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Device for filling cartridges of e-cigarettes with a liquid.

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The present invention relates to a device (10) for filling cartridges (12) of e-cigarettes with a liquid, the device comprising:

- a supply conduit (16) connected to a source (12) of liquid,
- a plunger pump (14) having an inlet (15) which is connected to the supply conduit, and an outlet (24), the plunger pump configured to pump a volume of liquid during a filling stroke,
- a discharge conduit (26) connected to the outlet (24) of the plunger pump,
- a discharge nozzle (28) connected to a downstream end (29) of the discharge conduit, the discharge nozzle being configured to be moved into an upwardly facing opening of the cartridge,
- an expansion device (30) which is connected to the discharge conduit, the expansion device being configured for increasing a volume (V) in the discharge conduit between the second non-return valve and the discharge nozzle, wherein the expansion of the discharge conduit is carried out directly after the plunger pump ends its filling stroke for preventing any drip to occur from the discharge nozzle after the filling stroke of the plunger pump has ended.

Title: Device for filling cartridges of e-cigarettes with a liquid

5 FIELD OF THE INVENTION

The present invention relates to a method and device for filling cartridges of e-cigarettes with a liquid.

10 BACKGROUND OF THE INVENTION

Electronic cigarettes (E-cigarettes) have become increasingly popular in the last years and are based on a battery-powered vaporizer which simulates tobacco smoking.

E-cigarettes generally have a heating element that atomizes a liquid solution known as e-liquid. E-liquids are usually a mixture of propylene glycol, glycerin, nicotine, and flavorings. E-cigarettes may provide nicotine by forming an aerosol of liquid particles. E-liquids without nicotine also exist.

Many E-cigarettes have been based on a cartridge system, wherein a user can exchange an empty cartridge with a new, full cartridge. Filling lines for filling these cartridges with the E-liquid (or liquid) have been developed.

The quantity of liquid that needs to be inserted into the cartridge is quite small. The discharge nozzle of the filling device is inserted into the cartridge, ejects this quantity of liquid in the cartridge, and is subsequently retracted from the cartridge.

It was recognized that existing filling lines have problems with drip. It was found that after the discharge nozzle is retracted from the cartridge, often one or more droplets of liquid drop from the discharge nozzle. This leads to filthiness of the filling line and the cartridges and loss of liquid.

OBJECT OF THE INVENTION

It is an object of the invention to provide a filling device for filling e-cartridges of e-cigarettes which leads to less drip.

It is an object of the invention to provide a filling device for filling e-cartridges of e-cigarettes which leads to less drip and functions in a simple and reliable manner.

It is another object of the invention to provide a filling device for filling e-cartridges of e-cigarettes which leads to less drip and in addition is relatively simple, so that a plurality of filling devices can be mounted on a single filling carousel and can be driven in a simple and reliable manner.

It is further object of the invention to provide a filling device for filling e-cartridges of e-cigarettes which is a suitable alternative to filling devices of the prior art.

THE INVENTION

In order to achieve at least one object, the invention provides a device for filling cartridges of e-cigarettes with a liquid, the device comprising:

- a supply conduit connected to a source of liquid,
- a plunger pump having an inlet which is connected to the supply conduit, and an outlet, the plunger pump being configured to pump a volume of liquid during a filling stroke,
- a discharge conduit connected to the outlet of the plunger pump,
- a discharge nozzle connected to a downstream end of the discharge conduit, the discharge nozzle being configured to inject the volume of liquid into the cartridge,

an expansion device which is connected to the discharge conduit, the expansion device being configured for increasing a volume (V) in the discharge conduit between the outlet of the plunger pump and the discharge nozzle at the end of the filling stroke for preventing any drip to occur from the discharge nozzle after the filling stroke of the plunger pump has ended.

The invention creates an underpressure in the discharge conduit at the end of the filling stroke which sucks any drop that may drip from the nozzle back into the discharge conduit. It was found that with this filling device, the problem of drip can effectively be mitigated.

The expansion device may comprise a movable part which is configured to make a reciprocating movement. This results in a relatively simple expansion device.

In an embodiment, the expansion device is provided in an ongoing section of the discharge conduit and expands the volume of the ongoing section. In this way the discharge conduit can be kept simple.

In an embodiment, the discharge conduit comprises:

- an ongoing section between the plunger pump and the discharge nozzle, and
- a dead-end section connected to the ongoing section,

wherein the expansion device is provided in the dead-end section and expands the
5 volume of the dead-end section.

It was found that the arrangement in a dead-end section results in a very reliable prevention of drip.

In an embodiment, the discharge conduit comprises a resilient tube section and
10 wherein the expansion device comprises an actuator which is configured to compress the resilient tube section from a first volume to a small volume, and wherein the resilient tube section expands from the small volume back to the first volume as a result of its resilience. This embodiment has an advantage in that there are no moving parts in the discharge conduit which contact the liquid in the discharge conduit.

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In an embodiment, the expansion device comprises an expansion plunger pump, the movable part being the plunger of the expansion plunger pump, wherein the expansion plunger pump has a chamber which is in fluid communication with the discharge conduit. This embodiment was found to be very sturdy and reliable.

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In an embodiment, the movable part makes a compression stroke and an expansion stroke, wherein during the compression stroke of the movable part the volume of the discharge conduit is decreased and wherein during an expansion stroke of the movable part the volume of the discharge conduit is increased.

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In an embodiment, the compression stroke of the movable part takes place during the filling stroke of the plunger pump and wherein the expansion stroke of the movable part takes place during the return stroke of the plunger pump. This arrangement allows an easy synchronization of the filling and the prevention of drip.

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In an embodiment, the plunger of the plunger pump and the movable part are driven by a single cam which is configured to run along a cam track, wherein the cam track drives both the plunger pump and the expansion device via the single cam, wherein the driving of the expansion device by the cam takes place directly or indirectly via an intermediate driving
35 element. The embodiment results in a simple and effective driving mechanism.

In an embodiment, at least a part of the movement of the movable part and the movement of the plunger is a joint movement. This embodiment allows a simple driving mechanism.

5 In an embodiment, the plunger of the plunger pump and the movable part of the expansion device are interconnected to make a joint reciprocating movement, wherein in particular a length of the stroke of the plunger pump and a length of the stroke of the expansion device are the same. This embodiment allows a simple mechanism of synchronization.

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In an embodiment, the movable part follows a part of the movement of the plunger of the plunger pump, and remains stationary for another part of the movement of the plunger of the plunger pump. The stroke which the movable part needs to make is typically shorter than the stroke of the plunger of the plunger pump. This can be facilitated by keeping the movable
15 part stationary for a part of the stroke.

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In an embodiment, the device comprises a moveable support to which the plunger of the plunger pump is connected, and an intermediate driving element connected to the moveable support, wherein the intermediate driving element makes a joint reciprocating
20 movement with the plunger of the plunger pump, wherein the movable part comprises a stop and wherein during the filling stroke the movable part remains stationary until at an engagement position the intermediate driving element engages said stop, wherein from this position onward the movable part moves jointly with the plunger of the plunger pump, and wherein during the return stroke the intermediate driving element disengages from the stop,
25 and wherein after the disengagement the movable part remains stationary. In this way, the smaller stroke of the movable part can be achieved in a simple manner.

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In an embodiment, the reciprocating movement of the plunger of the plunger pump and the reciprocating movement of the moveable part are parallel. This allows a simple
30 construction.

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In an embodiment, the device comprises at least two vertical guiding rods along which the plunger of the plunger pump and the movable part of the expansion device, either directly or indirectly via the intermediate driving element, move vertically up and down. In particular,
35 the plunger pump, the expansion device and the discharge nozzle may make a reciprocating movement along the same guides, wherein the guides and the reciprocating movement are in

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particular vertical. These embodiments are easy to implement in a larger filling machine such as a carousel. The vertical guiding rods create a reliable reciprocating movement.

5 In an embodiment, the plunger pump and the expansion device are mechanically coupled and make a synchronized stroke, and / or are electronically coupled and make a synchronized stroke which is controlled by a control unit. It was recognized that different kinds of synchronization are possible than a pure mechanical synchronization.

10 In an embodiment, during a part of the stroke of the plunger of the plunger pump no compression or expansion of the discharge conduit takes place, and wherein the compression and expansion only take place in an active stroke part, wherein the active stroke part is the part of the stroke where the plunger ends the filling stroke, changes direction and starts with the return stroke. This is a very efficient embodiment.

15 In an embodiment, the expansion device makes a cycle, wherein in the cycle the volume of the discharge conduit is first decreased from a first volume to a small volume and subsequently increased from the small volume back to the first volume. This allows a simple anti-drip mechanism.

20 In an embodiment, the discharge conduit expands directly after the filling stroke of the plunger pump. When the filling action ends, the risk of drip is the greatest. Therefore, the expansion takes place at this time.

25 In an embodiment, the plunger pump and the expansion device make a vertical stroke.

The filling opening of the cartridge may be facing upwardly.

In an embodiment, the discharge nozzle comprises at least one needle which is inserted into the cartridge, and wherein the source of the liquid is a reservoir.

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In an embodiment, the discharge nozzle is positioned above a filling position along a filling line, wherein the filling position comprises a cartridge support which supports a cartridge.

35 In an embodiment, the device is free of any actuators or drives besides the cams. This makes the device very simple and reliable.

The present invention further relates to a carousel comprising at least four of the devices according to any of the preceding claims, the carousel being configured for rotation

about a central axis, wherein the cam track is annular. In this way, the device can be implemented in a highly automatized filling line having a large through-put. The carousel may have more than ten or even more than twenty devices.

5 The present invention further relates to a method of filling cartridges of e-cigarettes with a liquid with substantially no drip at the end of the filling cycle, the method comprising:

- providing a device according to any of the preceding claims,
- providing a cartridge underneath the discharge nozzle,
- pumping a liquid with the plunger pump through the discharge nozzle in a filling
10 stroke,
- at the end of the filling stroke, expanding the volume of the discharge conduit with the expansion device for preventing any drip from occurring.

15 The method has substantially the same benefits as the device according to the invention.

In an embodiment of the method, a movable part of the expansion device makes a reciprocating movement.

20 In an embodiment, the plunger of the plunger pump and the movable part are connected to a single cam which runs along a cam track, wherein the cam track drives both the plunger pump and the expansion device via the single cam wherein the driving of the expansion device by the cam takes place directly or indirectly via an intermediate driving element.

25 In an embodiment of the method, at least a part of the movement of the movable part and the movement of the plunger of the plunger pump is a joint movement.

30 In an embodiment of the method, the plunger pump and the expansion device are mechanically coupled and make a synchronized stroke, and/or are electronically coupled and make a synchronized stroke which is controlled by a control unit.

35 In an embodiment of the method, the expansion device makes a cycle wherein the volume of the discharge conduit is first decreased from a first volume to a small volume and subsequently increased from the small volume back to the first volume.

In an embodiment of the method, the device is free of any actuators or drives besides the cam track and is actuated only by the cam track. This results in a simple and effective filling device.

5 In an embodiment of the method, a rotary carrousel is provided comprising at least four of the devices according to any of the preceding claims, and wherein the carrousel rotates about a central axis, wherein the cam track is annular, and wherein each time a cartridge is moved in synchronism with a rotating respective device for filling cartridges during the filling of the cartridge.

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In an embodiment of the method, the expansion of the discharge conduit is carried out directly after the plunger pump ends its filling stroke. As an alternative, an embodiment may be conceived wherein the expansion starts earlier, during the very end part of the filling stroke, and continues until after the filling stroke has ended.

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These and other aspects of the invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description and considered in connection with the accompanying drawings in which like reference symbols designate like parts.

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SHORT DESCRIPTION OF THE FIGURES

Figure 1 shows a schematic view of one embodiment of the invention.

