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(71) Applicant: **DAF TRUCKS N.V.** [NL/NL]; Hugo van der Goeslaan 1, 5643 TW Eindhoven (NL).

(72) Inventors: **VAN OOIJEN, Louis Hubert**; c/o Hugo van der Goeslaan 1, 5643 TW Eindhoven (NL). **DAS, Antonius Johannes Wilhelmus Agnes**; c/o Hugo van der Goeslaan 1, 5643 TW Eindhoven (NL).

(74) Agent: **WITMANS, H.A.**; P.O. Box 87930, 2508 DH Den Haag (NL).

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(54) Title: A CIRCULATING FUEL SUPPLY SYSTEM FOR A COMMERCIAL MOTOR VEHICLE

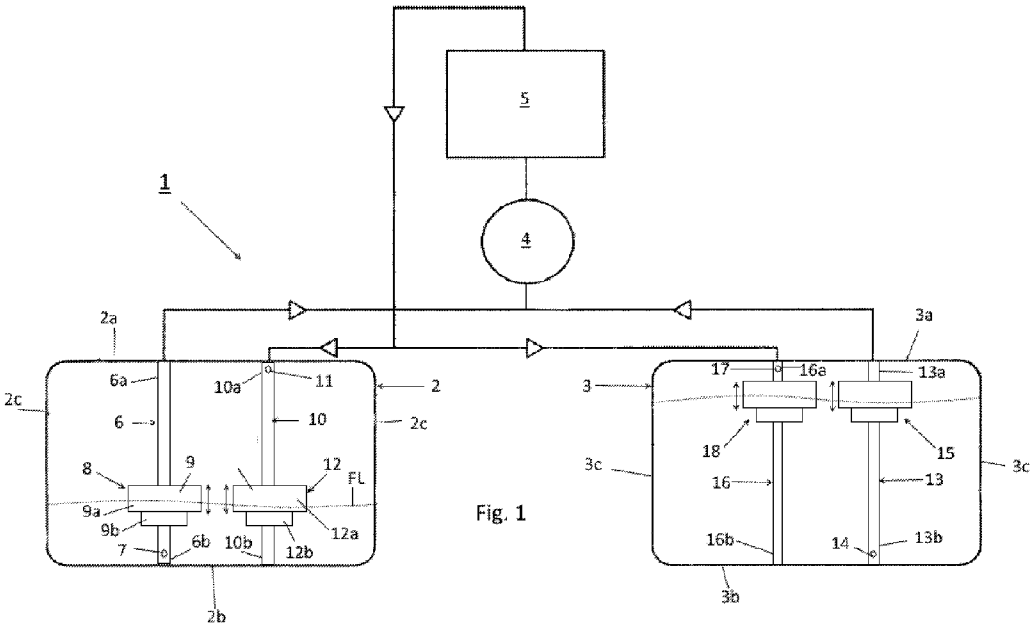

Fig. 1

(57) Abstract: A circulating fuel supply system for a commercial motor vehicle comprising a fuel storage tank having a top wall and a bottom wall opposite the top wall. A draw conduit extends into the fuel storage tank from the top wall to the bottom wall. An inlet for fuel is only provided in a lower end of the draw conduit and is spaced above the bottom wall. A first buoyant float body is positioned vertical movably around the first draw conduit for closing or opening the inlet for fuel in dependence of liquid fuel level in the fuel storage tank. The fuel supply system further comprises a return conduit extending into the fuel storage tank from the top wall to the bottom wall, said return conduit has a lower end positioned adjacent the bottom wall of the fuel storage tank, and an outlet for return fuel is included only in an upper end of the return conduit. A second buoyant float body is positioned vertical movably around the return conduit for closing or opening the outlet for return fuel in dependence of liquid fuel level in the fuel storage tank.

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Title: A circulating fuel supply system for a commercial motor vehicle.

