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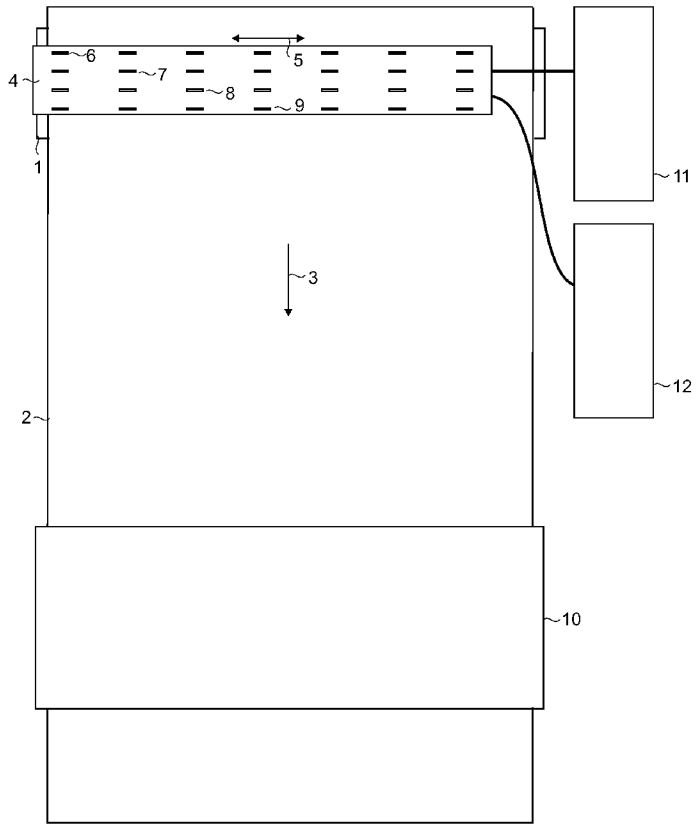
(54) Title: SPRAY HEAD AND DEVICE FOR PRINTING OR SPRAVING TEXTILE MATERIALS



(57) Abstract: The invention relates to a spray head for printing or spraying textile materials, comprising a liquid reservoir with spray apertures, valves for opening and closing the spray apertures and actuating members for actuating the valves. The actuating members are placed outside the liquid reservoir and they actuate the valves via rod-like elements. The liquid reservoir is provided with passage openings allowing passage of the rod-like elements.

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Spray head and device for printing or spraying textile materials

The invention relates to a spray head for printing or spraying textile materials, comprising a liquid reservoir with spray apertures, valves for opening and closing the spray apertures and actuating members for actuating the valves.

A spray head of this type is known. The known spray head is designed in the first place for the purpose of marking industrial products, for instance with a barcode or with a best-by date. It makes use of small soft-iron cores which are accommodated in the liquid reservoir and which are drawn into electromagnets likewise accommodated in the liquid reservoir and herein open the valves, whereby the spray head dispenses liquid droplets. When the electromagnet is no longer energized, a spring then pushes the valve shut again. The problem in the known spray head is that, in a textile printing application, it converts the control signals with a high control frequency almost completely into heat, whereby the temperature of the liquid for spraying can rise close to the valve, which can in turn cause colour variations or stripe formation, whereby the printed product becomes unsaleable, or in any case worthless.

The spray head according to the invention obviates these drawbacks and has the feature that the actuating members are placed outside the liquid reservoir, that the actuating members actuate the valves via rod-like elements and that the liquid reservoir is provided with passage openings allowing passage of the rod-like elements. In this manner it becomes possible to separately discharge the heat possibly generated by the actuating members such that the temperature of the liquid for spraying does not rise, particularly close to the valves.

A favourable embodiment, wherein a spray head with a minimum of components can be realized, has the feature that the valves are formed by spray apertures and outer ends of rod-like elements. The ends of rod-like elements are preferably provided here with a valve seat optimized for a good

sealing, so that the liquid reservoir can, if desired, be operated under increased pressure. With further preference each actuating member is provided close to the passage opening with at least one sealing ring so that no liquid can penetrate into the actuating member.

According to a further aspect of the invention, a favourable embodiment has the feature that the actuating members are mounted removably on the liquid reservoir so that, in the unlikely event an actuating member malfunctions, this actuating member can be replaced without this affecting the alignment of the spray head. If larger liquid droplets are for instance desired, the actuating members can also be replaced by actuating members with rod-like elements which perform a greater stroke, whereby larger liquid droplets are dispensed.

