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(54) **WATER SUPPLY SYSTEM FOR A TANK FOR A RESCUE VEHICLE**

(57) Water supply system (1) for a tank (2) for a rescue vehicle (1), comprising:
• a tank (2) defining an inner space (3) configured to store water;
• at least a hydraulic coupling (5) for hydraulic connecting with a source (H) of water in pressure,
• at least an hydraulic output (9) for hydraulic connecting with an output device for ejecting a pressurized fluid;
wherein the at least a hydraulic coupling (5) is fluidly con-

ected by a conduit (6) to the tank (2) in order to allow its filling,
the water supply system (1) further comprising a separation device (11) in fluidic communication with inner space (3) of the tank (2) and configured to allow a hydraulic bypass between the at least one hydraulic coupling (5) and the hydraulic output (9), without a direct physical fluidic communication between these latter.

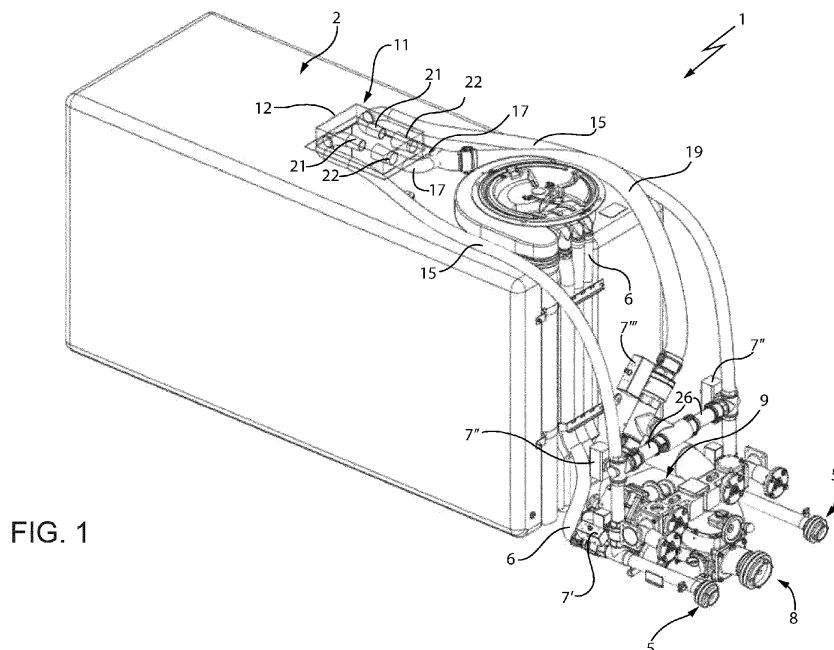


FIG. 1

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102020000018577 filed on 30/07/2020.

TECHNICAL FIELD

[0002] The present invention concerns a water supply system for a tank for a rescue vehicle, in particular water supply system for a tank making part of a firefighting vehicle.

BACKGROUND OF THE INVENTION

[0003] Rescue vehicles may be equipped with tanks for storing operational liquid that need to be used in rescue operations. An example of such a rescue vehicle is a firefighting vehicle into which water is used for preparing a fire extinguishing fluid used for firefighting use.

[0004] The water can be sucked by public waters, supplied by an external source such as a hydrant, or further spilled by the aforementioned tank that guarantee a reliable storage of water to supply the fire extinguishing fluid.

[0005] In case of supply of water by a hydrant, the water is already, at least partially, pressurized and therefore the pumps of the vehicle need not, or only partially, pressurize further the water. In case of supply of water by tank, the water is instead pressurized by a pump to provide the fire extinguishing fluid.

[0006] Most of the vehicles are equipped with a water supply system to allow both the aforementioned configurations, i.e. they comprise a tank that can be filled by hydrants or other sources of water.

[0007] An example of such water supply system is disclosed in DE102018201012 A1.

[0008] However, existing systems which enable tank operation in combination with a supply on the pressure side, such as the aforementioned one, are not suitable for complying with new standards that requires a strict separation between the drinking water, supplied by external source such as a hydrant and the not-drinking water, such as the ones contained downstream the tank and that may flow back during the use of the rescue vehicle.

[0009] The new standards are aimed to avoid any possible contamination of the public hydraulic network by the chemical agents such as fire extinguishing agents or by condemned water from the water tank. Such new standards are for example listed in regulations E DIN 14502-2 and DVGW W 405-B1.

