the outer casing 22 presents the access for the containers coming from the input unit 40, moved by the extraction means.

[0054] The main chamber 24 extends mainly in a first
5 sterilisation direction Y, preferably rectilinear.

[0055] Preferably the first sterilisation direction Y is inclined in relation to the input direction X, preferably orthogonal to it.

[0056] Moreover, the pre-sterilisation chamber 50 helps to
10 prevent the leakage of X-rays from the input unit 40.

[0057] The sterilisation group 20 further comprises at least one electron cannon suitable for emitting a cloud of electrons to sterilise the containers.

[0058] For an electron cannon, an emission cone of the
15 electronic cloud and an emission axis which defines such emission cone is defined.

[0059] For example, the group 20 comprises two electron cannons 28a, 28b, having respective emission axes E1, E2.

[0060] Preferably the emission axes E1, E2 lie on the same
20 horizontal plane or on planes parallel to the horizontal plane.

[0061] The cannons 28a, 28b are positioned in sequence in the first sterilisation direction Y, facing each other in the main chamber 24, positioned opposite one another.

25 [0062] The cannons 28a, 28b are positioned in sequence in

the sense that the containers are struck first by the electronic cloud emitted by the first cannon and then by the electronic cloud emitted by the second cannon, or, in a transition zone only, they are simultaneously subject
5 to the electronic cloud of the previous cannon and to the cloud of electrons of the next cannon.

[0063] The sterilisation group 20 further comprises support means of the containers along the main chamber 24 suitable for supporting said containers in the first
10 sterilisation direction Y.

[0064] For example, said support means comprise a first rail 30 which extends in the first sterilisation direction Y, which the containers are hung from, for example by means of the straw A.

15 [0065] The sterilisation group 20 further comprises first means of advancing the containers suitable for moving the containers in the first sterilisation direction.

[0066] To change direction from the input direction X to the first sterilisation direction Y, the first extraction
20 means act in conjunction with the means of advancement.

[0067] In particular, for example, the extraction means comprise a drum cam, positioned at the end of the pair of rails 140, suitable for pushing the containers into the main chamber 24, where they engage with the first means
25 of advancement.

[0068] For example, said first means of advancement comprise a rotor element 32 which extends with its axis along the first sterilisation direction Y, rotatable so as to push the containers in said direction Y.

5 [0069] For example, the rotor element 32 surmounts the first rail 30 and engages the top of the straw A of the container C, projecting from the first rail 30, to push the container in the first sterilisation direction Y,

[0070] Preferably moreover, the sterilisation group 20
10 further comprises guide means suitable for guiding the body of the containers in the first sterilisation direction Y.

[0071] For example, said guide means comprise a pair of threadlike guides 34 extending in the first sterilisation
15 direction Y, positioned below the first rail 30 and spaced out, so that the bodies B of the containers C are placed between them. Given the closeness of the guides 34, the oscillation of the containers is thereby limited or prevented.

20 [0072] The sterilisation chamber of the sterilisation group 20 further comprises a secondary chamber 36 which extends in a second sterilisation direction Z, incident to the first sterilisation direction Y, for example, preferably, orthogonal to it.

25 [0073] The rotor element 32 pushes the containers in the

first sterilisation direction Y, as far as the end of the first rail 30, where the first means of advancement co-operate with the second means of advancement to change the direction of advancement from the first sterilisation
5 direction Y to the second sterilisation direction Z.

[0074] The second means of advancement are suitable for moving the containers in the second sterilisation direction.

[0075] Moreover, the sterilisation group 20 comprises
10 second support means suitable for supporting the containers in the second sterilisation direction Y.

[0076] For example, the second support means comprise a second rail 150 which extends from the zone where the first rail 30 ends, in the second sterilisation direction
15 Z, and is suitable for hanging the containers C from, for example by means of the straw A.

[0077] In the transition zone between the first rail 30 and the second rail 150, the second means of advancement comprise a pusher 152 suitable for moving in alternated
20 translatable movement in the second sterilisation direction Z.

[0078] The movement of the pusher 152 is synchronised with the movement of the rotor 32, for example by means of a rotating cam 154, connected by a belt or chain to the
25 rotor element 32.

[0079] When the container C is left by the rotor element 32 at the end of the first rail 30, the second pusher 152 pushes said container along the second rail 102.

[0080] The containers hanging from the second rail 150
5 proceed in the second sterilisation direction Z as a result of the subsequent insertion of a further container in the tail, that is to say so that the subsequent container pushes the tail of the containers before it forward in the direction of advancement.

10 [0081] According to one embodiment variation (not shown), the second means of advancement are suitable for separately engaging sets of containers, to make them advance in the second sterilisation direction Z; for example, said second means of advancement are
15 structurally and functionally similar to said first means of advancement.

[0082] The sterilisation group 20 further comprises a further electron cannon 28c, such as a third cannon 28c positioned along the second sterilisation direction Z,
20 having an emission axis E3 incident to the horizontal plane, preferably orthogonal to it. In other words, the third cannon is positioned so that the emission axis E3 is parallel to the axis of the straw A of the container being treated.

25 [0083] It is therefore clear that the first sterilisation

direction Y and the second sterilisation direction Z together define a sterilisation path along the sterilisation chamber.

[0084] The sterilisation device 1 further comprises an
5 output unit 60, joined to the secondary chamber 36, downstream of the third cannon 28c in relation the direction of advancement of the containers being treated.

[0085] Preferably the output unit 60 is functionally and structurally similar to the input unit 40.

10 [0086] The treated containers pass from the sterilisation group 20 and in particular from its secondary chamber 36 to the output unit 60 and from this outside the device 1.

[0087] The sterilisation device comprises loading means suitable for loading a predefined number of containers C
15 from the secondary chamber 36 to the loading seat of the input unit.

[0088] Preferably, said loading means comprise a pusher with a "jumping" movement similar to that described above.

20 [0089] According to a preferred embodiment, the device 1 comprises a post-sterilisation chamber 55, shielded from the leakage of X-rays, extending in the second sterilisation direction Z, positioned downstream of the sterilisation group and upstream of the output unit 60.

25 [0090] For example, the loading means are housed in the

post-sterilisation chamber.

[0091] The post-sterilisation chamber also helps to prevent the leakage of X-rays from the output unit 60.

[0092] The containers C1 entering the input unit 40 are
5 aligned one after another with the walls facing each other; the containers C1 are facing in columns that is.

[0093] The containers C1 are moved so that one or more containers C2 are housed in the loading seat 58 of the input unit 40. When the number of containers housed in
10 the loading seat reaches a predefined number, the swivelling body 56 rotates to bring the loading seat 58 containing the containers C2 to align with the exit 46b and, preferably, the other loading seat 58, empty, to align with the entrance 46a for a further load.

15 [0094] The containers C3 contained in the loading seat 58 aligned with the exit 46b are moved so as to proceed along the input direction X, to then be deviated along the first sterilisation direction Y,

[0095] In particular, the containers C4 cross the main
20 chamber 20 aligned one behind the other in the first sterilisation direction Y, that is so to be facing in rows.

[0096] In the first sterilisation direction Y, the containers C4 undergo a first sterilisation by the first
25 and second cannon 28a, 28b, the emission axes of which

E1, E2 lie substantially on a horizontal plane.

[0097] In the first sterilisation direction Y, the containers C4 are positioned in rows, so that the walls B', B'' of the body B are in front of the emission cone of the electron cannons 28a, 28b. In other words, the bodies B of the containers C4 are substantially coplanar and lie on a single plane in relation to which the emission axes E1, E2 are incident.

[0098] Such arrangement permits an excellent sterilisation of the walls B', B'' of the body B of the containers C4 and, if necessary, of the gusset sides G where provided.

[0099] Downstream of the second cannon 28b, the containers being treated are deviated from the first sterilisation direction Y to the second sterilisation direction Z and at the same time moved along it so to enter and pass through the secondary chamber 36.

[00100] In particular, the containers C5 cross the secondary chamber 36 aligned one behind another with the walls facing each other; that is to say the containers C5 are facing in columns.

[00101] In the second sterilisation direction Z, the containers C5 undergo a second sterilisation by the third electron cannon 28c, the emission axis of which E3 is incident, in particular orthogonal to the horizontal plane.

[00102] In the second sterilisation direction Z, the containers C5 are positioned in columns, so that the axis of the straw A of the container is substantially parallel to the emission axis of the emission cone of the third
5 cannon 28c.

[00103] Such arrangement permits an excellent sterilisation of the straw A of the container C.

