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(54) **INKJET PRINTING APPARATUS**

TINTENSTRAHLDRUCKVORRICHTUNG

IMPRIMANTE À JET D'ENCRE

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(56) References cited:
EP-A1- 1 905 596
EP-A1- 3 042 776
EP-A2- 0 440 261
US-A1- 2011 074 849

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Description

FIELD OF THE INVENTION

[0001] The present invention generally pertains to an inkjet printing apparatus with a print head unit and a print head holding unit.

BACKGROUND ART

[0002] An inkjet printing apparatus is well known and comprises an inkjet print head unit and a print head holding unit. The inkjet print head unit is configured to generate droplets of a fluid recording substance, such as an ink, while the print head holding unit is configured to hold the print head unit in an accurate position such that the droplets can be accurately position on a recording medium, such as paper or any other substrate.

[0003] The recording medium and the print head unit are commonly moved relative to each other such that each location of the recording medium may be provided with the recording substance. Moving the recording medium and/or the print head unit results in inertia forces in the inkjet printing apparatus. These inertia forces may negatively affect the relative position between the recording medium and the print head unit, which as a result negatively affects a print quality due to inaccurately positioned droplets. Therefore, it is desired to minimize any inertia forces, or at least any positional in accuracy due to such inertia forces. US-A-2011/074849 discloses the preamble of claim 1.

SUMMARY OF THE INVENTION

[0004] In accordance with the present invention, an inkjet printing apparatus according to claim 1 is provided.

[0005] The print head unit has a first part configured to generate the actual droplets. For example, the droplet forming unit may be configured to perform any one of the well known droplet forming methods such as a thermal method, in which a heater generates a gas bubble forcing a droplet of liquid through a nozzle, or a method in which a piezo-electric element generates a pressure wave in an amount of liquid in a pressure chamber and the pressure wave results in a droplet being expelled through a nozzle. There are many other inkjet techniques for forming droplets and the present invention is not limited to any specific ones.

[0006] The droplet forming unit is to be controlled such that only at predetermined locations droplets land on the recording medium. A part of a control system is commonly provided on the print head unit. For example, an ejection signal for each one of a number of ejection units present in the droplet forming unit may be generated in such a part of the control system. The control unit in the print head unit may even store specific actuation signals for specific ejection units. As such, the control unit may be very specific to the droplet forming unit and it may be desired to uniquely connect the droplet forming unit and the control unit. However, the control unit adds weight to the print head, which results in additional inertia forces on the print head unit. Holding the print head unit in an accurate position becomes consequently more difficult. On the other hand, the inertia forces on the control unit and positional inaccuracy of the control unit may be acceptable, as long as the droplet forming unit is maintained in its accurate position. To enable an assembly in which the droplet forming unit is accurately held in position, while the control unit may move within a predetermined range, the print head unit is constructed such that the control unit and the droplet forming unit are functionally connected, while allowing a relative movement between the control unit and the droplet forming unit.

[0007] It is noted that the control unit may comprise certain recording substance handling parts such as a reservoir, a recording substance heating element, a filter element, and the like functionality. Similarly, the droplet forming unit may comprise certain control elements, such as an integrated circuit incorporated in a MEMS inkjet chip. For the present invention, it is essential that the print head unit comprises two moveably connected parts, wherein one part generates and expels the droplets and thus requires accurate positioning, while the other part does not require such accurate positioning.

[0008] The functional connection includes a mechanical connection that allows the relative movement, but prevents a too large movement that could damage any electrical, fluidic or any other functional connections.

[0009] In view of the two part construction of the print head unit, the print head holding unit comprises the first mounting unit for accurately positioning and holding the droplet forming unit and the second mounting unit for holding the control unit. The first and second mounting units are each constructed such that inertia forces acting on the control unit are not mechanically transmitted to the droplet forming unit. For example, the second mounting unit may be moveable relative to the first mounting unit or the control units may be held such that the control units are moveable relative to the second mounting unit. In any case, the second mounting unit holds the control unit in the predetermined range relative to the corresponding droplet forming unit.

[0010] The mounting element and the mating mounting element are provided, one on the control unit and the other one on the second mounting unit. The mounting element is slideably arranged and the mating mounting element is provided with the receptor for receiving a mating portion of the mounting element therein. The mating portion can be slid into the receptor and may engage the mating mounting element, thereby holding the control unit. In particular, at least one of the mounting element and the receptor has such a shape that sliding the mating portion into the receptor results in the control unit being moved into the position in which the control unit is held within the predetermined range. Mechanically, within the predetermined range, the control unit and the droplet

forming unit are preferably decoupled when mounted in the print head holding unit. This is efficiently and effectively provided by the shape of the mounting element and/or the mating mounting element.

[0011] The sliding movement results in the shapes of the mounting element and the mating mounting element being translated relative to each other and upon engagement any local differences in the shapes result in a movement of the control unit as described hereinafter in more detail with reference to specific embodiments. It is presumed that the described and illustrated embodiments are sufficient for a skilled person to readily understand that any other shapes and forms may be similarly suitable to provide for the desired movement and positioning of the control unit relative to the droplet forming unit.

[0012] In an embodiment, the print head unit comprises a coupling assembly having a first state and a second state. In the first state, the coupling assembly provides for a fixed connection between the control unit and the droplet forming unit. In the second state, the coupling assembly provides for the moveable connection between the control unit and the droplet forming unit, in which the control unit and the droplet forming unit can move relative to each other within the predetermined range. The mating action of the mounting element and the mating mounting element is such that the coupling assembly is operated from the first state to the second state, when the slideable element is operated.

[0013] The coupling assembly may be operated to change from the first state to the second state. In general, the difference in the direction of movement between the slideable mounting element and the control unit provides for design freedom and a compact design.

[0014] In an embodiment, the second mounting assembly comprises a slot for receiving a protruding portion of the control unit. Further, a resilient element is provided. The resilient element has a first retracted position allowing the protruding portion to be positioned in the slot and a second state for resiliently clamping the control unit, when positioned in the slot. The resilient element is switched from the first state to the second state by the sliding action of the mounting element. The resilient clamping in the slot provides for simple fastening of the control unit. A positioning accuracy may be relatively low, provided that the position is within the predetermined range relative to the corresponding droplet forming unit.

[0015] In an embodiment, the print head unit is vertically mounted in the print head holding unit. When positioned in the print head holding unit, the slideable mounting element is slideable in a substantially horizontal direction. The shape of the mounting element and/or the receptor of the mating mounting element is such that the sliding movement in the horizontal direction moves the control unit in the vertical direction away from the corresponding droplet forming unit. In this embodiment, for example, the control unit and the droplet forming unit are mechanically fixed upon vertical movement into the print head holding unit. The vertical movement of the control unit away from the droplet forming unit releases the fixation and the connection becomes a connection with which the control unit and the droplet forming unit are moveable relative to each other within the predetermined range. Thus, a dense arrangement of multiple print head units may be provided for, while allowing to replace a print head unit easily and quickly.

[0016] In an embodiment, the control unit is provided with a duct element and the slideable mounting element is slideably connected to the duct element. This provides for a simple construction and configuration.

[0017] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating 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.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying schematical drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Fig. 1A	shows a perspective view of an exemplary inkjet printing apparatus;
Fig. 1B	shows a schematic representation of a scanning inkjet printing assembly;
Fig. 2A	shows a schematic perspective view of a first embodiment of a print head unit for use with the present invention;
Fig. 2B	shows a detailed view of a coupling assembly as used in the print head unit shown in Fig. 2A;
Fig. 3A	shows a schematic perspective view of a second embodiment of a print head unit for use with the present invention;
Fig. 3B	shows a top view of the print head unit of Fig. 3A and mounted in a print head holding unit in accordance with the present invention;
Figs. 4A and 4B	schematically illustrate a method of mounting a print head unit in a print head holding unit in accordance with the present invention;
Fig. 4C	schematically illustrates an embodiment of a second mounting unit for use with the present invention; and
Figs. 5A and 5B	schematically illustrate an optional aspect of the method of mounting a print head unit in a print head holding

unit in accordance with the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

[0019] The present invention will now be described with reference to the accompanying drawings, wherein the same reference numerals have been used to identify the same or similar elements throughout the several views.

