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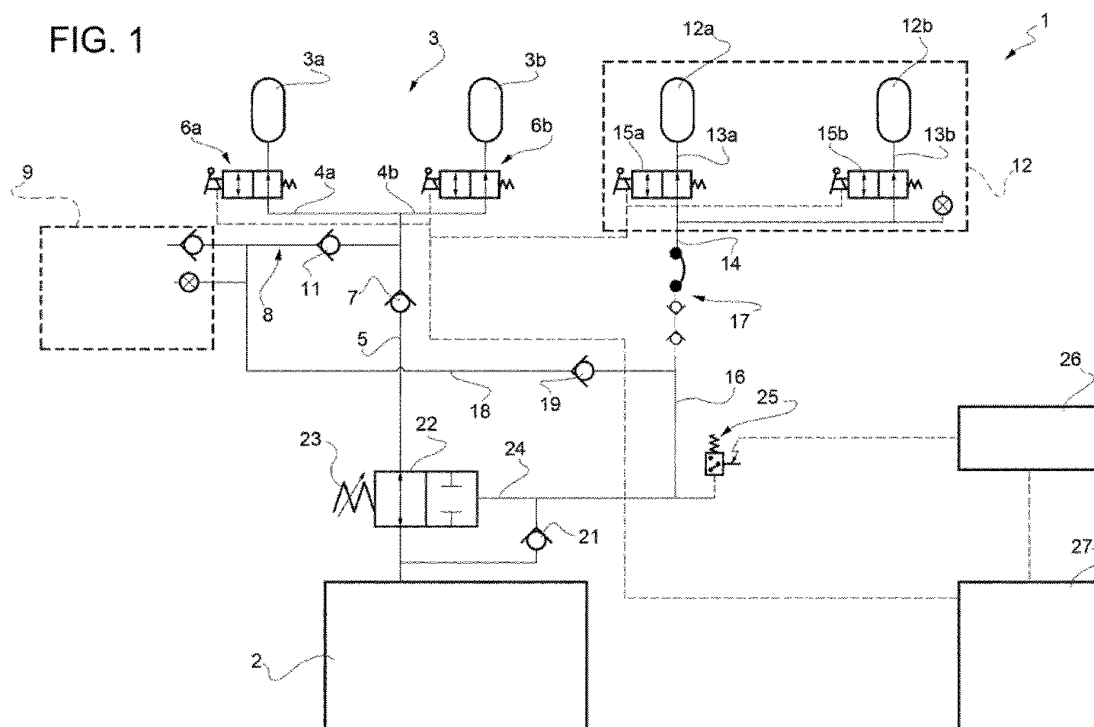
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(54) **GAS DISTRIBUTION CIRCUIT FOR FEEDING A GAS ENGINE FOR A WORK VEHICLE**

(57) Gas distribution circuit (1) for feeding a gas engine (2) of a work vehicle, comprising a main tank module (3) and being configured to be connected to at least one auxiliary tank module (12), main tank module (3) and auxiliary tank module (12) being fluidly connected to engine via respective first and second conduits (5, 16), the gas distribution circuit (1) comprising valve means (22)

fluidly interposed on the first conduit (5) and configured to allow or deny gas communication between main tank module (3) and engine (2), the valve means (22) allowing such fluid communication if pressure in the second conduit (16) is higher than a preset threshold, otherwise, fluid communication is allowed only between the at least one auxiliary tank module (12) and the engine (2).



Description

TECHNICAL FIELD

[0001] The present invention concerns a gas distribution circuit, in particular a gas distribution circuit for feeding a gas engine for a work vehicle.

BACKGROUND OF THE INVENTION

[0002] Tractors may be powered by using gas fuel in order to reduce the emissions with respect to other typology of fossil fuels.

[0003] One example of gas fuel is Compressed Natural Gas (CNG) (methane stored at high pressure) that is a fuel which can be used in place of gasoline.

[0004] Today the current design layout of a tractor does not allow to accommodate a main tank large enough for storing of a suitable amount of gas fuel to allow to power the engine for a full working day of the tractor. Accordingly, the tractor has to be used with an auxiliary gas tank that is carried by an auxiliary unit such as a towed implement or a range extender such as the front or rear hitch or fixed to the front on the front axle support.

[0005] Usually such main tank is used first for feeding the gas engine and, when such tank is almost empty, the auxiliary tank is used for feeding the engine.

[0006] However it may happen that main tank of the tractor has not sufficient gas for returning to its recovery, leaving its user in the fields without possibility of moving away.

[0007] Further, implements or range extenders provided with gas tanks are not usually driven on roads because they may be not homologated for such configuration and therefore, if the auxiliary unit has the entire tank full of gas, it should be left on the fields leading to the danger of explosion in hot/sunny environment.

[0008] In view of the above, the need is felt to foresee an optimized system for managing gas between a tractor and an auxiliary unit when such tractor uses gas for feeding its engine.

