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(54) **AN APPARATUS FOR THE POWDER COATING OF AN OBJECT AND RELATED OPERATIVE METHOD**

(57) The present invention concerns a device (1) for the powder coating of an object (100), and a related operative method for carrying out a color change. The apparatus (1) comprises:

- at least a first and a second container (10, 20) for painting powder;
- means (5) for the movement of said first and second container (10, 20) between an operative position (P1, P1', P1'') and a cleaning position (P2, P2', P2''), configured so that, when said first container (10) is in the operative position (P1, P1'), said second container (20) is in said cleaning position (P2, P2''), and so that when said

first container (10) is in the cleaning position (P2, P2'), said second container (20) is in the operative position (P1, P1'');

- means (4) for cleaning a container (10, 20), which are configured to empty and clean said first or said second container (10, 20), when said first or said second container (10, 20) is in the cleaning position (P2, P2', P2'');
- means (3) for withdrawing painting powder from said first or second container (10, 20), when said first or second container (10, 20) is in the operative position (P1, P1', P1''), and for feeding it to a device (3c) for delivering painting powder onto an object (100) to be painted.

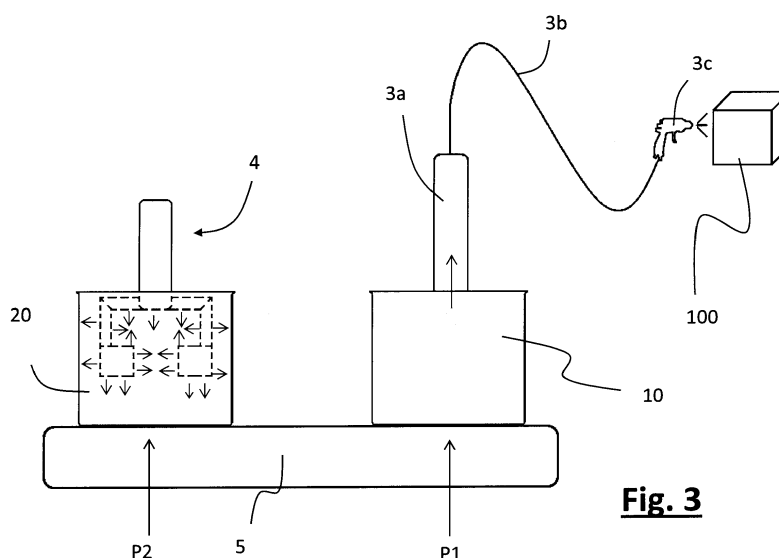


Fig. 3

Description

[0001] The present invention concerns the field of powder coating, and in particular a powder coating apparatus able to quickly carry out a color change.

[0002] As known, in a powder coating plant, painting powder is withdrawn from a source and placed inside a container, where it is sieved and then directed, typically by mixing it with compressed air, to a dedicated delivering device. This delivering device is generally shaped as a gun and adapted to spray painting powder against the objects to be painted. Due to electrostatic effect, the powder adheres to the objects. The objects are then heated in order to melt the painting powder, which then forms a colored layer adhering to the object itself.

[0003] The painting powder directed to the gun is of a single color. When different colors have to be applied on the same object, or when in a plant the object to be colored is changed, there is the need to change the source of the paint, i.e. to change the color of the paint, and all the elements that came into contact with the paint of the previous color have to be cleaned, so as to prevent residues of the previous color from mixing with the painting powder of the new color, thereby causing obviously unwanted effects.

[0004] These operations are known in the art as "color change" operations. During these operations, the plant is not working, i.e. no objects are colored. If the color change takes too much time, the plant productivity decreases.

[0005] Special care is required for the cleaning operations of the various elements, and in particular of the container receiving the powder from the source and directing it, typically after sieving, to the gun. It is therefore known to carry out these operations manually. Although a certain degree of precision in cleaning operations is guaranteed, the time required for a color change in such conditions is particularly high.

[0006] Automated systems for cleaning the container are also known, which, although reducing the time required for the color change, are not able to achieve completely satisfactory color-change times.

[0007] Purpose of this invention is therefore to provide an apparatus and a method for carrying out a color change in short time.

[0008] The present invention solves this and other purposes by means of an apparatus and a method according to the independent claims. Preferred aspects are set forth in the dependent claims.

[0009] According to an aspect of the invention, an apparatus for the powder coating of an object includes:

- at least a first and a second containers for painting powder;
- means for the movement of the first and second containers between an operative position and a cleaning position, which are configured so that, when the first container is in the operative position, the second con-

tainer is in the cleaning position, and so that when the first container is in the cleaning position, the second container is in the operative position;

- means for cleaning a container, which are configured to empty and clean the first or the second container, when the first or second container is in the cleaning position;
- means for withdrawing painting powder from the first or second container, when the first or second container is in the operative position, and for feeding it to a device for delivering painting powder onto an object to be painted;

[0010] The alternate movement of the containers between the two positions allows cleaning operations to be carried out on a container, while the other container is operated to feed powder against an object to be painted. Therefore, when carrying out a color change, it is possible to reverse the positions of the two containers, so that the previously used container can be cleaned, and the other previously cleaned container can be used to start the painting operations again. The next time color is changed, these operations are repeated. Therefore, thanks to this solution, a succession of color changes can be carried out in shorter time.

[0011] According to an aspect of this invention, the apparatus comprises means to refill the first or second container, which are preferably configured to refill the first or second container when the first or second container is in operative position.

[0012] According to an aspect of the present invention, the apparatus comprises at least two painting powder stocks, and the refilling means are selectively connectable to the stocks. This further reduces the time required for a color change.

[0013] According to a further aspect, the apparatus comprises movement means to move the painting powder stocks. In this way, the operations for refilling the containers, as well as the operations for cleaning them, can be automated and therefore the operations of a color change can be automated.

[0014] According to a further aspect, at least one of the containers includes:

- a sieving chamber to sieve painting powder to be sieved,
- a collecting chamber for the sieved painting powder,
- at least one sieve arranged next to at least one of the external surfaces of the sieving chamber, wherein the sieving chamber (12) is arranged at least partially, and preferably completely, within the collecting chamber, and comprises at least one opening for the inlet and/or outlet of powder.

[0015] According to a further aspect, the aforementioned sieving chamber has at least one cavity to allow at least part of the cleaning means to pass through the sieving chamber into the collecting chamber. In addition,

at least one portion of the cleaning means is configured so as to pass through at least one cavity during the cleaning of the container.

[0016] An aspect of the present invention further concerns a process for carrying out a color change by means of an apparatus according to one of the above described aspects, the process comprising the steps of:

- (a) arranging a first container, comprising painting powder of a first color, in operative position and a second container in cleaning position by the movement means;
- (b) withdrawing painting powder from the first container by the withdrawing means and feeding it to a device for delivering painting powder against an object to be painted;
- (c) emptying the second container, in case the second container contains painting powder, and inserting, at least partially, the cleaning means into the second container in order to clean the second container;
- (d) disengaging the withdrawing means from both the first container and the second container;
- (e) operating the movement means in order to bring the first container to the cleaning position and the second container to the operative position;
- (f) refilling the second container with painting powder of a second color;
- (g) withdrawing painting powder of the second color from the second container and feeding it to a device for delivering painting powder;
- (h) emptying the first container, in case the first container contains painting powder, and inserting, at least partially, the cleaning means into the first container in order to clean the first container;

wherein:

- at least part of step (c) occurs simultaneously with step (b)
- step (e) may be carried out before, or simultaneously with, or after step (f), preferably after step (f) so that the second container is refilled when it is in the operative position;
- at least part of step (h) occurs simultaneously with step (g).

[0017] According to a particular aspect, during step (f) movement means are operated to move a stock containing painting powder of the second color towards refilling means.

[0018] It should be noted that the operative position of the first container coincides with the operative position of the second container. Similarly, the cleaning position of the first container coincides with the cleaning position of the second container. In other words, the two containers are alternated between the same two positions.

[0019] However, the cleaning positions and/or the op-

erative positions can be different from each other. In other words, the first container can be cleaned in a position different from the position where the second container is cleaned, and/or powder can be withdrawn from the first container at a position different from the position in which powder can be withdrawn from the second container.

[0020] Hereinafter, referring to the appended figures, exemplary and non-limiting embodiments of the present invention will be described, wherein:

- figure 1 is a schematic view of a coating apparatus according to a possible embodiment;
- figures 2 - 8 are subsequent views of the color-change steps of an apparatus according to figure 1, and in which figures 5A and 5B are schematic plan views of the condition of figure 5;
- figures 9A, 9B are schematic views of a coating apparatus according to a first embodiment alternative to that of figures 1 - 8;
- figures 10A, 10B are schematic views of a coating apparatus according to a second embodiment alternative to that of figures 1 - 8;
- figure 11 is a schematic view of a coating apparatus according to a third embodiment alternative to that of figures 1 - 8;
- figures 12 - 14 are views of a possible container that can be used in a coating apparatus according to a possible embodiment;
- figure 15 is a view of the container of figures 12 - 14, inside which there are possible cleaning means that can be used in a coating apparatus according to a possible embodiment;
- figure 16 is a perspective view of the cleaning means of figure 15.

[0021] A powder coating apparatus 1 comprises at least a first container 10 and a second container 20 for the painting powder.

[0022] The containers 10, 20 can be connected in a known way to paint sources or stocks 2, so as to allow them to be filled with painting powder. As mentioned above, the containers 10, 20 are adapted to receive painting powder from sources or stocks 2 and to be connected to dedicated means 3 (better described below) for withdrawing the painting powder and sending it to a device 3c for delivering painting powder on an object to be painted.

[0023] Various types of containers 10, 20, known in the art, can be used according to the present invention. Preferably, the containers 10, 20 have the same shape (i.e. they are substantially identical), and in particular the shape described below. For the sake of simplicity, an embodiment of the containers, with particular reference to the first container 10, is now described in detail. However, the following description applies to the second container 20 too.

[0024] A container 10 for sieving painting powder comprises a sieving chamber 12 and a collecting chamber 13.

[0025] The container 10 is typically shaped like a bowl, which usually has cylindrical shape. Generally, the container 10 is open at a base.

[0026] Typically, the collecting chamber 13 is at least partially defined by the side walls of the container 11. In the embodiment shown, the collecting chamber 13 has a bottom 13a inserted inside the container 10, which defines the lower surface of the collecting chamber 13, while the side surfaces (or the side surface in this case) of the collecting chamber are defined, as mentioned, by the side walls (or the side wall in this case) of the container 10. Preferably the bottom 13a is obtained by means of a porous septum, which allows the passage of air, but prevents the passage of the powder. An air inlet 13b can be arranged below the bottom of the collecting chamber, so that air passes through the porous septum in order to fluidize the sieved powder contained inside the collecting chamber 13.

[0027] However, the possibility of having a collecting chamber 13 entirely contained within the container 10 is not excluded. As mentioned above, the collecting chamber 13 is typically open on top, so that the means 3 can withdraw the sieved powder from the container 10.

[0028] The sieving chamber 12 may have different shapes. The sieving chamber preferably defines a substantially enclosed room (with the exception of the inlet/outlet or the inlets/outlets for the painting powder) separated from the collecting chamber 13.

[0029] Typically, the sieving chamber 12 further has at least one external surface 12b, 12c, 12d adapted to define a space or room in which the powder to be sieved can be inserted and in which impurities or anyway elements that did not pass through the sieve 14 (better described below) can be retained. As discussed above, this space or room defined by the sieving chamber 12 is preferably substantially closed (with the exception of the inlet/outlet means of the painting powder), i.e. separated from the room defined by the collecting chamber, so as to prevent the powder to be sieved and contained in the sieving chamber 12 from entering the collecting chamber 13 without passing through the sieve 14.

[0030] In this regard, a less preferable solution is possible in which the sieving chamber is partially open, provided that contact between the powder to be sieved and the powder already sieved can be prevented. For example, the shape of the sieving chamber 12 may be similar to that of the collecting chamber, i.e. cylindrical with the upper base open.

[0031] The sieving chamber preferably has at least one base surface 12b, 12c and at least one side surface 12d. In the embodiment shown, in particular, the sieving chamber 12 has cylindrical shape, whereby it is provided with two base surfaces 12b, 12c and one side surface 2d.

[0032] The sieving chamber 12 is further provided with at least one sieve 14 placed next to at least part of an external surface 12b, 12c, 12d.

[0033] Preferably, the sieve 14 is arranged on at least 50%, more preferably at least 75%, of the external sur-

faces of the sieving chamber. Preferably, the sieve 14 should cover a percentage as large as possible of the external surfaces of the sieving chamber 2. In the embodiment shown, according to a preferred solution, the sieve 14 covers substantially entirely the external surfaces (or the external surface) 2b, 2c, 2d. In particular, it should be noted that the sieve 14 is explicitly shown only in figure 13, and only on half the sieving chamber 12, in order to allow the other half of the chamber itself to be more simply shown. However it is understood that, in the embodiment shown, the sieve 14 is substantially arranged outside the whole sieving chamber 12.

[0034] Preferably, the sieving chamber is formed by a frame 12f on which the sieve 14 is mounted; therefore at least part of the external surfaces 12b, 12c, 12d can consist exclusively of the sieve 14.