[0020] Fig. 1A shows an image forming apparatus 36, in particular an inkjet printer, wherein printing is achieved using a wide-format inkjet printing assembly. The wide-format image forming apparatus 36 comprises a housing 26, wherein the printing assembly, for example the inkjet printing assembly shown in Fig. 1B is placed. The image forming apparatus 36 also comprises a storage means for storing image receiving member 28, 30 (also referred to as a recording medium), a delivery station to collect the image receiving member 28, 30 after printing and storage means for marking material 20. In Fig. 1A, the delivery station is embodied as a delivery tray 32. Optionally, the delivery station may comprise processing means for processing the image receiving member 28, 30 after printing, e.g. a folder or a puncher. The wide-format image forming apparatus 36 furthermore comprises means for receiving print jobs and optionally means for manipulating print jobs. These means may include a user interface unit 24 and/or a control unit 34, for example a computer.

[0021] Images are printed on an image receiving member, for example paper, supplied by a roll 28, 30. The roll 28 is supported on the roll support R1, while the roll 30 is supported on the roll support R2. Alternatively, cut sheet image receiving members may be used instead of rolls 28, 30 of image receiving member. Printed sheets of the image receiving member, cut off from the roll 28, 30, are deposited in the delivery tray 32.

[0022] Each one of the marking materials for use in the printing assembly are stored in four containers 20 arranged in fluid connection with the respective print heads for supplying marking material to said print heads.

[0023] The local user interface unit 24 is integrated to the print engine and may comprise a display unit and a control panel. Alternatively, the control panel may be integrated in the display unit, for example in the form of a touch-screen control panel. The local user interface unit 24 is connected to a control unit 34 placed inside the printing apparatus 36. The control unit 34, for example a computer, comprises a processor adapted to issue commands to the print engine, for example for controlling the print process. The image forming apparatus 36 may optionally be connected to a network N. The connection to the network N is diagrammatically shown in the form of a cable 22, but nevertheless, the connection could be wireless. The image forming apparatus 36 may receive printing jobs via the network. Further, optionally, the controller of the printer may be provided with a USB port, so printing jobs may be sent to the printer via this USB port.

[0024] Fig. 1B shows an ink jet printing assembly 3. The ink jet printing assembly 3 comprises supporting means for supporting an image receiving member 2. The supporting means are shown in Fig. 1B as a platen 1, but alternatively, the supporting means may be a flat surface. The platen 1, as depicted in Fig. 1B, is a rotatable drum, which is rotatable about its axis as indicated by arrow A. The supporting means may be optionally provided with suction holes for holding the image receiving member in a fixed position with respect to the supporting means. The ink jet printing assembly 3 comprises print heads 4a - 4d, mounted on a scanning print carriage 5. The scanning print carriage 5 is guided by suitable guiding means 6, 7 to move in reciprocation in the main scanning direction B. Each print head 4a - 4d comprises an orifice surface 9, which orifice surface 9 is provided with at least one orifice 8. The print heads 4a - 4d are configured to eject droplets of marking material onto the image receiving member 2. The platen 1, the carriage 5 and the print heads 4a - 4d are controlled by suitable controlling means 10a, 10b and 10c, respectively.

[0025] The image receiving member 2 may be a medium in web or in sheet form and may be composed of e.g. paper, cardboard, label stock, coated paper, plastic or textile. Alternatively, the image receiving member 2 may also be an intermediate member, endless or not. Examples of endless members, which may be moved cyclically, are a belt or a drum. The image receiving member 2 is moved in the sub-scanning direction A by the platen 1 along four print heads 4a - 4d provided with a fluid marking material.

[0026] A scanning print carriage 5 carries the four print heads 4a - 4d and may be moved in reciprocation in the main scanning direction B parallel to the platen 1, such as to enable scanning of the image receiving member 2 in the main scanning direction B. Only four print heads 4a - 4d are depicted for demonstrating the invention. In practice an arbitrary number of print heads may be employed. In any case, at least one print head 4a - 4d per color of marking material is placed on the scanning print carriage 5. For example, for a black-and-white printer, at least one print head 4a - 4d, usually containing black marking material is present. Alternatively, a black-and-white printer may comprise a white marking material, which is to be applied on a black image-receiving member 2. For a full-color printer, containing multiple colors, at least one print head 4a - 4d for each of the colors, usually black, cyan, magenta and yellow is present. Often, in a full-color printer, black marking material is used more frequently in comparison to differently colored marking material. Therefore, more print heads 4a - 4d containing black marking material may be provided on the scanning print carriage 5 compared to print heads 4a - 4d containing marking material in any of the other colors. Alternatively, the print head 4a - 4d containing black marking material may be larger than any of the print heads 4a - 4d, containing a differently colored marking material.

[0027] The carriage 5 is guided by guiding means 6, 7. These guiding means 6, 7 may be rods as depicted in Fig. 1B. The rods may be driven by suitable driving means (not shown). Alternatively, the carriage 5 may be guided by other guiding means, such as an arm being able to move the carriage 5. Another alternative is to move the image receiving material 2 in the main scanning direction B.

[0028] Each print head 4a - 4d comprises an orifice surface 9 having at least one orifice 8, in fluid communication with a pressure chamber containing fluid marking material provided in the print head 4a - 4d. On the orifice surface 9, a number of orifices 8 is arranged in a single linear array parallel to the sub-scanning direction A. Eight orifices 8 per print head 4a - 4d are depicted in Fig. 1B, however obviously in a practical embodiment several hundreds of orifices 8 may be provided per print head 4a - 4d, optionally arranged in multiple arrays. As depicted in Fig. 1B, the respective print heads 4a - 4d are placed parallel to each other such that corresponding orifices 8 of the respective print heads 4a - 4d are positioned in-line in the main scanning direction B. This means that a line of image dots in the main scanning direction B may be formed by selectively activating up to four orifices 8, each of them being part of a different print head 4a - 4d. This parallel positioning of the print heads 4a - 4d with corresponding in-line placement of the orifices 8 is advantageous to increase productivity and/or improve print quality. Alternatively multiple print heads 4a - 4d may be placed on the print carriage adjacent to each other such that the orifices 8 of the respective print heads 4a - 4d are positioned in a staggered configuration instead of in-line. For instance, this may be done to increase the print resolution or to enlarge the effective print area, which may be addressed in a single scan in the main scanning direction. The image dots are formed by ejecting droplets of marking material from the orifices 8.

[0029] Upon ejection of the marking material, some marking material may be spilled and stay on the orifice surface 9 of the print head 4a - 4d. The ink present on the orifice surface 9, may negatively influence the ejection of droplets and the placement of these droplets on the image receiving member 2. Therefore, it may be advantageous to remove excess of ink from the orifice surface 9. The excess of ink may be removed for example by wiping with a wiper and/or by application of a suitable anti-wetting property of the surface, e.g. provided by a coating.

[0030] Fig. 2A shows a print head unit 4 for use in the present invention, wherein the print head unit 4 comprises a droplet forming unit 41 and a control unit 42. The droplet forming unit 41 is configured to generate and expel a droplet of the marking material (recording substance). The control unit 42 may comprise any elements such as electronic control circuitry, elements for pretreatment of the marking material (e.g. heater and/or filter) and any other element not directly affecting actual droplet formation. More in general, any element that does not affect the droplet size, direction, speed or similar droplet properties, when such element is displaced upon droplet generation, may be comprised in the control unit 42. Preferably, the mass of the droplet forming unit 41 is kept to a minimum such that any unexpected movement of the droplet forming unit 41 due to inertia forces is minimized.

