

(19)



(11)

EP 3 237 289 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

27.05.2020 Bulletin 2020/22

(51) Int Cl.:

B65B 29/00 ^(2006.01) **A24F 47/00** ^(2020.01)
B65B 3/04 ^(2006.01) **B67C 3/26** ^(2006.01)
B67C 3/28 ^(2006.01) **F16K 23/00** ^(2006.01)

(21) Application number: **15837143.5**

(86) International application number:

PCT/NL2015/050895

(22) Date of filing: **21.12.2015**

(87) International publication number:

WO 2016/105191 (30.06.2016 Gazette 2016/26)

(54) DEVICE AND METHOD FOR FILLING CARTRIDGES OF E-CIGARETTES WITH A LIQUID

VORRICHTUNG UND VERFAHREN ZUM BEFÜLLEN VON PATRONEN VON E-ZIGARETTEN MIT
EINER FLÜSSIGKEIT

DISPOSITIF ET PROCÉDÉ DE REMPLISSAGE DE CARTOUCHES DE CIGARETTES
ÉLECTRONIQUES AVEC UN LIQUIDE

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(72) Inventor: **SLURINK, Oscar**

8141 AJ Heino (NL)

(30) Priority: **23.12.2014 NL 2014045**

(74) Representative: **EP&C**

P.O. Box 3241

2280 GE Rijswijk (NL)

(43) Date of publication of application:

01.11.2017 Bulletin 2017/44

(56) References cited:

EP-A1- 2 708 491 WO-A1-2013/093763
DE-A1-102006 001 178 GB-A- 1 597 955
JP-A- H0 752 902 JP-A- H08 166 075
US-A1- 2003 178 504

(73) Proprietor: **Sluis Cigar Machinery B.V.**
8263 BC Kampen (NL)

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 3 237 289 B1

Description

JPH0752902.

FIELD OF THE INVENTION

[0001] The present invention relates to a method and device for filling cartridges of e-cigarettes with a liquid.

BACKGROUND OF THE INVENTION

[0002] 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.

[0003] 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.

[0004] 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.

[0005] 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.

[0006] An exemplary filling device is known from DE102006001178, disclosing a device for filling containers with a liquid, the device comprising: a supply conduit connected to a source of liquid, (not shown, but seen as implicit); implicit pumping means configured to pump a volume of liquid during a filling stroke; a discharge nozzle connected to a downstream end of a discharge conduit, the discharge nozzle being configured to inject the volume of liquid into the container; an expansion device which is connected to the discharge conduit, the expansion device being configured for increasing a volume in the discharge conduit between the pumping means 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 pumping means has ended; the expansion device comprising a movable part which is configured to make a reciprocating movement; and the movable part making 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. Similar types of filling devices are known from EP2708491, GB1597955, JPH08166075, and

OBJECT OF THE INVENTION

[0007] It is an object of the invention to provide a filling device for filling e-cartridges of e-cigarettes which leads to less drip.

[0008] 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.

[0009] 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.

[0010] 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

[0011] In order to achieve at least one object, the invention provides a device according to claim 1.

[0012] 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.

[0013] In an example of the device, 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.

[0014] In an example of the device, 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 volume of the dead-end section.

[0015] It was found that the arrangement in a dead-end section results in a very reliable prevention of drip.

[0016] In an example of the device, the discharge conduit comprises a resilient tube section and 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 example has an advantage in that there are no moving parts in the discharge conduit which contact the liquid in the discharge conduit.

[0017] In an example of the device, 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 example was found to be very sturdy and reliable.

[0018] In an example of the device, 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.

[0019] In an example of the device, 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 example allows a simple mechanism of synchronization.

[0020] In an example of the device, 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 part stationary for a part of the stroke.

[0021] In an example of the device, 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 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, 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.

[0022] In an example of the device, the reciprocating movement of the plunger of the plunger pump and the reciprocating movement of the moveable part are parallel. This allows a simple construction.

[0023] In an example of the device, 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, 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 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.

[0024] In an example of the device, 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.

[0025] In an example of the device, 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.

[0026] In an example of the device, 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.

[0027] In an example of the device, 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.

[0028] In an example of the device, the plunger pump and the expansion device make a vertical stroke.

[0029] The filling opening of the cartridge may be facing upwardly.

[0030] In an example of the device, the discharge nozzle comprises at least one needle which is inserted into the cartridge, and wherein the source of the liquid is a reservoir.

[0031] In an example of the device, 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.

[0032] In an example of the device, the device is free of any actuators or drives besides the cams. This makes the device very simple and reliable.

[0033] The present invention further relates to a carousel comprising at least four of the devices according to the invention, 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.

[0034] The present invention further relates to a method according to claim 14.

[0035] The method has substantially the same benefits as the device according to the invention.

[0036] In an example of the method, a movable part of the expansion device makes a reciprocating movement.

[0037] In an example of the method, 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 takes place indirectly via an intermediate driving element.

[0038] In an example 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.

[0039] In an example 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.

[0040] In an example 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.

[0041] In an example 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.

[0042] In an example of the method, a rotary carousel is provided comprising at least four of the devices according to any of the preceding claims, and wherein the carousel 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.

[0043] In an example 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.

[0044] 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.

SHORT DESCRIPTION OF THE FIGURES

[0045]

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 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.

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.

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.

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

DETAILED DESCRIPTION

[0046] Turning to figure 1, a schematic overview of a device 10 for filling cartridges of e-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 stroke. The stroke is generally a linear movement.

[0047] 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 the housing of the plunger pump.

[0048] 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 the discharge conduit into the plunger pump during a return stroke of the plunger pump.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] 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.

[0054] 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.

[0055] 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.

[0056] 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 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

[0057] 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.

[0058] 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 movable 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.

[0059] The plunger pump 14 and the expansion device 30 make a vertical stroke, but a different orientation is conceivable.

[0060] 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.

[0061] The expansion device 30 comprises a resilient tube section 52 which forms part of the discharge conduit 26. The movable part 50 is configured to act on this resilient tube section. The movable part forms an actuator which acts on the resilient tube section.

[0062] 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

[0063] 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.

[0064] Figure 6 shows the movable 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 movable 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.

[0065] The movable 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 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.

[0066] 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.

[0067] 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.

[0068] 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.

[0069] 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.

[0070] 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.

[0071] 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.

[0072] In another embodiment, the expansion stroke of the expansion device may start slightly earlier than the return stroke of the plunger pump.

[0073] 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.

[0074] 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.

[0075] 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.

[0076] The device may be free of any actuators or drives besides the cam(s) 40, 41. This results in a simple device.

[0077] The device 10 is in particular designed to be mounted on a rotary carousel comprising at least four devices 10. The carousel 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 filling station with little drip and no complex parts.

OPERATION

[0078] 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.

[0079] 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.

[0080] 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.

5 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 is that drip will not occur or at least be substantially reduced.

10 **[0081]** During the filling cycle, the movable part 50 of the expansion device 30 makes a reciprocating movement.

[0082] 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.

[0083] The expansion device is provided in the dead-end section and expands the volume of the dead-end section.

[0084] 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.

[0085] 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.

[0086] 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.

[0087] 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.

[0088] Turning to figures 11, 12, 13 and 14, a rotary carousel 100 comprising at least four of the devices 10 according to the invention is shown. A frame 101 supports the carousel. The carousel is configured for rotation about a central axis 102. The shown version of the 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 cartridges to the carousel 100 in the direction of arrow 107.

[0089] 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 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.

[0090] Turning in particular to figure 12, a cartridge 11 is shown in a cartridge holder 110. There are many cartridge holders, in particular the same number as the number of devices 10 on the carousel, in this case about twenty.

[0091] 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 downward through respective holes in the end pieces and the nozzles subsequently inject the liquid into the cartridges.

[0092] 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. 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.

[0093] As required, 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. Further, the terms and phrases used herein are not intended to be limiting, but rather, to provide an understandable description of the invention.

[0094] 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.

[0095] 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.

[0096] 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.

Claims

1. Device (10) for filling cartridges (11) 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 being 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 (26), the discharge nozzle being configured to inject the volume of liquid into 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 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, wherein;

- the expansion device comprises a movable part (50) which is configured to make a reciprocating movement,
- the movable part (50) 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,
- 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, and
- the plunger (22) of the plunger pump and the movable part (50) are driven by a single cam (40) which is configured to run along a cam track (104), 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 takes place indirectly via an intermediate driving element (75).
2. Device according to claim 1, wherein the expansion device is provided in an ongoing section of the discharge conduit and expands the volume of the ongoing section. 5
 3. Device according to claim 1, wherein the discharge conduit comprises: 10
 - an ongoing section (31) between the plunger pump and the discharge nozzle, and
 - a dead-end section (32) connected to the ongoing section, 15

wherein the expansion device is provided in the dead-end section and expands the volume of the dead-end section. 20
 4. Device according to any of the preceding claims, wherein the discharge conduit comprises a resilient tube section (52) and wherein the moveable part (50) 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. 25
 5. Device according to any of the preceding claims, wherein the expansion device (30) comprises an expansion plunger pump (70), the movable part being the plunger (71) of the expansion plunger pump (70), wherein the expansion plunger pump has a chamber (72), wherein the part of the chamber below the plunger (71) is in fluid communication with the discharge conduit. 30
 6. Device according to any of the preceding claims, wherein at least a part of the movement of the movable part (50) and the movement of the plunger (22) is a joint movement. 35
 7. Device according to any of the preceding claims, wherein the plunger (22) of the plunger pump and the movable part (50) 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. 40
 8. Device according to any of claims 1-6, wherein the movable part (50) follows a part of the movement of the plunger (22) of the plunger pump, and remains stationary for another part of the movement of the plunger (22) of the plunger pump. 45
 9. Device according to the previous claim, comprising a moveable support (38) to which the plunger (22) of the plunger pump is connected, and an intermediate driving element (75) which is connected to the moveable support (38), wherein the intermediate driving element makes a joint reciprocating movement with the plunger (22) of the plunger pump, wherein a stop (77) is attached to the movable part (50) 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 (50) moves jointly with the plunger (22) of the plunger pump, and wherein during the return stroke the intermediate driving element disengages from the stop, and wherein after the disengagement the movable part (50) remains stationary. 50
 10. Device according to any of the preceding claims, wherein 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. 55
 11. Device according to any of the preceding claims, wherein during a part of the stroke of the plunger (22) of the plunger pump no compression or expansion of the discharge conduit takes place, and wherein the compression and expansion only takes 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.
 12. Device according to any of the preceding claims, wherein 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, and wherein preferably the discharge conduit expands directly after the filling stroke of the plunger pump.
 13. Rotary carousel (100) comprising at least four of the devices (10) according to any of the preceding claims, the carousel being configured for rotation about a central axis (102), wherein the cam track is annular.
 14. Method of filling cartridges (12) 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 claims 1 - 12,
 - pumping a liquid with the plunger pump through the discharge nozzle in a filling 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. Method according to the preceding method claim, wherein a movable part (50) of the expansion device makes a reciprocating movement.