The present invention relates to a circulating fuel supply system for a commercial motor vehicle, in particular for a commercial truck with multiple fuel storage tanks.

Circulating fuel supply systems that include one or more fuel storage tanks are known and are typically used with commercial trucks. When applied to a commercial truck having two fuel storage tanks the circulating fuel supply system includes a fuel pump which – during operation - draws fuel from the fuel storage tanks through draw conduits mounted to the fuel storage tanks, which draw conduits extend into the fuel storage tanks from a top wall to a bottom wall thereof. The fuel drawn from the fuel storage tanks is supplied by the fuel pump to the engine of the commercial truck which consumes some of the fuel. Unconsumed fuel leaves the engine and is returned to the fuel storage tanks through return conduits mounted to the fuel storage tanks, which return conduits extend into the fuel storage tank. Thus, fuel is in constant circulation out of and back into the fuel storage tanks. Typically the fuel drawn from and returned to each fuel storage tank is not equal for the fuel storage tanks, which can result in premature depletion of fuel in one of the fuel storage tanks relative to other fuel storage tanks. This can result in air being supplied to the engine instead of fuel, to fuel starvation and engine operational problems.

It is an object of the invention to provide a circulating fuel supply system for a commercial motor vehicle in which the problems mentioned above are overcome in a relative simple manner.

According to the invention this object is obtained by a circulating fuel supply system for a commercial motor vehicle according to claim 1. In particular by letting the first return conduit extend into the first fuel storage tank from the top wall to the bottom wall the second buoyant float body positioned around the first return conduit can be raised or lowered

over the full height of the first fuel storage tank. In dependence of liquid fuel level in the first fuel storage tank the first buoyant float body can close or open the inlet for fuel and the second buoyant float body can open or close the outlet for return fuel in a relatively simple but effective manner. E.g. in case the fuel in the first fuel storage tank drops below a certain lower limit level the first buoyant float body closes the inlet for fuel, thereby preventing air from being drawn into the first draw conduit. On the other hand, in case the fuel in the first fuel tank exceeds a certain upper limit level the second buoyant float body closes the outlet for return fuel, thereby preventing that too much fuel is returned to the first fuel storage tank. In case the fuel in the first fuel storage tank has a level between the lower limit level and the upper limit level both the buoyant float bodies open the inlet for fuel and the outlet for return fuel.

In an embodiment the first draw conduit and the first return conduit are positioned adjacent one another and the first and the second buoyant float body are integrated in a first common buoyant float body. In this manner a single common buoyant float body can be used for opening or closing the inlet for fuel or the outlet for return fuel.

In a further embodiment of a circulating fuel supply system according to the invention the fuel supply system further comprises a second fuel storage tank, said second fuel storage tank having a top wall, a bottom wall opposite the top wall and side walls; a second draw conduit mounted to the second fuel storage tank, said second draw conduit extending into the second fuel storage tank from the top wall to the bottom wall, said second draw conduit having an upper end and a lower end, said lower end being positioned adjacent the bottom wall of the second fuel storage tank, and said lower end including an inlet for fuel spaced above the bottom wall of the second fuel storage tank and having a first end extending into the second fuel storage tank from the top wall to the bottom wall; a third buoyant float body positioned vertical movably around the second draw conduit, wherein