A further favourable embodiment has the feature that the actuating members comprise piezo elements. Piezo elements make it possible to open and reclose the valves at precisely determined times, while the development of heat is limited. An important additional advantage is that piezo elements are robust and can be readily manufactured in mass production within predetermined tolerances. Piezo elements can moreover be actuated using a bipolar voltage. With this bipolar voltage the opening of a valve can be realized in simple manner, and reclosing of the valve can also be supported. A further favourable embodiment has the feature that the piezo elements are provided with a central opening, whereby they can be coupled in simple manner to the associated rod-like elements.

A favourable alternative embodiment has the feature that the actuating members comprise electromagnets. The advantage of electromagnets is that they can be produced more cheaply than piezo elements and that they can be given a more slender form. The electromagnets can be embodied in traditional form, with a spring which closes the valve in a rest position, but the electromagnets are preferably each provided with a coil and a permanent magnet so that they can be actuated using a bipolar voltage. With this bipolar voltage the opening of a valve can be realized in simple manner, and reclosing of the valve can also be supported.

A further favourable embodiment has the feature that an actuating member is adapted in a situation of use to move a rod-like element to an adjustable stop point for the purpose of opening a valve. In this way the droplet size of the spray head can be adjusted per spray aperture in simple manner. It is possible to rely solely on the force of gravity to close the valve, but the actuating member can also be controlled such that the valve is actively closed.

The invention also relates to a device for printing or spraying textile materials, comprising a system of spray heads placed above the material, control means for the spray heads and transport means for transporting the textile materials, characterized in that the spray heads are of the type as specified in the foregoing paragraphs. Affordable, fast and very reliable spray heads can thus be realized, which moreover consist of relatively few parts.

A further favourable embodiment has the feature that the device also comprises a control voltage generator connected to a computer for generating control signals for controlling the actuating members. For each actuating member the computer can then provide the timing for opening and closing the associated valve and can determine a possible calibration voltage for each actuating member.

The invention will now be further elucidated with reference to the following figures, wherein:

Fig. 1 shows a schematic top view of a device according to the invention;
Fig. 2 shows a schematic front view of a possible embodiment of a spray head according to the invention;
Fig. 3A shows a schematic side view of this spray head;
Fig. 3B shows a schematic top view of this spray head;
Fig. 4 shows a schematic front view of an alternative embodiment of a spray head according to the invention;

Fig. 5 shows a schematic side view of this spray head.

Fig. 1 shows a schematic top view of a device according to the invention. A strip of textile 2 is carried over a table 1 in a direction indicated by an arrow 3. Above textile 2 a yoke 4 moves reciprocally in a direction indicated by an arrow 5. If use is made of the CMYK system, four groups of spray heads 6,7,8,9, which spray droplets of liquid onto textile 2 are for instance placed on yoke 4. Spray head 6 sprays for instance black ink, while spray heads 7,8,9 spray for instance cyan, yellow and magenta. It is also possible to realize other systems, which spray for instance 6,8,12 or more colours or chemicals which have the purpose of upgrading the textile in some way. The speed of textile 2 and of yoke 4 is chosen in combination with the geometry and placing of spray heads 6,7,8,9 in a manner which is further self-evident such that any conceivable pattern can be sprayed onto textile 2. It is also possible to provide the device with for instance four spray heads which each cover the whole width of strip of textile 2, whereby yoke 4 can be omitted. The size of a sprayed droplet depends on the type of material; a droplet can be relatively large, particularly for deep-pile materials. A droplet has a volume of roughly 1-200 nanolitres. Once the liquid has dried, strip of textile 2 is carried through a heating unit 10 where the liquid partially evaporates, reacts or sublimates and is absorbed to a significant extent into the fibres of textile 2, whereby a good wear-resistance of the pattern is obtained. The device further comprises a liquid cartridge 11 where the liquid for spraying is filtered, brought to a predetermined temperature and carried through the nozzles. Filtering is essential because otherwise the nozzles of spray heads 6,7,8,9 can become clogged, whereby lines of a different colour or a different pattern can result on textile 2. The temperature must be constant because temperature changes can affect the viscosity of the liquid for spraying, and thereby the size of a liquid droplet, and this can cause a change in the colour of the pattern or more generally a change in the layer thickness. Finally, the device comprises an actuating member 12, generally a computer together with an interface, with which nozzles 6,7,8,9 and the diverse drives (not shown) for moving the strip of textile 2 and optionally yoke 4 are controlled.

