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(54) Titre : MONTAGE PERMETTANT L'INTRODUCTION D'UN AGENT DE DECONTAMINATION DANS UNE ENCEINTE DE CONFINEMENT
(54) Title: ARRANGEMENT FOR INTRODUCING DECONTAMINATION AGENT INTO AN ENCLOSURE

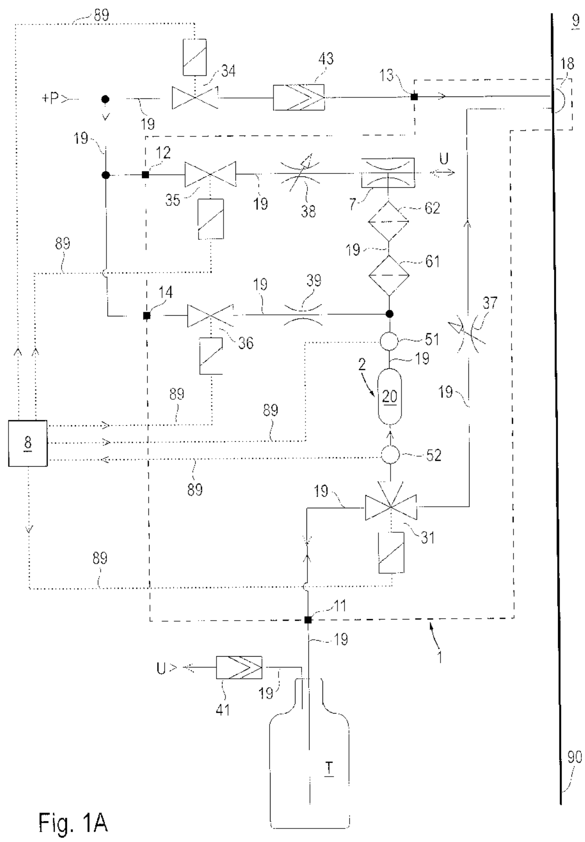

Fig. 1A

(57) Abrégé/Abstract:
The arrangement for introducing a desired quantity of decontamination agent into an enclosure (9) comprises in the first instance a tank (T) as a storage vessel for making available the decontamination agent in liquid form. The main constituent part is a dosing

(57) Abrégé(suite)/Abstract(continued):
device (1) with a spray nozzle (18) directed into the enclosure (9) for the purpose of atomizing the decontamination agent. At least one feed line from the ambient air (U), a compressed air connector (+P) and a controller (8) are provided for operating the dosing device (1). The dosing device (1) has a dosing vessel (2), which has a storage space (20) of defined volume for receiving an individual portion of decontamination agent. The storage space (20) is intended to be filled cyclically with a number (n) of portions of decontamination agent from the tank (T), and the portion contained in each case in the storage space (20) is introduced through the spray nozzle (18) into the enclosure (9) before a subsequent portion is received. The portion number (n) for achieving the desired quantity of required decontamination agent can be chosen between 1 and a whole multiple of 1. The storage space (20) is configured with a fixed or adjustable size and is formed as a separate container, cylinder, recess in the dosing vessel (2) or as an extended or looped tube length. The storage space (20) preferably has a volume in the range of 1 cm^3 to 5 cm^3.

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(54) **Title:** ARRANGEMENT FOR INTRODUCING DECONTAMINATION AGENT INTO AN ENCLOSURE

(54) **Bezeichnung:** ANORDNUNG ZUM EINBRINGEN VON DEKONTAMINATIONSMITTEL IN EIN CONTAINMENT.

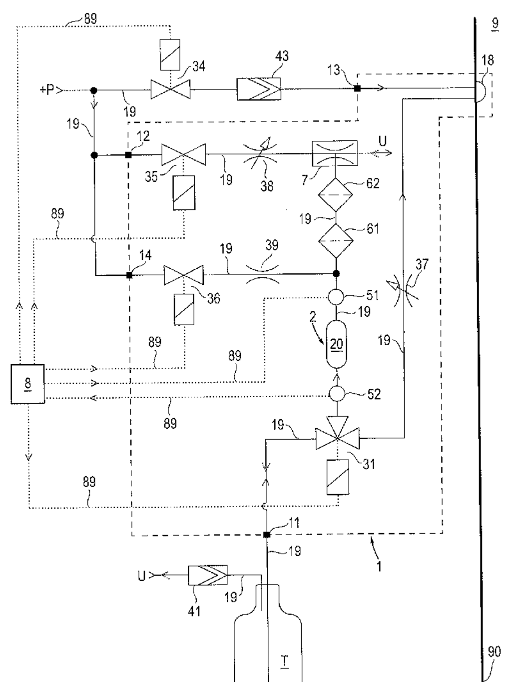

Fig. 1A

(57) **Abstract:** The arrangement for introducing a desired quantity of decontamination agent into an enclosure (9) comprises in the first instance a tank (T) as a storage vessel for making available the decontamination agent in liquid form. The main constituent part is a dosing device (1) with a spray nozzle (18) directed into the enclosure (9) for the purpose of atomizing the decontamination agent. At least one feed line from the ambient air (U), a compressed air connector (+P) and a controller (8) are provided for operating the dosing device (1). The dosing device (1) has a dosing vessel (2), which has a storage space (20) of defined volume for receiving an individual portion of decontamination agent. The storage space (20) is intended to be filled cyclically with a number (n) of portions of decontamination agent from the tank (T), and the portion contained in each case in the storage space (20) is introduced through the spray nozzle (18) into the enclosure (9) before a subsequent portion is received. The portion number (n) for achieving the desired quantity of required decontamination agent can be chosen between 1 and a whole multiple of 1. The storage space (20) is configured with a fixed or adjustable size and is formed as a separate container, cylinder, recess in the dosing vessel (2) or as an extended or looped tube length. The storage space (20) preferably has a volume in the range of 1 cm^3 to 5 cm^3.

(57) **Zusammenfassung:** Die Anordnung zum Einbringen einer Sollmenge an Dekontaminationsmittel in ein Containment (9) umfasst zunächst einen Tank (T) als Vorratsbehälter zur Bereitstellung des Dekontaminationsmittels in flüssiger Form. Wesensbestandteil ist eine Dosiervorrichtung (1) mit einer in das Containment (9) gerichteten Sprühdüse (18) zur Verneblung des Dekontaminationsmittels. Zumindest eine Zuführung aus der Umgebungsluft (U), ein Druckluftanschluss (+P) sowie eine Steuereinrichtung (8) sind zum Betrieb der Dosiervorrichtung (1) vorgesehen. Die Dosiervorrichtung (1) hat

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Erklärungen gemäß Regel 4.17:

— *hinsichtlich der Berechtigung des Anmelders, ein Patent zu beantragen und zu erhalten (Regel 4.17 Ziffer ii)*

Veröffentlicht:

— *mit internationalem Recherchenbericht (Artikel 21 Absatz 3)*

— *vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eingehen (Regel 48 Absatz 2 Buchstabe h)*

ein Dosierbehältnis (2), das einen Speicherraum (20) mit definiertem Volumen zur Aufnahme einer einzelnen Portion von Dekontaminati onsmittel besitzt. Der Speicherraum (20) ist zur taktweisen Füllung mit einer Anzahl (n) von Portionen an Dekontaminationsmittel aus dem Tank (T) bestimmt, und die im Speicherraum (20) jeweils enthaltene Portion wird durch die Sprühdüse (18) in das Containment (9) vor Aufnahme einer nächsten Portion eingebracht. Hierbei ist die Portionsanzahl (n) zum Erreichen der Sollmenge an benötigtem Dekontaminationsmittel zwischen 1 und einem Ganzen Vielfachen von 1 wählbar. Der Speicherraum (20) ist mit einer feststehenden oder einstellbaren Grösse ausgebildet und als separater Container, Zylinder, Aussparung im Dosierbehältnis (2) oder als gestreckte oder geschleifte Rohrlänge beschaffen. Der Speicherraum (20) hat vorzugsweise ein Volumen im Bereich von 1 cm^3 bis 5 cm^3.

Arrangement for introducing decontamination agent into an enclosure

Field of the invention

The invention relates to an arrangement for introducing a desired quantity of decontamination agent into a containment facility. Possible containment facilities are in particular isolators, for example for the pharmaceutical-chemical industry, sluices and safety workbenches, for example for microbiological tasks or tasks involving toxic substances. Moreover, the term includes all types of RABS (Restricted Access Barrier Systems) including mobile and stationary systems, such as means of transport and rooms for treating, isolating and/or diagnosing patients, as well as production rooms and laboratories. The arrangement includes a tank as a storage vessel for storing the decontamination agent in liquid form and also a metering apparatus having a spray nozzle that is directed into the containment facility so as to atomize the decontamination agent. A compressed air connection and a control unit are provided so as to operate the metering apparatus.

Prior art

CH 689 178 A5 discloses an apparatus for the gaseous decontamination of clean rooms, said device having an evaporator unit, a vessel for storing a liquid decontamination agent, a feeder device and a control unit for the process sequence. Whereas the evaporator unit is arranged inside the clean room, a hose line extends from the storage vessel that is positioned outside the clean room that is to be decontaminated.

CH 699 032 B1 discloses a method for the decontamination of a clean room and of treatment articles that may be brought temporarily into said clean room. A decontamination agent that is in liquid form in the normal state is supplied from a storage vessel by way of a feed line to a heatable evaporator. The vaporous decontamination agent that is produced in the evaporator is introduced by way of a feed line merely by means of adiabatic expansion directly into the clean room in order to precipitate as a condensate in the clean room and in the event that treatment articles have been brought into the clean room to precipitate on said treatment articles. After a defined reaction time, the precipitated condensate is removed from the clean room in a flushing phase.

The subject of WO 2008/116 341 A2 is a decontamination arrangement for a clean room within an isolator or a sluice and for treatment articles that may be brought temporarily into the clean room. A storage vessel is used to provide a decontamination agent that is in liquid form in the normal state. Moreover, an evaporator apparatus is provided that comprises a heatable evaporator that comprises an evaporator cell. A first feed line leads from the storage vessel to the evaporator cell. A feeder assembly is arranged in the first feed line so as to transport the decontamination agent into the evaporator cell. A second feed line leads from a compressed air unit into the evaporator cell. The vaporized decontamination agent that is produced in the evaporator cell is introduced into the clean room by means of a flow connection that extends from the evaporate cell. The flow connection is formed by a nozzle, which is connected to the evaporator cell, with its inner hollow chamber and the junction that continues therefrom. The nozzle comprises a head, from which the junction flows outwards, and has a shaft that protrudes through the floor of the clean room as far as the evaporator cell.

WO 2013/003 967 A1 proposes an apparatus for the decontamination of a containment facility and/or of treatment articles that may be brought temporarily into said containment facility, said apparatus having a reservoir for storing a decontamination agent that is liquid in the normal state. Moreover, the apparatus comprises an atomizer that is influenced by a compressed air source so as to convert the decontamination agent into an aerosol. The apparatus has at least one outlet that is provided for introducing the aerosol, which is produced in the apparatus, directly into the containment facility. The reservoir and the atomizer are an integral component of the apparatus that may be installed as a whole on or in the containment facility. The reservoir is filled with decontamination agent in the factory or may be filled prior to use by the user. The entire apparatus or at least the reservoir is configured as a disposable item. The atomizer is a Venturi nozzle into which a primary duct flows and said primary duct leads to the reservoir. A secondary duct flows into the atomizer and has a connection to the compressed air source. The fill quantity in the reservoir is determined for a defined volume of a containment facility.

US 2011/0 266 376 A1 discusses an arrangement for introducing a desired quantity of decontamination agent into a containment facility. A tank has the function of a storage vessel for storing the decontamination agent in liquid form. Moreover, the arrangement comprises a metering apparatus having a spray nozzle that is directed into the containment facility so as to atomize the decontamination agent. The metering apparatus comprises a metering container that comprises a storage chamber that has a defined volume for receiving an individual portion of decontamination agent. A compressed air connection and a control unit are used to operate the metering apparatus.

EP 2 839 845 A1 relates to an apparatus that uses nitrogen oxide to sterilize articles that have been brought into a containment facility. The sterilization liquid is stored in a container and is supplied by way of a through-flow counter or a metering pump in a calculated required quantity to a spray nozzle that flows into the containment facility for the purpose of acting on the article.

Finally, EP 2 692 848 A1 discusses an apparatus for introducing a mist of decontamination agent into a containment facility that comprises a storage vessel from which a defined liquid volume is transported into a bottle by means of a controlled pump. A level sensor on the bottle signals that the pump is to be switched off if the set liquid level is realized. The decontamination agent is drawn off by means of suction from the bottle and supplied to an atomizer that flows into the containment facility. The apparatus with the components and the manner in which said components are positioned with respect to one another renders it possible to produce a fine mist of decontamination agent without having to use a heater and an ultrasound atomizer, and simultaneously it is prevented that larger liquid drops are sprayed into the containment facility.

Object of the invention

In the case of the hitherto known structural designs that use a metering apparatus for introducing the decontamination agent into a containment facility, the heated evaporators are often encumbered with problems. In order to introduce a precise as possible metered quantity into the containment facility, it is necessary to use a cost-intensive measuring apparatus, at least one set of scales that require the corresponding amount of space and line connections. A further disadvantage of many of the devices provided for the mentioned purpose is the considerable amount of time required to perform a decontamination process.

In relation to the hitherto known prior art, the object of the invention is based on an innovative arrangement for introducing a desired quantity of decontamination agent into a containment facility. An overall cost-effective solution is to be realized with respect to the outlay relating to the components used, the amount of space required, the accuracy of the metered quantity, the level of safety, the wide range of possible applications and time saved when performing the decontamination processes.

Overview of the invention

The arrangement is proposed for introducing a desired quantity of decontamination agent into a containment facility. The arrangement includes a tank as a storage vessel for storing the decontamination agent in liquid form and also a metering apparatus having a spray nozzle that is directed into the containment facility so as to atomize the decontamination agent. A compressed air connection and a control unit are provided so as to operate the metering apparatus. The metering apparatus has a metering container that comprises a storage chamber that has a defined volume for receiving an individual portion of decontamination agent. The storage chamber is used to sequentially receive a number of portions of decontamination agent from the tank, while the portion that is respectively held in the storage chamber is provided so as to be introduced by means of the spray nozzle into the containment facility prior to receiving a subsequent portion. The number of portions for realizing the desired quantity of required decontamination agent may be selected between 1 and a whole number multiple of 1.

Particular embodiments of the invention are defined below: the storage chamber is configured with a fixed or adjustable size and provided as a separate container, a cylinder, a recess in the metering container or as an extended or drawn tube length. The storage chamber has a volume in the range of 1 cm^3 to 50 cm^3, preferably in the range of 1 cm^3 to 5 cm^3.

For example, a standpipe, a piston or an electrical probe, which may be inserted into the storage chamber and whose position may be adjusted, or a hose winding or tubing winding with a specific inner cross-section and length of winding are used in order to be able to adjust the size of the portion of decontamination agent that may be held in the storage chamber

The compressed air connection is used to fill the storage chamber with decontamination agent from the tank and to operate the spray nozzle based on the Venturi principle. The metering apparatus comprises a feeder device for filling the storage chamber with decontamination agent from the tank. A fill level sensor, a closure element or an adjustable standpipe, an adjustable piston or an adjustable electrical probe are used so as to signal that a complete portion of decontamination agent has been supplied into the storage chamber and that the supply from the tank is to be terminated. The closure element is provided as a floatation body that is arranged in the storage chamber or as a semi-permeable membrane. The adjustable electrical probe cooperates with a fixed electrical contact and they are both covered by the decontamination agent when a complete portion of decontamination agent has been supplied.

It is possible to program into the control unit the time sequence with the start, the process flow and the termination of the procedure of introducing the desired quantity of decontamination agent into the containment facility and the desired quantity by virtue of determining the number of portions. It is also possible to program that, after the process of introducing the desired quantity of decontamination agent into the containment facility has been terminated, any decontamination agent remaining in the metering apparatus is returned to the tank.

In order to introduce the desired quantity of decontamination agent into the containment facility, the following are provided for controlling the process flow and the metered quantity:

a) a first category of control elements in the form of 3-way valves which are influenced by the control unit by way of control lines and are installed in substance lines that convey decontamination agent or ambient air;
b) a second category of control elements in the form of stop valves which are influenced by the control unit by way of control lines and are installed in substance lines that convey decontamination agent or ambient air; and
c) a third category of control elements in the form of restrictor valves, preferably adjustable, which are installed in substance lines that convey decontamination agent or compressed air.

The compressed air and ambient air that are supplied into the arrangement flow through cleaning filters.

The metering apparatus is designed as a compact assembly and may be installed in close proximity to the containment facility in order to realize a minimal length of the substance line from the storage chamber to the spray nozzle and consequently to realize a minimal transportation time for the decontamination agent that is supplied in portions from the storage chamber in the spray nozzle. The tank, the source for the compressed air and the control unit are located outside the metering apparatus. In so doing, the metering apparatus is controlled by way of the central control unit that is already provided for the containment facility. Alternatively, it is also possible to provide a separate control unit that is integrated into the metering apparatus.

Defined on the metering apparatus in accordance with a *first variant* of the arrangement are:

a) a first connection site by means of which a substance line originating from the tank leads into the metering apparatus, wherein a substance line that forms a feed line from the ambient air flows into the tank; and

b) a second connection site, a third connection site and a fourth connection site, by means of which respectively a substance line that originates from the compressed air connection leads into the metering apparatus.

Moreover, the metering apparatus comprises:

a) a first control element and the substance line that continues from the first connection site leads to said first control element and said first control element is connected by way of a control line to the control unit;

b) a fifth control element and the substance line that continues from the second connection site leads to said fifth control element and said fifth control element is connected by way of a control line to the control unit;

c) a sixth control element and the substance line that continues from the fourth connection site leads to said sixth control element and said sixth control element is connected by way of a control line to the control unit.

A fourth control element that is connected by way of a control line to the control unit is installed in the substance line that conveys compressed air to the third connection site.

A substance line continues from the first control element to the metering container that has the storage chamber arranged therein, and a further substance line extends from the first control element to the spray nozzle. A substance line continues from the fifth control element and continues to a feeder device that flows into the ambient air and is preferably in the form of a Venturi nozzle. A substance line extends from the third connection site to the spray nozzle. A substance line continues from the sixth control element and flows above a fill level sensor into the substance line that leads onwards to the first safety element.

A substance line extends from the storage chamber by way of a fill level sensor, which is connected via a control line to the control unit, onwards to a first safety element and from there to the feeder device. An eighth control element, preferably in the form of an adjustable restrictor valve, is installed in the substance line between the fifth control element and the feeder device. A ninth control element, preferably in the form of a restrictor valve, is installed in the substance line between the sixth control element and its junction into the substance line that leads onwards to the first safety element.

An empty status sensor that is connected via a control line to the control unit is installed in the substance line between the first control element and the metering container. A second safety element is provided in the substance line between the first safety element and the feeder device, wherein the two safety elements are preferably configured as semi-permeable membranes. A seventh control element, preferably in the form of an adjustable restrictor valve, is installed in the other substance line between the first control element and the spray nozzle.

