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(54) A method and a system for refuelling of gas driven vehicles and a vehicle gas container

(57) A method and a system for refuelling of gas driven vehicles, particularly buses and lorries, from a gas fuelling station is done in short time by supplying the vehicle gas container (40) from two opposite directions simultaneously. The vehicle gas container comprises two openings (44, 45) situated at opposite ends, each opening equipped with a refuelling valve. Only one of the openings (44) is equipped with a feeding valve for supplying driving gas to the vehicle engine (E) when driving. Favourably the vehicle gas container (40) is divided in at least two separate sections (40A, 40B) used one at a time for driving of the vehicle and refuelled automatically step by step by starting with the section (40A) having the lowest pressure.

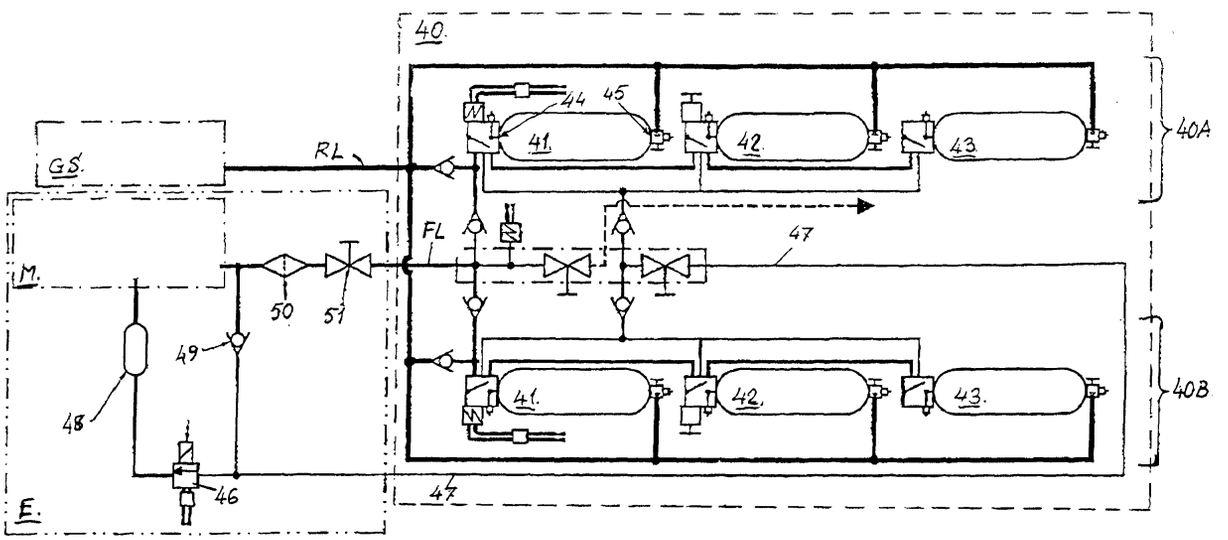

Fig. 3

EP 1 559 949 A1

Description

Technical Field

[0001] The present invention relates to a method for refuelling of gas driven vehicles, particularly buses and lorries, from a gas fuelling station having a compressor plant and/or a gas store able to supply gas at a high pressure to a vehicle gas container having two openings. Furthermore the present invention also relates to a system for carrying out the method and to a vehicle gas container being part of the system.

Prior Art

[0002] When dealing with refuelling of gas driven vehicles, in particalar gas driven buses and lorries, there exists a problem as the gas used is compressible, i.e. the gas volume is large at a low pressure and small at a higher pressure. This involves some time problems as the refuelling time requested by the "market" ought to be the same as the time used when refuelling of liquid fuels like petrol, diesel, propane etc. Thus, there exists a demand on a refuelling tim of less than five minutes.