[0009] Furthermore, European Regulation R110 concerning gas vehicles and gas arrangements for elements related to storing, distributing and using such gas imposes strict requirements to be accomplished by vehicle manufacturers. Exempli gratia, electrical actuation in circuit 1 should be avoided.

[0010] Therefore, the need is felt to provide a system for distributing gas to a gas engine for a work vehicle which uses, in an optimized way, the gas contained in a plurality of tanks and which complies with R110 requirements.

[0011] An aim of the present invention is to satisfy the above mentioned needs.

SUMMARY OF THE INVENTION

[0012] The aforementioned aim is reached by a gas

distribution circuit as claimed in the appended set of claims.

BRIEF DESCRIPTION OF DRAWINGS

[0013] 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 gas distribution circuit for a gas engine according to a first embodiment of the present invention;
- Figure 2 is a gas distribution circuit for a gas engine according to a second embodiment of the present invention; and
- Figure 3 is a gas distribution circuit for a gas engine according to a third embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Figure 1 discloses a gas distribution circuit 1 for feeding a gas engine 2 of a work vehicle, e.g. a tractor (not shown), according to a first embodiment of the invention.

[0015] Gas distribution circuit 1 comprises a main tank module 3 for storing gas in compressed/liquid phase; in the disclosed embodiment circuit 1 comprises two main tanks 3a, 3b fluidly connectable to engine 2 as disclosed in the following.

[0016] According to the described embodiment, first and second main tanks 3a, 3b are fluidly connected together by respective conduits 4a, 4b which joins into a common conduit 5 which is then fluidly connectable to engine 2.

[0017] In greater particular, circuit 1 comprises, on each main tank 3a, 3b on the respective conduits 4a, 4b a valve 6a, 6b configured to allows passage of gas between main tanks 3a, 3b and conduit 5 or only in the direction directed to tanks 3a, 3b. Preferably, such valves 6a, 6b are two ways - two position valves and, preferably, electro-mechanically actuated valves, according to R110 EU requirements.

[0018] Circuit 1 further comprises a check valve 7 fluidly interposed on conduit 5 between conduits 4a, 4b and engine 2 and configured to allow the passage of gas only from tanks 3a, 3b to engine 2.

[0019] Conduit 5 is furthermore fluidly connected via a filling conduit 8 to a filling port 9 configured to allow filling of main tank module 3. Filling port 9 may be of any known typology and therefore it is not described for sake of brevity. Circuit 1 further comprises a check valve 11 fluidly interposed on filling conduit 8 and configured to allow the passage of gas only from filling port 9 towards main tank module 3.

[0020] Gas distribution circuit 1 is configured to allow the coupling of an auxiliary tank module 12 for storing gas in compressed/liquid phase; in the disclosed embodiment circuit 1 comprises two auxiliary tanks 12a, 12b fluidly connectable to engine 2 as disclosed in the following.

[0021] According to the described embodiment, first and second auxiliary tanks 12a, 12b are fluidly connected together by respective conduits 13a, 13b which joins into a common conduit 14 which is then fluidly connectable to engine 2.

[0022] In greater particular, circuit 1 comprises, on each auxiliary tank 12a, 12b on the respective conduits 13a, 13b a valve 15a, 15b configured to allow passage of gas between auxiliary tanks 12a, 12b and conduit 14 or only in the direction directed to tanks 12a, 12b. Preferably such valves 15a, 15b are two ways - two position valves and, preferably, electro-mechanically actuated valves according to R110 EU requirements.

[0023] Circuit 1 comprises a conduit 16 fluidly connecting engine 2 and provided with a coupling interface 17 configured to selectively fluidly connect conduit 14 with conduit 16. In particular, coupling interface 17 may be of any typology, e.g. comprising a quick coupler and a flexible hose, and herein not described for sake of brevity.

[0024] Conduit 16 is furthermore fluidly connected to filling port 9 via a conduit 18 joint to conduit 16 downstream with respect to coupling interface 17. In particular, circuit 1 comprises a check valve 19 fluidly interposed on conduit 18 and configured to allow the passage of gas only from filling port 9 towards auxiliary tank module 12.

[0025] Advantageously, circuit 1 comprises a check valve 21 fluidly interposed on conduit 16 upstream with respect to engine 2 and downstream with respect to junction of conduit 18 with conduit 16. Check valve 21 is configured to allow the passage of gas only from auxiliary tanks 12a, 12b towards engine 2.

[0026] Advantageously, circuit 1 comprises a valve 22 configured to allow or deny the passage of gas from main tank module 3 towards engine 2 according to the pressure of gas coming from auxiliary tank module in conduit 16.

[0027] According to the described embodiment, valve 22 is a two ways - two positions pressure actuated valve configured to assume a first position into which it allows gas communication between engine 2 and conduit 5 or a second position into which denies gas communication between these latter elements.