<u>Brief description of the attached drawings</u>

In the drawings shows:

Figure 1A – the circuit diagram of a *first variant* of the arrangement;

Figure 1B – a perspective schematic diagram of the metering apparatus shown in figure 1A;

Figure 1C – a frontal view of the metering apparatus in accordance with figure 1B;

Figure 1D – a lateral view of the metering apparatus in accordance with figure 1B;

Figure 1E – a partial exploded view of the metering apparatus in accordance with figure 1B;

Figure 1F – a more detailed exploded view of the metering apparatus in accordance with figure 1B;

Figure 1G – an even more detailed exploded view of the metering apparatus in accordance with figure 1B;

Figure 1H – the vertical sectional view on the line A–A in figure 1D;

Figure 1J – the horizontal sectional view on the line B–B in figure 1D;

Figure 2A – the circuit diagram of a *second variant* of the arrangement;

Figure 2B – a perspective schematic diagram of the metering apparatus shown in figure 2A;

Figure 2C – a partial exploded view of the metering apparatus in accordance with figure 2B;

Figure 3A – the circuit diagram of a *third variant* of the arrangement;

Figure 3B – a perspective schematic diagram of the metering apparatus shown in figure 3A;

Figure 3C – a partial exploded view of the metering apparatus in accordance with figure 3B;

Figure 4A – the circuit diagram of a *fourth variant* of the arrangement;

Figure 4B – a perspective schematic diagram of the metering apparatus shown in figure 4A;

Figure 4C – a partial exploded view of the metering apparatus in accordance with figure 4B;

Figure 5 – the circuit diagram of a *fifth variant* of the arrangement;

Figure 6 – the circuit diagram of a *sixth variant* of the arrangement;

Figure 7 – the circuit diagram of a *seventh variant* of the arrangement;

Figure 8 – the circuit diagram of an *eighth variant* of the arrangement;

Figure 9A – the circuit diagram of a *ninth variant* of the arrangement;

Figure 9B – a perspective schematic drawing of the metering apparatus shown in figure 9A with a storage chamber that is adjustable in size and a connected tank for storing decontamination agent;

Figure 9C – a perspective view of the metering container shown in figure 9B with an empty storage chamber in the large volume setting and a spherical closure element as a flotation body;

Figure 9D – an enlarged vertical sectional view of the metering container in accordance with figure 9C;

Figure 9E – the view in accordance with figure 9C with a filled storage chamber and small volume setting;

Figure 9F – an enlarged vertical sectional view of the metering container in accordance with figure 9E;

Figure 9G – a vertical sectional view of the metering container shown in figure 9B with a closure element as a semi-permeable membrane;

Figure 9H – a perspective view of a modified metering container with an electrically adjustable portion size in the storage chamber;

Figure 9J – a plan view of the structural design in accordance with figure 9H; and

Figure 9K – the vertical sectional view on the line C-C in figure 9J.

Exemplary embodiment

The detailed description of the arrangement in accordance with the invention for introducing a desired quantity of decontamination agent into a containment facility is provided below with reference to the attached drawings. In so doing, the structural design of a total of nine variants of the arrangement and their function is explained. In the interest of avoiding repetitions, the following statement applies for the description of the individual variants: if reference numerals are provided in a figure sequence that is associated with one variant but not explained in the associated description text, then reference is made to their explanation in the preceding variants.

Figures 1A to 1J (*first variant* of the arrangement)

Initially defined on the metering apparatus **1** is a first connection site **11** by means of which a substance line **19** that originates from the tank **T** leads into the metering apparatus **1**, *wherein a substance line* **19** *that forms a feed line from the ambient air* **U** flows into the tank **T**. Moreover, a second connection site **12**, a third connection site **13** and a fourth connection site **14** are provided, by means of which respectively a substance line **19** that originates from the compressed air connection **+P** leads into the metering apparatus **1**. The substance line **19** that continues from the first connection site **11** leads to a first control element **31**, simultaneously the first control element **31** is connected via a control line **89** to the control unit **8**. The substance line **19** that continues from the second connection site **12** leads to a fifth control element **35**, and simultaneously the fifth control element **35** is connected via a control line **89** to the control unit **8**. The substance line **19** that continues from the fourth connection site **14** leads to a sixth control element **36**, and simultaneously the sixth control element **36** is connected via a control line **89** to the control unit **8**. A fourth control element **34** that is connected via a control line **89** to the control unit **8** is installed in the substance line **19** that conveys compressed air **+P** to the third connection site **13**.

A substance line **19** continues from the first control element **31** to the metering container **2** that has the storage chamber **20** arranged therein, said storage chamber being for example in the size of 1 $cm^{3.}$ A further substance line **19** extends from the first control element **31** to the spray nozzle **18** discharging into the containment facility **9**, said spray nozzle is inserted into the chamber wall **90** of said containment facility **9**. A substance line **19** continues from the fifth control element **35** and extends to a feeder device **7** that flows into the ambient air **U** and is preferably in the form of a Venturi nozzle. A substance line **19** extends from the third connection site **13** to the spray nozzle **18**. A substance line **19** continues from the sixth control element **36** and flows above a fill level sensor **51** into the substance line **19** that leads onwards to the first safety element **61**.

A substance line **19** extends from the storage chamber **20** by way of a fill level sensor **51**, which is connected via a control line **89** to the control unit **8**, onwards to a first safety element **61** and from there to the feeder device **7**. An eighth control element **38**, preferably in the form of an adjustable restrictor valve, is installed in the substance line **19** between the fifth control element **35** and the feeder device **7**. A ninth control element **39**, preferably in the form of a restrictor valve, is installed in the substance line **19** between the sixth control element **36** and its junction into the substance line **19** that leads onwards to the first safety element **61**. An empty status sensor **52** that is connected via a control line **89** to the control unit **8** is arranged in the substance line **19** between the first control element **31** and the metering container **2**. A second safety element **62** is installed in the substance line **19** between the first safety element **61** and the feeder device **7**, wherein the two safety elements **61**,**62** are preferably configured as semi-permeable membranes. The two safety elements **61**,**62** form a double shielding-arrangement so that decontamination agent does not unintentionally pass by way of the feeder device **7** into the environment **U**, on the other hand, however, air may be drawn by means of suction into the storage chamber **20**.

A seventh control element **37**, preferably in the form of an adjustable restrictor valve, is installed in the other substance line **19** between the first control element **31** and the spray nozzle **18**. The control elements **37–39** are used to finely adjust the function of the entire arrangement. It is possible to determine the flow resistance of the seventh control element **37**, for example by means of the selected flow cross-section and length of the hose connection between the line connections **23** at the housing **10** and at the spray nozzle **18**. The through-flow rate of the decontamination agent is optimized by means of the seventh control element **37** in order to realize that said decontamination agent exits the spray nozzle **18** in the form of a fine as possible mist. The eighth control element **38** is used to adjust the output of the feeder device **7** in order to build up the liquid column that is to be maintained from the tank **T** via the substance line **19** through the storage chamber **20** as far as the first sensor **51**, including to overcome the flow resistance that is prevailing along this path.

The tank **T**, the control unit **8**, the source for the compressed air **+P** and the feed line from the ambient air **U** are located outside the metering apparatus **1**. The metering apparatus **1** that is structured within the connection sites **11–14** is configured in a compact manner (cf. figures 1B to 1J), broken down on a modular basis into a cover **17**, below that a housing **10**, below that a metering container **2**, below that a further housing **10** and at the very bottom the first control element **31**. Seals **28** and screws **29** of different dimensions are used to assemble the metering apparatus **1**. The two safety elements **62**,**61** that are held spaced apart from one another by a spacer element **69** are located in the upper housing **10**, wherein a funnel **67** is arranged below the first safety element **61**. The degassing chamber **15** adjoins the storage chamber **20** at the top and extends into the upper housing **10**.

A substance line **19** that originates from the ambient air **U** flows into the tank **T** so that, as the decontamination agent is drawn off by means of suction from the tank **T**, it is possible for air to flow in, and, as the decontamination agent is returned from the line system into the tank **T**, displaced air may escape into the ambient air **U**. A first filter **41** is installed in this substance line **19** in order to ensure that only cleaned air passes into the tank **T**.

During the start-up of the installation, the first control element **31** and the fifth control element **35** receive status pulses from the control unit **8** so as to open the first control element **31** from the tank **T** to the metering container **2** and to open the fifth control element **35** so as to feed compressed air **+P** into the feeder device **7**, as a result of which decontamination agent is drawn by means of suction into the storage chamber **20** by way of the two safety elements **61**,**62**. As soon as the desired fill level in the storage chamber **20** is realized, the fill level sensor **51** signals this to the control unit **8**, as a result of which decontamination agent is no longer drawn off by means of suction from the tank **T**, the first control element **31** is switched over, the fourth control element **34** is opened and the fifth control element **35** is closed. Consequently, the spray nozzle **18** is supplied with compressed air **+P** by way of the substance line **19**, the Venturi effect is started and thus the portion of decontamination agent that is available in the storage chamber **20**, in close proximity to the containment facility **9**, is drawn in by means of suction and introduced into the containment facility **9** in aerosol form. A third filter **43** located downstream of the fourth control element **34** guarantees that only pure compressed air **+P** passes to the spray nozzle **18**. If the storage chamber **20** has been emptied, the empty status sensor **52** signals this to the control unit **8** and as required, the storage chamber **20** may be re-filled with the next portion of decontamination agent and its processing then started.

If the desired quantity of required decontamination agent is realized for performing a proper decontamination procedure of the containment facility **9** with a corresponding number **n** of portions – the path along the substance line **19** from the first control element **31** by way of the seventh control element **37** to the spray nozzle **18** is emptied by means of suction – and the line system is to be emptied, the control unit **8** is switched over. The first control element **31** opens the return path from the storage chamber **20** into the tank **T**. The compressed air **+P** that is fed in by way of the sixth control element **36** forces the decontamination agent that is still located in the storage chamber **20** and in the adjoining substance lines **19** back into the tank **T**. In so doing, the ninth control element **39** is used for calculating the required pressure of the compressed air **+P** that is supplied by way of the sixth control element **36** for the purpose of returning the residual decontamination agent into the tank **T**.

The metering apparatus **1** is composed essentially from the upper and the lower housing part **10**, the metering container **2** that is arranged between said housing parts and the cover **17** that is placed on the top. The line connections **23** are provided for connecting to the respective sections of the substance lines **19**. The adjustable seventh control element **37** is formed for example by virtue of selectively dimensioning a substance line **19** of a specific length section and flow cross-section.

Figures 2A to 2C (*second variant* of the arrangement)

This metering apparatus **1** is composed essentially from the one housing part **10**, the metering container **2** that is arranged thereon and the cover **17** that is placed on the top. In comparison to the *first variant*, this arrangement has fewer components. The fourth connection site **14**, the sixth control element **36**, the ninth control element **39** and the first sensor **51** for signaling the fill level and also the associated sections of substance lines **19** and control lines **89** are omitted. The end of the procedure of feeding portions of decontamination agent into the metering container **2** is controlled in this case on a time basis in that the fifth control element **35** is closed and subsequently the first control element **31** is switched to feed the spray nozzle **18**. While the metering container **2** is being emptied – also while decontamination agent is being returned into the tank **T** – air flows by way of the feeder device **7** through the two safety elements **62**,**61** so as to compensate the volume in the metering container **2**. After the process of decontaminating the container facility **9** in the proper manner has been terminated, any decontamination agent remaining in the arrangement is returned into the tank **T** in this case not by means of pressure and suction but rather merely by virtue of the force of gravity on account of the height difference with respect to the tank **T** positioned below.

Figures 3A to 3C (*third variant* of the arrangement)

This metering apparatus **1** is even more compact with the housing part **10**, the metering container **2** that is arranged therein and the cover **17** that is placed on the top. In comparison to the *second variant*, the second safety element **62** is omitted in this case, in lieu of the second sensor **52** for detecting the empty status of the metering container **2** there is now only the first sensor **51** for detecting the fill level, and the size of the storage chamber **20** in the pot-like metering container **2** is now adjustable, for example between 1 cm^3 and 50 cm^3. The adjustability is realized by means of a stand pipe **27** that protrudes into the storage chamber **20** and is height adjustable.

The feeder device **7** that is influenced with compressed air **+P** by way of the open fifth control element **35** causes in turn decontamination agent to be drawn by means of suction out of the tank **T** by way of the first control element **31** into the metering container **2** until the first sensor **51** indicates that the fill volume has realized the set fill volume, upon which the first control element **31** switches over so as to feed the spray nozzle **18**. Any decontamination agent remaining in the arrangement is returned into the tank **T** merely by virtue of the force of gravity.

Figures 4A to 4C (*fourth variant* of the arrangement)

Also, this metering apparatus **1** is very compact with the housing part **10**, the metering container **2** that is arranged therein and the cover **17** that is placed on the top. In order to fasten the first sensor **51**, a mounting plate **16** that is to be screwed to the housing **10** is provided in addition. The single difference with respect to the structural design of the *third variant* is that in lieu of the previously used metering container **2** having the storage chamber **20** with an adjustable storage volume, in the case of this exemplary embodiment the size of the storage chamber **20** is defined by virtue of dimensioning a hose winding or tubing winding. Depending upon the inner cross-section and length of the winding, it is possible to form a storage volume of for example between 1 cm^3 and 5 cm^3. As in the case in the *third variant,* the metering container **2** is filled with decontamination agent that is fed into the containment facility **9** by way of the spray nozzle **18** and any decontamination agent remaining in the arrangement is returned to the tank **T**.

Figure 5 (*fifth variant* of the arrangement)

In relation to the *fourth variant*, the fifth control element **35** and the feeder device **7** are omitted, only a second control element **32** is installed in lieu of these fittings. A control line **89** leads from the control unit **8** to the second control element **32** and a substance line **19** leads out of the ambient air **U** through the second connection site **12** by way of the first safety element **61** and the seventh control element **37.** The adjustable seventh control element **37** is used to adjust the quantity of incoming air as the storage chamber **20** empties. The second safety element **62** is now positioned between the first sensor **51** for indicating the filled storage chamber **20** and the second control element **32**. Moreover, a third sensor **53** is installed between the junction of the substance line **19**, which originates from the second control element **32**, into the substance line **19** that leads to the spray nozzle **18**, and said third sensor signals the absence of decontamination agent, in particular the portion of decontamination agent from the metering container **2** is processed by way of the spray nozzle **18**.

The storage chamber **20** is now filled with decontamination agent from the tank **T** solely by means of the suction effect of the spray nozzle **18** by way of the second control element **32** and the second safety element **62**. The first safety element **61** is used as a filter for the air incoming from the environment **U** into the substance line **19** and simultaneously as a barrier in the event that, as a result of a defect, decontamination agent should penetrate into this section of the substance line **19**, said decontamination agent is consequently unable to pass into the environment **U**. The second safety element **62** is installed quasi upstream of the first safety element **61**. Any decontamination agent remaining in the arrangement is also returned into the tank **T** in this case by virtue of the force of gravity.

Figure 6 (*sixth variant* of the arrangement)
In the case of this exemplary embodiment, decontamination agent that is drawn off by means of suction from the storage chamber **20** is no longer fed to the spray nozzle **18** by way of the second control element **32** but rather by way of the open fifth control element **35** in the case of the first sensor **51** signaling the fill level. While decontamination agent is being supplied to the spray nozzle **18**, the first control element **31** with the substance line **19** leading to the tank **T** is closed, whereas the control element with the substance line **19** leading to the ambient air **U** is open. The section of the substance line **19** leads from the ambient air **U** initially through the second connection site **12**, the first safety element **61** being connected downstream of said second connection site **12**. The adjustable seventh control element **37** is arranged in the substance line **19** between the first safety element **61** and the connection to the first control element **31**, wherein the first safety element **61** and the seventh control element **37** have the function as previously described (cf. figure 5).

Conversely, if the first sensor **51** does not signal the presence of decontamination agent but rather signals the presence of air, this indicates that the storage chamber **20** is either completely empty or not yet completely filled. Consequently, the fifth control element **35** is closed or remains closed and the first control element **31** is open towards the tank **T** but closed towards the ambient air **U**. In the case that compressed air **+P** is continuously supplied by way of the fourth control element **34**, the suction effect that is generated by the spray nozzle **18** through the second safety element **62** and through the storage chamber **20** refills or completely fills said storage chamber with a next portion **n** of decontamination agent. However, the second safety element **62** does not allow any possibly entrained particles of decontamination agent to pass through. Any decontamination agent remaining in the arrangement flows in turn solely by virtue of the force of gravity into the tank **T**.

Figure 7 (*seventh variant* of the arrangement)

This exemplary embodiment is simplified with respect to the structural design of the *sixth variant*. The section of the substance line **19**, which is routed in the bypass and has the fifth control element **35** installed therein, and the second control element **62** are omitted. Apart from the reduced level of safety, the operating principle is virtually identical.

In the case that the first sensor **51** signals the fill level, in accordance with pulses from the control unit **8**, the first control element **31** is closed towards the tank **T** and open towards the ambient air **U**. The spray nozzle **18** that is influenced with compressed air **+P** by way of the fourth control element **34** and the third filter **43** causes decontamination agent to be drawn in by means of suction from the filled storage chamber **20** and said decontamination agent is fed into the containment facility **9** in an atomized form.

Conversely, if the first sensor **51** signals only the presence of air – the storage chamber **20** is thus empty or not completely filled – the first control element **31** is opened or remains open towards the tank **T** and closed towards the ambient air **U**. The compressed air **+P** that is supplied to the spray nozzle **18** by way of the fourth control element **34** generates a suction effect that acts on the storage chamber **20** and as a result generates its next fill with a further portion **n** of decontamination agent that is then available for feeding into the containment facility **9**. Any decontamination agent remaining in the arrangement is returned into the tank **T** on the basis of the force of gravity.

Figure 8 (*eighth variant* of the arrangement)

The structural design of this exemplary embodiment represents an obvious variation with respect to the *fifth variant*. In lieu of the hose winding or tubing winding that is provided for dimensioning the size of the storage chamber **20**, the top-like metering container **2** that has an adjustable storage volume – for example between 1 cm^3 and 50 cm^3 – is used. The third sensor **53** is omitted and the first safety element **61** is now arranged at the position of the second safety element **62**, namely between the first sensor **51** and the second control element **32**. In addition, the adjustable seventh control element **37** is now arranged in the substance line **19** between the first control element **31** and the junction of the substance line **19** that originates from the second control element **32** into the first control element **31**.

At the start of the filling mode, the first sensor **51** detects that the fill level of the storage chamber **20** is insufficient. The control unit **8** causes the first control element **31** to open namely from the storage chamber **20** only towards the tank **T**, and said control unit causes the second control element **32** to open namely from the spray nozzle **18** only towards the storage chamber **20** with the result that the suction effect from the spray nozzle **18** that is influenced by compressed air **+P** extends by way of the storage chamber **20** as far as into the tank **T** and the storage chamber **20** is successively filled with decontamination agent.

The end of the process of filling the storage chamber **20** is detected by the first sensor **51** and processed by way of the control unit **8** with the result that a switch-over is performed. The first control element **31** changes into the open position now only from the storage chamber **20** towards the spray nozzle **18**, and the second control element **32** changes into the open position now from the ambient air **U** only more towards the storage chamber **20**. As a result, according to the flow resistance set at the seventh control element **37**, decontamination agent that is drawn in by means of suction from the spray nozzle **18** flows at a corresponding through-flow rate and in an atomized form into the containment facility **9**. Any decontamination agent remaining in the arrangement flows back into the tank **T** owing to the effect of the force of gravity.

Figures 9A to 9K (*ninth variant* of the arrangement)
Reference is made to the *eighth variant* for a comparison of the structural design of this arrangement. The storage chamber **20** of the metering container **2** is in turn adjustable, for example it has a storage volume between 1 cm^3 and 50 cm^3.

