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(54) **Method and apparatus for recovering the refrigerant from an air conditioning system**

Verfahren und Vorrichtung zur Rückgewinnung von Kältemittel aus einer Klimaanlage

Procédé et appareil destiné à récupérer et à régénérer un fluide de refroidissement dans un climatiseur

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Description

DESCRIPTION

Field of the invention

[0001] The present invention relates to a method for recovering a refrigerant from an air conditioning system, for example an A/C system of cars.

[0002] Furthermore, the invention relates to an apparatus for recovering, depurating and refilling a refrigerant into said air conditioning system.

Background of the invention

[0003] As known, the refrigerant present in conditioning systems, in particular A/C systems on board of vehicles such as cars, is periodically recovered and recycled for eliminating impurities accumulated during the operation. A type of recovering and regenerating machine is disclosed in EP1367343A1, showing the features of the preamble of claims 1 and 6. US-A-5 172 562 also discloses an apparatus and a method according to the preamble of claims 1 and 6 respectively.

[0004] Furthermore, for opposing the greenhouse effect due to the dispersion of the refrigerant gas used in the conditioning systems, laws and regulations define more and more restrictive limits on the waste gas recovering processes, like for refrigerant R-134a currently known in most of the air conditioning systems of cars. In particular, the presently known regulations require that at least the 95.0% of the total gas contained in the air conditioning system is recovered.

[0005] With the introduction in the new cars, for example according to the 2006/40/CE regulation, of the refrigerant called HFO-1234yf, which has a lower impact on global heating than HFC-134a, but a much higher cost, the step of recovering the gas becomes important concerning both the environmental and the economic aspects.

[0006] A further drawback concerned with the safety of the recovering and regenerating steps is concerned with the fact that refrigerant HFO 1234yf is inflammable. Actually, residual fractions refrigerant present in the system, whose recovery would require too much time, are normally discharged in the environment when the vacuum pump of the refrigerant recovering machines is operated. The vacuum step is a step necessary that is done before refilling the gas. The discharge of small amounts of refrigerant, which then would make a mix with the oxygen present in the air, can generate a gaseous mixture capable of exploding or catching fire, with consequent danger for objects and people.

[0007] The operations of recovering, regenerating and refilling the refrigerant effected by machines as described in EP1367343A1 must follow particular standards, like SAE J2843 and SAE J2788, which, beyond defining a minimum threshold recovered refrigerant (for example

95%), define also safety conditions and time limits for carrying out these steps. In particular, at least the 95.0% of refrigerant has to be recovered in a maximum time of 30 min, without heating the components of the system, in an outside temperature range between 21° and 24°C etc.

[0008] The above described standards cannot be easily accomplished by the existing recovering machines. A particularly disadvantageous situation, cannot fulfill such standards, occurs when the temperature around the air conditioning system is very low, at which is even difficult to recover 90% of the refrigerant. In fact, at such a low external temperature, the refrigerant present in the system is mainly in liquid form, and then difficult to recover.

[0009] Circuits equipped with a heating system exist, in order to assist the recovery. However, these circuits make the air conditioning system less safe and more expensive. Operations of heating the system are also risky and complex, since the storage reservoir of the refrigerant of the car A/C systems are normally located in not easily accessible zones, behind the motor.

[0010] With reference to Fig. 1, a diagrammatical view of a car A/C system 200 of known type comprises a condenser 201, a filter 202, a calibrated hole 203, an evaporator 204, a storage container for the refrigerant 205, which separates the liquid phase and the gaseous phase, and a compressor 206. Downstream of the compressor a high pressure connection 221 is provided, whereas on the storage container a low pressure connection 222 is provided.

[0011] Presently, a machine of known type 230 (Fig. 1) for recovering and regenerating refrigerants, similar to that described in EP1367343A1, can recover the refrigerant from a hermetic compressor 233, connected by means of flexible tubes that reaches collector 235 and a high pressure 221 and a low pressure 222 connections to the air conditioning system. Owing to the work of the compressor 233, the refrigerant is subjected to suction up to pressures quite below the atmospheric pressure and accumulated after the process for regenerating in a storage cylinder 234.

[0012] More precisely, when the system 200 is turned off, the liquid fraction of the refrigerant tends to migrate by the pressure difference from the high pressure zone 221 towards the storage container 205, running through the calibrated hole 203 and the compressor 206. The recovering of refrigerant is carried out mainly in liquid phase from the high pressure connection 221 and in gaseous phase from the low pressure connection 222. However, in environmental conditions of low temperature a large amount of the liquid fraction of the refrigerant is in the storage container 205, and the step of recovering the refrigerant from evaporation can be carried out only by remarkably lowering the suction depression of the machine, by the compressor unit 233. For reaching these conditions, however, a high increase of the time for recovering and treating the refrigerant is necessary. To the end of recovering at least 95%, in order to meet the Reg-

ulations, the time for the recovery can exceed 30 minutes.

[0013] The recovering and regenerating step of the refrigerant requires a vacuum pump 231, which is completely separated from the compressor unit 233, and which carries out the vacuum step, up to maximum vacuum grade possible, discharging in the environment the refrigerant that was not recoverable with the previous recovery step, and assisting the following refilling of regenerated refrigerant. It must be noted that the less is the refrigerant that remains after the step of recovering, the more is refrigerant that is discharged in atmosphere, with the above described drawbacks of polluting, risk of catching fire, and waste of expensive refrigerant.

[0014] It is therefore desirable to speed up the time for emptying the air conditioning system and increasing the quantity of recovered refrigerant.

[0015] An expensive solution would be to use a high power compressor for creating a maximum suction of the refrigerant in a short time. However, this solution would increase too much the costs of the machine, owing not only to the higher cost of the compressor, but also to an overall a more robust sizing of suction system to bear the more powerful action of the compressor. Such solution, furthermore, would not solve completely the above described problems, and would complicate the regeneration process.

Summary of the invention

[0016] It is then a feature of the present invention to provide an apparatus for recovering the refrigerant from an air conditioning system, like an A/C system for cars, in a way that a minimum quantity of refrigerant is left in the storage container of the air conditioning system and the recovery is as quick as possible.

[0017] It is also a feature of the present invention to provide an apparatus for increasing the speed of the fluid through the apparatus same and then of reducing the time necessary for regenerating the fluid.

[0018] It is a particular object of the present invention to provide an apparatus that makes it possible to obtain the above described advantages without however causing excessive costs for additional implementations.

[0019] It is also a feature of the present invention to modify an existing recovering or regenerating apparatus without introducing heavy constructional complications.

[0020] It is a further feature of the present invention to provide a method that achieves the same advantages.

[0021] These and other objects are achieved by an apparatus for recovering a refrigerant from an air conditioning system, comprising:

- a collector arranged to connect hydraulically a high pressure branch and a low pressure branch of the air conditioning system with a fluid feeding duct in the apparatus;
- an evaporator arranged to separate the refrigerant from impurities through an evaporation of residual

liquid fractions of the refrigerant obtaining a purified refrigerant that rises towards an upper part of the evaporator and impurities that are concentrated in a lower part of the evaporator;

- a suction unit for circulating the purified refrigerant exiting from the evaporator, the suction unit being in hydraulic connection with the feeding duct through the evaporator, the suction unit comprising a compressor;
- a condenser in hydraulic connection with the suction unit for circulating the refrigerant, the condenser arranged to cool and condense the refrigerant exiting from the suction unit;
- a storage container in hydraulic connection with the condenser, the storage container arranged to contain the refrigerant condensed by the condenser;

wherein upstream of the evaporator an auxiliary compressor means is provided arranged in parallel to the feeding duct, the auxiliary compressor means being configured to boost the flow rate of the refrigerant towards the evaporator and for assisting a progressive pressure reduction of the refrigerant in the air conditioning system in cooperation with the suction unit.