Figure 2 shows a schematic view of another embodiment of the invention.

Figure 3 shows an isometric view of an embodiment of the invention with a part cut

25 away

Figure 4 shows an isometric view of the embodiment of fig. 3 after a filling stroke with a part cut away.

Figure 5 shows an isometric view of the embodiment of figs. 3 and 4 from another side.

Figure 6 shows an isometric view of the embodiment of fig. 5 with a part cut away.

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Figure 7 shows an isometric view of the embodiment of fig. 6 after a compression stroke with a part cut away.

Figure 8 shows an isometric view of another embodiment of the invention with a part cut away.

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Figure 9 shows an isometric view of yet another embodiment of the invention with a part cut away.

Figure 10 shows an isometric view of again another embodiment of the invention with a part cut away.

Figure 11 shows an isometric view of a carousel filling station.

Figure 12 shows a close up isometric view of a part of the carousel filling station of figure 11.

Figure 13 is a sectional side view of the carousel filling station.

5 Figure 14 shows another isometric view of the carousel filling station.

DETAILED DESCRIPTION

Turning to figure 1, a schematic overview of a device 10 for filling cartridges of e-
10 cigarettes with a liquid is shown. The device comprises a source of liquid in the form of a
reservoir 12. The device further comprises a plunger pump 14 which has an inlet 15 on an
inlet side and a supply conduit 16 which extends from the reservoir to the inlet of the plunger
pump. The plunger pump comprises a plunger 22 which makes a reciprocating movement
indicated by arrow 23. The reciprocating movement comprises a filling stroke and a return
15 stroke. The stroke is generally a linear movement.

The plunger pump comprises a first non-return valve 18 provided on the inlet side of
the plunger pump for preventing a return flow into the supply conduit during a filling stroke of
the plunger pump. The first non-return valve may be provided in the supply conduit 16 or at
20 the housing of the plunger pump.

The plunger pump 14 comprises an outlet 24 on an outlet side. The outlet forms the
start of the discharge conduit. The plunger pump comprises a second non-return valve 19 on
the discharge side. The second non-return valve is provided for preventing a return flow from
25 the discharge conduit into the plunger pump during a return stroke of the plunger pump.

The plunger pump is configured to pump a volume of liquid during the filling stroke. A
discharge conduit 26 is connected to the outlet 24 of the plunger pump.

30 The device further comprises a discharge nozzle 28 connected to a downstream end
29 of the discharge conduit 26. The discharge nozzle is directed downwards. The discharge
nozzle is positioned above a filling position along a filling line, wherein the filling position
comprises a cartridge support which supports a cartridge. The discharge nozzle is configured
to be moved into an upwardly facing opening of the cartridge.

35 The device further comprises an expansion device 30 which is connected to the
discharge conduit. The expansion device is configured for increasing a volume (V) in the
discharge conduit between the second non-return valve 19 and the discharge nozzle 28. The

expansion device comprises a moveable part 50. The moving of the moveable part is indicated with the arrow 51. The movement 23 of the plunger 22 and the movement 51 of the moveable part can be related to one another, as will be discussed below.

5 The expansion of the discharge conduit is generally carried out directly after the plunger pump ends its filling stroke and prevents any drip to occur from the discharge nozzle after the filling stroke of the plunger pump has ended. In this way, the filling line and the cartridges are kept clean and waste of valuable liquid is prevented.

10 The expansion device 30 comprises a movable part which is configured to make a reciprocating movement and which will be discussed hereinafter. The expansion device 30 is provided in an ongoing section 31 of the discharge conduit and expands the volume of the ongoing section. The ongoing section 31 extends between the plunger pump and the discharge nozzle.

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Turning to figure 2, an alternative embodiment is shown. The discharge conduit 26 comprises a dead-end section 32. The expansion device 30 acts on the dead end section of the discharge conduit.

20 Turning to figures 3 and 4, an embodiment of the device 10 is shown, wherein the reservoir and first non-return valve is left out. The side of the plunger pump 14 is shown. The plunger pump 14 comprises a plunger 22 which moves in a reciprocating manner in a cylindrical chamber 25 in a housing 36. The housing 36 forms the barrel of the plunger pump. The arrow 37 indicates from which direction the liquid is supplied to the plunger pump.

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The plunger 22 extends upwards and is mounted on a moveable support 38 via a connector 27 to the moveable support 38. The moveable support 38 slides up and down along two guides 39A, 39B. The guides 39A, 39B extend through holes in the moveable support 38. The guides may be rigidly connected to the housing 36. A cam 40 in the form of a
30 roller is connected to the moveable support 38 and in use runs along a cam track with which the pumping action can be controlled. The plunger pump does not require a separate actuator or drive. It is noted that the plunger pump is oriented vertically, but another direction is possible

35 Figure 4 shows the plunger 22 in the lower position, i.e. at the end of the filling stroke and the beginning of the return stroke. Figure 3 shows the plunger 22 in the upper position, i.e. at the end of the return stroke and the beginning of the filling stroke.

Turning to figures 5, 6, 7 and in particular to figure 5, the opposite side of the embodiment of figures 3, 4 is shown. The embodiment has an expansion device 30 which acts on an ongoing section of the discharge conduit 26 as is shown schematically in figure 1. The expansion device 30 comprises a movable part 50. The movable part 50 is fixed to the moveable support 38 which also supports the plunger 22 of the plunger pump 14. The moveable part 50 and the plunger 22 therefore make a same, synchronized movement. The movable part of the expansion device has a small volume position and a large volume position.

10 The plunger pump 14 and the expansion device 30 make a vertical stroke, but a different orientation is conceivable.

The plunger 22 of the plunger pump and the movable part 50 are connected to a single cam 40 which runs along a cam track. The cam track drives both the plunger pump and the expansion device via the single cam 40.

The expansion device 30 comprises a resilient tube section 52 which forms part of the discharge conduit 26. The moveable part 50 is configured to act on this resilient tube section. The moveable part forms an actuator which acts on the resilient tube section.

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The device 10 further comprises a nozzle support 42 which also slides on the guides 39A, 39B. The nozzle support 42 has a cam 41. The cam is designed to run in a cam track which is a different cam track as the cam track of the cam 40. The nozzle 28 is mounted to the nozzle support 42 and can make a vertical reciprocating movement as indicated by arrow 43. In the other figures, the part 42 is not shown, but it may be there

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Figures 6 and 7 show the device 10 but without the discharge nozzle support. The device 10 is shown with a front part cut away to explain the inner working of the device 10.

30 Figure 6 shows the moveable part 50 in the upper position in which the resilient tube section 52 is in the expanded state and prior to a compression stroke. Figure 7 shows the moveable part 50 in the lower position in which the resilient tube section 52 is in the compressed state, i.e. just after finishing a compression stroke.

The moveable part 50, which acts as an actuator is configured to compress the resilient tube section from a first volume to a small volume, and when the actuator is moved upwards again in an expansion stroke the resilient tube section 52 expands from the small volume

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back to the first volume as a result of its own resilience. The discharge resilient tube section 52 expands directly after the filling stroke of the plunger pump.

During the compression stroke of the movable part 50 the volume of the discharge conduit is decreased and during an expansion stroke of the movable part the volume of the discharge conduit is increased.

The compression stroke of the movable part 50 takes place during the filling stroke of the plunger pump 14 and the expansion stroke of the movable part 50 takes place during the return stroke of the plunger pump 14.

The plunger 22 of the plunger pump and the movable part 50 of the expansion device are interconnected and make a joint reciprocating movement. In particular, the length of the stroke of the plunger pump 14 and the length of the stroke of the expansion device 30 are the same.

The plunger 22 of the plunger pump and the movable part 50 are connected to the single cam 40 which is configured to run along a cam track. In use, the cam track drives both the plunger pump and the expansion device via the single cam.

The plunger pump 14, the expansion device 30 and the discharge nozzle 28 make a reciprocating movement along the same guides 39A, 39B, wherein the guides and the reciprocating movement are in particular vertical.

The plunger pump 14 and the expansion device 30 are mechanically coupled via the moveable support 38 and make a synchronized stroke. In an alternative embodiment, the plunger pump 14 and the expansion device 30 may be electronically coupled and may make a synchronized stroke which is controlled by a control unit. It is also conceivable that only a part of the movement is synchronized.

In another embodiment, the expansion stroke of the expansion device may start slightly earlier than the return stroke of the plunger pump.

The movable part 50 of the expansion device 30 makes a stroke which comprises an idle stroke part 60 and an active stroke part 62, indicated in figure 6. In the idle stroke part, no compression or expansion of the discharge conduit takes place, and wherein the

compression and expansion only takes place in the active stroke part. The active stroke part 62 is the lower part of the stroke.

5 The moveable part makes a cycle. The volume of the discharge conduit 26 is first decreased from a first volume to a smaller volume and subsequently increased from the smaller volume back to the first volume.

10 The discharge nozzle 28 comprises at least one needle 66 which is inserted into the cartridge. The insertion movement and the subsequent retraction movement is controlled with the cam 41 which runs in a cam track.

The device may be free of any actuators or drives besides the cams(s) 40, 41. This results in a simple device.

15 The device 10 is in particular designed to be mounted on a rotary carrousel comprising at least four devices 10. The carrousel is configured for rotation about a central axis, wherein the cam track(s) for the cams 40, 41 is/are annular, in particular circular. This results in a simple and effective filing station with little drip and no complex parts.

20 OPERATION

In use, the device 10 is provided. Typically, a plurality of devices 10, in particular at least four, are arranged on a carousel, but other configurations are conceivable.

25 A cartridge is provided underneath the discharge nozzle. If a plurality of devices 10 are provided on a carousel, typically a continuous flow of empty cartridges is supplied to the carousel on a conveyor. The individual cartridges are synchronized with the rotating device, and each cartridge is positioned underneath the needle 28 of a filling device.

30 The liquid is pumped by the plunger pump through the discharge conduit and through the discharge nozzle in a filling stroke. The liquid is injected into a cartridge of an e-cigarette. After the filling stroke has ended the volume of the discharge conduit is increased with the expansion device for preventing any drip from occurring. As a result of the expanding volume of the discharge conduit, a pressure drop will occur in the discharge conduit which will suck the last part of the liquid in the discharge needle back into the discharge conduit. The result 35 is that drip will not occur or at least be substantially reduced.

During the filling cycle, the movable part 50 of the expansion device 30 makes a reciprocating movement.

Turning to figure 8, another embodiment is shown in which the expansion device acts on a dead-end section 32 of the discharge conduit 26. The dead-end section is connected to the ongoing section 31. The dead-end section 32 is closed off with a plug 68.

The expansion device is provided in the dead-end section and expands the volume of the dead-end section.

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Turning to figure 9, an embodiment is shown wherein the expansion device 30 comprises an expansion plunger pump 70. The movable part 50 is the plunger 71 of the expansion plunger pump. The movable part 50 slides in a cylindrical chamber 72 and makes a reciprocating movement. The part of the chamber 72 below the plunger is in fluid communication with the discharge conduit 26. The expansion plunger pump acts on an ongoing section of the discharge conduit.

The moveable part 50 extends through a through hole 76 in an intermediate driving element 75 and slides relative to the intermediate driving element 75. A stop member 77 is provided on the moveable part 50. The intermediate driving element 75 is rigidly connected to the moveable support 38 via bolts 78. The sliding action of the moveable part 50 relative to the intermediate driving element 75 allows the moveable part to remain stationary (or idle) for a large part of the stroke of the plunger pump 14 when the moveable support 38 moves downward. The movable part only moves together with the plunger 22 during the bottom part of the stroke.

A spring 81 is provided to create a biasing force in order to keep the stop member in engagement with the intermediate driving element 75. When the intermediate driving element 75 moves upwards, the stop member 77 also moves upwards as a result of the action of the spring.