[0035] The sieve 14 typically comprises a wire mesh whose "aperture", i.e. an average distance between successive mesh wires, is preferably less than or equal to 400 microns.

[0036] The sieve is typically constrained to the sieving chamber by an anti-vibration support.

[0037] The sieving chamber 12 has at least one opening 12a to allow powder inlet/outlet. In particular, in the embodiment shown, the sieving chamber has an opening 12a which, in normal conditions of use, is used to allow the inlet of powder to be sieved into the chamber. During the cleaning operations of the container, on the other hand, the opening 12a is used to suction the residues held inside the sieving chamber 12 at the end of the sieving operations (e.g. too large powder particles, impurities, etc.).

[0038] However, different openings can be used, for example openings exclusively dedicated to the inlet of powder, and openings exclusively dedicated to outlet of powder and/or impurities.

[0039] According to a particular aspect, the sieving chamber 12 has one or more cavities 11 (two cavities 11 in the particular embodiment shown) to allow cleaning means 4 (better described below) to pass in the container 10, and in particular in the collecting chamber 13.

[0040] The sieving chamber 12 is at least partially, and preferably entirely, arranged inside the collecting chamber 13. Therefore, preferably the sieving chamber 12 is inside the collecting chamber 13 and separate therefrom. As mentioned above, the sieving chamber 12 and the collecting chamber preferably have similar shape. Therefore, according to an aspect the side surface 12d (or the side surfaces in case of polyhedral shape) of the sieving chamber 12 faces the side (inner) surface of the collecting chamber 13.

[0041] In this way, the container remains compact, and the powder sieved by the sieve 14 can be more easily retained inside the collecting chamber 13.

[0042] The container 10 typically has a support 15 on which the sieving chamber 12 is mounted. The support 15 may have different shapes adapted to bear the collecting chamber 12. In the shown embodiment the sup-

port 15 has truncated-cylinder shape. Screws 16, or similar threaded elements, can be used to constrain the sieving chamber 12 to the respective support 15.

[0043] According to a possible embodiment, as shown in the figures, the container 10 has means 17 to vibrate the sieving chamber 12, or at least the sieve 14. These means 17 may be general means known in the art and suitable for this purpose.

[0044] In particular, in the embodiment shown, there are vibrating elements 17a, 17b. These vibrating elements 17a, 17b are preferably arranged in combination with anti-vibration supports 17c, which allow the vibration to be transferred to the sieve 14, thus dampening the vibration transmitted to the container 10. Different number, arrangement and types of vibrating elements can be used with respect to what has been shown (for example a single vibrating element placed in direct or indirect communication with the sieve 14).

[0045] Referring to the figures, the element 17a is an ultrasound vibrating element, whereas the element 17b is a pneumatic vibrating element. An air inlet 18 is preferably placed on the container 10 in order to supply air to the pneumatic vibrating element 17b for the optimal operation thereof.

[0046] As specified above, although the solution described above is preferred for the containers 10, 20, there is the possibility of using different types of containers that are able to receive (and preferably sieve) the painting powder from a stock 2, and to deliver it to the withdrawing means 3 that withdraw the paint itself.

[0047] The apparatus 1 is further provided with means 5 to move the containers 10, 20 between an operative position P1 and a cleaning position P2. Various movement means 5 to move the containers 10, 20 can be used. Typically, the containers 10, 20 are placed on a movable support 5a, which is moved by a motor M (schematically shown only in figure 1). The movable support 5a can be for example a rotating platform (as shown for example in the embodiment of figures 1 - 8), or an element movable along a path (as shown for example in the embodiments of figures 9A - 11).

[0048] In general, the movement means 5 allow the containers 10, 20 to be moved so that, when the first container 10 is in the operative position P1, the second container is in the cleaning position P2, and so that when the first container 10 is in the cleaning position P2, the second container is in the operative position P1.

[0049] The "operative position P1" is the position in which the container 10, 20 can be used to withdraw painting powder therefrom and send it to a dedicated delivering device 3c to allow the painting of an object 100.

[0050] The "cleaning position P2" is the position in which cleaning operations can be carried out on the container 10, 20.

[0051] Preferably, as shown in figures 1 - 8, there is a single operative position P1 and a single cleaning position P2. In other words, the two containers 10, 20 are preferably alternated between the two positions P1, P2.

A single operative position P1 is then configured so as to allow painting powder to be alternately withdrawn from the first container 10 and the second container 20. Similarly, a single cleaning position P2 can be configured so as to alternately clean the first container 10 and the second container 20.

[0052] In this embodiment the same cleaning means 4 are alternately inserted into the first container 10 and the second container 20. Similarly, the same withdrawing means 3 are alternately inserted into the first container 10 and the second container 20.

[0053] In possible variations, the operative position P1' of the first container 10 differs from the operative position P1" of the second container and/or the cleaning position P2' of the first container 10 differs from the cleaning position P2" of the second container 20. In this case, different cleaning means 4 and/or different withdrawing means 3 must be provided. This increases the costs of the apparatus 1 but also saves further time in color change operations, as better discussed below.

[0054] Possible embodiments according to this configuration are schematically shown in figures 9A - 11.

[0055] In figures 9A, 9B, the containers 10, 20 share the same operative position P1, i.e. they are alternately arranged in the same operative position, while the cleaning positions P2', P2" are different from each other, i.e. the cleaning position P2' of the first container is different from the cleaning position P2" of the second container 20. In this embodiment, the same withdrawing means 3 are alternately coupled to the first container 10 and the second container 20. First cleaning means 4' can be coupled only to the first container 10, whereas second cleaning means 4" can be coupled only to the second container.

[0056] In the alternative solution of figures 10A, 10B, both operative positions P1 and cleaning positions P2 are different for the two containers 10, 20. In this embodiment, first cleaning means 4' can be coupled only to the first container 10, whereas second cleaning means 4" can be coupled only to the second container. Similarly, first withdrawing means 3' can be coupled only to the first container 10, whereas second withdrawing means 3" can be coupled only to the second container. In other words, the operative position P1' of the first container differs from the operative position P1" of the second container 20, and the cleaning position P2' of the second container differs from the cleaning position P2" of the second container 20.

[0057] By properly arranging the various elements of the apparatus 1, first withdrawing means 3' couplable only to the first container 10, and second withdrawing means 3" couplable only to the second container can be provided, but single cleaning means 4 are (alternately) couplable to either the first container 10 and the second container 20. In other words, the operative position P1' of the first container differs from the operative position P1" of the second container, whereas the cleaning position P2 of the first container 10 coincides with the cleaning

position P2 of the second container 20. A possible embodiment providing this solution is schematically shown in figure 11.

[0058] In general, according to the present invention, when the first container 10 is in the operative position P1, P1', the second container is in the cleaning position P2, P2", and vice versa, so that while a container is used to paint an object 100, the other container is cleaned.

[0059] The withdrawing means 3 can be of various types known in the art. Typically, the withdrawing means comprise a suctioning element 3a that can be inserted into the container 10, 20. A hose 3b, or similar element, is connected to a delivering device 3c (typically in the form of a user-operated gun) to deliver painting powder on an object to be painted 100. Proper devices known in the art and not shown in detail (typically comprising an air compressor) are used to allow the suction of the painting powder through the withdrawing means 3.

[0060] Various types of cleaning means 4, known in the art, can be used with the present invention. Typically, these cleaning means comprise both suctioning elements, to allow the suction of the painting powder that may remain in the container 10, 20, and elements adapted to deliver a cleaning fluid at least against the walls of the container 10, 20 (and preferably also of the sieve 14 that may be held in the container 10, 20). According to a possible aspect the cleaning fluid is air, so the same device can be used alternatively either to suction the residual powder and to feed air to the container 10, 20 in order to clean it.

[0061] According to a possible embodiment the cleaning means 4 preferably comprise at least one movable arm 4a. According to a possible embodiment, the movable arm 4a comprises a typically elongated body 41a and a head 42a laterally protruding with respect to the body 41a. Furthermore, the movable arm has a plurality of nozzles 4b adapted to eject a fluid to clean the container. Typically such fluid is air. In this case, the cleaning device 4 comprises or is connectable to an air source (known in the art and not shown in the figures), e.g. a compressor.

[0062] Preferably, the nozzles 4b are arranged so that the fluid is ejected in several directions. More specifically, each nozzle typically has a main direction of fluid ejection. This direction may be different for different nozzles. In this way, for example, different elements of the container or even different surfaces of the same container can be effectively cleaned.

[0063] Generally, the movable arm 4a is hollow inside in order to facilitate the passage of the air or fluid used for cleaning the container 10.

[0064] The arm 4a can be moved in various directions according to the needs. In an embodiment shown in the figures, the movable arm 4a is rotatable. In particular, the cleaning means 4 have a longitudinal A axis typically coinciding, in use, with the longitudinal axis of the container 10, and the movable arm 4a can be rotated around this axis A. According to a possible solution, the movable

arm 4a has a L-shaped body 41a having a first portion substantially orthogonal to the axis A and a second portion substantially parallel to the axis A.

[0065] Appropriate motorized means can be provided to move the movable arm 4a. Preferably, however, as in the embodiment shown, the arrangement of the nozzles 4b is such that, when the cleaning fluid is ejected therefrom, the movable arm is naturally rotated.

[0066] In other words, due to fluid ejection from the nozzles 4b, a torque is applied on the movable arm 4a, which is then rotated.

[0067] An actuator 43, e.g. an electric or pneumatic one, may also be provided in order to arrange the arm 4a (or arms 4a) in a position such as to allow the device 4 to be removed from the container 10, e.g. a position in which the arm 4a is placed at the cavities 2e.

[0068] More than one movable arm 4a can be provided on the cleaning means 4. In the shown embodiment there are two moving arms 4a that are both rotatable, preferably in synchronous way.

[0069] The cleaning means 4 preferably also have a suctioning element 4c that can be inserted into the sieving chamber 12, typically through the opening 2a. Generally, as in the embodiment shown, this suctioning element 4c is in the form of a tubing connected in a known way to a suctioning element known in the art, which can alternatively be part of the means 4, or an external element specifically connected thereto.

[0070] The configuration of the cleaning device 4 and container 10 preferably allows the former to be inserted into the latter. As already mentioned, for example, the sieving chamber 12 preferably has cavities 11 to allow the cleaning device 4 to be inserted into the container 10. Referring to the embodiment shown, the cavities 11 are complementarily shaped with respect to the heads 42a of the movable arms 4a, so as to allow the heads to pass through the sieving chamber 12, i.e. to go past the sieving chamber when the cleaning device 4 is moved to be inserted into the container 10.

[0071] Additional devices, not shown in detail, can be used to suction the contents of the collecting chamber 12 or, before ejecting a cleaning fluid, air can be suctioned by the nozzles 4b, so as to remove the painting powder left in the container 10, 20.

[0072] Preferably, the apparatus 1 comprises at least two stocks 2a, 2b that can be used to refill the containers 10, 20 after they have been cleaned. Appropriate refilling means are provided in the apparatus 1 for this purpose. These means, known in the art, are adapted to transfer painting powder from a stock to a container 10, 20. Typically, these withdrawing means 3 comprise a source of compressed air (not shown in detail) adapted to allow the powder to be suctioned from the stock 2a, 2b and delivered to the container 10, 20.

[0073] According to a possible aspect, the stock 2a, 2b with the appropriate color, i.e. the painting powder with the color chosen for filling the container 10, 20, can be manually arranged in the apparatus 1 at the withdraw-

ing means 3, so as to allow them to transfer the powder from the stock 2a, 2b to the container 10, 20. According to a preferred embodiment, the apparatus 1 is provided with movement means 7 adapted to automatically arrange the stock 2a, 2b containing the powder of the desired color near the withdrawing means 3. These additional movement means 7 are also known in the art and may include, for example, a rotating and/or translating platform.

[0074] The apparatus 1 is further provided with a control unit known in the art and not shown in detail, the latter being adapted to control the operations at least of the cleaning means 4, the withdrawing means 3 and the movement means 5. The coupling between the containers 10, 20 and the various devices of the apparatus (cleaning means 4, withdrawing means 3, etc.) typically occurs by relative movement between the two elements. This movement can be provided by the movement means 5 (typically by means of a vertical movement thereof) and/or by means of a movement of the devices themselves, i.e. the cleaning means and/or the withdrawing means 3, etc. In this case, one or more motors (not shown in the figures) to move the cleaning means 4 and/or the withdrawing means 3 and/or the refilling means 6, etc., are provided. These motors are in turn connected to the control unit, so that the latter can control their activation.

[0075] The steps of a color change are now discussed in detail, with particular reference to figures 1 - 8. As evident to the field technician, the following description also applies to the embodiments of figures 9A - 11.

[0076] Initially, the movement means 5 are operated so that the first container 10 comprising painting powder of a first color is arranged in the operative position P1 and the second container 20 is arranged in the cleaning position P2. This condition is depicted, in particular, in Figure 1.

[0077] Then, the cleaning means 4 are coupled to the second container 20 and the withdrawing means 3 are coupled to the first container 10. The second container 20 is cleaned by the means 4, which direct a fluid, typically compressed air, against the walls of the container itself. At the same time, painting powder is withdrawn from the first container by the withdrawing means 3 and fed through the gun or similar device against object 100 to be painted. This condition is depicted in figures 2 and 3. In particular, figure 2 shows the step of emptying the second container 20, while figure 3 shows the step of directing a cleaning fluid against the walls of the second container 20.