[0022] This way, the auxiliary compressor means causes the air conditioning system to reach quickly the low pressures that allow an almost complete recovery of the refrigerant. More precisely, the suction unit which is normally provided for circulating the purified refrigerant, which in substance is the compressor that is arranged downstream of the evaporator, carries out its suction function of the cooling liquid from the air conditioning system through the evaporator and the feeding duct coming from the collector. The presence of the auxiliary compressor upstream of the evaporator boosts the compressor of the suction unit speeding up the emptying steps of the system, recovering more refrigerant possible, and reaching a maximum vacuum rate in the system at the end of the recovery step. The recovery time can then be remarkably decreased about 30% with respect to the prior art recovering systems.

[0023] Advantageously, the feeding duct comprises a first portion, downstream of the collector, and a second portion consecutive to the first portion and arranged upstream of the evaporator, and the auxiliary compressor means is arranged in parallel to the second portion, in the second portion a feed valve being arranged that is movable between an open position and a closed position, in a way that, when the pressure in the first portion is higher than a threshold value, the auxiliary compressor does not operate and the feed valve is in open position, and in a way that, when the pressure in the first portion is lower than the threshold value, the auxiliary compressor means is turned on and the feed valve is in closed position, causing the refrigerant to be fed to the evaporator through the auxiliary compressor means, which helps to reduce further the pressure on the first portion

of the feeding duct in cooperation with the suction unit.

[0024] This way, the first recovery step, i.e. when the pressure in the system is still enough high, for example above 200mb, can be carried out in a traditional way only by the compressor of the suction unit. Instead, for lower pressures, the feed valve is closed, and the auxiliary compressor means is activate and contributes to reach quickly minimum values of pressure in the system.

[0025] In a possible embodiment, the auxiliary compressor means comprises a vacuum generation device. This way, once ended the recovering step of a significant fraction of refrigerant, for example beyond 95/96% of recovered refrigerant, it is possible to continue the recovery increasing the vacuum rate in the system.

[0026] Advantageously, said vacuum generation device is connected hydraulically with the evaporator by a three-way valve, the three-way valve arranged to connect selectively the vacuum generation device with the evaporator, or with a purge duct, in a such a way to allow the vacuum generation device to work selectively either, as auxiliary compressor means, or to purge the refrigerant that cannot be regenerated and still residually present in the air conditioning system. This way, it is possible to stop recovering the refrigerant beyond the above described significant threshold, or an upper threshold, and purge the residual fraction, whereas in the meantime the evaporator, the compressor of the suction unit and the condenser are completing the regeneration of the refrigerant.

[0027] Alternatively, the auxiliary compressor means for reducing the pressure of the refrigerant on the first portion of the feeding duct comprises a dry-operating compressor, and wherein upstream of the dry-operating compressor a vacuum generation device is arranged to purge the refrigerant that cannot be regenerated from the apparatus for recovering refrigerant.

[0028] This way, it is possible to use a dry-operating compressor of minimum consumption and cost, in addition to the vacuum pump normally present in the recovery and regeneration machines of known type. The dry-operating compressor does not require lubrication since it exploits the lubricant already present in the refrigerant that is subjected to suction from the air conditioning system.

[0029] According to another aspect of the invention, a method for recovering and regenerating a refrigerant from an air conditioning system comprises the steps of:

- feeding a refrigerant through a collector in a refrigerant regenerating apparatus, the collector arranged to connect hydraulically a fluid feeding duct of the apparatus with a high pressure branch and a low pressure branch of the air conditioning system;
- evaporating residual liquid fractions of the refrigerant by an evaporator arranged to separate the refrigerant from impurities obtaining a purified refrigerant that is concentrated in an upper part of the evaporator and impurities that are concentrated in a lower

part of the evaporator;

- causing a suction and circulating the refrigerant through the apparatus by a suction unit, the suction unit being in hydraulic connection with the feeding duct through the evaporator;
- condensing the refrigerant exiting from the suction unit by a condenser in hydraulic connection with the suction unit for circulating the refrigerant;
- accumulating the refrigerant condensed by the condenser into a container in hydraulic connection with the condenser;

whose main feature is that the suction step and the step of circulating the refrigerant through the apparatus is carried out by the suction unit and by auxiliary compressor means that operate upstream of the evaporator, and that increase the flow rate of the refrigerant towards the evaporator for assisting a reduction of pressure of the refrigerant in the air conditioning system.

Brief description of the drawings

[0030] Further characteristic and/or advantages of the method and of the apparatus for recovering and regenerating refrigerant in conditioning systems, according to the present invention will be made clearer with the following description of an exemplary embodiment thereof, exemplifying but not limitative, with reference to the attached drawings in which:

- Fig. 1 shows an apparatus for recovering and regenerating refrigerant according to the prior art, connected to an air conditioning system;
- Fig. 2 shows the circuit of the apparatus for recovering and regenerating according to the prior art of Fig. 1;
- Fig. 3 shows a diagrammatical view of a first exemplary embodiment of an apparatus for recovering and regenerating according to the invention;
- Fig. 4 shows a diagrammatical hydraulic view of a first preferred exemplary embodiment of an apparatus for recovering and regenerating according to the invention;
- Fig. 5 shows a diagrammatical view of a second exemplary embodiment of an apparatus for recovering and regenerating according to the invention;
- Fig. 6 shows a diagrammatical hydraulic view of a second preferred exemplary embodiment of an apparatus for recovering and regenerating according to the invention;
- Fig. 7 shows a diagrammatical view of a third exemplary embodiment of an apparatus for recovering and regenerating according to the invention;
- Fig. 8 shows a diagrammatical hydraulic view of a third preferred exemplary embodiment of an apparatus for recovering and regenerating according to the invention.

Description of preferred exemplary embodiments

[0031] With reference to Fig. 3, an apparatus 230 for recovering and regenerating the refrigerant coming from collector 235 comprises, with respect to the systems of the prior art of Fig. 1 and 2, a vacuum pump 231, or alternatively, a dry-operating compressor, upstream of evaporator 232 and in parallel to feeding duct 101, in a way that, in a predetermined operative configuration, the refrigerant can cover in series a path through vacuum pump 231, evaporator 232 and suction unit 233.

[0032] Vacuum pump 231 can be excluded from the regeneration circuit or included in the circuit by means of valves 241a and 241b. Such particular technical solution allows vacuum pump 231 to work in the suction step only when suction unit 233 drops below a threshold pressure, obtaining a further reduction of the pressure in feeding duct 101 and therefore in the apparatus arranged between collector 235 and suction unit 233.

[0033] This way, differently from the prior art, for example as described for Figs. 1 and 2, vacuum pump 231 of the system 230, or alternatively, the dry-operating compressor, according to the invention, assist the evaporation of the refrigerant, thus increasing the speed of recovering the refrigerant and maximizing the amount of refrigerant recovered, as described above.

[0034] With reference to Fig. 4, in more detail, the feeding duct comprises a first portion 101a, downstream of the collector, and a second portion 101b, consecutive to the first portion 101a and arranged upstream of evaporator 232. This way, the auxiliary compressor means is arranged in parallel to second portion 101b, in which feed valve 241a is present. Such valve is movable between an open position and a closed position, and, when the pressure in the first portion 101a remains above a threshold value, the auxiliary compressor 231, i.e. the vacuum pump or dry-operating compressor, does not operate and feed valve 241a is in an open position. Instead, when the pressure in the first portion 101b is lower than the threshold value, the auxiliary compressor 231 turns on and the feed valve is in closed position, so that the refrigerant is fed to the evaporator through the auxiliary compressor 231, which works, in order to lower further the pressure on the first portion 101a of feeding duct 101, in cooperation with suction unit 233, in the recovery when suction unit 233 "finds it difficult" to complete the action of recovery. In Figs. 3 and 4 a safety valve 241b is also shown which is arranged to avoid losses and leaks through the auxiliary compressor 231 when feed valve 241a is open.

[0035] In Fig. 4 parts of the recovering and regenerating circuit are furthermore shown that are already known in the existing machines, like the condenser, the oil separator, the collection reservoir for the residues concentrated by evaporator 232, etc., as already described in EP1367343A1.