[00104] The containers C5 are moved so that one or more containers C6 are housed in the loading seat of the
10 output unit 60. When the number of containers housed in the loading seat reaches a predefined number, the swivelling body rotates to bring the loading seat containing the containers C6 to align with the exit and, preferably, the other loading seat, empty, to align with
15 the entrance for a further load.

[00105] The containers C7 contained in the loading seat aligned with the exit are moved to the outside of the sterilisation device.

[00106] The change of direction in the advancement of
20 the containers during sterilisation makes it possible to optimise the exposition times of the parts of these to the electron beams.

[00107] In particular, in the first sterilisation direction Y, the containers C4 are facing in rows and,
25 given the arrangement of the electron cannons 28a, 28b,

the sterilisation is particularly effective on the walls B', B'' of the body B, which are particularly thin. The width dimension W of the containers C determines the transit time under the emission cones of the cannons 28a
5 28b of said containers.

[00108] In the second sterilisation direction Z, the containers C5 are facing in columns and, given the arrangement of the electron cannon 28c, the sterilisation is particularly effective inside the straw A. The
10 thickness dimension T of the containers C determines the transit time under the emission cone of the cannon 28c of said containers.

[00109] Since the width W of the containers C is much greater than the thickness T of the same (the reason for
15 which they are called thin walled containers), the exposition to the first sterilisation is much less than the exposition to the second sterilisation, with respect to the relative needs, since the walls of the container need a less prolonged sterilisation than the straw.

20 [00110] In general, along a sterilisation path, along which a first reference plane Pr1 and a further reference plane Pr3 are defined, separate from each other and incident to said sterilisation path, the first electron cannon 28a has an emission axis E1 lying on the first
25 reference plane Pr1 and the further electron cannon 28c

has an emission axis E3 lying on the further reference plane Pr3. The emission axis E3 of the further cannon 28c is inclined in relation to the sterilisation path, unlike the emission axis E1 of the first cannon 28a.

5 [00111] The container C can thereby be sterilised in different directions, to optimise the action of the electron clouds on different areas of the container.

[00112] Preferably moreover, a sterilisation system 100 comprises the sterilisation device, a support
10 structure 102, which the device is placed on, for example raised off the ground, and an outer casing 104, which the device is contained in, suitable for acting as a screen to the leakage of radiation.

[00113] The outer casing 104 is composed of side walls
15 in lead, which screen any radiation.

[00114] The casing 104 is fitted with a pair of seats 108, made in the side wall, at the point of the input unit and the output unit.

[00115] In the closed configuration, said units project
20 outside the casing 104, to permit access of the containers to be sterilised or to allow the exit of the sterilised containers.

[00116] Preferably moreover, the structure 102
comprises a plurality of pillars 106, on which the casing
25 104 slides, to lower onto the device 1 and to contain it,

or to lift up to permit servicing operations for example.

[00117] Innovatively, the low voltage electron beam sterilisation device according to the present invention is particularly suitable for treating thin-walled,
5 flexible containers.

[00118] Advantageously, the device according to the invention is utilisable directly incorporated into the production plant since it greatly limits, in compliance with existing legislation, the leakage of radiation.

10 [00119] In particular, the design of the device according to the present invention follows the practical design rule known as the " 3 bounce rule "according to which, any ray emitted by the cannons must bounce of the inner wall of the casing three times before getting
15 out of the casing, thereby practically giving a zero value to the energy possessed.

[00120] Moreover, advantageously, it optimises the exposition times of the containers to the sterilisation, differentiating the exposure times according to the needs
20 of the parts to be sterilised.

[00121] It is clear that a person skilled in the art may make modifications to the device described above.

[00122] For example, according to one embodiment variation, the electron cannon for the second
25 sterilisation is on a plane with the cannon for the first

sterilisation while after the first sterilisation the containers are made to rotate in such a way as to position themselves with the straw parallel to the emission axis of the cannon for the second sterilisation.

5 [00123] According to a further embodiment variation, the input unit and/or output unit have more than two loading seats, for example angularly equidistant.

[00124] According to yet a further embodiment, the first sterilisation is performed by a single electron
10 cannon.

[00125] According to yet a further embodiment, the second sterilisation is performed by two or more electron cannons.

[00126] Furthermore, according to one embodiment
15 variation, the swivelling body of the input unit and/or output unit performs a rotation of 90° to bring the loaded containers into alignment for exit.

[00127] According to a further embodiment variation, the motor for driving the swivelling body is connected to
20 it by a cinematic chain.

[00128] Such variations are also included within the sphere of protection as defined by the following claims.

Claims

1. Sterilisation device (1) with electron beams for thin walled containers (C) comprising:

- a sterilisation chamber, shielded to the rays generated
5 by the electron beams, extending along a sterilisation path, wherein along said sterilisation path, a first reference plane (Pr1) and a further reference plane (Pr3) are defined, separate from each other and incident to said sterilisation path;
- 10 - a first electron cannon (28a) having an emission axis (E1) lying on the first reference plane (Pr1); and
- a further electron cannon (28c) having an emission axis (E3) lying on the further reference plane (Pr3);

wherein the emission axis (E3) of the further cannon
15 (28c) is inclined in relation to the sterilisation path, unlike the emission axis (E1) of the first cannon (28a).

2. Device according to claim 1, wherein the emission axis (E1) of the first cannon (28a) and the sterilisation path define an emission plane (Pe1) and the emission axis (E3)
20 of the further cannon (28c) is orthogonal to said emission plane (Pe1).

3. Device according to claim 1 or 2, wherein the inner chamber comprises a main chamber (24) extending in a first sterilisation direction (X) and a secondary chamber
25 (36) extending in a second sterilisation direction (Z),

said second sterilisation direction (Z) being incident, for example orthogonal, to the first sterilisation direction (Y).

4. Device according to claim 3, wherein the first cannon
5 (28a) is positioned along the first sterilisation direction (Y).

5. Device according to claim 3 or 4, wherein the further cannon (28c) is positioned along the second sterilisation direction (Z).

10 6. Device according to any of the previous claims, comprising a second electron cannon (28b) having an emission axis (E2), said second cannon (28b) being positioned on the emission plane (Pe1) of the first cannon (28a), on the side opposite the first cannon (28a)
15 in relation to the first sterilisation direction.

7. Device according to any of the previous claims, wherein, upstream of the sterilisation chamber a pre-sterilisation chamber (50) is positioned, shielded from the leakage of rays generated by the electron beams,
20 extending in an input direction X, orthogonal to the first sterilisation direction.

8. Device according to any of the previous claims, wherein, downstream of the sterilisation chamber, a post-sterilisation chamber (55) is positioned, shielded from
25 the leakage of rays generated by the electron beams,

extending in an output direction, orthogonal to the first sterilisation direction.

9. Device according to any of the previous claims, comprising, upstream of the sterilisation chamber, a
5 swivelling, two-sector input unit (40).

10. Device according to any of the previous claims, comprising, downstream of the sterilisation chamber a swivelling, two-sector output unit (60).

11. Method of sterilising thin-walled containers (C),
10 comprising the steps of:

- making the containers (C) to be treated advance along a sterilisation path;
- emitting a first electronic cloud along an emission axis (E1) inclined in relation to the emission direction;
- 15 - subjecting the containers to a first sterilisation by the first cloud of electrons;
- emitting a further electronic cloud along an emission axis (E3) inclined in relation to the emission direction; in a different way to the emission axis of the first
20 emission cloud;
- subjecting the containers to a second sterilisation by the further cloud of electrons.

12. Sterilisation device (1) with electron beams for thin walled containers (C) comprising:
25 - a main chamber (24) extending in a first sterilisation

direction (X) and a secondary chamber (36) extending in a second sterilisation direction (Z), said second sterilisation direction (Z) being incident, for example orthogonal, to the first sterilisation direction (Y);

- 5 - a first electron cannon (28a) having an emission axis (E1) positioned along the first sterilisation direction(Y); and
- a further electron cannon (28c) having an emission axis (E3) positioned along the second sterilisation
- 10 direction(Z).

13. Device according to claim 12, comprising:

- first support means, positioned along the first sterilisation direction (Y), suitable for guiding the containers (C) so that they are positioned alongside each
- 15 other in rows; and
- second support means, positioned along the second sterilisation direction (Z), suitable for guiding the containers (C) so that they are positioned behind each other in columns.