[0078] At the end of the cleaning and painting operations, the withdrawing means 3 are disengaged from the first container 10 and the cleaning means are disengaged from the second container 20. This condition is depicted in figure 4.

[0079] The movement means 5 are then operated in order to bring the first container to the cleaning position P2 and the second container 20 to the operative position P1. Figure 5 shows the movement of the two containers

10, 20 by the means 5. In figures 5A and 5B, the movement is further schematically shown in plan view. The arrangement of figure 6 is obtained at the end of the movement.

[0080] As shown in Figure 7, the refilling means 6 are preferably operated so that the second container 20 is refilled with the painting powder of a second color. This operation can be carried out when the second container is in the cleaning position (typically after the cleaning operations) or when the container is in the operative position, typically before coupling the withdrawing means to the second container 20. In addition, movable refilling means 6 may be further provided, i.e. able to follow the second container during its movement between the cleaning position 3 and the operative position, so as to at least partially refill the second container 20 during this movement.

[0081] As mentioned above, the apparatus may also have additional movement means 7 adapted to bring the proper stock 2a, 2b (i.e. the one containing the painting powder of the desired color, i.e. in this case the second color) at the refilling means 6.

[0082] Typically, during these last two steps, cleaning operations also carried out also on the withdrawing means 3 and/or cleaning means 4, and in general on the various elements that came into contact with the painting powder of the first color. These steps are carried out by devices and methods known in the art and are not describe in detail herein. In order to minimize such cleaning times, different cleaning means 4 and/or withdrawing means 3 may be provided, so that non-operative means can be cleaned while coupling the other ones to the containers 10, 20. Similar embodiments are briefly depicted in figures 9A - 11.

[0083] Once the second container 20, refilled with the painting powder of the second color, is in operative position P1 and the first container 10 is in the cleaning position P2, the painting operations of an object 100 may be resumed, while the first container 10 is cleaned, as shown in figure 8.

[0084] Thanks to the present apparatus and method, color changes can be sequentially operated, with substantially identical and reduced waiting time for each color change.

Claims

1. An apparatus (1) for the powder coating of an object (100), wherein said apparatus (1) comprises:
 - at least a first and a second container (10, 20) for painting powder;
 - means (5) for the movement of said first and second container (10, 20) between an operative position (P1, P1', P1'') and a cleaning position (P2, P2', P2''), configured so that, when said first container (10) is in the operative position (P1,

- P1'), said second container (20) is in said cleaning position (P2, P2"), and so that when said first container (10) is in the cleaning position (P2, P2'), said second container (20) is in the operative position (P1, P1");
- means (4, 4', 4") for cleaning a container (10, 20), configured to empty and clean said first or said second container (10, 20), when said first or second container (10, 20) is in the cleaning position (P2, P2', P2");
- means (3, 3', 3") for withdrawing painting powder from said first or second container (10, 20), when said first or second container (10, 20) is in the operative position (P1, P1', P1"), and for feeding it to a device (3c) for delivering painting powder onto an object (100) to be painted;
2. The apparatus (1) according to claim 1, comprising means (6) to refill said first or second container (10, 20), preferably configured to refill said first or second container (10, 20) when said first or second container (10, 20) is in the operative position (P1, P1, P1").
 3. The apparatus (1) according to claim 2, comprising at least two painting powder stocks (2a, 2b), said refilling means (6) being selectively connectable to said painting powder stocks (2a, 2b).
 4. The apparatus (1) according to claim 3, comprising means (7) for the movement of said painting powder stocks (2a, 2b).
 5. The apparatus (1) according to one of the preceding claims, wherein at least one of said first and second containers (10, 20) comprises:
 - a sieving chamber (12) to sieve painting powder to be sieved,
 - a collecting chamber (13) for the sieved painting powder,
 - at least one sieve (14) arranged at least one of the external surfaces (12b, 12c, 12d) of said sieving chamber (12), wherein said sieving chamber (12) is arranged at least partially, preferably completely, within said collecting chamber (13), and comprises at least one opening (12a) for the inlet and/or outlet of powder.
 6. The apparatus (1) according to claim 5, wherein said sieving chamber (12) is provided with at least one cavity (11) allowing at least a portion of said cleaning means (4, 4', 4") to pass through said sieving chamber (12), into said collecting chamber (13), and wherein at least a portion of said cleaning means (4, 4', 4") is configured to pass through said at least one cavity (11) during the cleaning of said container (10).
 7. A process for a color change by means of an appa-

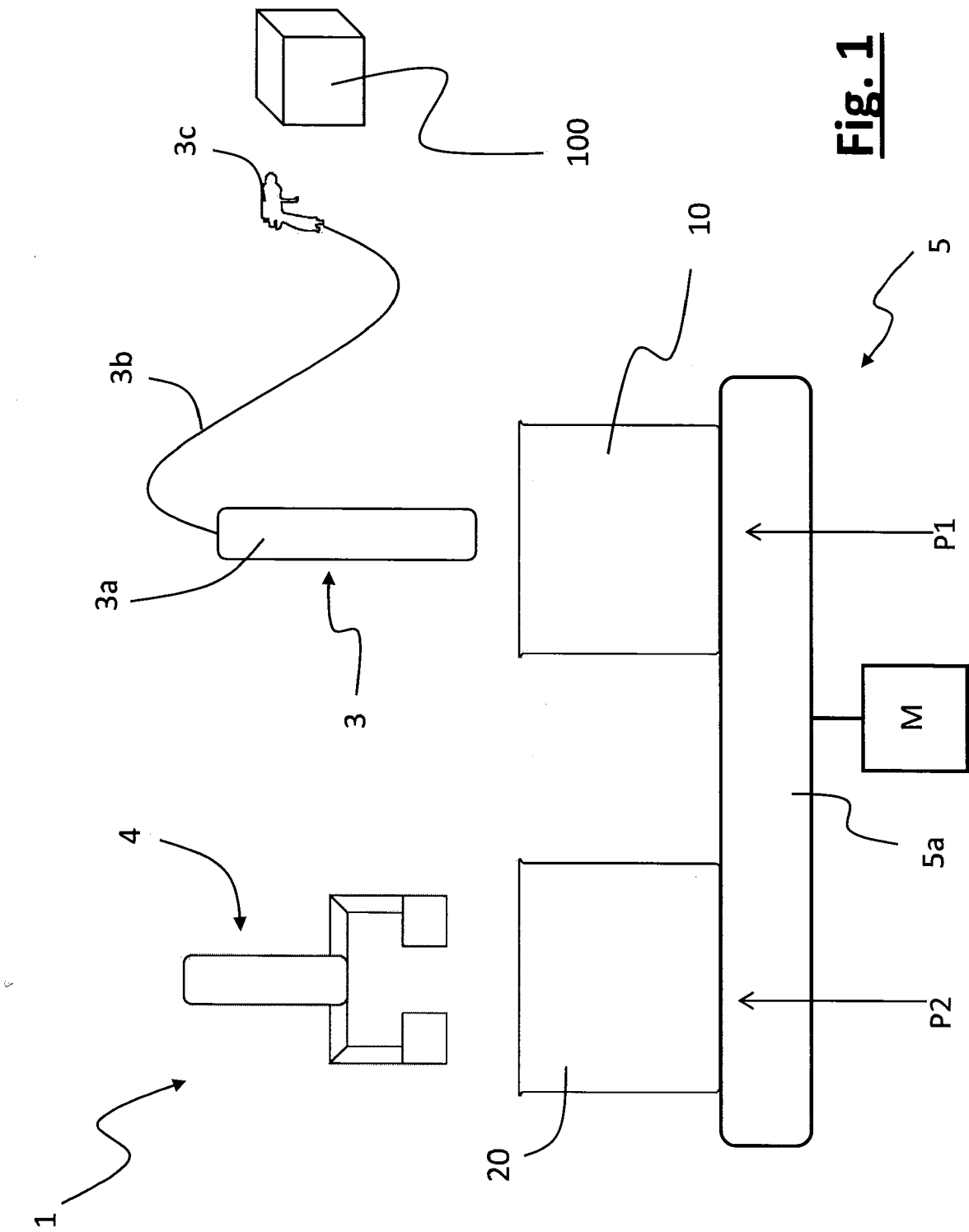
ratus according to any one of the preceding claims, comprising the steps of:

- (a) arranging a first container (10), comprising painting powder of a first color, in said operative position (P1, P1') and a second container (20) in said cleaning position (P2, P2") by means of said movement means;
- (b) withdrawing painting powder from said first container (10) by means of said withdrawing means (3) and feeding it to a device (3c) for delivering painting powder;
- (c) emptying said second container (20), in case said second container (20) contains painting powder, and inserting, at least partially, said cleaning means (4) into said second container (20) in order to clean said second container (20);
- (d) disengaging said withdrawing means (3, 3', 3") from said first container (10) and disengaging said cleaning means (4, 4', 4") from said second container (20);
- (e) operating said movement means (5) in order to bring said first container (10) to said cleaning position (P2, P2') and said second container (20) to said operative position (P1, P1");
- (f) refilling said second container (20) with painting powder of a second color;
- (g) withdrawing painting powder of said second color from said second container (20) and feeding it to a device (3c) for delivering painting powder;
- (h) emptying said first container, in case said first container contains painting powder, and inserting, at least partially, said cleaning means (4) into said first container (10) in order to clean said first container (10);

wherein:

- at least part of said step (c) occurs simultaneously with said step (b);
- said step (e) may be carried out before, or simultaneously with, or after said step (f), preferably after said step (f) so that said second container (20) is refilled when it is in said operative position;
- at least part of said step (h) occurs simultaneously with said step (g).

8. The process according to claim 7, wherein during said step (f), movement means (7) are operated to move a stock (2a, 2b), containing said painting powder of said second color, towards refilling means (6).