[0031] The droplet forming unit 41 may employ any known technique for forming droplets. For example, a electro-mechanical transducer such as a piezo-electric actuator, may be used for generating a pressure wave in the marking material present in a pressure chamber, due to which pressure wave a droplet of marking material is expelled through a nozzle, which nozzle is in fluidic communication with said pressure chamber. Other techniques include, but are not limited to a thermal actuation. Further, the droplet forming unit may employ a drop-on-demand technique or a continuous droplet formation technique, which are both well known in the art and are therefore not further elucidated herein. In general, the present invention is not limited to any specific kind of droplet formation technique.

[0032] For handling purposes, it may be desired to handle the print head unit 4 as a single unit, when the print head unit 4 is not mounted in a print head holding unit of a printing apparatus. Thereto, in this embodiment, the print head unit 4 is provided with a coupling assembly 43. The coupling assembly 43 as illustrated comprises a resilient lever 431 and a mating notch 432. In a first state as illustrated in Fig. 2A, the mating notch 432 is introduced in a recess enclosed by the resilient lever 431 and the mating notch 432 is clamped by the resilient notch 431, thereby mechanically holding the droplet forming unit 41 and the control unit 42 in a fixed positional relation, allowing the print head unit 4 to be handled as a single unit.

[0033] Fig. 2B shows a detailed view of the coupling assembly 43 in a second state. In the second state, the mating notch 432 is released from the recess and is not clamped by the resilient lever 431. As a result, the coupling assembly 43 provides a predetermined range in which the control unit 42 and the droplet forming unit 41 may move relative to each other. Other elements (not shown) provide for a connection between the control unit 42 and the droplet forming unit 41 keeping the two parts of the print head unit 4 together. Such other elements may be mechanical elements, but may additionally or alternatively be fluidic elements (e.g. supply tube for supplying the marking material to the droplet forming unit 41) or electrical elements (e.g. an electrical cable for providing an ejection firing signal to the droplet forming unit 41).

[0034] The coupling assembly 43 is not essential to the present invention, although it may be preferred. Further, the coupling assembly 43 is not limited to the embodiment as illustrated in Figs. 2A and 2B. For example, the resilient lever 431 may be embodied so as not to clamp the mating notch 432, but a separate fixing assembly may be provided, e.g. based on a magnetic principle. Any other technique for detachably connecting two

parts may be employed as well. Such other techniques are well known and a skilled person is presumed to be enabled to select any suitable technique from such known techniques.

[0035] Fig. 3A shows another embodiment of a print head unit 4 for use in the present invention. The print head unit 4 comprises the droplet forming unit 41 and the control unit 42. A coupling assembly as illustrated in Figs. 2A and 2B is not shown, but it may or it may not be present. Essentially, the print head unit 4 needs to provide for a state in which the droplet forming unit 41 and the control unit 42 may be moveably connected, i.e. connected, while enabled to move relative to each other within a predetermined range.

[0036] For mounting purposes, in this embodiment, the control unit 42 is provided with protruding portions 421 and 422, which assist in positioning and holding the control unit 42 in a print head holding unit which is described hereinafter.

[0037] In this embodiment, the control unit 42 is provided with a duct element 44, which is provided for guiding a flow of fluid cooling medium, such as air or water, along an element to be cooled, such as an electronic component like an ASIC (application specific integrated circuit). The duct element 44 may be fluidically connected to a supply port and an outlet port in the above-mentioned print head holding unit, for example, for a supply and drainage of the fluid cooling medium. The duct element 44 is, in this embodiment, provided with two guide pins 441 and 442, extending outwardly as seen from an internal duct in the duct element 44. The guide pins 441, 442 are used for holding and guiding a slideably arranged mounting element 46, having two guide slits 461, 462. The guide pins 441, 442 protrude through the guide slits 461, 462, respectively, allowing the mounting element 46 to slide over the duct element 44. In this embodiment, the slideable mounting element 46 is further provided with two linear cams 463 and 464, operatively connected to two cam followers 451 and 452, respectively. The cam followers 451, 452 are connected to or part of a resilient element 45, which is configured to clamp the control unit 42 in the print head holding unit and which is further described in more detail in relation to Fig. 4C hereinbelow.

[0038] The slideable mounting element 46 is provided with two ramp portions 465 and 466. The function of these ramp portions 465, 466 is described hereinbelow in relation to Figs. 4A and 4B.

[0039] Fig. 3B illustrates the print head unit 4 as shown in Fig. 3A, when mounted in a print head holding unit, which print head holding unit comprises a first mounting unit (not shown) for holding the droplet forming unit 41. The first mounting unit may be any kind of holding unit for suitably positioning and holding the droplet forming unit 41. Such a suitable holding unit is well known in the art and is therefore not further described or elucidated herein. In any case, the present invention is not limited to any specific kind of holding unit for holding the droplet forming unit 41.

[0040] The print head holding unit further comprises a second mounting unit comprising a left second mounting part 51L and a right second mounting part 51R. Hereinafter, the left part 51L and the right part 51R may be together referred to as the second mounting unit 51. The left part 51L and the right part 51R function as the mating mounting elements for the slideable mounting element 46.

[0041] The second mounting unit 51 comprises a first slot 513a and a second slot 512a for receiving the protruding portions 422 and 421, respectively, of the control unit 42. The slideable mounting element 46 has been slit into a mounting position as compared to the position of the mounting element 46 shown in Fig. 3A. Sliding the mounting element 46 into the mounting position has resulted in the control unit 42 having been moved away from the droplet forming unit 41, which is shown in and described in relation to Figs. 4A and 4B in more detail. Further, a camming action of the linear cams 463 and 464 and the cam followers 451 and 452 has resulted in the resilient element 45 clamping the control unit 42 in the second mounting unit 51 as shown in and described in relation to Figs. 5A and 5B in more detail.

[0042] The second mounting unit 51 is designed to hold multiple print head units 4 in dense array. For example, a further print head unit 4 may be introduced in the first and second slots 513b and 512b, which are provided directly next to a first side of the illustrated print head unit. Further, on an opposite, second side of the illustrated print head, a duct port 511 is shown. The duct port 511 is provided for a fluidic connection to the duct of the duct element 44 of a further print head unit. The duct port 511 for the illustrated print head unit is not visible due to the slideable mounting element 46, in this top view covering the duct element 44. As apparent to those skilled in the art, further slots 512, 513 and duct ports 511 may be present, but not shown in Fig. 3B (see for example Fig. 4C).

[0043] Fig. 4A shows the print head unit comprising the control unit 42 and the droplet forming unit 41 and mounted in the second mounting unit 51, comprising left part 51L and right part 51R. In this schematic drawing, the control unit 42 is represented by the duct element 44.

[0044] The second mounting unit 51 comprises a first engagement surface 514L and a second engagement surface 514R for engaging the slideable mounting element 46 and in particular for engaging a first ramp portion 466 and a second ramp portion 465, respectively. The slideable mounting element 46 is illustrated in an unmount position.

[0045] Fig. 4B illustrates the print head unit of Fig. 4A, wherein the slideable mounting element 46 has been moved into its mounting position as indicated by arrow P. Upon sliding into the mounting position, the ramp portions 465 and 466 engaged their respective engagement surfaces 514R and 514L and corresponding to the shape of the ramp portions 465, 466 of the mounting element 46, the mounting element 46 has been moved away from

the droplet forming unit 41. Due to the connection through the guide pins 441, 442, the duct element 44 and correspondingly the control unit 42 are also moved away from the droplet forming unit 41. With the droplet forming unit 41 being held in position in the first mounting unit (not shown as above described), the droplet forming unit 41 and the control unit 42 are moved apart as indicated by arrow Q. With reference to the embodiment of Figs. 2A and 2B, such relative movement may provide for a release of a coupling assembly 43 and thus for bringing the print head unit in a state wherein the control unit 42 and the droplet forming unit 41 are moveably connected.