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Turning to figure 10 an embodiment is shown having an expansion device 30 in the form of an expansion plunger pump which acts on a dead-end section 32 of the discharge conduit 26.

Turning to figures 11, 12, 13 and 14, a rotary carrousel 100 comprising at least four of the devices 10 according to the invention is shown. A frame 101 supports the carrousel. The carrousel is configured for rotation about a central axis 102. The shown version of the

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carousel comprises about twenty devices 10 for filling the cartridges. The devices 10 are driven by the cam track 104 along which the cams 40 move. The cam track is annular. In top view, the carousel rotates clockwise, see arrow 105. An infeed unit 106 in the form of a rotary feeder wheel is provided at one side of the carousel 100. The infeed unit 106 feeds
5 cartridges to the carousel 100 in the direction of arrow 107.

The carousel receives the cartridges and rotates the cartridges about the axis 102 over an angle of about 300 degrees. During the rotation of the carousel, the plunger 22 of the plunger pump makes the stroke and the movable part 50 of the expansion device also makes
10 a stroke. The cartridge is filled with substantially no drip. Subsequently, the cartridge is transferred from the carousel to the outfeed unit 108 which comprises two rotary conveyors which rotate in the direction of arrows 109.

Turning in particular to figure 12, a cartridge 11 is shown in a cartridge holder 110.
15 There are many cartridge holders, in particular the same number as the number of devices 10 on the carousel, in this case about twenty.

The end pieces 112 through which the nozzles are moved in a downwards direction are also shown directly above the cartridge holders 110. In use, the needles 66 are moved
20 downward through respective holes in the end pieces and the nozzles subsequently inject the liquid into the cartridges.

Turning to figure 13, the nozzles 28 in the form of needles are shown and a cartridge 11 is shown on the left side. The needle on the left side is inserted partially into the cartridge.
25 It will be clear that the carousel 100 is quite a complex machine which comprises many parts, and the simple drive system of the present invention provides the benefit of keeping the complexity within manageable limits.

As required, detailed embodiments of the present invention are disclosed herein;
30 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. Further, the
35 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, not excluding other elements or steps.

5

Any reference signs in the claims should not be construed as limiting the scope of the claims or the invention. It will be recognized that a specific embodiment as claimed may not achieve all of the stated objects.

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The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CONCLUSIES

1. Inrichting (10) voor het vullen van cartridges (11) van e-sigaretten met een vloeistof, de inrichting omvattende:
 - een toevoerleiding (16) die is verbonden met een bron (12) van vloeistof,
 - een plunjerpomp (14) met een inlaat (15) die is verbonden met de toevoerleiding, en
 - 5 een uitlaat (24), waarbij de plunjerpomp is geconfigureerd om gedurende een vulslag een volume van vloeistof te pompen,
 - een afvoermond (28) die is verbonden met een stroomafwaarts daarvan gelegen uiteinde (29) van de afvoerleiding (26), waarbij de afvoermond is ingericht om het volume van vloeistof in de cartridge te injecteren,
 - 10 - een expansie-inrichting (30) die is verbonden met de afvoerleiding, waarbij de expansie-inrichting is ingericht voor het vergroten van een volume (V) van de afvoerleiding tussen de uitlaat van de plunjerpomp en de afvoermond aan het uiteinde van de vulslag voor het voorkomen van druppelen van de afvoermond nadat de vulslag van de plunjerpomp is afgelopen.
 - 15
2. Inrichting volgens conclusie 1, waarbij de expansie-inrichting een beweegbaar gedeelte (50) heeft dat is ingericht om een reciprocerende beweging te maken.
3. Inrichting volgens conclusie 1 of 2, waarbij de expansie-inrichting is verschaft in een
- 20 doorgaand gedeelte van de afvoerleiding en het volume van het doorgaande gedeelte vergroot.
4. Inrichting volgens conclusie 1 of 2, waarbij de afvoerleiding omvat:
 - een doorgaand gedeelte (31) tussen de plunjerpomp en de afvoermond, en
 - 25 - een doodlopend gedeelte (32) dat is verbonden met het doorgaande gedeelte, waarbij de expansie-inrichting is verschaft in het doodlopende gedeelte en het volume van het doodlopende gedeelte vergroot.
5. Inrichting volgens een van de conclusies 2-4, waarbij de afvoerleiding een
- 30 veerkrachtig buisgedeelte (52) omvat, waarbij het beweegbare deel (50) is ingericht om het veerkrachtige buisgedeelte samen te drukken van een eerste volume naar een kleiner volume, en waarbij het veerkrachtige buisgedeelte van het kleine volume terug uitzet naar het eerste volume als gevolg van zijn eigen veerkracht.
- 35 6. Inrichting volgens een van de conclusies 2-4, waarbij de expansie-inrichting (30) een

expansie-plunjerpomp (70) omvat, waarbij het beweegbare deel de plunjer (71) van de expansie-plunjerpomp (70) is, en waarbij de expansie-plunjerpomp een kamer (72) heeft, waarbij het deel van de kamer onder de plunjer (71) in vloeistof-communicatie is met de afvoerleiding.

5

7. Inrichting volgens een van de conclusies 2-6, waarbij het beweegbare deel (50) een compressie-slag en een expansie-slag maakt, waarbij gedurende de compressie-slag van het beweegbare deel het volume van de afvoerleiding wordt verkleind en waarbij gedurende een expansie-slag van het beweegbare deel het volume van de afvoerleiding wordt vergroot.

10

8. Inrichting volgens conclusie 7, waarbij de compressie-slag van het beweegbare deel plaatsvindt gedurende de vulslag van de plunjerpomp en waarbij de expansie-slag van het beweegbare deel plaatsvindt gedurende de teruggaande slag van de plunjerpomp.

15

9. Inrichting volgens een van de conclusies 2-8, waarbij de plunjer (22) van de plunjerpomp en het beweegbare deel (50) worden aangedreven door een enkele nok (40) die is ingericht om te bewegen langs een nokkenbaan (104), waarbij de nokkenbaan via de enkele nok zowel de plunjerpomp als de expansie-inrichting aandrijft, waarbij het aandrijven van de expansie-inrichting door de nok direct plaatsvindt of indirect via een tussenliggend aandrijvend element (75).

20

10. Inrichting volgens een van de conclusies 2-9, waarbij ten minste een deel van de beweging van het beweegbare deel (50) en de beweging van de plunjer (22) een gemeenschappelijke beweging is.

25

11. Inrichting volgens een van de conclusies 2-10, waarbij de plunjer (22) van de plunjerpomp en het beweegbare deel (50) van de expansie-inrichting met elkaar verbonden zijn om een gezamenlijke reciprocerende beweging te maken, waarbij in het bijzonder een lengte van de slag van de plunjerpomp en een lengte van de slag van de expansie-inrichting gelijk zijn.

30

12. Inrichting volgens een van de conclusies 2-10, waarbij het beweegbare deel (50) de beweging van de plunjer (22) van de plunjerpomp gedurende een deel van de beweging daarvan volgt, en gedurende een deel van de beweging van de plunjer (22) van de plunjerpomp stationair blijft.

35

13. Inrichting volgens de voorgaande conclusie, omvattende een beweegbare steun (38) waarmee de plunjer (22) van de plunjerpomp is verbonden, en een tussenliggend aandrijvend element (75) dat is verbonden met de beweegbare steun (38), waarbij het tussenliggende aandrijvende element een gezamenlijke reciprocerende beweging met de plunjer (22) van de plunjerpomp maakt, waarbij een stop (77) is verbonden met het beweegbare deel (50) en waarbij gedurende de vulslag het beweegbare deel stationair blijft tot aan een aangrijpingspositie waarin het tussenliggende aandrijfelement aangrijpt op genoemde stop, waarbij vanaf deze positie het beweegbare deel (50) gezamenlijk met de plunjer (22) van de plunjerpomp beweegt, en waarbij gedurende de teruggaande slag het tussenliggende aandrijfelement los komt van de stop, en waarbij na het loskomen het beweegbare deel (50) stationair blijft.
14. Inrichting volgens een van de conclusies 2-13, waarbij de reciprocerende beweging van de plunjer (22) van de plunjerpomp en de reciprocerende beweging van het beweegbare deel parallel zijn aan elkaar.
15. Inrichting volgens een van de voorgaande conclusies, waarbij de plunjerpomp, de expansie-inrichting en de afvoermond (28) een verticale reciprocerende beweging maken.
16. Inrichting volgens een van de voorgaande conclusies, omvattende ten minste twee verticale geleidingsstangen (39A, 39B) waarlangs de plunjer van de plunjerpomp van het beweegbare deel van de expansie-inrichting, hetzij direct hetzij indirect via het tussenliggende aandrijfelement (75), verticaal op en neer bewegen.
17. Inrichting volgens een van de voorgaande conclusies, waarbij de plunjerpomp en de expansie-inrichting mechanisch gekoppeld zijn en een gesynchroniseerde slag maken, en/of elektronisch gekoppeld zijn en een gesynchroniseerde slag maken die wordt bestuurd door een besturings-unit.
18. Inrichting volgens een van de voorgaande conclusies, waarbij gedurende een deel van de slag van de plunjer (22) van de plunjerpomp geen compressie of expansie van de afvoerleiding plaatsvindt, en waarbij de compressie en expansie alleen plaatsvindt in een actief slagdeel, waarbij het actieve slagdeel het deel van de slag is waar de de vulslag eindigt, de plunjer van richting verandert en start met de teruggaande slag.

- 5
19. Inrichting volgens een van de voorgaande conclusies, waarbij de expansie-inrichting een cyclus maakt, waarbij in de cyclus het volume van de afvoerleiding eerst wordt verkleind van een eerste volume naar een klein volume en vervolgens wordt vergroot van het kleine volume terug naar het eerste volume.
20. Inrichting volgens een van de voorgaande conclusies, waarbij de afvoerleiding direct na de vulslag van de plunjerpomp uitzet.
- 10
21. Inrichting volgens een van de voorgaande conclusies, waarbij de plunjerpomp en de expansie-inrichting een verticale slag maken.
- 15
22. Inrichting volgens een van de voorgaande conclusies, waarbij de afvoermond ten minste een naald omvat die wordt ingebracht in de cartridge, en waarbij de bron van de vloeistof een reservoir (12) is.
23. Inrichting volgens een van de voorgaande conclusies, waarbij de afvoermond is gepositioneerd boven een vulpositie langs de vullijn, waarbij de vulpositie een cartridgesteun omvat die een cartridge ondersteunt.
- 20
24. Inrichting volgens een van de voorgaande conclusies, waarbij de inrichting behalve de nokken (40, 41) vrij is van actuatoren of aandrijvingen.
- 25
25. Roterende carrousel (100), omvattende ten minste vier van de inrichtingen (10) volgens een van de voorgaande conclusies, waarbij de carrousel is ingericht voor rotatie om een centrale as (102), waarbij de nokkenbaan ringvormig is.
- 30
26. Werkwijze voor het vullen van cartridges (12) van e-sigaretten met een vloeistof waarbij er in hoofdzaak geen druppelen optreedt aan de einde van de vulcyclus, de werkwijze omvattende:
- het verschaffen van een inrichting volgens een van de conclusies 1-24,
 - het gedurende een vulslag door de afvoermond pompen van een vloeistof door middel van de plunjerpomp,
 - aan het einde van vulslag, het laten uitzetten van het volume van de afvoerleiding met de expansie-inrichting voor het voorkomen van het optreden van druppelen.
- 35
27. Werkwijze volgens de voorgaande werkwijzeconclusie, waarbij een beweegbaar deel (50) van de expansie-inrichting een reciprocerende beweging maakt.