The substance line **19** extends from the tank **T** through the first connection site **11** to the first control element **31** that is configured as a 3-way valve and from said first control element a connection leads by way of the substance line **19** to the metering container **2** and a further connection leads by way of a substance line **19** to the third control element **33**. A substance line **19** extends from the third control element **33** – in the form of a 3-way valve – towards the second control element **32** that is likewise a 3-way valve, and a further connection leads by way of the substance line **19** towards the spray nozzle **18**. The adjustable seventh control element **37** is arranged between the third control element **33** and the spray nozzle **18**. As is the case in all previous variants, the substance line **19** leads from a compressed air connection **+P** through the third connection site **13** to the spray nozzle **18**. The fourth control element **34** and the third filter **43** are arranged in the substance line **19** between the compressed air connection **+P** and the third connection site **13**. A connection of the second control element **32** flows with the first fill level sensor **51** that is connected therebetween into the metering container **2** and a further connection of this control element **32** extends as a substance line **19** through the second connection site **12**, which has a second filter **42** that is connected upstream, towards the ambient air **U**. The fill level sensor **51** and the four control elements **31–34** are connected to the control unit **8** by way of control lines **89**.

As the storage chamber **20** is being filled, the first control element **31** is only open from the metering container **2** towards the tank **T** but is in the closed position towards the third control element **33**. Another connection of the third control element **33** is open towards the second control element **32** and from there onwards to the metering container **2**. The remaining connection of the third control element **33** extends open by way of the seventh control element **37** to the spray nozzle **18**, where the suction of the decontamination agent is generated. The remaining connection of the second control element **33** is simultaneously closed towards the ambient air **U**.

As the first sensor **51** detects that the set fill level in the storage chamber **20** has been realized, the arrangement is switched over to the start in the spray mode. The connection at the first control element **31** is closed from the metering container **2** to the tank **T** and the connection to the third control element **33** is opened. Simultaneously, the connection from the third control element **33** towards the second control element **32** is closed and the connection from the second control element **32** by way of the second connection site **12** towards the ambient air **U** is opened, with the result that the decontamination agent that is drawn in by means of suction from the storage chamber **20** successively by the spray nozzle **18** that is influenced with compressed air **+P** may be replaced by incoming air. In this situation, the connection coming from the storage chamber **20** via the first control element **31** and further via the third control element **33** and the seventh control element **37** is open towards the spray nozzle **18**. Any decontamination agent remaining in the arrangement is also returned into the tank **T** in this case solely by virtue of the force of gravity.

In accordance with figures 9B to 9G, the adjustability of the fill volume of the storage chamber **20** of the metering container **2** is based on a cylindrical body having a lower base part **21**, in which is arranged the storage chamber **20**, and on a lifting part **22** that slides in a telescopic manner over the base part **21**. The lifting part **22** comprises a piston **22'** that protrudes in an axial manner into the storage chamber **20** and as the lifting part **22** moves further over the base part **21** changes the size of the storage chamber **20**, for example between a larger volume $\mathbf{V_1}$ and a smaller volume $\mathbf{V_2}$.

When the storage chamber **20** is in the empty state, a closure element **25** – in figures 9C to 9F a floatation ball – lies on the bottom of the base part **21**. As the storage chamber **20** is successively filled, the closure element **25** floats upwards until the desired level is realized, at which point the closure element **25** blocks the funnel-shaped junction of the duct **24** that extends in an axial manner through the piston **22'**.

In the case of the embodiment of the metering container **2** in accordance with figure 9G, in lieu of the spherical closure element **25** that is based on a floatation principle, a closure element **25** in the form of a semi-permeable membrane is arranged upstream of the funnel-shaped junction of the duct **24** that extends in an axial manner through the piston **22'** and said semi-permeable membrane prevents decontamination agent passing into the duct **24**. At the base part **21**, a substance line **19** leads from the tank **T** or from the spray nozzle **18** into the storage chamber **20**. On the other hand, a substance line **19** leads from the outlet of the duct **24** starting at the line connection **23** to the fill level sensor **51** and from there finally to the ambient air **U** or to the spray nozzle **18**.

In the case of the embodiment of the metering container **2** in accordance with figures 9H to 9K, only the base part **21** is provided and an electrical probe **27'**, which has an adjustable insertion depth, adjusts the portion size in the storage chamber **20**, for example between a larger volume V_1 and a smaller volume V_2. In the case of a completely empty storage chamber **20** or where the fill level has not yet been realized, the electrical contact **26** and the electrical probe **27'** are not covered, which is detected by the first sensor **51**. Conversely, when the fill level is realized, the electrical contact **26** and the electrical probe **27'** are covered, which is registered by the first sensor **51**. The feed system into the base part **21** is equivalent to that in figure 9B to 9G. A substance line **19** that leads finally to the ambient air **U** or to the spray nozzle **18** extends from a separate line connection **23** that flows into the storage chamber **20**.

Claims

1. An arrangement for introducing a desired quantity of decontamination agent into a containment facility (**9**) comprising:

a) a tank (**T**) as a storage vessel for storing the decontamination agent in liquid form;

b) a metering apparatus (**1**) having a spray nozzle (**18**) that is directed into the containment facility (**9**) so as to atomize the decontamination agent;

c) a compressed air connection (**+P**) and a control unit (**8**) so as to operate the metering apparatus (**1**), wherein

d) the metering apparatus (**1**) has a metering container (**2**) that comprises a storage chamber (**20**) that has a defined volume for receiving an individual portion of decontamination agent, characterized in that

e) the storage chamber (**20**) is provided so as to successively receive a number (**n**) of portions of decontamination agent from the tank (**T**) and the portion that is respectively held in the storage chamber (**20**) is provided so as to be introduced by means of the spray nozzle (**18**) into the containment facility (**9**) prior to receiving a subsequent portion, wherein the number (**n**) of portions for realizing the desired quantity of required decontamination agent may be selected between 1 and a whole number multiple of 1.

2. The arrangement as claimed in claim 1, characterized in that the storage chamber (**20**):

a) is configured with a fixed or adjustable size;

b) is provided as a separate container, a cylinder, a recess in the metering container (**2**) or as an extended or drawn tube length; and

c) the storage chamber (**20**) has a volume in the range of 1 cm^3 to 50 cm^3, preferably in the range of 1 cm^3 to 5 cm^3.

3. The arrangement as claimed in at least one of claims 1 and 2, characterized in that in order to be able to adjust the size of the portion of decontamination agent that may be held in the storage chamber (**20**):

a) a standpipe (**27**), a piston (**22'**) or an electrical probe (**27'**), which may be inserted into the storage chamber (**20**) and whose position may be adjusted; or

b) a hose winding or tubing winding with a specific inner cross-section and length of winding are used.

4. The arrangement as claimed in at least one of claims 1 to 3, <u>characterized in that</u>:

a) the compressed air connection (**+P**) is used to fill the storage chamber (**20**) with decontamination agent from the tank (**T**) and to operate the spray nozzle (**18**) based on the Venturi principle; and

b) the metering apparatus (**1**) comprises a feeder device (**7**) for filling the storage chamber (**20**) with decontamination agent from the tank (**T**).

5. The arrangement as claimed in at least one of claims 1 to 4, <u>characterized in that</u> a fill level sensor (**51**), a closure element (**25**) or an adjustable standpipe (**27**), an adjustable piston (**22'**) or an adjustable electrical probe (**27'**) are used so as to signal that a complete portion of decontamination agent has been supplied into the storage chamber (**20**) and to terminate the supply from the tank (**T**).

6. The arrangement as claimed in claim 5, <u>characterized in that</u>:

a) the closure element (**25**) is provided as a floatation body that is arranged in the storage chamber (**20**) or as a semi-permeable membrane; and

b) the adjustable electrical probe (**27'**) cooperates with a fixed electrical contact (**26**), both of which are covered by the decontamination agent when a complete portion of decontamination agent has been supplied.

7. The arrangement as claimed in at least one of claims 1 to 6, <u>characterized in that</u> it is possible to program into the control unit (**8**):

a) the time sequence with the start, the process flow and the termination of the procedure of introducing the desired quantity of decontamination agent into the containment facility (**9**); and

b) the desired quantity by virtue of determining the number (**n**) of portions.

8. The arrangement as claimed in claim 7, characterized in that it is possible to program into the control unit (**8**) that after the process of introducing the desired quantity of decontamination agent into the containment facility (**9**) has been terminated any decontamination agent remaining in the metering apparatus (**1**) is returned to the tank (**T**).

9. The arrangement as claimed in at least one of claims 1 to 8, characterized in that:

a) in order to introduce the desired quantity of decontamination agent into the containment facility (**9**), the following are provided for controlling the process flow and the metered quantity:

aa) a first category of control elements (**31–33**) in the form of 3-way valves which are influenced by the control unit (**8**) by way of control lines (**89**) and are installed in substance lines (**19**) that convey decontamination agent or ambient air (**U**);

ab) a second category of control elements (**34–36**) in the form of stop valves which are influenced by the control unit (**8**) by way of control lines (**89**) and are installed in substance lines (**19**) that convey decontamination agent or ambient air (**+P**); and

ac) a third category of control elements (**37–39**) in the form of restrictor valves, preferably adjustable, which are installed in substance lines (**19**) that convey decontamination agent or compressed air (**+P**); and

b) the compressed air (**+P**) and ambient air (**U**) that are supplied into the arrangement flow through cleaning filters (**41–43**).

10. The arrangement as claimed in at least one of claims 1 to 9, characterized in that:

a) the metering apparatus (**1**) is designed as a compact assembly and may be installed in close proximity to the containment facility (**9**) in order to realize a minimal length of the substance line (**19**) from the storage chamber (**20**) to the spray nozzle (**18**) and consequently to realize a minimal transportation time for the decontamination agent that is supplied in portions from the storage chamber (**20**) to the spray nozzle (**18**); and

b) the tank (**T**), the source for the compressed air (**+P**) and the control unit (**8**) are located outside the metering apparatus (**1**); wherein

c) a central control unit that is already provided for the containment facility (**9**) may be used as a control unit (**8**) for the metering apparatus (**1**) or alternatively it is possible to provide a separate control unit (**8**) that is integrated into the metering apparatus (**1**).

11. The arrangement as claimed in at least one of claims 1 to 10, <u>characterized in that</u> defined on the metering apparatus (**1**) are:

a) a first connection site (**11**) by means of which a substance line (**19**) that originates from the tank (**T**) leads into the metering apparatus (**1**), wherein a substance line (**19**) that forms a feed line from the ambient air (**U**) discharges into the tank (**T**); and

b) a second connection site (**12**), a third connection site (**13**) and a fourth connection site (**14**), by means of which respectively a substance line (**19**) that originates from the compressed air connection (**+P**) leads into the metering apparatus (**1**).

12. The arrangement as claimed in claim 11, <u>characterized in that</u>:

a) the metering apparatus (**1**) further comprises:

aa) a first control element (**31**) wherein the substance line (**19**) that continues from the first connection site (**11**) leads to said first control element and said first control element is connected by way of a control line (**89**) to the control unit (**8**);

ab) a fifth control element (**35**) wherein the substance line (**19**) that continues from the second connection site (**12**) leads to said fifth control element and said fifth control element is connected by way of a control line (**89**) to the control unit (**8**); and

ac) a sixth control element (**36**) wherein the substance line (**19**) that continues from the fourth connection site (**14**) leads to said sixth control element and said sixth control element is connected by way of a control line (**89**) to the control unit (**8**); and

b) a fourth control element (**34**) that is connected via a control line (**89**) to the control unit (**8**) is installed in the substance line (**19**) that conveys compressed air (**+P**) to the third connection site (**13**).

13. The arrangement as claimed in claim 12, <u>characterized in that</u>:

a) a substance line (**19**) continues from the first control element (**31**) to the metering container (**2**) that has the storage chamber (**20**) arranged therein, and a further substance line (**19**) extends from the first control element (**31**) to the spray nozzle (**18**);

b) a substance line (**19**) continues from the fifth control element (**35**) and extends to a feeder device (**7**) that discharges into the ambient air (**U**) and is preferably in the form of a Venturi nozzle;

c) a substance line (**19**) extends from the third connection site (**13**) to the spray nozzle (**18**);

d) a substance line (**19**) extends from the sixth control element (**36**) and discharges above a fill level sensor (**51**) into the substance line (**19**) that leads onwards to the first safety element (**61**).

14. The arrangement as claimed in claim 13, <u>characterized in that</u>:

a) a substance line (**19**) extends from the storage chamber (**20**) via a fill level sensor (**51**), which is connected via a control line (**89**) to the control unit (**8**), onwards to a first safety element (**61**) and from there to the feeder device (**7**);

b) an eighth control element (**38**), preferably in the form of an adjustable restrictor valve, is installed in the substance line (**19**) between the fifth control element (**35**) and the feeder device (**7**); and

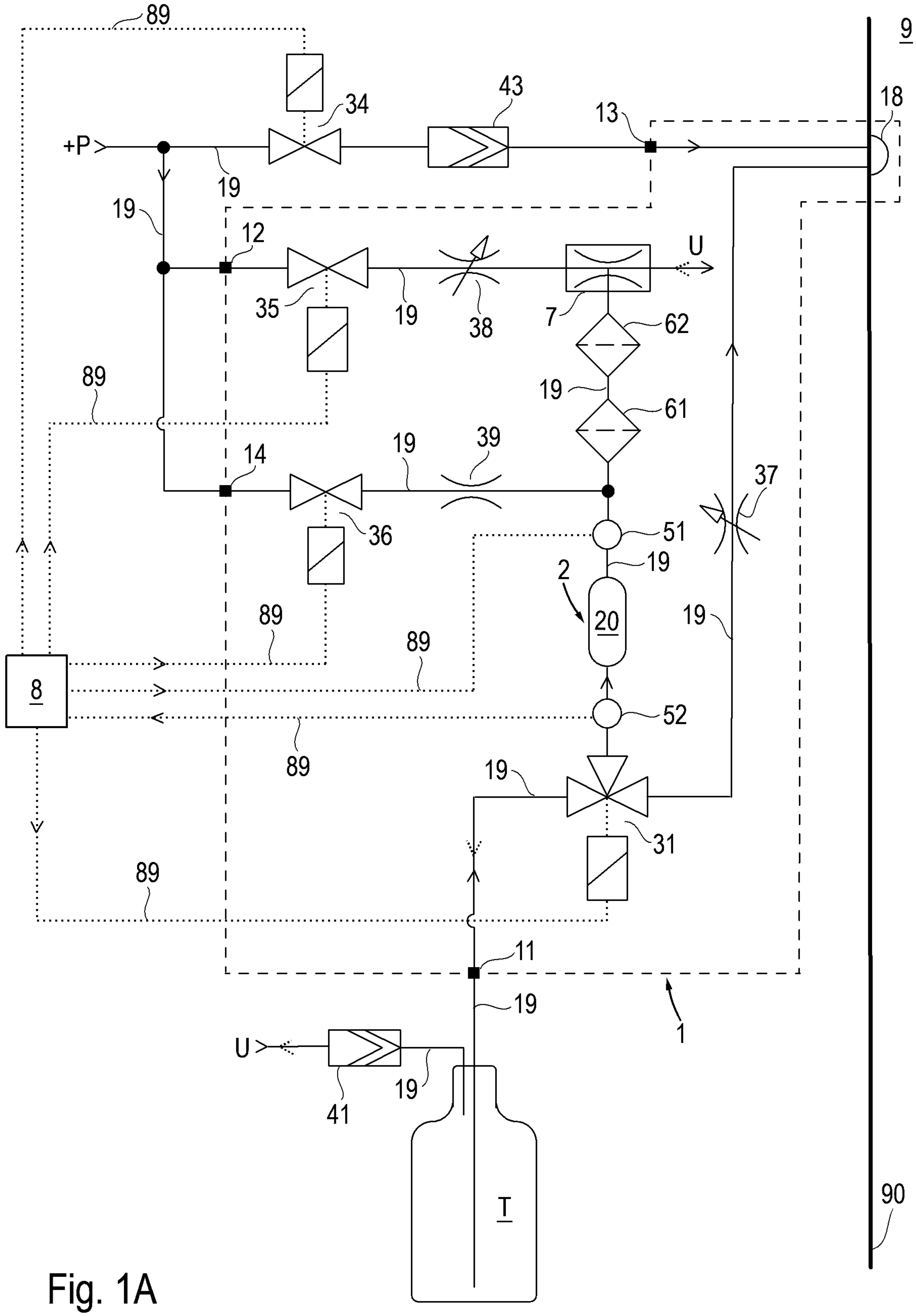
c) a ninth control element (**39**), preferably in the form of a restrictor valve, is installed in the substance line (**19**) between the sixth control element (**36**) and its junction into the substance line (**19**) that leads onwards to the first safety element (**61**).