[0046] Fig. 4C shows in some more detail a side view of the second mounting unit 51, in particular the right part 51R. The second mounting unit 51 comprises multiple adjacent arranged slots 513b and 513c, interposed by corresponding duct ports 511a, 511b and 511c. Adjacent to the duct ports 511a, 511b and 511c, corresponding engagement surfaces 514a, 514b and 514c are shown. The engagement surfaces 514a, 514b and 514c are part of respective receptors 515, in which the respective slideable mounting elements 46 are received upon mounting of respective print head units. As apparent from this side view, print head units may be arranged close to each other such to provide for a dense arrangement, while due to the present invention, the print head units may be easily individually unmounted and removed from their respective slots and similarly print head units may be easily and individually mounted by introduction into the respective slots.

[0047] Fig. 5A illustrates the control unit 42 and the slideable mounting element 46 in the unmount position. The resilient element 45 is shown in dashed lines, since the resilient element 45 is arranged in the duct element 44 in the illustrated embodiment (see e.g. Fig. 3A) and is thus not visible in this top view. The resilient element 45 is connected to the cam followers 451 and 452. The cam followers are operatively coupled to the cams 463 and 464, respectively, and are thus operated by sliding the mounting element 46 from the unmount position to the mounting position.

[0048] Fig. 5B shows the print head unit of Fig. 5A with the mounting element 46 slit into the mounting position corresponding to arrow P. Due to the movement of the mounting element 46, the cam followers 451 and 452 have been forced in the direction indicated by arrow R and the resilient element 45 has correspondingly moved. Each end portion of the resilient element 45 (i.e. the portions protruding from the duct of the duct element 44, as illustrated in Fig. 3A) is configured to engage an internal wall of the corresponding duct port 511 (shown in Fig. 3B and 4C) and thereby exerting a force F. The force F simultaneously forces the protruding portions 421, 422 against an internal wall of the corresponding slots 512, 513. Due to the resulting friction, the control unit 42 is held in position, while the resiliency of the resilient element 45 still allows movement relative to the droplet forming unit 41. In another embodiment, however, the second mounting unit 51 may be moveable relative to the first mounting unit, in which embodiment the control unit 42 may be fixedly arranged in the second mounting unit 51.

[0049] While the drawings of Figs. 3A - 5B illustrate a particular embodiment of the present invention, there are multiple different embodiments envisaged. For example, the slideable mounting element 46 may be a part of the second mounting unit 51 and correspondingly an engagement surface may be provided on the control unit 42 of the print head unit 4. In another example, the slideable mounting element 46 may be arranged directly on the control unit 42 instead of on the duct element 44.

[0050] Additionally or alternatively, the resilient element may be omitted or may be arranged separate from the duct element 44. The resilient element 45 may, for example, be part of the second mounting unit 51 or may be arranged on the print head unit differently. If present, the resilient element 45 may be operatively connected to the slideable mounting element 46, as illustrated, or the resilient element 45 may be separately operateable.

[0051] Additionally or alternatively, as mentioned above, the print head unit may comprise a coupling assembly providing a fixed connection and a moveable connection. Such a coupling assembly may have any suitable construction.

[0052] In the illustrated embodiment, the shape of the ramp portions 465, 466 of the mounting element 46 provide for the movement of the control unit 42 relative to the droplet forming unit 41. Additionally or alternatively, the shape of the engagement surface 514 may provide for the movement. Essentially, the cooperation between the slideable mounting element and the mating mounting element is to provide for the relative movement between the control unit 42 and the droplet forming unit 41. A skilled person readily understands which other or similar shapes are suitable to provide for such a relative movement.

[0053] Thus, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. In particular, features presented and described in separate dependent claims may be applied in combination and any advantageous combination of such claims is herewith disclosed.

[0054] Further, it is contemplated that structural elements may be generated by application of three-dimensional (3D) printing techniques. Therefore, any reference to a structural element is intended to encompass any computer executable instructions that instruct a computer to generate such a structural element by three-dimensional printing techniques or similar computer controlled manufacturing techniques. Furthermore, such a refer-

ence to a structural element encompasses a computer readable medium carrying such computer executable instructions.

[0055] Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention. The terms "a" or "an", as used herein, are defined as one or more than one. The term plurality, as used herein, is defined as two or more than two. The term another, as used herein, is defined as at least a second or more. The terms including and/or having, as used herein, are defined as comprising (i.e., open language). The term coupled, as used herein, is defined as connected, although not necessarily directly.

Claims

1. Inkjet printing apparatus, the inkjet printing apparatus comprising at least one print head unit and a print head holding unit, wherein the print head unit comprises:

- a droplet forming unit (41); and
- a control unit (42), wherein the droplet forming unit and the control unit are moveably connected;

wherein the print head holding unit comprising:

- a first mounting unit for accurately positioning and holding the droplet forming unit; and
- a second mounting unit (51) for holding the control unit within a predetermined range relative to the corresponding droplet forming unit;**characterized in that** a mounting element (46) and a mating mounting element (51L, 51R) are provided for mounting the control unit in the second mounting unit, the mounting element being a slideably arranged element and the mating mounting element having a receptor (515) for receiving a mating portion of the mounting element,

one of the mounting element and mating mounting element being arranged on the control unit and the other one of the mounting element and mating mounting element being arranged on the second mounting unit; **characterised in that**

- the receptor is provided with an engagement surface (514, 514a, 514b, 514c, 514L, 514R);
- the mating portion of the slideably arranged mounting element is configured to engage with the engagement surface;
- the shape of the engagement surface or the shape of the mating portion forms a ramp (465, 466), wherein the ramp is configured and arranged to move the control unit upon mounting in a direction having a component that is perpendicular to a direction of the sliding movement of the slideable mounting element, into a position in which the control unit is held within the predetermined range.

2. Inkjet printing apparatus according to claim 1, wherein the print head unit comprises a coupling assembly (43) having a first state and a second state, wherein

- in the first state, the coupling assembly provides for a fixed connection between the control unit and the droplet forming unit;
- in the second state, the coupling assembly provides for the moveable connection between the control unit and the droplet forming unit, in which the control unit and the droplet forming unit can move relative to each other within the predetermined range; and

wherein movement of the control unit into said position, upon mounting of the control unit, operates the coupling assembly from the first state to the second state.

3. Inkjet printing apparatus according to any of the preceding claims, wherein a resilient element (45) is provided and the second mounting assembly comprises a slot (512a, 513a) for receiving a protruding portion (421, 422) of the control unit, the resilient element having a first retracted position allowing the protruding portion to be positioned in the slot and the resilient element having a second state for resiliently clamping the control unit, when positioned in the slot, wherein the resilient element is arranged such that it is switched from the first state to the second state by the sliding action of the mounting element.

4. Inkjet printing apparatus according to any of the preceding claims, wherein the print head unit is vertically mounted in the print head holding unit and, when positioned in the print head holding unit, the slideable mounting element is slideable in a substantially horizontal direction, and wherein the shape of at least one of the mounting element and the receptor of the mating mounting element is such that the sliding movement in the horizontal direction moves the control unit in the vertical direction away from the droplet forming unit.

5. Inkjet printing apparatus according to any of the preceding claims, wherein the control unit is provided with a duct element (44) and the slideable mounting element is slideably connected to the duct element.