[0028] In greater detail, valve 22 is balanced by an elastic element 23 determining a preset threshold under which valve 22 is maintained into the above mentioned first position. Preferably such threshold may be varied and set according to user's settings. More preferably such threshold may be set as 40 bar.

[0029] The force applied by elastic element 23 is balanced by a pilot signal 24 taken from conduit 16, i.e. representing the pressure of gas into auxiliary tanks 12a, 12b. Accordingly, if pressure into these latter is lower,

valve 22 allows fluidic communication from main tanks 3a, 3b, otherwise fluidic communication from main tanks 3a, 3b is denied and engine 2 is feed by auxiliary tanks 12a, 12b.

[0030] Circuit 1 may further comprise a pressure sensor 25 configured to detect pressure on conduit 16 and connected to an indicator 26 suitable for indicating the fuel level on auxiliary tank module 12. Advantageously, indicator 26 is an electrical indicator and is electrically connected to pressure sensor 25.

[0031] Circuit 1 may further comprise an electronic control unit 27 configured to monitor and control electrical elements of circuit 1. According to the described embodiment, control unit 27 is electrically connected to indicator 26 and to valves 6a, 6b and 15a 15b respectively to monitor acquired pressure data or to allow their position switch.

[0032] The operation of the above disclosed embodiment is the following.

[0033] In a first working mode, i.e. gas distribution to engine mode, supposing that auxiliary tank module 12 is attached to conduit 16, gas flows into conduit 16 through check valve 21 and then to engine 2. Check valve 19 deny the passage of gas to filling port 9. The pressure of gas inside conduit 16 is measured by sensor 25, displayed by indicator 26 and acquired by control unit 27. From conduit 16 pressure pilot signal 24 acts against force of elastic element 23 therefore maintaining valve 22 in its second position, i.e. denying flow passage from conduit 5 to engine 2.

[0034] The above configuration is maintained till pressure in conduit 16 is above the pressure threshold given by force of elastic element 23. Once passed below such threshold, valve 22 switch position thereby allowing passage of gas from conduit 5 to engine 2. In parallel, gas in conduit 5 do not pass in conduit 16 because of check valve 21. The same situation occurs in case no auxiliary tank module 12 is present. Indeed, no pressure pilot signal 24 would be present and accordingly elastic element 23 will maintain valve 22 in its first position, i.e. allowing feeding of engine 2 by main tank module 3.

[0035] In a second working mode, i.e. filling tank mode, gas will pass in conduits 8 and 18 towards main and auxiliary tank modules 3, 12 through the respective check valves 11 and 19 so as to allow their filling.

[0036] Figure 2 discloses a gas distribution circuit 1 according to a second embodiment of the invention.

[0037] Circuit of figure 2 comprises essentially the same elements of the circuit 1 as disclosed in the first embodiment, except for the fact that the system further comprises at least an emergency switch 28 configured to shutoff valves 6a, 6b, 15a, 15b of main and auxiliary tank modules 3, 12 so that no fluidic communication is possible to/from engine 2.

[0038] The operation of the above mentioned embodiment is the same of the first embodiment, except for the fact that, if a fault occurs in engine 2 or in other vehicle elements or in circuit 1, valves 6a, 6b, 15a, 15b are shut-

tled off. Control unit 27 may take care of emergency switch activation, in known way.

[0039] Figure 3 discloses a gas distribution circuit 1 according to a third embodiment of the invention. Such embodiment is directed to implement the embodiment as described in figure 1 in case of more different auxiliary tank modules 12.

[0040] In the describe alternative embodiment, gas distribution circuit 1 is configured to allow the coupling of two auxiliary tank modules 12', 12'' for storing gas in compressed/liquid phase; similarly to the first and second embodiments, modules 12', 12'' comprises each two tanks 12a', 12a'', 12b', 12b'' fluidly connected together by respective conduits 13a', 13a'', 13b', 13b'' respectively joining into common conduits 14', 14'' which are each separately then fluidly connectable to engine 2.

[0041] Always similarly to what described to the other embodiments, circuit 1 comprises, on auxiliary tanks 12a', 12a'', 12b', 12b'' a valve 15a', 15a'', 15b', 15b'' on the respective conduits and configured to allows passage of gas in between auxiliary tanks 12a', 12a'', 12b', 12b'' or only in the direction directed to these latter. Preferably such valves are realized as described for the other embodiments.

[0042] Circuit 1 comprises, for each auxiliary tank module 12 respective conduits 16', 16'' fluidly connecting engine 2 and each provided with a coupling interface 17', 17'' configured to selectively fluidly connect conduits 14', 14'' with conduits 16', 16''. As said for the other embodiments, coupling interface 17 may be of any typology.