Fig. 2 shows a schematic front view of a possible embodiment of a spray head 6 according to the invention. Spray head 6 consists of a metal or plastic housing 13 with a cover 14 and is provided with a liquid channel 15 and a control channel 16 separated by a separating wall 17. Carried through liquid channel 15 is liquid for spraying, which can escape via a nozzle 18 in the form of a droplet. Control channel 16 comprises a piezo element 19 which is provided on both sides with a metallized layer to which a control voltage can be connected and one side of which is mounted conductively on separating wall 17, for instance using silver epoxy. The opposite side is provided with a connection 20 which leaves housing 13 via a glass bead 21. If a positive voltage is for instance connected to piezo element 19 via connection 20, the centre of piezo element 19 will then move upward. If a negative voltage is connected, the centre will then move downward. On the centre of piezo element 19 rests a plastic disc 22 which is formed integrally with a rod-like element 23, on which is mounted a valve seat 24 which is made of rubber and which at rest seals nozzle 18 in that a spring 25 presses disc 22 in the direction of nozzle 18. Rod-like element 23 pierces separating wall 17. In order to prevent liquid for spraying from liquid channel 15 being able to penetrate into control channel 16, separating wall 17 is provided with a seal 26, here embodied as O-ring, at the position of rod-like element 23. If a positive voltage is fed via connection 20 for a predetermined time, a droplet of a predetermined size will then leave nozzle 18 via nozzle 18. If the positive voltage is removed, disc 22 will then move downward again and nozzle 18 is closed by valve seat 24. It can be advantageous to have the closing of nozzle 18 take place by feeding a negative voltage for a short time via connection 20. Closing of nozzle 18 then takes place more quickly because the mass of piezo element 19 no longer plays any part and only the mass spring system formed by spring 25, disc 22 and rod-like element 23 determines the speed, and because valve seat 24 now lands relatively hard on nozzle 18. Valve seat 24 can otherwise be omitted if rod-like element 23 is manufactured from a relatively soft plastic. The movement which rod-like element 23 must make for proper operation of spray head 6 amounts to about 60 micron. Such a displacement can be taken up by O-ring 26 without rod-like element 23 sliding in O-ring 26, thus ensuring a perfect seal. Control

channel 16 is preferably ventilated with dry air in order to increase the lifespan of piezo element 19.

It is of course the intention that, once spray head 6 has been mounted, valve seat 24 only just closes nozzle 18 so that a droplet of liquid can be produced with a voltage pulse with a minimal amplitude on connection 20. If this is not the case as a result of tolerances for the different components of spray head 6, this situation can then still be achieved by applying a low direct voltage to piezo element 19 via connection 20, onto which voltage a voltage pulse can subsequently be superimposed in order to open the valve. This direct voltage causes no additional heat development and does not limit the operation of spray head 6.

Fig. 3A shows a schematic side view of spray head 6 with housing 13, cover 14 with connections 20a,20b,.., liquid channel 15 with connections 28,29 and control channel 16 in which a number of piezo elements 19a,19b are accommodated, with which nozzles 18a,18b,.. can be opened and reclosed. Spray head 6 for instance contains 16 spray apertures, whereby on the one hand it can be produced in relatively simple manner and on the other the number of connections in the form of hoses and cables is limited. Further shown are discs 22a,22b,.., rod-like elements 23a,23b,.. and springs 25a,25b,.., as well as O-rings 26a,26b,..

Fig. 3B shows a schematic top view of spray head 6, wherein cover 14 is removed. Piezo elements 19a,19b,.., springs 25a,25b,.. and connections 28,29 are shown.

Fig. 4 shows a schematic front view of an alternative embodiment of a spray head 30 according to the invention. Spray head 30 consists of a metal or plastic housing 13 in which is situated a liquid channel 15. Carried through liquid channel 15 is liquid for spraying which can escape in the form of a droplet via a nozzle 18. Placed on housing 13 are a number of actuating members 31, with which rod-like elements 23 manufactured from metal or plastic can be moved upward, whereby liquid for spraying present in liquid

channel 15 can escape in the form of droplets via nozzles 18. An actuating member 31 consists here of a housing 32 manufactured from a ferromagnetic material such as soft iron, into which is placed a coil 33 wound onto a hollow core 34 manufactured from a ferromagnetic material such as ferrite. Rod-like element 23 runs through hollow core 34 and is provided on the top with a permanent magnet in the form of a disc 35, wherein the magnetization direction is chosen to be perpendicular to the plane of disc 35. When no current is being carried through coil 33, disc 35 will be pulled toward hollow core 34, whereby nozzle 18 is closed. When a current is being carried through coil 33, disc 35 will want to move up or downward, depending on the direction of the current. In this way nozzle 18 can be opened, wherein the stroke of rod-like element 23, and thereby the flow resistance of nozzle 18, can be selected by adjusting an adjusting screw 36. If desired, the closing of nozzle 18 can be accelerated by carrying a current briefly in reverse direction through coil 33. In order to prevent liquid for spraying from liquid channel 15 being able to penetrate into actuating member 31 or flow outside, actuating member 31 is provided with seals 26a,26b, here embodied as O-rings.