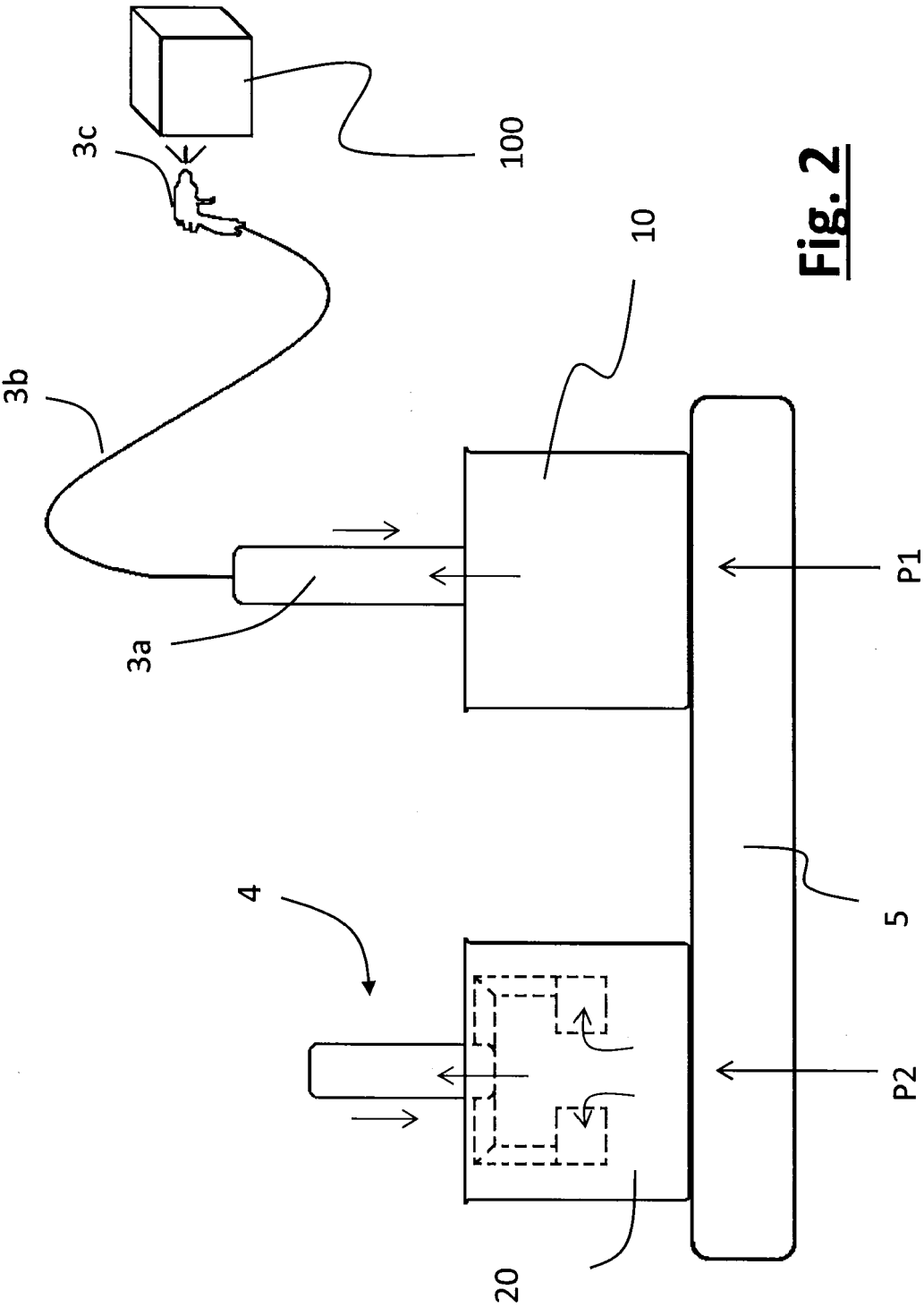


Fig. 2

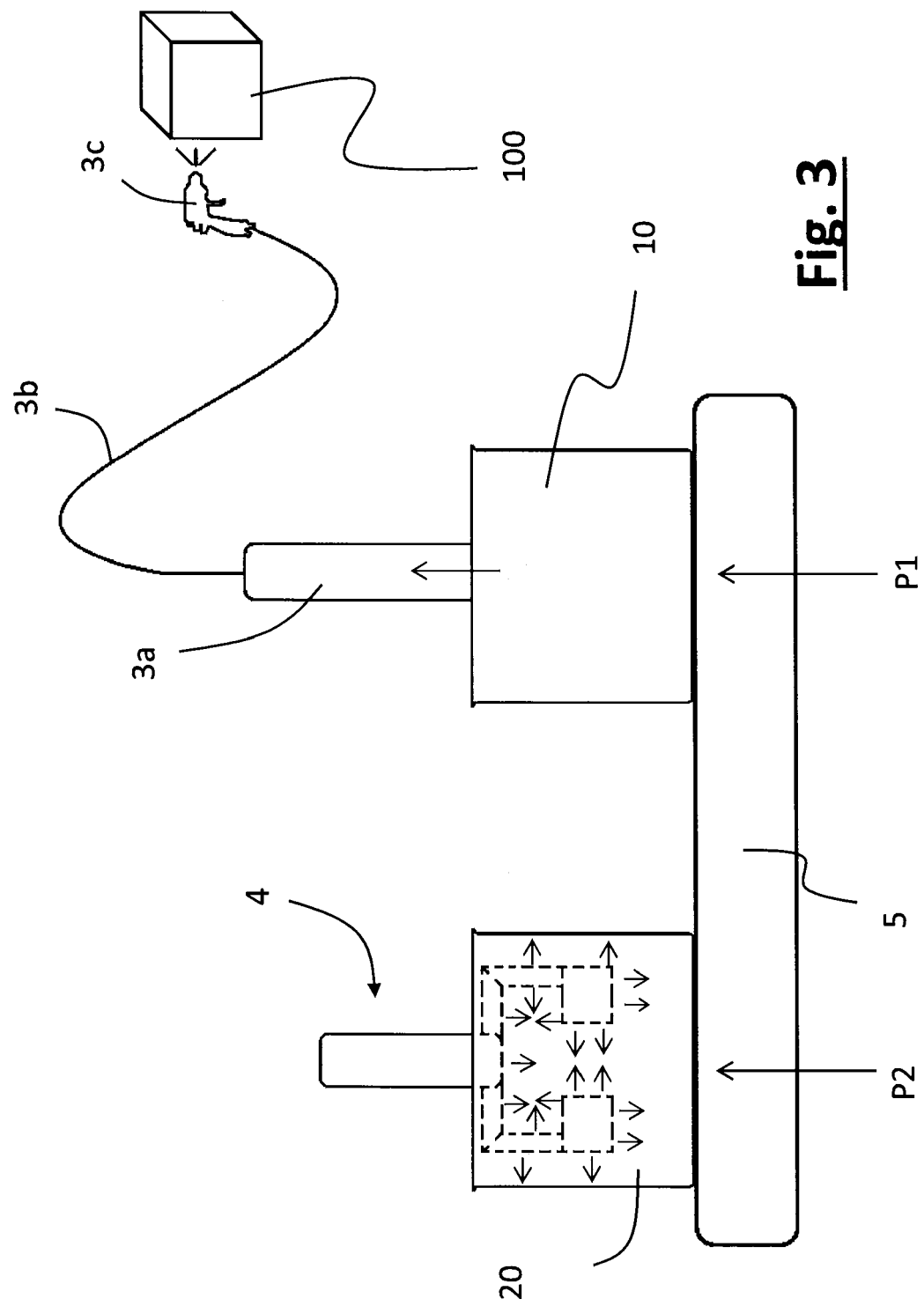


Fig. 3

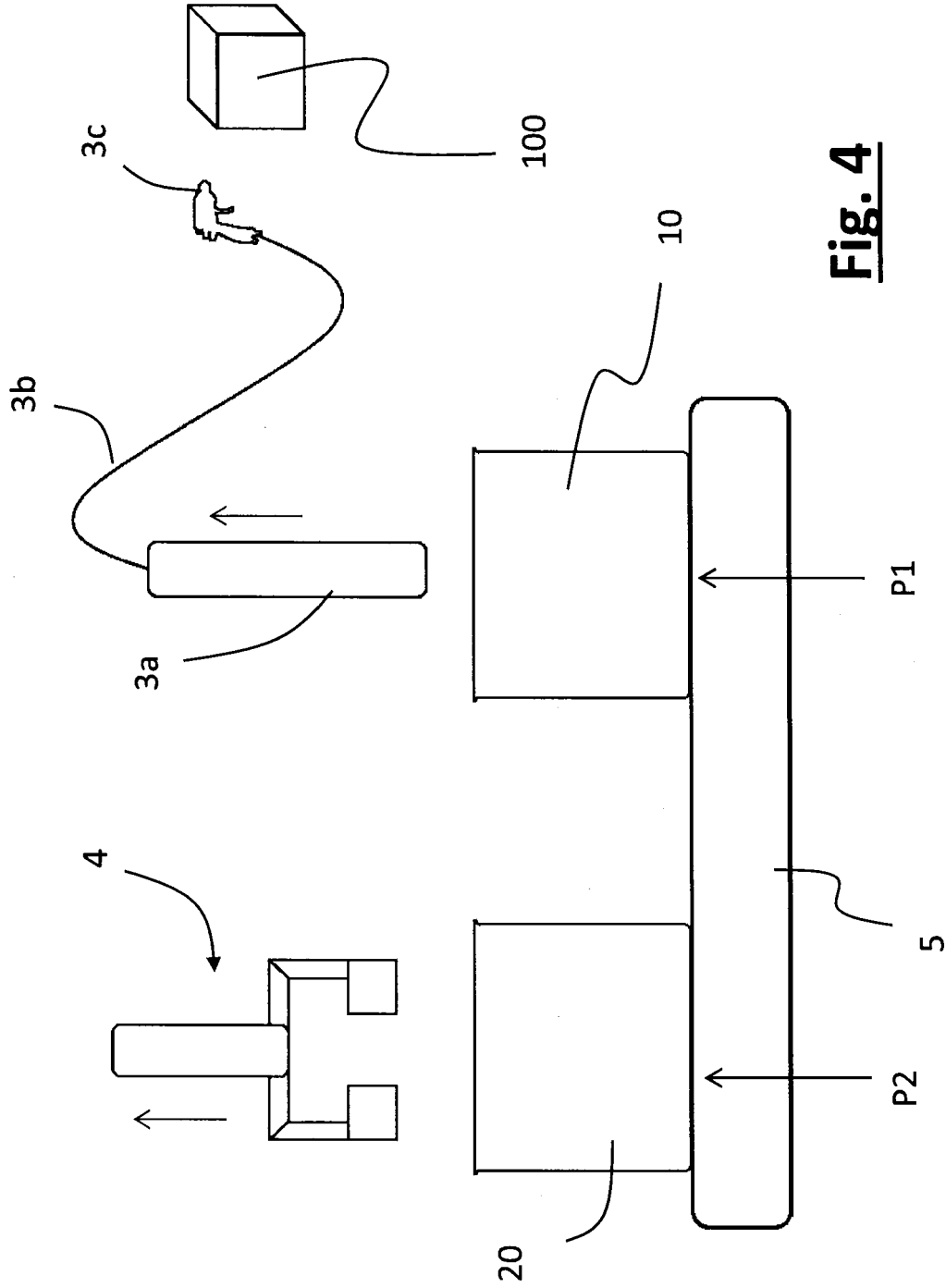


Fig. 4

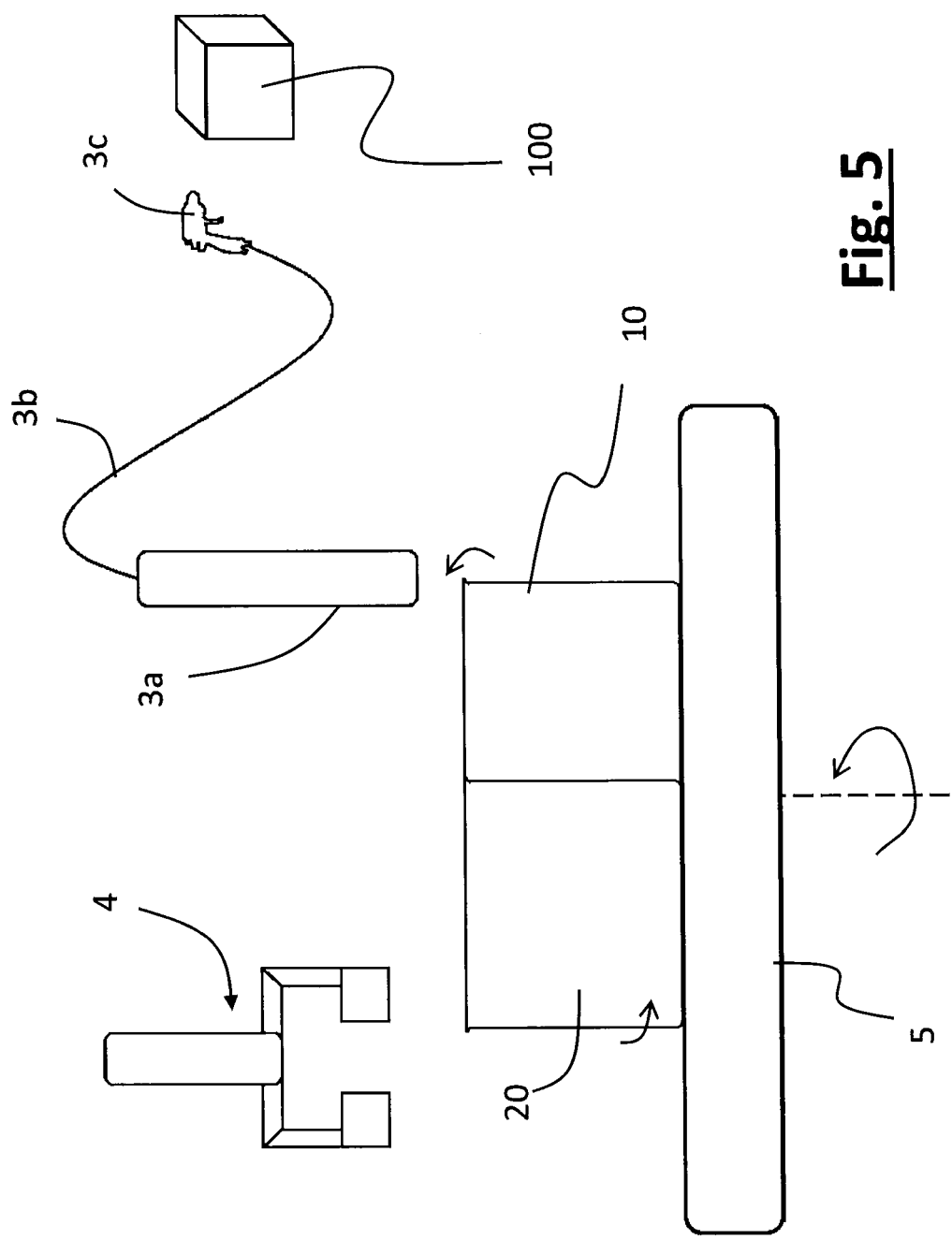


Fig. 5