[0010] Therefore, the need is felt to provide a water supply system for a rescue vehicles that allows at the same time to comply with new regulation for separation of drinking water with respect to non-drinking waters and provide the same operative functionalities of existing wa-

ter supply systems.

[0011] An aim of the present invention is to satisfy the above mentioned needs in a cost effective and optimized way.

SUMMARY OF THE INVENTION

[0012] The aforementioned aim is reached by a water supply system and a rescue vehicle as claimed in the appended independent claims.

[0013] Preferred embodiments of the invention are realized according to the claims dependent or related to the above independent claims.

BRIEF DESCRIPTION OF DRAWINGS

[0014] For a better understanding of the present invention, a preferred embodiment is described in the following, by way of a non-limiting example, with reference to the attached drawings wherein:

- Figure 1 is a perspective view showing a possible physical embodiment of a water supply system according to the present invention;
- Figure 2 is a schematic of a water supply system according to a first embodiment of the present invention; and
- Figure 3 is a schematic of a water supply system according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0015] Figures 2 discloses a first embodiment of a water supply system 1 for a rescue vehicle (not shown) such as a firefighting vehicle.

[0016] The water supply system 1 comprises a tank 2 configured to delimit an inner space 3 configured to store water, as described in the following. The water filled inside the inner space 3 is contained at a level L that is retrieved by level detection means 4. In particular, the level L is controlled to be lower with respect to a maximum level L_{MAX} , in the disclosed example equal to the maximum height of the tank 2. The tank 2 may further comprise water overflow means 4', not further described into detail, being known in the art.

[0017] Tank 2 is fluidly connected to at least an input hydraulic coupling 5 that allows the fluidic connection to a source H of fluid such as a hydrant (not shown). In particular, in the described embodiment the water supply system 1 comprises two input hydraulic couplings 5.

[0018] Each input hydraulic coupling 5 can be realized as an opening configured to allow the mechanical coupling with a connection tube for connecting the latter with the source H, such as a hydrant.

[0019] Each input hydraulic coupling 5 is fluidly connected via a respective conduit 6 to the top of tank 2 thereby allowing the filling of inner space 3 of water.

[0020] Preferably, the water supply system 1 comprises valve means 7' fluidly interpose on conduit 6 and configured to allow the passage of fluid only from the input hydraulic coupling 5 to the tank 2, and possibly vary such flow.

[0021] The water supply system 1 advantageously comprises pump means 8 fluidly connected via a conduit 10 to a hydraulic output 9, e.g. an opening configured to be connected to ejector means such as a nozzle to provide a flow F of fire extinguishing fluid.

[0022] As can be appreciated by figures 2 and 3, the pump means 8 can manage the water coming from tank 2 or from an external source H of water towards the hydraulic output 9.

[0023] According to the invention, the water supply system 1 comprises a separation device 11 in fluidic communication with inner space 3 of tank 2 and configured to allow an alternative fluidic connection, i.e. a fluidic bypass, between input hydraulic couplings 5 and hydraulic conduit 10, without a direct physical fluidic communication between these latter.

[0024] In particular, the separation device 11 comprises a housing 12 defining a space 13 in fluidic communication with inner space 3 of the tank 2 via a first opening 14. Advantageously, the housing 12 is arranged on a portion of the tank 2 so that the first opening 14 is always placed above the maximum level L_{MAX} of fluid stored in tank 2. In particular, as show in the figure, the housing 12 is preferably arranged on the top of tank 2 so that the first opening 14 has an opening axle that is substantially vertical.

[0025] The space 13 is also in fluid communication with input hydraulic coupling 5 via a conduit 15 fluidly connecting a second opening 16, realized in housing 12, to the conduits 6 upstream with respect to valve means 7'. The space 13 is furthermore in fluid communication with hydraulic output 9 and pump means 8 via a conduit 17 fluidly connecting a third opening 18, realized in housing 12, to the conduit 10 downstream to hydraulic input 8 but upstream to the connection with tank 2.

[0026] According to the disclosed embodiment, the housing 12 defines a pair of second openings 16 and a pair of third openings 18 and respective conduits 15, 17. In particular, the openings 16, 18 are positioned on top the first opening 14. Advantageously, the pair of second openings 16 is positioned faced with respect to the pair of third opening 18. In greater particular, the two pairs of openings 16, 18 are concentric with each other, i.e. their centers are substantially at the same height measured at the position of the first opening 14.