liquid fuel acting on the third buoyant float body will raise or lower the third buoyant float body, said third buoyant float body being arranged for closing or opening the inlet for fuel in dependence of liquid fuel level in the second fuel storage tank; a second return conduit mounted to the second fuel storage tank, said second return conduit extending into the second fuel storage tank from the top wall to the bottom wall, said second return conduit having an upper end and a lower end, said lower end being positioned adjacent the bottom wall of the second fuel storage tank, and said upper end including an outlet for return fuel, said outlet for return fuel being spaced below the top wall of the second fuel storage tank; and a fourth buoyant float body positioned vertical movably around the second return conduit, wherein liquid fuel acting on the fourth buoyant float body will raise or lower the fourth buoyant float body, said fourth buoyant float body being arranged for closing or opening the outlet for return fuel in dependence of liquid fuel level in the second fuel storage tank. In this embodiment the second fuel storage tank is substantially identical to the first fuel storage tank. By using such a first and a second fuel storage tank, the circulation of fuel can be balanced. For example, in case the fuel in the first fuel storage tank drops below the lower limit level the first buoyant float body closes the inlet for fuel, as a result of which the fuel pump experiences more resistance when drawing fuel from the first fuel storage tank and thus the fuel pump will draw fuel from the second fuel storage tank, assuming the second fuel storage tank is sufficiently filled with fuel. On the other hand, in case the fuel in the first fuel tank exceeds the upper limit level the second buoyant float body closes the outlet for return fuel, thereby preventing that too much fuel is returned to the first fuel storage tank, and return fuel is then returned to the second fuel storage tank.

It is preferred when the second draw conduit and the second return conduit are positioned adjacent one another and the third and the fourth buoyant float body are integrated in a second common buoyant float body.

In an embodiment of the circulating fuel supply system according to the invention the first fuel storage tank and the second fuel storage tank are arranged at different heights in the motor vehicle. By using the present invention the first and the second fuel storage tank need not be arranged at the same height in the motor vehicle in order to provide a balanced circulation of fuel. Please note that the present invention is not limited to commercial motor vehicles having one or two fuel storage tank, and that the motor vehicle can have three or more fuel tanks, wherein each of these can be constructed in the same manner as the first and the second fuel storage tank.

In a further embodiment of a circulating fuel supply system according to the invention each inlet for fuel is formed by at least one inlet opening radially extending through the respective draw conduit and each outlet for return fuel is formed by at least one outlet opening radially extending through the respective return conduit. In this manner it is possible to construct each buoyant float body as an annular element. Preferably the annular element comprises an upper hollow part having a first diameter, and a lower part having a second diameter, wherein the first diameter is larger than the second diameter. It is advantageous when the annular element is made of plastic.

The invention will be further explained with reference to the Figure, in which a non-limiting exemplary embodiment of according to the invention is shown:

Fig. 1 schematically shows an embodiment of a circulating fuel supply system for a commercial motor vehicle according to the invention comprising a first and a second fuel storage tank;

Figs. 2A and 2B schematically show the first fuel storage tank of the embodiment shown in Fig. 1 with different fuel levels in the first fuel storage tank; and

Fig. 3 schematically shows a further embodiment of a circulating fuel supply system for a commercial motor vehicle according to the invention with a common buoyant float body for the first draw conduit and the first return fuel conduit.

In Fig. 1 schematically an embodiment of a circulating fuel supply system 1 for a commercial motor vehicle according to the invention comprising a first fuel storage tank 2 and a second fuel storage tank 3 is shown. The circulating fuel supply system 1 comprises in a known manner a fuel pump 4 for supplying fuel from the fuel storage tanks 2, 3 to an engine 5 of the commercial motor vehicle.

The first fuel storage tank 2 has a top wall 2a, a bottom wall 2b opposite the top wall 2a and side walls 2c. A first draw conduit 6 is mounted to the first fuel storage tank 2 and extends into the first fuel storage tank 2 from the top wall 2a to the bottom wall 2b. The first draw conduit 6 has an upper end 6a and a lower end 6b. The lower end 6b is positioned adjacent the bottom wall 2b of the first fuel storage tank 2. In the lower end 6b of the first draw conduit 6 an inlet 7 for fuel spaced above the bottom wall 2b of the first fuel storage tank 2. The inlet 7 for fuel is only provided in the lower end 6b of the draw conduit 6. The inlet 7 for fuel can e.g. comprise a number of openings with a circular, rectangular or elliptical cross section, which in the shown embodiment extend radially through the draw conduit 6.