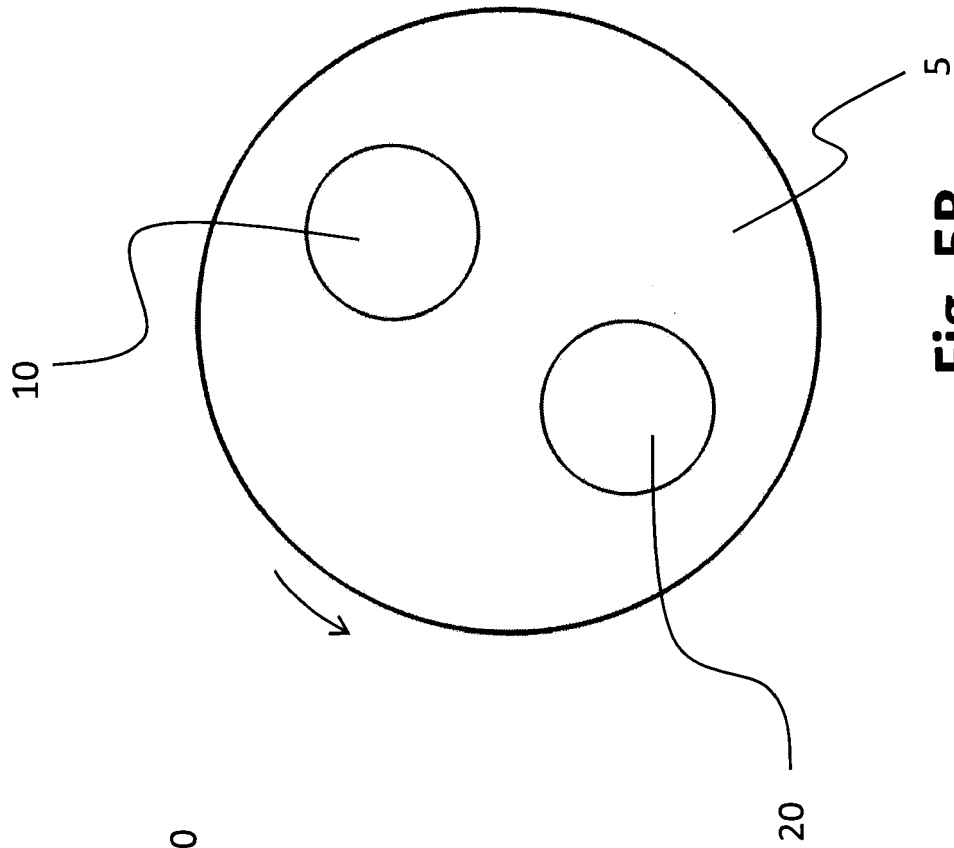


Fig. 5B

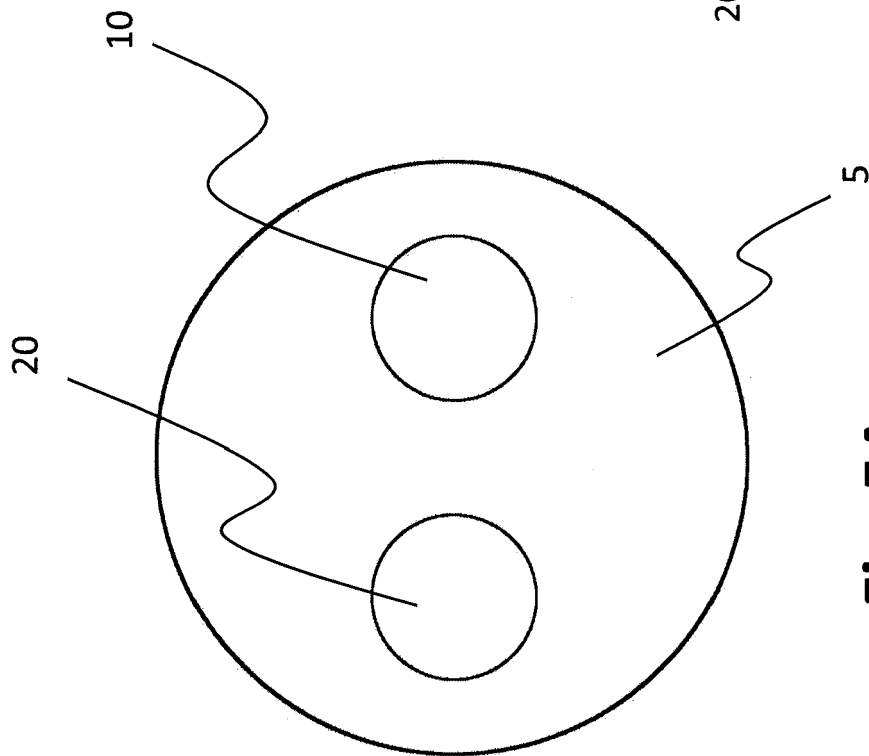


Fig. 5A

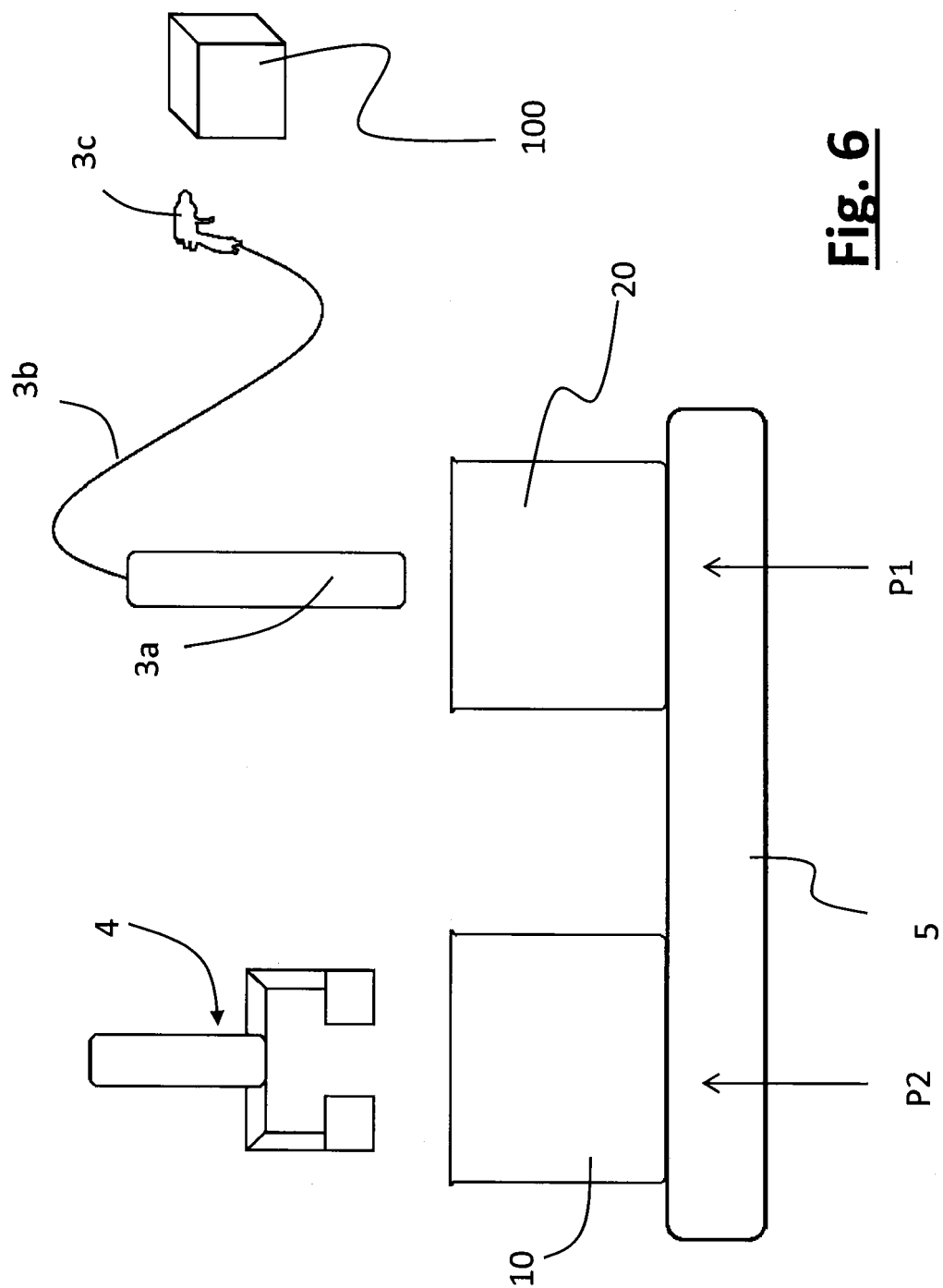


Fig. 6

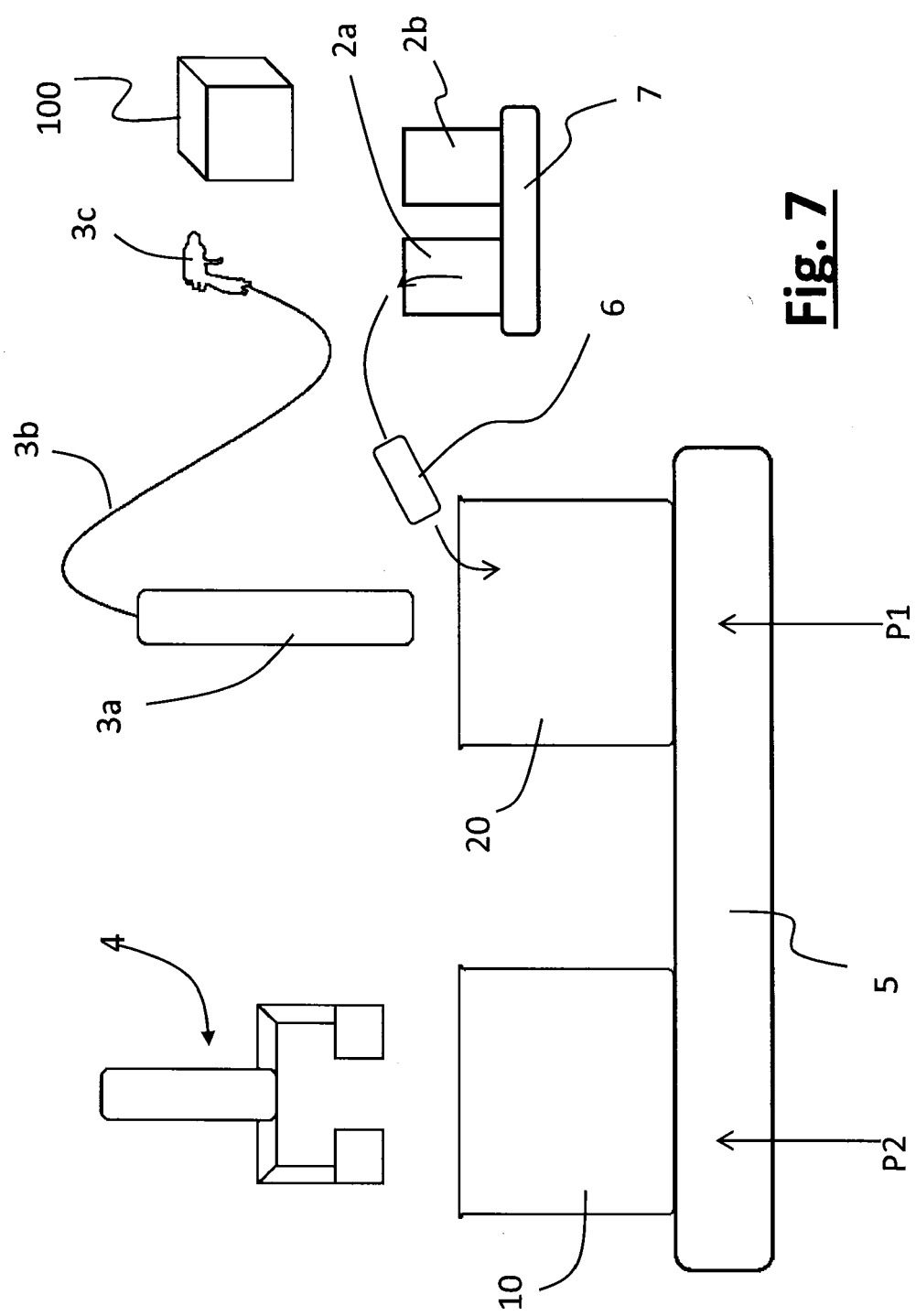