[0027] Preferably, also each conduit 15 is advantageously furthermore provided with valve means 7" configured to allow the passage of fluid only from the input hydraulic coupling 5 to the separation device 11 and possibly is configured to control the fluid flow.

[0028] Preferably, the conduits 17 joint into a single conduit 19 downstream to the separation device 11, such that the single conduit 19 is fluidly connected, as defined

above, to hydraulic output 9 and pump means 8 upstream with respect to the connection of tank 2 but downstream to possible connection of suction of external source H for pump means 8. In this way, if water comes from single conduit 19, water can pass through pump means 8 to hydraulic output 9.

[0029] Advantageously, the separation device 11 comprises second and third openings 16, 18 respectively a first pipe 21 and a second pipe 22. The first pipe 21 extend from second opening 16 towards the third opening 18 and terminates opened in the space 13 while the second pipe 22 extend from third opening 18 towards the second opening 16 and terminates opened in the space 13. According to the above described configuration, the separation device 11 therefore comprises a pair of first pipes 21 extending from second openings 16 and a pair of second pipes 22 extending from third openings 18.

[0030] Consequently to the above, between first pipe 21 and second pipe 22 there is a free distance X extending along the longitudinal direction of the pipes 21, 22 and the free distance X is dimensioned to:

- allow the passage of pressurized fluid coming from second opening 16 via first pipe 21 to second pipe 22 "jumping" through the space 13 and then to conduits 17 and 19;
- deny the possible return flow of water flowing back from conduits 17, 19, thereby leading the latter flow to fall down in inner space 3 via first opening 14.

[0031] In order to facilitate the passage of pressurized fluid from first pipe 21 to second pipe 22, preferably the diameter of the terminal portion of at least one of the two pipes 21, 22 can be different from the remaining portion of these latter.

[0032] In particular, the opened terminal portion of second pipe 22 is a tapered portion 23 so as to have a terminal diameter greater than the terminal diameter of first pipe 21.

[0033] The dimension of the tapered portion 23 and of terminal diameter is configured to avoid the spreading of pressurized water in space 13.

[0034] Figure 3 discloses a second embodiment of the water supply system 1 according to the invention that differs from the first embodiment by allowing the possibility to provide water from another source, e.g. from another rescue vehicle.

[0035] Accordingly, the water supply system 1 comprises hydraulic coupling means 25 fluidly interposed on conduit 15 between the valve means 7" and the separation device 11. In the disclosed embodiment, consequently to the described configuration, the water supply system 1 comprises a hydraulic coupling means 25 for each of the two conduits 15.

[0036] In the described embodiment, hydraulic coupling means 25 comprises valve means configured to allow (compliance for drinking water protection requested) or bypass (no drinking water protection requested)

the passage through the separation device 11. If the flow passage is permitted, the water passes in the separation device 11 that is realized as described above.

[0037] If the flow passage is denied, the hydraulic coupling means 25 allows the passage of fluid through by-pass conduits 26, e.g. two by-pass conduits 26 that join into a single conduit 27. These conduits 26, 27 fluidly connect the hydraulic coupling means 25 to conduit 19 downstream to the joint of the two conduits 17 coming from separation device 11.

[0038] According to this embodiment, water supply system 1 comprises valve means 7 fluidly interposed on conduit 19 upstream to the joint connection of conduits 17 but downstream to the connection of conduit 19 with conduit 27 and configured to allow the fluid passage only from separation device 11 towards hydraulic output 9.

[0039] Figure 1 shows a physical possible embodiment of the water supply system 1 described above according to the second embodiment of the present invention.

[0040] It can be appreciated that preferably both the input hydraulic coupling 5, the conduits 15, 17, 19, 26, the pump means 8 and the hydraulic output 9 can be arranged to occupy a lateral wall of tank 2 and only half of the top portion of tank 2.

[0041] In this way, the tank 2 can be housed inside a respective lodging of the rescue vehicle so that the lateral wall of tank 2 comprising the aforementioned element can be placed in correspondence of an accessible portion of the rescue vehicle for rescue operations and for facilitating maintenance operations.

[0042] In all the aforementioned embodiments, valve means 7 can be realized with an electro-actuated valve in order to manage the flow between the related conduits but avoiding any return flow.