[0043] Each conduit 16', 16'' is furthermore fluidly connected to a filling port 9 via a respective conduit 18', 18'' joint to the respective conduit 16', 16'' downstream with respect to coupling interface 17', 17''. In particular, circuit 1 comprises a check valve 19', 19'' respectively fluidly interposed on each conduit 18', 18'' and configured to allow the passage of gas only from filling port 9 towards auxiliary tank modules 12', 12''.

[0044] Advantageously, circuit 1 comprises a check valve 21', 21'' fluidly interposed on each conduit 16', 16'' upstream with respect to engine 2 and downstream with respect to junction of conduits 18', 18'' with the respective conduit 16', 16''. Check valve 21 is configured to allow the passage of gas only from auxiliary modules 12', 12'' towards engine 2.

[0045] Advantageously, circuit 1 comprises a valve 22', 22'' configured to allow or deny the passage of gas from main tank module 3 towards engine 2 according to the pressure of gas coming from auxiliary tank modules 12', 12'' in conduits 16', 16''.

[0046] Similarly to the other described embodiments, valves 22', 22'' are a two ways- two positions pressure-actuated valve configured to assume a first position into which they allow gas communication between engine 2 and conduit 5 or a second position into which they deny gas communication between these latter elements. Similarly, valves 22', 22'' are each balanced by an elastic element 23', 23'' determining preset thresholds under

which valves 22', 22'' are maintained into the above mentioned first positions. Preferably such thresholds may be varied and set according to user's settings.

[0047] In particular, valves 22', 22'' are fluidly connected in series so that the valve 22' related to first auxiliary tank module 12' is upstream with respect to valve 22'' related to second auxiliary tank module 12''.

[0048] More preferably such thresholds may differ with respect to the other, so that it is possible to allow first the fluid communication of second auxiliary tank module 12'', then the fluid communication of first auxiliary tank module 12' and, then, fluid communication of main auxiliary tank module 3 towards engine 2.

[0049] The force applied by elastic element 23', 23'' is balanced by a respective pilot signal 24', 24'' taken from the related conduit 16', 16'', i.e. representing the pressure of gas into auxiliary tank modules 12', 12''. Accordingly, if pressure conduit 16'' is higher than the set threshold of valve 22'', valve 22'' allows fluidic communication between second auxiliary tank module 12'' and engine 2, otherwise it is denied such communication and it is allowed fluidic communication between first auxiliary tank module 12' and engine 2 till pressure 24' is higher than the set threshold of valve 22'; otherwise, such communication is denied and the it is allowed fluidic communication between main tank module 3 and engine 2.

[0050] According to the above disclosed structure, circuit 1 may further comprise pressure sensors 25', 25'' configured to detect pressure on conduit 16', 16'' and an electronic control unit 27 configured to monitor and control electrical elements of circuit 1, i.e. indicator 26 and all valves of modules 3, 12' and 12'' respectively to monitor acquired pressure data or to allow their position switch.

[0051] The operation of the above disclosed embodiment is the following.

[0052] In a first working mode, i.e. gas distribution to engine mode, supposing that auxiliary tank modules 12', 12'' are attached to conduit 16', 16'', then gas flows into conduit 16'' from second auxiliary tank 12'' through check valve 21'' and then to engine 2. Check valve 19'' deny the passage of gas to filling port 9. The pressure of gas inside conduit 16 is measured by sensor 25'', displayed by indicator 26 and acquired by control unit 27. From conduit 16'' pressure pilot signal 24'' acts against force of elastic element 23'' therefore maintaining valve 22'' in its second position, i.e. denying flow passage from conduit 16' to engine 2.

[0053] The above configuration is maintained till pressure in conduit 16'' is above the pressure threshold given by force of elastic element 23''. Once passed below such threshold, valve 22'' switches position thereby allowing passage of gas from conduit 16', i.e. to first auxiliary tank module 12' to engine 2. In parallel, gas in conduit 16' does not pass in conduit 16'' because of check valve 21''. The same situation occurs in case no second auxiliary tank module 12'' is present. Indeed, no pressure pilot signal 24'' would be present and accordingly elastic ele-

ment 23" will maintain valve 22" in its first position, i.e. allowing feeding of engine 2 by first auxiliary module 12'.

[0054] Then, the operation is the same as described in the first embodiment, into which gas from first auxiliary tank module 12' flows to engine 2 till pressure on conduit 16' is higher than the pressure threshold of valve 22', otherwise gas will flow from main tank module 3, as already described and not repeated for sake of brevity.

[0055] In a second working mode, i.e. filling tank mode, gas will pass in conduits 8, 18' and 18" towards main and first and second auxiliary tank modules 3, 12', 12" through the respective check valves 11, 19', 19" so as to allow their filling.

[0056] In view of the foregoing, the advantages of a gas distribution circuit 1 according to the invention are apparent.

[0057] First, it is possible to automatically control the feeding of gas to engine 2 selecting first the auxiliary tank module 12 and, then, main tank module 3 without incurring in an electrical control.

[0058] Valve means 2 are simple, economic and versatile since the preset threshold may be varied according to user's setting.