[0036] With reference to Figs. 5 and 6, in an exemplary embodiment of the invention, vacuum pump 231, beyond being arranged in order to be excluded or included by

the valves 241a and 241b, as already described with reference to Figs. 3 and 4, can be connected hydraulically to evaporator 242 by a three-way valve 241c. Such particular technical solution allows a double function to vacuum pump 231:

- moving to a first hydraulic connection position of vacuum pump 231 with evaporator 232, when also valve 241b is open, and valve 241a is closed, i.e. as already above described for reducing the pressure in feeding duct 101 and therefore along the devices arranged between collector 235 and suction unit 233,
- moving to a second hydraulic connection position with the environment of vacuum pump 231, for purging the not recoverable refrigerant, when it is not advisable to continue the recovering of refrigerant.

[0037] Three-way valve 241c, in the second position, with valve 241a closed and vacuum pump 231 in function, allows to continue purging and vacuuming the system, insulating at the same time evaporator 232 and suction unit 233, which can complete the recovery up to an exhaustion of refrigerant in evaporator 232.

[0038] With reference to Figs. 7 and 8, an apparatus for recovering and regenerating refrigerant comprises, with respect to the systems of the prior art of Fig. 1 and 2, a dry-operating compressor 243 upstream of evaporator 232 in parallel to feeding duct 101. The dry-operating compressor 243 is excluded from or included in the regeneration circuit by valves 241a and 241b, in the way described also with reference to Figs. 3-6. Such particular technical solution allows the dry-operating compressor 243 to turn on only in the suction step when the pressure in suction unit 233 drops below a threshold, obtaining a further reduction of the pressure in feeding duct 101 and therefore along the devices arranged between collector 235 and suction unit 233. This way, similarly to the other solutions above described, the dry-operating compressor 243 assist evaporating the refrigerant in the air conditioning system, increasing the speed of recovering the refrigerant and the maximum amount of refrigerant recovered.

[0039] By closing valves 241a and 241b and turning the dry-operating compressor 243 off, it is possible, in a traditional way, to operate vacuum pump 231 for purging the refrigerant that cannot be recovered, when it is not preferred continue the recovering process, by insulating at the same time evaporator 232 and suction unit 233, which can complete the regeneration up to exhaustion of refrigerant in evaporator 232.

[0040] The solution of the dry-operating compressor 243 maximizes the efficiency of the machine with a minimum additional cost, since it is a low cost component of and it requires minimum maintenance. It does not require lubrication because it exploits the presence of oil in the refrigerant that is recovered from the system. Further, it normally has not a high vacuum tightness, and then cannot be used for vacuuming the air conditioning system,

but this function is not necessary especially when the vacuum pump is present, which intervenes as described above.

[0041] The foregoing description of a specific embodiment will so fully reveal the invention according to the conceptual point of view, so that others, by applying current knowledge, will be able to modify and/or adapt for various applications such an embodiment without further research and without parting from the invention, and it is therefore to be understood that such adaptations and modifications will have to be considered as equivalent to the specific embodiment. The means and the materials to realize the different functions described herein could have a different nature without, for this reason, departing from the field of the invention. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Claims

1. An apparatus for recovering a refrigerant (230) from an air conditioning system (200), said apparatus (230) comprising:

- a collector (235) hydraulically connected to a high pressure branch (221) and a low pressure branch (222) of the air conditioning system (200) with a fluid feeding duct (101) in said apparatus (230);
- an evaporator (232) arranged to separate said refrigerant from impurities through an evaporation of residual liquid fractions of said refrigerant, in order to obtain a purified refrigerant that evaporates and rises towards an upper part of the evaporator (232), and to obtain impurities that are concentrated in a lower part of said evaporator (232);
- a suction unit (233) for circulating the purified refrigerant exiting from said evaporator (232), said suction unit (233) being in hydraulic connection with said feeding duct (101) through said evaporator, said suction unit (233) comprising a compressor;
- a condenser (236) in hydraulic connection with said suction unit (233), said condenser (236) arranged to condense the refrigerant exiting from said suction unit (233);
- a storage container (234) in hydraulic connection with said condenser (236), said storage container (234) arranged to contain the refrigerant condensed by said condenser (236);

characterized in that upstream of said evaporator (232) an auxiliary compressor means is provided arranged in parallel to said feeding duct, said auxiliary compressor means configured to boost the flow rate of said refrigerant towards said evaporator (232) and for assisting

a progressive pressure reduction of said refrigerant in said air conditioning system (200) in co-operation with said suction unit (233).

2. The apparatus (230) according to claim 1, wherein said feeding duct (101) comprises a first portion (101a), downstream of said collector (235), and a second portion (101b) consecutive to said first portion (101a) and arranged upstream of said evaporator (232), and said auxiliary compressor means is arranged in parallel to said second portion (101b), wherein in said second portion (101b) a feed valve (241a) is arranged movable between an open position and a closed position, so that, when the pressure in said first portion (101a) is higher than a threshold value, said auxiliary compressor means is turned off and said feed valve (241a) is in open position, and so that, when the pressure in said first portion (101a) is less than said value, said auxiliary compressor means is turned on and said feed valve (241a) is in closed position, so that the refrigerant is fed to said evaporator (232) through said auxiliary compressor means, which cooperates with said suction unit (233) for lowering further the pressure on said first portion (101a) of said feeding duct (101).
3. The apparatus (230) according to claim 2, wherein said auxiliary compressor means for lowering the pressure of said refrigerant on said first portion (101a) of said feeding duct comprises a vacuum generation device (231).
4. The apparatus (230) according to claim 3, wherein said vacuum generation device (231) is connected hydraulically with said evaporator (232) by a three-way valve (241c), said three-way valve (241c) arranged to connect selectively said vacuum generation device (231) with said evaporator (232), or with a purge duct (242), in order to cause said vacuum generation device (231) to work selectively either as auxiliary compressor means or as purge means, for purging the refrigerant that cannot be regenerated and still residually present in said air conditioning system (200).
5. The apparatus (230) according to claim 2, wherein said auxiliary compressor means for reducing the pressure of said refrigerant on said first portion (101a) of said feeding duct (101) comprises a dry-operating compressor (243), and wherein upstream of said dry-operating compressor (243) a vacuum generation device (231) is arranged to purge the refrigerant that cannot be regenerated from said apparatus for recovering refrigerant (230).
6. A method for recovering and regenerating a refrigerant from an air conditioning system (200), said method comprising the steps of:

- feeding a refrigerant through a collector (235) into a recovering and regenerating apparatus (230), said collector (235) arranged to connect hydraulically a feeding duct (101) of said apparatus (230) with a high pressure branch and a low pressure branch of said air conditioning system (200);

- evaporating residual liquid fractions of said refrigerant from an evaporator (232) arranged to separate said refrigerant from impurities obtaining a purified refrigerant that evaporates rising towards an upper part of the evaporator (232) and obtaining impurities that are concentrated in a lower part of said evaporator (232);

- causing a suction and circulation of the refrigerant through the apparatus (230) by a suction unit (233), said suction unit (233) being in hydraulic connection with said feeding duct (101) through said evaporator (232);

- condensing the refrigerant exiting from said suction unit (233) by a condenser (232) in hydraulic connection with said suction unit (233);

- accumulating refrigerant condensed by said condenser (232) into a container (234) in hydraulic connection with said condenser (232);

characterized in that said step of causing a suction and circulation of the refrigerant through the apparatus (230) is carried out by said suction unit (233) in combination with an auxiliary compressor means that operates upstream of said evaporator (232), and that increases the flow rate of said refrigerant towards said evaporator (232) for assisting a reduction of the pressure of said refrigerant in said air conditioning system (200).