[0043] Furthermore, the water supply system 1 may comprise an electronic control unit, not shown, configured to control the aforementioned valve means 7, 7', 7'', 7''', if realized with electro-actuated valves or pump means 8 on the basis of data:

- retrieved by a plurality of sensors configured to measure the flow in specific points of the water supply system 1,
- retrieved by level sensor means 4 related to level of water in tank 2,
- indicating a request of the operators, e.g. an increasing or decreasing request of flow at hydraulic output 9.

[0044] The operation of the water supply system 1 according to the invention and described as above is the following, making reference to the first embodiment of figure 2.

[0045] In a first possible mode of operation, i.e. a tank operation mode, the input hydraulic coupling 5 are not coupled to the source H and there is enough water in tank 2 to allow the operation of pump means 8. In such condition, the electronic control unit controls pump

means 8 to provide an amount of water flow at hydraulic output 9 to ensure a requested flow.

[0046] In a second possible mode of operation, i.e. integrated water supply mode, the input hydraulic coupling 5 are coupled to the source H and the requested flow at hydraulic output 9 is so that all the provided fluid by source H is needed to be sent to separation device 11. Accordingly, electronic control unit avoids passage of fluid via valve means 7 towards conduit 6 to tank 2 and allows a full passage of fluid towards conduit 15. The fluid then passes inside separation device 11 via first pipe 21 and is ejected towards the opposite second pipe 22 thereby allowing the flow to pass towards conduit 17 and 19 and then to hydraulic output 9. Thanks to the tapered portion 23, the possible spreading of water flow is collected inside second pipe 22 and, in this way, the water comes to pump means 8 already pressurized. If, for any reason, there would be a return flow of water towards separation device 11, the fluid will pass into second pipe 23 but will not have sufficient pressure to "jump" towards the first pipe 21 and therefore will pass into space 13 and to tank 2 through opening 14.

[0047] In a third possible mode of operation, i.e. integrated water supply plus tank filling, the input hydraulic coupling 5 are coupled to the source H and the requested flow at hydraulic output 9 is so that only a portion of the provided fluid by source H is needed to be sent to separation device. Accordingly, electronic control unit controls valve means 7 to allow part of such water to flow towards conduit 6 to tank 2 in order to fill the tank. Such passage is guaranteed till the level L of fluid does not reach the maximum level L_{MAX} in the tank 2. At the same time, the electronic control unit allows a passage of some of the water flow towards conduit 15. The fluid then passes inside separation device 11 and operated as described in the second operation mode.

[0048] In a fourth possible mode of operation, i.e. integrated water supply plus tank suction, the input hydraulic coupling 5 are coupled to the source H and the requested flow at hydraulic output 9 is so that all the provided fluid by source H is needed to be sent to separation device but is not sufficient to provide enough water. Accordingly, electronic control unit avoids passage of fluid via valve means 7 towards conduit 6 to tank 2 and allows a full passage of fluid towards conduit 15. The fluid then passes inside separation device 11 as described in the second operation mode. At the same time, electronic control unit controls pump means 8 to provide an extra amount of water flow at hydraulic output 9 to ensure a requested flow, spilling water from tank 2, if the latter has a sufficient level L of water stored in space 3.

[0049] The operation of the second embodiment of figure 3 defines the above defined fourth mode of operation if the input hydraulic coupling 5 are coupled to a source of public water such as a hydrant.

[0050] If instead the input hydraulic coupling 5 is connected to a different source (e.g. not drinking water or another vehicle), therefore the hydraulic coupling means

25 can be controlled to by-pass the separation device 11 thereby allowing a direct connection of input hydraulic coupling 5 to hydraulic output 9.

[0051] In view of the foregoing, the advantages of a water supply system 1 according to the invention are apparent.

[0052] Thanks to the proposed water supply system 1, it is possible to provide a versatile and automatic water supply system that allows all known possible modes of operation, as known in the art, but, at the same time, complies with the requirements of new regulations for separating drinking and non-drinking water.

[0053] The proposed system is compact and can be easily managed either by the operator or in an automatic way by an electronic control unit according to the request of flow at hydraulic output 9.

[0054] The proposed separation device 11 allows a free inlet separation between the drinking and non-drinking water side of the tank 2 in an economic and easy to manufacture manner.