A first buoyant float body 8 is positioned vertical movably (as indicated by the double headed arrow) around the first draw conduit 6. Liquid fuel acting on the first buoyant float body 8 will raise or lower the first buoyant float body 8. The first buoyant float body 8 is arranged for closing or opening the inlet 7 for fuel in dependence of liquid fuel level FL in

the first fuel storage tank 2. In the embodiments shown in Figures 1 and 2B the liquid fuel level FL, FL" are such that the first buoyant float body 8 exposes the inlet 7 for fuel, while in the embodiment shown in Fig. 2A the liquid fuel level FL' is such that the first buoyant float body 8 closes the inlet 7 for fuel.

In the shown embodiments the buoyant float body 8 is an annular element 9 comprising an upper hollow part 9a having a first diameter and a lower part 9b having a second diameter, wherein the first diameter is larger than the second diameter. In the shown embodiments the annular element 9 is made of plastic.

The circulating fuel supply system 1 according to the invention further comprises a first return conduit 10 mounted to the first fuel storage tank 2. The first return conduit 10 extends into the first fuel storage tank 2 from the top wall 2a to the bottom wall 2b and has an upper end 10 a and a lower end 10b. The lower end 10b of the first return conduit 10 for return fuel is positioned adjacent the bottom wall 2b of the first fuel storage tank 2. The upper end 10a of the first return conduit 10 for return fuel includes an outlet 11 for return fuel. The outlet 11 for return fuel is provided only in the upper end 10a of the return fuel conduit 10 and is spaced below the top wall 2a of the first fuel storage tank 2. The outlet 11 for return fuel can e.g. comprise a number of openings with a circular, rectangular or elliptical cross section, which in the shown embodiment extend radially through the return fuel conduit 10.

A second buoyant float body 12 is positioned vertical movably (as indicated by the double headed arrow) around the first return fuel conduit 10. Liquid fuel acting on the second buoyant float body 12 will raise or lower the second buoyant float body 12. The second buoyant float body 12 is arranged for closing or opening the return fuel outlet 11 in dependence of liquid fuel level FL in the first fuel storage tank 2. In the embodiments shown in Figures 1 and 2A the liquid fuel level FL, FL' are such that the

second buoyant float body 12 exposes the outlet 11 for return fuel, while in the embodiment shown in Fig. 2B the liquid fuel level FL" is such that the second buoyant float body 12 closes the outlet 11 for return fuel.

The second fuel storage tank 3 has a top wall 3a, a bottom wall 3b opposite the top wall 3a and side walls 3c. A second draw conduit 13 is mounted to the second fuel storage tank 3 and extends into the second fuel storage tank 3 from the top wall 3a to the bottom wall 3b. The second draw conduit 13 has an upper end 13a and a lower end 13b. The lower end 13b is positioned adjacent the bottom wall 3b of the second fuel storage tank 3. In the lower end 13b of the second draw conduit 13 an inlet 14 for fuel spaced above the bottom wall 3b of the second fuel storage tank 3. The inlet 14 for fuel is only provided in the lower end 13b of the second draw conduit 13. The inlet 14 for fuel can e.g. comprise a number of openings with a circular, rectangular or elliptical cross section, which in the shown embodiment extend radially through the second draw conduit 13.

A third buoyant float body 15 is positioned vertical movably (as indicated by the double headed arrow) around the second draw conduit 13. Liquid fuel acting on the third buoyant float body 15 will raise or lower the third buoyant float body 15. The third buoyant float body 15 is arranged for closing or opening the inlet 14 for fuel in dependence of liquid fuel level in the second fuel storage tank 3, in a manner equivalent to the first buoyant float body 8 in the first fuel storage tank 2. The third buoyant float body 15 is constructed in the same manner as the first buoyant float body 8.