Also shown in the figure is a valve seat 24 which is mounted on rod-like element 23 and which provides the actual sealing of nozzle 18, and a plastic disc 37 which provides for local mechanical guiding of rod-like element 23, and a connector 38 for power supply to coil 33.

Because the mechanical properties of actuating members 31 can differ from each other, it can be advantageous to provide each actuating member 31 with a calibration chip 39, for instance accommodated in space 40, in which these differences are compensated so that the actuating members are mutually interchangeable. In order to simplify the logistics of the necessary wiring, it can be advantageous to provide each actuating member 31 with additional electronics which convert the control to simple yes/no signals.

Fig. 5 shows a schematic side view of spray head 30 with housing 13, liquid channel 15 with connections 28,29 and a number of actuating members

31a,31b,.. with which nozzles 18a,18b,.. can be opened and reclosed. Spray head 30 for instance comprises 16 spray apertures, whereby on the one hand it can be produced in relatively simple manner and on the other the number of connections in the form of hoses and cables is limited. It will be apparent that, if desired, actuating members 31a,31b,.. can be placed much closer together than is indicated in the figure.

Claims

1. Spray head for printing or spraying textile materials, comprising a liquid reservoir with spray apertures, valves for opening and closing the spray apertures and actuating members for actuating the valves, characterized in that the actuating members are placed outside the liquid reservoir, that the actuating members actuate the valves via rod-like elements and that the liquid reservoir is provided with passage openings allowing passage of the rod-like elements.

2. Spray head as claimed in claim 1, characterized in that the valves are formed by spray apertures and outer ends of rod-like elements.

3. Spray head as claimed in claim 2, characterized in that outer ends of rod-like elements are provided with a valve seat.

4. Spray head as claimed in any of the foregoing claims, characterized in that an actuating member is provided close to the passage opening with at least one sealing ring.

5. Spray head as claimed in any of the foregoing claims, characterized in that the actuating members are mounted removably on the liquid reservoir.

6. Spray head as claimed in any of the foregoing claims, characterized in that the actuating members comprise piezo elements.

7. Spray head as claimed in claim 6, characterized in that the piezo elements are provided with a central opening.

8. Spray head as claimed in any of the claims 1-5, characterized in that the actuating members comprise electromagnets.

9. Spray head as claimed in claim 8, characterized in that the electromagnets are each provided with a coil and a permanent magnet.

10. Spray head as claimed in claim 9, characterized in that an actuating member is adapted in a situation of use to move a rod-like element to an adjustable stop point for the purpose of opening a valve.

11. Device for printing or spraying textile materials, comprising a system of spray heads placed above the material, control means for the spray heads and transport means for transporting the textile materials, characterized in that the device is provided with spray heads as claimed in any of claims 1-10.

12. Device as claimed in claim 11, characterized in that the device also comprises a control voltage generator connected to a computer for generating control signals for controlling the actuating members.