28. Werkwijze volgens een van de voorgaande werkwijzeconclusies, waarbij de plunjer (22) van de plunjerpomp en het beweegbare deel (50) zijn verbonden met een enkele nok (40) die beweegt langs een nokkenbaan, waarbij de nokkenbaan via de enkele nok zowel de plunjerpomp als de expansie-inrichting aandrijft, waarbij de aandrijving van de expansie-inrichting door de nok direct plaatsvindt of indirect via een tussenliggend aandrijvend element (75).
29. Inrichting volgens een van de voorgaande werkwijzeconclusies, waarbij ten minste een deel van de beweging van het beweegbare deel (50) en de beweging van de plunjer (22) een gezamenlijke beweging is.
30. Werkwijze volgens een van de voorgaande werkwijzeconclusies, waarbij de expansie inrichting een cyclus maakt waarin het volume van de afvoerleiding eerst wordt verkleind van een eerste volume naar een klein volume en vervolgens wordt vergroot van het kleine volume terug naar het eerste volume.
31. Werkwijze volgens een van de voorgaande werkwijzeconclusies, waarbij de inrichting behalve de nokkenbaan vrij is van actuatoren of aandrijvingen en alleen wordt aangedreven door de nokkenbaan.
32. Werkwijze volgens een van de voorgaande werkwijzeconclusies, waarbij een roterende carrousel (100) is verschaft, omvattende ten minste vier van de inrichtingen volgens een van de voorgaande conclusies, en waarbij de carrousel roteert om een centrale as (102), waarbij de nokkenbaan ringvormig is, en waarbij gedurende het vullen van de cartridge telkens een cartridge synchroon met een roterende respectieve inrichting (10) wordt bewogen.
33. Werkwijze volgens een van de voorgaande werkwijzeconclusies, waarbij de expansie van de afvoerleiding direct nadat de plunjerpomp zijn vulslag beëindigt wordt uitgevoerd.