[0059] Furthermore, the proposed gas distribution circuit 1 is scalable, i.e. may be used without major modification with more than one auxiliary tank module 12. In such case, moreover, it is possible to set different pressure thresholds so as to discharge a single auxiliary tank module 12', 12" one by one.

[0060] It is furthermore possible to use the same filling port 9 to refill both main and auxiliary tank modules 3, 12 in a quick way.

[0061] Further the presence of emergency switches 28 and indicator 26 allows respectively to lock the system in case of a fault, to monitor the value of the gas level in auxiliary tank module 12. The parallel use of a control unit 27 allows to monitor and control the aforementioned elements.

[0062] It is clear that modifications can be made to the described gas distribution circuit 1 which do not extend beyond the scope of protection defined by the claims.

[0063] For example, both main and auxiliary tank modules 3, 12 can comprise different number of tanks 3a, 3b, 12a, 12b and number and typology of valves 6a, 6b, 15a, 15b.

[0064] Valve means 22 may be substituted by equivalent valves with respect to the described one having the same functionality. Similar consideration may be applied to sensor means 25, indicator 26 and emergency switches 28.

[0065] It is clear that number of auxiliary tank modules 12', 12" may be varied and that pressure threshold may be set so as to obtain a parallel or an alternative feeding from such modules.

Claims

1. Gas distribution circuit (1) for feeding a gas engine (2) of a work vehicle, said gas distribution circuit (1) comprising a main tank module (3) and being configured to be in fluid communication with at least one auxiliary tank module (12), said main tank module (3) being fluidly connected to said engine via a first conduit (5) and said at least one auxiliary tank module (12) being connectable to said engine via a second conduit (16), said gas distribution circuit (1) comprising valve means (22) fluidly interposed on said first conduit (5) and configured to allow or deny gas communication between said main tank module (3) and said engine (2), said valve means (22) allowing such fluid communication if pressure in said second conduit (16) is higher than a preset threshold, otherwise, fluid communication is allowed only between said at least one auxiliary tank module (12) and said engine (2).
2. Gas distribution circuit according to claim 1, wherein said valve means (22) comprises a two ways - two positions pressure actuated valve.
3. Gas distribution circuit according to claim 1 or 2, wherein said preset threshold is variable.
4. Gas distribution circuit according to any of the preceding claims, wherein said valve means (22) are configured to allow or deny said fluid communication according to a balance between a first pressure force given by elastic means (23) acting on said valve means (22) and a second pressure force given by a pressure pilot signal (24) taken from said second conduit (16).
5. Gas distribution circuit according to any of the preceding claims, further comprising a check valve (21) fluidly interposed on said second conduit (16) configured to allow passage of gas only from said auxiliary tank unit (12) to said engine (2).
6. Gas distribution circuit according to any of the preceding claims, further comprising a check valve (7) fluidly interposed on said first conduit (5) configured to allow passage of gas only from said main tank unit (3) to said engine (2).
7. Gas distribution circuit according to any of the preceding claims, comprising a first auxiliary tank module (12') and at least a second auxiliary tank module (12"), said first and second auxiliary tank module (12', 12") being connectable to said engine (2) via respective second conduits (16', 16"), said circuit (1) comprises respectively valve means (22', 22") on said first conduit (5), said valve means (22', 22") allowing said fluid communication if pressure in said