15. The arrangement as claimed in claim 14, characterized in that:

a) an empty status sensor (**52**) that is connected via a control line (**89**) to the control unit (**8**) is installed in the substance line (**19**) between the first control element (**31**) and the metering container (**2**);

b) a second safety element (**62**) is installed in the substance line (**19**) between the first safety element (**61**) and the feeder device (**7**), wherein the two safety elements (**61**,**62**) are preferably configured as semi-permeable membranes; and

c) a seventh control element (**37**), preferably in the form of an adjustable restrictor valve, is provided in the other substance line (**19**) between the first control element (**31**) and the spray nozzle (**18**).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9
34
43
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+P
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19
38
7
62
89
19
61
14
19
39
37
36
51
2
19
89
20
19
89
8
52
89
19
31
89
11
19
1
U
41
19
T
90

Fig. 1A

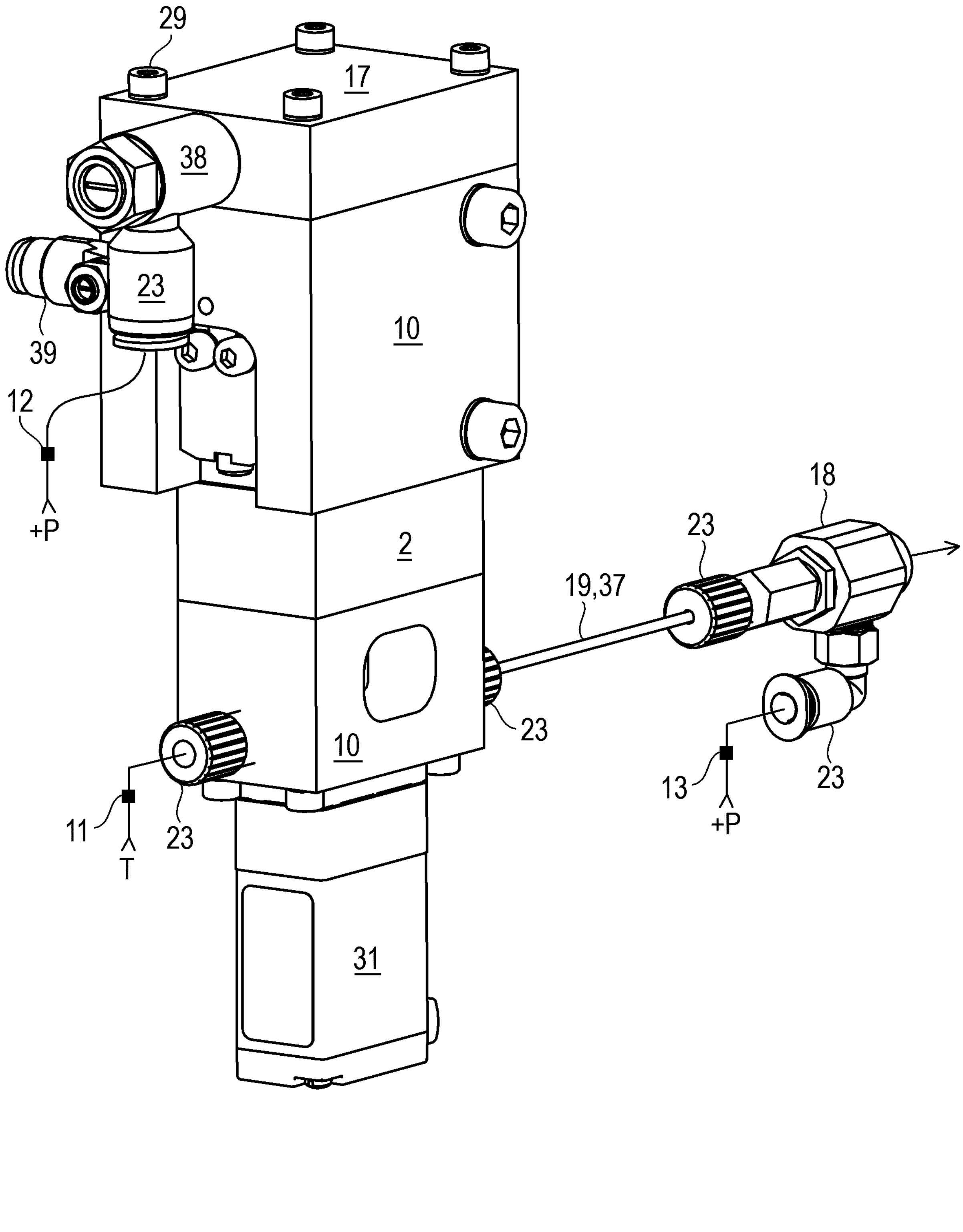


Fig. 1B

Fig. 1D

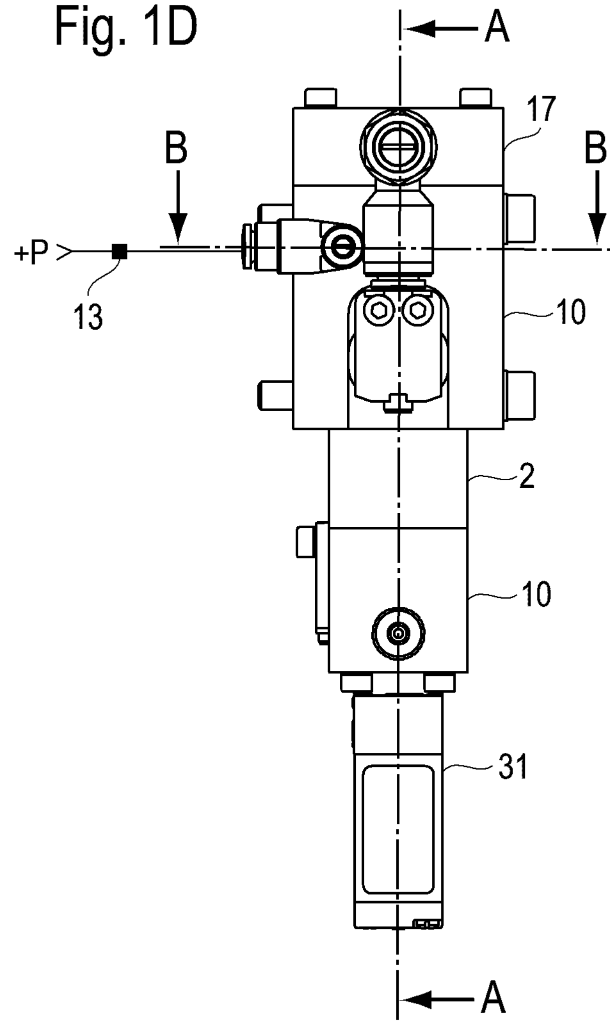

A
B
B
17
+P
13
10
2
10
31
A

Fig. 1C

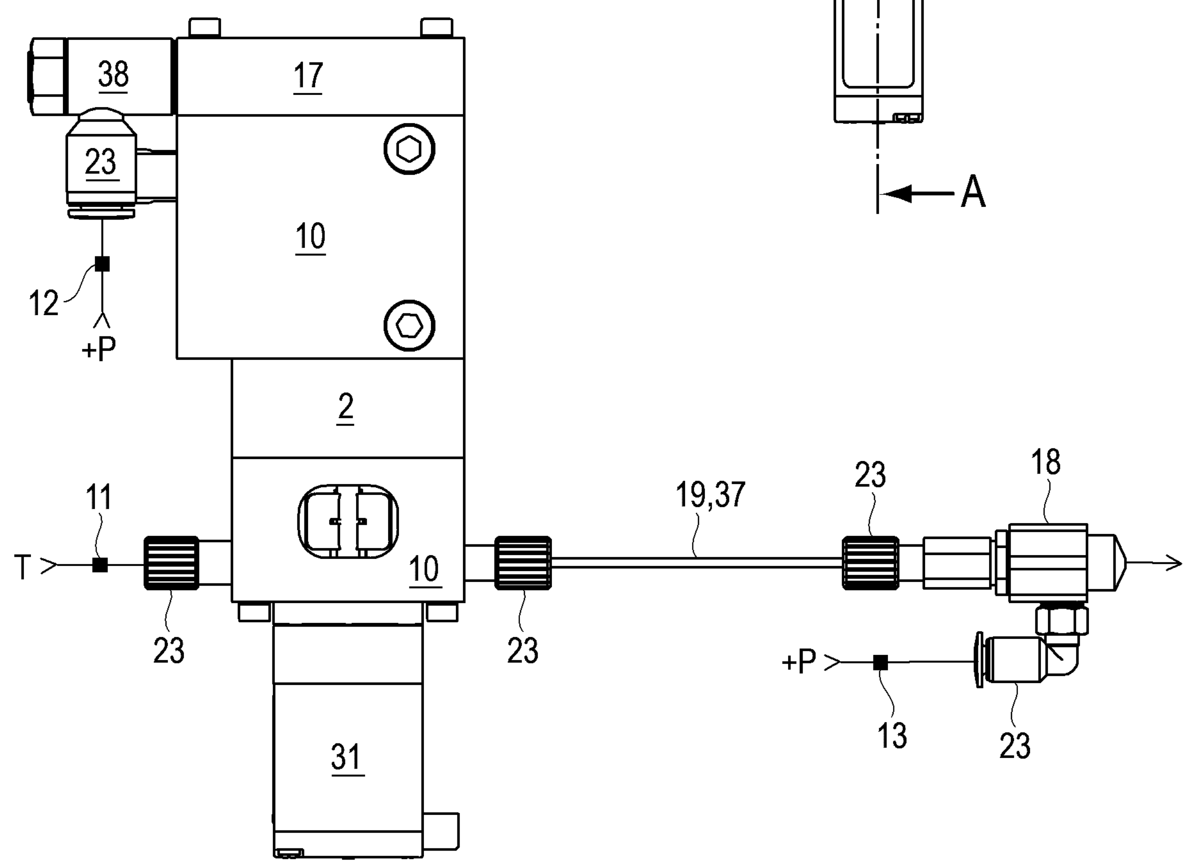

38
17
23
10
12
+P
2
11
T
10
23
23
19,37
23
18
+P
13
23
31

Fig. 1E

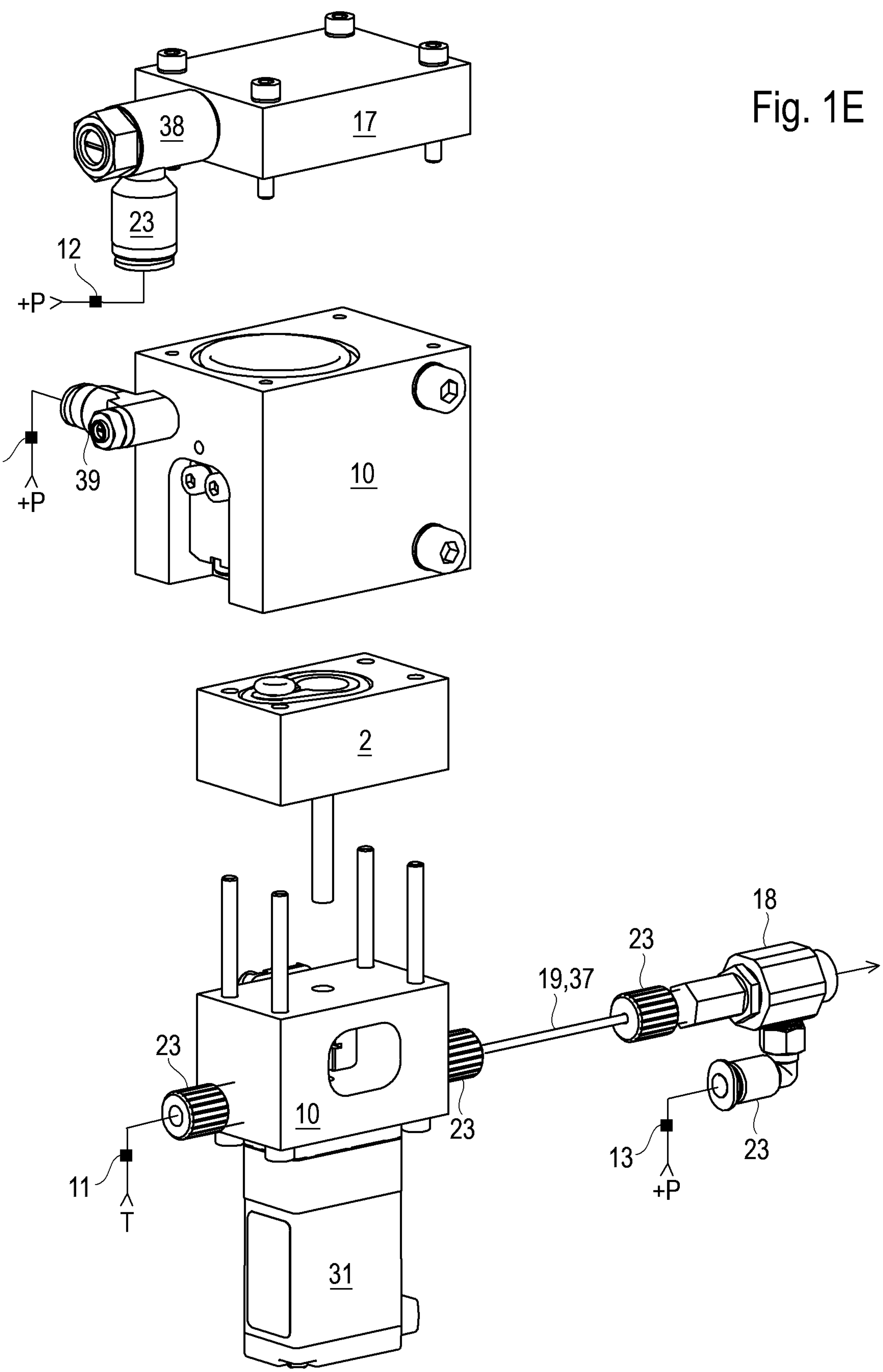


Fig. 1F

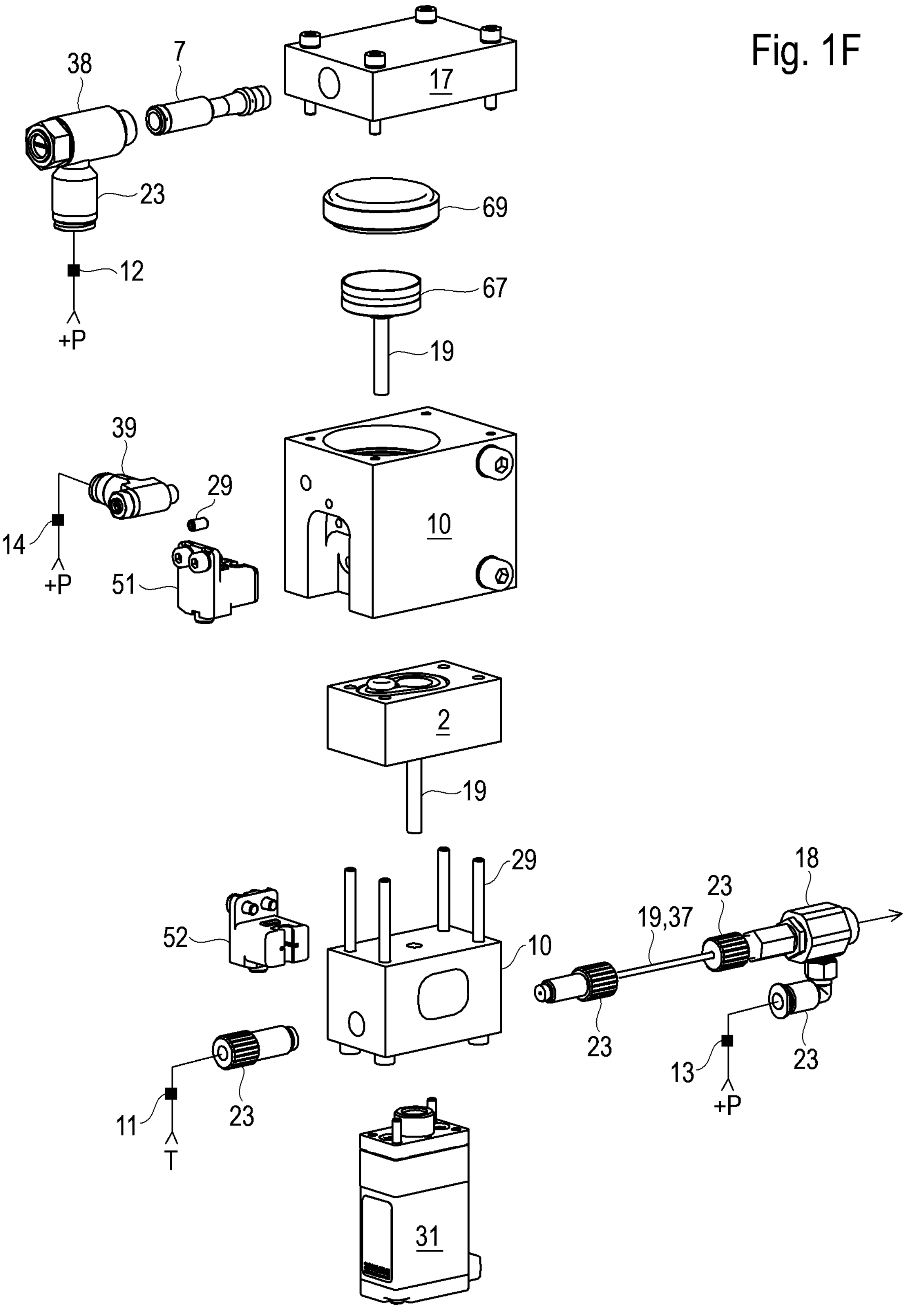
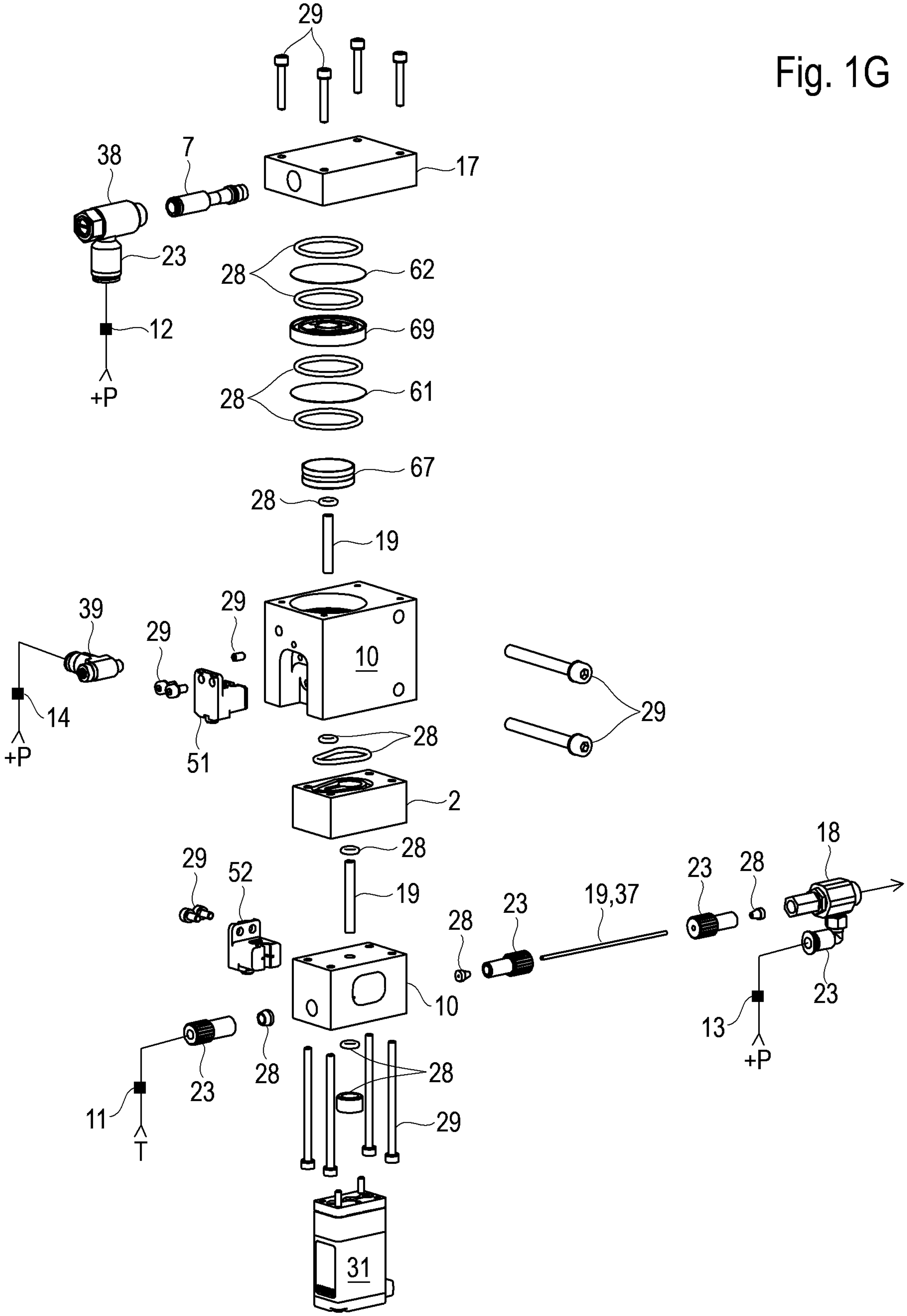