[0055] The use of pipes 21, 22 and in particular a terminal tapered portion 23 allows to provide a good transmission of the pressurized water without a significant pressure drop or dispersion of water.

[0056] As said, the proposed water supply system 1 allows to provide many different operational configuration to provide flow to hydraulic output 9 and/or filling the tank 2.

[0057] It is clear that modifications can be made to the described water supply system 1 which do not extend beyond the scope of protection defined by the claims.

[0058] For example, the separation device 11 may be realized in other different ways or not provided with the proposed pipes 21, 22.

[0059] The number and shapes of tank 2, conduits and openings mentioned in the description may be varied according to the typology and dimension of the rescue vehicle.

[0060] Clearly, other operational elements may be provided in addition to the disclosed water supply system 1 and the electronic control unit may use data retrieved by many other sensors to control the operation of the water supply system 1.

Claims

1. Water supply system (1) for a tank (2) for a rescue vehicle (1), said water supply system (1) comprising:

- a tank (2) defining an inner space (3) for storing water;
- at least one input hydraulic coupling (5) for hydraulic connecting to a source (H) of water in pressure,
- at least one hydraulic output (9) for hydraulic connecting to an output device for ejecting a pressurized fluid;

wherein said at least one hydraulic coupling (5) is fluidly connected to said tank (2) by a conduit (6) in order to allow its filling,

said water supply system (1) further comprising a separation device (11) in fluidic communication with the inner space (3) of said tank (2) and with said conduit (6) and configured to allow a hydraulic by-pass between said at least one input hydraulic coupling (5) and said hydraulic output (9) without a direct physical fluidic communication between said at least one input hydraulic coupling (5) and said hydraulic output (9).

2. Water supply system according to claim 1, wherein said separation device (11) is carried by a portion of said tank (2) positioned above the maximum level (L_{MAX}) of water that can be stored inside said tank (2).

3. Water supply system according to claim 1 or 2, wherein said separation device (11) comprises a housing (12) defining a space (13) in fluidic communication with inner space (3) of said tank (2) and at least one first opening (16) in fluid communication with said conduit (6) and at least one second opening (18) in fluid communication with said hydraulic output (9), the first and second openings (16, 18) being arranged to be faced one with respect to the other so that the water coming from said input hydraulic coupling (5) can flow to said hydraulic output (9) by jumping from said at least one first opening (16) to said at least second opening (18).

4. Water supply system according to claim 3, wherein said at least one first opening (16) is coaxial to said at least second opening (18).

5. Water supply system according claim 3 or 4, wherein said separation device (11) comprises a first pipe (21) extending from said at least one first opening (16) and terminating in fluid communication with said space (13) and a second pipe (22) extending from said at least one second opening (18) and terminating in fluid communication with said space (13), said first and second pipes (21) being faced one with respect to the other and distanced of a predetermined distance (X) along their longitudinal axis direction.

6. Water supply system according to claim 5, wherein said distance (X) is dimensioned to allow the passage of water from said first pipe (21) towards said second pipe (22) and a passage of return flow of water from said second pipe (22) in said space (13).

7. Water supply system according to claim 5 or 6, wherein said second pipe (22) comprises a terminal tapered portion (23) having a terminal diameter greater than the diameter of the pipe (22).

8. Water supply system according to any of the preceding claims, wherein said tank (2) comprises level sensor means (4) configured to detect a level (L) of fluid inside said inner space (3). 5
9. Water supply system according to any of the preceding claims, wherein said tank (2) comprises overflow means (4'). 10
10. Water supply system according to any of the preceding claims comprising valve means (7', 7'') fluidly interposed between said at least one input hydraulic coupling (5) and said tank (2) and between said at least one input hydraulic coupling (5) and said separation device (11), said valve means (7', 7'') being configured to allow the passage of fluid only from said input hydraulic coupling (5) and to regulated such passage of fluid through, respectively, said tank (2) and said separation device (11). 15 20
11. Water supply system according to any of the preceding claims, comprising pump means (8) fluidly interposed between said tank (2), said separation device (11) and said hydraulic output (9), said pump means (8) being configured to pump water from said tank (2) towards said hydraulic output (9) or from an external source (H) or from said separation device (11). 25 30
12. Water supply system according to claims 10 to 11, further comprising an electronic control unit configured to control the operation of said valve means (7', 7'') and said pump means (8) on base of data received by a user of said rescue vehicle or retrieved by said level sensor means (4). 35
13. Water supply system according to any of the preceding claims, further comprising hydraulic coupling means (25) fluidly interposed between said at least one input hydraulic coupling (5), said separation device (11) upstream to this latter and said hydraulic output (9), said hydraulic coupling means (25) comprising valve means configured to allow the passage of fluid through the separation device (11) towards said output hydraulic device (9) or to by-pass said separation device (11) by allowing a direct fluidic connection between said at least one input hydraulic coupling (5) and said hydraulic output (9). 40 45
14. Water supply system according to claim 13 further comprising valve means (7''') fluidly interposed downstream to said separation device (11), said valve means (7''') being configured to allow the passage of fluid only from said separation device (11) and to regulated such passage of fluid towards said hydraulic output (9). 50 55
15. Tank (2) provided with a water supply system (1) according to any of the preceding claims.
16. Tank according to claim 15, wherein said water supply system (1) being arranged to occupy only a lateral side of said tank (2) and only a portion of the top of said tank (2).
17. Rescue vehicle comprising a tank (2) provided with a water supply system according to any of the preceding claims.