Fig. 1

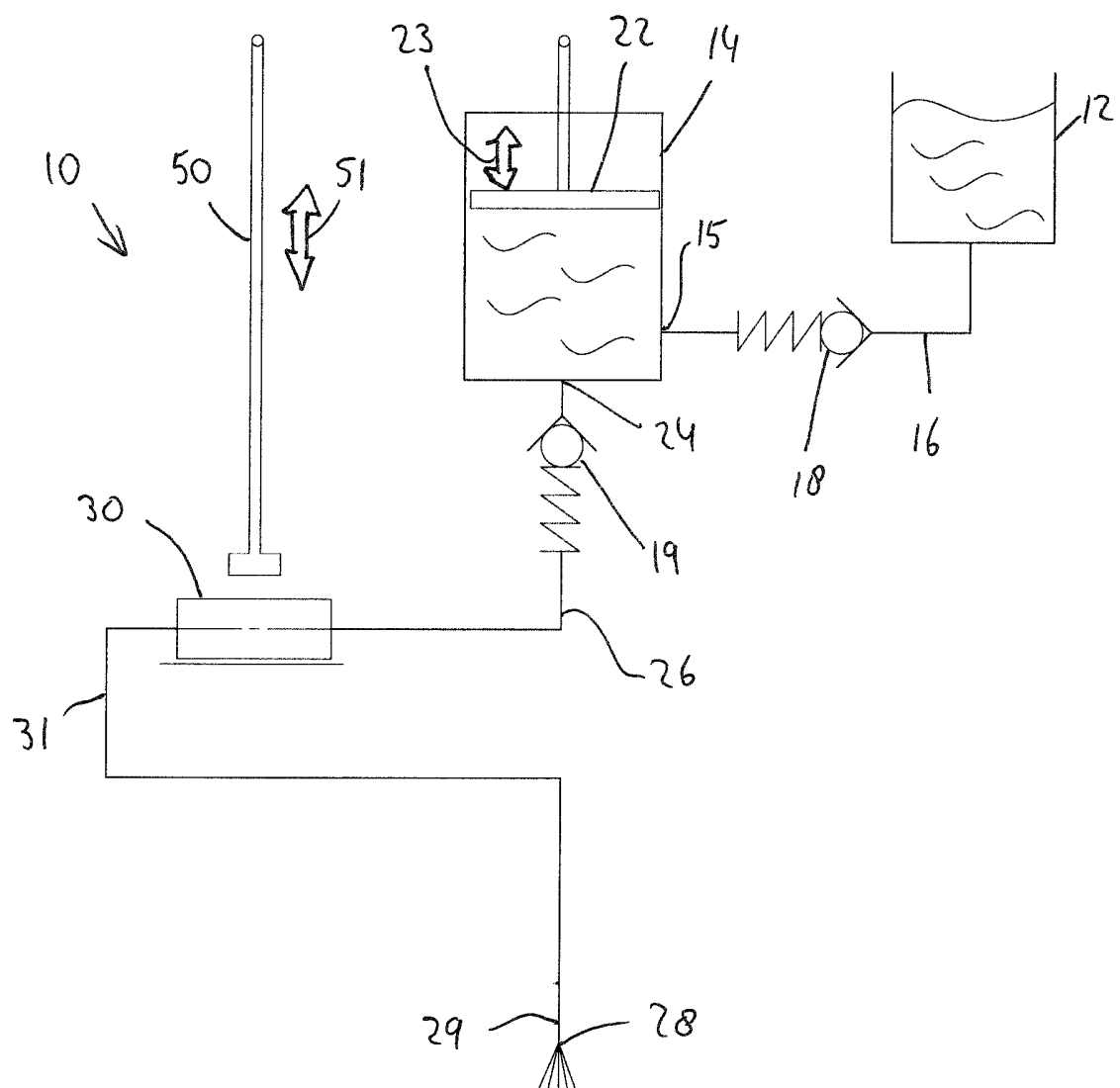


Fig. 2

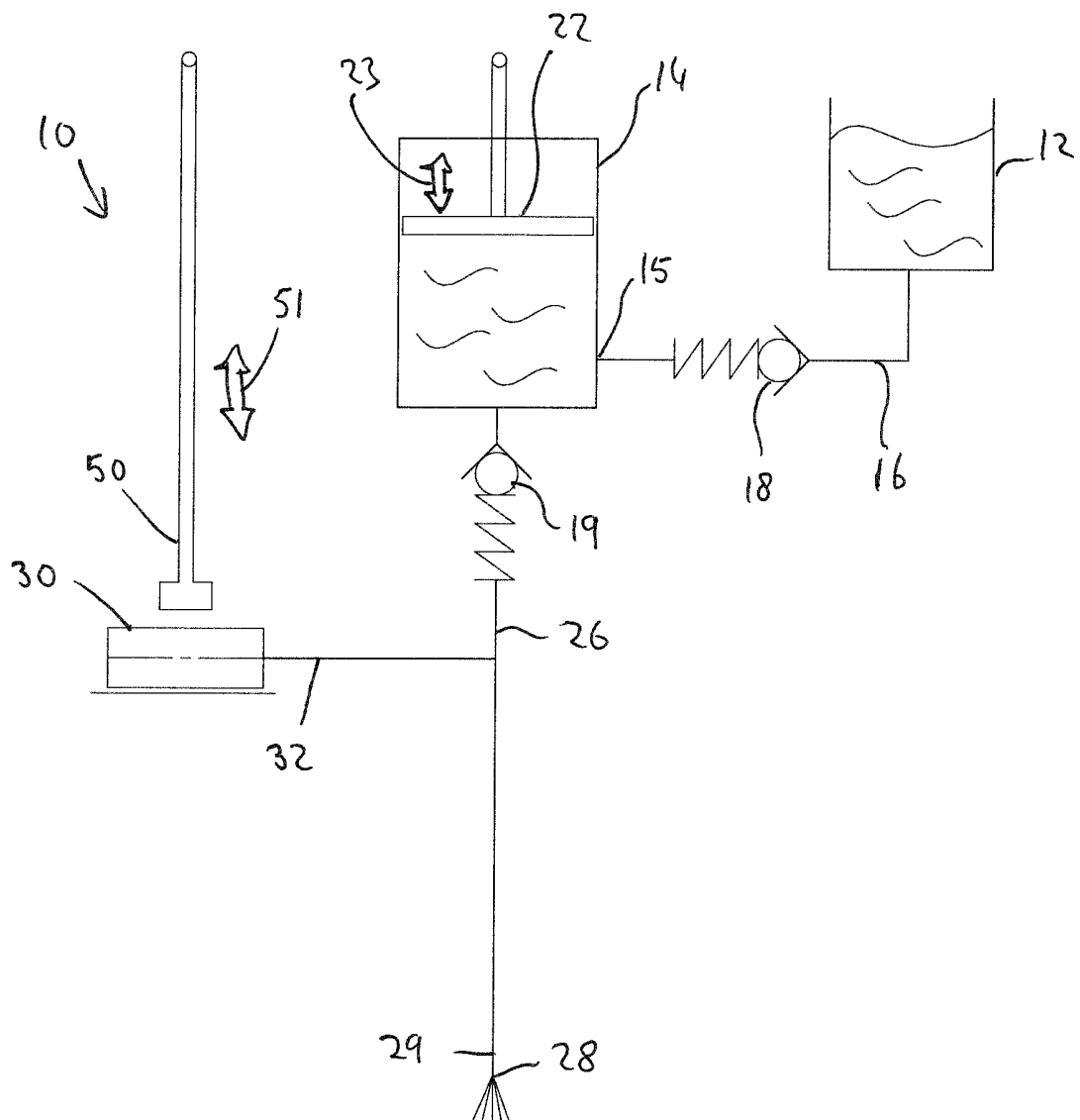


Fig. 3

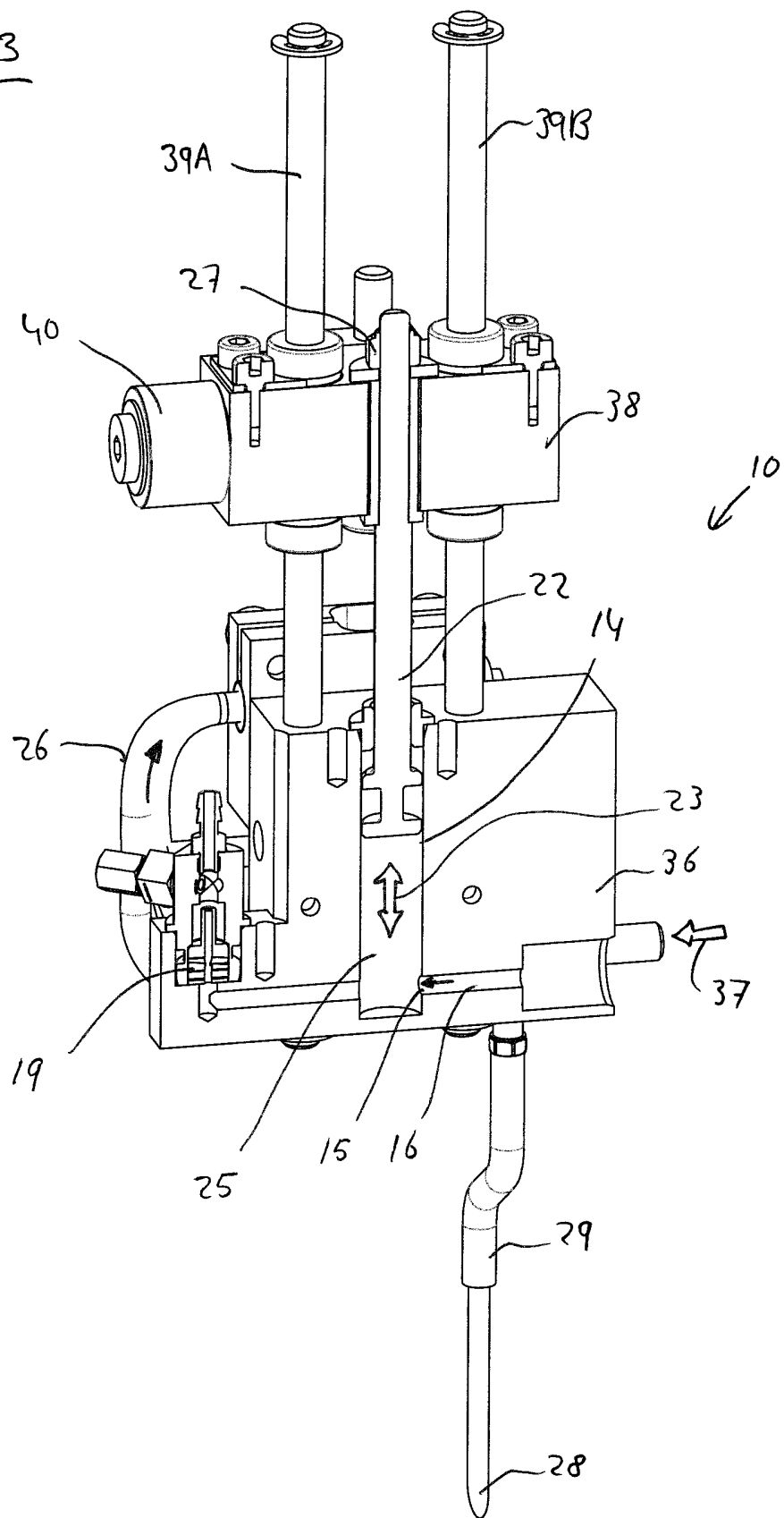


Fig. 4

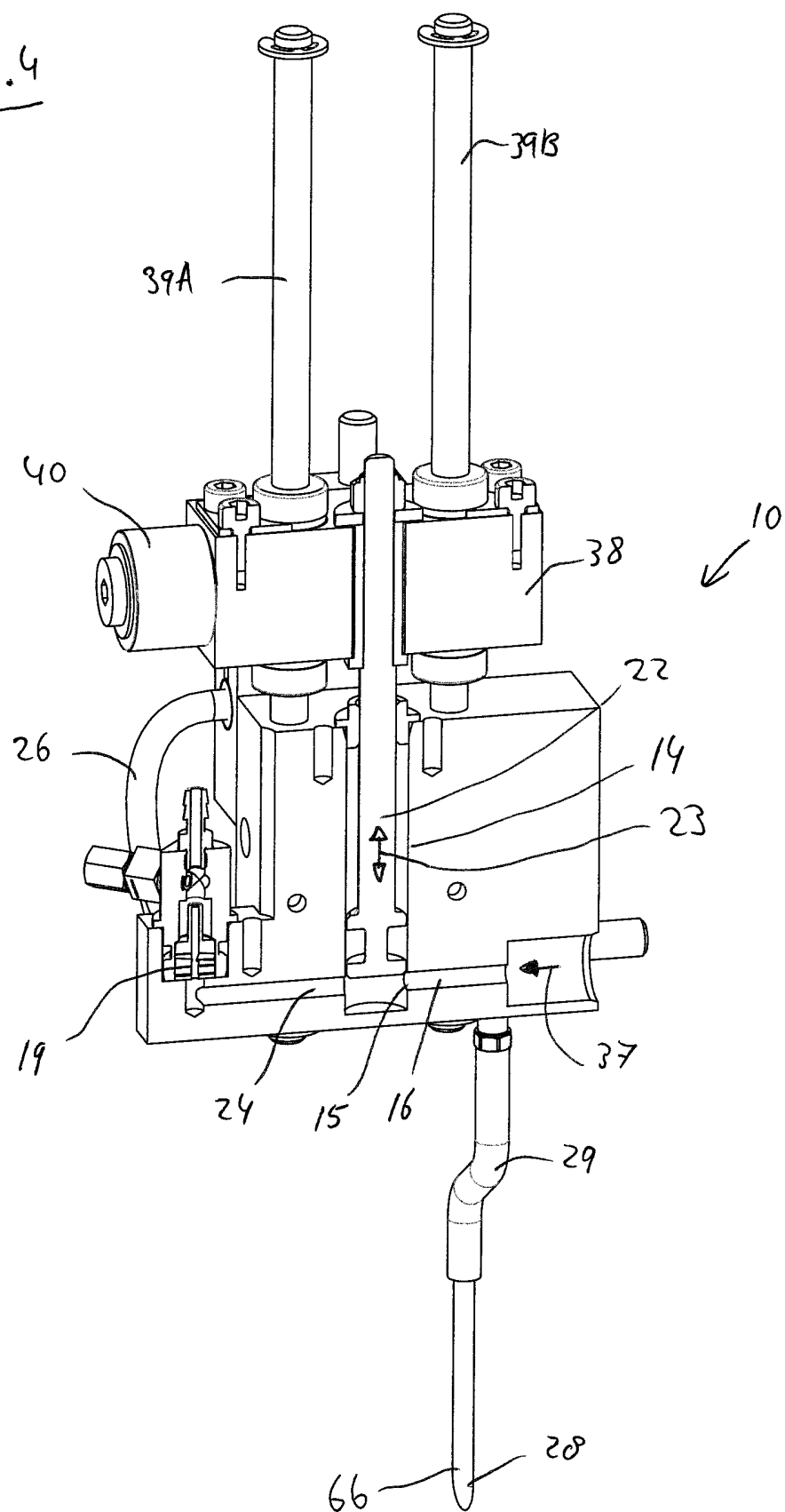


Fig. 5