Fig. 7

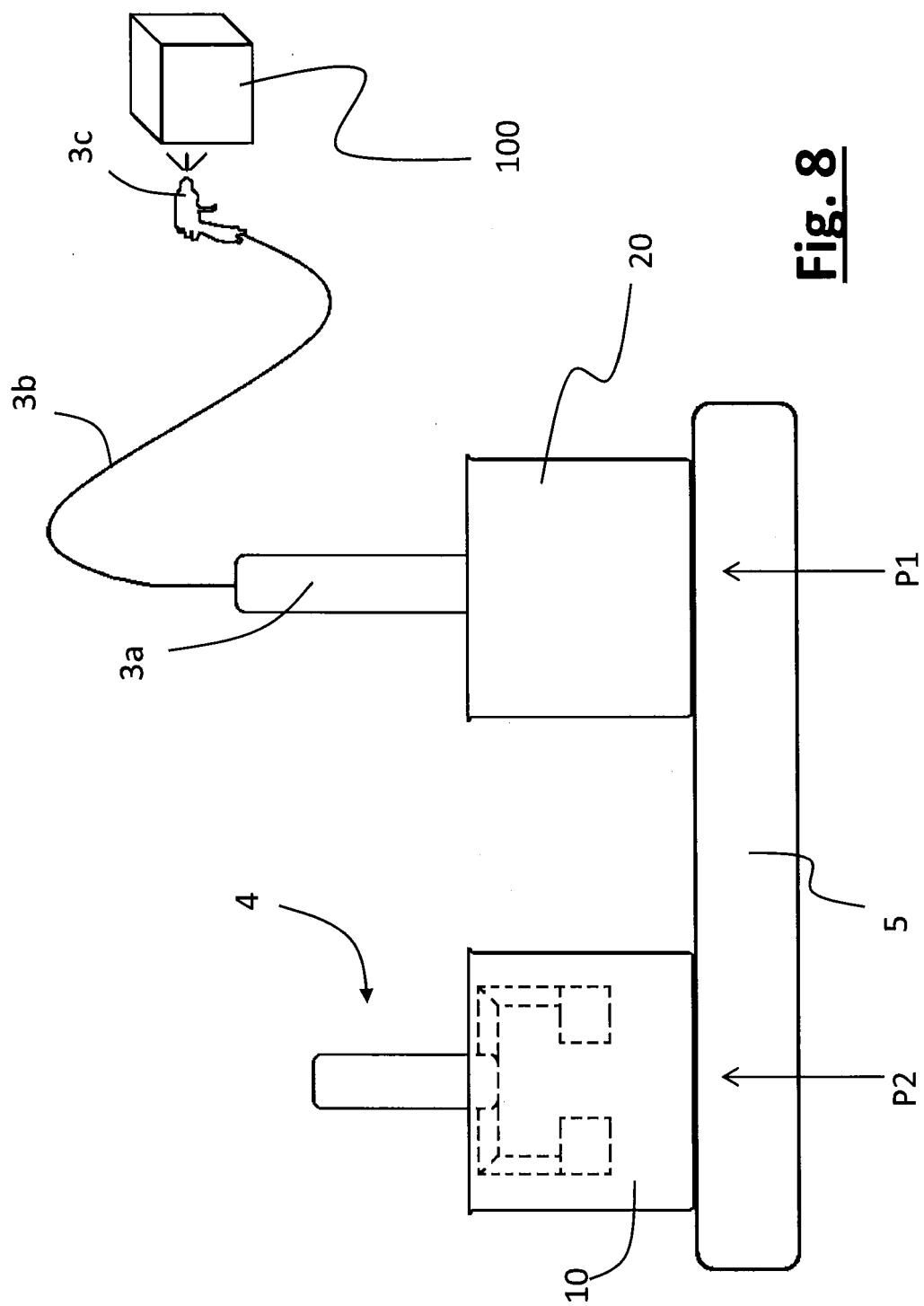


Fig. 8

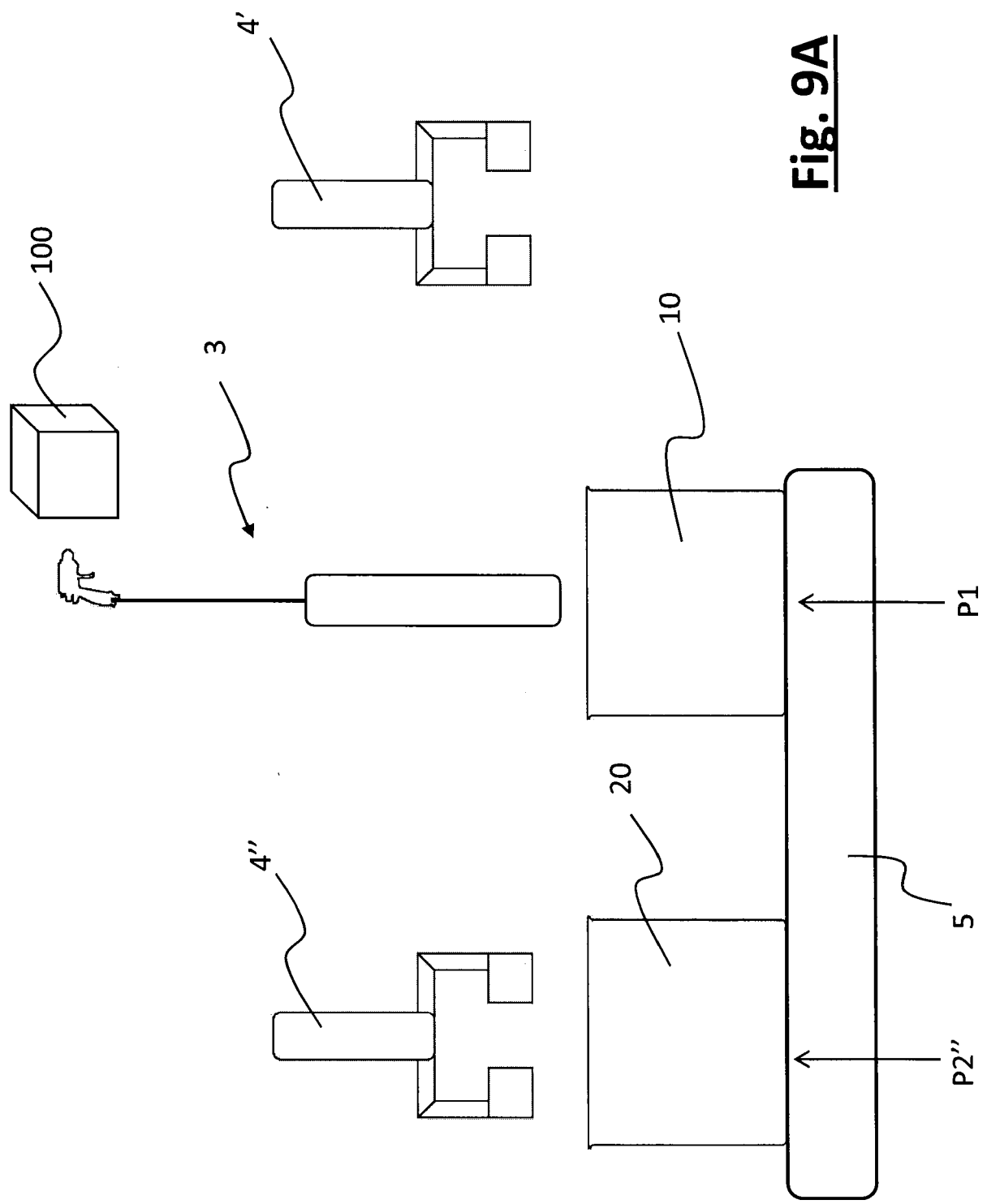


Fig. 9A

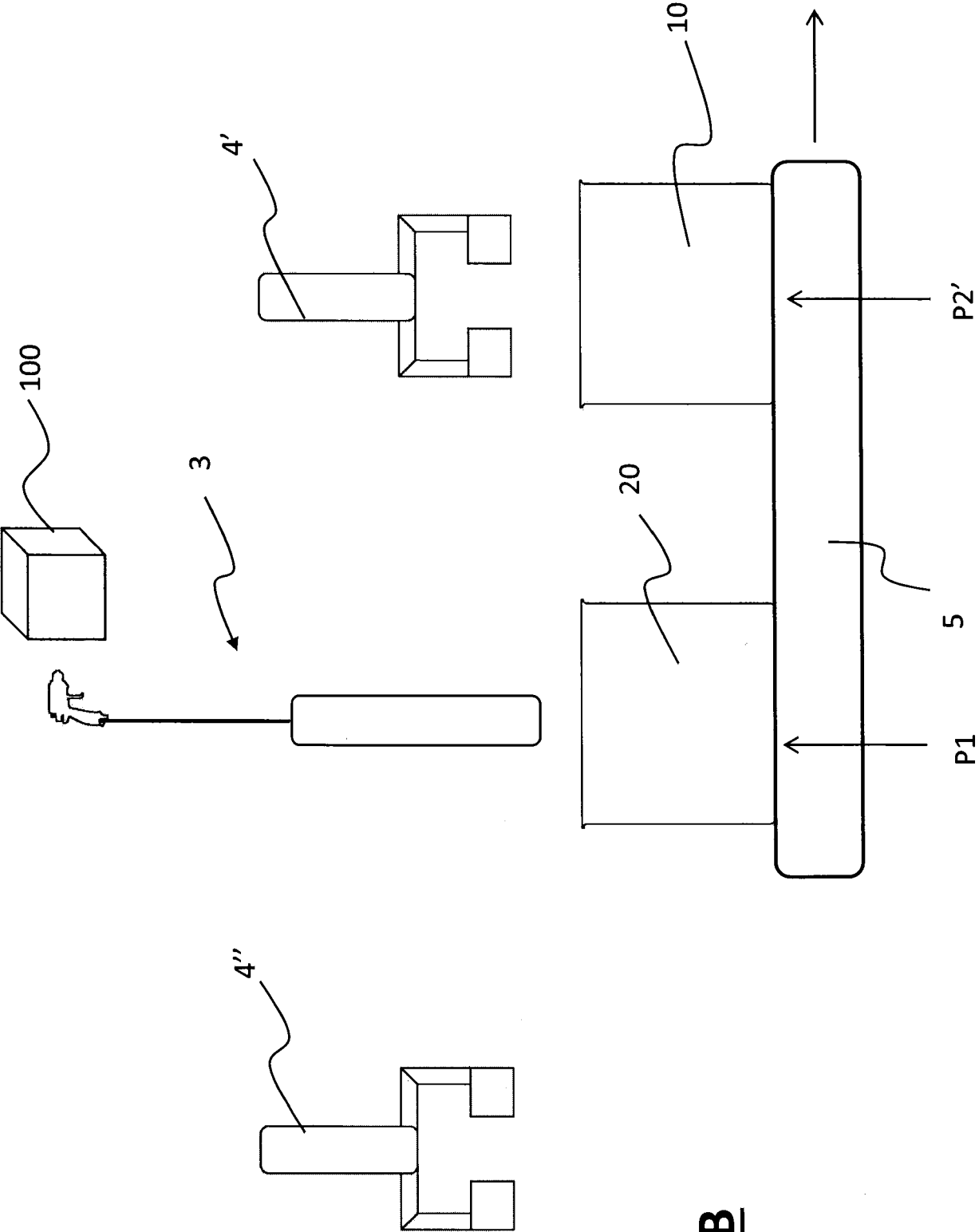


Fig. 9B

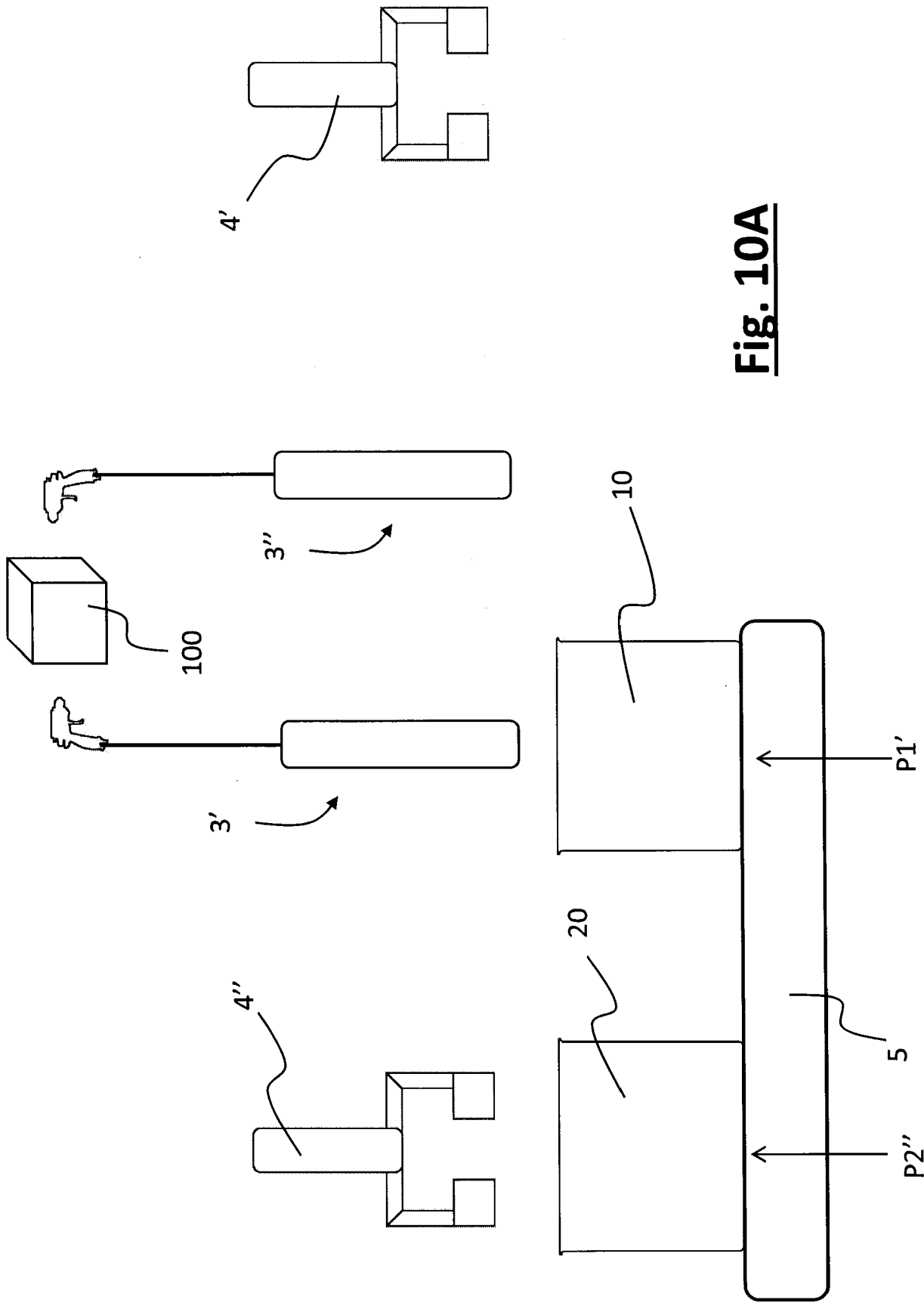