38
7
17
23
69
12
+P
67
19
39
29
14
10
+P
51
2
19
29
52
18
23
10
19,37
23
13
23
23
+P
11
23
T
31

Fig. 1G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38
7
17
23
28
62
12
69
+P
28
61
67
28
19
39
29
29
10
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14
+P
51
28
2
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52
28
19
18
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28
19,37
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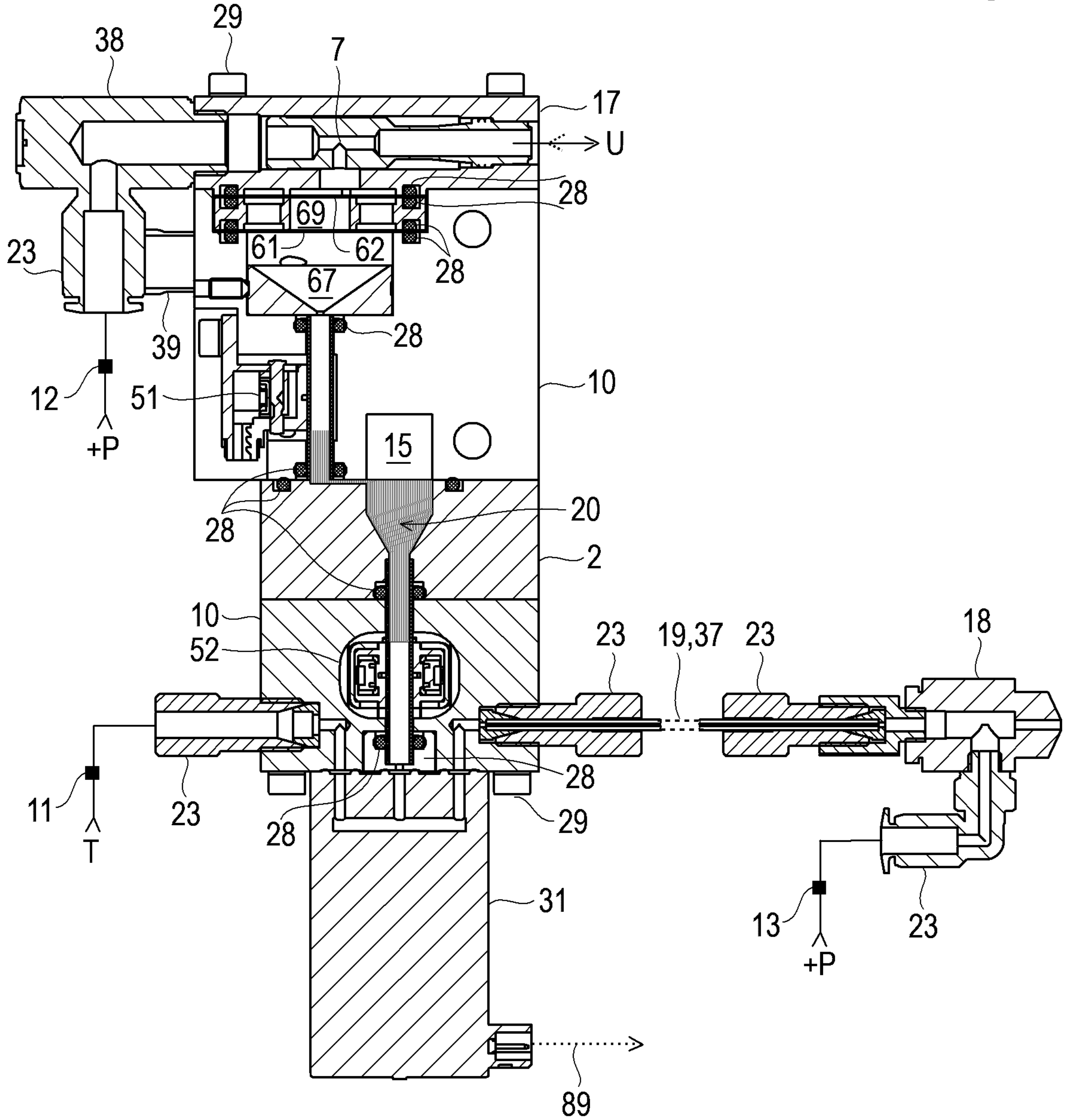
23
10
23
13
28
+P
28
11
23
29
T
31

Fig. 1H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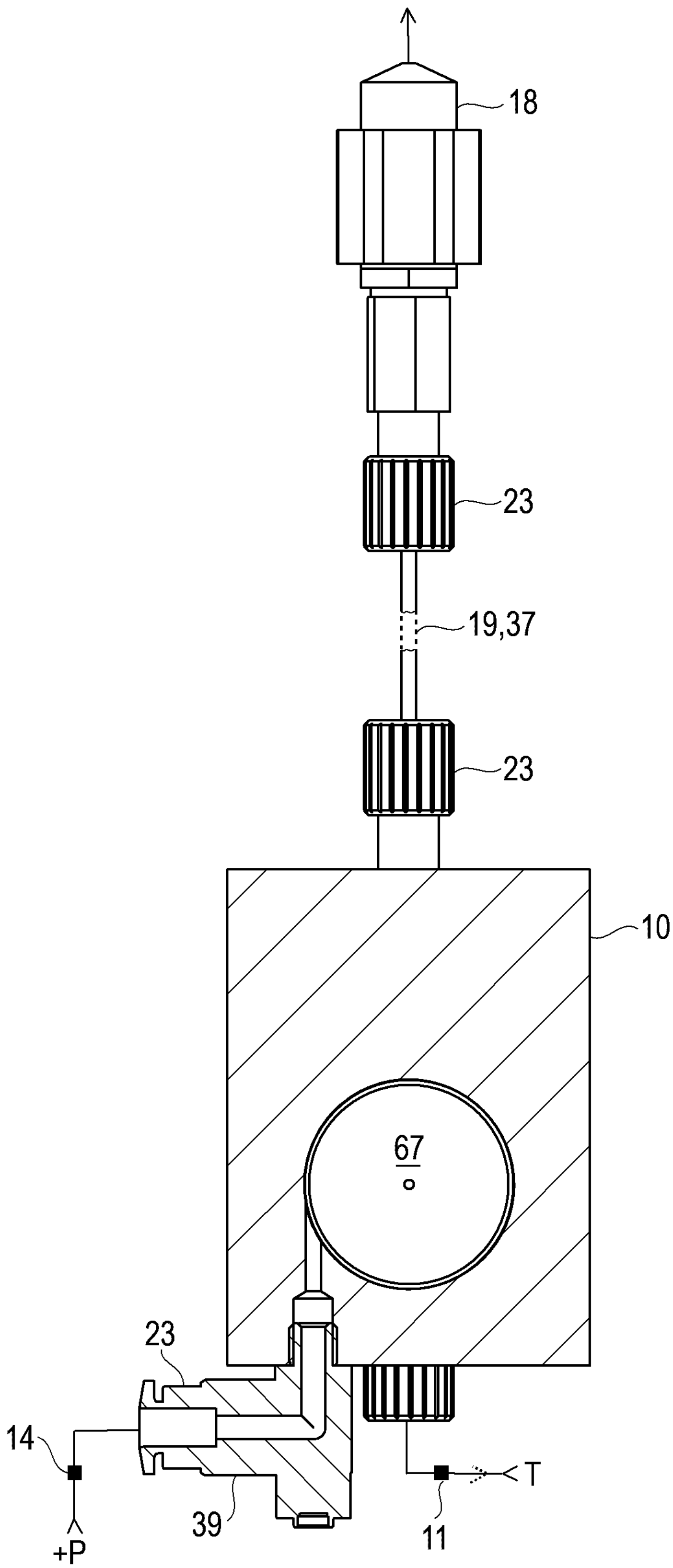
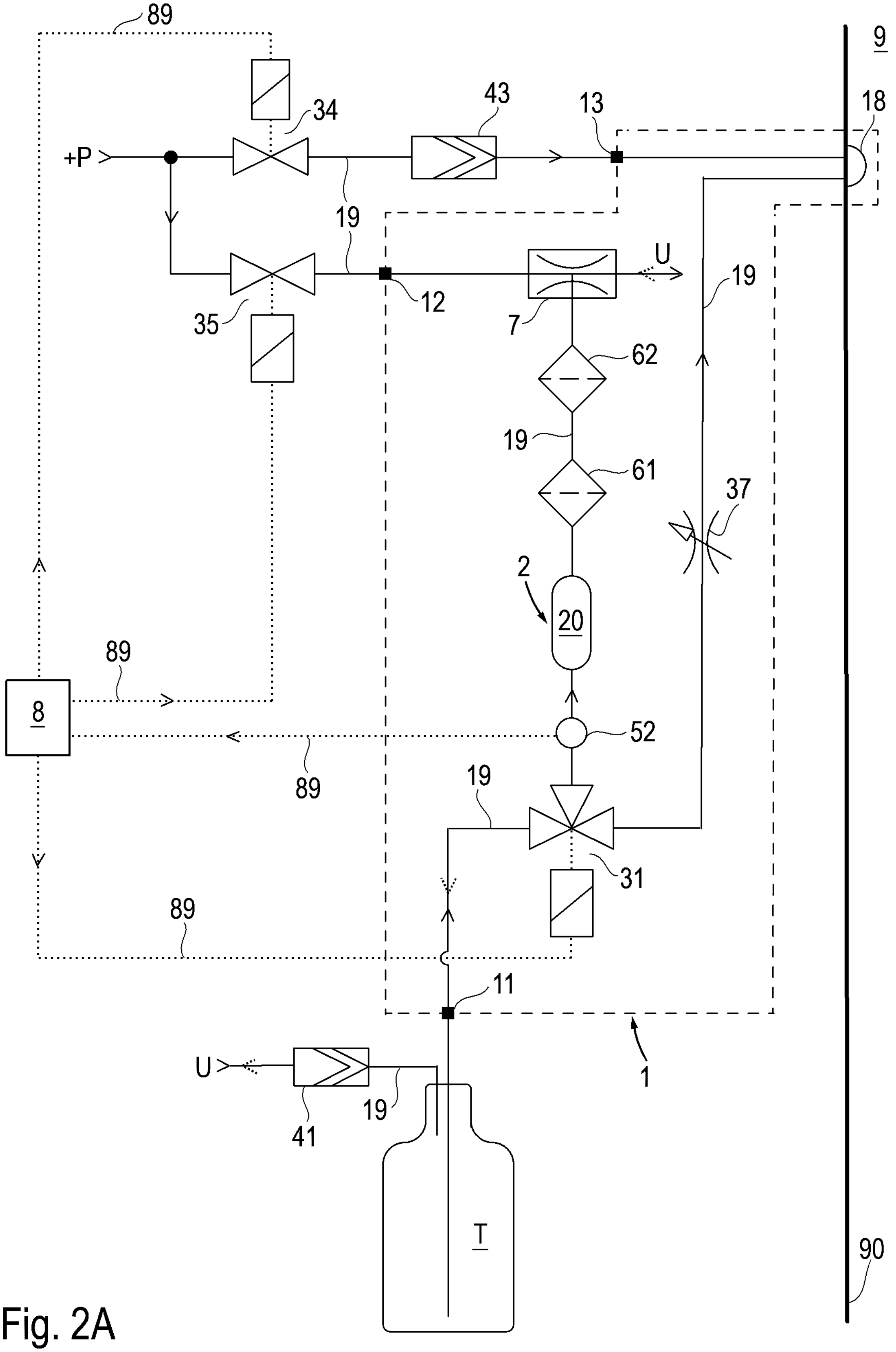
+P
23
89

Fig. 1J

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61
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89
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52
89
19
31
89
11
1
U
41
19
T
90

Fig. 2A

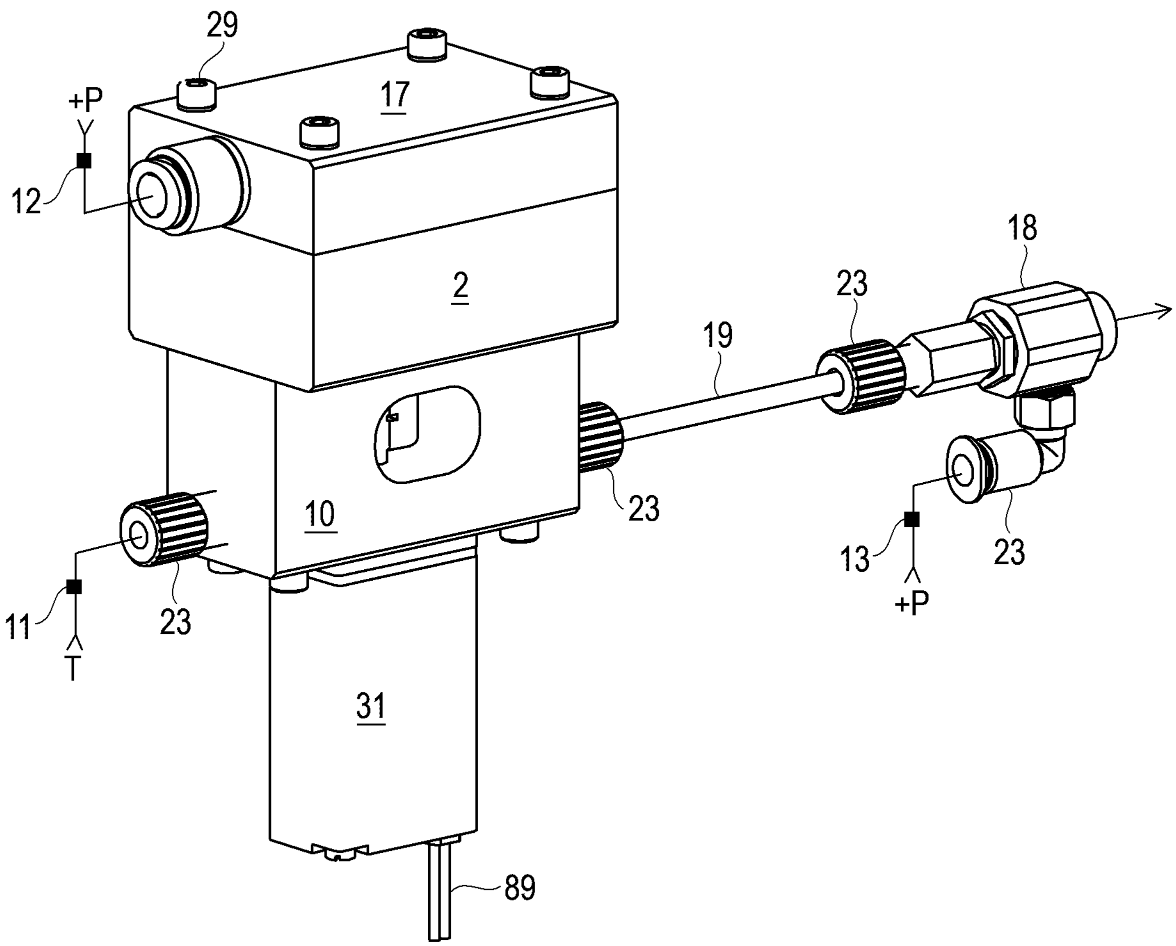
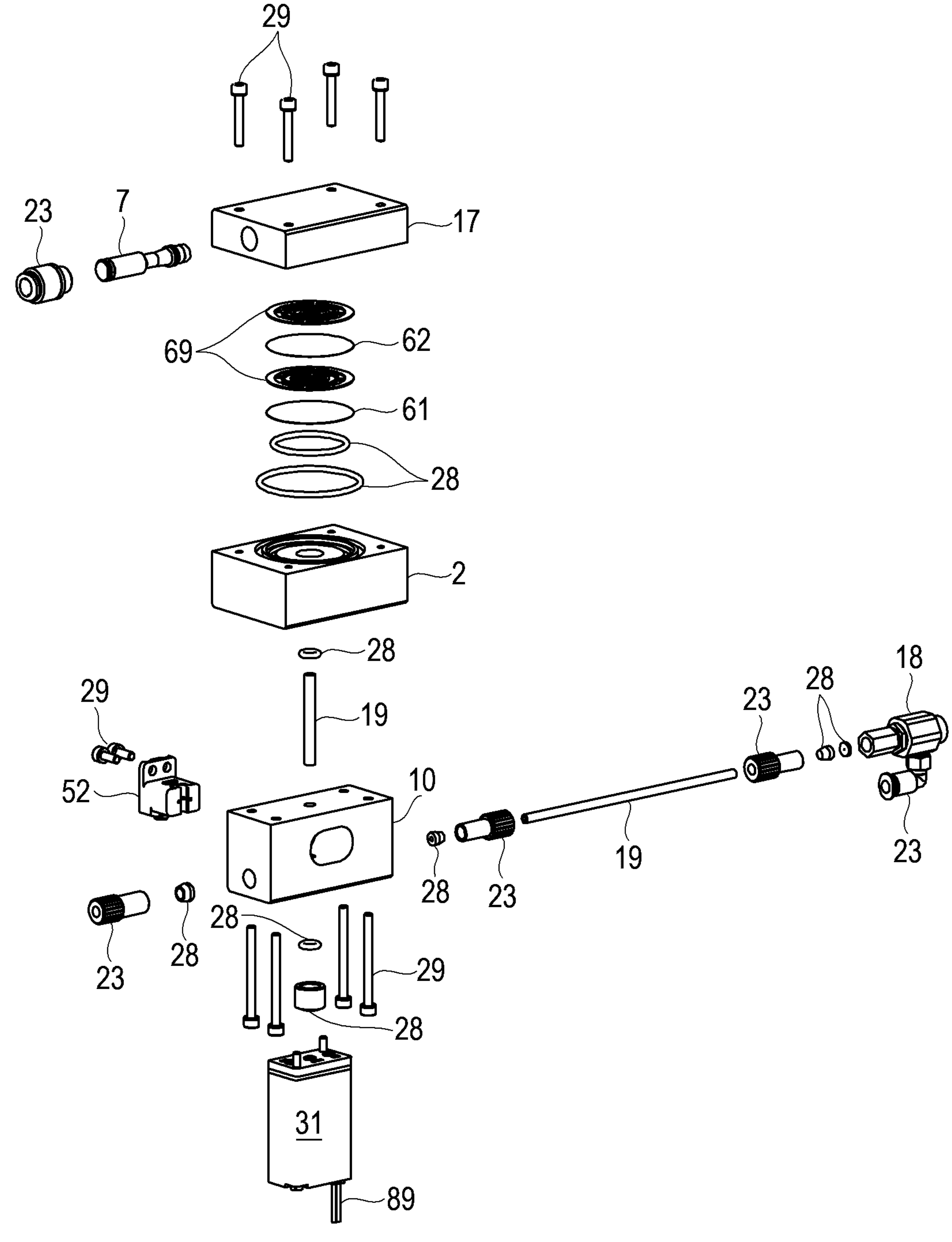