Patentansprüche

1. Vorrichtung (10) zum Füllen von Kartuschen (11) von E-Zigaretten mit einer Flüssigkeit, wobei die Vorrichtung umfasst:

- eine Zufuhrleitung (16), die mit einer Flüssigkeitsquelle (12) verbunden ist;
- eine Kolbenpumpe (14), die einen mit der Zufuhrleitung verbundenen Einlass (15) und einen Auslass (24) aufweist, wobei die Kolbenpumpe so ausgebildet ist, dass sie während eines Füllhubs ein Flüssigkeitsvolumen pumpt;
- eine Auslassleitung (26), die mit dem Auslass (24) der Kolbenpumpe verbunden ist;
- eine Auslassdüse (28), die mit einem nachgeordneten Ende (29) der Auslassleitung (26) verbunden ist, wobei die Auslassdüse so ausgebildet ist, dass sie das Flüssigkeitsvolumen in die Kartusche einspritzt;
- eine Expansionsvorrichtung (30), die mit der Auslassleitung verbunden ist, wobei die Expansionsvorrichtung so ausgebildet ist, dass sie ein Volumen (V) in der Auslassleitung zwischen dem Auslass der Kolbenpumpe und der Auslassdüse am Ende des Füllhubs vergrößert, um zu verhindern, dass ein Nachtropfen aus der Auslassdüse auftritt, nachdem der Füllhub der Kolbenpumpe beendet ist, wobei:

- die Expansionsvorrichtung ein bewegliches Teil (50) umfasst, das so ausgebildet ist, dass es eine hin- und hergehende Bewegung ausführt;
- das bewegliche Teil (50) einen Kompressionshub und einen Expansionshub ausführt; wobei während des Kompressionshubs des beweglichen Teils das Volumen der Auslassleitung verringert wird und wobei während eines Expansionshubs des beweglichen Teils das Volumen der Auslassleitung vergrößert wird;
- der Kompressionshub des beweglichen Teils während des Füllhubs der Kolbenpumpe stattfindet und wobei der Expansionshub des beweglichen Teils während des Rückhubs der Kolbenpumpe stattfindet; und

-- der Kolben (22) der Kolbenpumpe und das bewegliche Teil (50) durch einen einzelnen Nocken (40) angetrieben werden, der so ausgebildet ist, dass er entlang einer Nockenbahn (104) läuft, wobei die Nockenbahn sowohl die Kolbenpumpe als auch die Expansionsvorrichtung über den einzelnen Nocken antreibt, wobei der Antrieb der Expansionsvorrichtung durch den Nocken direkt oder indirekt über ein Zwischenantriebsselement (75) erfolgt.

2. Vorrichtung nach Anspruch 1, wobei die Expansionsvorrichtung in einem fortlaufenden Abschnitt der Auslassleitung vorgesehen ist und das Volumen des fortlaufenden Abschnitts expandiert.

3. Vorrichtung nach Anspruch 1, wobei die Auslassleitung umfasst:

- einen fortlaufenden Abschnitt (31) zwischen der Kolbenpumpe und der Auslassdüse, und
- einen Totendabschnitt (32), der mit dem fortlaufenden Abschnitt verbunden ist, wobei die Expansionsvorrichtung in dem Totendabschnitt vorgesehen ist und das Volumen des Totendabschnitts expandiert.

4. Vorrichtung nach einem der vorangegangenen Ansprüche, wobei die Abflussleitung einen elastischen Rohrabschnitt (52) umfasst und wobei das bewegliche Teil (50) so ausgebildet ist, dass es den elastischen Rohrabschnitt von einem ersten Volumen auf ein kleines Volumen komprimiert, und wobei der elastische Rohrabschnitt aufgrund seiner Elastizität von dem kleinen Volumen zurück auf das erste Volumen expandiert.

5. Vorrichtung nach einem der vorangegangenen Ansprüche, wobei die Expansionsvorrichtung (30) eine Expansionskolbenpumpe (70) umfasst, wobei das bewegliche Teil der Kolben (71) der Expansionskolbenpumpe (70) ist, wobei die Expansionskolbenpumpe eine Kammer (72) aufweist, wobei der Teil der Kammer unterhalb des Kolbens (71) in Fluidverbindung mit der Auslassleitung steht.

6. Vorrichtung nach einem der vorangegangenen Ansprüche, wobei zumindest ein Teil der Bewegung des beweglichen Teils (50) und die Bewegung des Kolbens (22) eine gemeinsame Bewegung sind.

7. Vorrichtung nach einem der vorangegangenen Ansprüche, bei der der Kolben (22) der Kolbenpumpe und das bewegliche Teil (50) der Expansionsvorrichtung miteinander verbunden sind, um eine gemeinsame Hin- und Herbewegung auszuführen, wobei insbesondere eine Länge des Hubs der Kolbenpumpe

pe und eine Länge des Hubs der Expansionsvorrichtung gleich sind.

8. Vorrichtung nach einem der Ansprüche 1 bis 6, wobei das bewegliche Teil (50) einem Teil der Bewegung des Kolbens (22) der Kolbenpumpe folgt und bei einem anderen Teil der Bewegung des Kolbens (22) der Kolbenpumpe stationär bleibt. 5
9. Vorrichtung nach dem vorangegangenen Anspruch, umfassend einen beweglichen Träger (38), mit dem der Kolben (22) der Kolbenpumpe verbunden ist, und ein Zwischenantriebsselement (75), das mit dem beweglichen Träger (38) verbunden ist, wobei das Zwischenantriebsselement eine gemeinsame Hin- und Herbewegung mit dem Kolben (22) der Kolbenpumpe ausführt, wobei ein Anschlag (77) an dem beweglichen Teil (50) befestigt ist und wobei während des Füllhubs das bewegliche Teil stationär bleibt, bis in einer Eingriffsposition das Zwischenantriebsselement mit dem Anschlag in Eingriff kommt, wobei sich das bewegliche Teil (50) von dieser Position an gemeinsam mit dem Kolben (22) der Kolbenpumpe bewegt, und wobei während des Rückhubs das Zwischenantriebsselement sich aus dem Eingriff mit dem Anschlag löst, und wobei nach dem Lösen aus dem Eingriff das bewegliche Teil (50) stationär bleibt. 10
15
20
25
10. Vorrichtung nach einem der vorangegangenen Ansprüche, wobei die Kolbenpumpe und die Expansionsvorrichtung mechanisch gekoppelt sind und einen synchronisierten Hub ausführen, und/oder elektronisch gekoppelt sind und einen synchronisierten Hub ausführen, der durch eine Steuereinheit gesteuert wird. 30
35
11. Vorrichtung nach einem der vorangegangenen Ansprüche, wobei während eines Teils des Hubs des Kolbens (22) der Kolbenpumpe keine Kompression oder Expansion der Auslassleitung stattfindet, und wobei die Kompression und die Expansion nur in einem aktiven Hubteil stattfindet, wobei der aktive Hubteil der Teil des Hubs ist, in dem der Kolben den Füllhub beendet, die Richtung ändert und mit dem Rückhub beginnt. 40
45
12. Vorrichtung nach einem der vorangegangenen Ansprüche, wobei die Expansionsvorrichtung einen Zyklus ausführt, wobei in dem Zyklus das Volumen der Auslassleitung zunächst von einem ersten Volumen auf ein kleines Volumen verringert wird und anschließend von dem kleinen Volumen zurück auf das erste Volumen erhöht wird, und wobei vorzugsweise die Auslassleitung direkt nach dem Füllhub der Kolbenpumpe expandiert. 50
55
13. Drehkarussell (100), das zumindest vier der Vorrich-

tungen (10) nach einem der vorangegangenen Ansprüche umfasst, wobei das Karussell zur Drehung um eine zentrale Achse (102) eingerichtet ist, wobei die Nockenbahn ringförmig ist.

14. Verfahren zum Füllen von Kartuschen (12) von E-Zigaretten mit einer im Wesentlichen am Ende des Füllzyklus nicht tropfenden Flüssigkeit, wobei das Verfahren umfasst:

- Bereitstellen einer Vorrichtung nach einem der Ansprüche 1 bis 12,
- Pumpen einer Flüssigkeit mit der Kolbenpumpe durch die Auslassdüse in einem Füllhub,
- am Ende des Füllhubs Expansion des Volumens der Auslassleitung mit der Expansionsvorrichtung, um zu verhindern, dass ein Nachtropfen auftritt.