Patentansprüche

1. Vorrichtung zur Rückgewinnung eines Kältemittels (230) aus einer Klimaanlage (200), wobei die Vorrichtung (230) folgendes umfasst:
 - einen Kollektor (235), der hydraulisch mit einer Hochdruckverzweigung (221) und einer Niederdruckverzweigung (222) der Klimaanlage (200) verbunden ist, mit einer Fluidzufuhrleitung (101) in der Vorrichtung (230);
 - einen Evaporator (232), der so angeordnet ist, dass er das Kältemittel durch Verdampfung von flüssigen Restanteilen des Kältemittels von Unreinheiten trennt, um ein gereinigtes Kältemittel zu erhalten, das verdampft und zu einem oberen Teil des Evaporators (232) aufsteigt, und um Unreinheiten zu erhalten, die in einem unteren Teil des Evaporators (232) konzentriert sind;
 - eine Saugereinheit (233) zum Zirkulieren des gereinigten Kältemittels, das aus dem Evaporator

(232) austritt, wobei die Saugereinheit (233) über den Evaporator eine hydraulische Verbindung mit der Zufuhrleitung (101) aufweist, wobei die Saugereinheit (233) einen Kompressor umfasst;

- einen Kondensator (236) in hydraulischer Verbindung mit der Saugereinheit (233), wobei der Kondensator (236) so angeordnet ist, dass er das aus der Saugereinheit (233) austretende Kältemittel kondensiert;

- einen Speicherbehälter (234) in hydraulischer Verbindung mit dem Kondensator (236), wobei der Speicherbehälter (234) so angeordnet ist, dass er das durch den Kondensator (236) kondensierte Kältemittel speichert;

dadurch gekennzeichnet, dass stromaufwärts des Evaporators (232) eine Hilfskompressoreinrichtung parallel zu der Zufuhrleitung angeordnet ist, wobei die Hilfskompressoreinrichtung so konfiguriert ist, dass sie die Strömungsrate des Kältemittels zu dem Evaporator (232) verstärkt und eine progressive Drucksenkung des Kältemittels in der Klimaanlage (200) in Kooperation mit der Saugereinheit (233) unterstützt.

2. Vorrichtung (230) nach Anspruch 1, wobei die Zufuhrleitung (101) einen ersten Abschnitt (101 a) stromabwärts des Kollektors (235) und einen zweiten Abschnitt (101 b) nach dem ersten Abschnitt (101 a) und stromaufwärts des Evaporators (232) umfasst, und wobei die Hilfskompressoreinrichtung parallel zu dem zweiten Abschnitt (101 b) angeordnet ist, wobei in dem zweiten Abschnitt (101 b) ein Speiseventil (241 a) beweglich zwischen einer offenen Position und einer geschlossenen Position angeordnet ist, so dass, wenn der Druck in dem ersten Abschnitt (101 a) höher ist als ein Schwellenwert, die Hilfskompressoreinrichtung abgeschaltet wird und sich das Speiseventil (241 a) an der offenen Position befindet, und so dass, wenn der Druck in dem ersten Abschnitt (101 a) niedriger ist als der Wert, die Hilfskompressoreinrichtung eingeschaltet wird und sich das Speiseventil (241 a) an der geschlossenen Position befindet, so dass das Kältemittel durch die Hilfskompressoreinrichtung dem Evaporator (232) zugeführt wird, wobei die Hilfskompressoreinrichtung mit der Saugereinheit (233) zusammenarbeitet, um den Druck an dem ersten Abschnitt (101 a) der Speiseleitung (101) weiter zu senken.
3. Vorrichtung (230) nach Anspruch 2, wobei die Hilfskompressoreinrichtung zum Senken des Drucks des Kältemittels an dem ersten Abschnitt (101 a) der Speiseleitung eine Vakuumerzeugungsvorrichtung (231) umfasst.
4. Vorrichtung (230) nach Anspruch 3, wobei die Vakuumerzeugungsvorrichtung (231) über ein Dreiwegeventil (241 c) hydraulisch mit dem Evaporator

(232) verbunden ist, wobei das Dreiwegeventil (241 c) so angeordnet ist, dass es selektiv die Vakuumerzeugungs Vorrichtung (231) mit dem Evaporator (232) oder mit einer Entleerungsleitung (242) verbindet, um zu bewirken, dass die Vakuumerzeugungs Vorrichtung (231) selektiv entweder als Hilfskompressoreinrichtung oder als Entleerungseinrichtung arbeitet, um das Kältemittel, das nicht regeneriert werden kann und sich in Resten nach wie vor in der Klimaanlage (200) befindet, zu entleeren.

5. Vorrichtung (230) nach Anspruch 2, wobei die Hilfskompressoreinrichtung zum Senken des Drucks des Kältemittels an dem ersten Abschnitt (101 a) der Speiseleitung (101) einen Trockenbetriebskompressor (243) umfasst, und wobei stromaufwärts des Trockenbetriebskompressors (243) eine Vakuumerzeugungs Vorrichtung (231) angeordnet ist, um das Kältemittel, das nicht regeneriert werden kann, zur Rückgewinnung des Kältemittels (230) aus der Vorrichtung zu entleeren.
6. Verfahren zur Rückgewinnung und Regeneration eines Kältemittels aus einer Klimaanlage (200), wobei das Verfahren die folgenden Schritte umfasst:
 - Zuführen eines Kältemittels durch einen Kollektor (235) in eine Rückgewinnungs- und Regenerationsvorrichtung (230), wobei der Kollektor (235) so angeordnet ist, dass er eine Speiseleitung (101) der Vorrichtung (23) hydraulisch mit einer Hochdruckverzweigung und einer Niederdruckverzweigung der Klimaanlage (200) verbindet;
 - Verdampfen von flüssigen Restanteilen des Kältemittels durch einen Evaporator (232), der so angeordnet ist, dass er das Kältemittel von Unreinheiten trennt, wobei ein gereinigtes Kältemittel erhalten wird, das verdampft und zu einem oberen Teil des Evaporators (232) aufsteigt, und wobei Unreinheiten erhalten werden, die in einem unteren Teil des Evaporators (232) konzentriert sind;
 - Bewirken einer Saugfunktion und Zirkulation des Kältemittels durch die Vorrichtung (230) durch eine Saugereinheit (233), wobei die Saugereinheit (233) über den Evaporator eine hydraulische Verbindung mit der Speiseleitung (101) aufweist;
 - Kondensieren des aus der Saugereinheit (233) austretenden Kältemittels durch einen Kondensator (236) in hydraulischer Verbindung mit der Saugereinheit (233);
 - Akkumulieren von durch den Kondensator (232) kondensiertem Kältemittel in einen Behälter (234) in hydraulischer Verbindung mit dem Kondensator (232);

dadurch gekennzeichnet, dass der Schritt des

Bewirkens einer Saugfunktion und Zirkulation des Kältemittels durch die Vorrichtung (230) durch die Saugereinheit (233) in Kombination mit einer Hilfskompressoreinrichtung ausgeführt wird, die stromaufwärts des Evaporators (232) arbeitet und welche die Strömungsrate des Kältemittels zu dem Evaporator (232) erhöht, um eine Senkung des Drucks des Kältemittels in der Klimaanlage (200) zu unterstützen.

Revendications

1. Appareil pour récupérer un fluide de refroidissement (230) d'un système de climatisation (200), ledit appareil (230) comprenant :

un collecteur (235) hydrauliquement relié à une branche haute pression (221) et à une branche basse pression (222) du système de climatisation (200) à l'aide d'un conduit d'alimentation en fluide (101) dans ledit appareil (230) ;

un évaporateur (232) conçu pour séparer ledit fluide de refroidissement des impuretés par une évaporation des fractions liquides résiduelles dudit fluide de refroidissement, afin d'obtenir un fluide de refroidissement purifié qui s'évapore et monte vers une partie supérieure de l'évaporateur (232), et pour obtenir des impuretés qui sont concentrées dans une partie inférieure dudit évaporateur (232) ;

une unité d'aspiration (233) pour faire circuler le fluide de refroidissement purifié sortant dudit évaporateur (232), ladite unité d'aspiration (233) étant en liaison hydraulique avec ledit conduit d'alimentation (101) par l'intermédiaire dudit évaporateur, ladite unité d'aspiration (233) comprenant un compresseur ;

un condenseur (236) en liaison hydraulique avec ladite unité d'aspiration (233), ledit condenseur (236) étant conçu pour condenser le fluide de refroidissement sortant de ladite unité d'aspiration (233) ;

un récipient de stockage (234) en liaison hydraulique avec ledit condenseur (236), ledit récipient de stockage (234) étant conçu pour contenir le fluide de refroidissement condensé par ledit condenseur (236) ;

caractérisé en ce que, en amont dudit évaporateur (232), un moyen compresseur auxiliaire est disposé parallèlement audit conduit d'alimentation, ledit moyen compresseur auxiliaire étant conçu pour augmenter le débit dudit fluide de refroidissement vers ledit évaporateur (232) et pour contribuer à une réduction de pression progressive dudit fluide de refroidissement dans ledit système de climatisation (200) en coopération avec ladite unité d'aspiration (233).