Patentansprüche

1. Tintenstrahldruckgerät, welches Tintenstrahldruckgerät wenigstens eine Drucckopfeinheit und eine Druckkopfhalteeinheit aufweist, wobei die Druckkopfeinheit aufweist:

   - eine Tröpfchenbildungseinheit (41); und
   - eine Steuereinheit (42), wobei die Tröpfchenbildungseinheit und die Steuereinheit beweglich verbunden sind;

   wobei die Druckkopfhalteeinheit aufweist:

   - eine erste Montageeinheit zum genauen Positionieren und Halten der Tröpfchenbildungseinheit; und
   - eine zweite Montageeinheit (51) zum Halten der Steuereinheit innerhalb eines vorbestimmten Bereiches relativ zu der entsprechenden Tröpfchenbildungseinheit;

   dadurch gekennzeichnet, dass ein Montageelement (46) und ein dazu passendes Montageelement (51L, 51R) dazu vorgesehen sind, die Steuereinheit in der zweiten Montageeinheit zu montieren, wobei das Montageelement ein verschiebbar angeordnetes Element ist und das dazu passende Montageelement eine Aufnahme (515) zur Aufnahme eines passenden Teils des Montageelements aufweist, wobei eines der Bauteile: Montageelement und passendes Montageelement, an der Steuereinheit angeordnet ist und das andere dieser Bauteile an der zweiten Montageeinheit angeordnet ist;
   dadurch gekennzeichnet, dass

   - die Aufnahme mit einer Anlagefläche (514, 514a, 514b, 514c, 514L, 514R) versehen ist;
   - der passende Teil des verschiebbar angeordneten Montageelements dazu konfiguriert ist, an der Anlagefläche in Anlage zu kommen;
   - die Form der Anlagefläche oder die Form des passenden Teils eine Rampe (465, 466) bildet, wobei die Rampe so konfiguriert und angeordnet ist, dass die Steuereinheit bei der Montage in einer Richtung bewegt wird, die eine Komponente senkrecht zu einer Richtung der Verschiebebewegung des verschiebbaren Montageelements hat, in eine Position, in welcher die Steuereinheit innerhalb des vorbestimmten Bereiches gehalten ist.

2. Tintenstrahldruckgerät nach Anspruch 1, bei dem die Druckkopfeinheit eine Kopplungseinrichtung (43) aufweist, die einen ersten Zustand und einen zweiten Zustand hat, wobei

   - in dem ersten Zustand die Kopplungseinrichtung für eine feste Verbindung zwischen der Steuereinheit und der Tröpfchenbildungseinheit sorgt;
   - in dem zweiten Zustand die Kopplungseinrichtung für eine bewegliche Verbindung zwischen der Steuereinheit und der Tröpfchenbildungseinheit sorgt, bei der sich die Steuereinheit und die Tröpfchenbildungseinheit relativ zueinander innerhalb des vorbestimmten Bereiches bewegen kann; und
   - wobei die Bewegung der Steuereinheit in die genannte Position, bei der Montage der Steuereinheit, die Kopplungseinrichtung von dem ersten Zustand in den zweiten Zustand umstellt.

3. Tintenstrahldruckgerät nach einem der vorstehenden Ansprüche, bei dem ein nachgiebiges Element (45) vorgesehen ist und die zweite Montageanordnung einen Schlitz (512a, 513a) zur Aufnahme eines vorstehenden Teils (421, 422) der Steuereinheit aufweist, wobei das nachgiebige Element eine erste zurückgezogene Position aufweist, die es dem vorstehenden Teil erlaubt, in dem Schlitz positioniert zu werden, und das nachgiebige Element einen zweiten Zustand zum nachgiebigen Klemmen der Steuereinheit aufweist, wenn sie in dem Schlitz positioniert ist, wobei das nachgiebige Element so angeordnet ist, dass es durch die Schiebewirkung des Montageelements aus dem ersten Zustand in den zweiten Zustand umgestellt wird.

4. Tintenstrahldruckgerät nach einem der vorstehenden Ansprüche, bei dem die Druckkopfeinheit vertikal in der Druckkopfhalteeinheit montiert ist und, wenn sie in der Druckkopfhalteeinheit montiert ist, das verschiebbare Montageelement in einer im wesentlichen horizontalen Richtung verschiebbar ist, und wobei die Form des Montageelements und/oder der Aufnahme für das passende Montageelement derart ist, dass die Verschiebebewegung in der horizontalen Richtung die Steuereinheit in der vertikalen Richtung von der Tröpfchenbildungseinheit weg bewegt.

5. Tintenstrahldruckgerät nach einem der vorstehenden Ansprüche, bei dem die Steuereinheit ein Leitungselement (44) aufweist und das verschiebbare Montageelement verschiebbar mit dem Leitungselement verbunden ist.

Revendications

1. Appareil d'impression à jet d'encre, l'appareil d'impression à jet d'encre comprenant au moins une unité de tête d'impression et une unité de maintien de tête d'impression, dans lequel l'unité de tête d'impression comprend :

- une unité de formation de gouttelettes (41) ; et
- une unité de commande (42), dans lequel l'unité de formation de gouttelettes et l'unité de commande sont reliées de manière amovible ;

dans lequel l'unité de maintien de tête d'impression comprend :

- une première unité de montage pour positionner avec précision et maintenir l'unité de formation de gouttelettes ; et
- une seconde unité de montage (51) pour maintenir l'unité de commande à l'intérieur d'une plage prédéterminée par rapport à l'unité de formation de gouttelettes correspondante ; **caractérisé en ce qu'**un élément de montage (46) et qu'un élément de montage complémentaire (51L; 51R) sont prévus pour monter l'unité de commande dans la seconde unité de montage, l'élément de montage étant un élément agencé de manière coulissante et l'élément de montage complémentaire ayant un récepteur (515) pour recevoir une partie complémentaire de l'élément de montage,

l'un de l'élément de montage et de l'élément de montage complémentaire étant agencé sur l'unité de commande et l'autre de l'élément de montage et de l'élément de montage complémentaire étant agencé sur la seconde unité de montage ;
caractérisé en ce que

- le récepteur est pourvu d'une surface de mise en prise (514, 514a, 514b, 514c, 514L, 514R) ;
- la partie complémentaire de l'élément de montage agencé de manière coulissante est configurée pour se mettre en prise avec la surface de mise en prise ;
- la forme de la surface de mise en prise ou la forme de la partie complémentaire constitue une rampe (465, 466), dans lequel la rampe est configurée et agencée pour déplacer l'unité de commande lors du montage dans une direction ayant un composant qui est perpendiculaire à une direction du mouvement coulissant de l'élément de montage coulissant, dans une position dans laquelle l'unité de commande est maintenue à l'intérieur de la plage prédéterminée.

2. Appareil d'impression à jet d'encre selon la revendication 1, dans lequel l'unité de tête d'impression comprend un ensemble de couplage (43) ayant un premier état et un second état, dans lequel

- dans le premier état, l'ensemble de couplage fournit une connexion fixe entre l'unité de commande et l'unité de formation de gouttelettes ;
- dans le second état, l'ensemble de couplage fournit une connexion amovible entre l'unité de commande et l'unité de formation de gouttelettes, dans lequel l'unité de commande et l'unité de formation de gouttelettes peuvent se déplacer l'une par rapport à l'autre au sein de la plage prédéterminée ; et

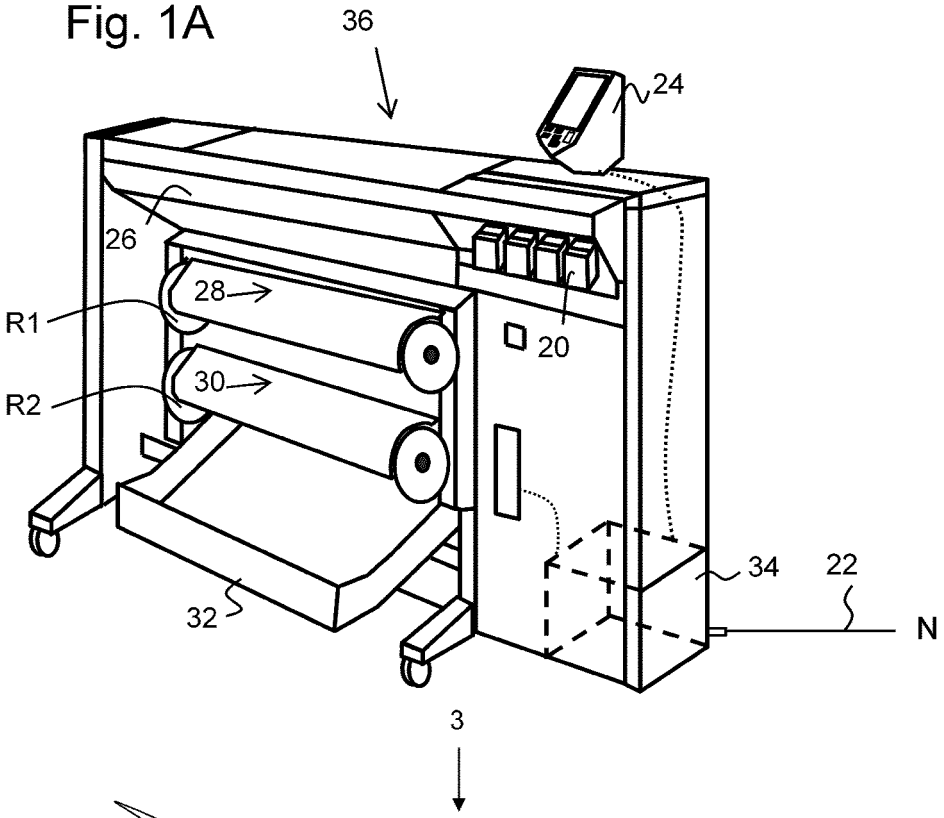
dans lequel le mouvement de l'unité de commande dans ladite position, lors du montage de l'unité de commande, actionne l'ensemble de couplage du premier état vers le second état.