15. Verfahren nach dem vorangegangenen Verfahrensanspruch, wobei ein bewegliches Teil (50) der Expansionsvorrichtung eine hin- und hergehende Bewegung ausführt.

Revendications

1. Dispositif (10) de remplissage de cartouches (11) de cigarettes électroniques avec un liquide, le dispositif comprenant:
 - un conduit d'alimentation (16) relié à une source (12) de liquide,
 - une pompe à piston (14) possédant une entrée (15) qui est reliée au conduit d'alimentation, et une sortie (24), la pompe à piston étant configurée pour pomper un volume de liquide lors d'une course de remplissage,
 - un conduit de décharge (26) relié à la sortie (24) de la pompe à piston,
 - une buse de décharge (28) reliée à une extrémité aval (29) du conduit de décharge (26), la buse de décharge étant configurée pour injecter le volume de liquide dans la cartouche,
 - un dispositif d'expansion (30) qui est relié au conduit de décharge, le dispositif d'expansion étant configuré pour augmenter un volume (V) dans le conduit de décharge entre la sortie de la pompe à piston et la buse de décharge à la fin de la course de remplissage pour empêcher toute coulure de se produire à partir de la buse de décharge après la fin de la course de remplissage de la pompe à piston, dans lequel
 - le dispositif d'expansion comprend une partie mobile (50) qui est configurée pour effectuer un mouvement alternatif,
 - la partie mobile (50) effectue une course

- de compression et une course de détente, dans lequel, pendant la course de compression de la partie mobile, le volume du conduit de décharge est diminué et dans lequel, pendant une course de détente de la partie mobile, le volume du conduit d'évacuation est augmenté,
- la course de compression de la partie mobile a lieu pendant la course de remplissage de la pompe à piston et dans lequel la course de détente de la partie mobile a lieu pendant la course de retour de la pompe à piston, et
- le piston (22) de la pompe à piston et la partie mobile (50) sont entraînés par une came unique (40) qui est configurée pour courir le long d'une piste de came (104), dans lequel la piste de came entraîne à la fois la pompe à piston et le dispositif d'expansion via la came unique, dans lequel l'entraînement du dispositif d'expansion par la came a lieu directement ou a lieu indirectement via un élément d'entraînement intermédiaire (75).
2. Dispositif selon la revendication 1, dans lequel le dispositif d'expansion est prévu dans une section continue du conduit de décharge et augmente le volume de la section continue.
 3. Dispositif selon la revendication 1, dans lequel le conduit de décharge comprend:
 - une section continue (31) entre la pompe à piston et la buse de décharge, et
 - une section en cul-de-sac (32) reliée à la section continue,
 dans lequel le dispositif d'expansion est prévu dans la section en cul-de-sac et augmente le volume de la section en cul-de-sac.
 4. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le conduit de décharge comprend une section de tube élastique (52) et dans lequel la partie mobile (50) est configurée pour comprimer la section de tube élastique d'un premier volume à un petit volume, et dans lequel la section de tube élastique se dilate du petit volume pour revenir au premier volume en raison de son élasticité.
 5. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le dispositif d'expansion (30) comprend une pompe à piston d'expansion (70), la partie mobile étant le piston (71) de la pompe à piston d'expansion (70), dans lequel la pompe à piston d'expansion possède une chambre (72), dans lequel la partie de la chambre au-dessous du piston (71) est en communication fluidique avec le conduit de décharge.
 6. Dispositif selon l'une quelconque des revendications précédentes, dans lequel au moins une partie du mouvement de la partie mobile (50) et du mouvement du piston (22) est un mouvement conjoint.
 7. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le piston (22) de la pompe à piston et la partie mobile (50) du dispositif d'expansion sont interreliés pour effectuer un mouvement alternatif conjoint, dans lequel en particulier une longueur de la course de la pompe à piston et une longueur de la course du dispositif d'expansion sont identiques.
 8. Dispositif selon l'une quelconque des revendications 1 à 6, dans lequel la partie mobile (50) suit une partie du mouvement du piston (22) de la pompe à piston, et reste stationnaire pendant une autre partie du mouvement du piston (22) de la pompe à piston.
 9. Dispositif selon la revendication précédente, comprenant un support mobile (38) auquel le piston (22) de la pompe à piston est relié, et un élément d'entraînement intermédiaire (75) qui est relié au support mobile (38), dans lequel l'élément d'entraînement intermédiaire effectue un mouvement alternatif conjoint avec le piston (22) de la pompe à piston, dans lequel une butée (77) est fixée à la partie mobile (50) et dans laquelle, pendant la course de remplissage, la partie mobile reste stationnaire jusqu'à ce que, à une position d'engagement, l'élément d'entraînement intermédiaire coopère avec ladite butée, dans lequel, à partir de cette position, la partie mobile (50) se déplace conjointement avec le piston (22) de la pompe à piston, et dans lequel, pendant la course de retour, l'élément d'entraînement intermédiaire se dégage de la butée, et dans lequel, après le désengagement, la partie mobile (50) reste stationnaire.
 10. Dispositif selon l'une quelconque des revendications précédentes, dans lequel la pompe à piston et le dispositif d'expansion sont couplés mécaniquement et effectuent une course synchronisée, et / ou sont couplés électroniquement et effectuent une course synchronisée qui est commandée par une unité de commande.
 11. Dispositif selon l'une quelconque des revendications précédentes, dans lequel, pendant une partie de la course du piston (22) de la pompe à piston, aucune compression ou détente du conduit de décharge n'a lieu, et dans lequel la compression et la détente n'ont lieu que pendant une partie de course active, dans lequel la partie de course active est la partie de la course où le piston termine la course de remplissage.

ge, change de direction et commence la course de retour.

12. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le dispositif d'expansion effectue un cycle dans lequel, au cours du cycle, le volume du conduit de décharge est d'abord diminué d'un premier volume à un petit volume, puis augmenté du petit volume pour revenir au premier volume, et dans lequel, de préférence, le conduit de décharge se dilate directement après la course de remplissage de la pompe à piston. 5
10

13. Carrousel rotatif (100) comprenant au moins quatre des dispositifs (10) selon l'une quelconque des revendications précédentes, le carrousel étant configuré pour tourner autour d'un axe central (102), dans lequel la piste de came est annulaire. 15

14. Procédé de remplissage de cartouches (12) de cigarettes électroniques avec un liquide, pratiquement sans coulure à la fin du cycle de remplissage, le procédé comprenant les étapes de: 20
 - fournir un dispositif selon l'une quelconque des revendications 1 à 12, 25
 - pomper un liquide avec la pompe à piston à travers la buse de décharge dans une course de remplissage,
 - à la fin de la course de remplissage, augmenter le volume du conduit de décharge avec le dispositif d'expansion pour empêcher toute coulure de se produire. 30

15. Procédé selon la revendication précédente, dans lequel une partie mobile (50) du dispositif d'expansion effectue un mouvement alternatif. 35