2. Appareil (230) selon la revendication 1, ledit conduit d'alimentation (101) comprenant une première partie (101 a), en aval dudit collecteur (235), et une seconde partie (101 b) consécutive à ladite première partie (101 a) et disposée en amont dudit évaporateur (232), et ledit moyen compresseur auxiliaire étant disposé parallèlement à ladite seconde partie (101 b), dans ladite seconde partie (101 b) une vanne d'alimentation (241 a) étant disposée mobile entre une position ouverte et une position fermée, de sorte que, lorsque la pression dans ladite première partie (101 a) est supérieure à une valeur seuil, ledit moyen compresseur auxiliaire soit mis hors tension et ladite vanne d'alimentation (241 a) soit en position ouverte, et de sorte que, lorsque la pression dans ladite première partie (101 a) est inférieure à ladite valeur, ledit moyen compresseur auxiliaire soit mis sous tension et ladite vanne d'alimentation (241 a) soit en position fermée, de sorte que le fluide de refroidissement soit envoyé audit évaporateur (232) par l'intermédiaire dudit moyen compresseur auxiliaire, qui coopère avec ladite unité d'aspiration (233) pour réduire encore davantage la pression sur ladite première partie (101 a) dudit conduit d'alimentation (101). 5 10 15 20 25
3. Appareil (230) selon la revendication 2, ledit moyen compresseur auxiliaire pour réduire la pression dudit fluide de refroidissement sur ladite première partie (101 a) dudit conduit d'alimentation comprenant un dispositif de production de vide (231). 30
4. Appareil (230) selon la revendication 3, ledit dispositif de production de vide (231) étant relié hydrauliquement audit évaporateur (232) par un robinet à trois voies (241 c), ledit robinet à trois voies (241 c) étant conçu de sorte à relier de façon sélective ledit dispositif de production de vide (231) audit évaporateur (232), ou à un conduit de purge (242), afin d'amener ledit dispositif de production de vide (231) à fonctionner de façon sélective comme un moyen compresseur auxiliaire ou comme un moyen de purge, pour purger le fluide de refroidissement qui ne peut pas être régénéré et est résiduellement présent dans ledit système de climatisation (200). 35 40 45
5. Appareil (230) selon la revendication 2, ledit moyen compresseur auxiliaire pour réduire la pression dudit fluide de refroidissement sur ladite première partie (101 a) dudit conduit d'alimentation (101) comprenant un compresseur à fonctionnement à sec (243), et en amont dudit compresseur à fonctionnement à sec (243), un dispositif de production de vide (231) étant disposé pour purger le fluide de refroidissement qui ne peut pas être régénéré dudit appareil pour récupérer le fluide de refroidissement (230). 50 55
6. Procédé pour récupérer et régénérer un fluide de

refroidissement d'un système de climatisation (200), ledit procédé comportant les étapes consistant à :

introduire le fluide de refroidissement à travers un collecteur (235) dans un appareil de récupération et de régénération (230), ledit collecteur (235) étant conçu pour relier hydrauliquement un conduit d'alimentation (101) dudit appareil (230) à une branche haute pression et à une branche basse pression dudit système de climatisation (200) ;
 évaporer les fractions liquides résiduelles dudit fluide de refroidissement d'un évaporateur (232) conçu pour séparer ledit fluide de refroidissement des impuretés, en obtenant un fluide de refroidissement purifié qui s'évapore en montant vers une partie supérieure de l'évaporateur (232) et en obtenant des impuretés qui sont concentrées dans une partie inférieure dudit évaporateur (232) ;
 provoquer une aspiration et une circulation du fluide de refroidissement à travers l'appareil (230) par une unité d'aspiration (233), ladite unité d'aspiration (233) étant en liaison hydraulique avec ledit conduit d'alimentation (101) par l'intermédiaire dudit évaporateur (232) ;
 condenser le fluide de refroidissement sortant de ladite unité d'aspiration (233) par un condenseur (232) en liaison hydraulique avec ladite unité d'aspiration (233) ;
 accumuler le fluide de refroidissement condensé par ledit condenseur (232) dans un récipient (234) en liaison hydraulique avec ledit condenseur (232) ;
caractérisé en ce que ladite provocation d'aspiration et de circulation du fluide de refroidissement à travers l'appareil (230) est effectuée par ladite unité d'aspiration (233) en association avec un moyen compresseur auxiliaire qui fonctionne en amont dudit évaporateur (232), et qui augmente le débit dudit fluide de refroidissement vers ledit évaporateur (232) pour aider à réduire la pression dudit fluide de refroidissement dans ledit système de climatisation (200).

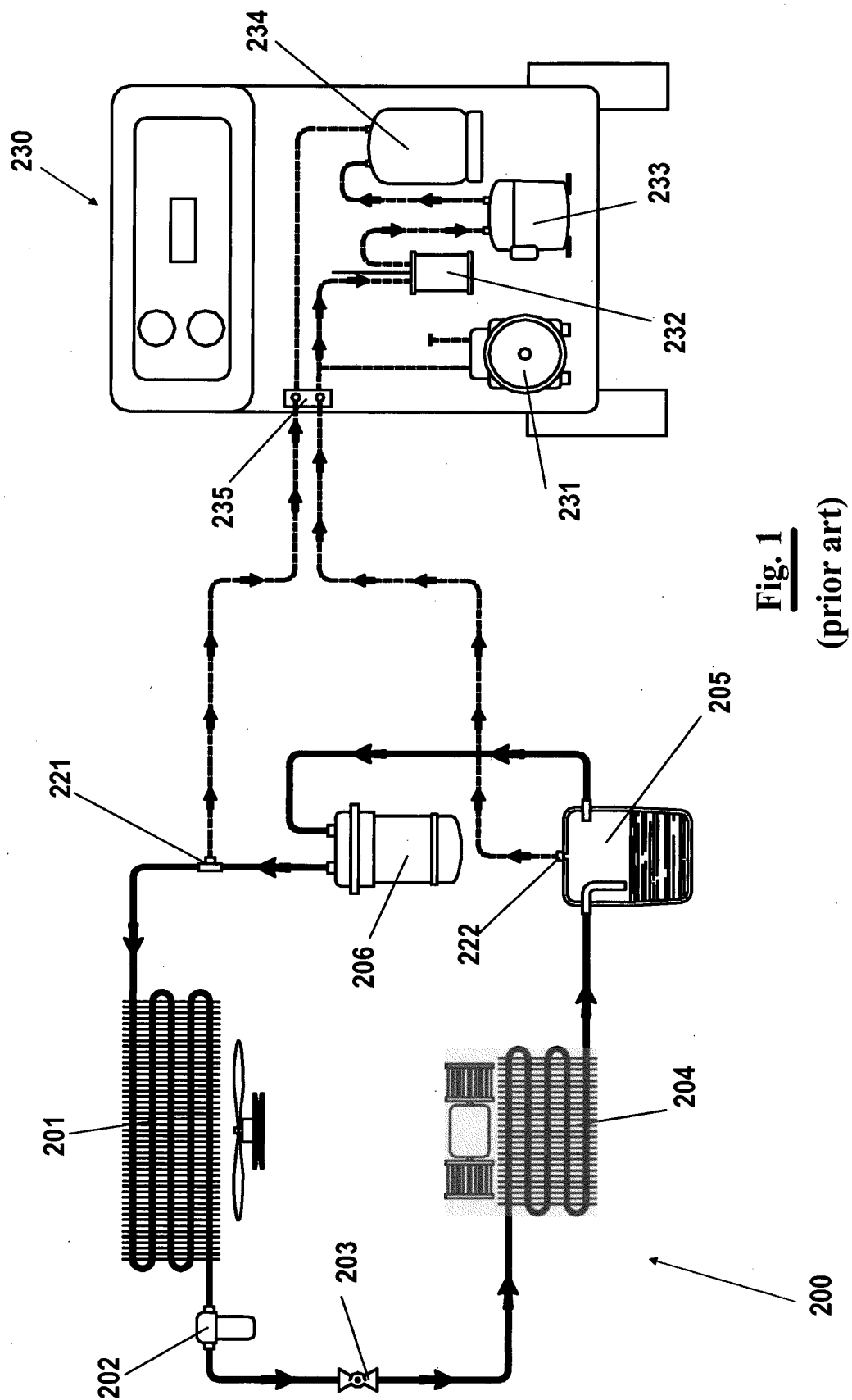


Fig. 1
(prior art)