20 14. Method of sterilising thin-walled containers (C), comprising the steps of:

- making the containers (C) to be treated advance along a first sterilisation axis (Y);
- emitting a first cloud of electrons along the first
- 25 sterilisation axis and subjecting the containers to a

first sterilisation by the first cloud of electrons;

- deviating the containers from the first sterilisation direction (Y) to the second sterilisation direction (Z) and making the containers advance along said second
5 sterilisation direction;

- emitting a further cloud of electrons along the second sterilisation axis and subjecting the containers to a further sterilisation by the further cloud of electrons.

15. Method according to claim 14, wherein:

10 - in the step of making the containers (C) to be treated advance along a first sterilisation axis (Y), said containers advance positioned alongside each other in rows; and

- in the step of making the containers advance along the
15 second sterilisation direction (Z), said containers advance behind each other in columns.

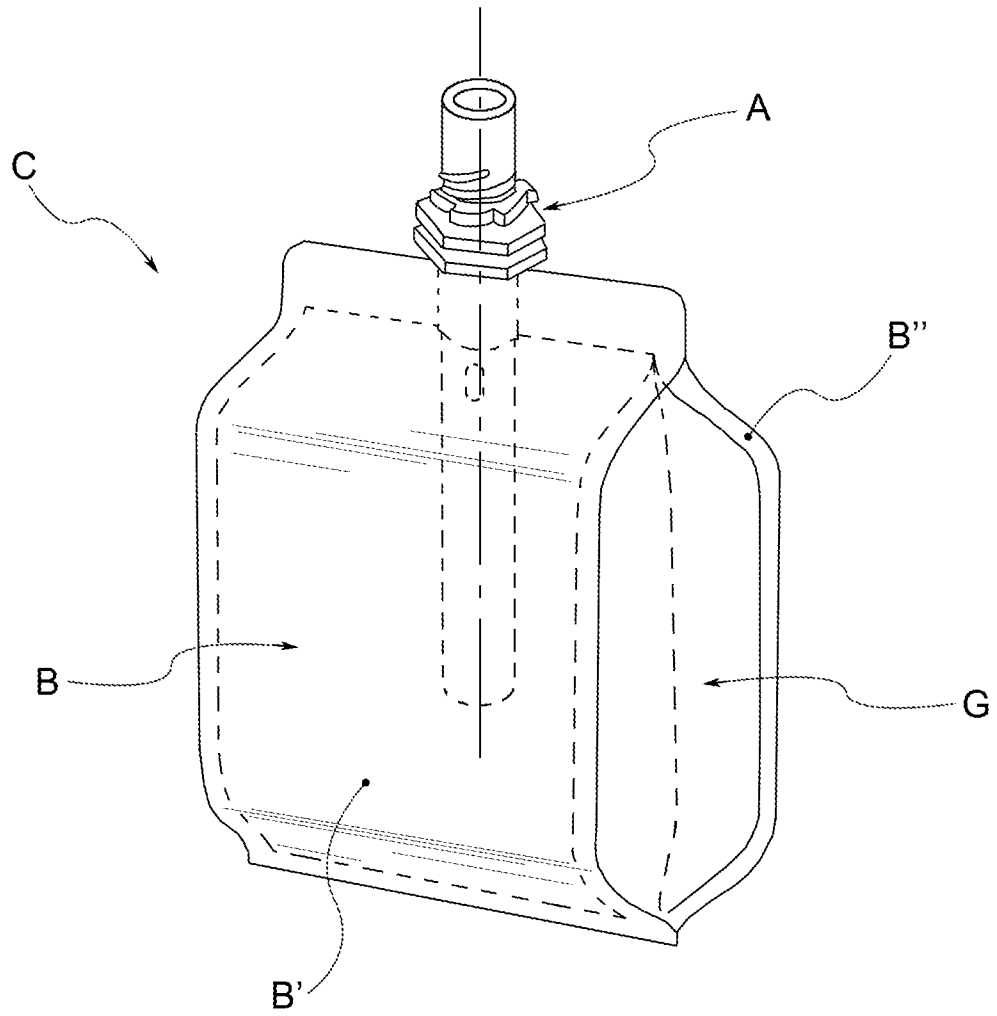


Fig. 1

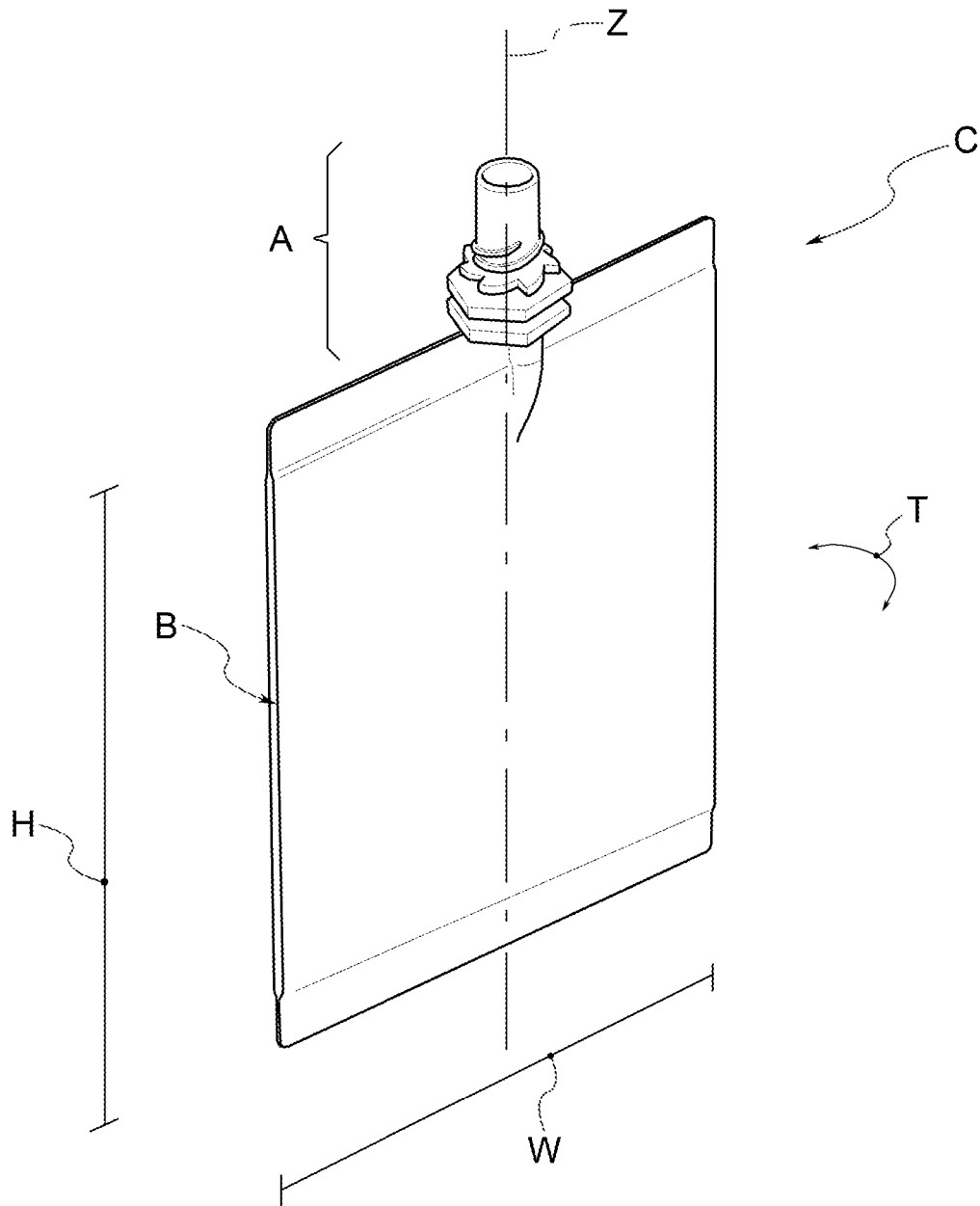


Fig. 2

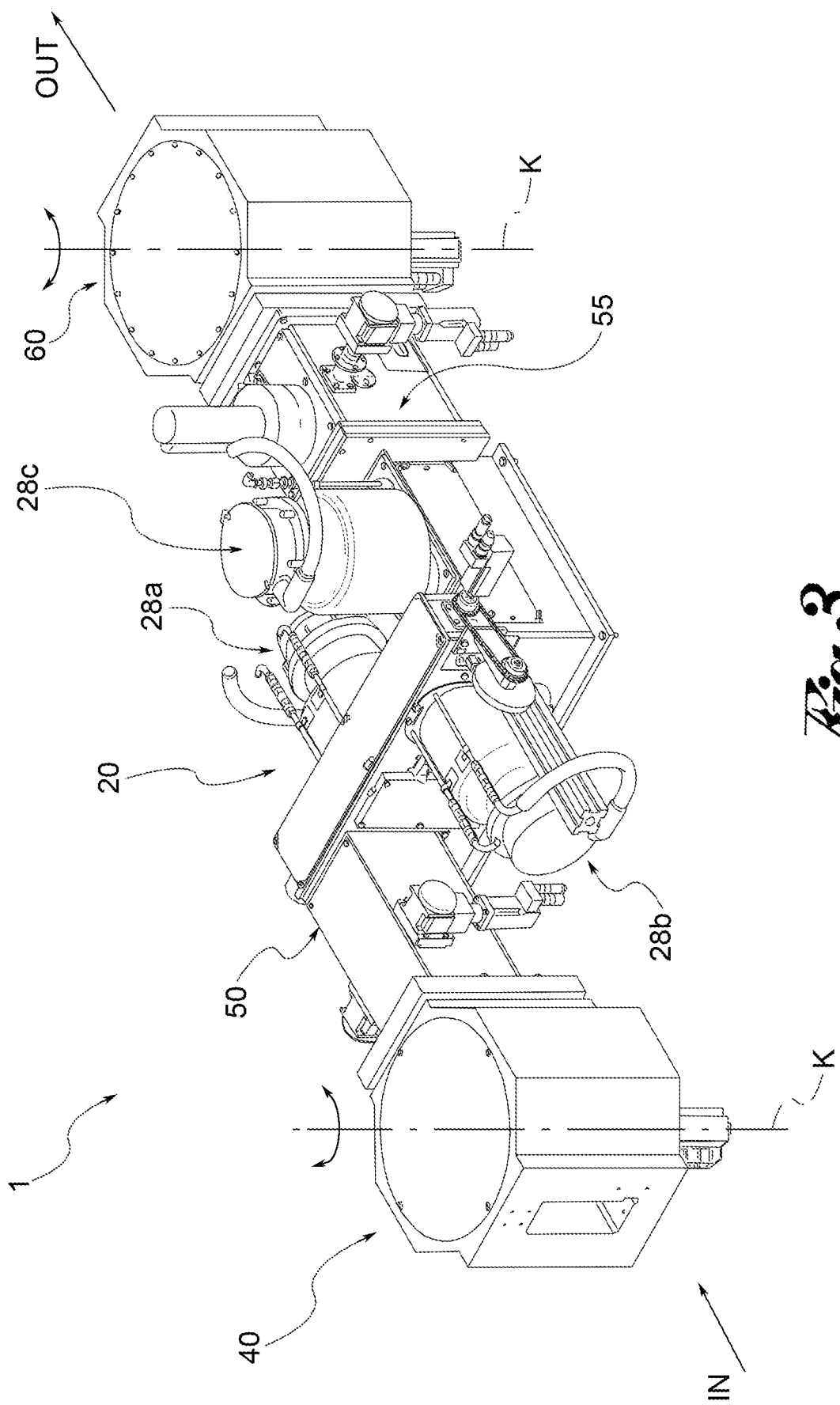


Fig. 3

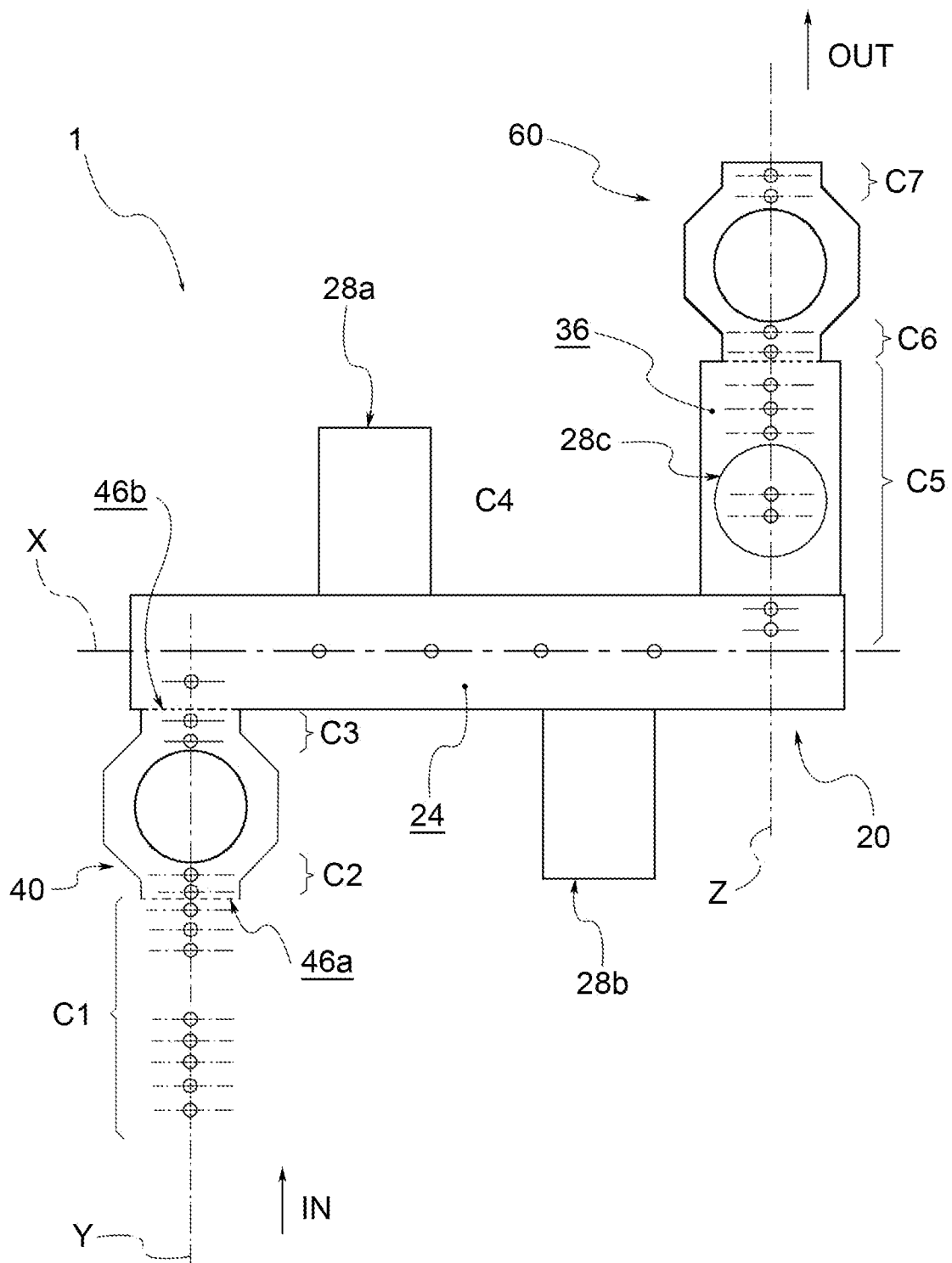


Fig. 4

Fig. 5

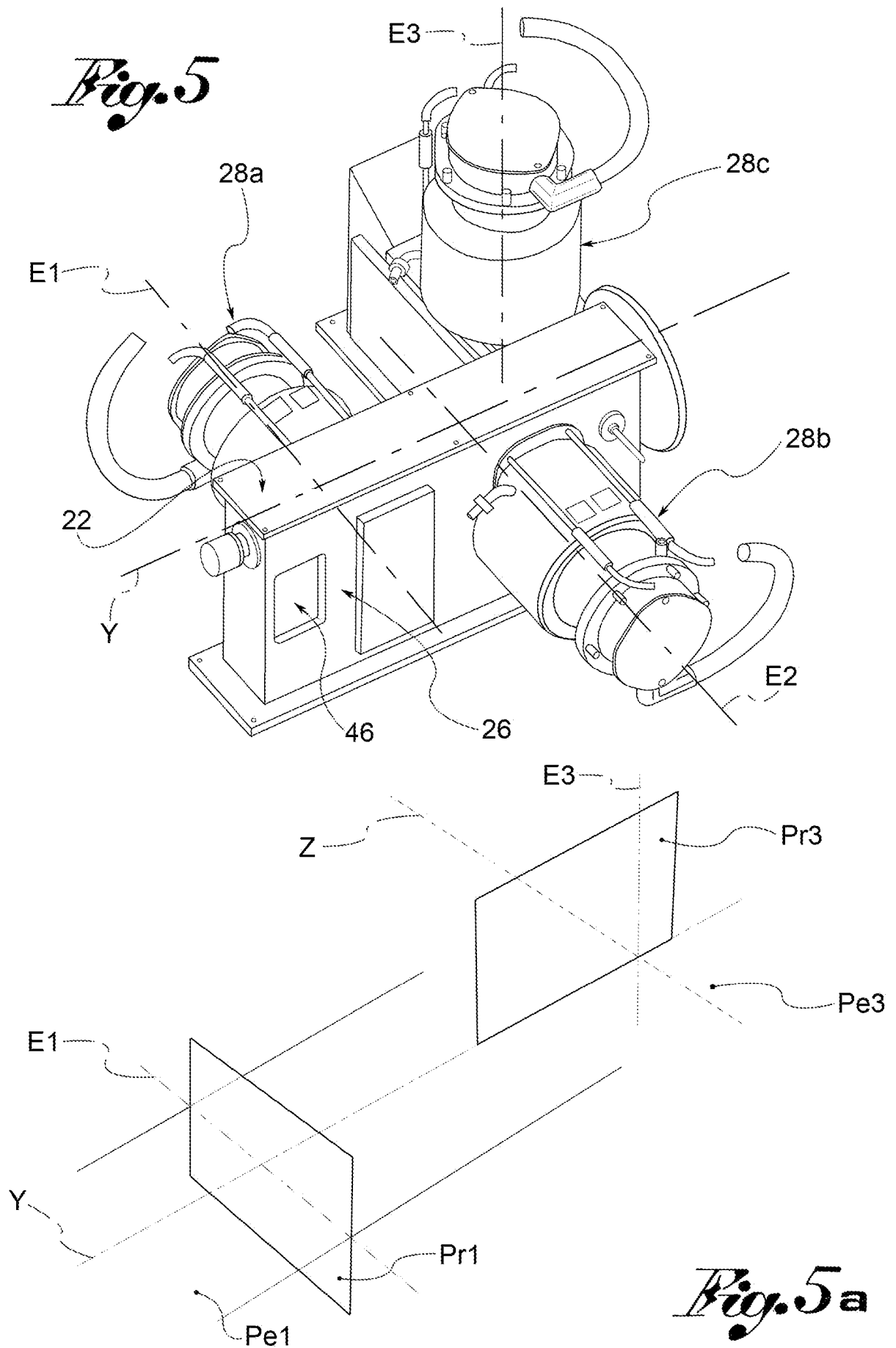
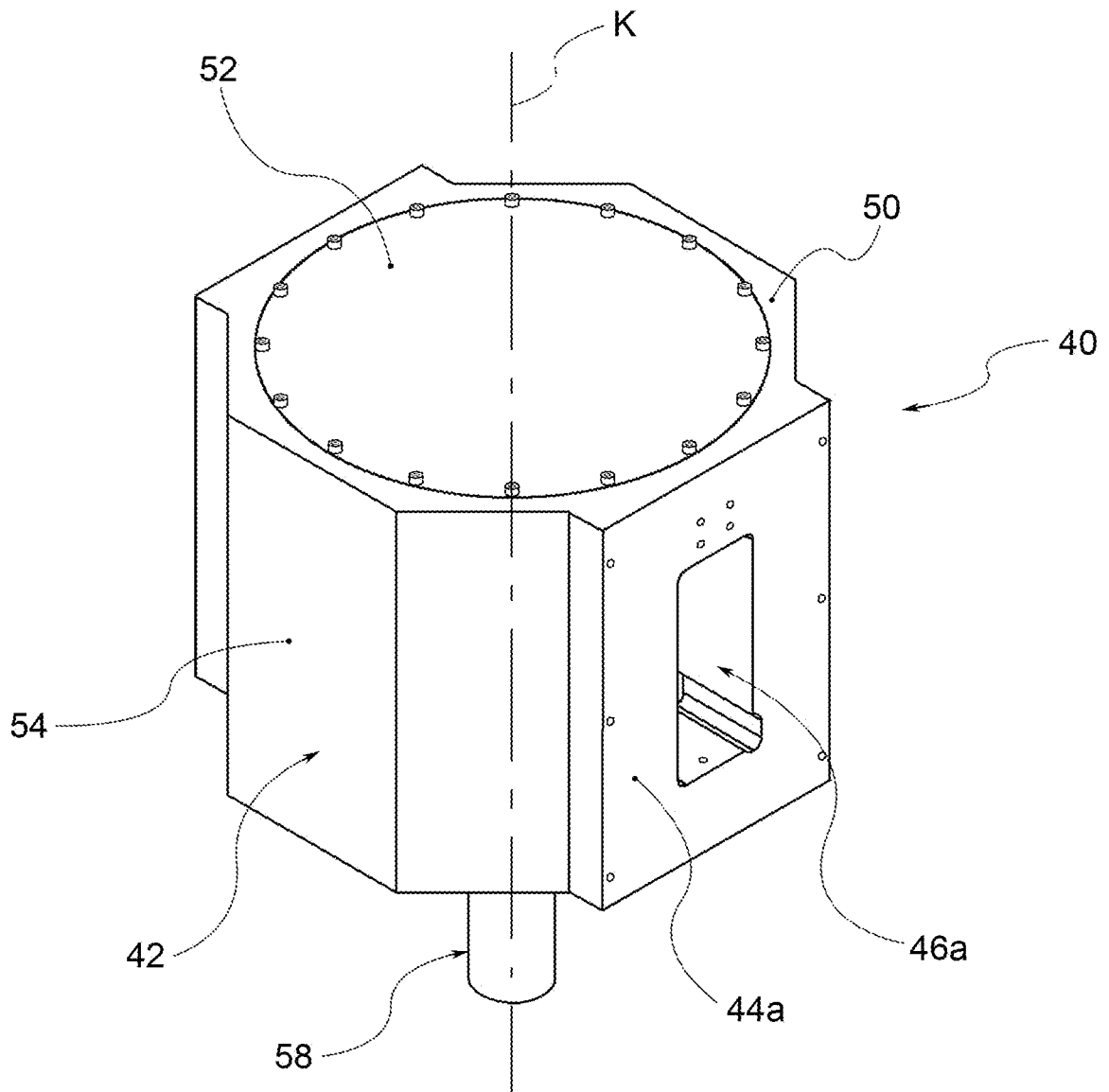