40

45

50

55

Fig. 1

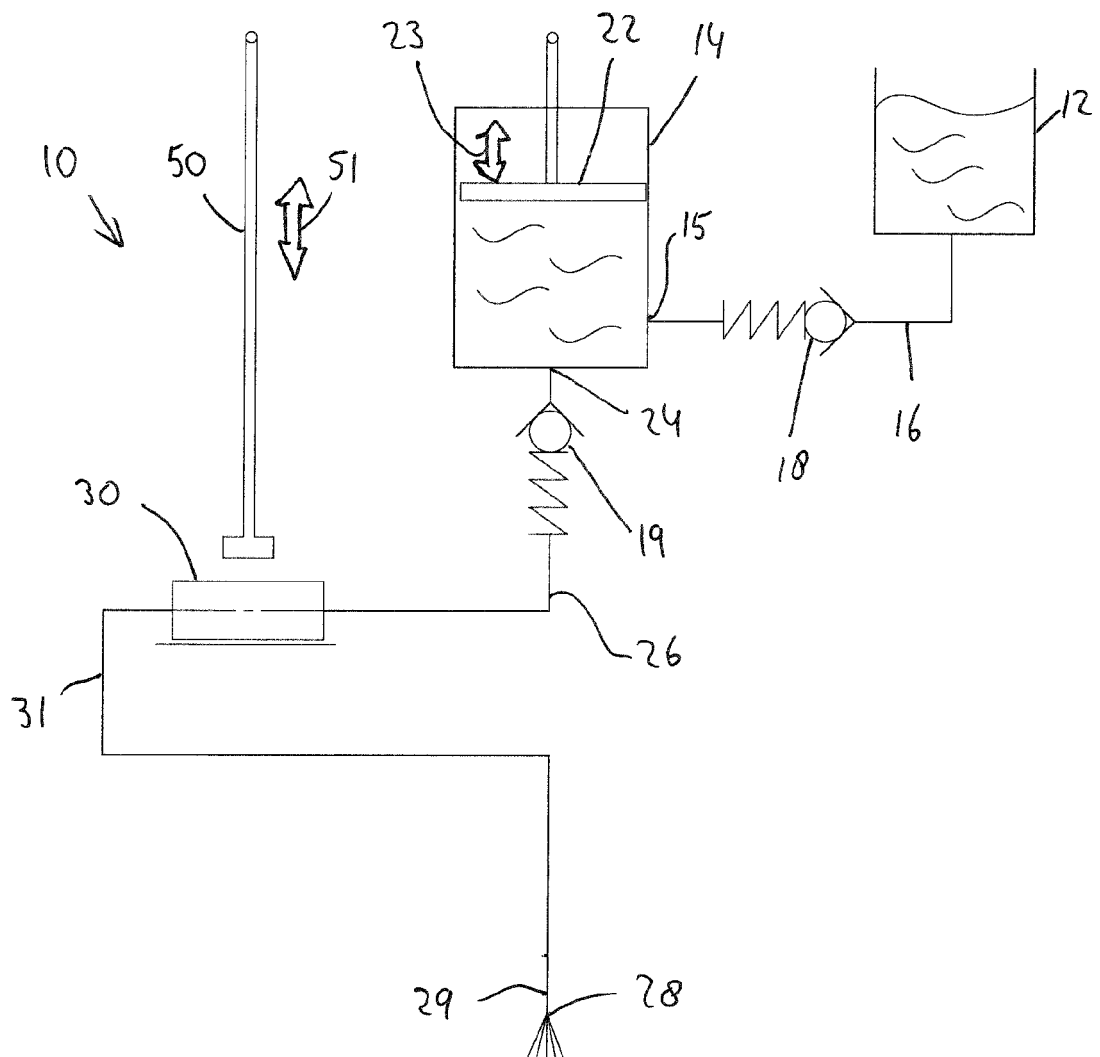


Fig. 2

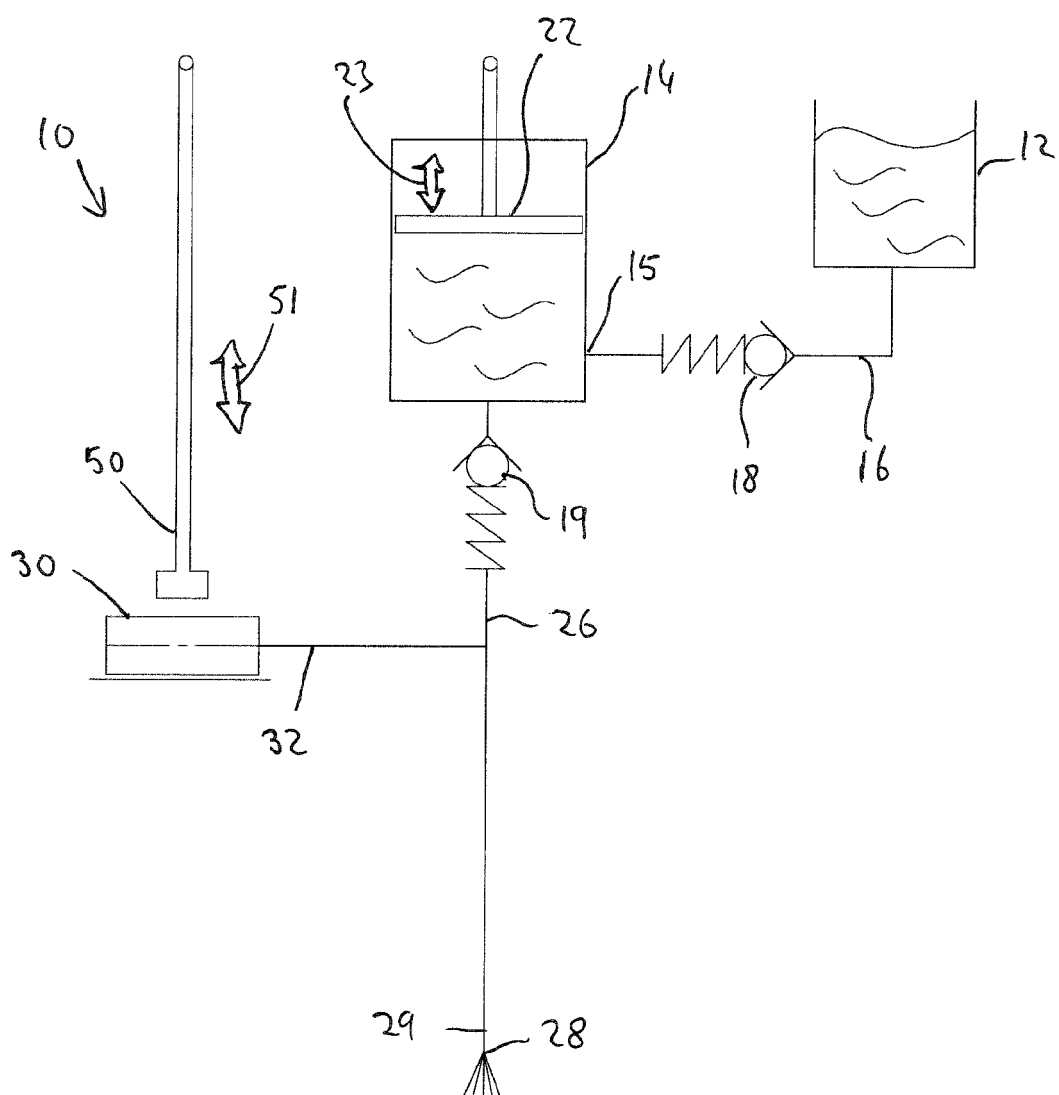


Fig. 3

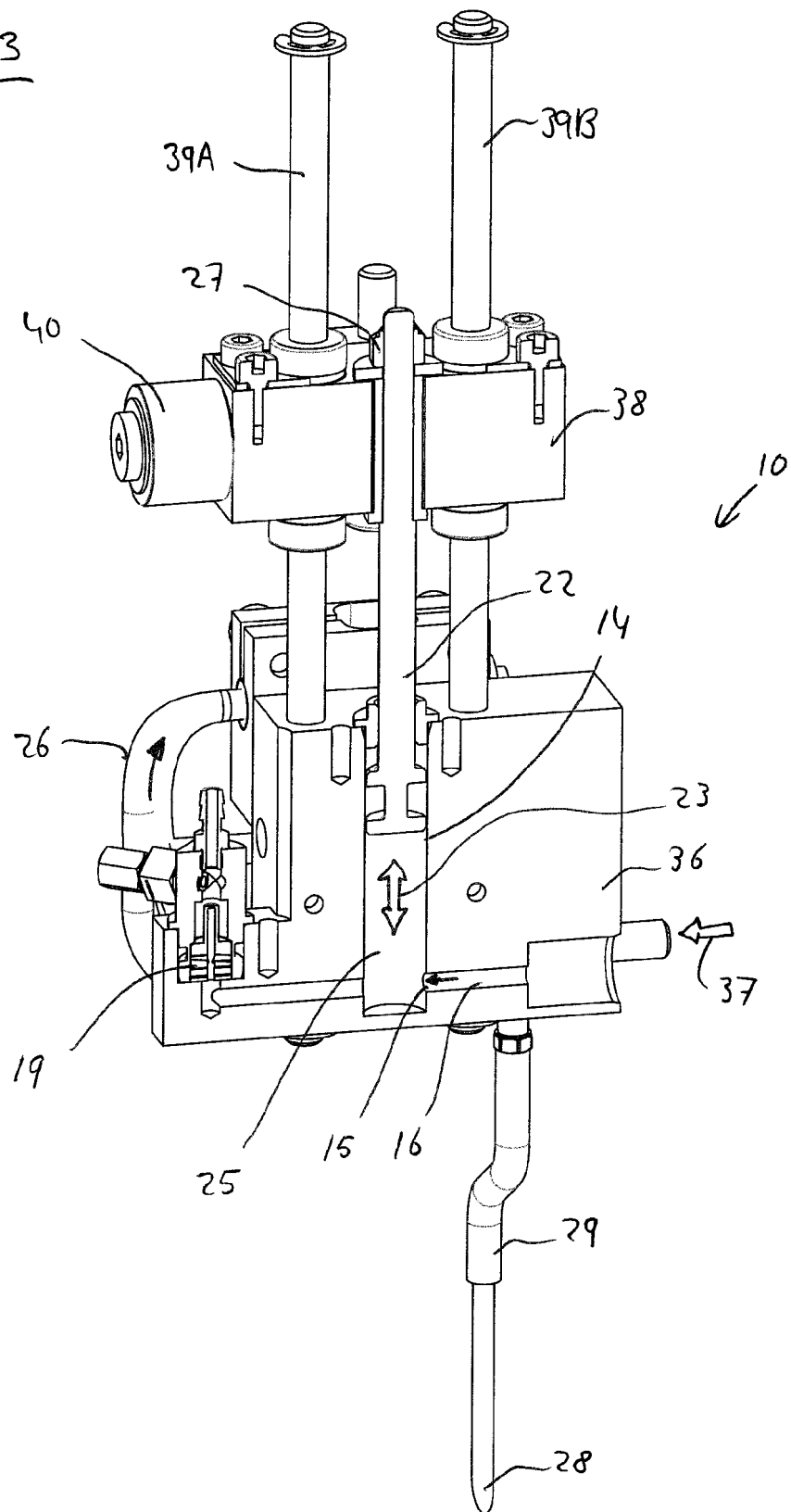