3. Appareil d'impression à jet d'encre selon l'une quelconque des revendications précédentes, dans lequel un élément élastique (45) est prévu et le second élément de montage comprend une fente (512a, 513a) pour recevoir une partie en saillie (421, 422) de l'unité de commande, l'élément élastique ayant une première position en retrait permettant à la partie en saillie d'être positionnée dans la fente et l'élément élastique ayant un second état pour serrer de manière élastique l'unité de commande, lorsqu'elle est positionnée dans la fente, dans lequel l'élément élastique est agencé de telle sorte qu'il est commuté du premier état au second état par l'action coulissante de l'élément de montage.

4. Appareil d'impression à jet d'encre selon l'une quelconque des revendications précédentes, dans lequel l'unité de tête d'impression est montée verticalement dans l'unité de maintien de tête d'impression et, lorsqu'elle est positionnée dans l'unité de maintien de tête d'impression, l'élément de montage coulissant peut coulisser dans une direction sensiblement horizontale, et dans lequel la forme d'au moins un de l'élément de montage et du récepteur de l'élément de montage complémentaire est telle que le mouvement coulissant dans la direction horizontale déplace l'unité de commande dans la direction verticale à l'écart de l'unité de formation de gouttelettes.

5. Appareil d'impression à jet d'encre selon l'une quelconque des revendications précédentes, dans lequel l'unité de commande est pourvue d'un élément de conduit (44) et l'élément de montage coulissant est monté de manière coulissante dans l'élément de conduit.

Fig. 1A


36
24
26
28
R1
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R2
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34
22
N
32
3