Fig. 5a

*Fig. 6*

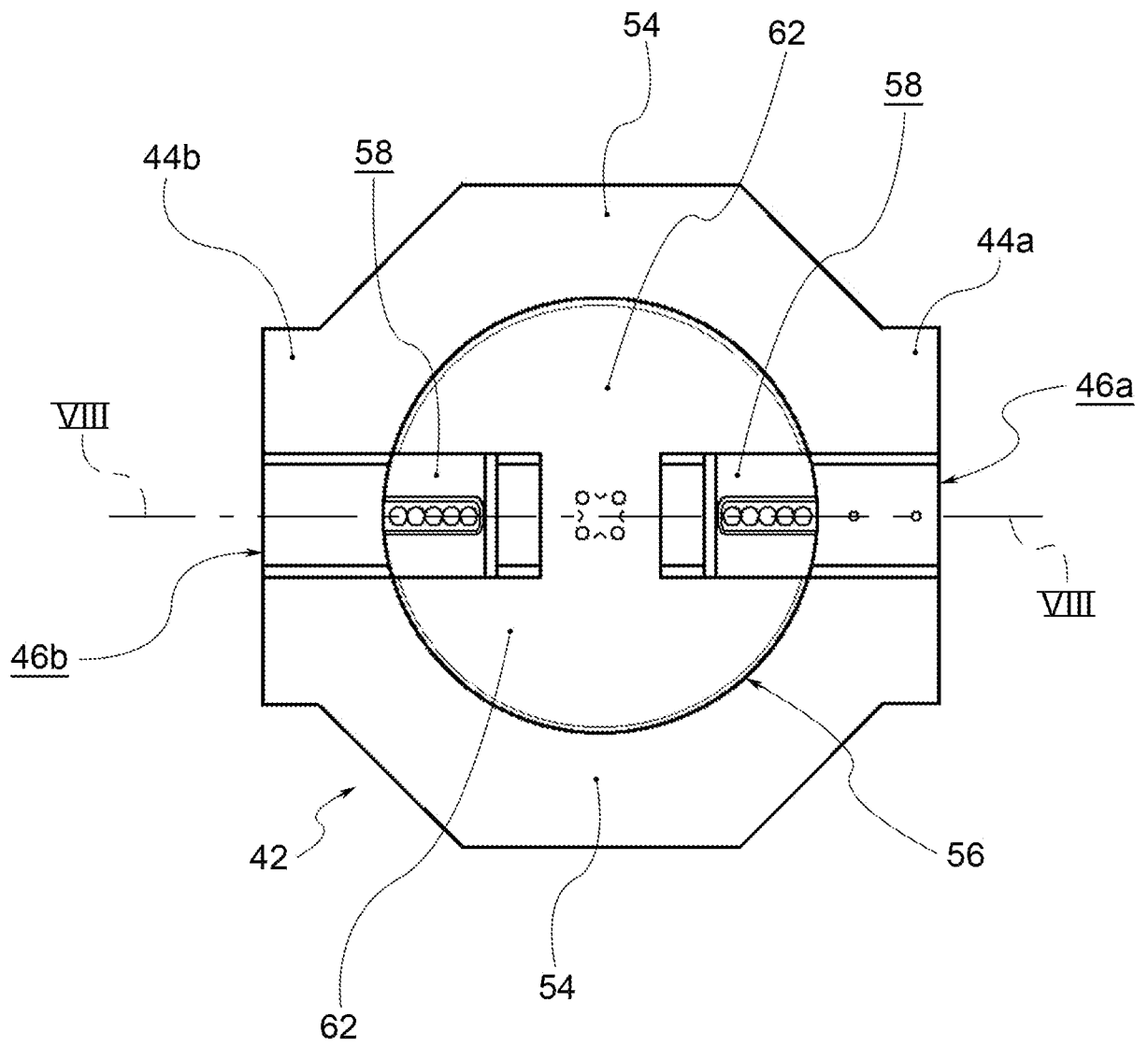
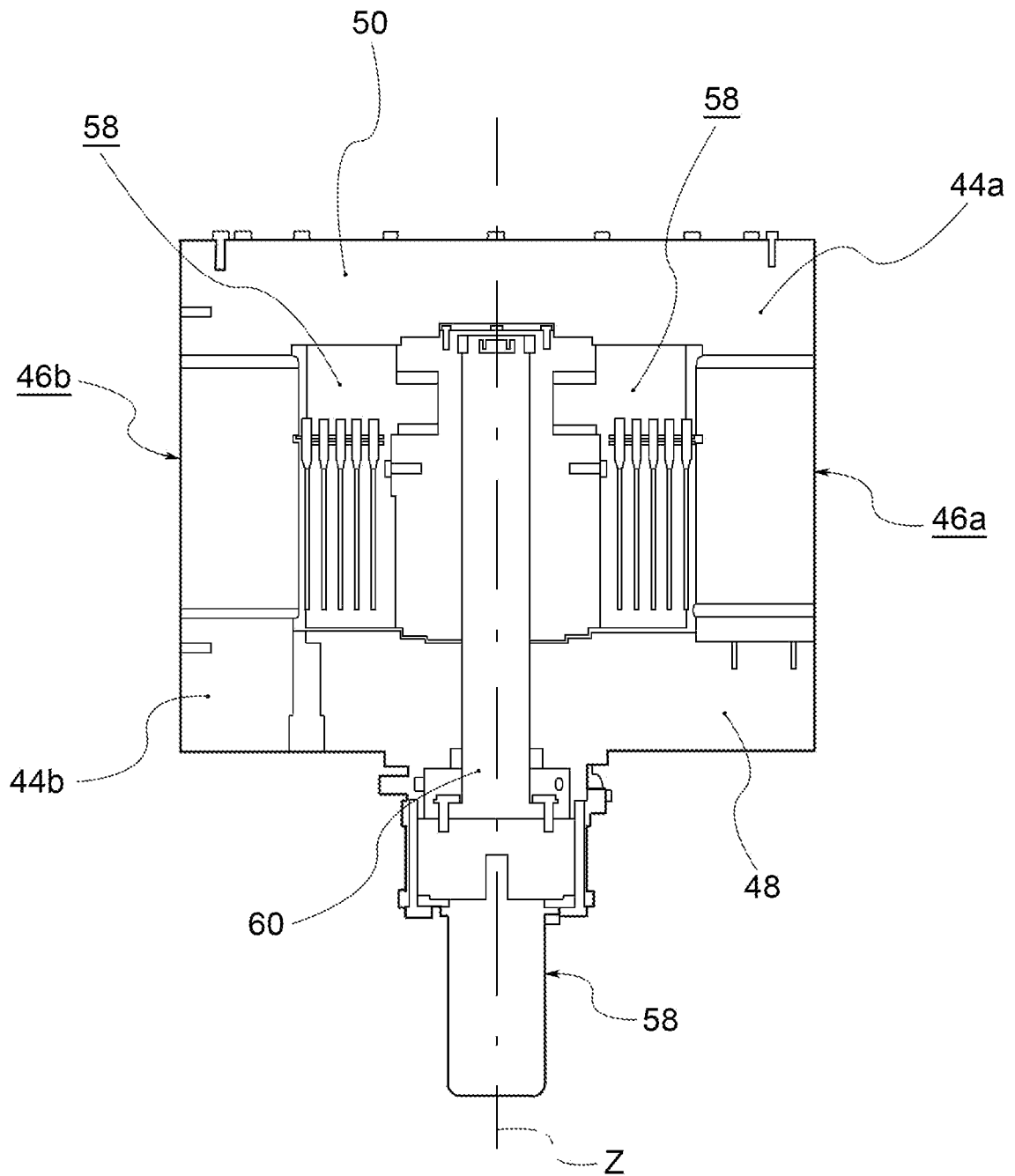