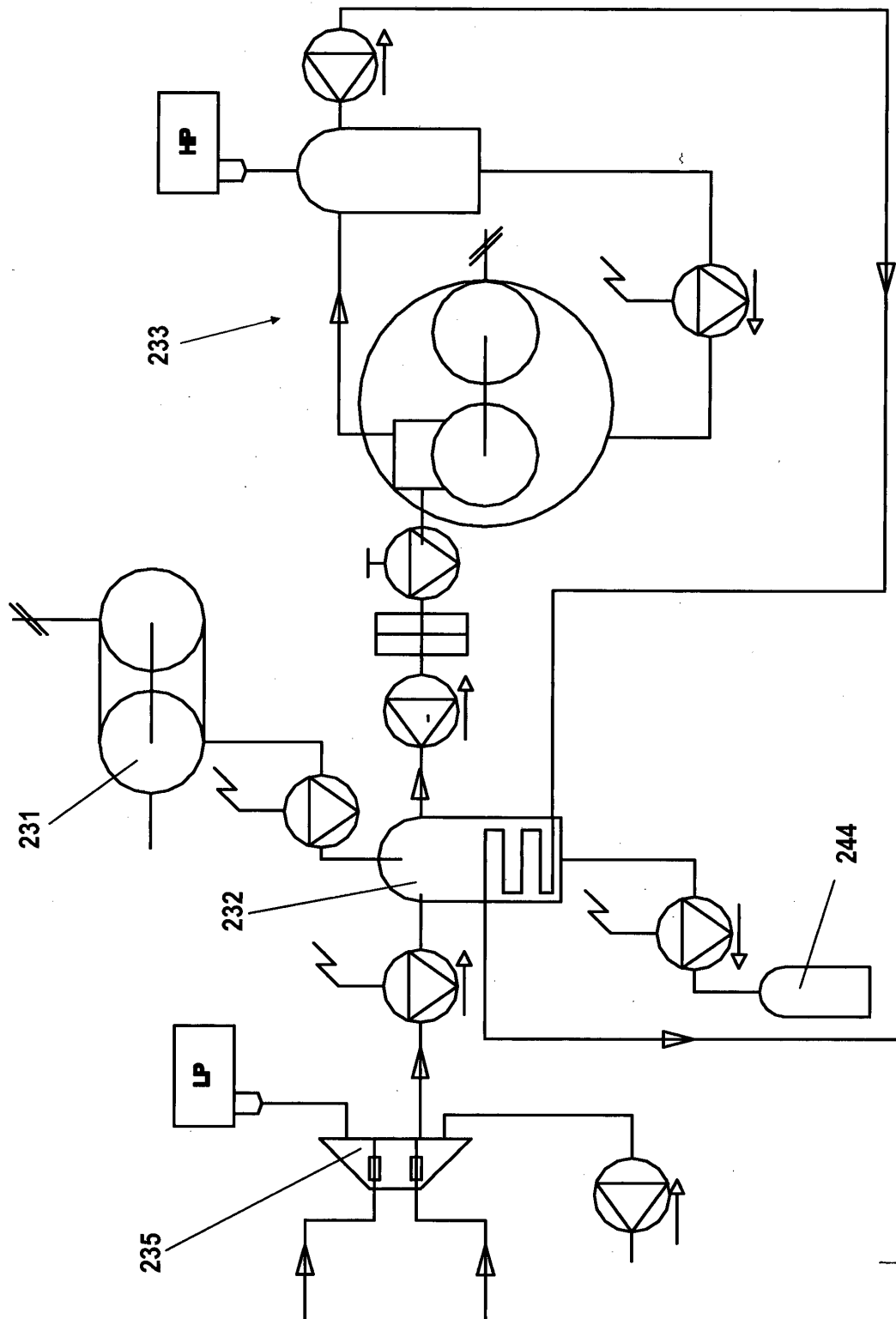


Fig. 2
(prior art)