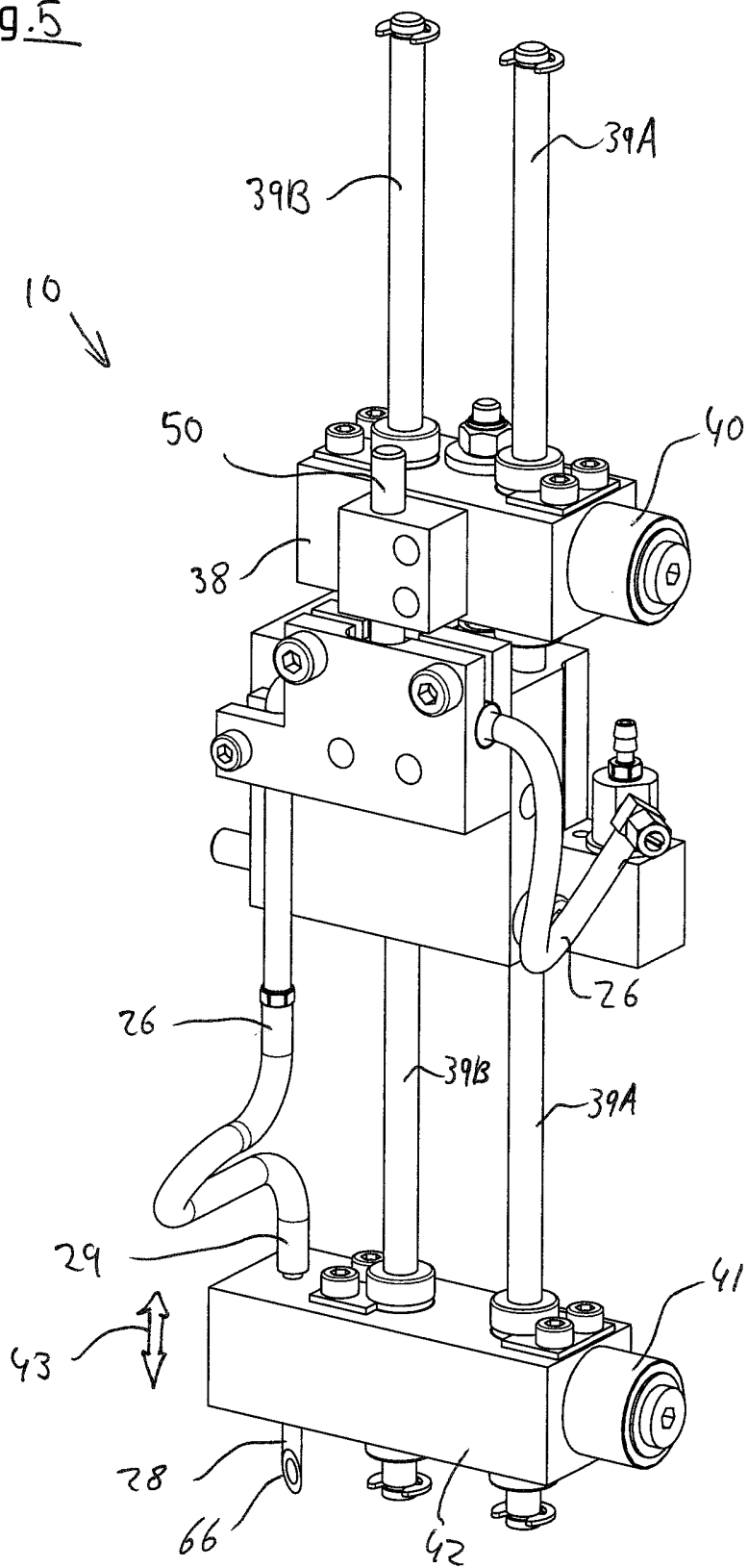


Fig. 6

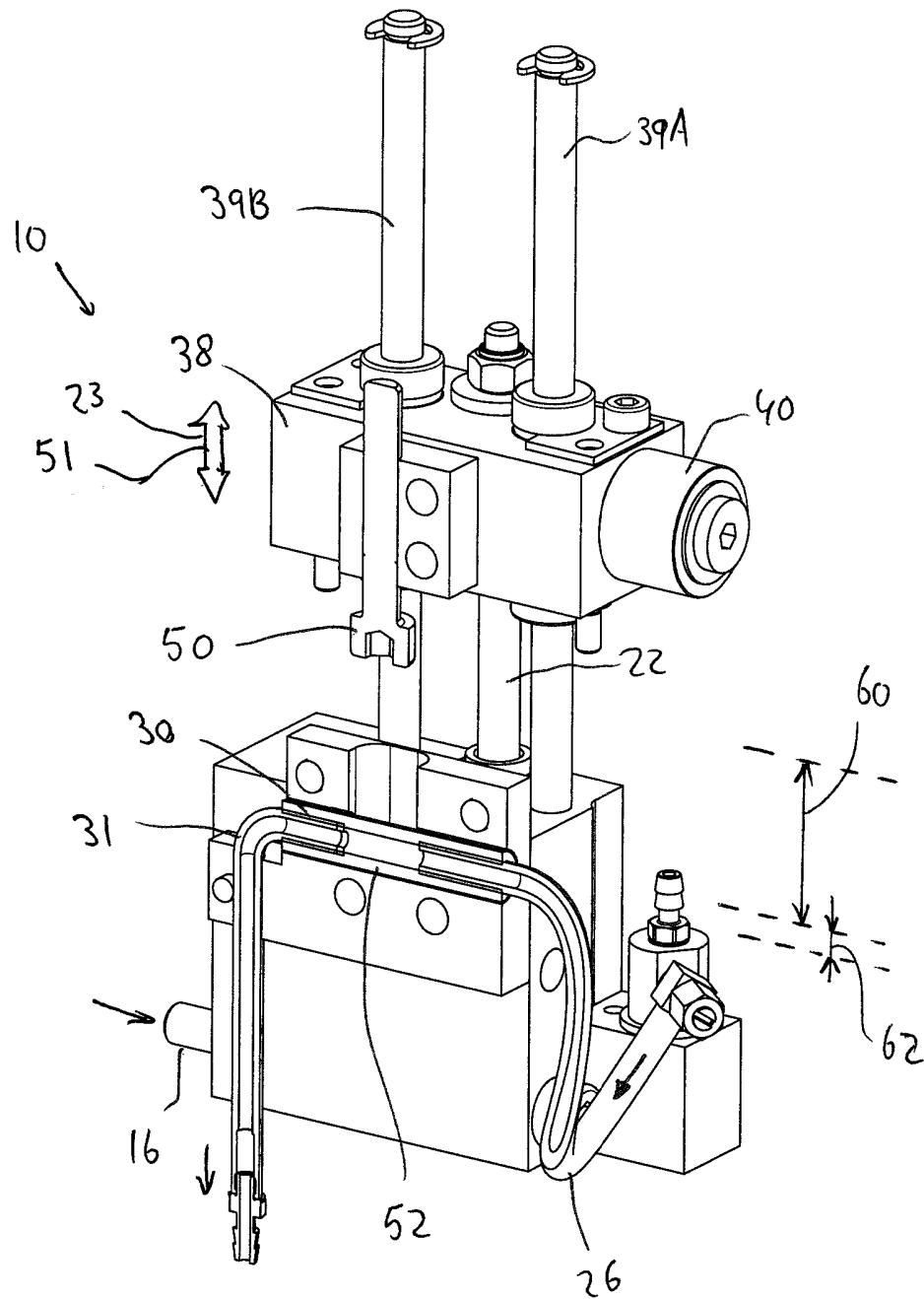


Fig. 7

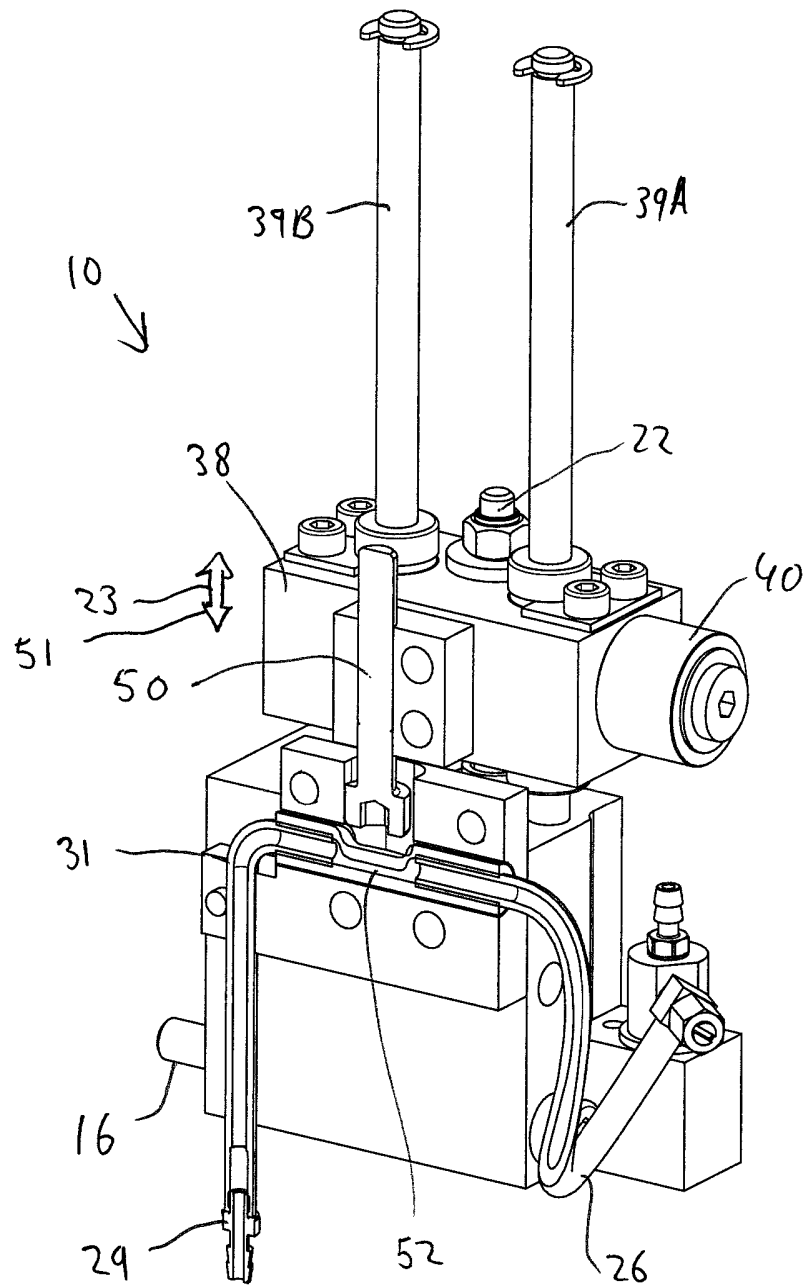


Fig. 9

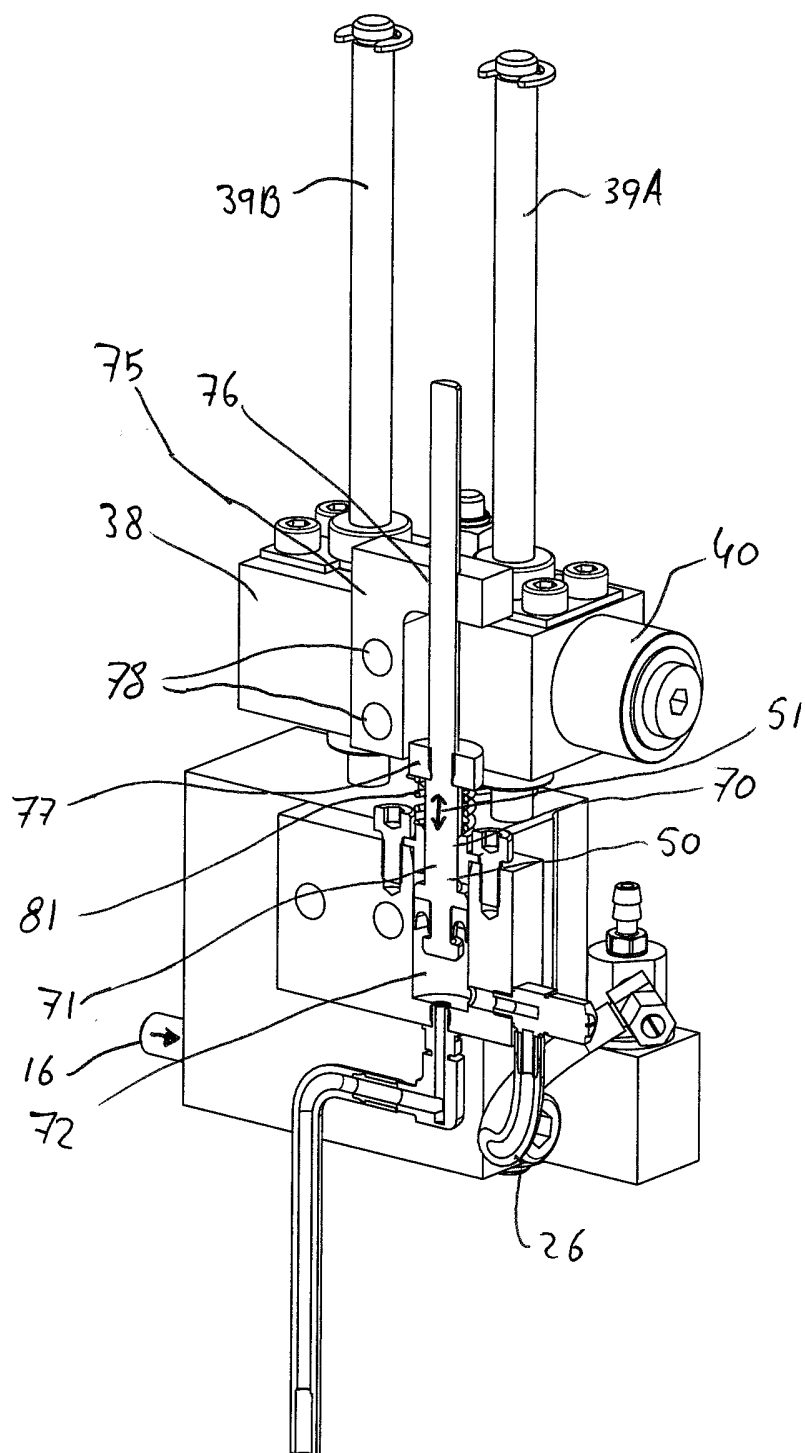
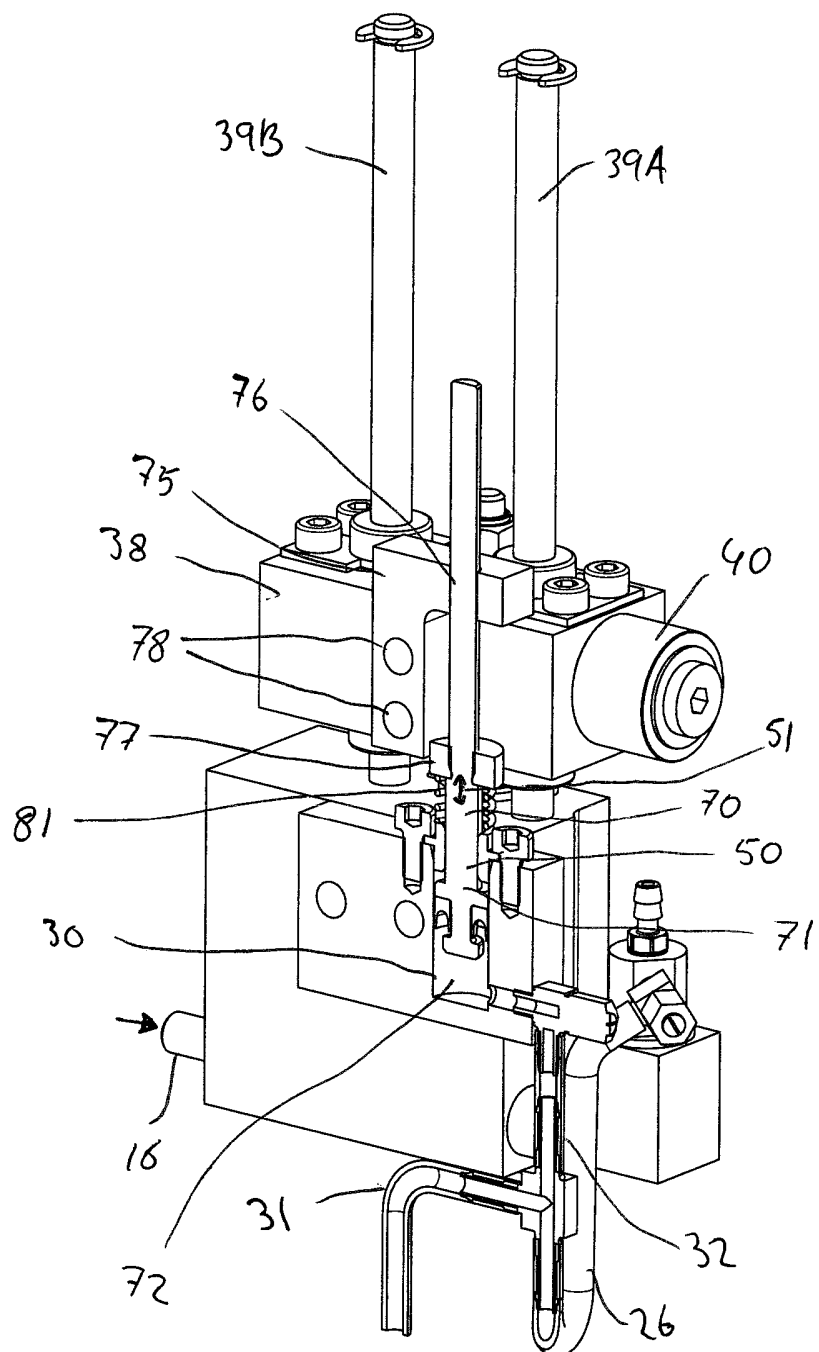