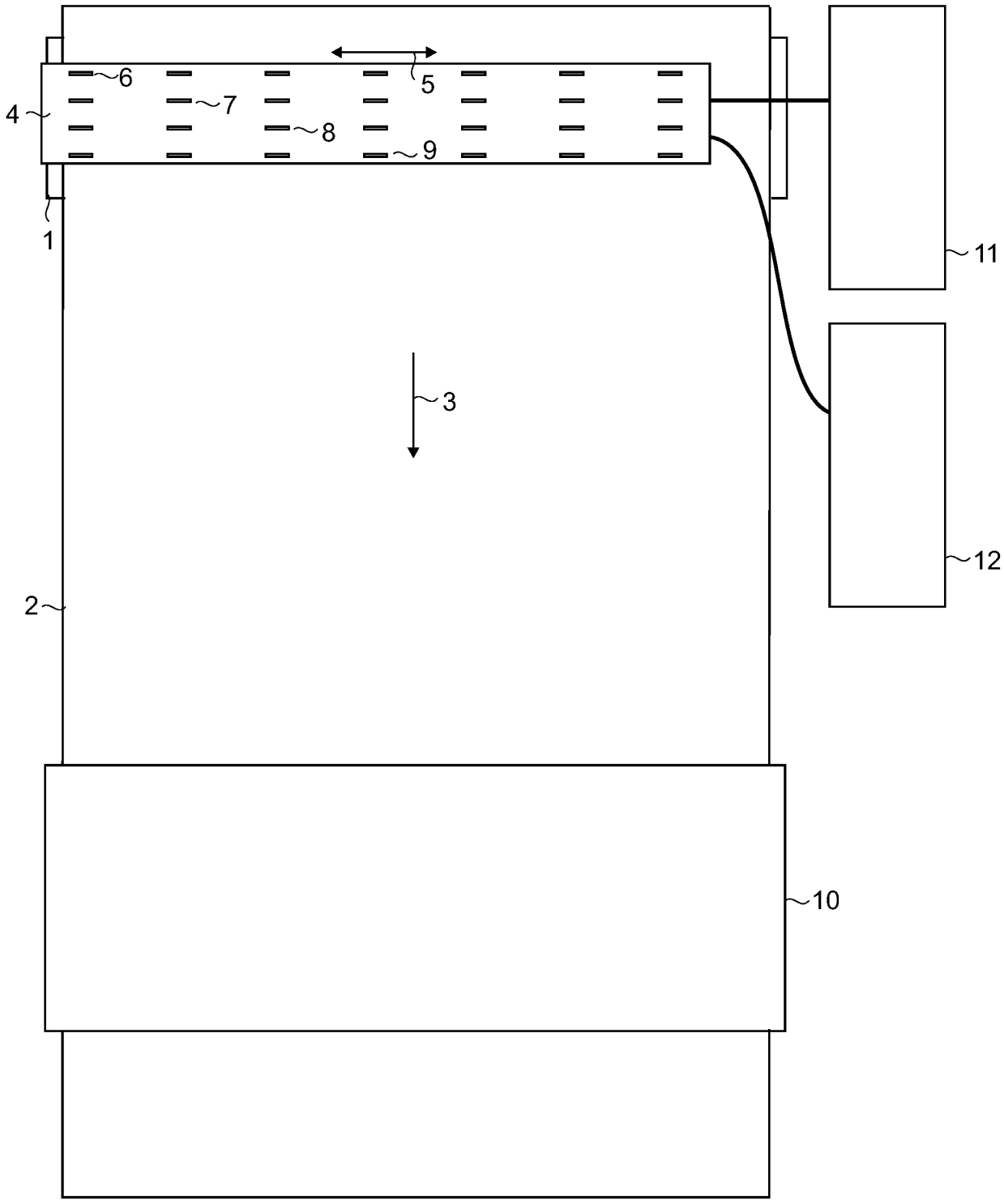

Fig. 1

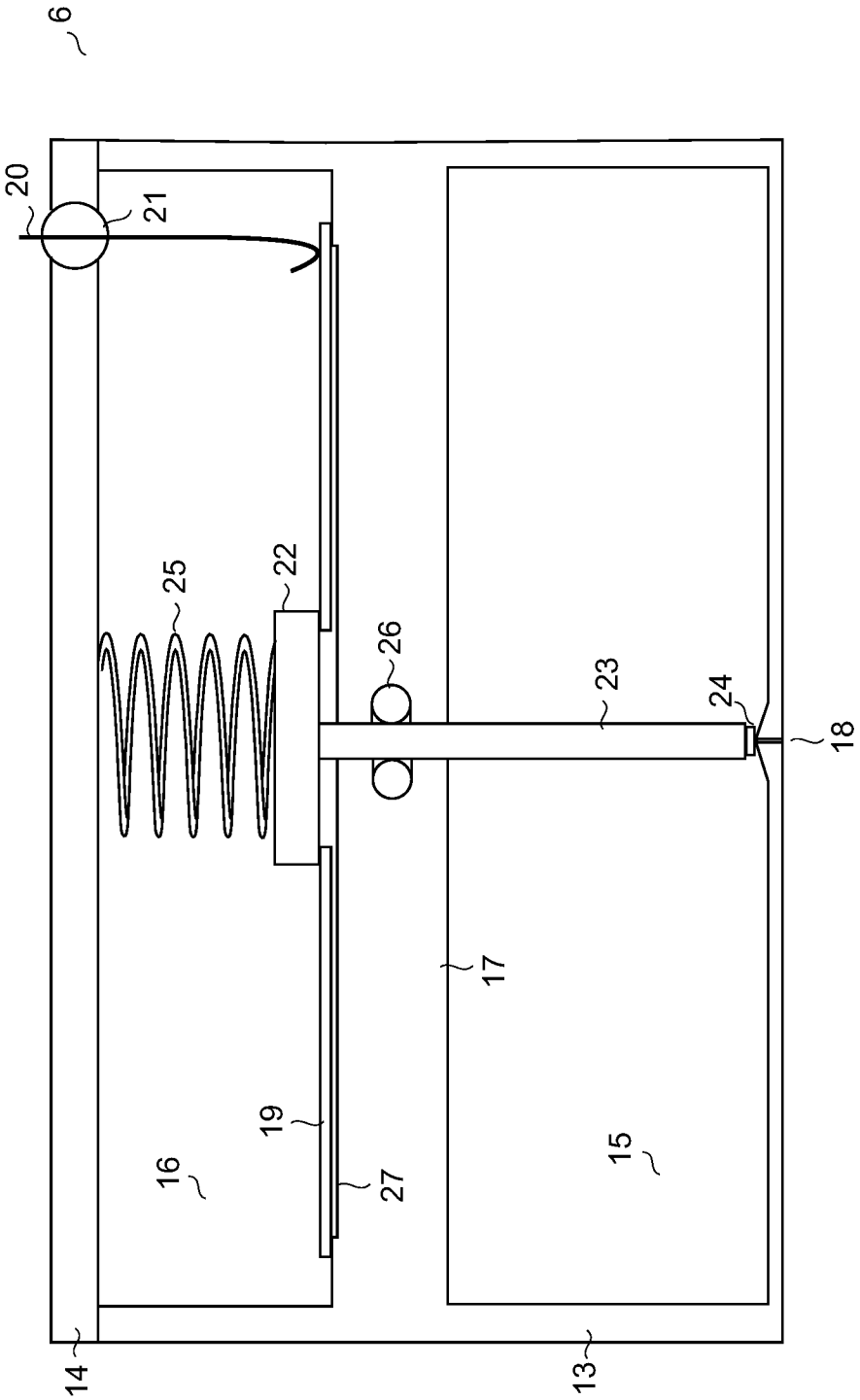

Fig. 2