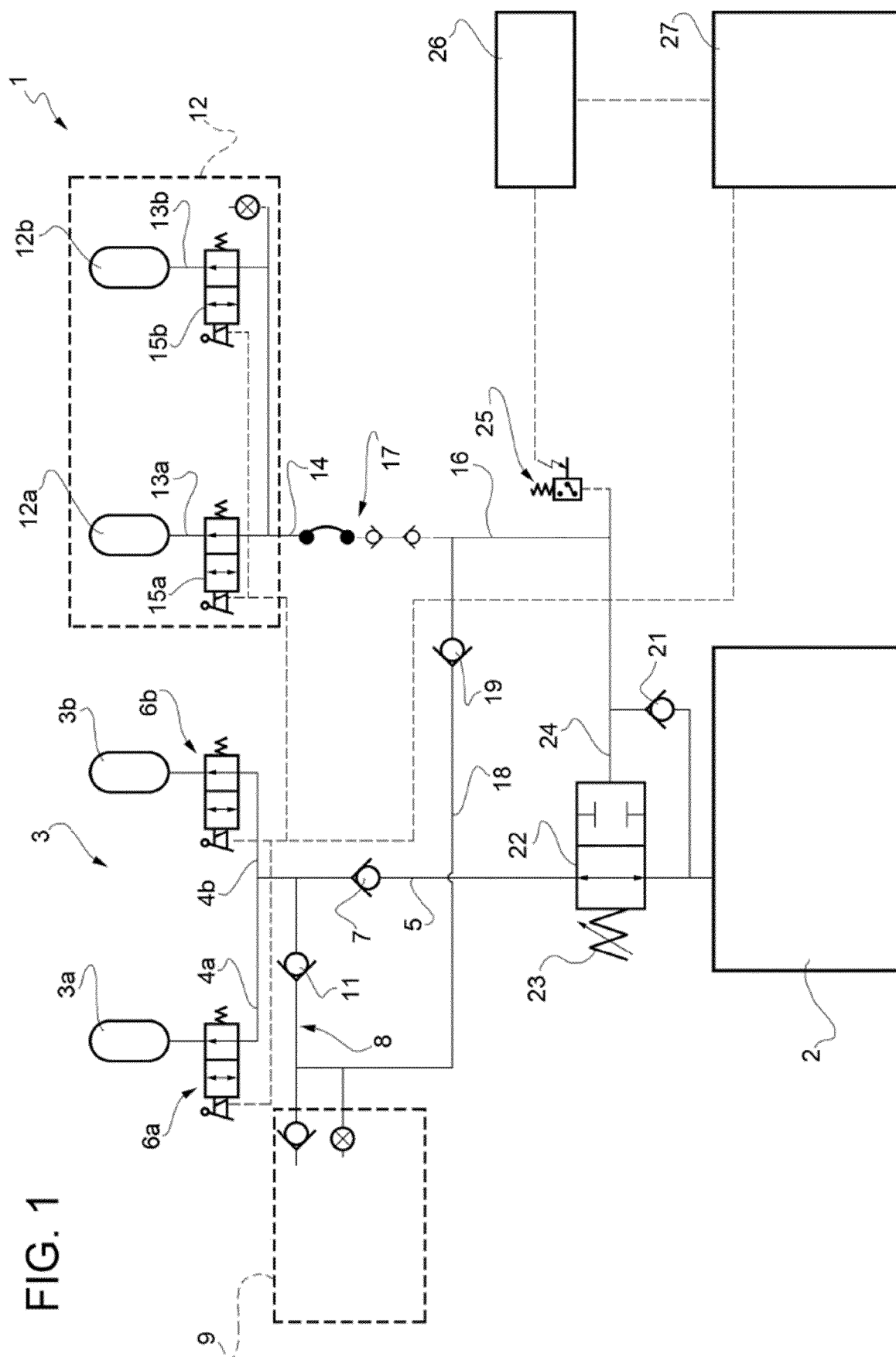
second conduits (16', 16'') is higher than respective preset thresholds.