[0003] Up to now the refuelling process has been a "one way" affair, i.e. the vehicle gas container is refuelled through the container valve also being used as a feeding valve for driving of the vehicle motor. The gas fuel container of the vehicle is normally of a so called composite construction, i.e. the container has an inside tube which as such does not stand the requested pressure but is embedded in an outside fibre clad comprising an epoxy resine. Such a composite container has two openings, one at each end of the container. Smaller containers, having a length of up to say 1,5 meter, has got one of the openings plugged. If the container length is more than 1,5 meter the authorities stipulate that each one of the openings is equipped with a thermal release mechanism discharging the gas in case of fire. If such a release mechanism was missing there will be a great risk for having a fast pressure rise inside the container which in such a case results in an explosion.

[0004] Containers of composite type are rather expensive compared to steel containers but they hav quite other safety qualities motivating their usage.

[0005] As the refuelling time are essential there are situations where it is necessary to make use of containers of a certain size. However, making the container still larger does not solve the time problem due to the fact that refuelling has been made through the container valve at the one end of the container. The container valve normally has a restricted opening which is not able to feed through more gas per time unit. Therefore, solutions has been to arrange several smaller containers which will be more expensive rather a smaller number of larger containers. The costs for a small container being proportional more expensive than a larger container.

Summary of the Invention

[0006] The intention with the present invention is to speed up the refuelling of gas driven vehicles and to solve the problems mentioned above. Thus, in addition to having a refuel time of the same order as the one for refuelling with liquid fuels it has also to be possible to make use of larger gas fuel containers in the gas driven vehicles without endangering the safety. By using larger gas containers only a small number of containers is needed per vehicle which reduces the installation costs.

[0007] The object of the present invention has been solved by a method and a system for refuelling of gas driven vehicles where the two openings of the vehicle gas container is used in such a way that the refuelling of gas is made simultaneously in opposite directions to the container. A suitable vehicle gas container according to the invention is equipped in such a way that it is possible to refuel it from two opposite directions simultaneously.

[0008] At a preferred embodiment of the invention the refuelling of the container is made step by step as the container is divided in separate sections used one at a time for driving of the vehicle. Each section of the vehicle gas container of the preferred embodiment is equipped with two openings having refuelling valves, but only one of these two openings is equipped with a feeding valve for gas supply of the vehicle engine.

[0009] Still other embodiments of the present invention are set out in the dependent claims.

Brief Description of the Drawings

[0010] The invention will be described below with reference to the accompanying drawings, in which

Fig. 1 shows a schematical diagram of the system for refuelling of a gas driven vehicle according to the invention,

Fig. 2 shows a schematical view of the gas store for supplying of refuelling gas to the gas driven vehicle according to the invention, and

Fig. 3 shows a schematical view of the vehicle gas container and the refuel line thereof and the feeding line for the vehicle engine.

Detailed Description of a Preferred Embodiment

[0011] The principles of a method for refuelling of a natural gas driven vehicle (NGV) E is shown in Fig. 1. Such a method may make use of a compressor plant CP, a gas store GS or the like.

[0012] In Fig. 1 a schematical view is shown of the compressor plant CP being of a traditional type including a CNG compressor 10, a safety valve 11, a pressure gauge 12 for the compressor pressure, a condenser and

dryer 13, a filter 15, and a pressure maintaining valve 14.

[0013] Fig. 2 shows a type of gas store GS for natural gas which can be charged from a gas source or a compressor plant CP. Conveniantly the gas store GS is divided in att least two sections (in the present embodiment in three sections 20, 21, 22) or banks. Each section 20 - 22 may in turn include two or more cylinders A, B. The gas supply to and from each one of the sections 20 - 22 is controlled by a cylinder valve 23 the input of which is connected to a filling line FL from the gas source or compressor plant. The cylinder valve 23 input is also used as an output connected to a refuelling line RL connectable to the gas driven vehicle E (Fig. 1) through a break away valve 24 and a filling pipe nozzle 25 connected to the break away valve 24 by a hose 28. For separation of the filling line FL from the refuelling line RL solenoid and check valves 26 are introduced in the filling line FL.

[0014] The cylinder valves 23 as well as the break away valves 24 are in connection with an evacuation line 27 taking care of overpressure situations with respect to the safety case.