A second return conduit 16 is mounted to the second fuel storage tank 3 and extends into the second fuel storage tank 3 from the top wall 3a to the bottom wall 3b and has an upper end 16a and a lower end 16b. The lower end 16b of the second return fuel conduit 16 is positioned adjacent the bottom wall 3b of the second fuel storage tank 3. The upper end 16a of the second return fuel conduit 16 includes an outlet 17 for return fuel. The outlet 17 for return fuel is provided only in the upper end 16a of the second

return fuel conduit 16 and is spaced below the top wall 3a of the second fuel storage tank 3. The outlet 17 for return fuel can e.g. comprise a number of openings with a circular, rectangular or elliptical cross section, which in the shown embodiment extend radially through the second return fuel conduit 16.

A fourth buoyant float body 18 constructed in the same manner as the second buoyant float body 12 is positioned vertical movably (as indicated by the double headed arrow) around the second return fuel conduit 16. Liquid fuel acting on the fourth buoyant float body 18 will raise or lower the fourth buoyant float body 18. The fourth buoyant float body 18 is arranged for closing or opening the second return fuel outlet 17 in dependence of liquid fuel level in the second fuel storage tank 3.

In case during operation of the circulating fuel supply system 1 for a commercial motor vehicle according to the invention the fuel in the first fuel storage tank 2 drops below a certain lower limit level such that the first buoyant float body 8 closes the inlet 7 for fuel (as shown in Fig. 2A), the fuel pump 4 experiences more resistance when drawing fuel from the first fuel storage tank and thus the fuel pump can not draw any or much less fuel from the first fuel tank 2 and will consequently draw fuel from the second fuel storage tank 3, assuming the second fuel storage tank 3 is sufficiently filled with fuel. On the other hand, in case the fuel in the first fuel tank 2 exceeds the upper limit level the second buoyant float body 12 closes the outlet 11 for return fuel (as shown in Fig. 2B), thereby preventing that too much fuel is returned to the first fuel storage tank 2, and return fuel is then returned to the second fuel storage tank 3, assuming the second fuel storage tank 3 is not completely filled with fuel.

In the embodiment of the circulating fuel supply system 1 for a commercial motor vehicle according to the invention as shown in Fig. 3 the first draw conduit 6 and the firs return fuel conduit 10 are positioned adjacent one another and the a common buoyant float body 19 integrating

the first and second buoyant float bodies 8 and 12 is positioned vertical movably (as indicated by the double headed arrow) around both the first draw conduit 6 and the first return fuel conduit 10. Liquid fuel acting on the common buoyant float body 19 will raise or lower the common buoyant float body 19. In another not shown embodiment the third and fourth buoyant float bodies 15 and 18 are integrated in a further common buoyant float body.

Claims

1. A circulating fuel supply system for a commercial motor vehicle comprising:

a first fuel storage tank, said first fuel storage tank having a top wall, a bottom wall opposite the top wall and side walls;

a first draw conduit mounted to the first fuel storage tank, said first draw conduit extending into the first fuel storage tank from the top wall to the bottom wall, said first draw conduit having an upper end and a lower end, said lower end being positioned adjacent the bottom wall of the first fuel storage tank, and said lower end including an inlet for fuel spaced above the bottom wall of the first fuel storage tank, said inlet for fuel being provided only in said lower end;

a first buoyant float body positioned vertical movably around the first draw conduit, wherein liquid fuel acting on the first buoyant float body will raise or lower the first buoyant float body, said first buoyant float body being arranged for closing or opening the inlet for fuel in dependence of liquid fuel level in the first fuel storage tank;

a first return conduit mounted to the first fuel storage tank, said first return conduit extending into the first fuel storage tank from the top wall to the bottom wall, said first return conduit having an upper end and a lower end, said lower end being positioned adjacent the bottom wall of the first fuel storage tank, and said upper end including an outlet for return fuel, said outlet for return fuel being provided only in said upper end and is spaced below the top wall of the first fuel storage tank; and

a second buoyant float body positioned vertical movably around the first return conduit, wherein liquid fuel acting on the second buoyant float body will raise or lower the second buoyant float body, said second buoyant float body being arranged for closing or opening the outlet for return fuel in dependence of liquid fuel level in the first fuel storage tank.