Fig. 10



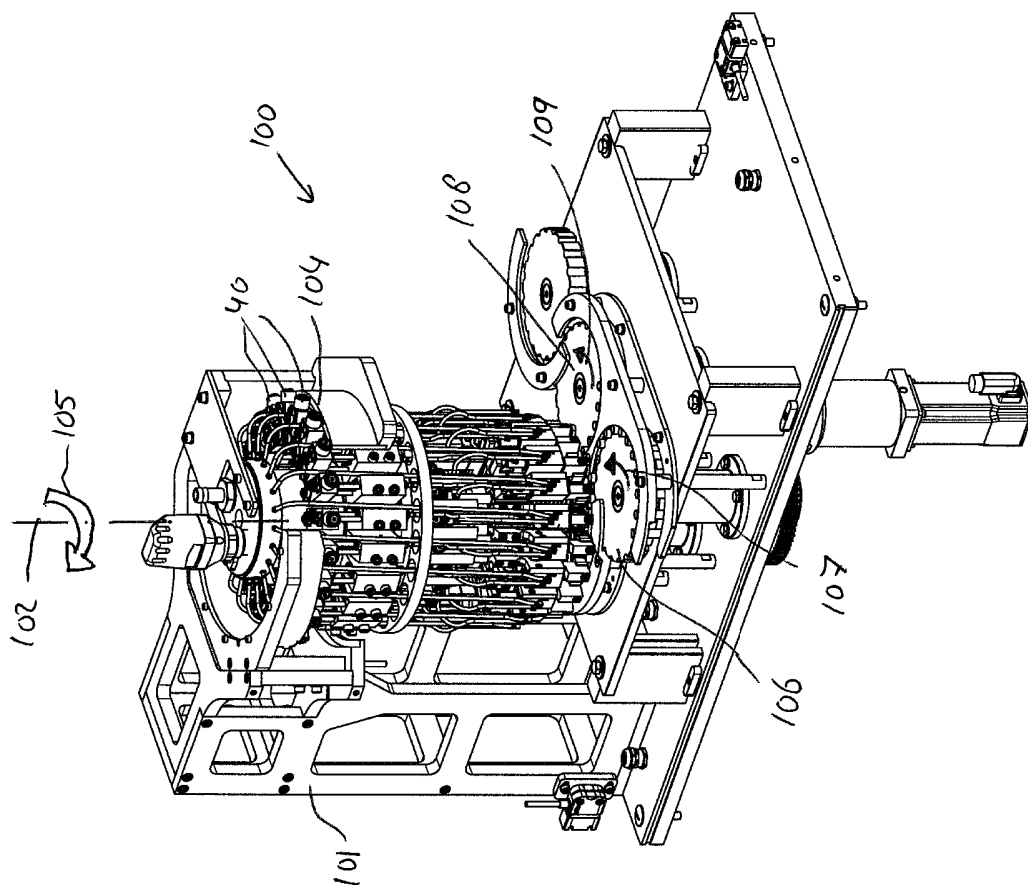


Fig. 11

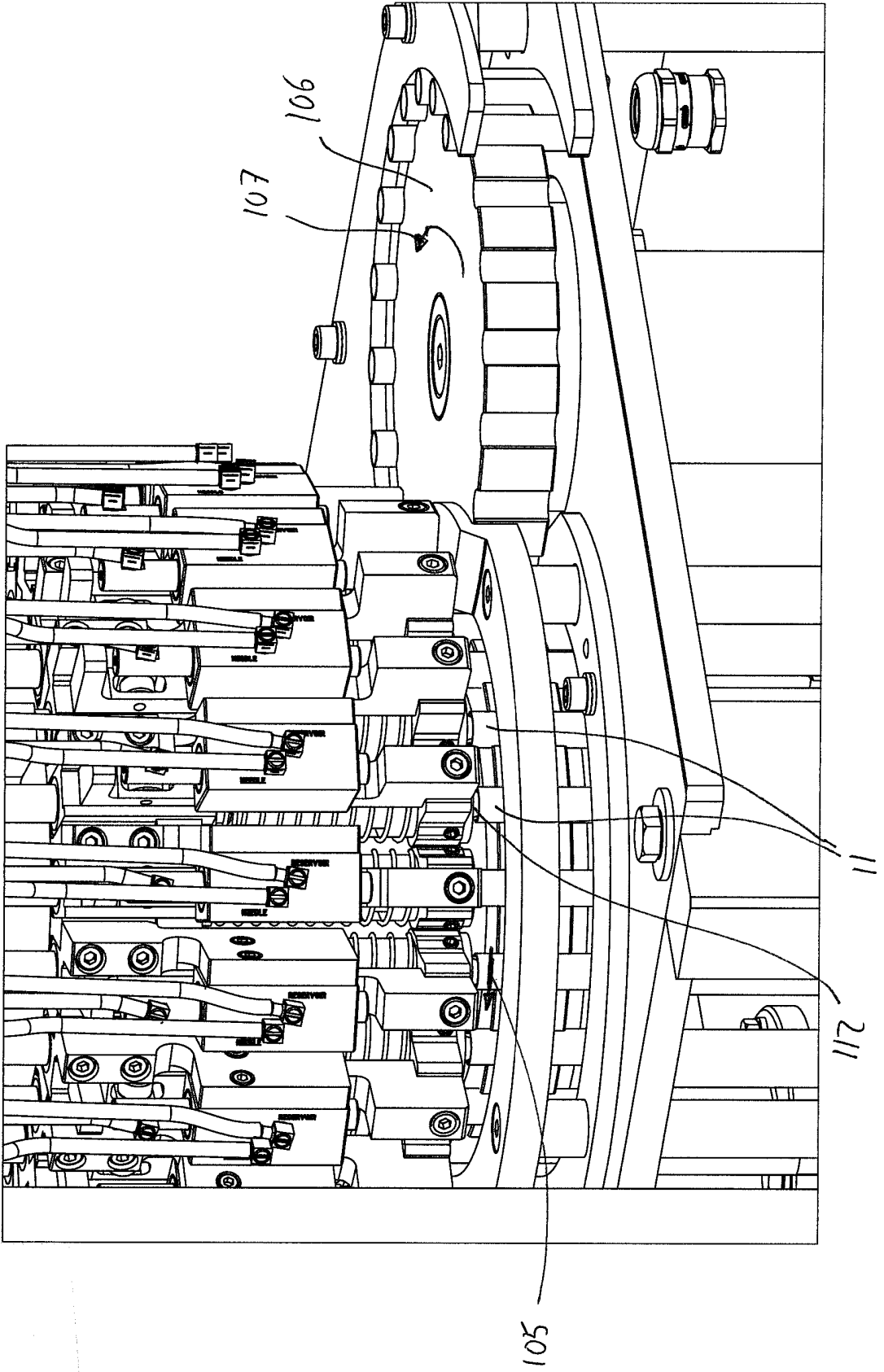
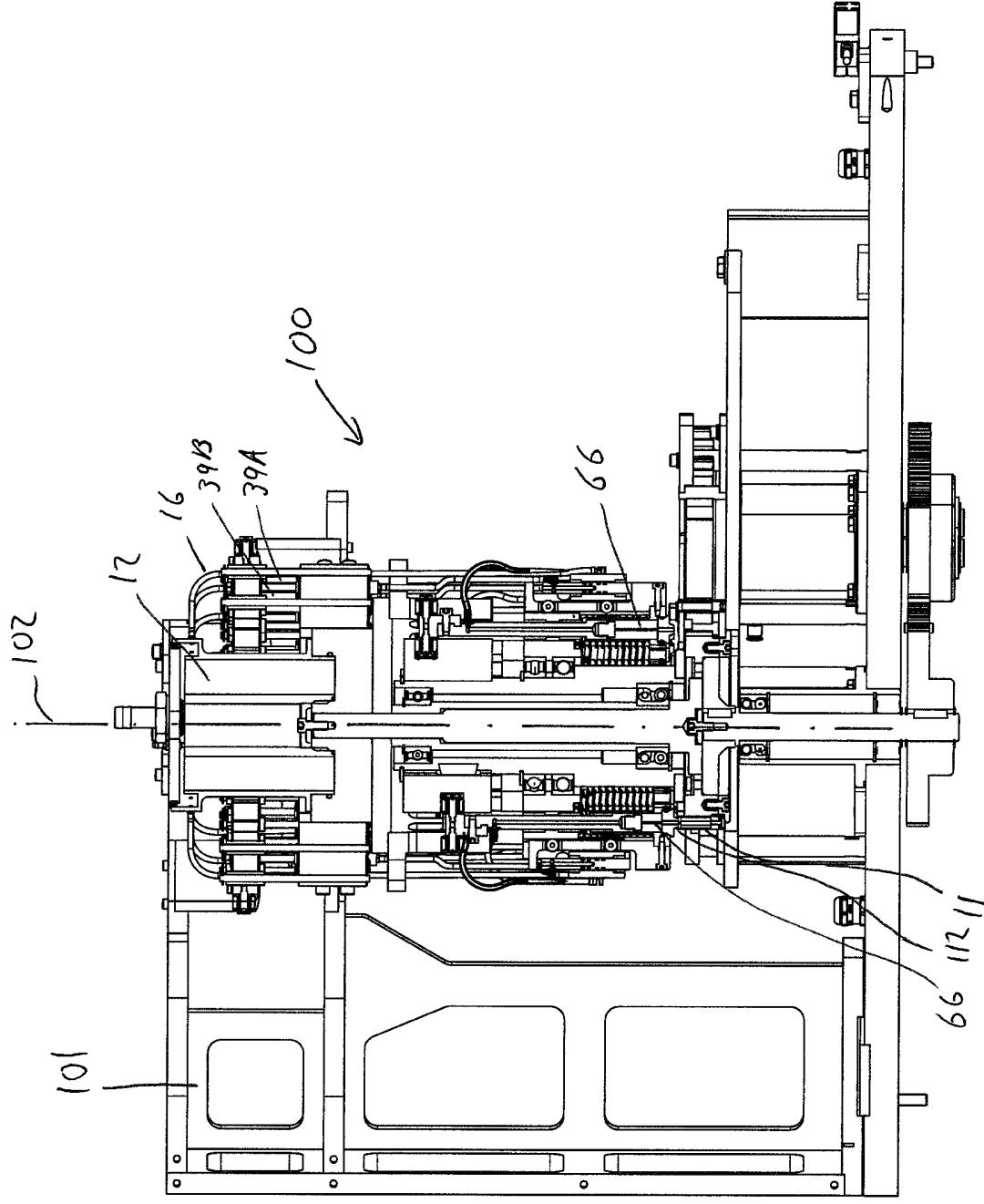