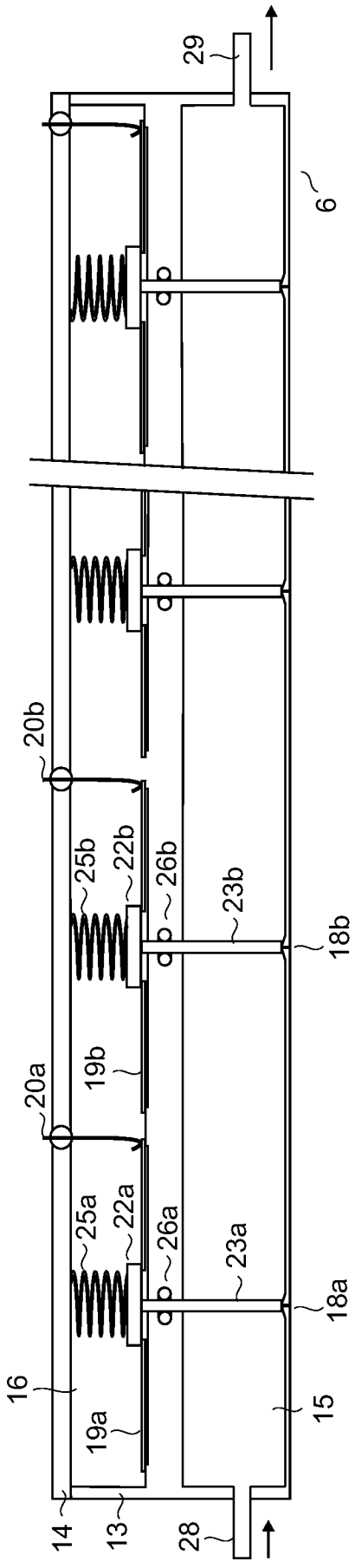
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Fig. 3A