2. The circulating fuel supply system according to claim 1, wherein the first draw conduit and the first return conduit are positioned adjacent one another and wherein the first and the second buoyant float body are integrated in a first common buoyant float body.

3. The circulating fuel supply system according to claim 1 or 2, wherein the fuel supply system further comprises a second fuel storage tank, said second fuel storage tank having a top wall, a bottom wall opposite the top wall and side walls;

a second draw conduit mounted to the second fuel storage tank, said second draw conduit extending into the second fuel storage tank from the top wall to the bottom wall, said second draw conduit having an upper end and a lower end, said lower end being positioned adjacent the bottom wall of the second fuel storage tank, and said lower end including an inlet for fuel spaced above the bottom wall of the second fuel storage tank, said inlet for fuel being provided only in said lower end;

a third buoyant float body positioned vertical movably around the second draw conduit, wherein liquid fuel acting on the third buoyant float body will raise or lower the third buoyant float body, said third buoyant float body being arranged for closing or opening the inlet for fuel in dependence of liquid fuel level in the second fuel storage tank;

a second return conduit mounted to the second fuel storage tank, said second return conduit extending into the second fuel storage tank from the top wall to the bottom wall, said second return conduit having an upper end and a lower end, said lower end being positioned adjacent the bottom wall of the second fuel storage tank, and said upper end including an outlet for return fuel, said outlet for return fuel being provided only in said upper end and is spaced below the top wall of the second fuel storage tank; and

a fourth buoyant float body positioned vertical movably around the second return conduit, wherein liquid fuel acting on the fourth buoyant float body will raise or lower the fourth buoyant float body, said fourth

buoyant float body being arranged for closing or opening the outlet for return fuel in dependence of liquid fuel level in the second fuel storage tank.

4. The circulating fuel supply system according to claim 3, wherein the second draw conduit and the second return conduit are positioned adjacent one another and wherein the third and the fourth buoyant float body are integrated in a second common buoyant float body.

5. The circulating fuel supply system according to claim 3 or 4, wherein the first fuel storage tank and the second fuel storage tank are arranged at different heights in the motor vehicle.

6. The circulating fuel supply system according to any one of the preceding claims, wherein each inlet for fuel is formed by at least one inlet opening radially extending through the respective draw conduit and wherein each outlet for return fuel is formed by at least one outlet opening radially extending through the respective return conduit.

7. The circulating fuel supply system according to any one of the preceding claims, wherein each buoyant float body is an annular element.

8. The circulating fuel supply system according to claim 7, wherein the annular element comprises an upper hollow part having a first diameter, and a lower part having a second diameter, wherein the first diameter is larger than the second diameter.