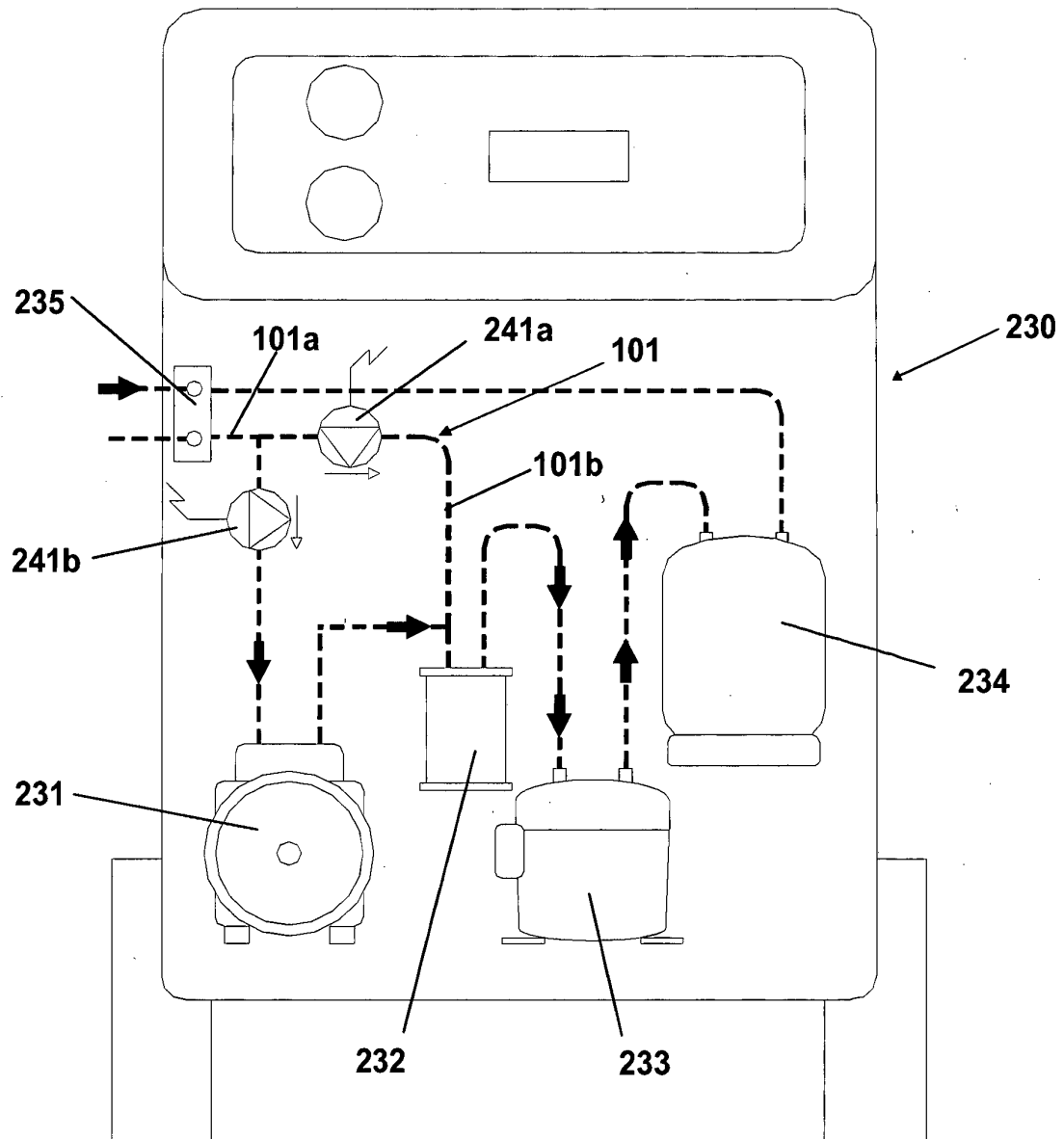


Fig. 3

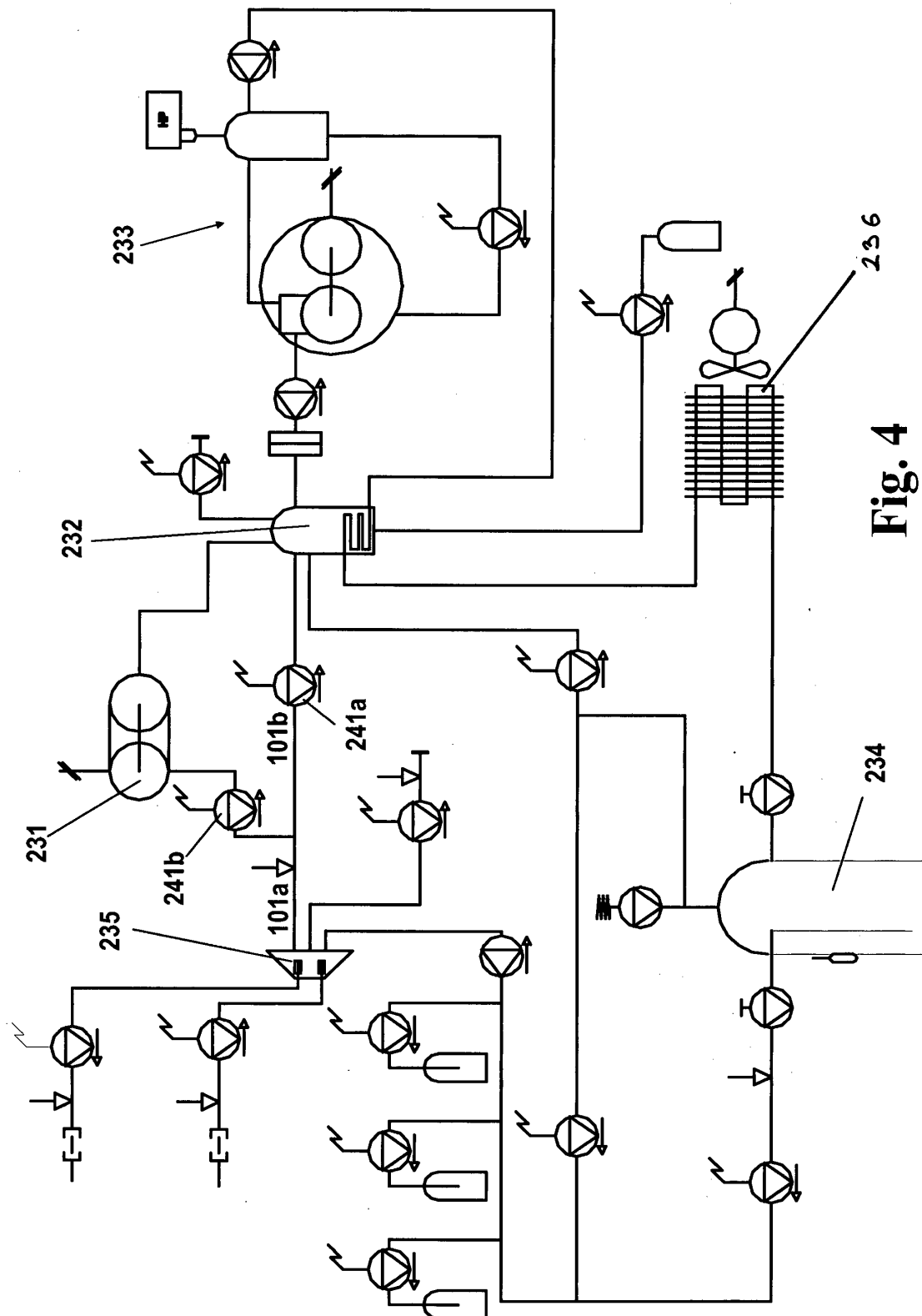


Fig. 4

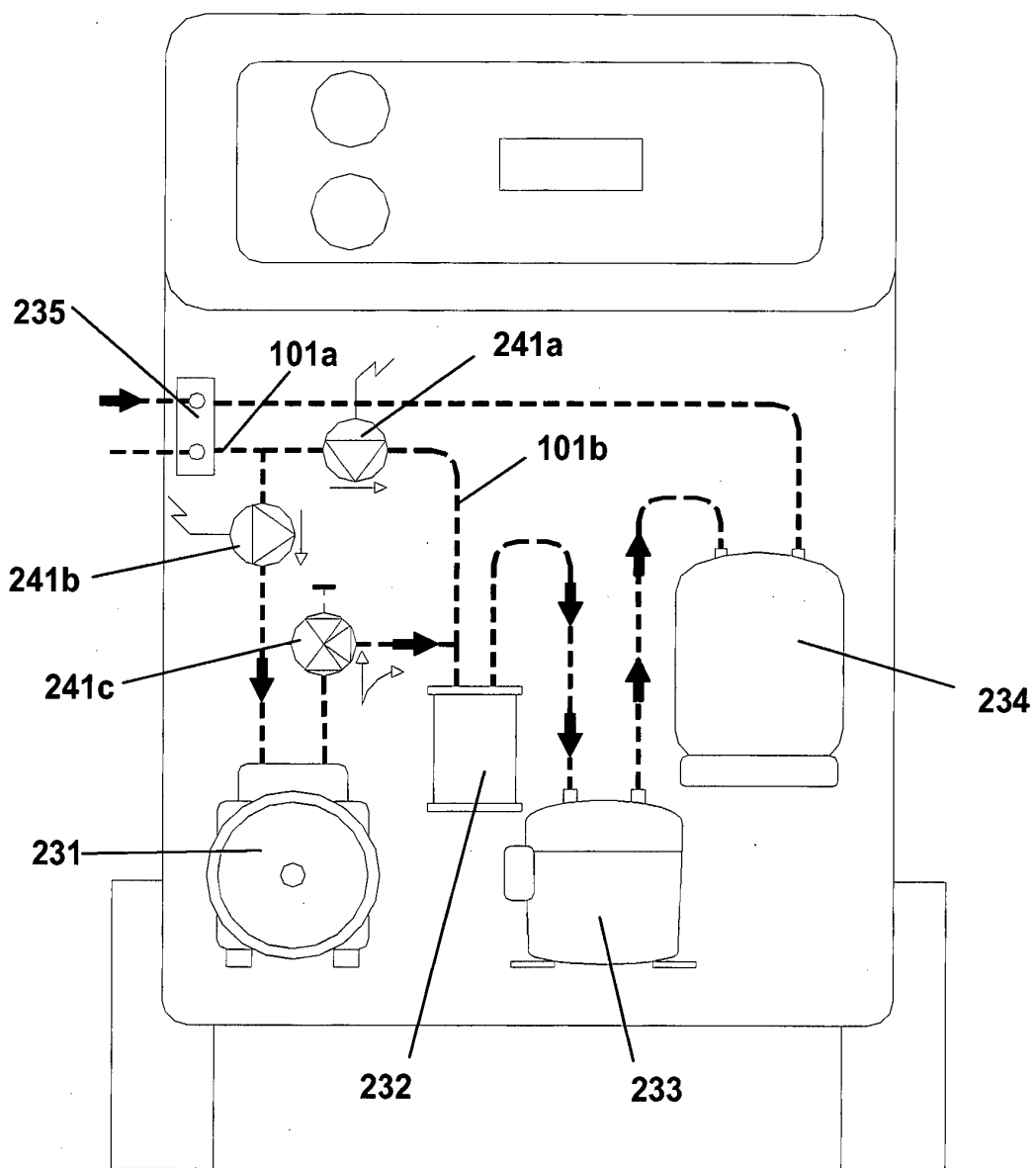