Fig. 2B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28
31
89

Fig. 2C

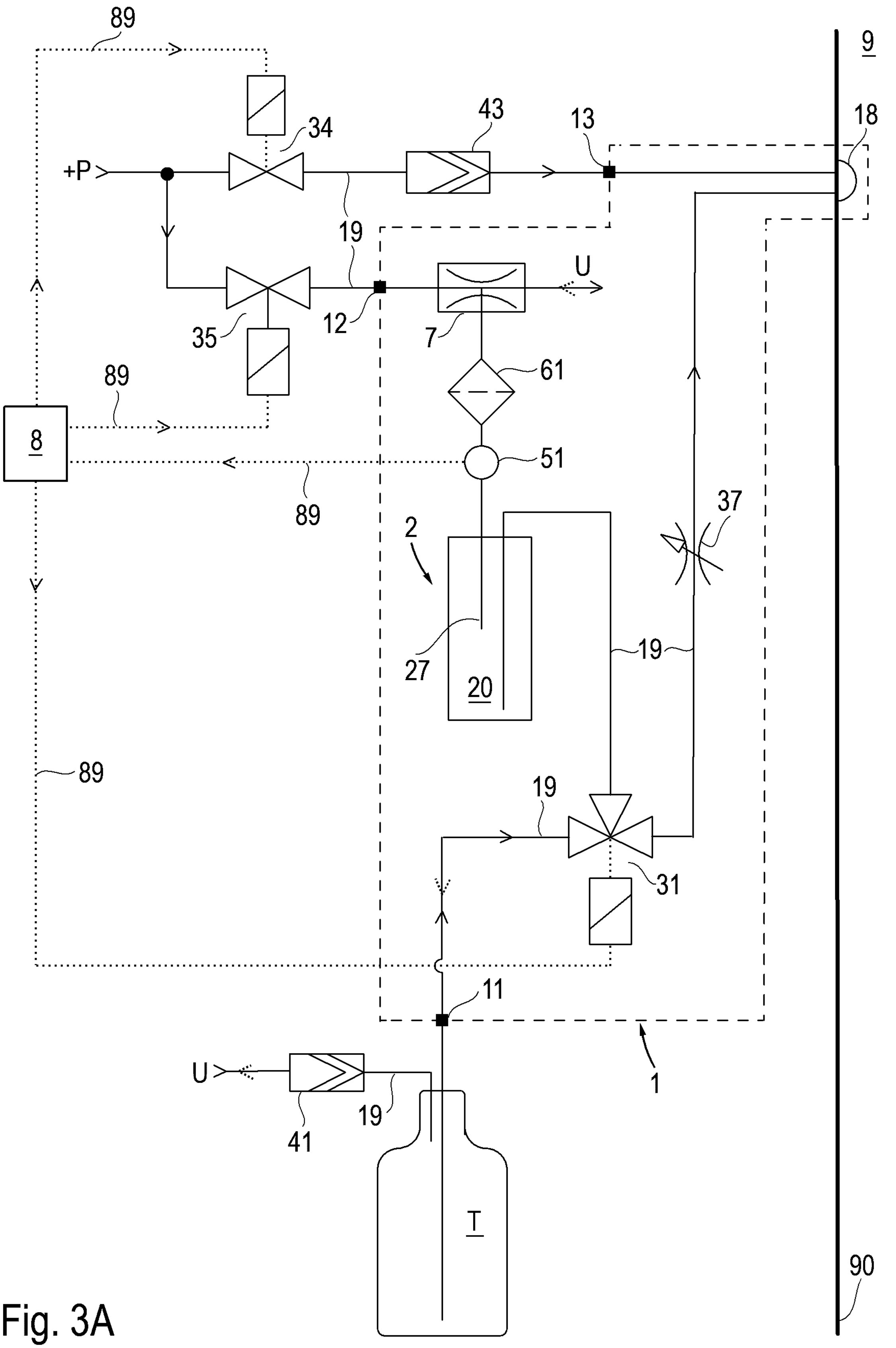

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Fig. 3A

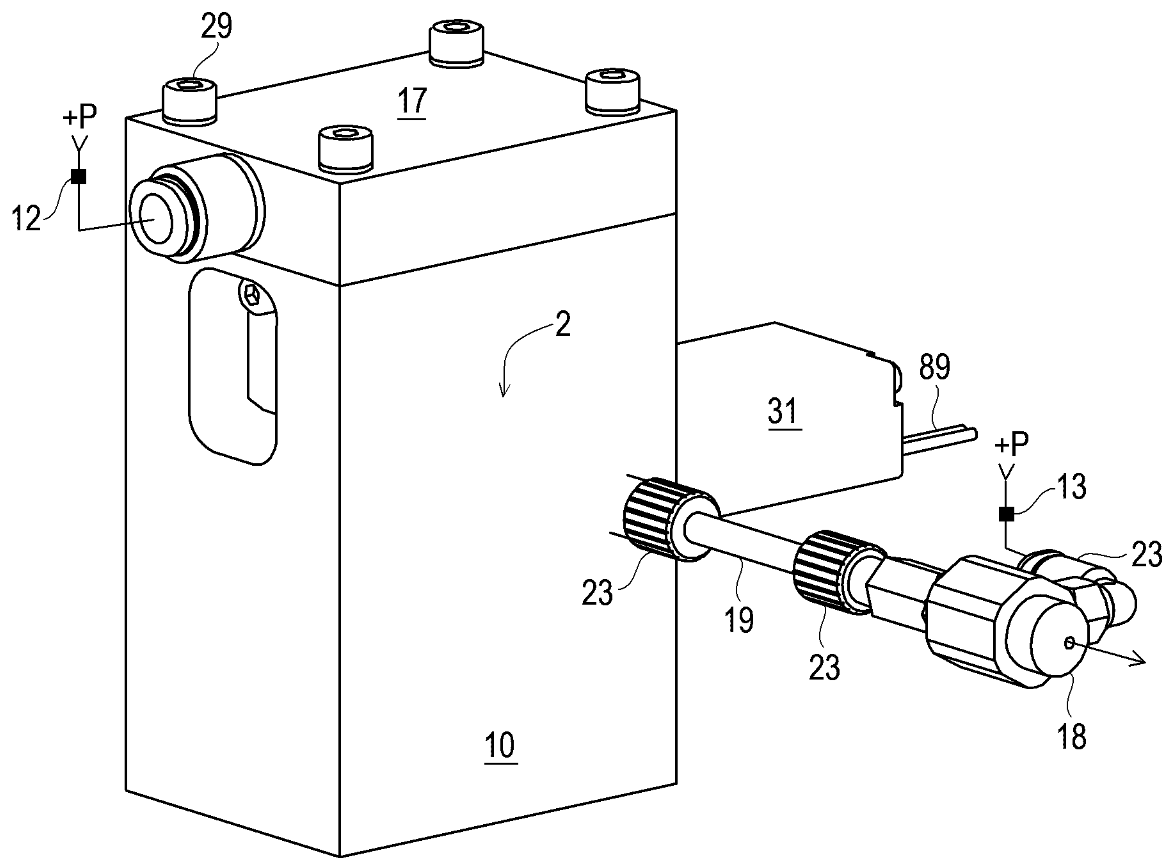

Fig. 3B

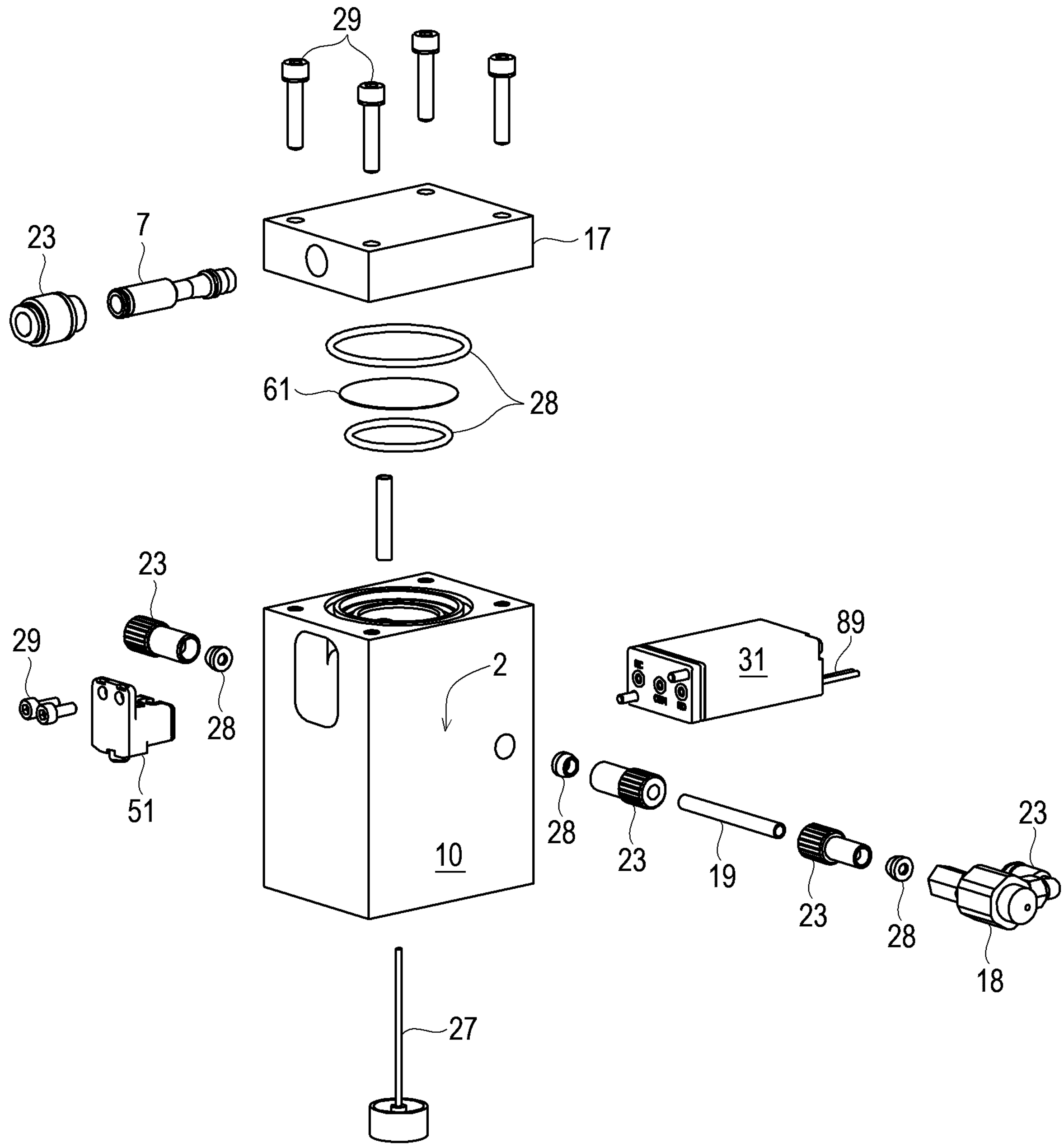

Fig. 3C

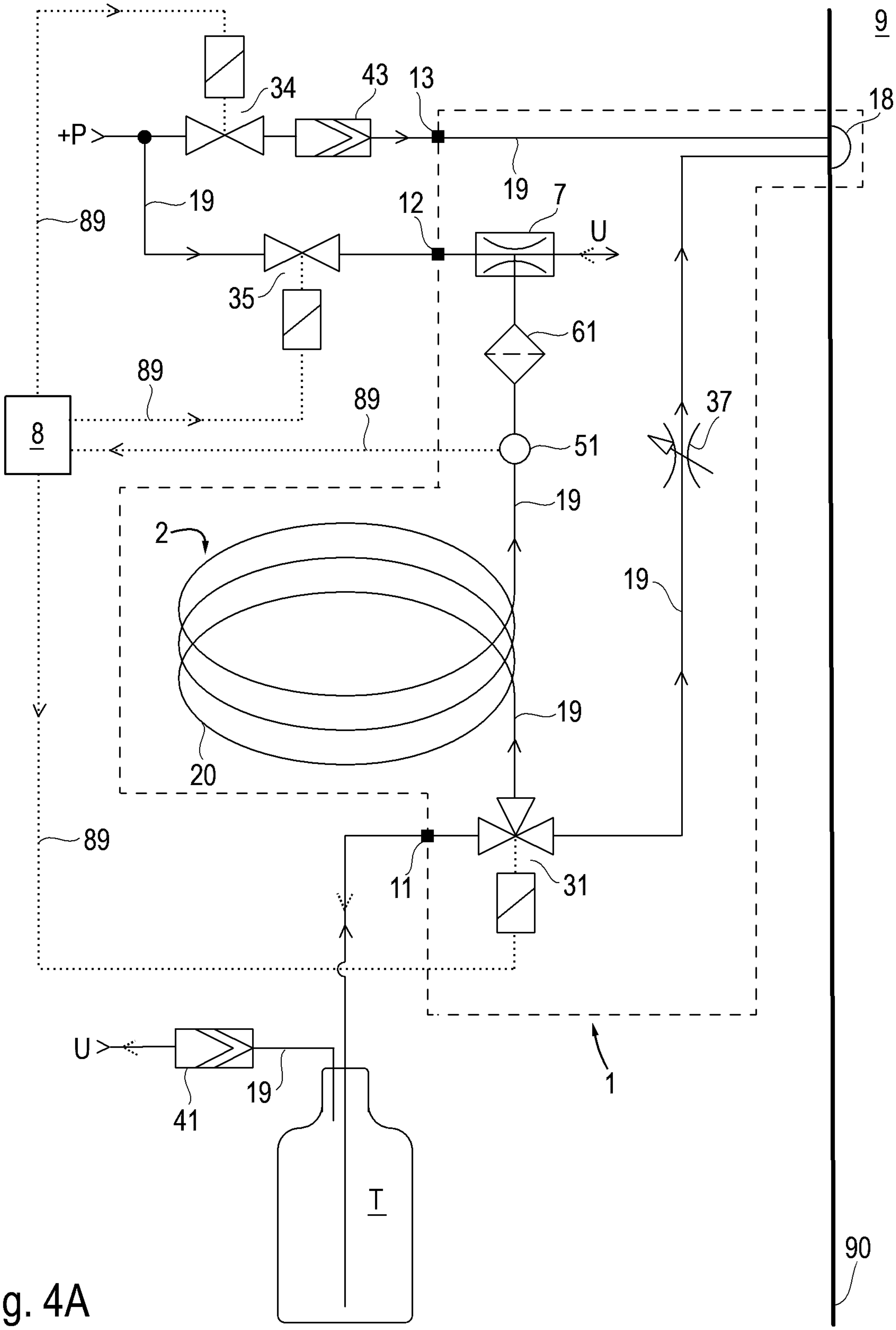
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Fig. 4A

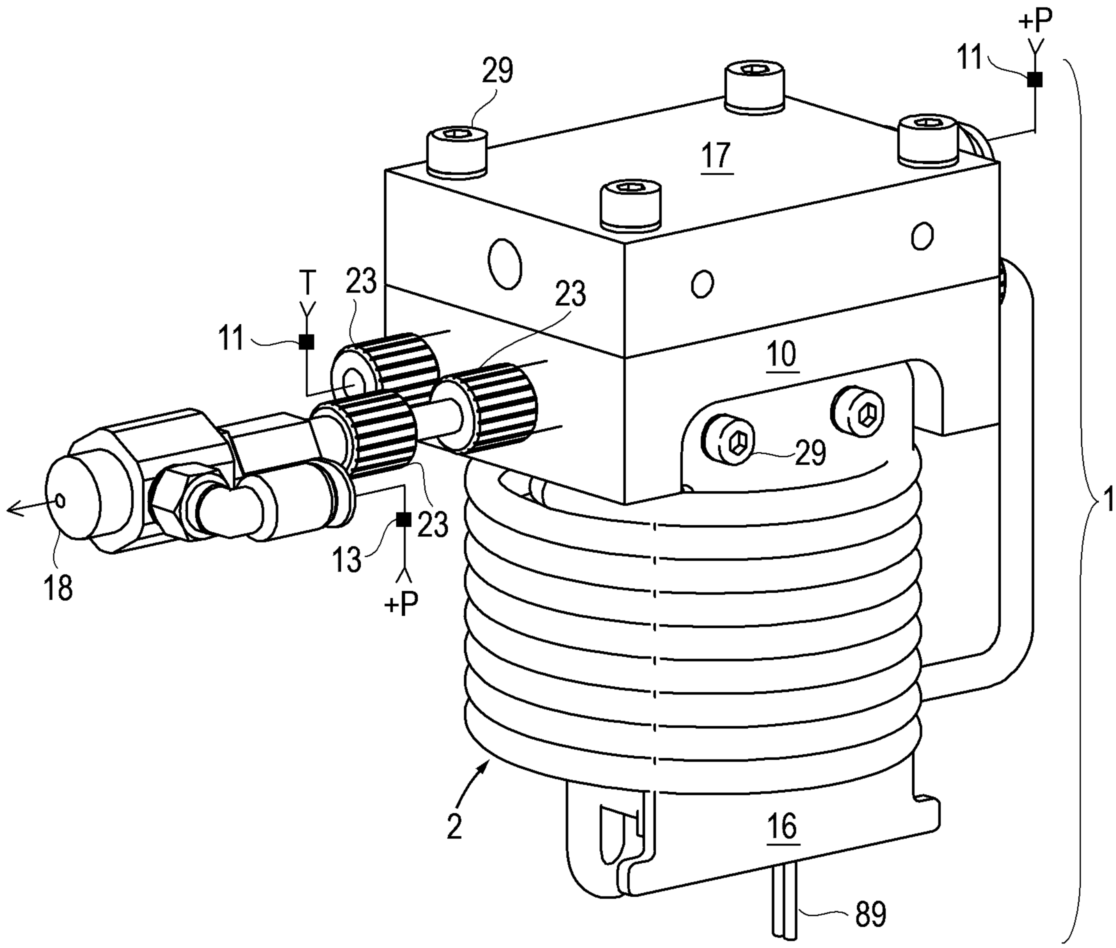
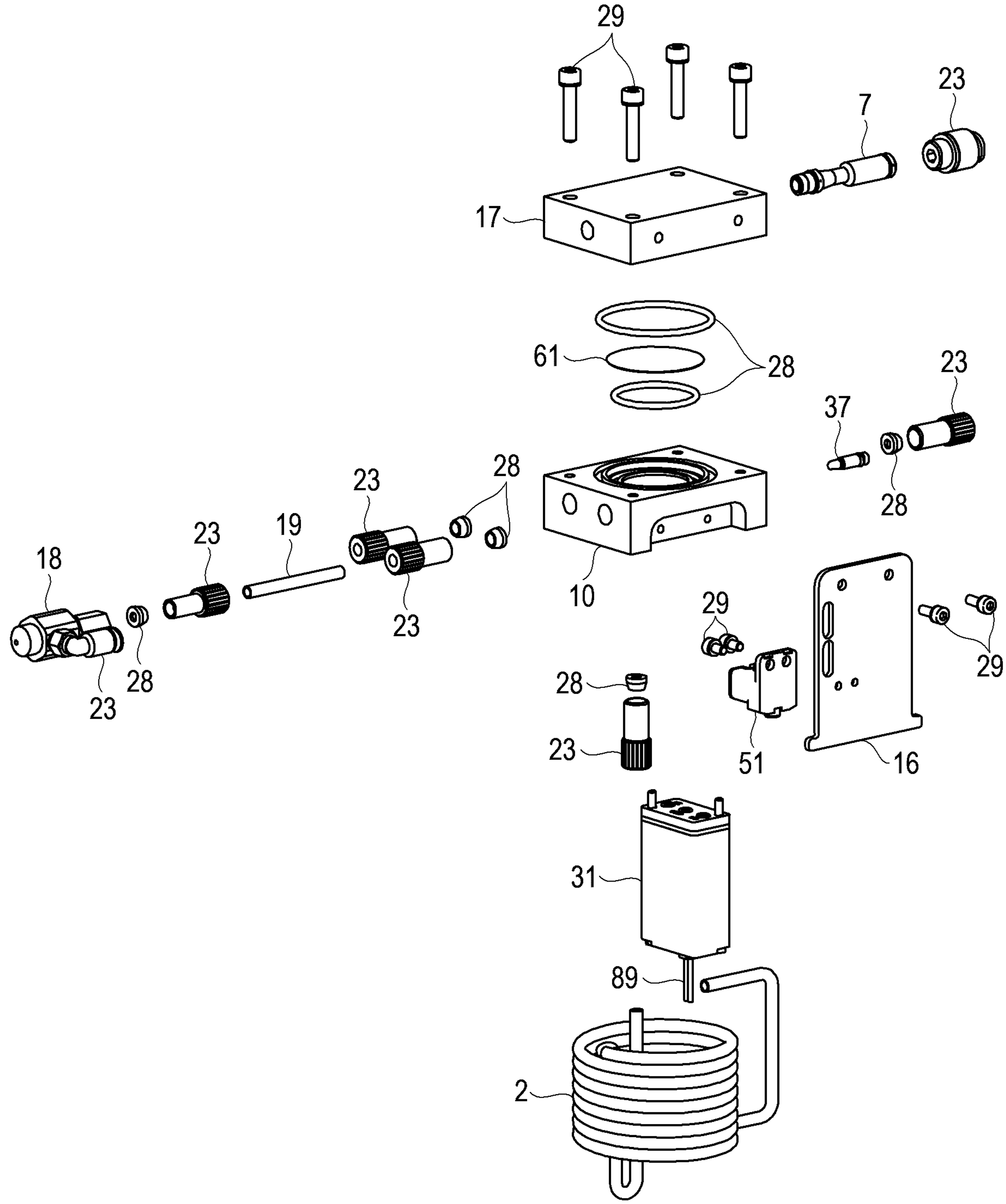