9. The circulating fuel supply system according to claim 7 or 8, wherein the annular element is made of plastic.

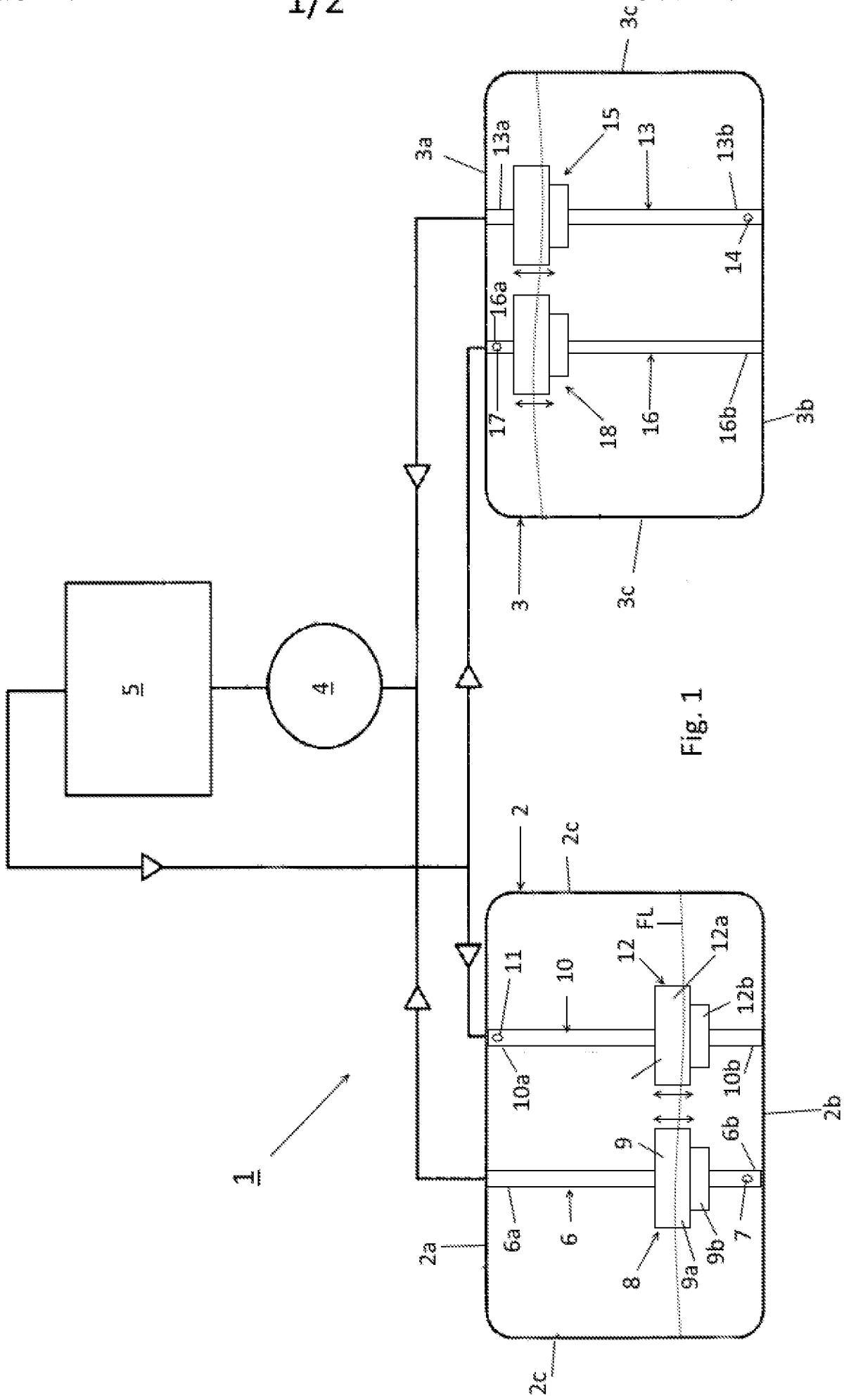
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Fig. 1