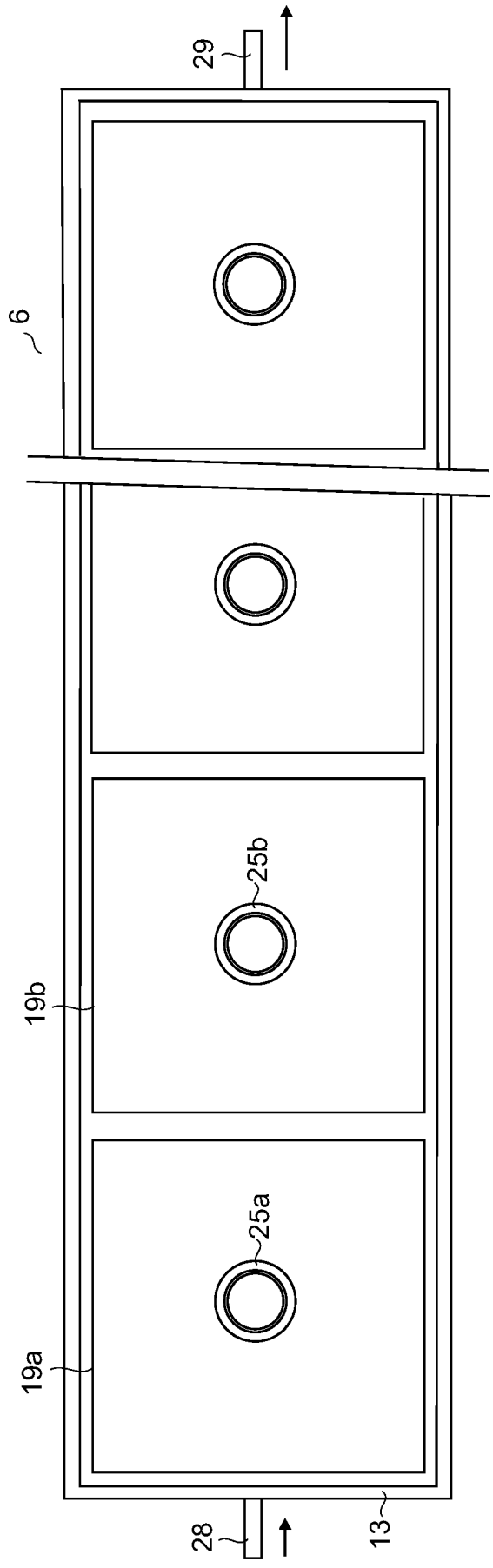
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Fig. 3B