[0015] The gas store GS is favourably constructed for so called cascade refuelling.Thus, said at least two sections or banks 20 - 22 of the gas store GS are working with different pressures. Then the first section 20 - having the lower pressure - is used for bottom refuelling of the gas driven vehicle container. The second section 21 - having higher pressure - and eventual further sections 22 - having still higher pressures - are used in steps for refuelling the gas driven vehicle container step by step with higher fuel pressure after closing off the the section (s) 20 (21) with lower pressure. This way of refuelling means that more vehicles can be refuelled before the pressure of the gas store GS has dropped to a level below a predetermined lowest pressure value. The cascade refuelling is controlled by the check valves 26 being of solenoid valve type having manual bypass and being introduced in the refuelling line RL.

[0016] Now returning to Fig. 1 it can be seen that the refuelling line RL comprises a temperature compensation arrangement 30. The temperature compensation arrangement 30 includes two control branches 31, 32, one 32 of which comprises a temperature compensated pressure regulator 33 acted on by a reference pressure tank 34 for the temperature compensated refuelling pressure. The other branch 31 comprises a temperature compensated safety valve 35 acted on by a reference pressure tank 36 having a pressure value of P+10%.

[0017] Normal refuelling gas pressure in the refuelling line RL at the refuelling desk/dispenser 37 is P = 200 bar at 15 °C. By using the temperature compensation arrangement 30 the ambient temperature is taken into consideration, so that the refuelling gas pressure varies with the ambient temperature.

[0018] Fig. 3 shows a preferred of the vehicle gas container 40 of the present invention. To obtain the best possible refuelling time, i.e. about the same time with regard to refuelling of liquid fuels, such as petrol, diesel, propane, etc., the vehicle gas container 40 is divided in two sections 40A, 40B each one including three separate gas cylinders 41, 42, 43. Each gas cylinder 41, 42, 43 is made in form of a composite container having two openings 44, 45 situated att opposite ends of the gas cylinder 41, 42, 43. Both the openings 44, 45 are equipped with a refuelling valve, but only one 44 of the openings is equipped with a feeding valve for supplying gas to the gas driven vehicle engine E through the feeding line FL. Thus, each gas cylinder 41, 42, 43 is refuelled simultaneously in two directions opposite each other through the refuelling line RL from the gas store GS described above with reference to Figs. 1 and 2.

[0019] The gas supplying device including a feeding valve of the type similar to the one connected to the gas cylinder opening 44 may be of the type described in the prior patent applications EP-A-01 202 724.9 and EP-A-03 445 127.8 filed by the present applicant. These applications also describe the system of gas supply to the gas driven motor M within the engine compartment E involving a solenoid valve 46 controlling a low pressure pilot line 47, a dumping cylinder 48, a check valve 49, a filter 50, and a manually operated stop valve 51.

[0020] When driving the vehicle it is suitable to make use of the gas from one section of gas cylinders 41, 42, 43 at a time. Thus, before connecting another section to the feed line FL the previous connected section ought to be almost emptied. Such a stepped feeding method may be controlled by pressure sensors.

[0021] The stepped feeding method is favourable later on when the vehicle arrives at the refuelling station. By having a gas store GS constructed for so called cascade refuelling, as described above, the contribution of the gas store high pressure sections is less and it will be possible to use the gas store GS for consecutive or simultaneous refuelling of a greater number of vehicles, i.e. a smaller gas store GS can be used for the very same number of vehicles without impairing the refuelling time.

[0022] Though having described a preferred embodiment of the present invention it should be evident for a man skilled in the art that there are many ways to develop and improve the system described without departing from the inventive idea. For instance the number of sections and/or cylinders of the gas store GS and the vehicle gas container 40 mentioned above may be more than the given number.

[0023] Accordingly the particularly disclosed scope of the invention is set forth in the following claims.