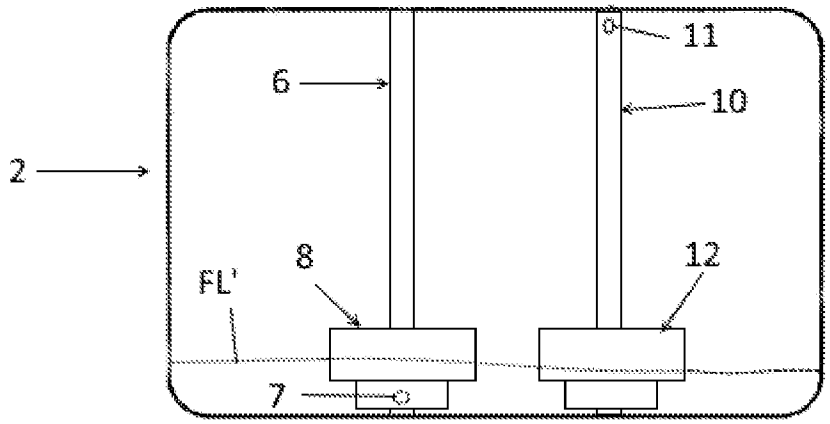

Fig. 2A

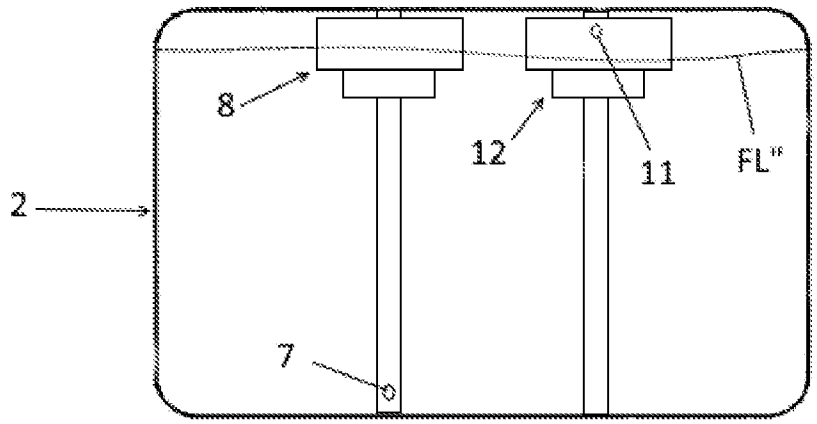

Fig. 2B

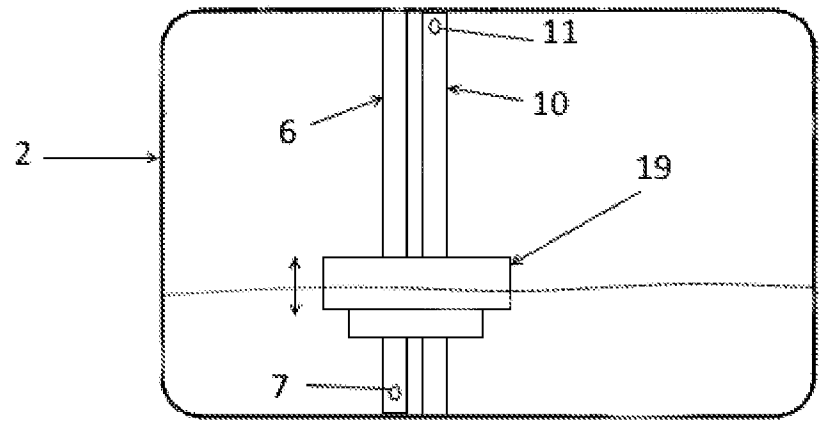

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2019/050790

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60K15/03 B60K15/077
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6 845 782 B2 (INT TRUCK INTELLECTUAL PROP CO [US]) 25 January 2005 (2005-01-25)	1,3,5-9
A	figures 1, 4, 6 column 2, line 36 - line 50 column 4, line 38 - line 55 column 4, line 57 - line 60	2,4
Y	DE 10 2010 032620 A1 (DAIMLER AG [DE]) 17 March 2011 (2011-03-17)	1,3,5-9
A	figures 3, 4 paragraphs [0023], [0027], [0028]	2,4
A	US 5 168 891 A (GREEN CHARLES J [US] ET AL) 8 December 1992 (1992-12-08) figure 2 abstract	1

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search	Date of mailing of the international search report
17 February 2020	25/02/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Waldstein, Martin

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2019/050790

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 201 298 A (SHEARN KENNETH M [US]) 13 April 1993 (1993-04-13) figures 1, 4a, 4b column 2, line 30 - line 49 column 5, line 6 - line 24 -----	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2019/050790

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