Fig. 4B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89
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Fig. 4C

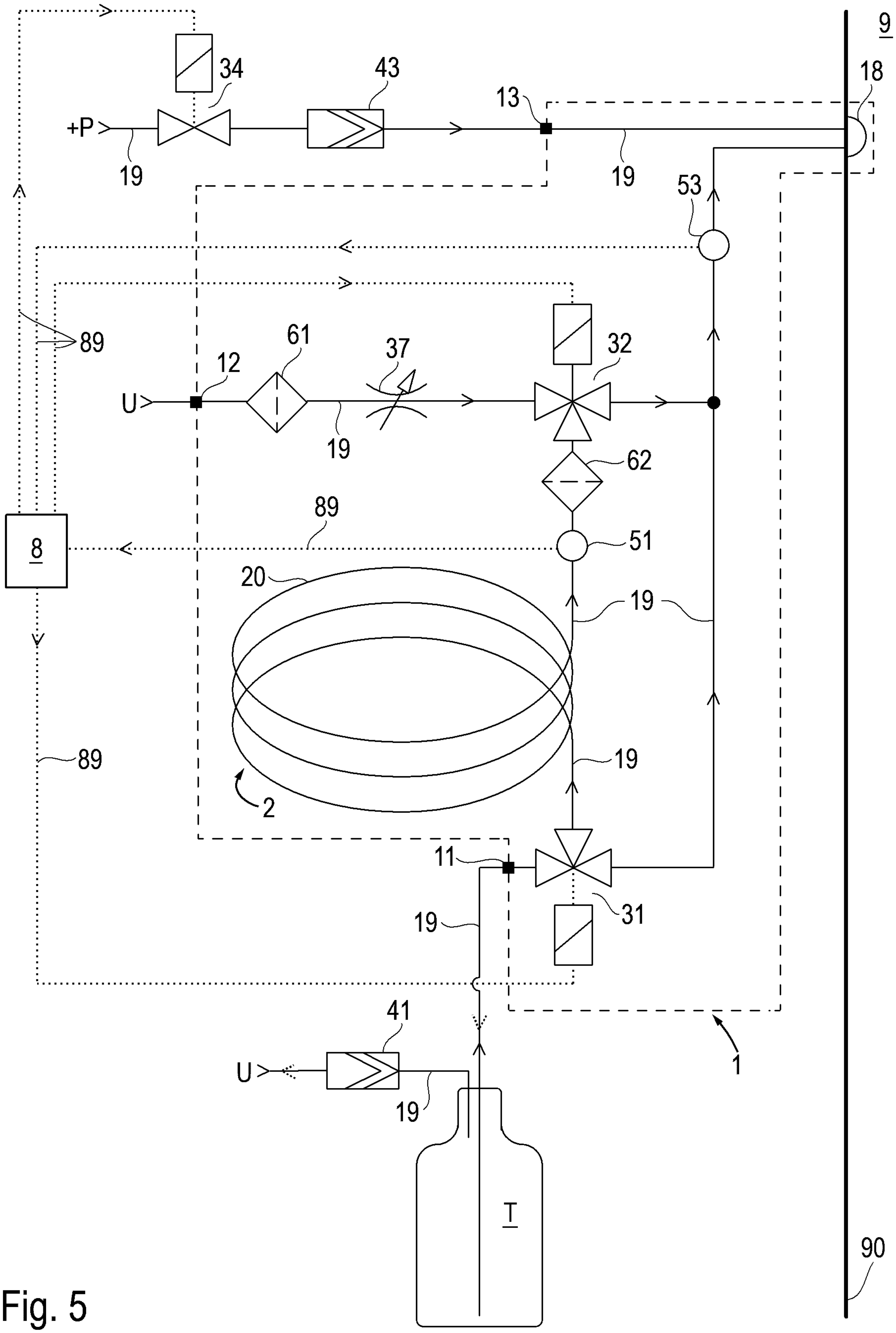
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Fig. 5

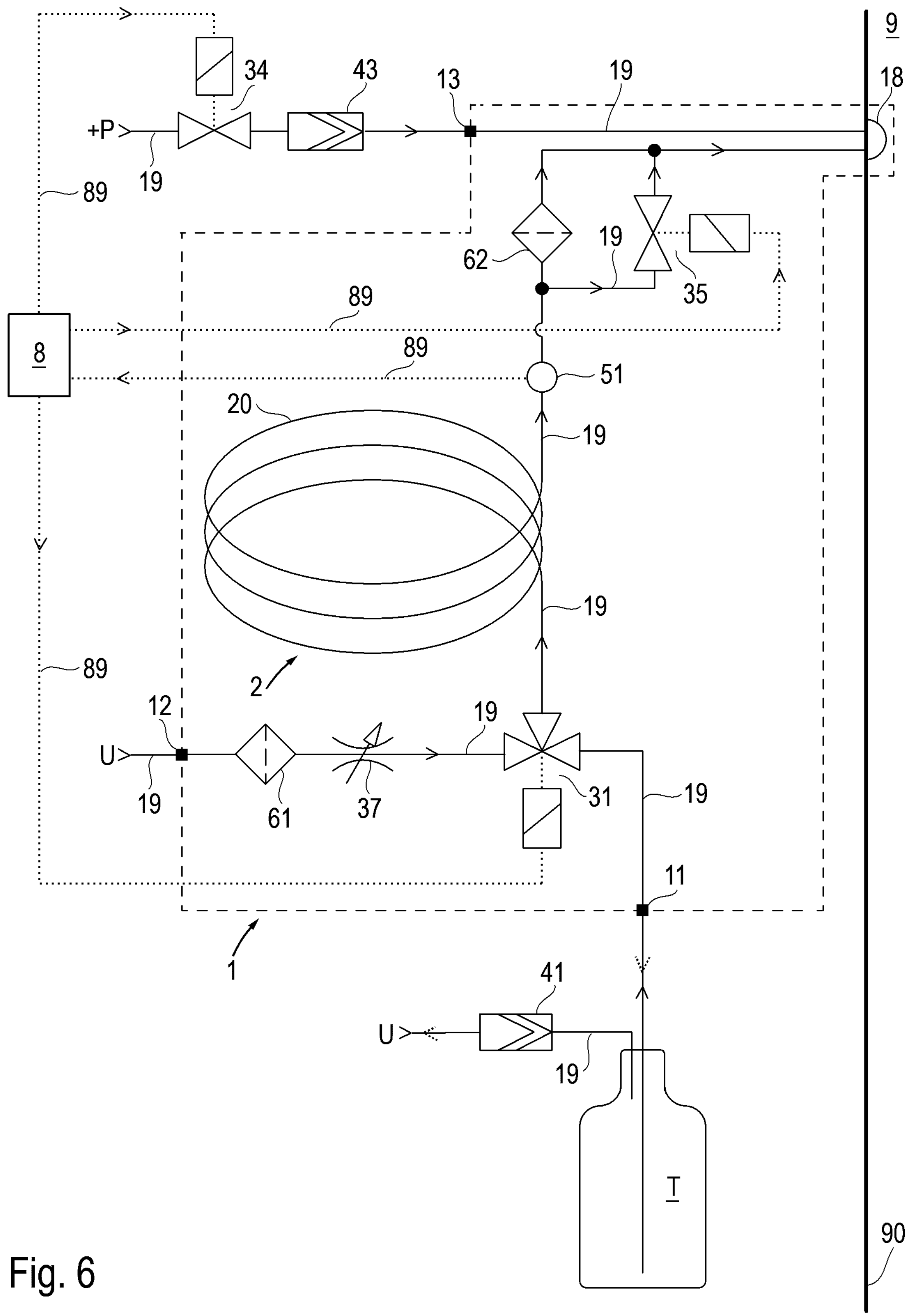

Fig. 6

Date Reçue/Date Received 2020-08-25

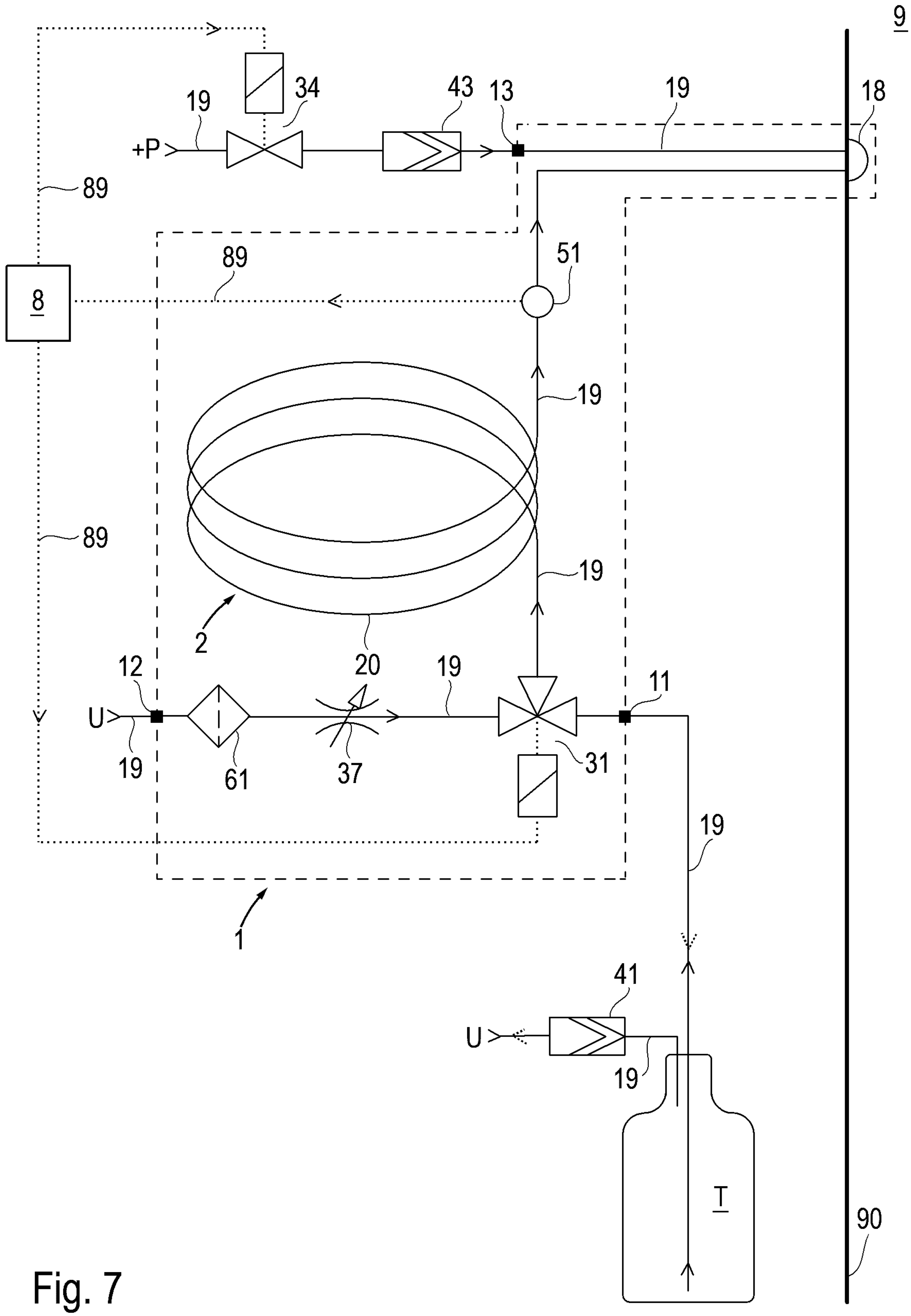
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Fig. 7

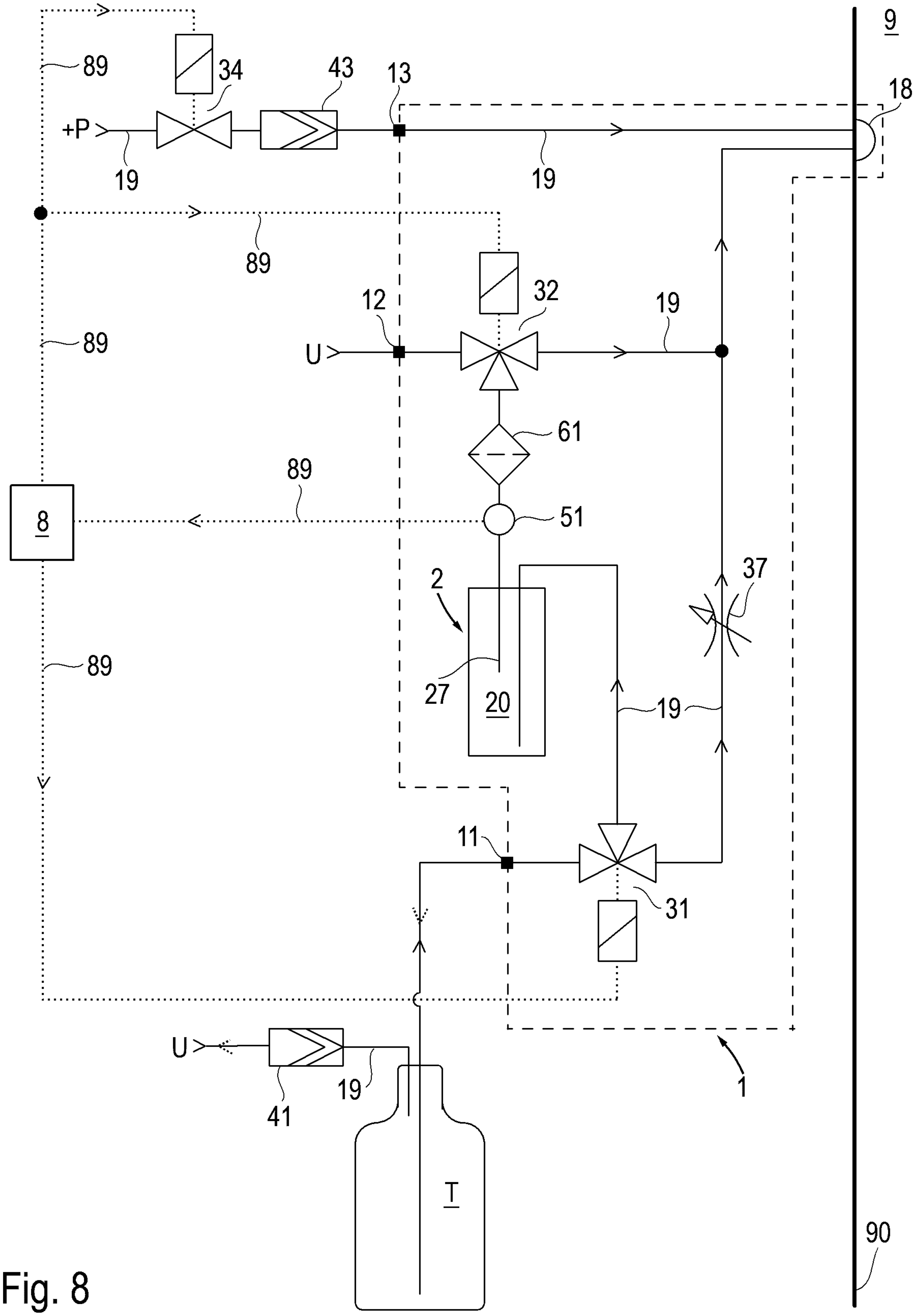
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Fig. 8