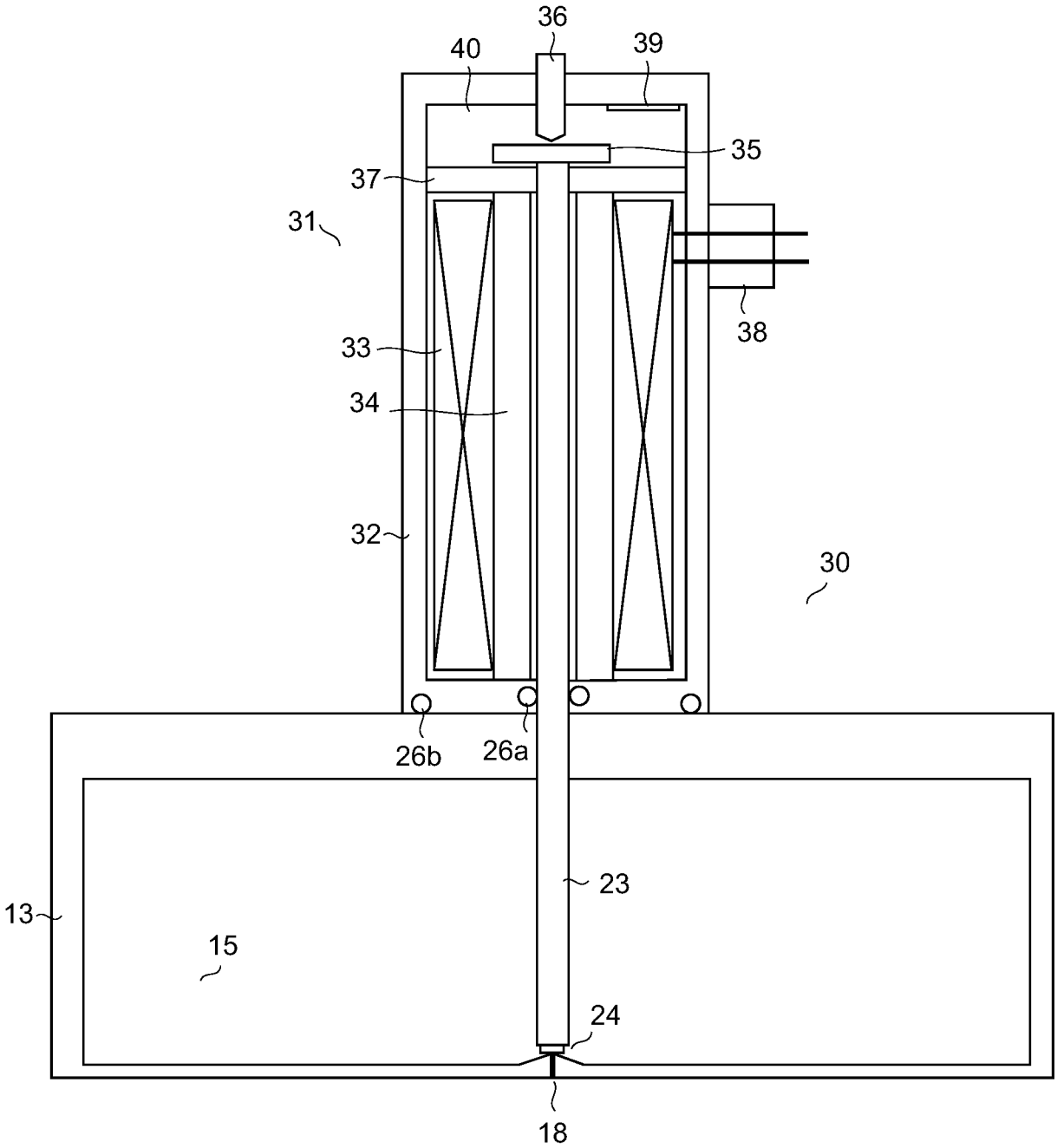

Fig. 4

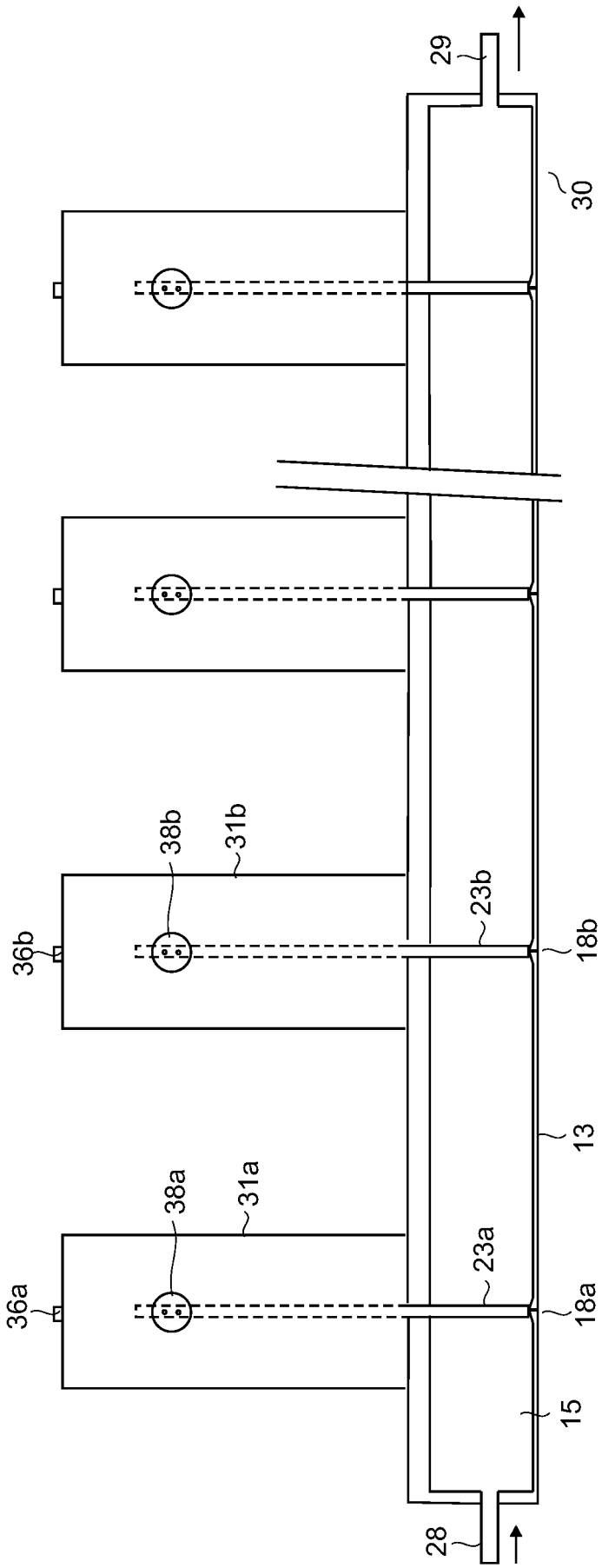

Fig. 5