Fig. 7

*Fig. 8*

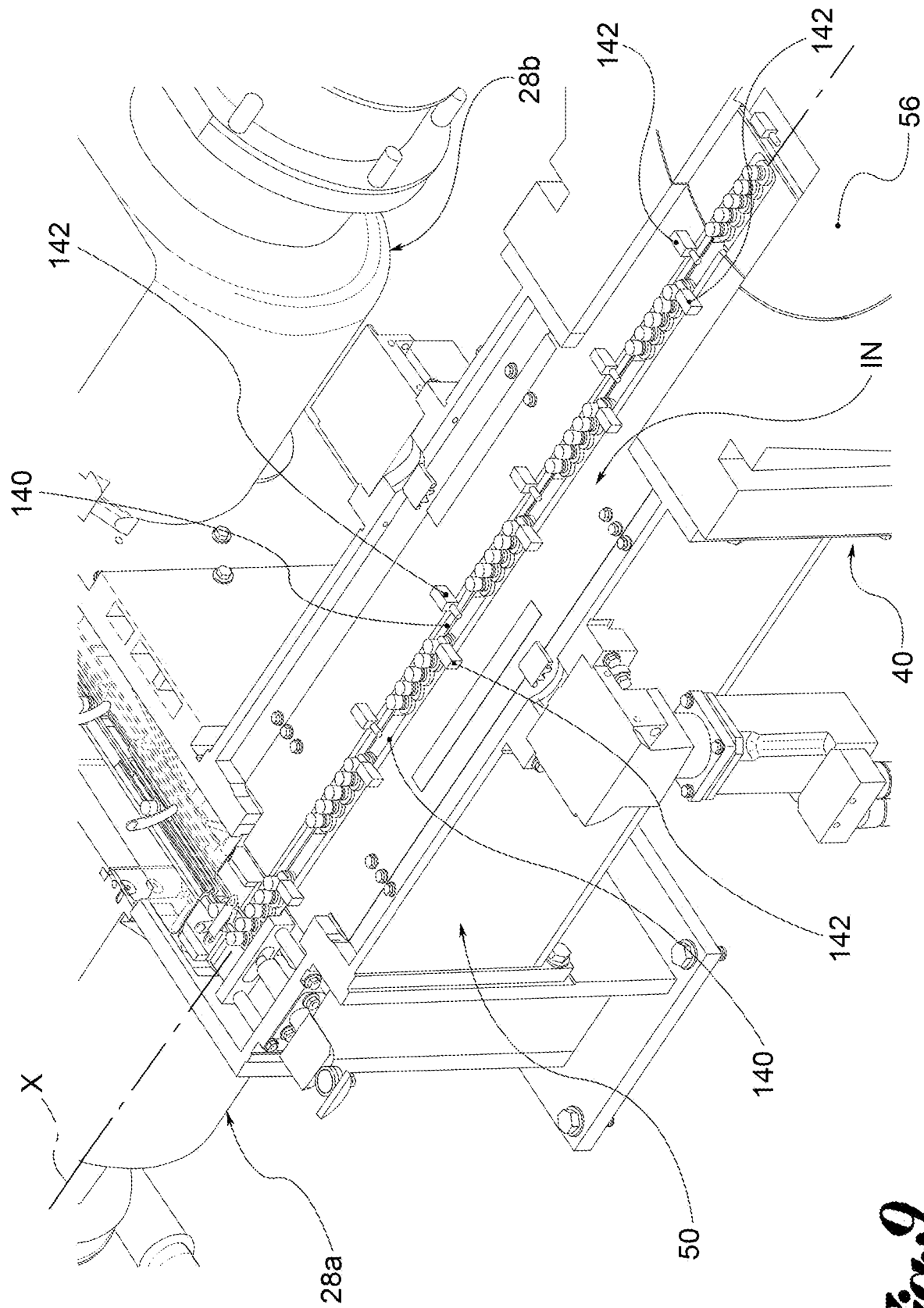


Fig. 9

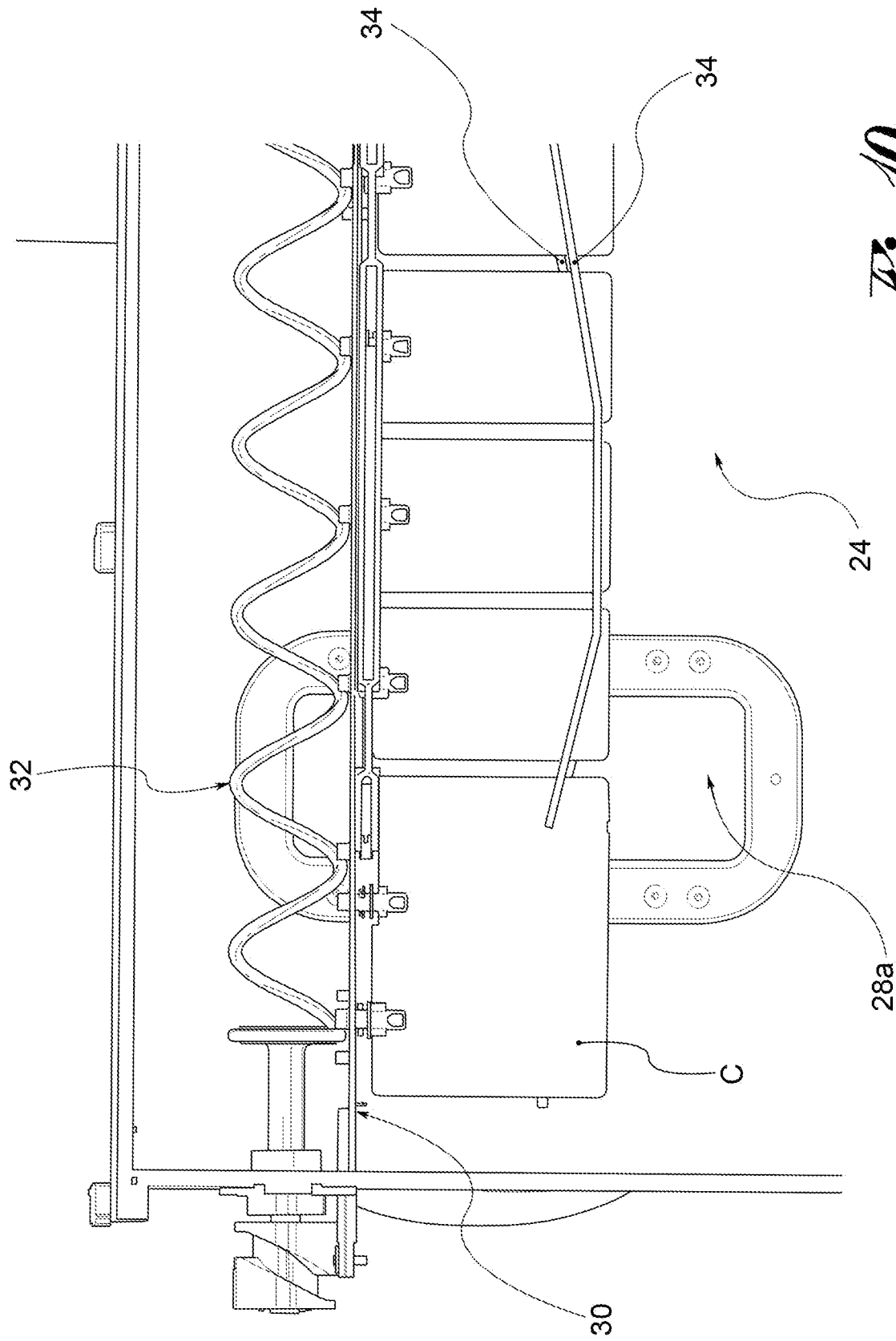
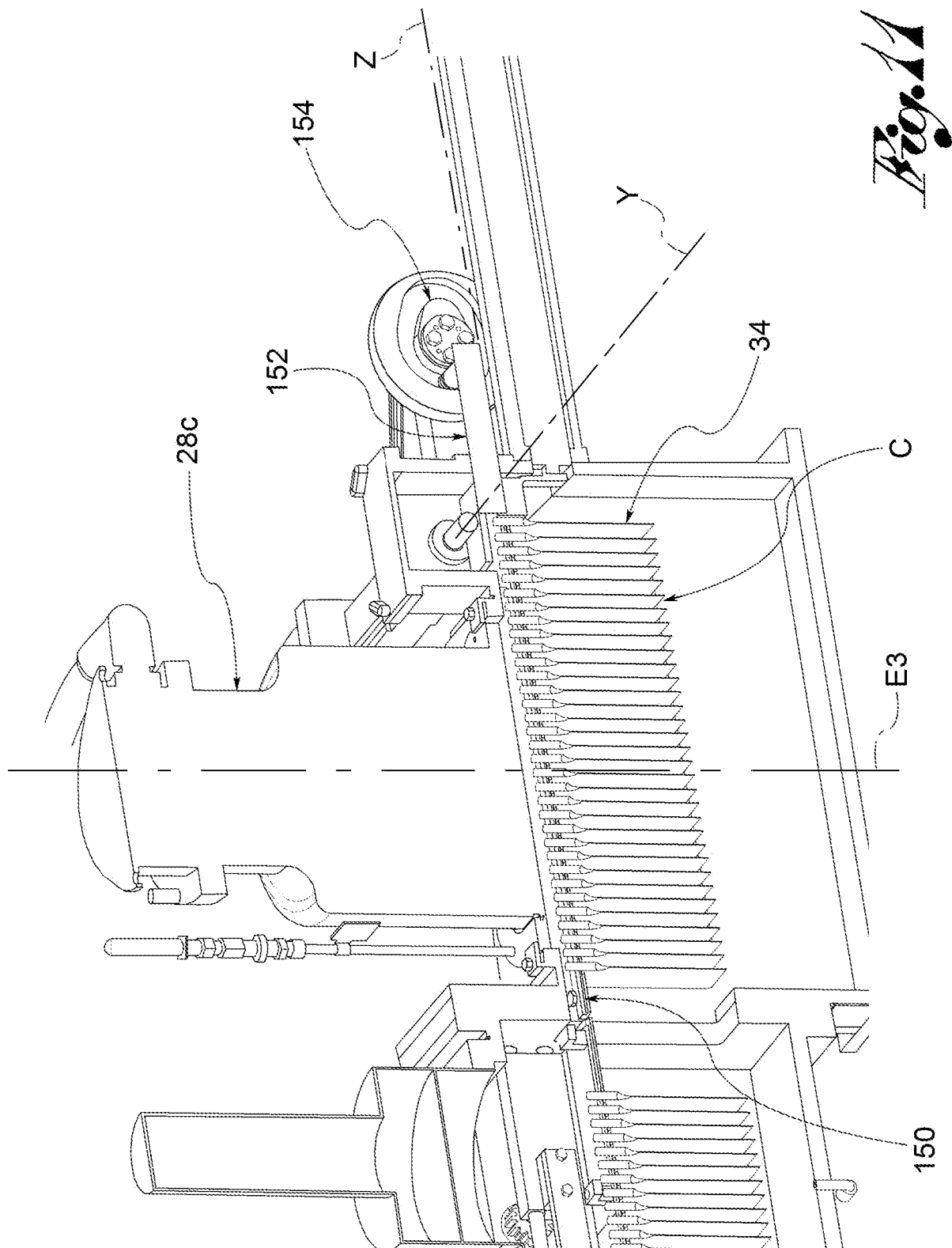