List of Reference Characters

[0024]

A,B	Cylinders
CP	Compressor plant
E	Vehicle engine

FL	Filling line
GS	Gas store
M	Motor
RL	Refuelling line
10	CNG compressor
11	Safety valve
12	Manometer
13	Condenser and dryer
14	Pressure maintaining valve
15	Filter
20,21,22	Sections
23	Cylinder valve
24	Break away valve
25	Filling pipe nozzle
26	Solenoid and check valve
27	Evacuation line
28	Hose
30	Temperature compensation arrangement
31,32	Control branch
33	Temperature compensated pressure valve
34	Reference pressure tank
35	Temperature compensated safety valve
36	Reference pressure tank
37	Refuelling desk/dispenser
40	Vehicle gas container
40A,40B	Gas section
41,42,43	Gas cylinder
44,45	Opening
46	Solenoid valve
47	Pilot line
48	Dumping cylinder
49	Check valve
50	Filter
51	Manually operated stop valve

Claims

1. A method for refuelling of gas driven vehicles, particularly buses and lorries, from a gas fuelling station having a compressor plant (CP) and/or a gas store (GS) able to supply gas at a high pressure to a vehicle gas container (40) having two openings (44, 45), **characterized in that** gas from said fuelling station is supplied to the vehicle gas container (40) in such a way that the refuelling of the gas is made simultaneously in opposite directions through said openings (44, 45) to the container (40).

2. A method according to claim 1, **characterized in that** said refuelling is made through said two openings (44, 45) arranged at opposite ends of the vehicle gas container (40).

3. A method according to claim 2, **characterized in that** said refuelling is made automatically step by step of said vehicle gas container (40) being divided in separate sections (40A, 40B) used one at a time for driving of the vehicle.

4. A method according to claim 3, **characterized in that** said refuelling of the separate container sections (40A, 40B) is made in such a way that the section (40A) having lowest gas pressure is automatically refuelled in first hand to be followed by refuelling of the rest of the container sections (40B) in pressure order.

5. A method according to any of the preceding claims, **characterized in that** said refuelling is made under consideration of temperature compensation controlled by a pressure and/or safety valve arrangement (30).

6. A system for refuelling of gas driven vehicles, particularly buses and lorries, from a gas fuelling station having a compressor plant (CP) and/or a gas store (GS), said vehicles including a gas container (40) comprising two openings (44, 45), **characterized in that** both said openings (44, 45) of the vehicle gas container (40) are used simultaneously for refuelling of the gas in opposite directions to the container (40).

7. A system according to claim 6, **characterized in that** said two openings (44, 45) of the vehicle gas container (40) are situated at opposite ends of the vehicle gas container (40).

8. A system according to claim 7, **characterized in that** said two openings (44, 45) of the vehicle gas container (40) are equipped with refuelling valves, but only one (44) of said openings is equipped with a feeding valve used for supplying gas to the vehicle engine (E).

9. A system according to any of the claims 6 - 8, **characterized in that** said fuelling station gas store (GS) being divided in at least two sections (20, 21, 22), one (20) of which used for bottom filling at a low pressure, and the other section(s) (21, 22) being used in steps for filling at higher pressures after closing the section(s) (20) with lower pressure.

10. A system according to any of the claims 6 - 9, **characterized in that** the vehicle gas container (40) being divided in at least two separate sections (40A, 40B) used one at a time for driving of the vehicle engine (E), and refuelled automatically step by step by starting with the one (40A) having the lowest pressure.

11. A system according to any of the claims 6 - 10, **characterized by** temperature compensating arrangement (30) involved in the refuelling line (RL) from said fuelling station up-stream the the filling pipe

nozzle (25).

12. A system according to claim 11, **characterized in that** included in said temperature compensating arrangement (30) are a temperature compensated pressure regulator (33) and a temperature compensated safety valve (35).

13. A vehicle gas container (40) of gas driven vehicles, particularly buses and lorries, to be refuelled from a gas fuelling station having a compressor plant (CP) and/or a gas store (GS), said vehicle gas container (40) comprising two openings (44, 45), **characterized in that** both said openings (44, 45) of the vehicle gas container (40) are used simultaneously for refuelling of the gas in opposite directions to the container (40).