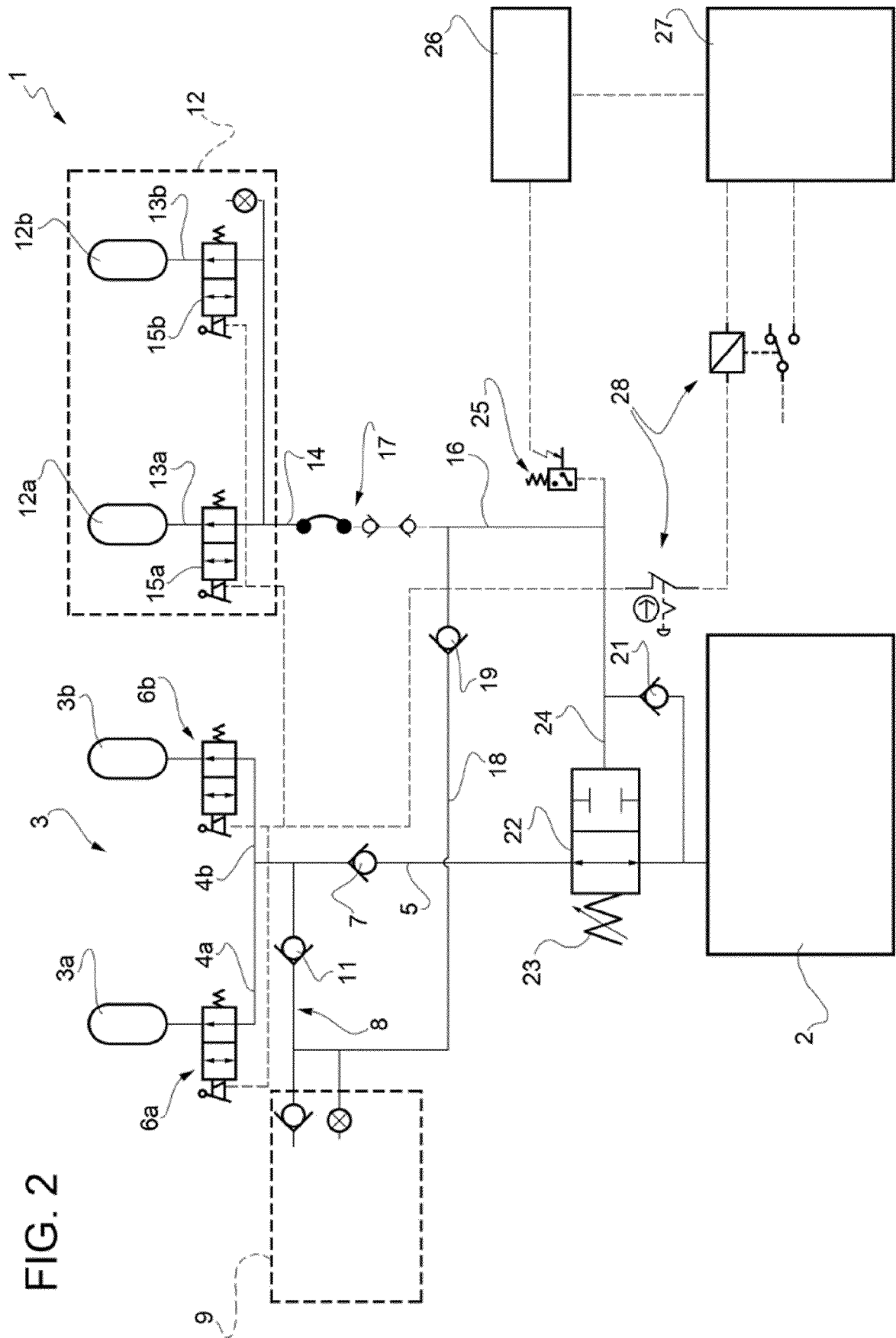
8. Gas distribution circuit according to claim 7, wherein the preset thresholds of said valve means (22', 22'') are different. 5
9. Gas distribution circuit according to claim 7 or 8, wherein the preset threshold of the second auxiliary tank module (12'') is higher than the preset threshold of the first auxiliary tank module (12'). 10
10. Gas distribution circuit according to any of the preceding claims, further comprising a filling port (9) fluidly connected to said first and second conduits (5, 16) via respective conduit (8, 18) provided with check valves (11, 19), each configured to allow the passage of gas only from said filling port (9) towards said conduits (5, 16). 15
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11. Gas distribution circuit according to any of the preceding claims, further comprising at least one coupling interface (17, 17', 17'') configured to fluidly connect second conduit (16, 16', 16'') to said at least one auxiliary tank module (12, 12', 12''). 25
12. Gas distribution circuit according to any of the preceding claims, wherein said main tank module (3) and said at least one auxiliary tank module (12, 12'', 12'') each comprises a plurality of tanks (3a, 3b, 12a, 12b, 12a', 12b', 12a'', 12b'') fluidly connected together. 30
13. Gas distribution circuit according to any of the preceding claims, wherein said main and said at least one auxiliary tank module (3, 12, 12'', 12'') each comprises valve means (6a, 6b, 15a, 15b, 15a', 15b', 15a'', 15b'') configured to either allow fluidic communication between at least one tank (3a, 3b, 12a, 12b, 12a', 12b', 12a'', 12b'') and the respective first and second conduits (5, 16, 16', 16'') or allow fluidic communication only towards said at least one tank (3a, 3b, 12a, 12b, 12a', 12b', 12a'', 12b''). 35
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14. Gas distribution circuit according to claim 13, wherein said valve means (6a, 6b, 15a, 15b, 15a', 15b', 15a'', 15b'') are electro-mechanical actuated valves. 45
15. Gas distribution circuit according any of the preceding claims, comprising emergency switch means (28) configured to lock the communication from said main and auxiliary tanks (3, 12) towards said engine (2). 50
16. Gas distribution circuit according any of the preceding claims, comprising sensor means (25, 25', 25'') configured to detect a pressure value in said second conduit (16, 16', 16'') and an indicator (26) configured 55