Fig. 10A

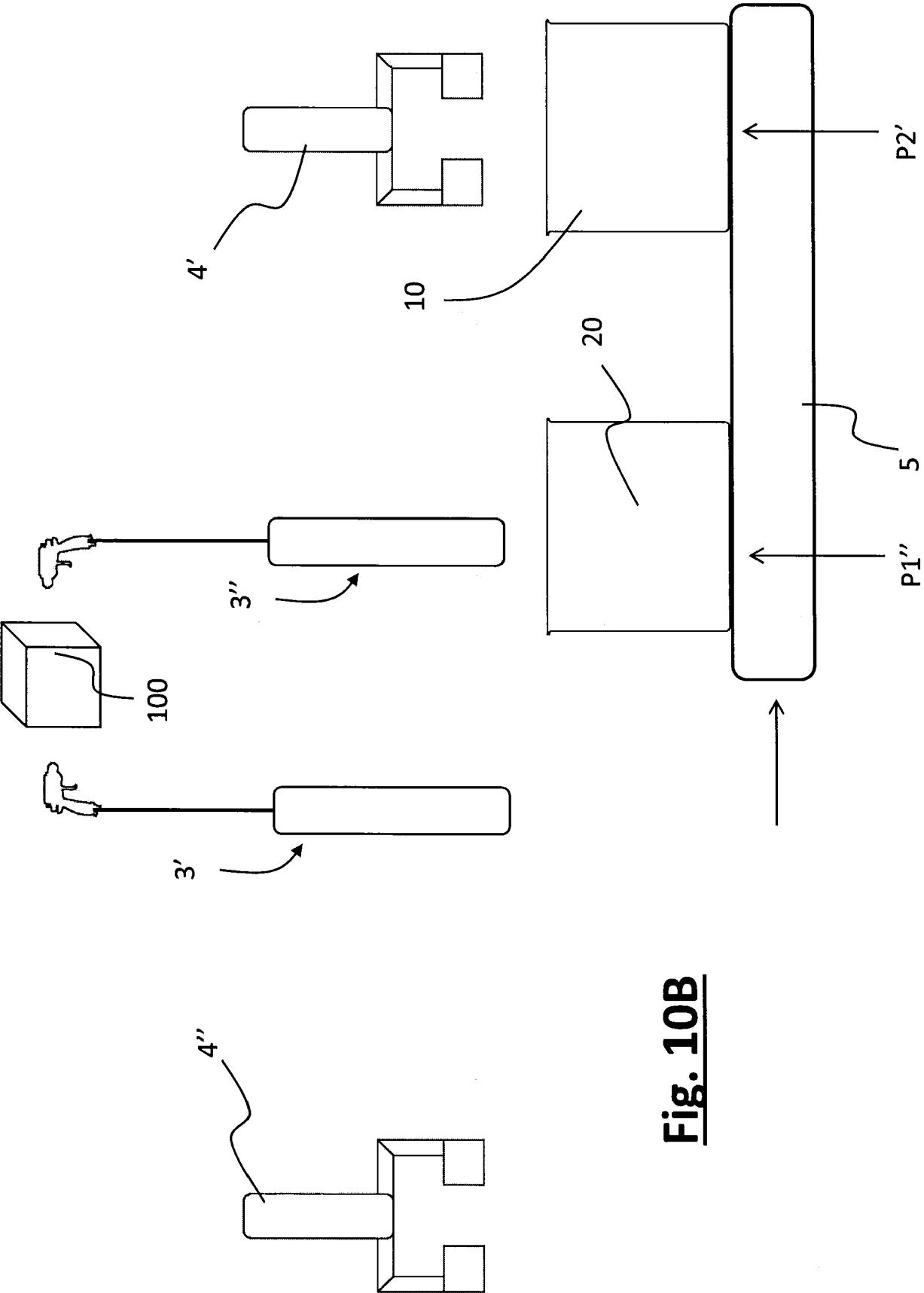


Fig. 10B

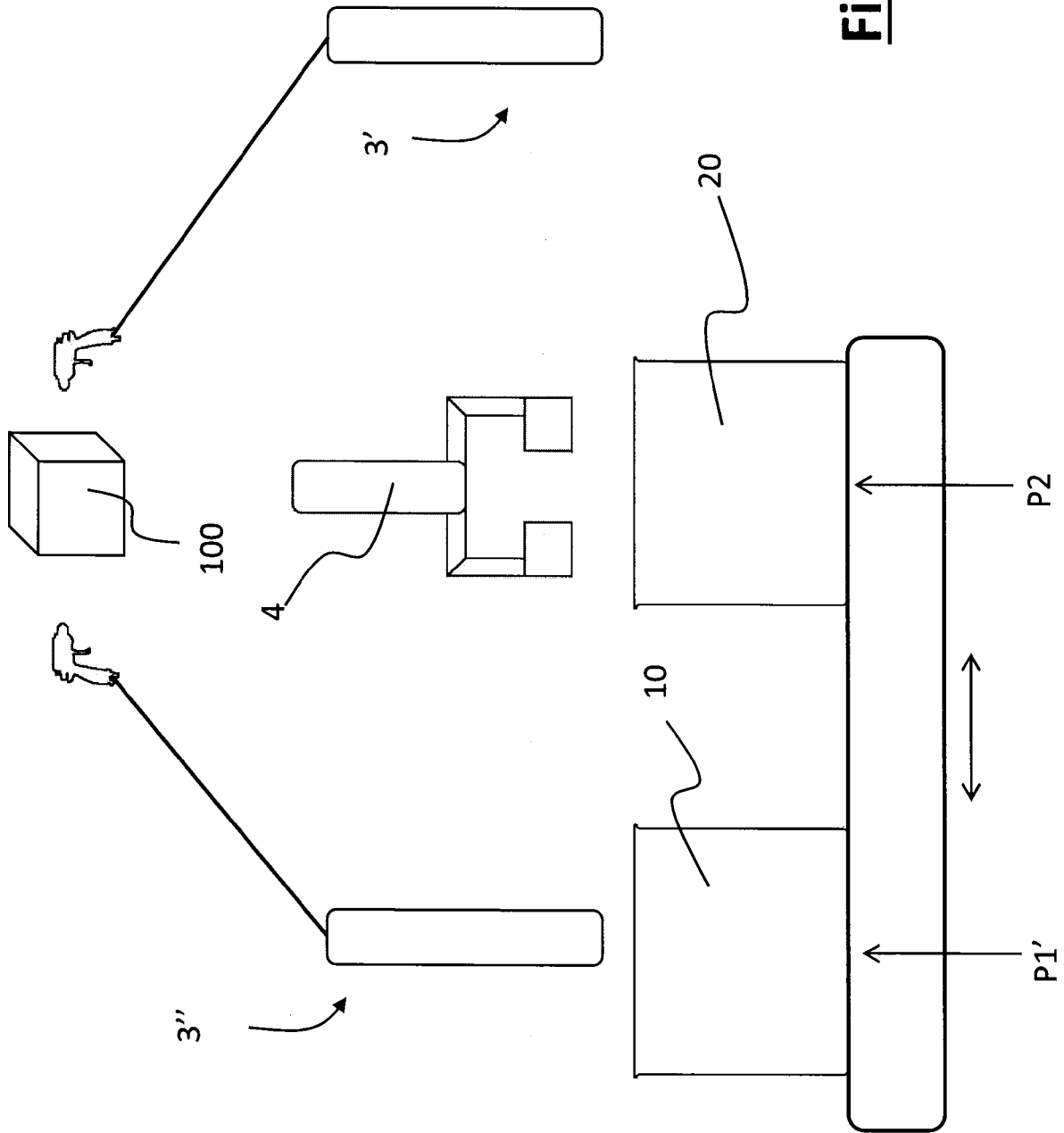


Fig. 11

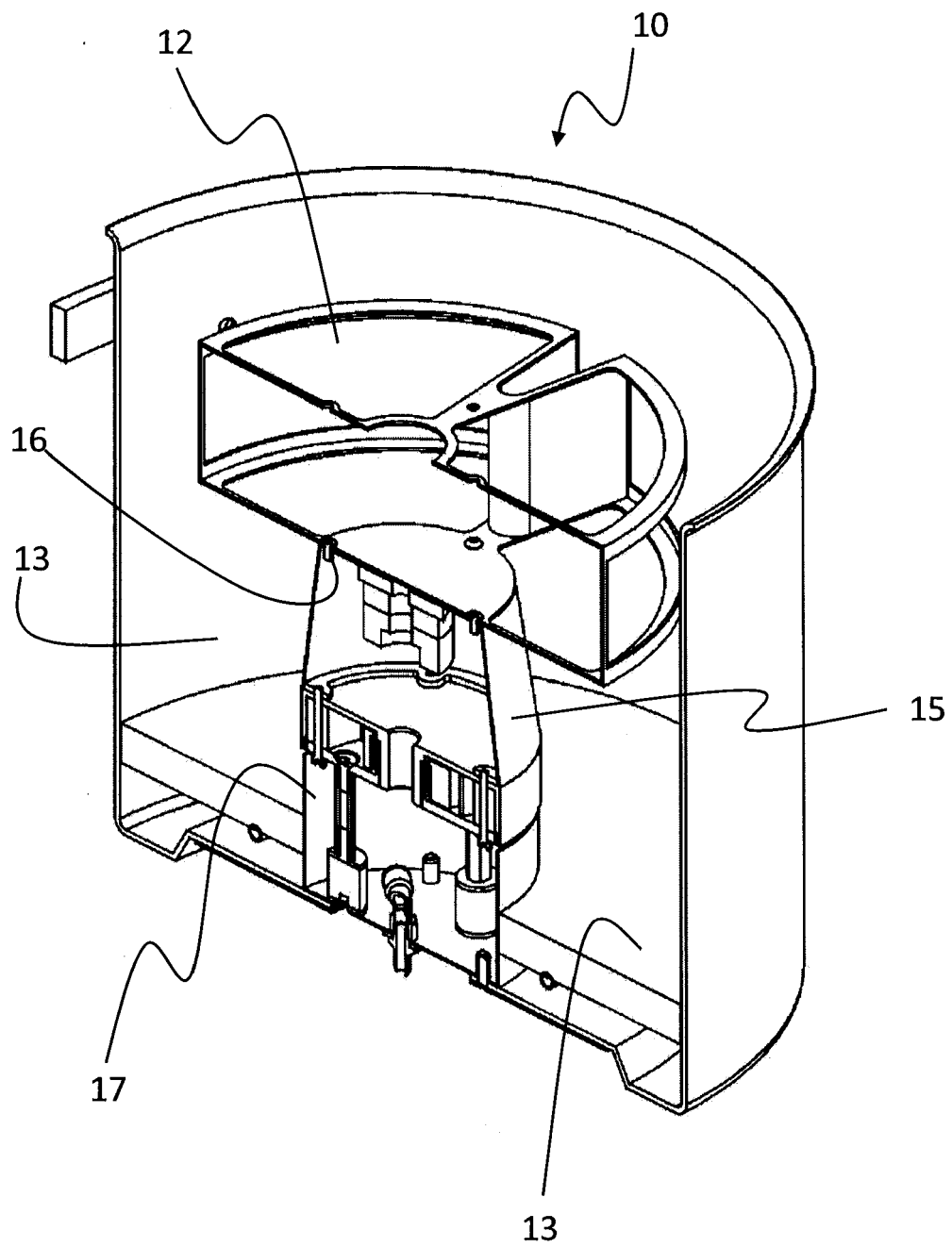
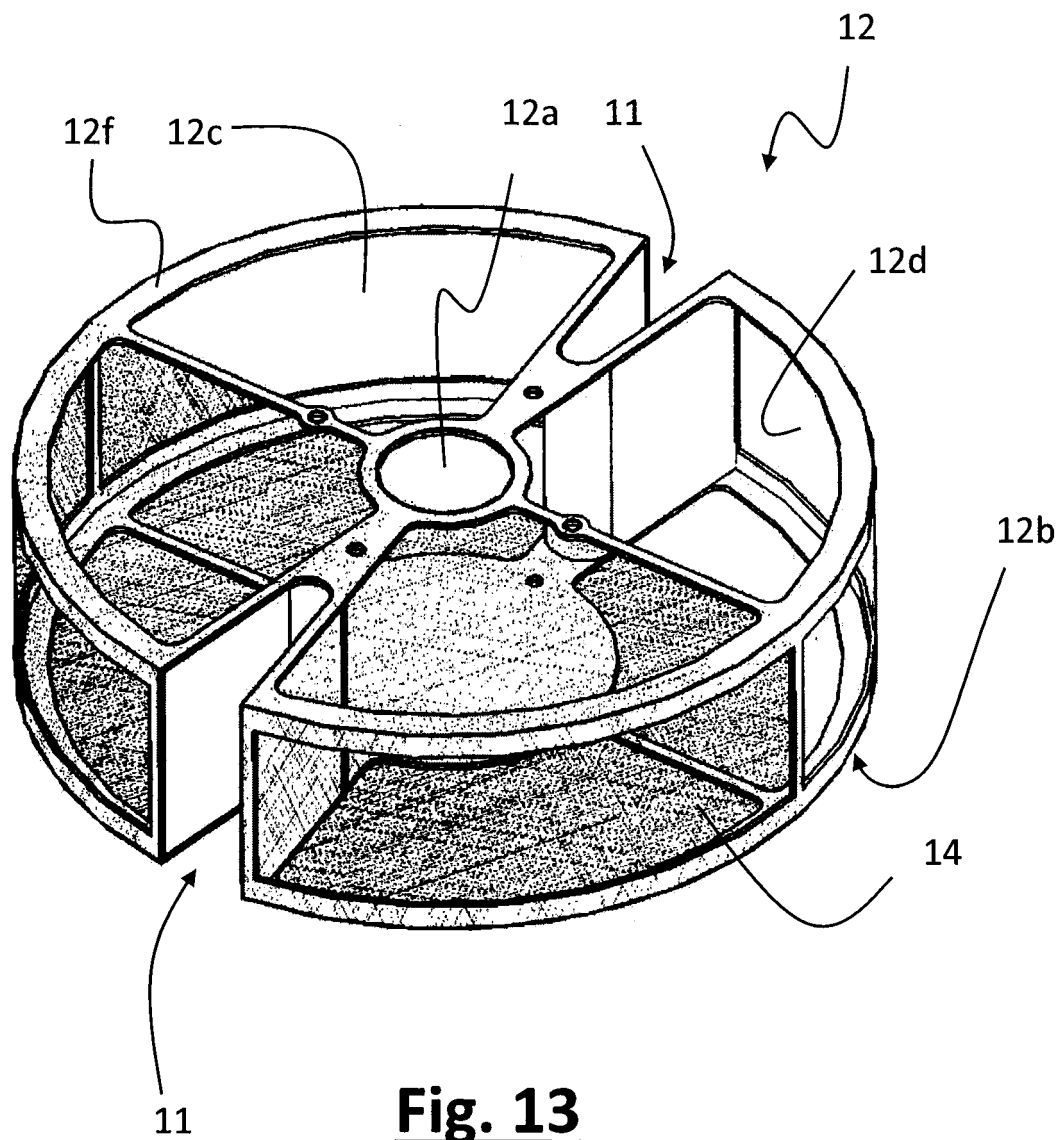