Fig. 4

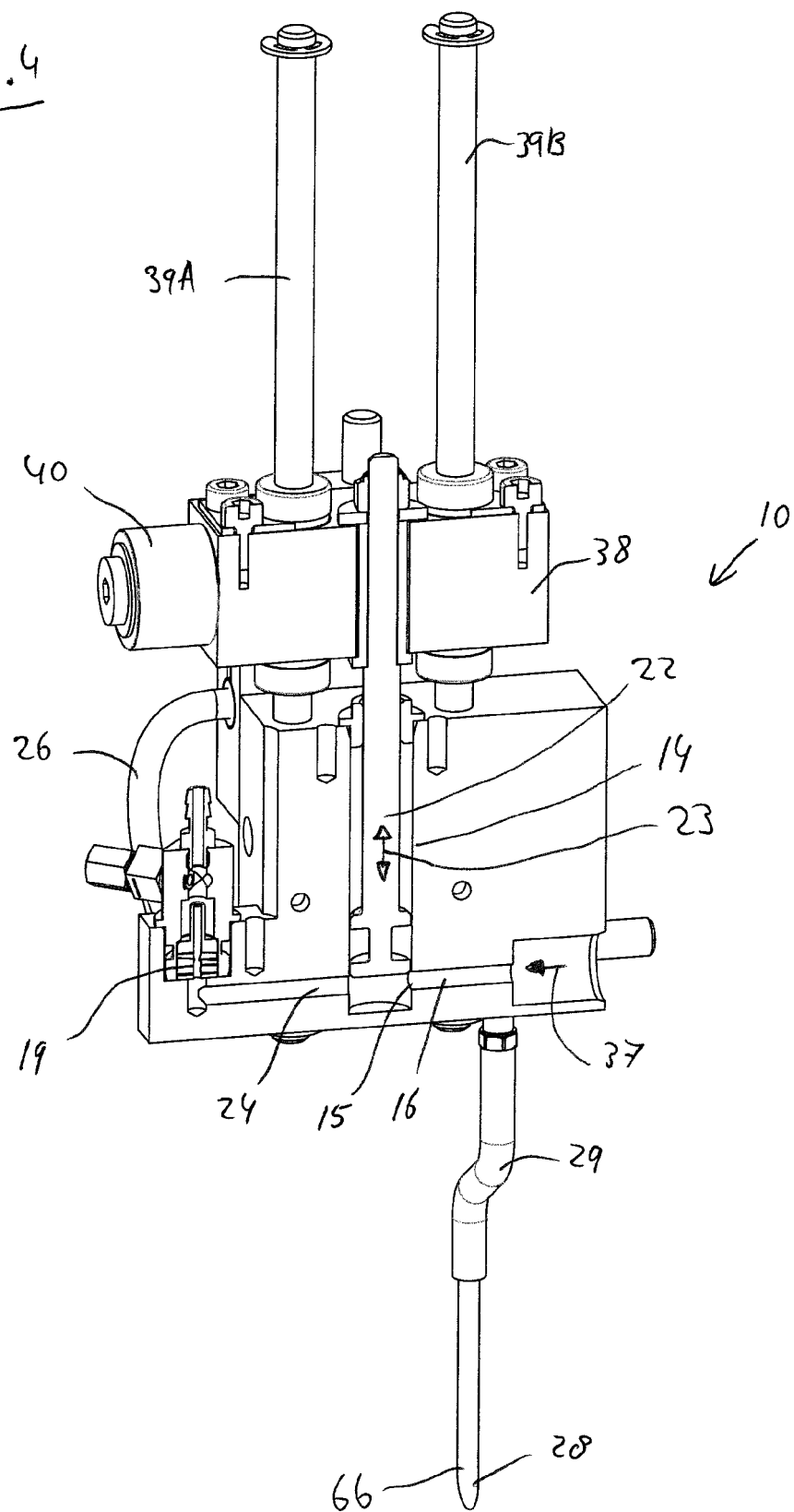


Fig.5

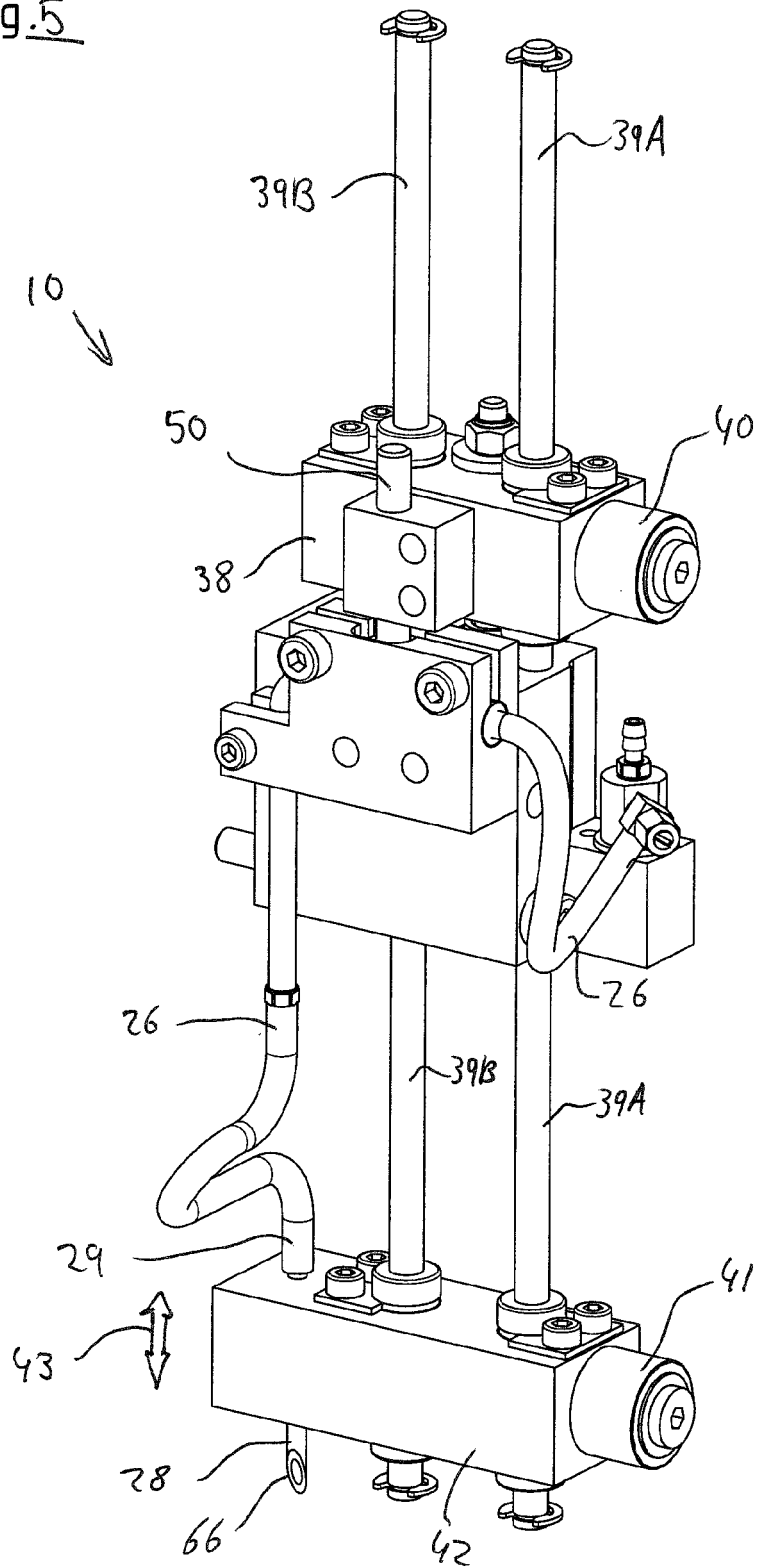


Fig. 6

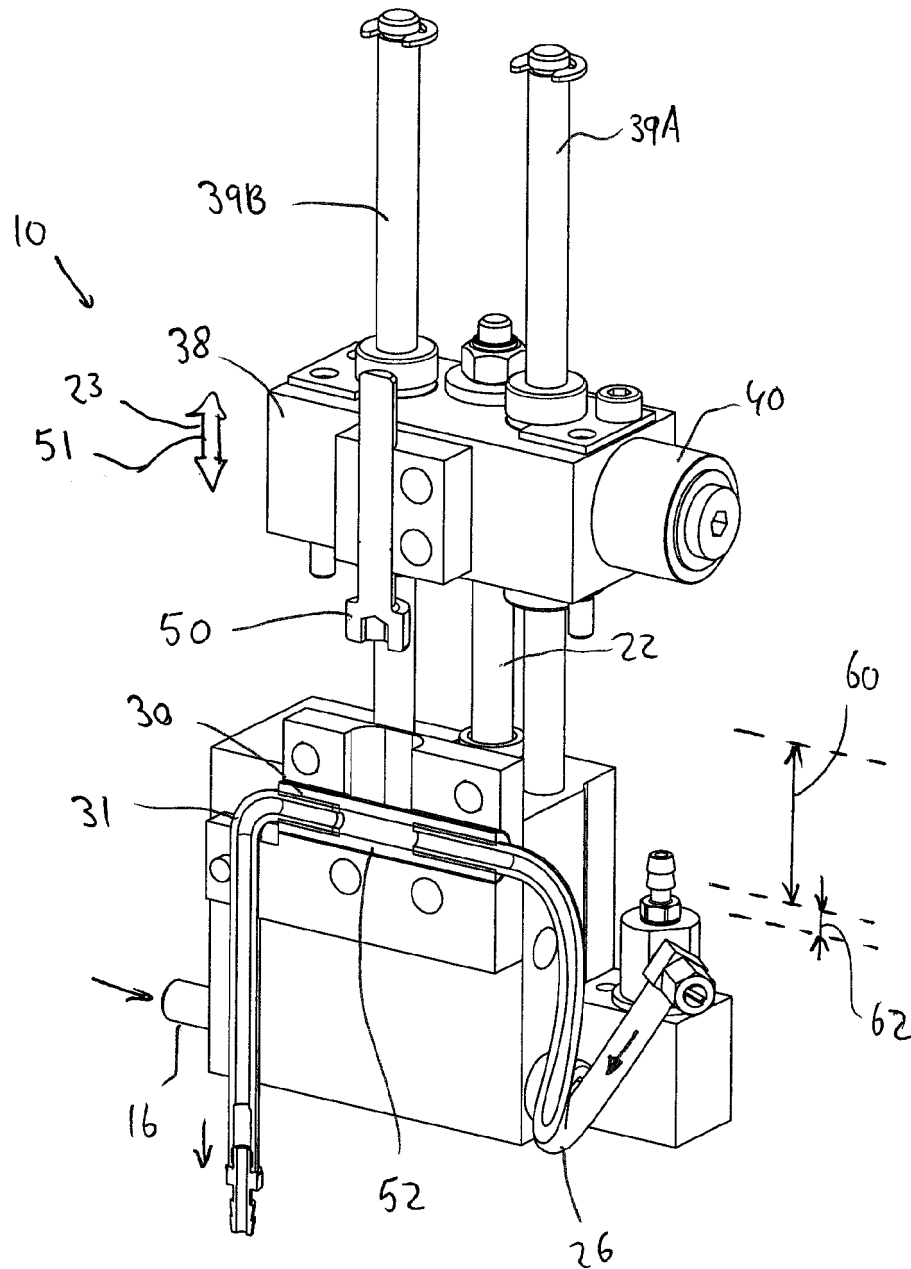