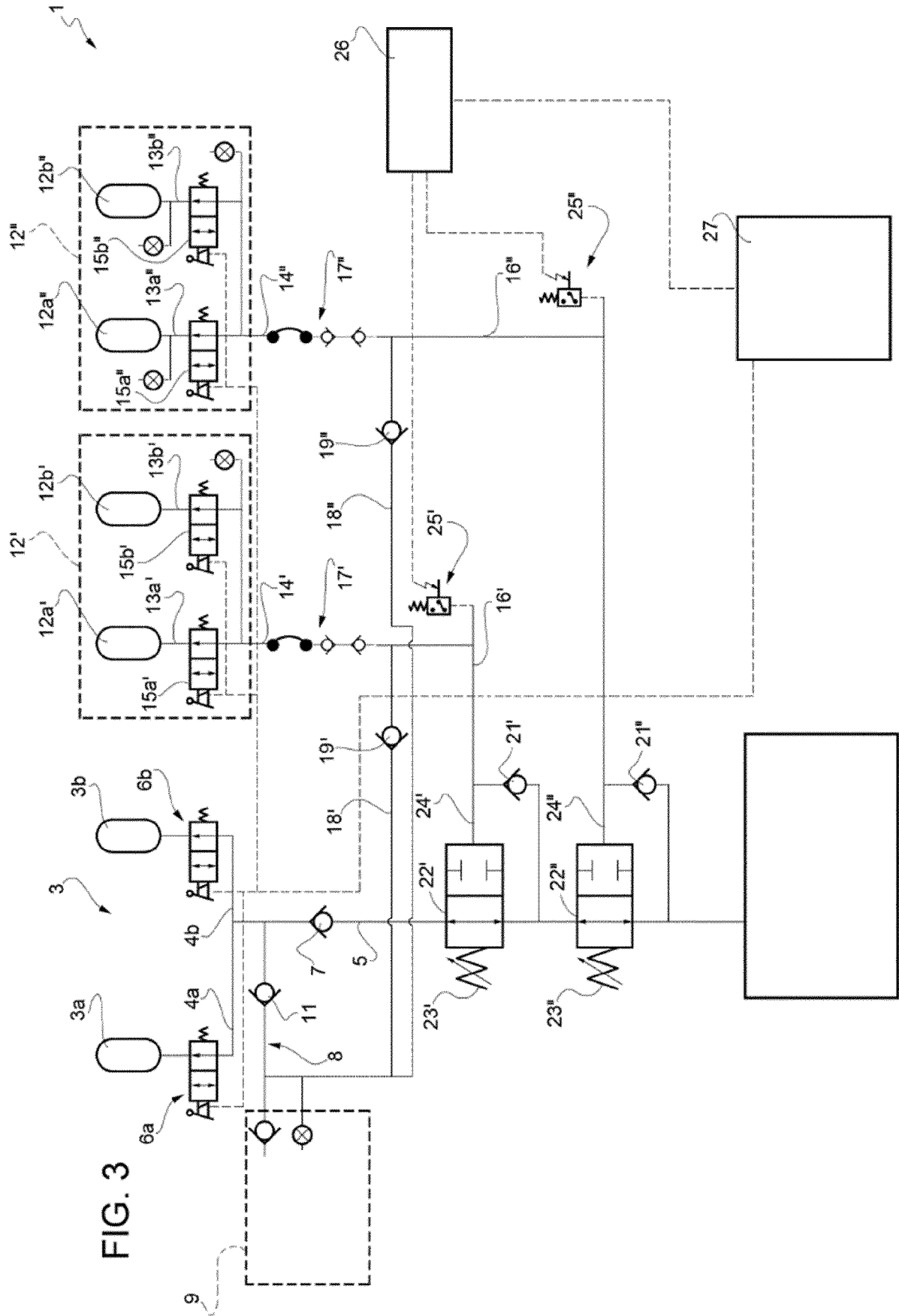
to display such pressure value.

17. Gas distribution circuit according any claims 13 to 16, further comprising an electronic control unit (27) electrically connected to the electrical components of said circuits and configured to monitor and/or to control their operation.

FIG. 1









EUROPEAN SEARCH REPORT

 Application Number
 EP 20 17 5881

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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)
X A	US 2006/118175 A1 (MATHISON STEVEN R [US] ET AL) 8 June 2006 (2006-06-08) * figures 2,3,4 *	1-3,5-7, 10-14 4,8,9,15	INV. F17C7/00
X A	US 8 539 972 B2 (XU HUANEN [CN]; BEIJING BOLKEN EQUIPMENT CORP [CN]) 24 September 2013 (2013-09-24) * column 9; figures 1,6 *	1-7, 10-17 8,9	
X	US 2009/283351 A1 (CANNET GILLES [FR] ET AL) 19 November 2009 (2009-11-19) * paragraphs [0017] - [0019], [0023]; figures 1,2 *	1-14,16, 17	
X	US 5 014 733 A (WILSON EARL L [US]) 14 May 1991 (1991-05-14) * figure 1 *	1-6,11, 12	
			TECHNICAL FIELDS SEARCHED (IPC)
			F17C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 22 September 2020	Examiner Papagiannis, Michail
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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 EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 17 5881

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006118175 A1	08-06-2006	NONE	
US 8539972 B2	24-09-2013	CN 101086322 A US 2010193045 A1 WO 2009006852 A1	12-12-2007 05-08-2010 15-01-2009
US 2009283351 A1	19-11-2009	AT 447137 T AU 2005276314 A1 BR PI0514231 A CA 2576450 A1 CN 101006303 A EP 1779026 A1 ES 2335223 T3 FR 2874247 A1 JP 2008509368 A KR 20070049660 A US 2009283351 A1 WO 2006021699 A1 ZA 200701111 B	15-11-2009 02-03-2006 03-06-2008 02-03-2006 25-07-2007 02-05-2007 23-03-2010 17-02-2006 27-03-2008 11-05-2007 19-11-2009 02-03-2006 30-07-2008
US 5014733 A	14-05-1991	NONE	