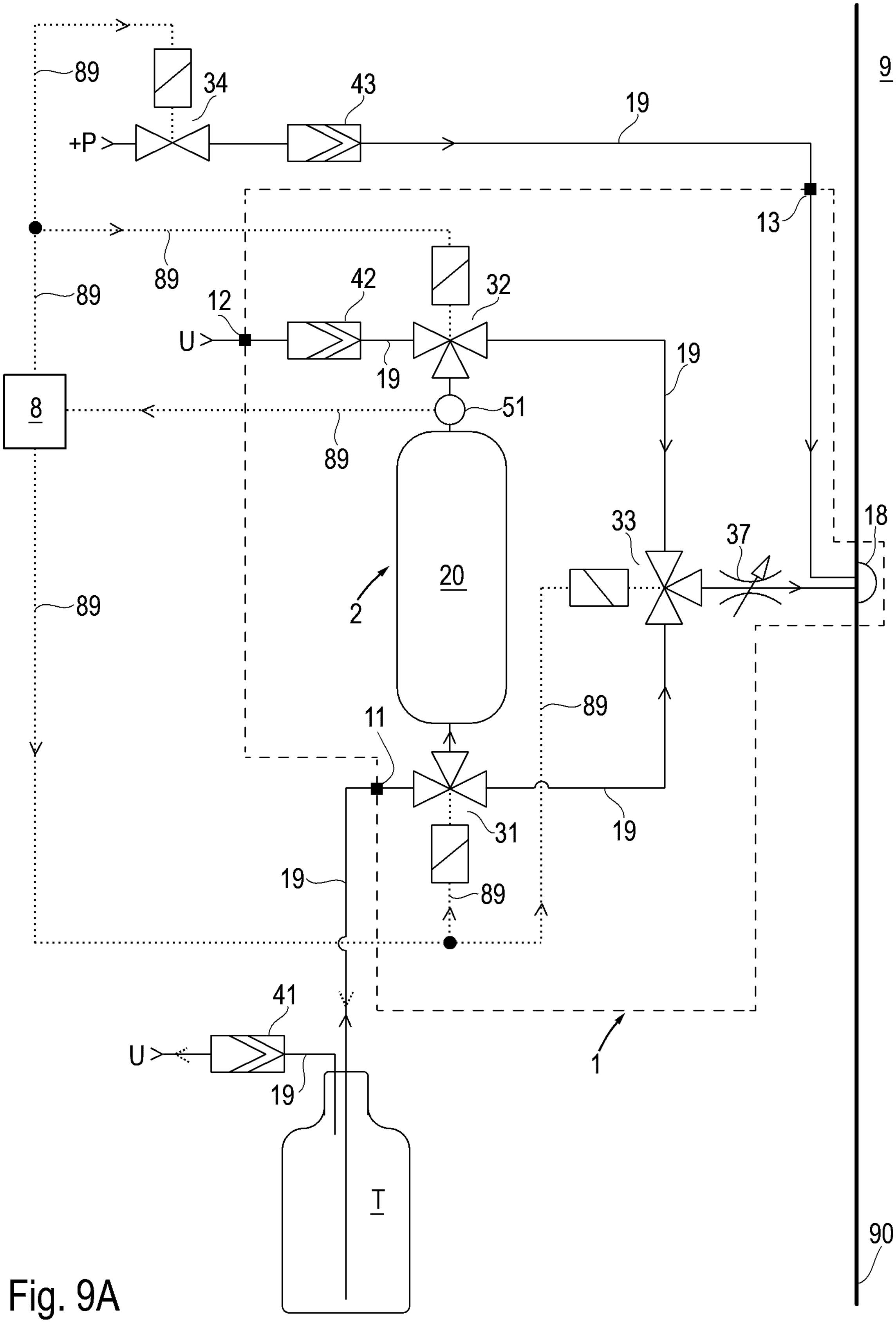

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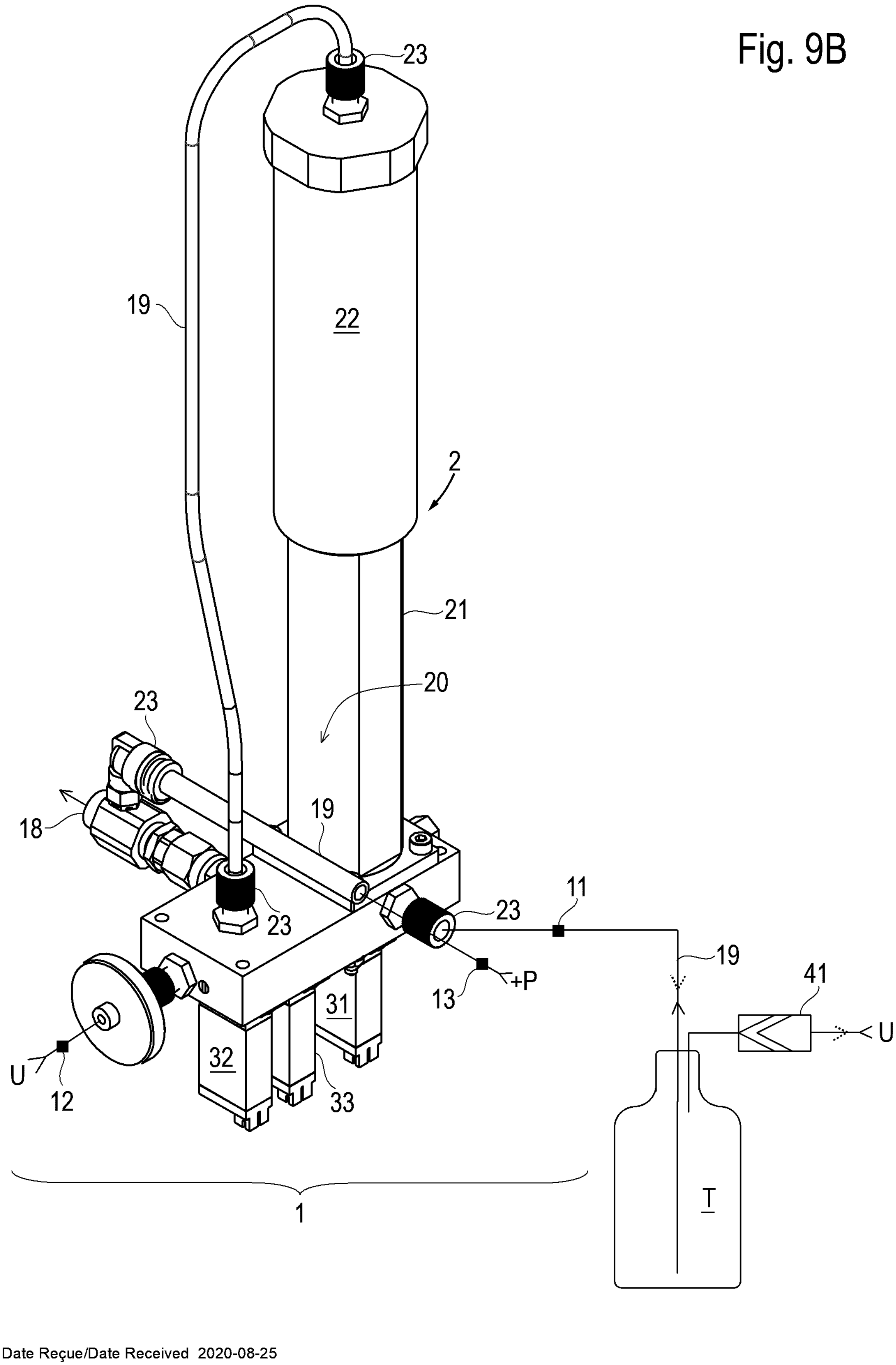
Fig. 9A

Fig. 9B



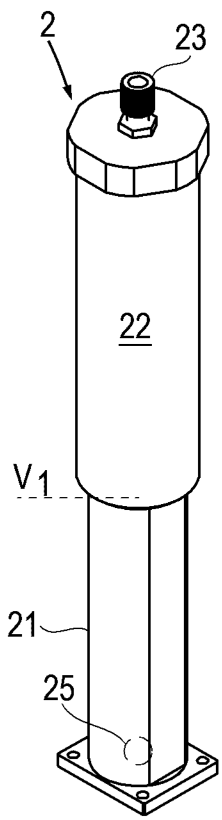
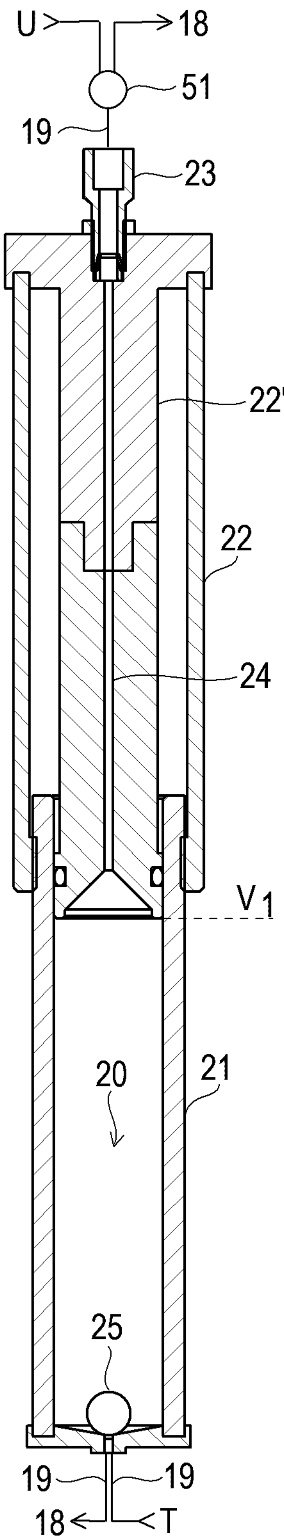


Fig. 9C

Fig. 9D



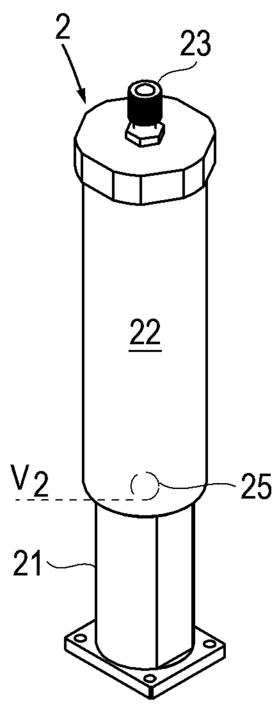
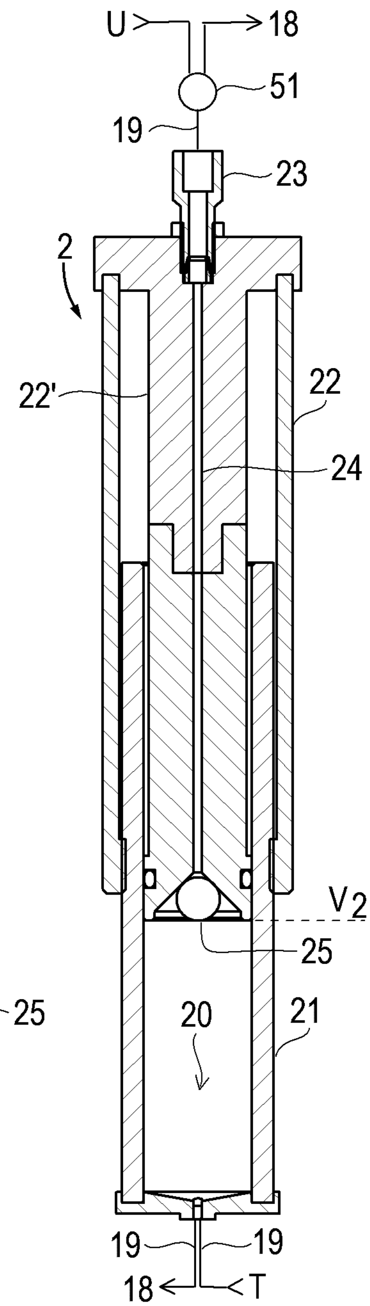


Fig. 9E

Fig. 9F



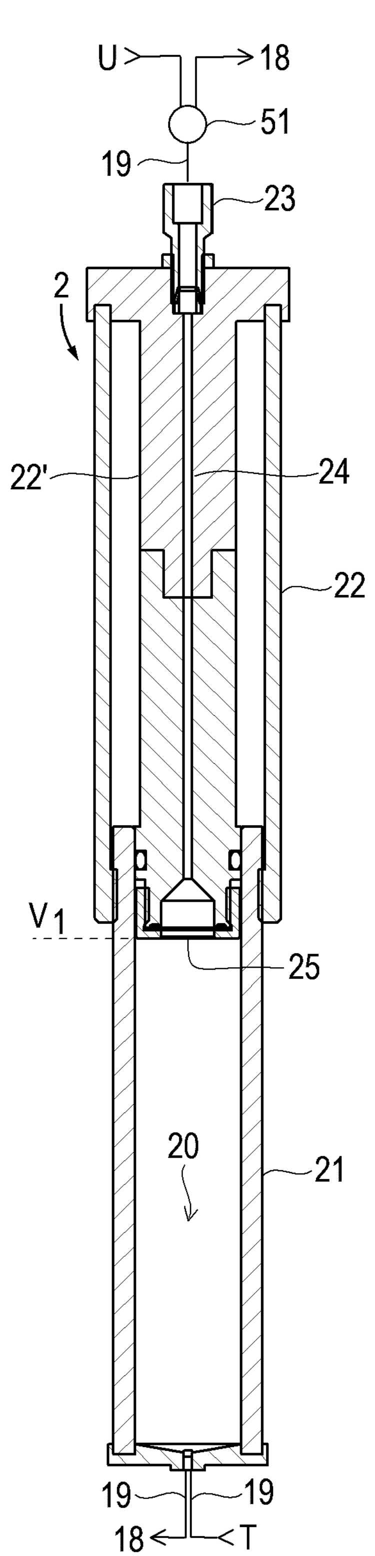


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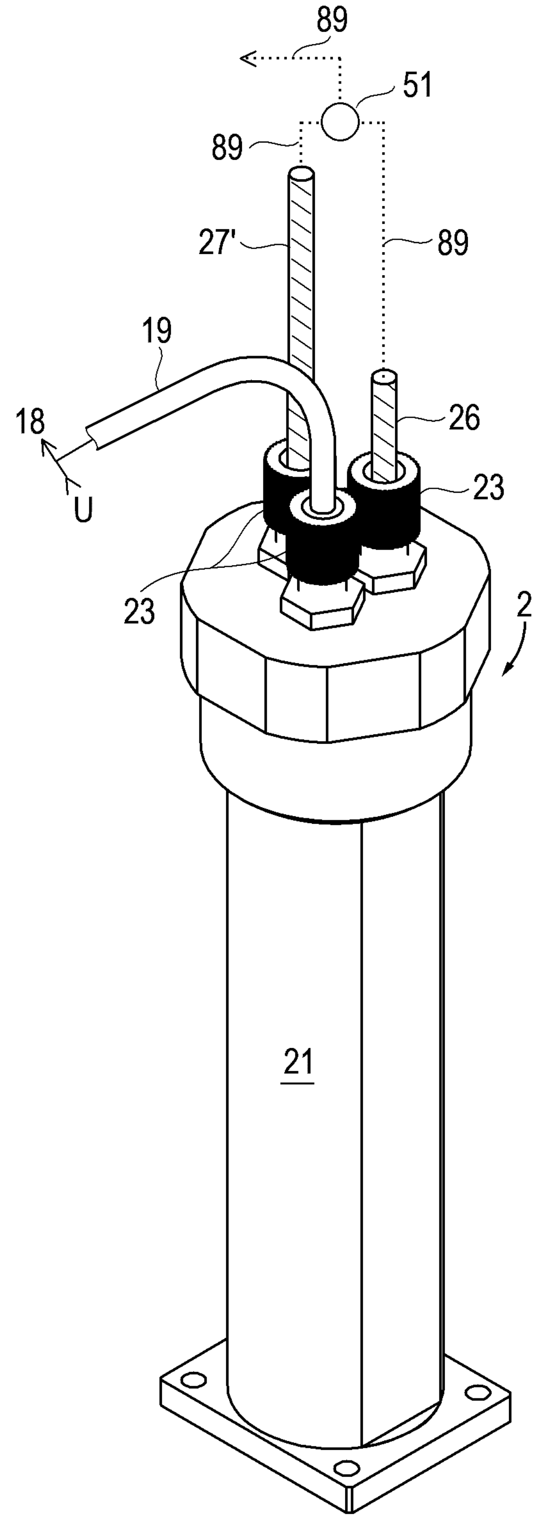
Fig. 9G



89
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27'
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Fig. 9H

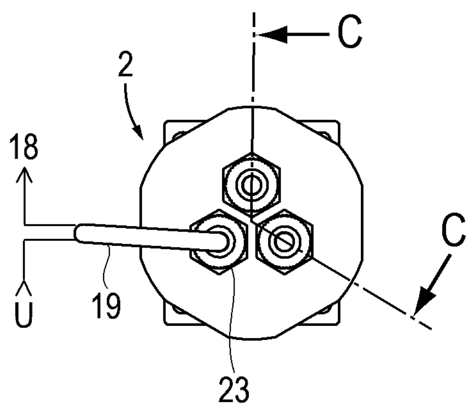


Fig. 9J

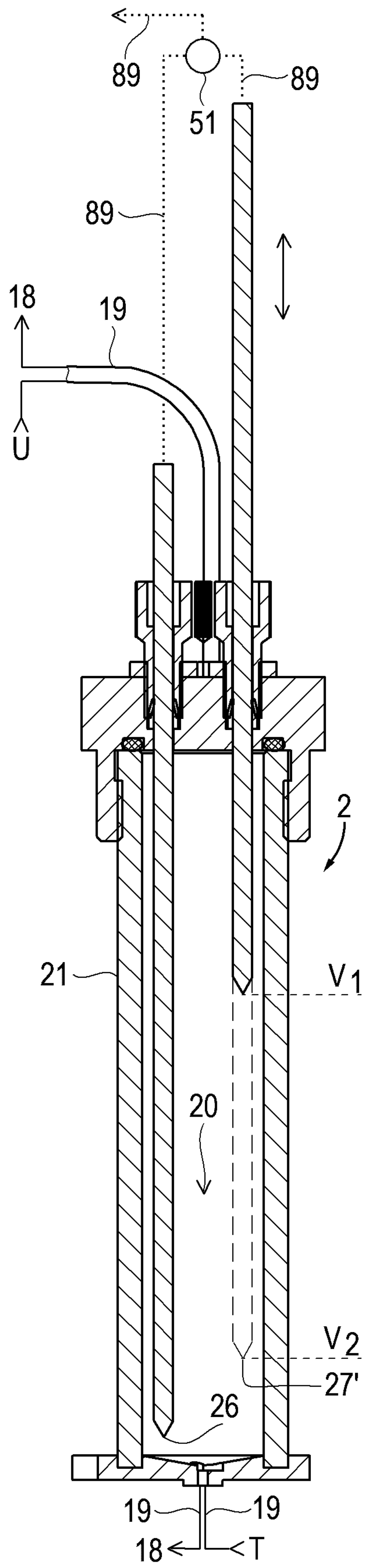
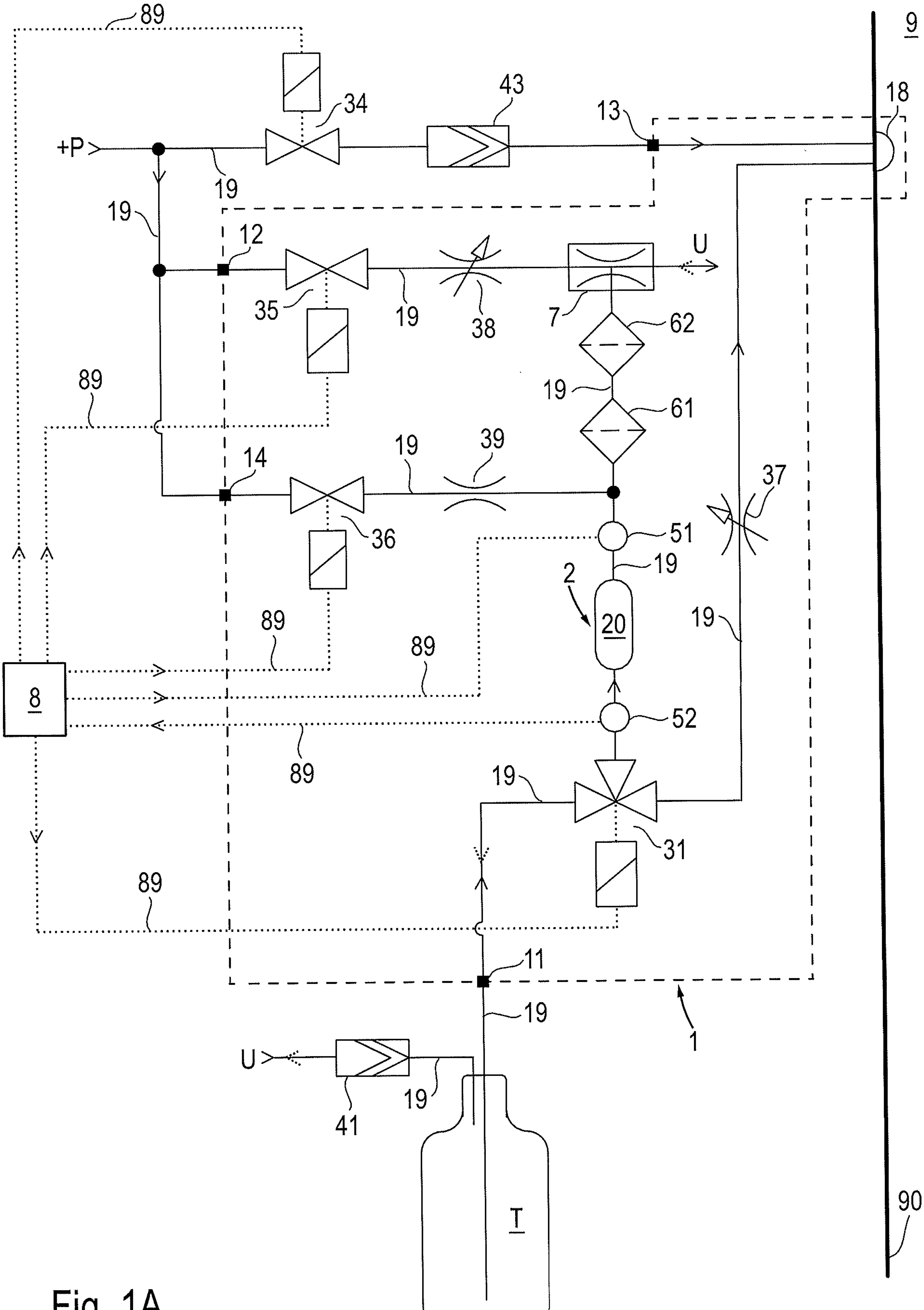


Fig. 9K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52
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41
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90

Fig. 1A