Fig. 12



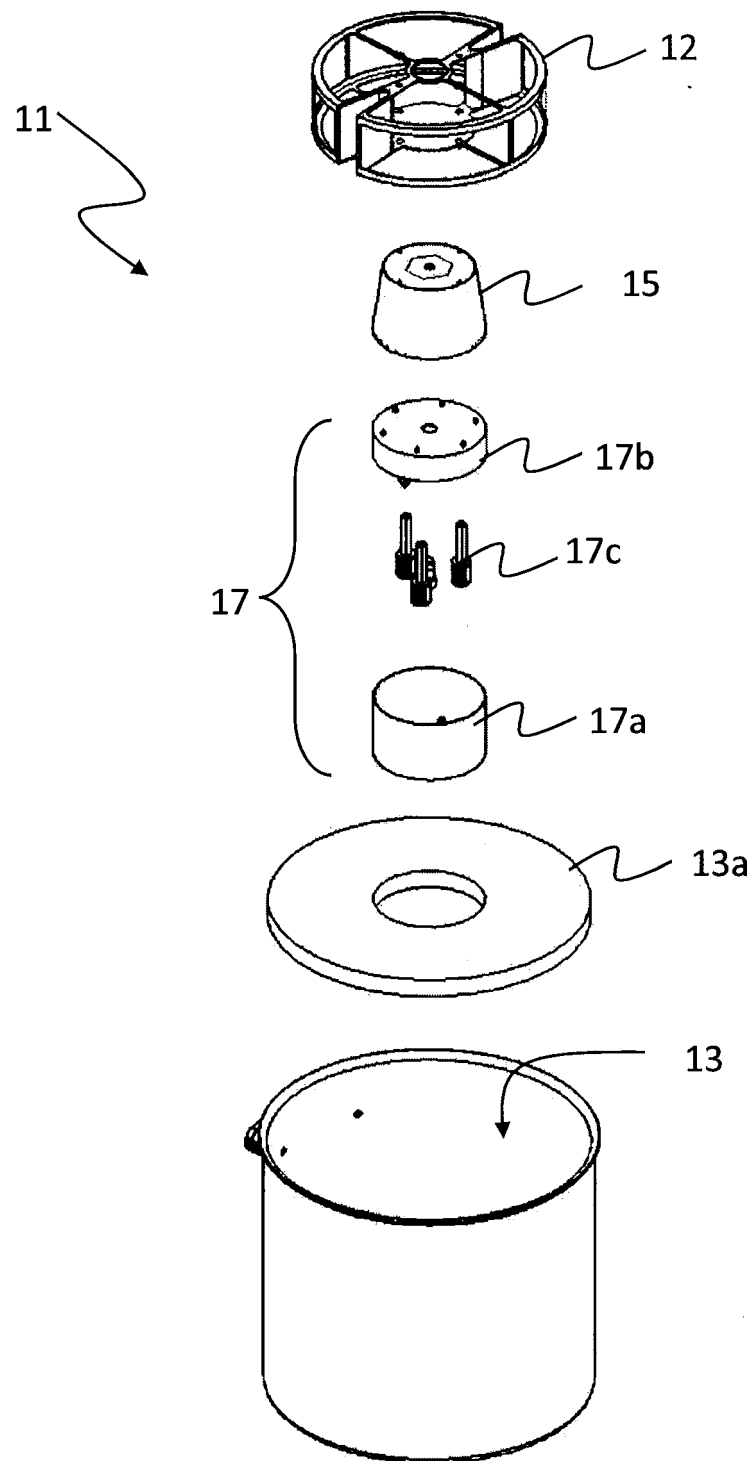


Fig. 14

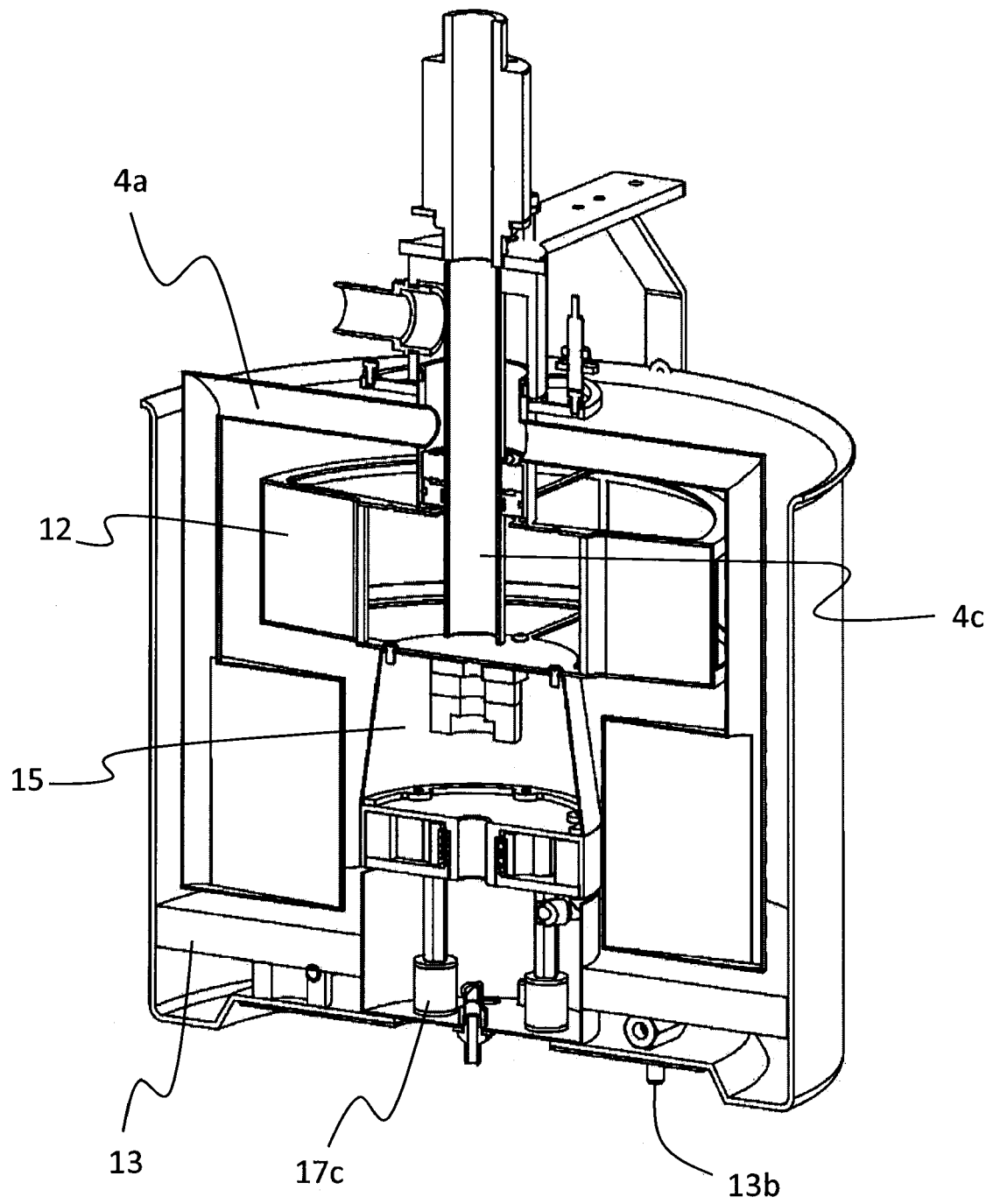


Fig. 15

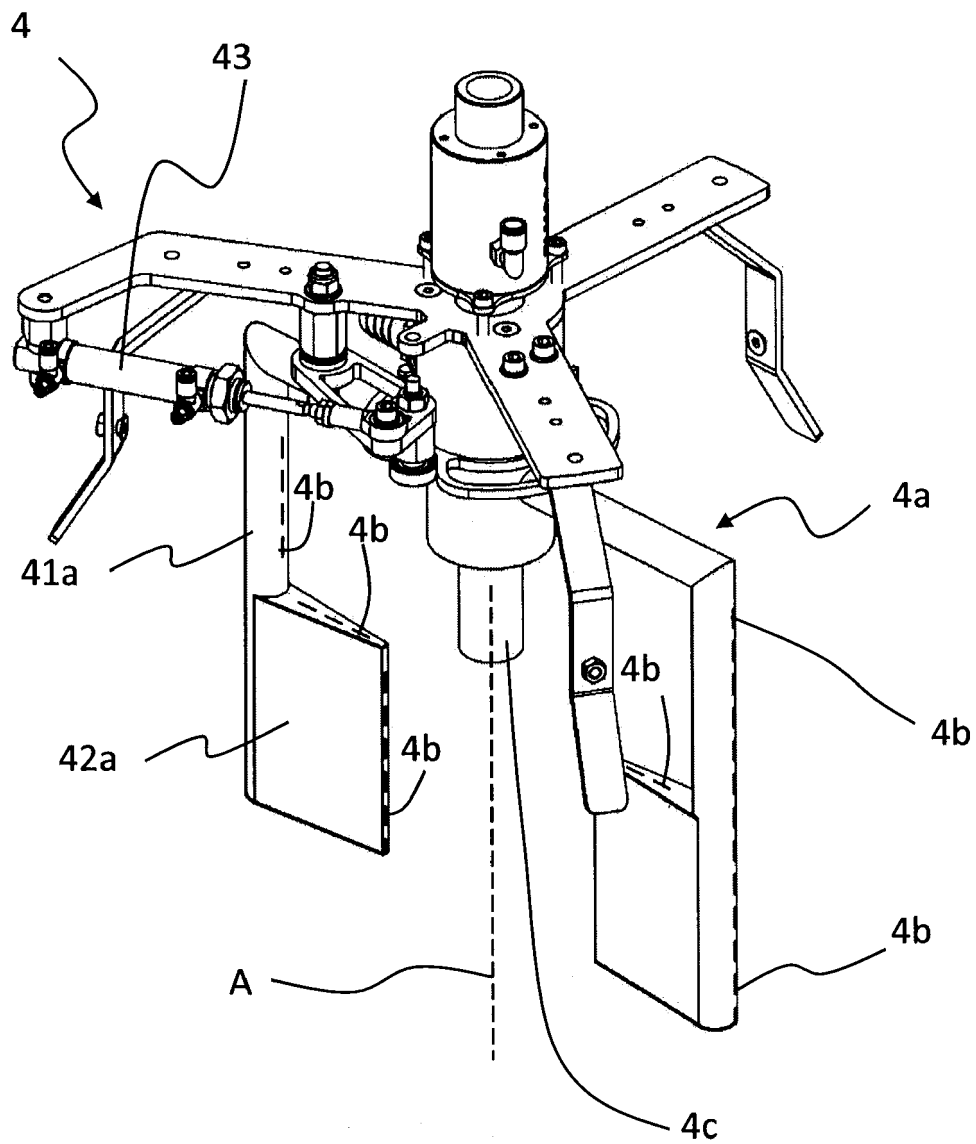


Fig. 16



EUROPEAN SEARCH REPORT

Application Number
EP 18 16 6440

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			B05B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 31 May 2018	Examiner Roldán Abalos, Jaime
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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5 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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