Fig. 7

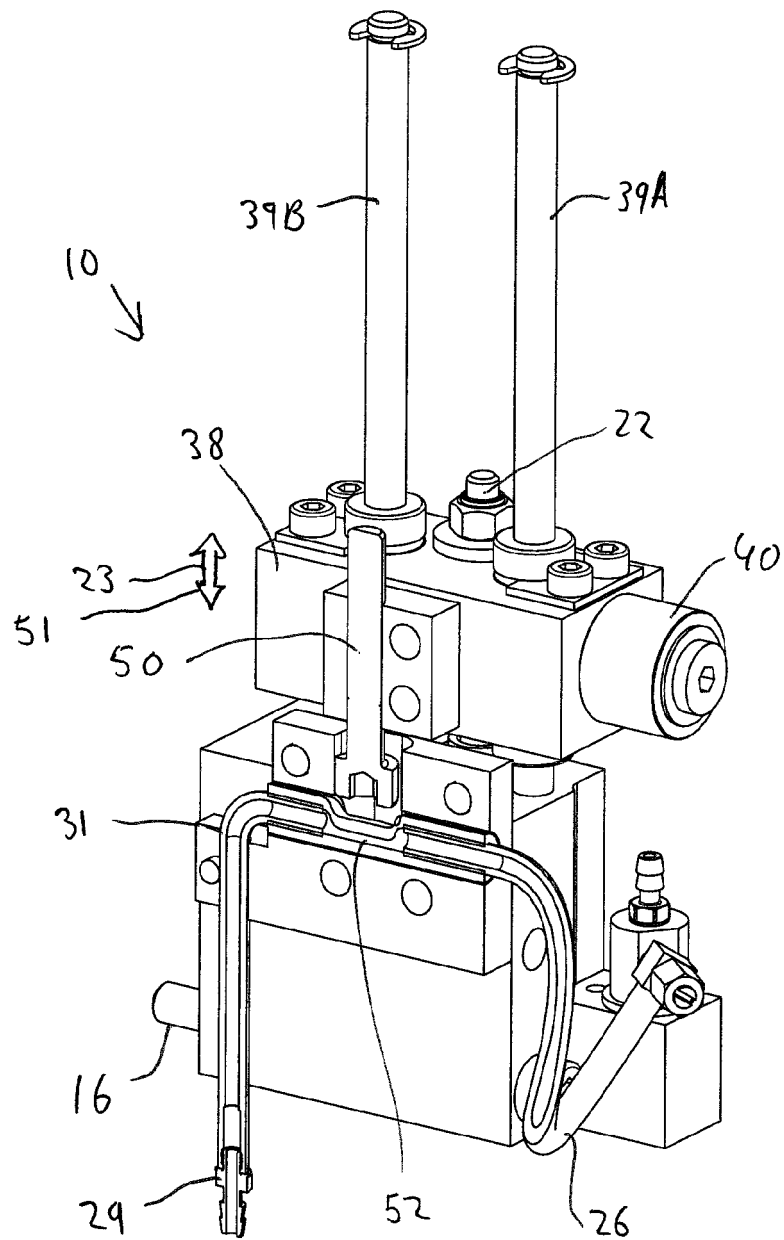


Fig. 8

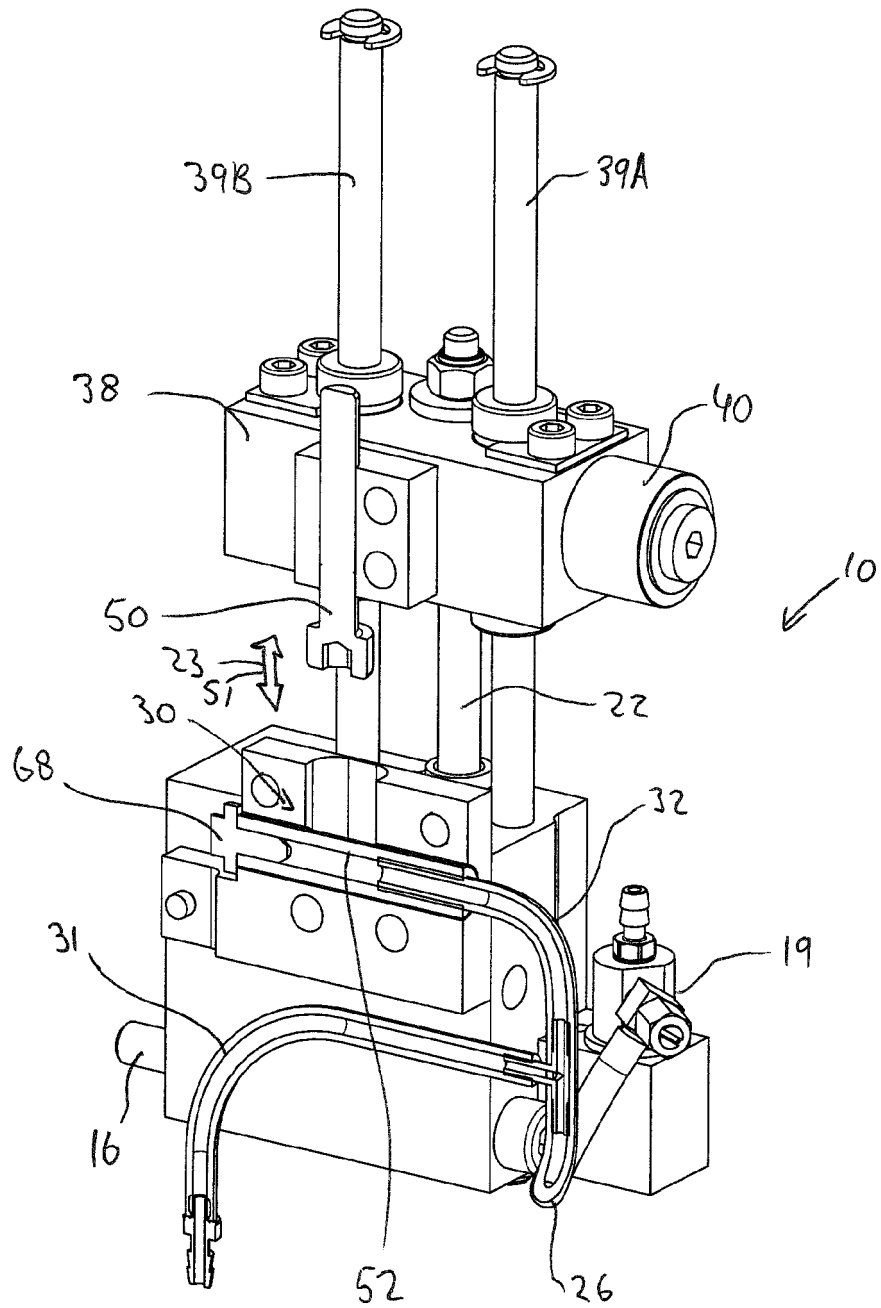


Fig. 9

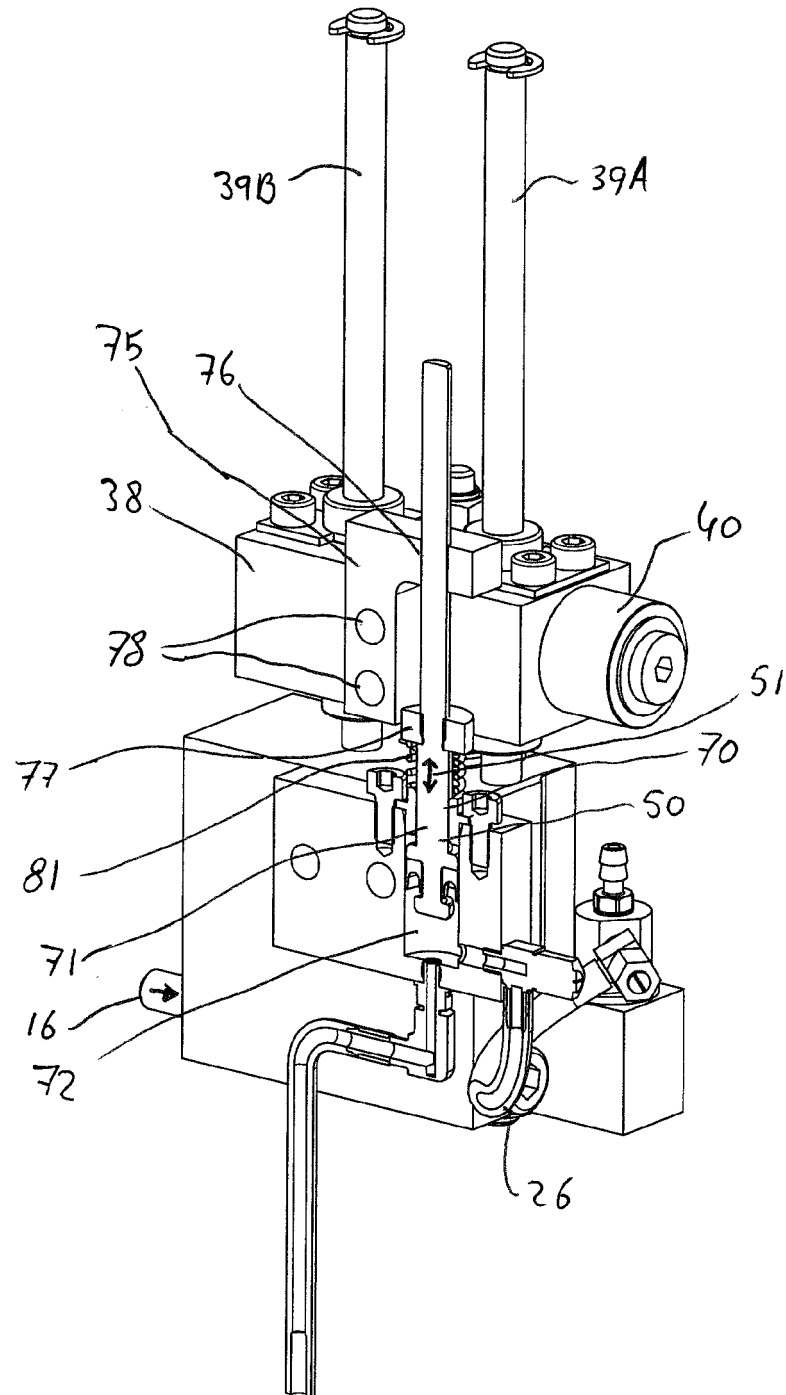