14. A vehicle gas container according to claim 13, **characterized in that** said two openings (44, 45) of the vehicle gas container (40) are equipped with refuelling valves, but only one of said openings is equipped with a feeding valve used for supplying gas to the vehicle engine (E).

15. A vehicle gas container according to any of the claims 13 and 14, **characterized in that** the vehicle gas container (40) being divided in at least two separate sections (40A, 40B) used one at a time for driving of the vehicle engine (E), and refuelled step by step by starting with the one (40A) having the lowest pressure.

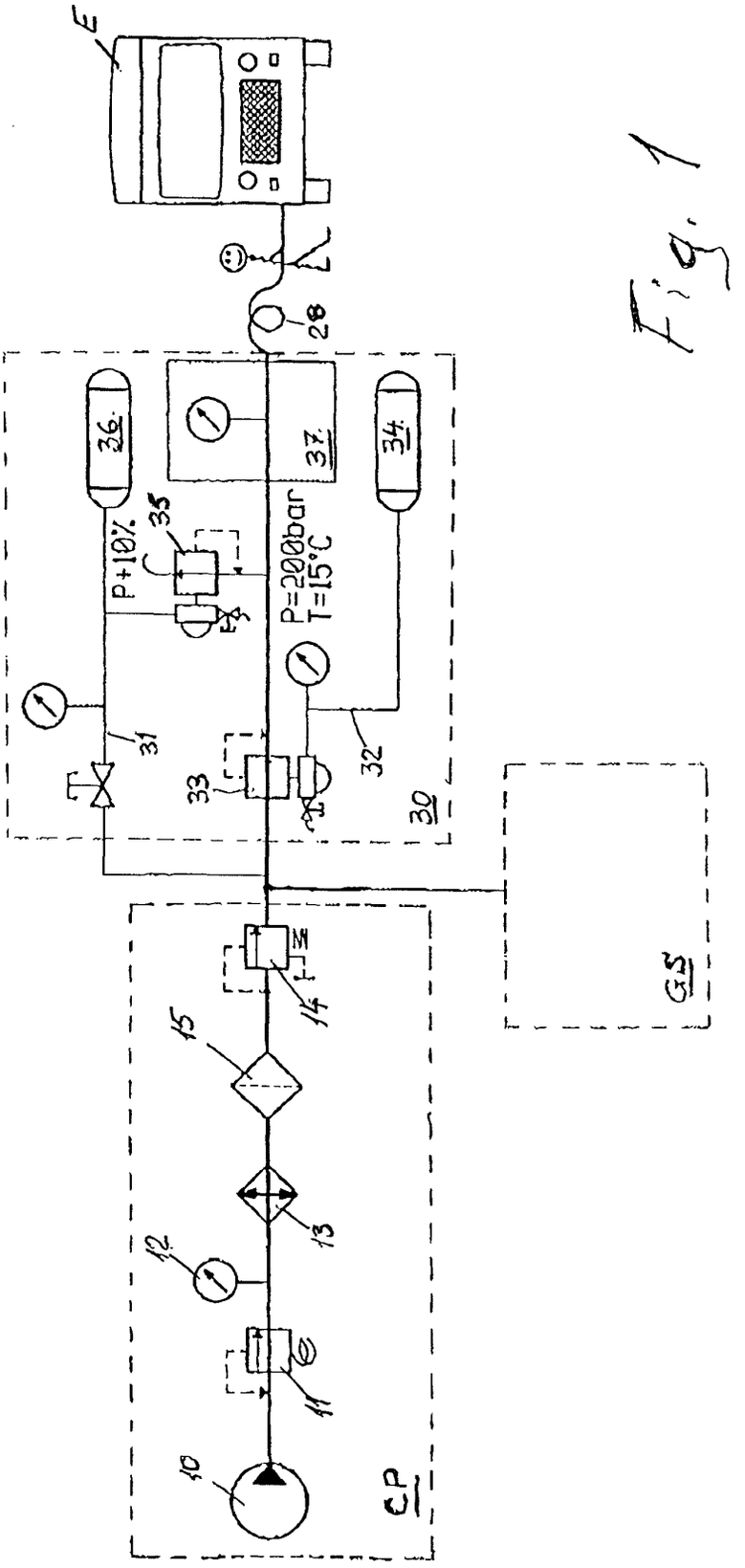

Fig. 1

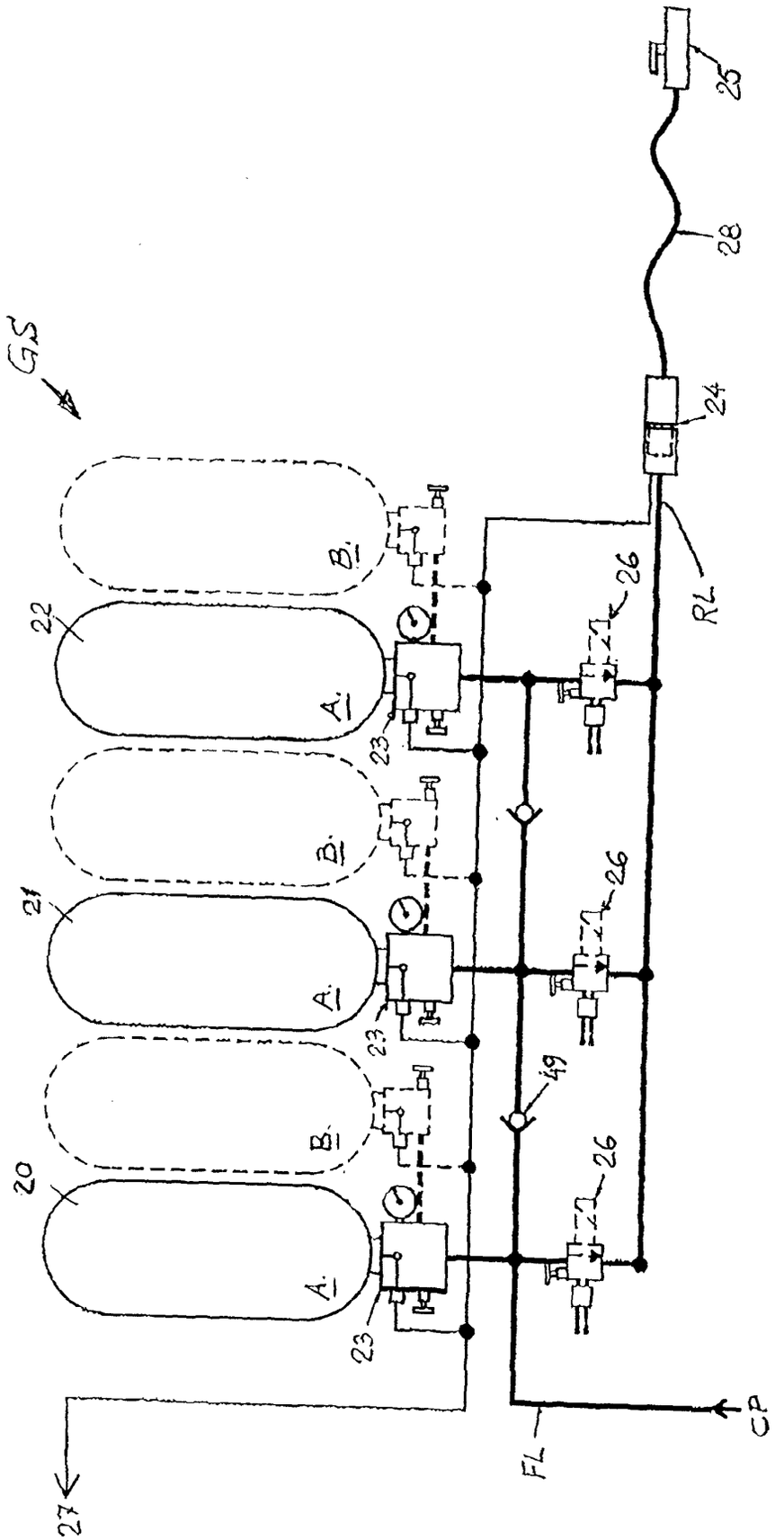

Fig. 2

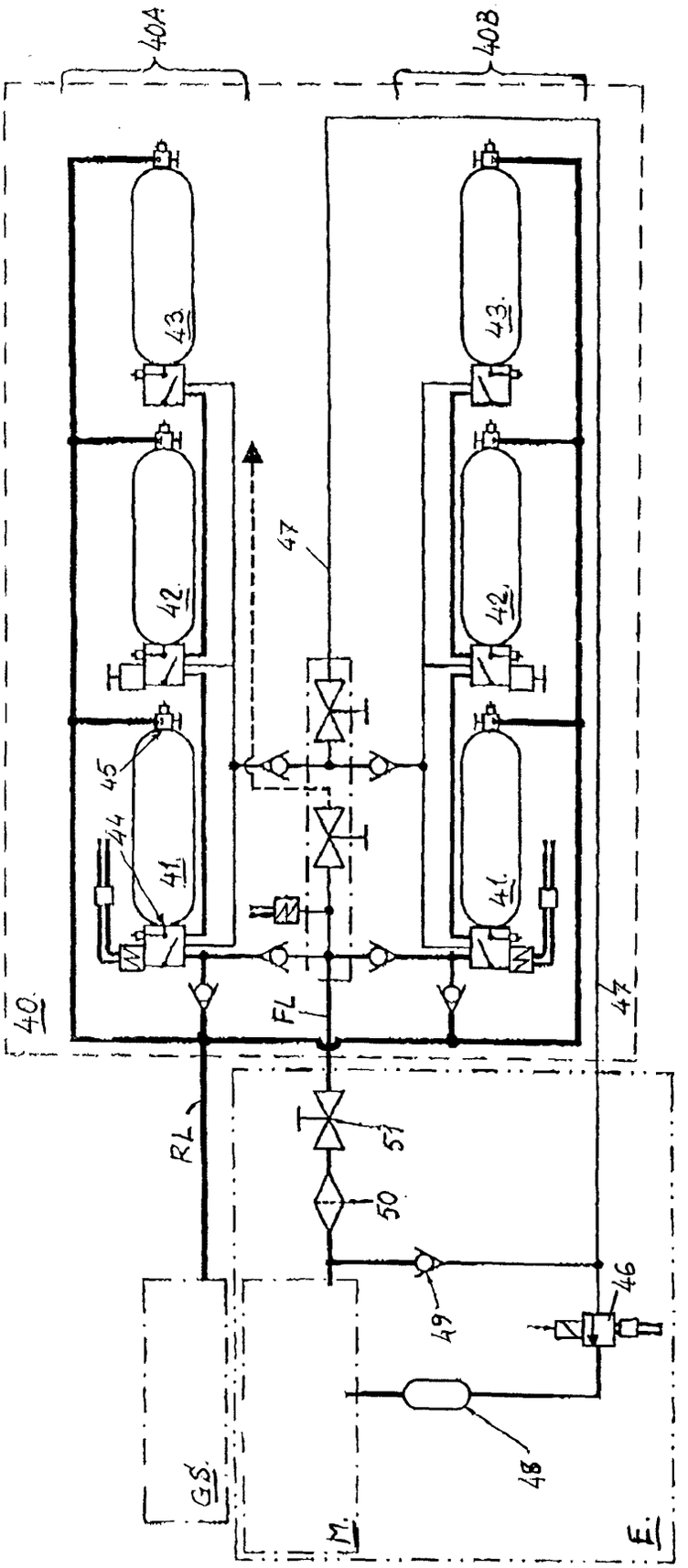

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 44 5007

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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F17C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 May 2005	Ott, T

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 44 5007

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