Fig. 12

Fig. 13



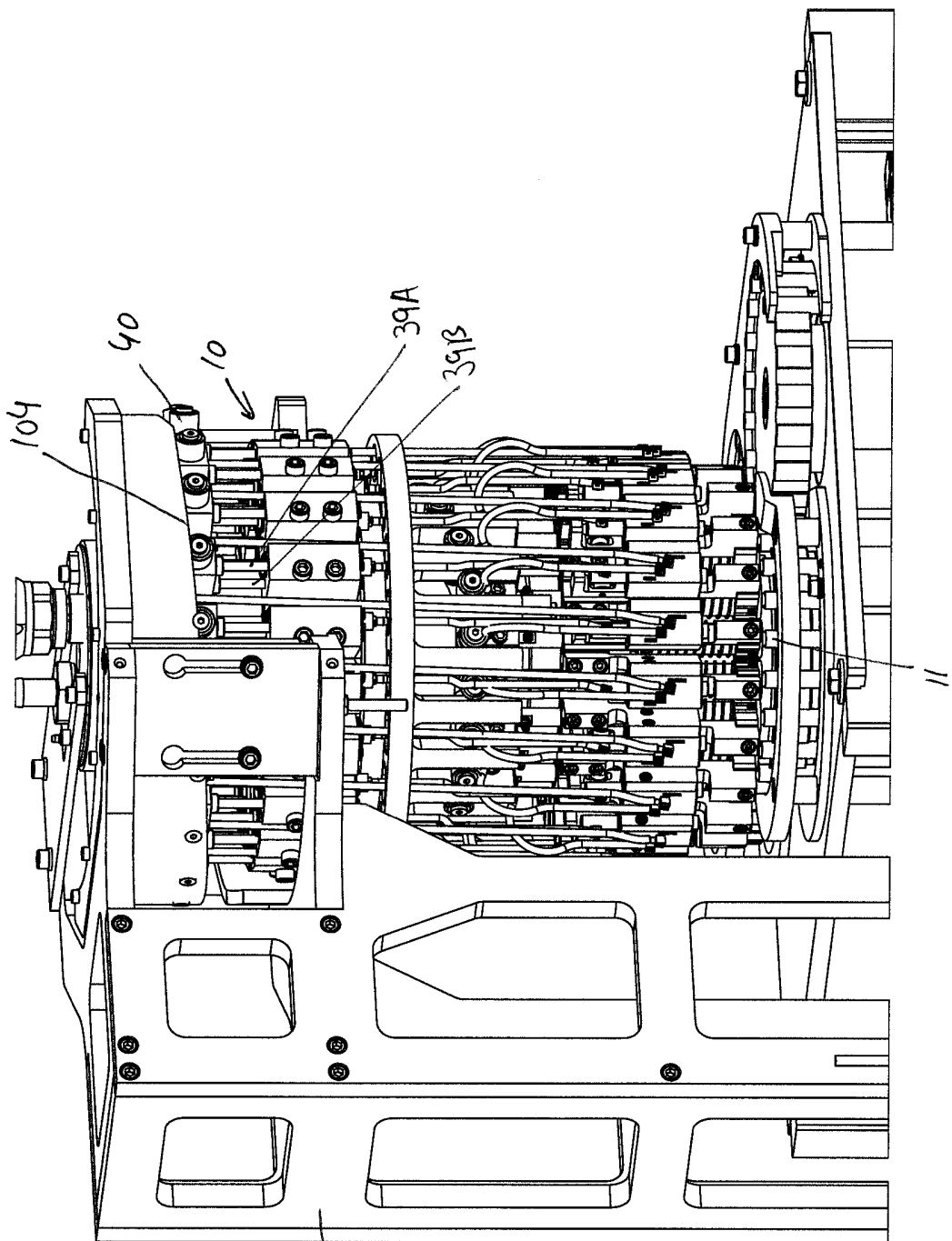


Fig. 14

ABSTRACT

The present invention relates to a device (10) for filling cartridges (12) of e-cigarettes with a liquid, the device comprising:

- a supply conduit (16) connected to a source (12) of liquid,
- 5 – a plunger pump (14) having an inlet (15) which is connected to the supply conduit, and an outlet (24), the plunger pump configured to pump a volume of liquid during a filling stroke,
- a discharge conduit (26) connected to the outlet (24) of the plunger pump,
- a discharge nozzle (28) connected to a downstream end (29) of the discharge conduit, the discharge nozzle being configured to be moved into an upwardly
10 facing opening of the cartridge,
- an expansion device (30) which is connected to the discharge conduit, the expansion device being configured for increasing a volume (V) in the discharge conduit between the second non-return valve and the discharge nozzle, wherein the expansion of the discharge conduit is carried out directly after the plunger
15 pump ends its filling stroke for preventing any drip to occur from the discharge nozzle after the filling stroke of the plunger pump has ended.

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	P32186NL00/WHA
Nederlands aanvraag nr.	Indieningsdatum
2014045	23-12-2014
	Ingeroepen voorrangsdatum
Aanvrager (Naam)	
Sluis Cigar Machinery B.V.	
Datum van het verzoek voor een onderzoek van internationaal type	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr.
21-03-2015	SN 63707
I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)	
Volgens de internationale classificatie (IPC)	
B65B29/00	A24F47/00
B67C3/26	B67C3/28
	F16K23/00
II. ONDERZOCHE GEBIEDEN VAN DE TECHNIEK	
Onderzochte minimumdocumentatie	
Classificatiesysteem	Classificatiesymbolen
IPC	B65B A24F B67C F16K
Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen	
III. ☐	GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES (opmerkingen op aanvullingsblad)
IV. ☐	GEBREK AAN EENHEID VAN UITVINDING (opmerkingen op aanvullingsblad)

**ONDERZOEKSRAPPORT BETREFFENDE HET
RESULTAAT VAN HET ONDERZOEK NAAR DE STAND
VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE**

Nummer van het verzoek om een onderzoek naar
de stand van de techniek
NL 2014045

A. CLASSIFICATIE VAN HET ONDERWERP

INV. B65B29/00 A24F47/00 B65B3/04 B67C3/26 B67C3/28
F16K23/00
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimum documentatie (classificatie gevolgd door classificatiesymbolen)
B65B A24F B67C F16K

Onderzochte andere documentatie dan de minimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)

EP0-Internal

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	DE 10 2006 001178 A1 (ARNITZ THEO [DE]) 12 juli 2007 (2007-07-12)	1-8,26
A	* alineas [0004], [0022], [0023], [0032] - [0041]; figuren 3,4a,4b,4c *	9
X	EP 2 708 491 A1 (KRONES AG [DE]) 19 maart 2014 (2014-03-19) * alineas [0038] - [0051]; figuren *	1-8,26
X	GB 1 597 955 A (SHANDON SOUTHERN PROD) 16 september 1981 (1981-09-16) * bladzijde 3, regel 62 - bladzijde 4, regel 49; figuren *	1-8,26
X	JP H08 166075 A (JUKI KK) 25 juni 1996 (1996-06-25) * samenvatting; figuren *	1-8,26
	----- -/--	

☒ Verdere documenten worden vermeld in het vervolg van vak C.

☒ Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvraag vermeld

"E" eerdere octrooi(aanvraag), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvraag, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"Z" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid

3 juli 2015

Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type

Naam en adres van de instantie

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

De bevoegde ambtenaar

Philippon, Daniel

**ONDERZOEKSRAPPORT BETREFFENDE HET
RESULTAAT VAN HET ONDERZOEK NAAR DE STAND
VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE**

Nummer van het verzoek om een onderzoek naar
de stand van de techniek

NL 2014045

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	JP H07 52902 A (SHIBUYA KOGYO CO LTD) 28 februari 1995 (1995-02-28) * samenvatting; figuren * -----	1-8,26
X	US 2003/178504 A1 (FUKANO YOSHIHIRO [JP] ET AL) 25 september 2003 (2003-09-25) * het gehele document * -----	1-8,26
A	WO 2013/093763 A1 (GD SPA [IT]) 27 juni 2013 (2013-06-27) * het gehele document * -----	1-33

**ONDERZOEKSRAPPORT BETREFFENDE HET
RESULTAAT VAN HET ONDERZOEK NAAR DE STAND
VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE**

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar
de stand van de techniek

NL 2014045

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
DE 102006001178 A1	12-07-2007	GEEN	
EP 2708491 A1	19-03-2014	CN 103663322 A DE 102012108526 A1 EP 2708491 A1	26-03-2014 13-03-2014 19-03-2014
GB 1597955 A	16-09-1981	GEEN	
JP H08166075 A	25-06-1996	GEEN	
JP H0752902 A	28-02-1995	JP 3454875 B2 JP H0752902 A	06-10-2003 28-02-1995
US 2003178504 A1	25-09-2003	DE 10309112 A1 JP 3825342 B2 JP 2003254459 A US 2003178504 A1	23-10-2003 27-09-2006 10-09-2003 25-09-2003
WO 2013093763 A1	27-06-2013	EP 2794398 A1 JP 2015500782 A KR 20140107568 A WO 2013093763 A1	29-10-2014 08-01-2015 04-09-2014 27-06-2013

WRITTEN OPINION

File No. SN63707	Filing date (<i>day/month/year</i>) 23.12.2014	Priority date (<i>day/month/year</i>)	Application No. NL2014045
International Patent Classification (IPC) INV. B65B29/00 A24F47/00 B65B3/04 B67C3/26 B67C3/28 F16K23/00			
Applicant Sluis Cigar Machinery B.V.			

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

	Examiner Philippon, Daniel
--	-------------------------------

WRITTEN OPINION

Application number

NL2014045

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
 - ☐ a sequence listing
 - ☐ table(s) related to the sequence listing
 - b. format of material:
 - ☐ on paper
 - ☐ in electronic form
 - c. time of filing/furnishing:
 - ☐ contained in the application as filed.
 - ☐ filed together with the application in electronic form.
 - ☐ furnished subsequently for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes: Claims	1-33
	No: Claims	
Inventive step	Yes: Claims	9-25, 27-33
	No: Claims	1-8, 26
Industrial applicability	Yes: Claims	1-33
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

- 1 Reference is made to the following documents:
 - D1 DE 10 2006 001178 A1
 - D2 EP 2 708 491 A1 (
 - D3 GB 1 597 955 A
 - D4 JP H08 166075 A
 - D5 JP H07 52902 A
- 2 The present application does not meet the criteria of patentability, because the subject-matter of claim 1 does not involve an inventive step.
 - 2.1 D1 discloses (see the embodiment according to figures 3, 4a, 4b, 4c and paragraphs 22,23, 33-41) a device for filling containers 12 with a liquid, the device comprising:
 - a supply conduit 13 connected to a source of liquid (not shown),
 - pumping means having an inlet which is connected to the supply conduit, and an outlet (not shown, but can be considered as implicit),
 - a discharge conduit connected to the outlet of the pumping means,
 - a discharge nozzle (needle 15) connected to a downstream end of the discharge conduit, the discharge nozzle 15 being configured to inject the volume of liquid into the container 12,
 - an expansion device 40 which is connected to the discharge conduit, the expansion device being configured for increasing a volume in the discharge conduit between the outlet of the pumping means and the discharge nozzle for preventing any drip to occur from the discharge nozzle after the pumping has ended.
 - 2.2 This known device is suitable for filling many types of containers, in particular cartridges of e-cigarettes.
 - 2.3 The subject-matter of claim 1 therefore differs from this prior art in that the pumping means is a plunger pump having an inlet which is connected to the supply conduit, and an outlet, the plunger pump being configured to pump a volume of liquid during a filling stroke.

- 2.4 Such plunger pumps are of common use in the art. The type of pump used does not have any functional relationship with the expansion device. It is clear for the person skilled in the art that such a plunger pump can be used with the device according to D1. The pumping means may be interchanged where circumstances make it desirable without involving an inventive step.
- 3 A similar reasoning can be done starting from the prior art according to any of D2-D5, which disclose devices similar to the device of D1.
- 4 The same reasoning applies, *mutatis mutandis*, to the subject-matter of the corresponding independent claim 26 for a method, which therefore is also considered not inventive.
- 5 Dependent claims 2-8 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of inventive step. They concern features which are disclosed in at least one of documents D1-D5, or are straightforward possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to solve the problem posed.
- 6 The combination of the features of dependent claims 8 and 9 (i.e. the features of claims 1,2,7-9) is neither known from, nor rendered obvious by, the available prior art. The specific structural design of the driving means according to these claims is not suggested in an obvious manner by the prior art.
- 7 With such an amended independent claim for a device, the independent claim for a method would also involve an inventive step since it claims the step of providing a device according to claim 1.
- 8 Some of the claims 10-25 and 27-33 relate to slight constructional changes in the device of claim 1 and come within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen. However, as dependent claims they would meet the requirements of inventive step insofar as claim 1 involves an inventive step.