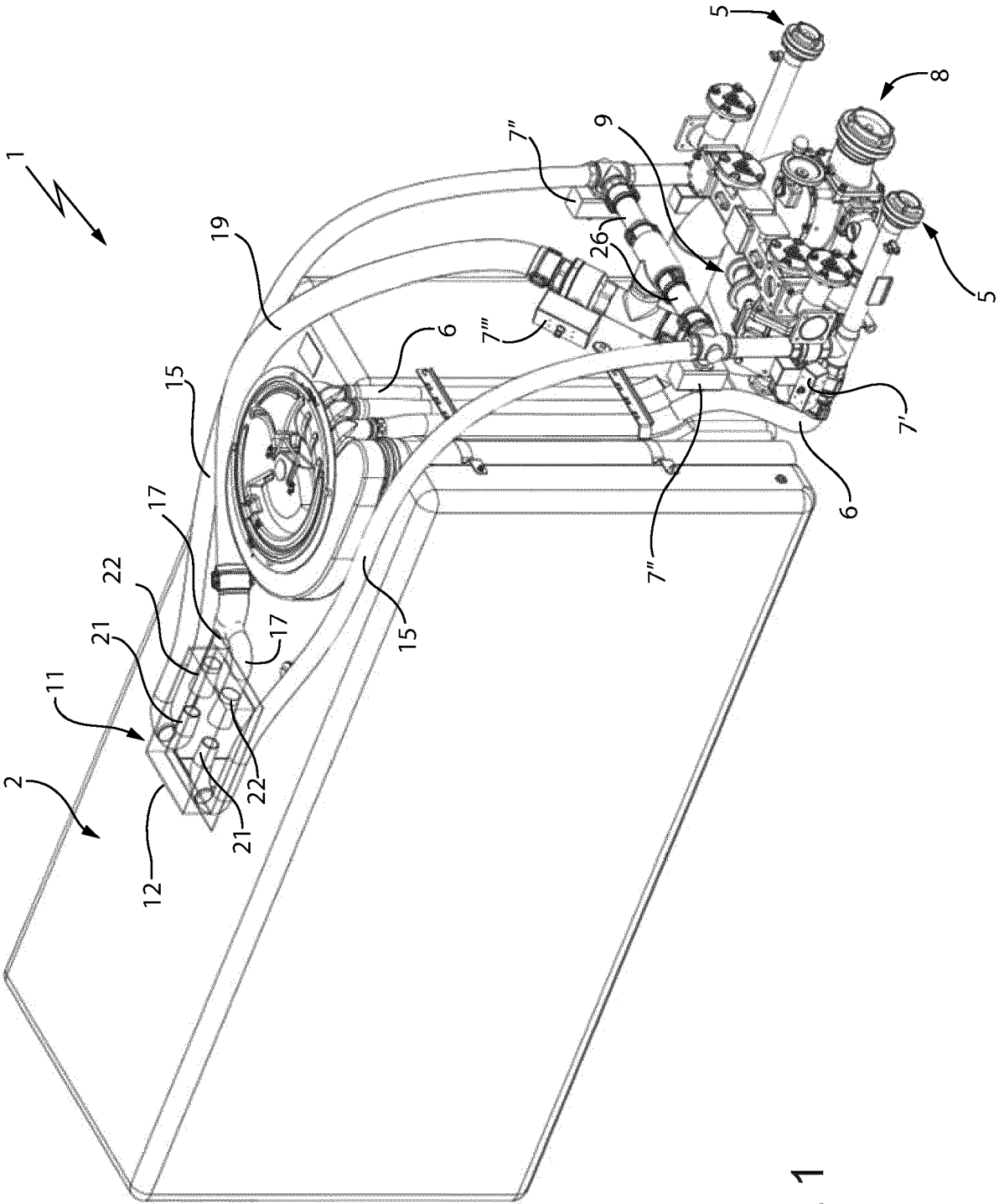


FIG. 1

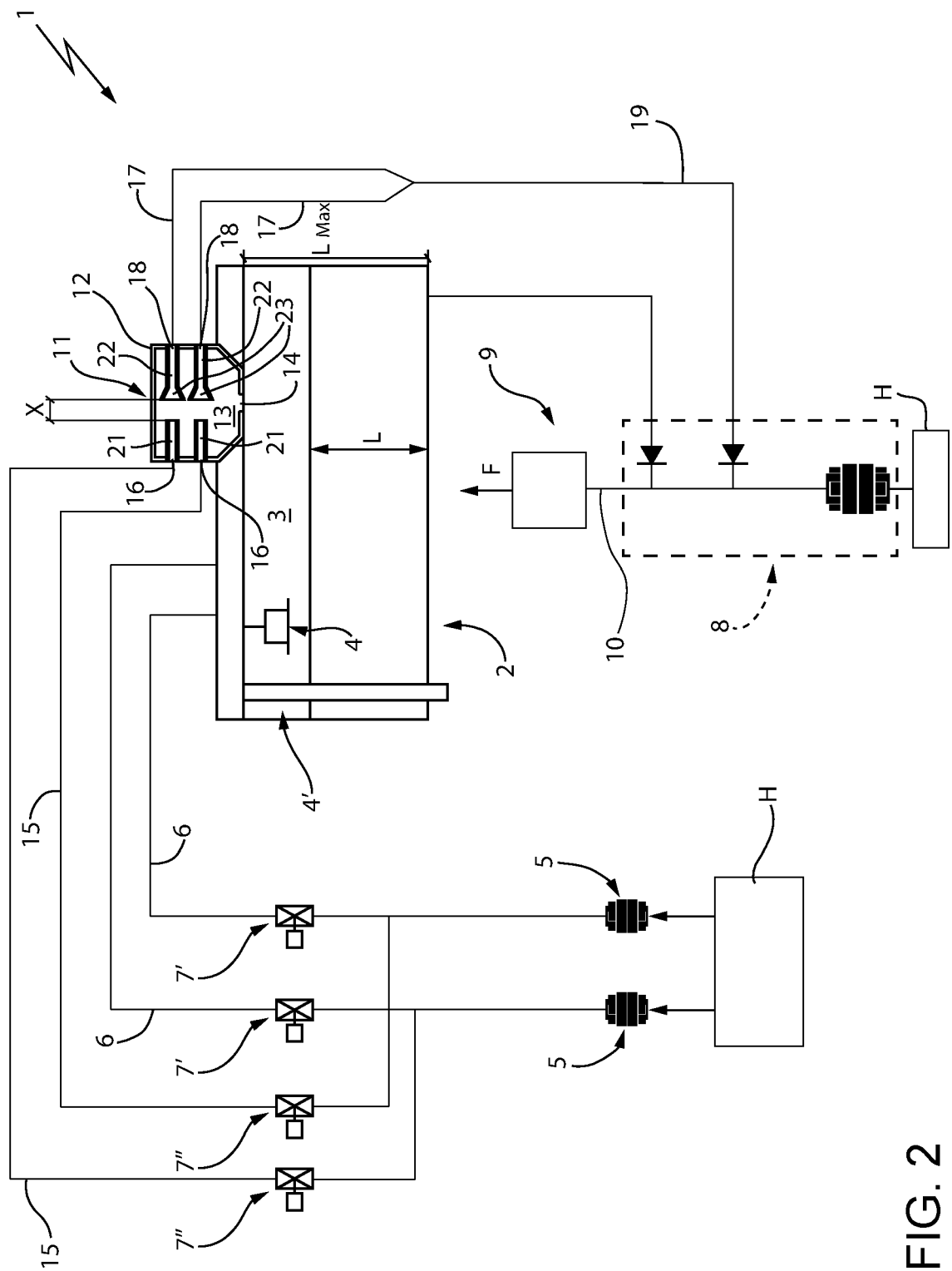


FIG. 2

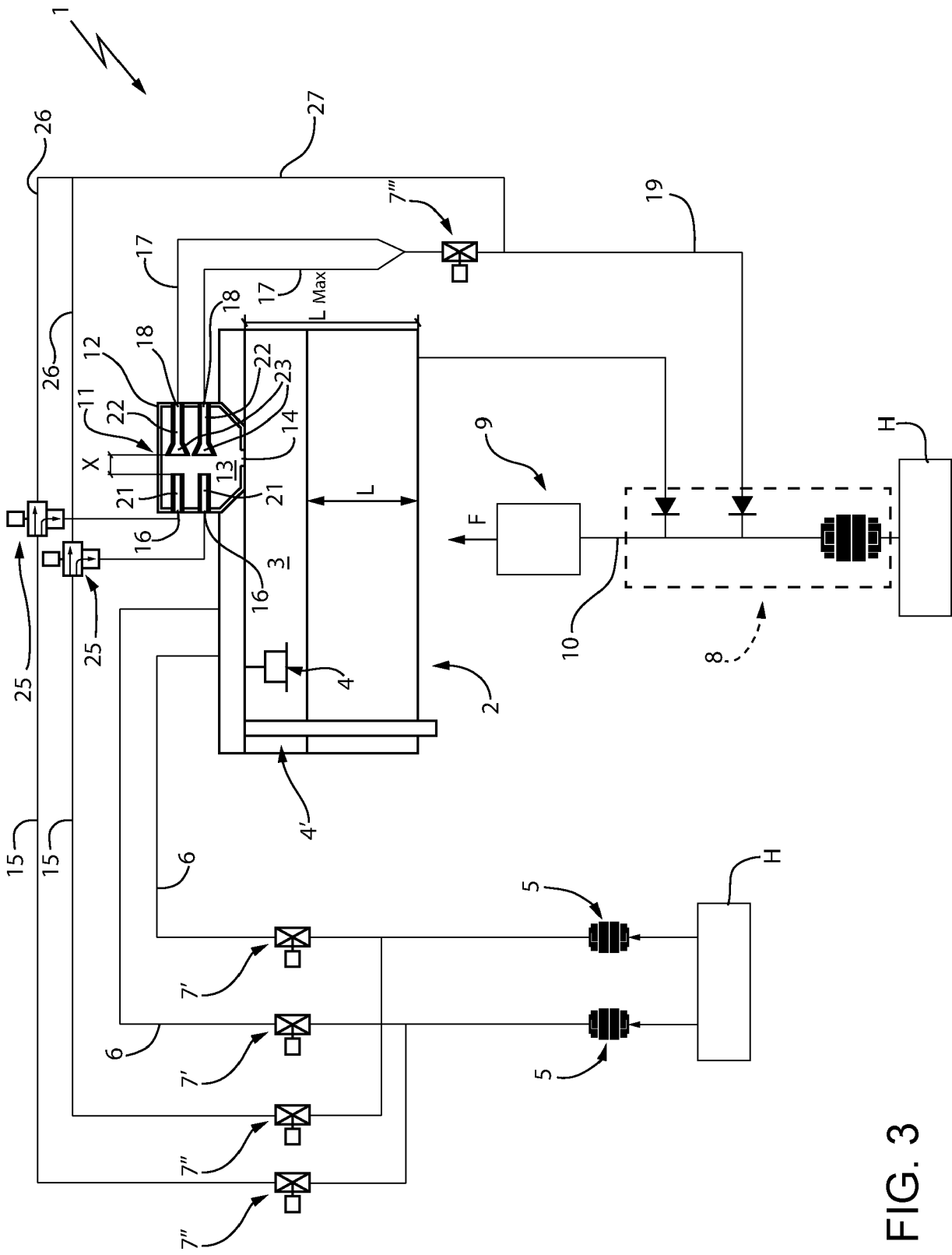


FIG. 3



EUROPEAN SEARCH REPORT

Application Number
EP 21 18 8903

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* figures *	3-7	
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		19 November 2021	Andlauer, Dominique
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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