Fig. 10



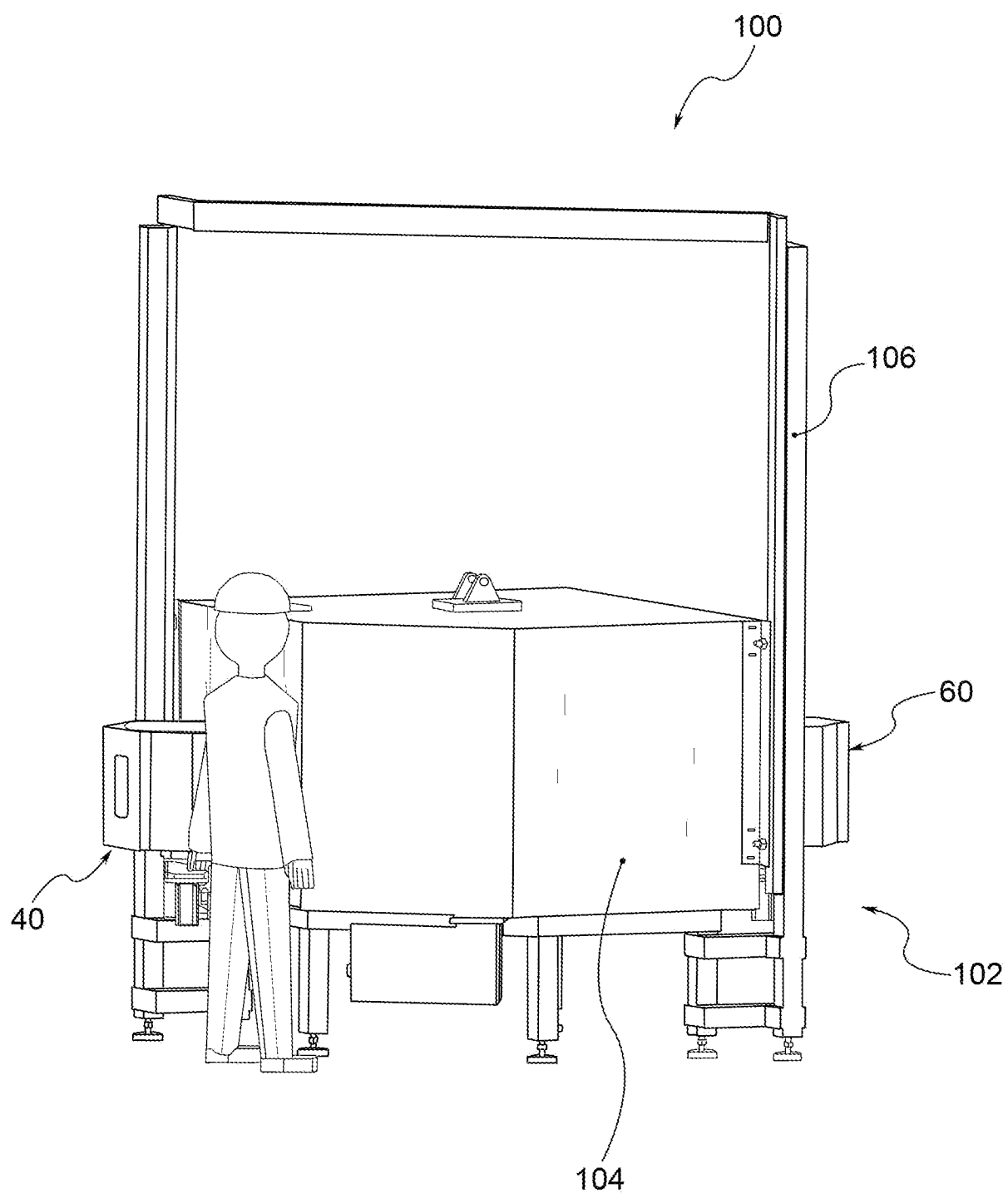
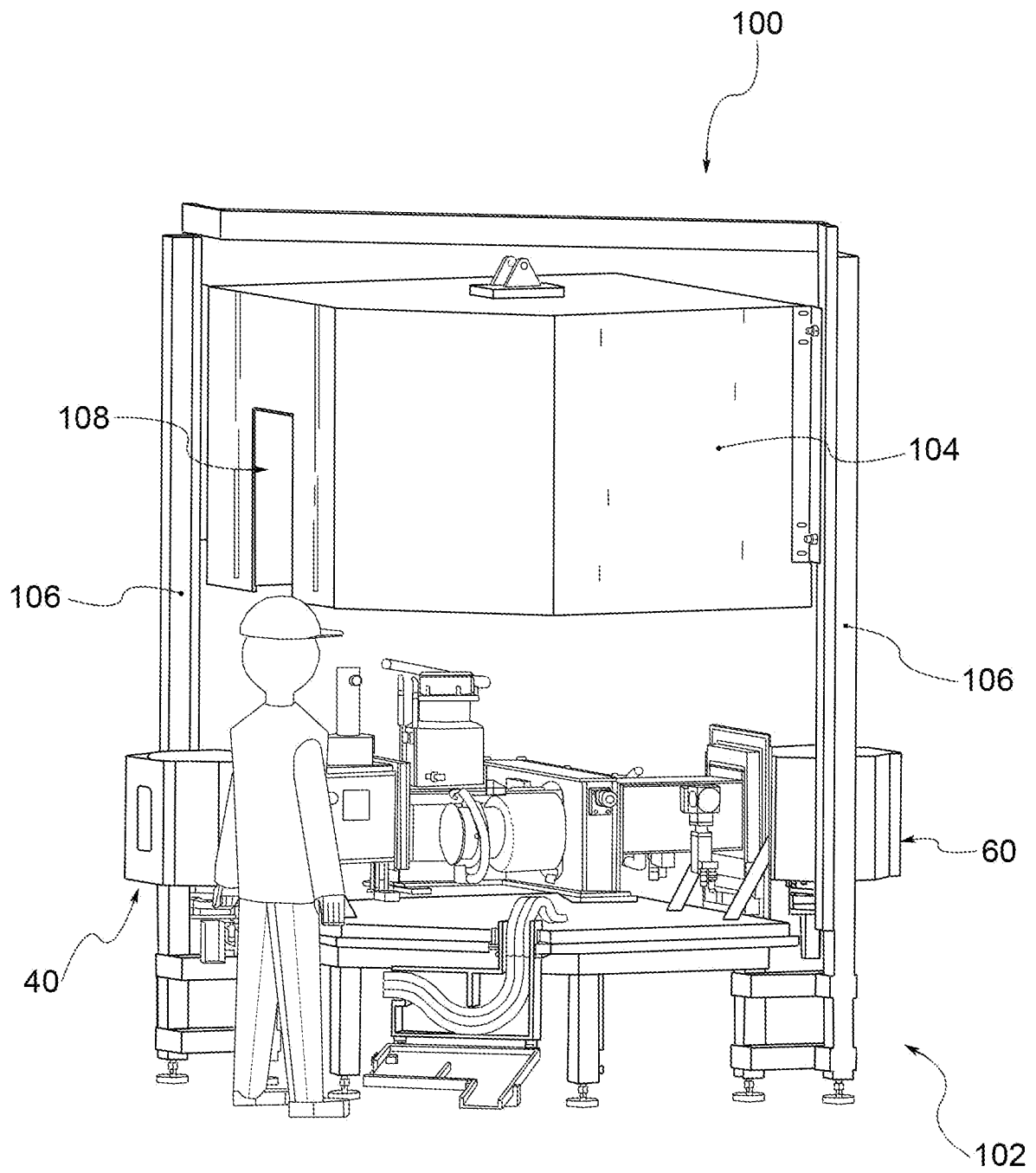


Fig. 12a

*Fig. 12b*

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/051903

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65B55/08
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65B

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

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

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2002 308229 A (ISHIKAWAJIMA HARIMA HEAVY IND) 23 October 2002 (2002-10-23) abstract	1-15
Y	US 2004/036039 A1 (MILLER ROBERT BRUCE [US]) 26 February 2004 (2004-02-26) paragraphs [0009], [0019]	1-15
Y	US 2007/145304 A1 (ROCHE MICHEL [FR] ET AL) 28 June 2007 (2007-06-28) figure 7	1-15

☐

Further documents are listed in the continuation of Box C.

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See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

25 June 2012

Date of mailing of the international search report

05/07/2012

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Authorized officer

Bjola, Bogdan

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/051903

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