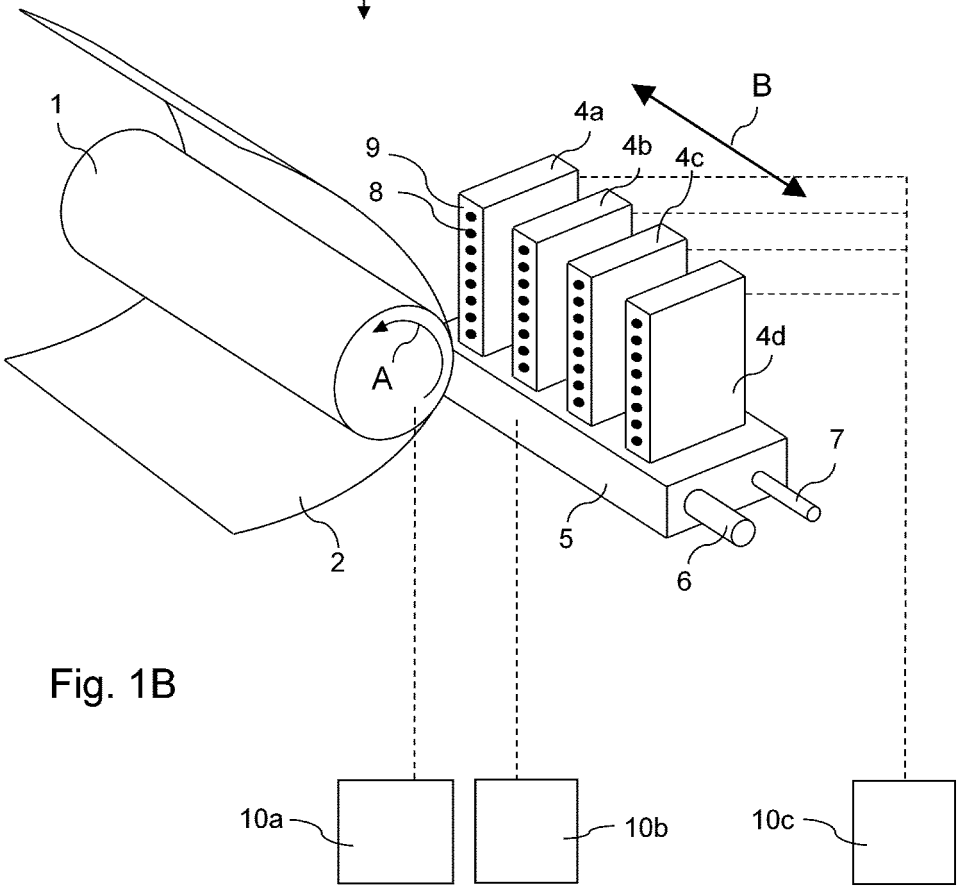

1
B
4a
9
4b
4c
8
4d
A
7
5
2
6
10a
10b
10c

Fig. 1B

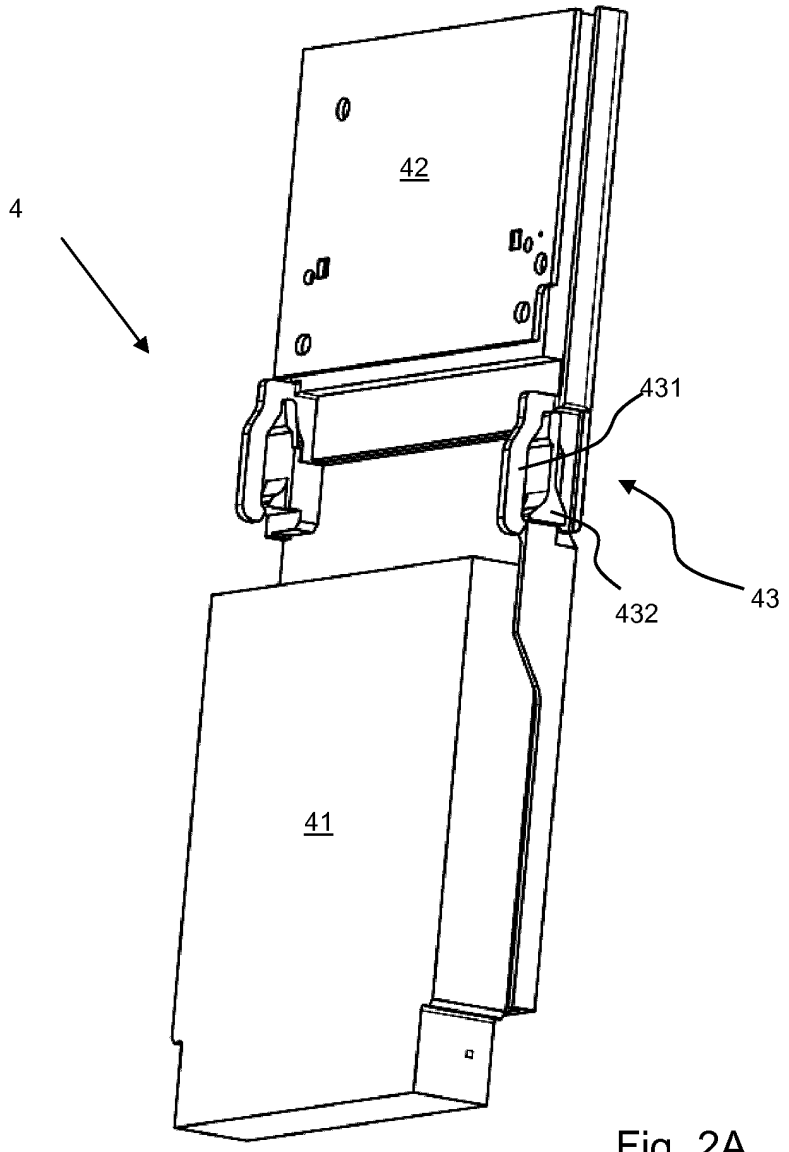


Fig. 2A

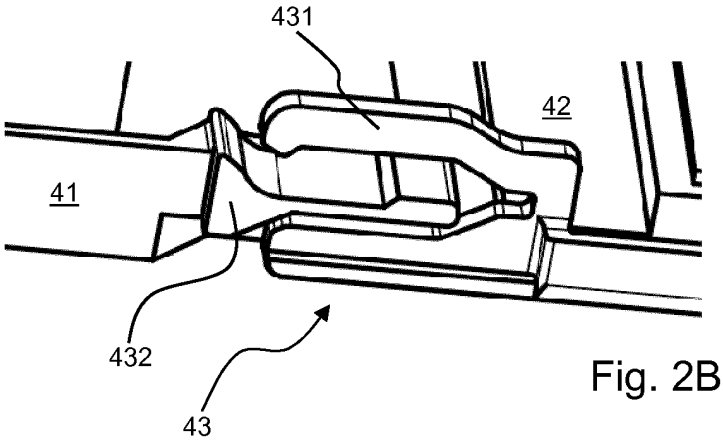


Fig. 2B

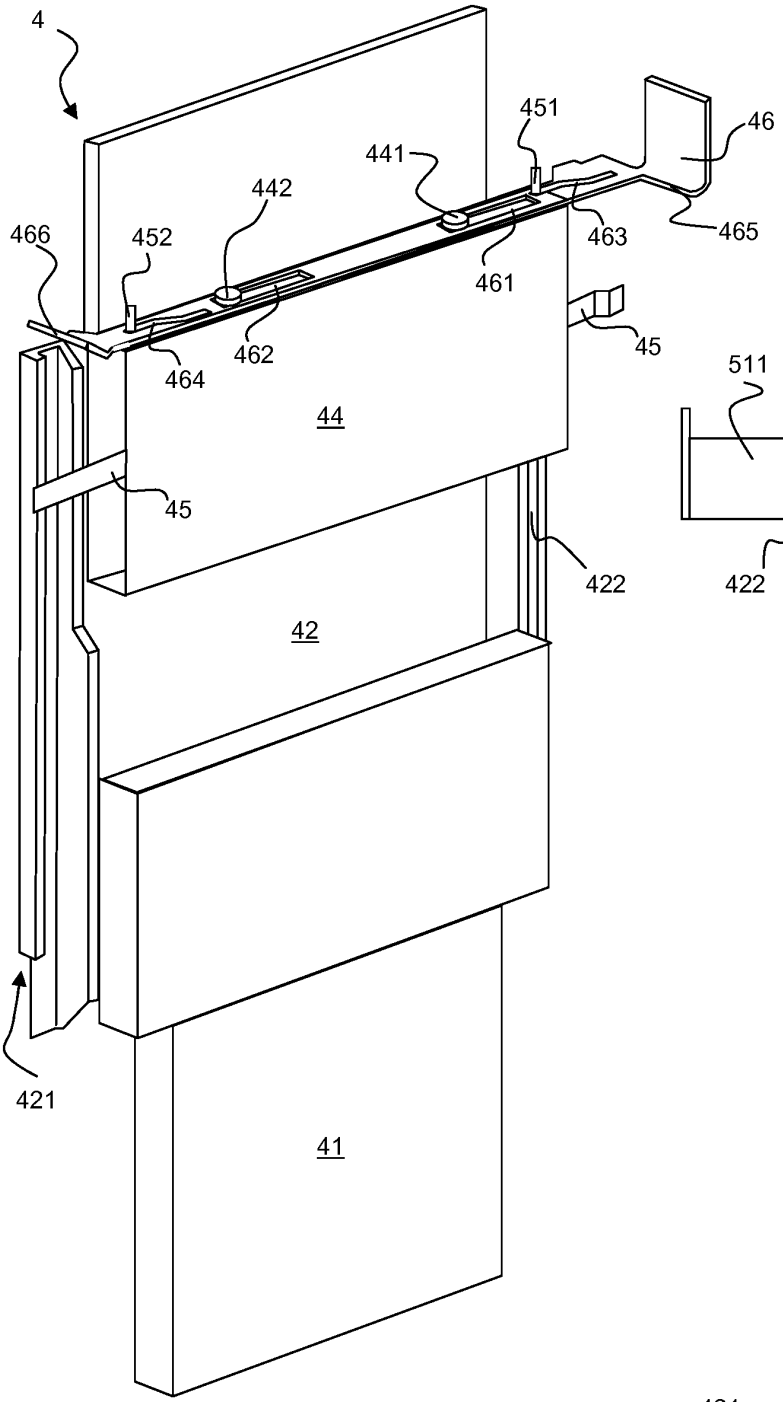

4
451
46
441
442
466
452
463
465
461
462
45
464
44
45
422
42
421
41

Fig. 3A

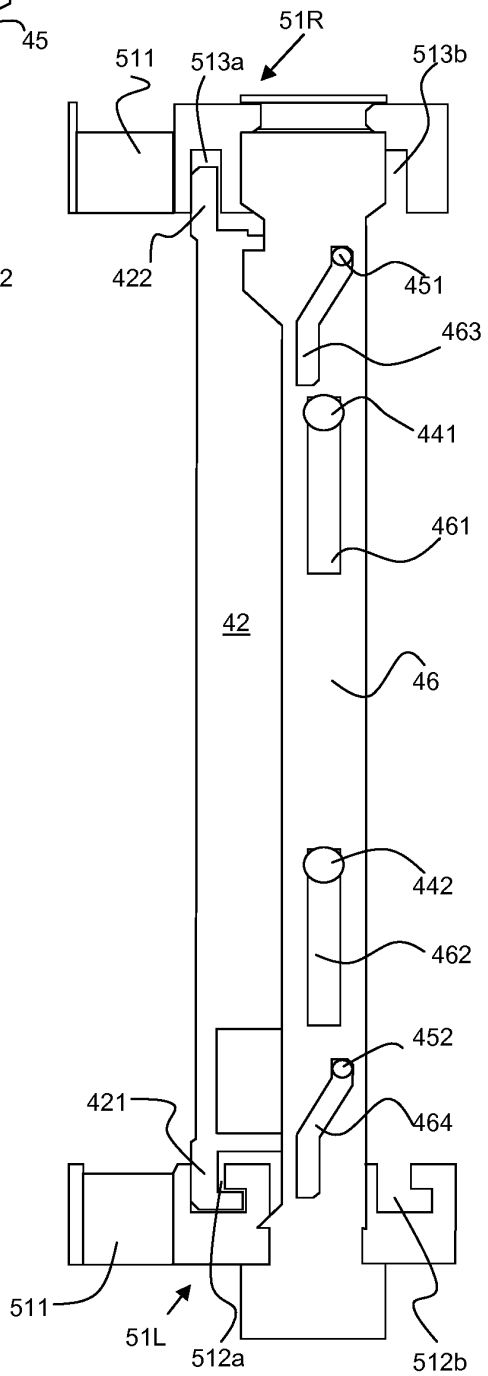

51R
511
513a
513b
422
451
463
441
461
42
46
442
462
452
421
464
511
51L
512a
512b