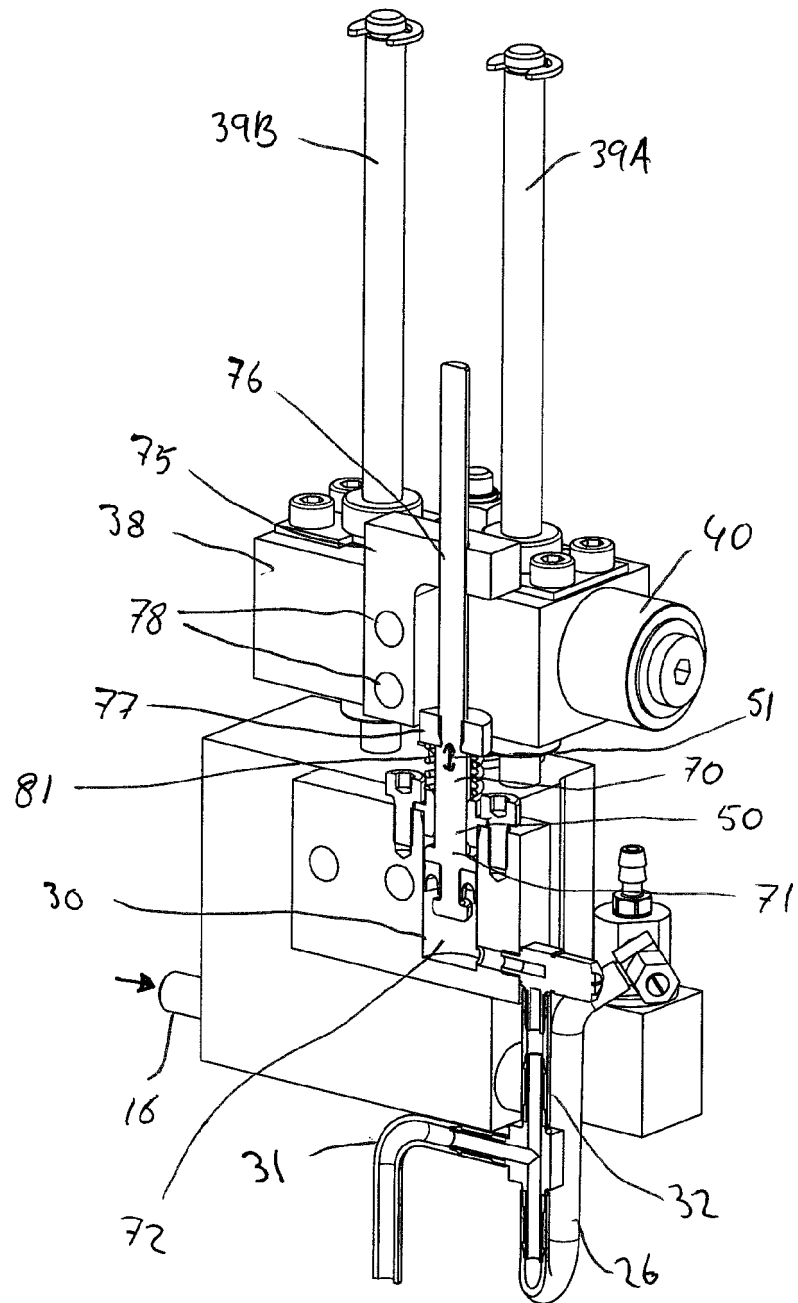


Fig. 10



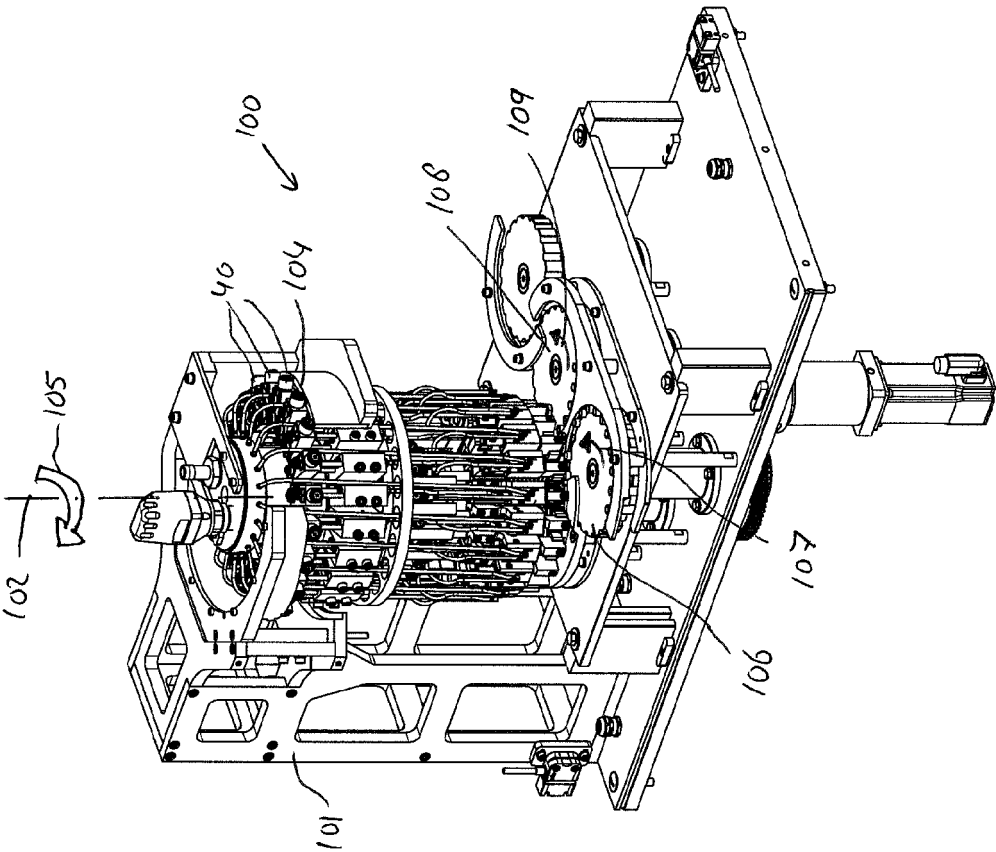
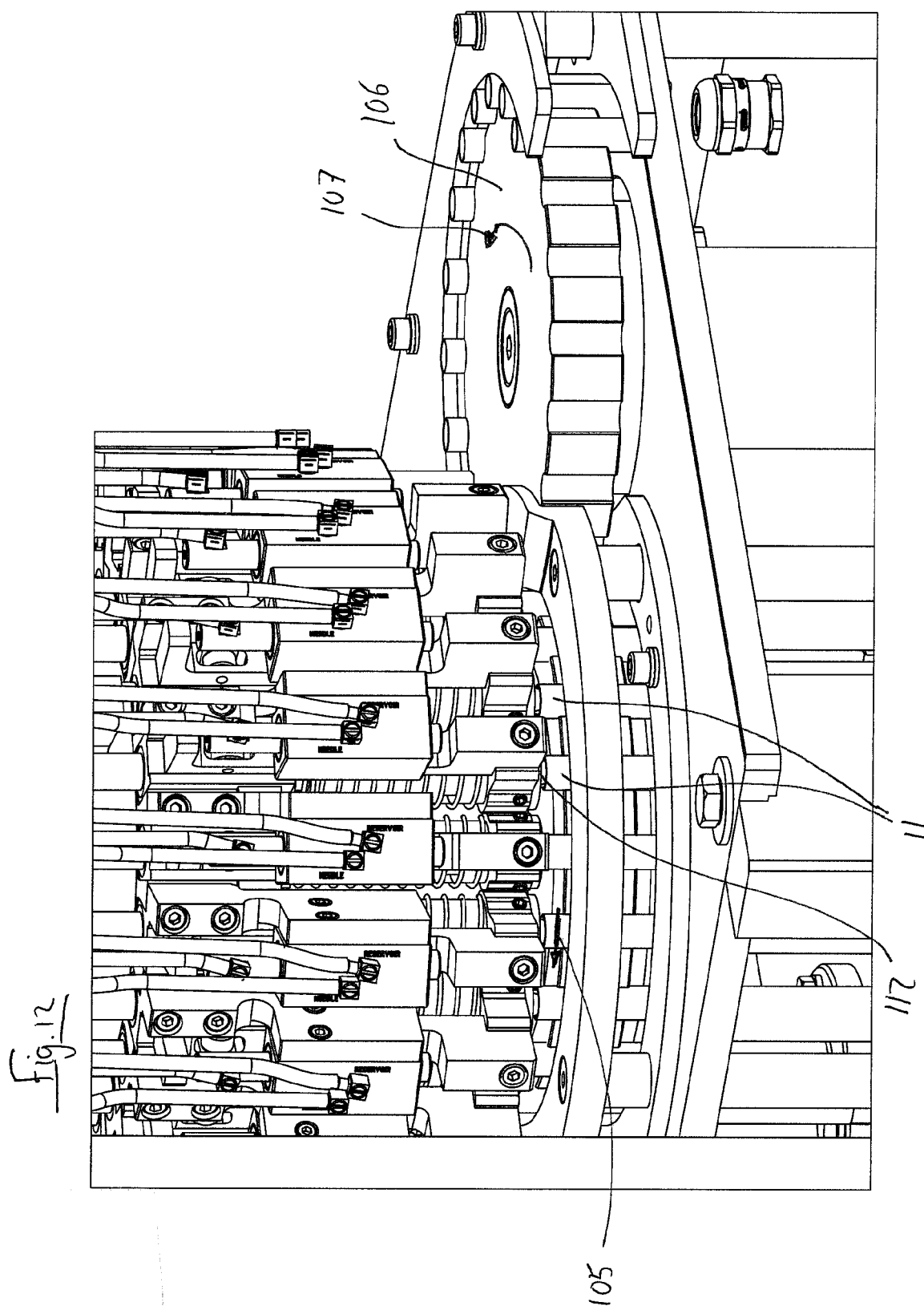