Fig. 3B

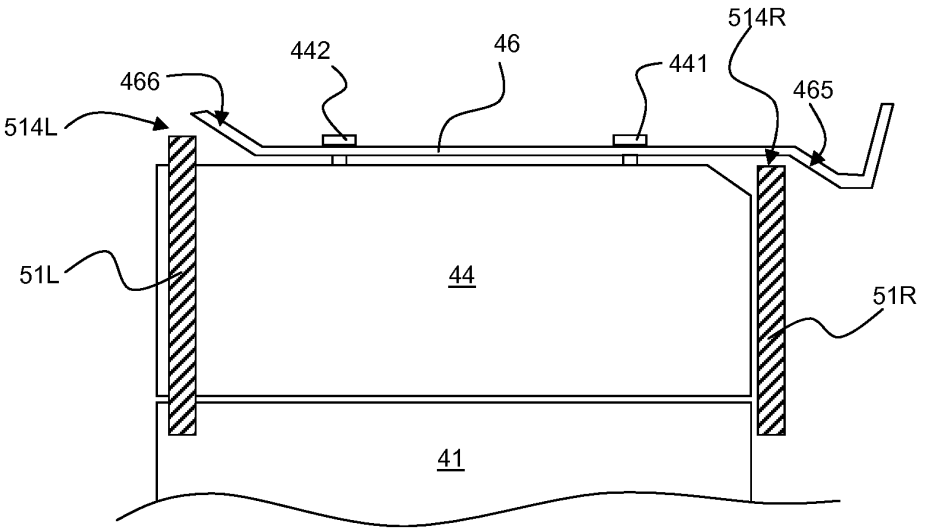


Fig. 4A

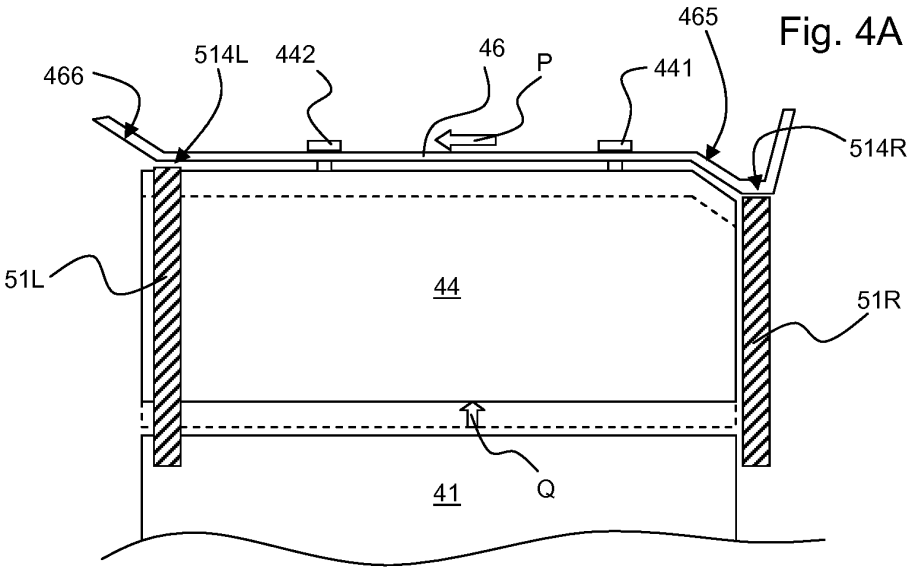


Fig. 4B

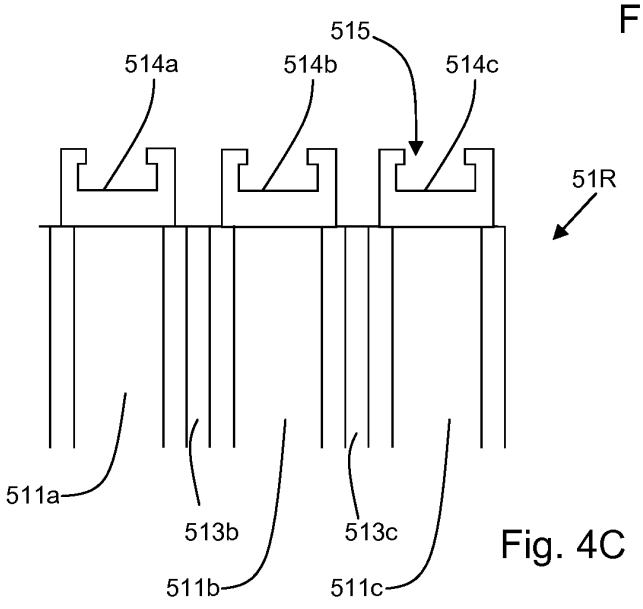


Fig. 4C

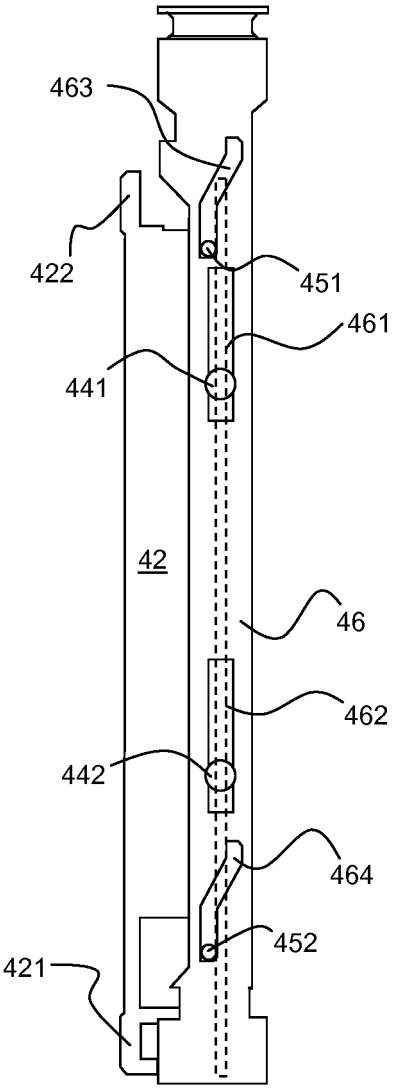

463
422
451
461
441
42
46
462
442
464
452
421

Fig. 5A

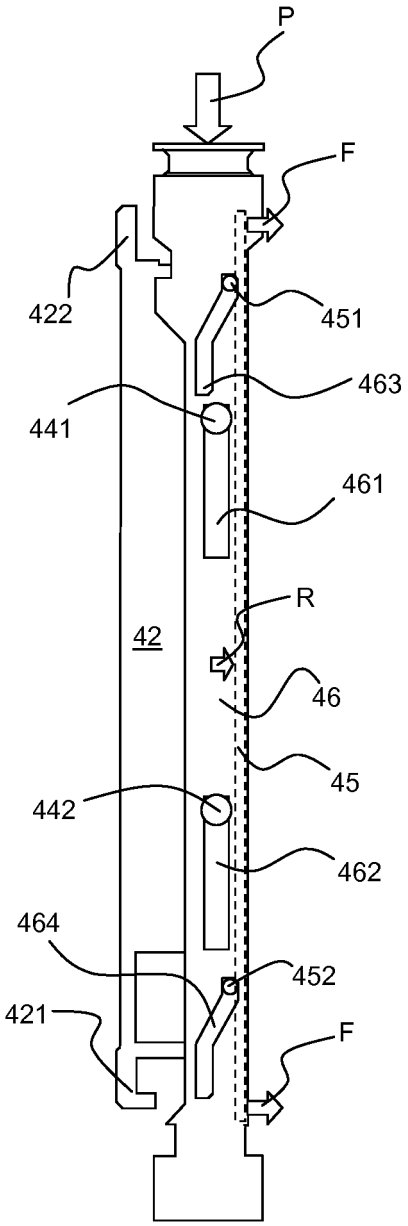

P
F
422
451
463
441
461
R
42
46
45
442
462
464
452
421
F

Fig. 5B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2011074849 A **[0003]**