Fig. 11



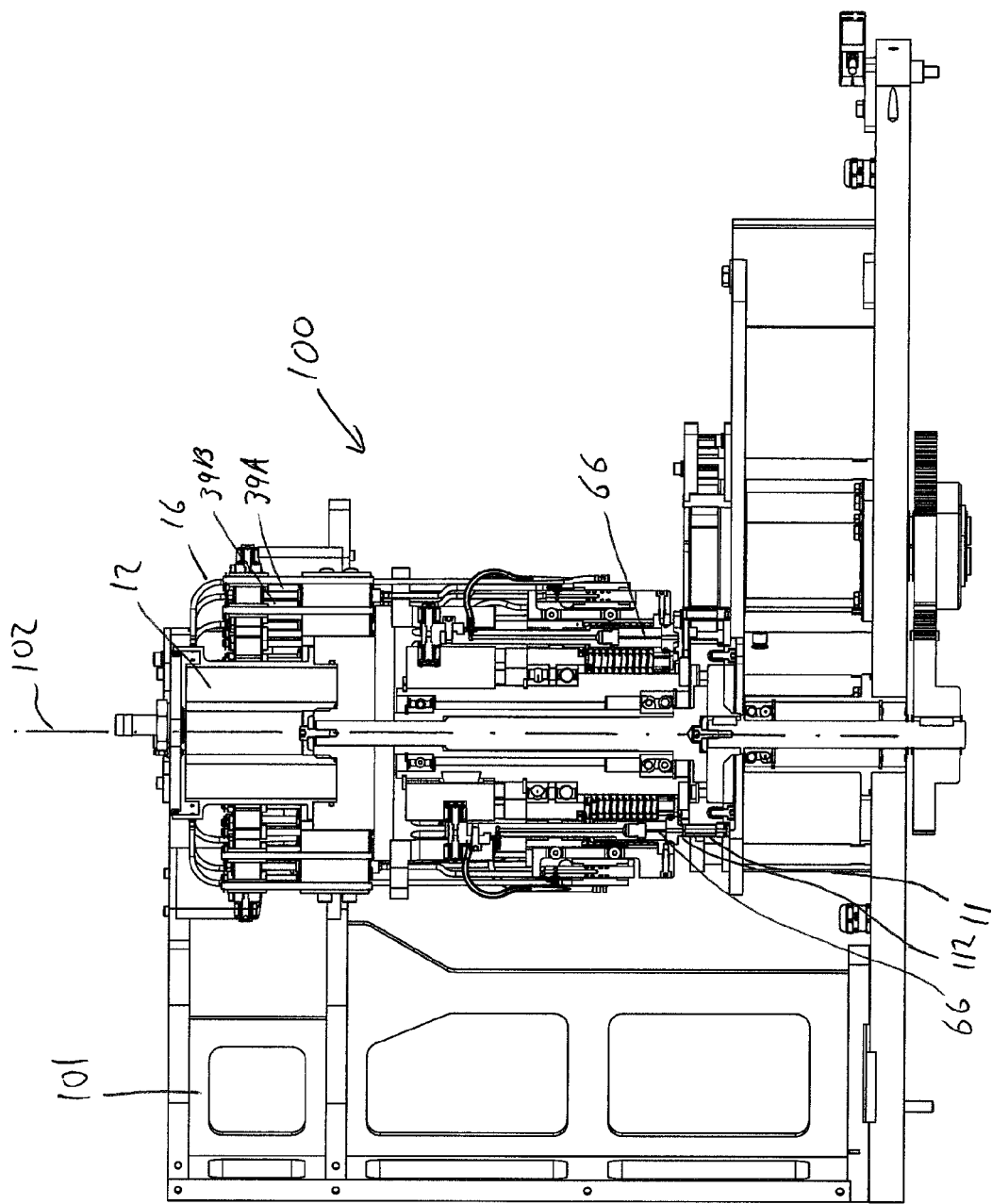


Fig. 13

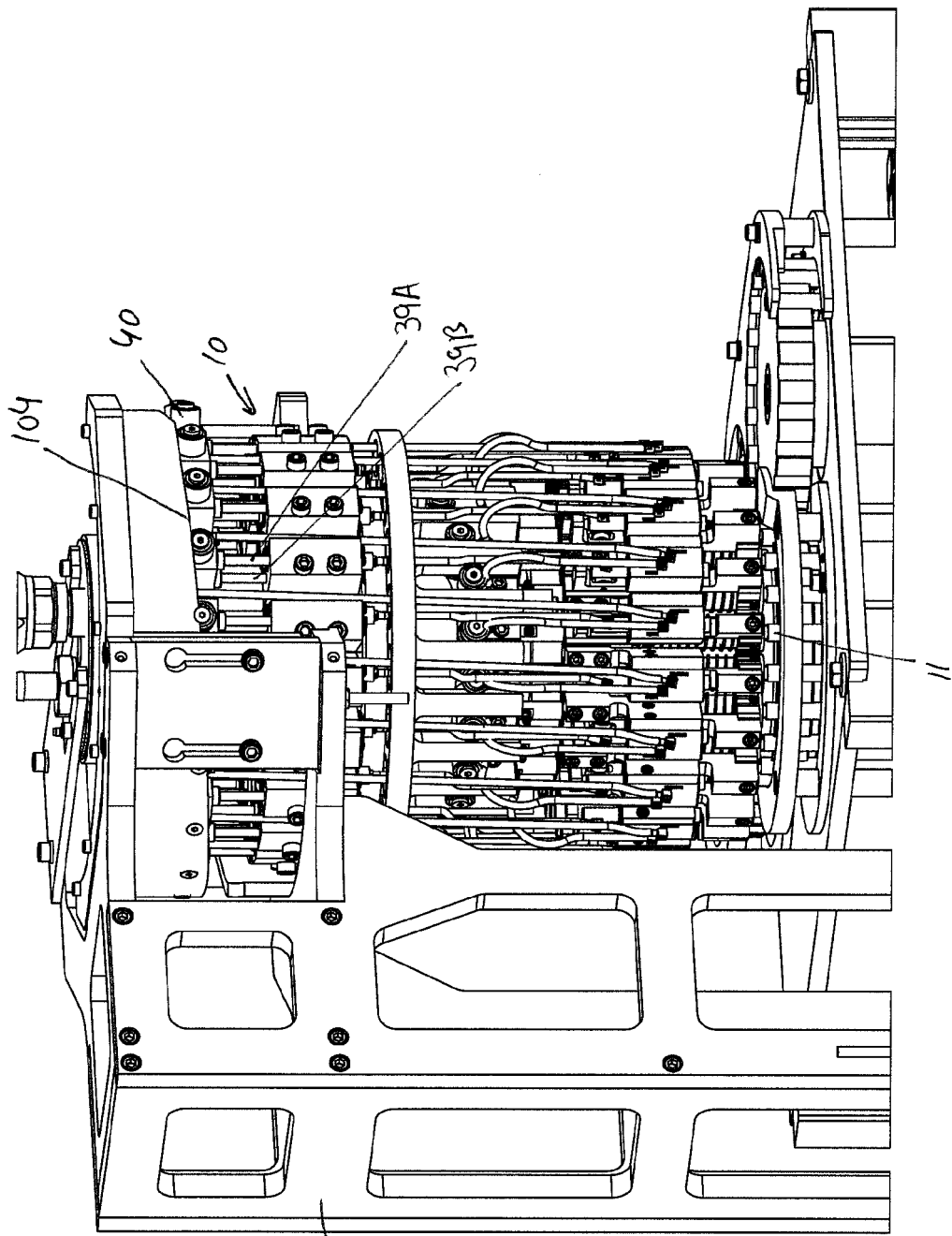


Fig. 14

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 102006001178 [0006]
- EP 2708491 A [0006]
- GB 1597955 A [0006]
- JP H08166075 B [0006]
- JP H0752902 B [0006]