Fig. 5

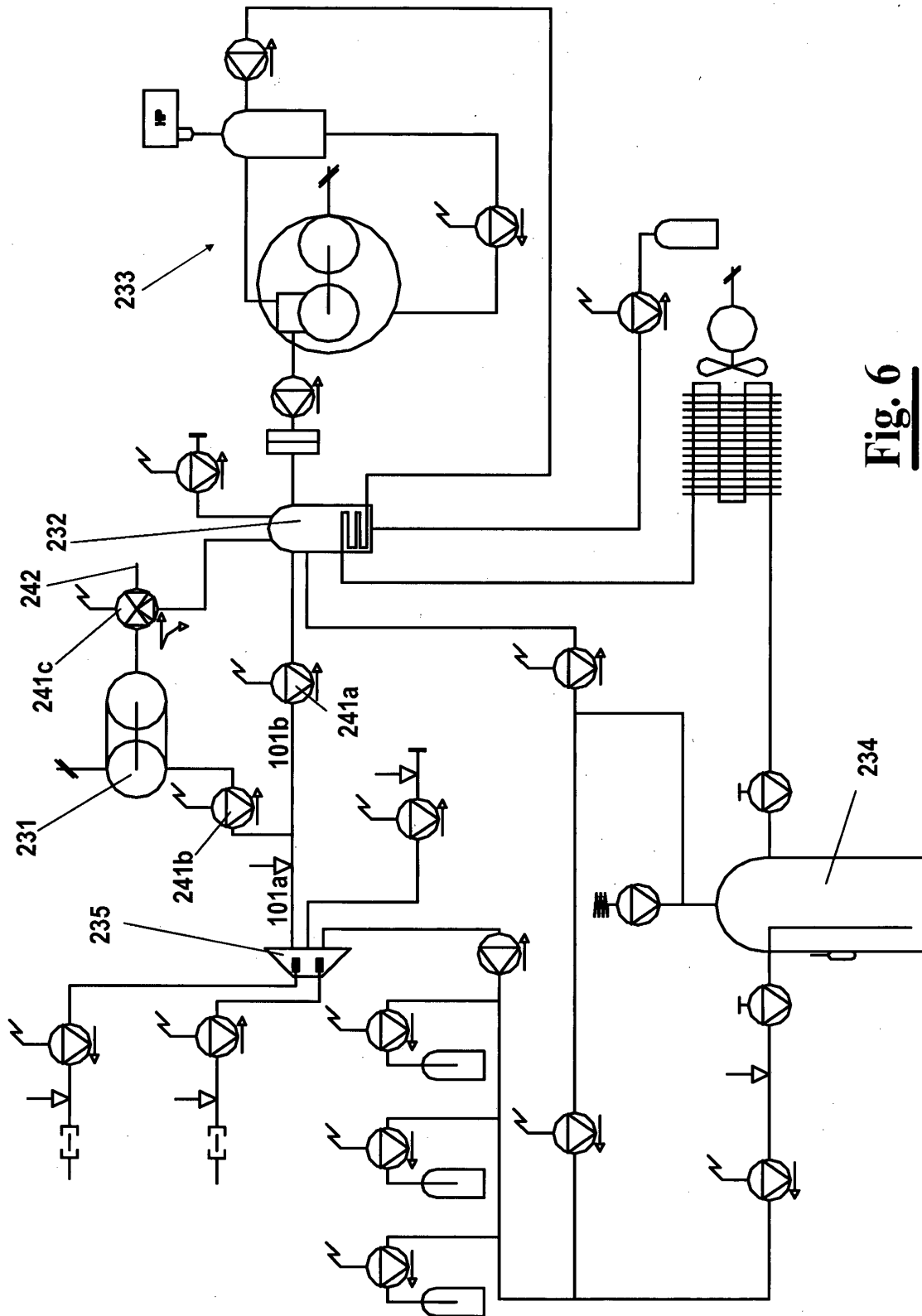


Fig. 6

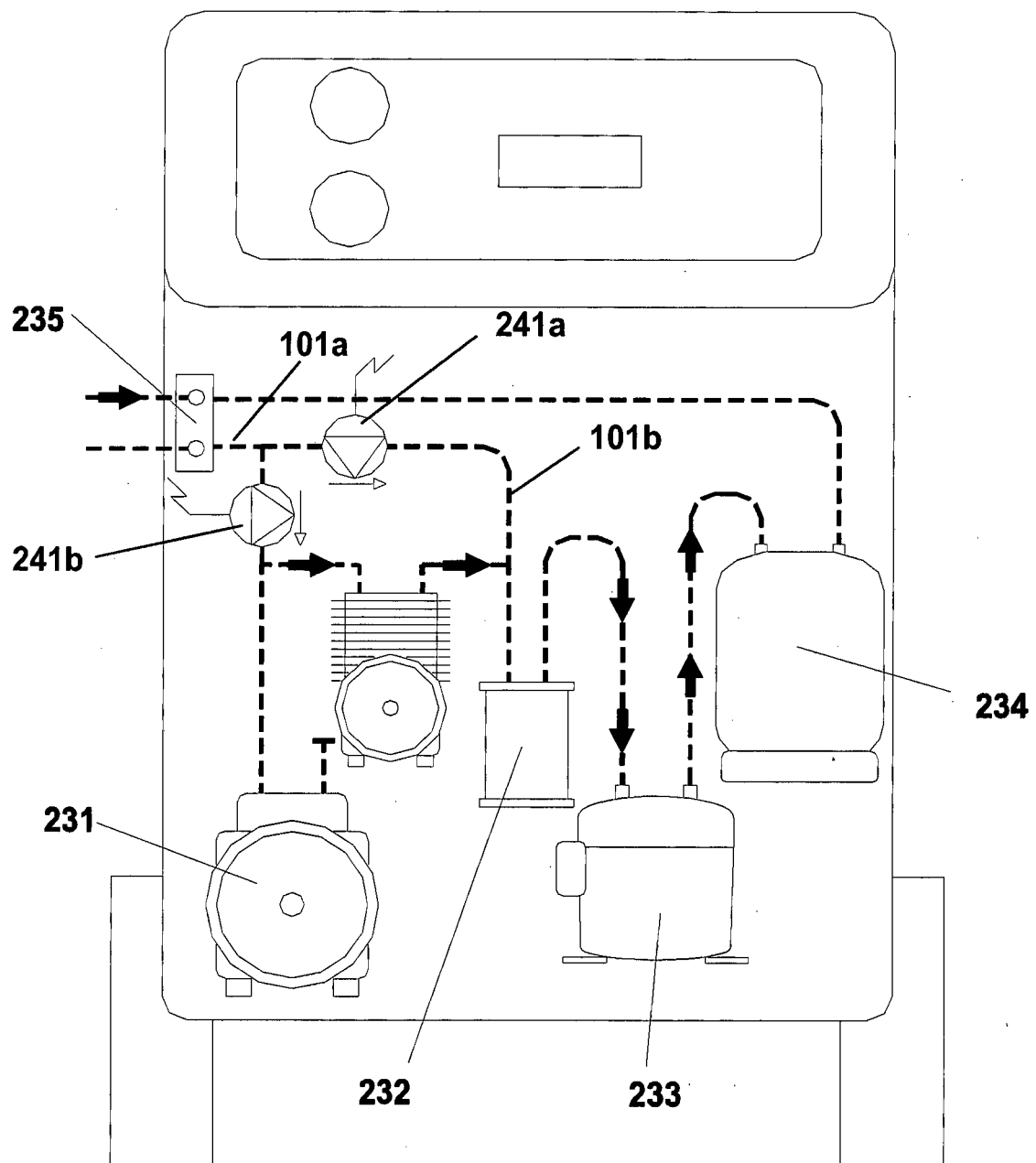


Fig. 7

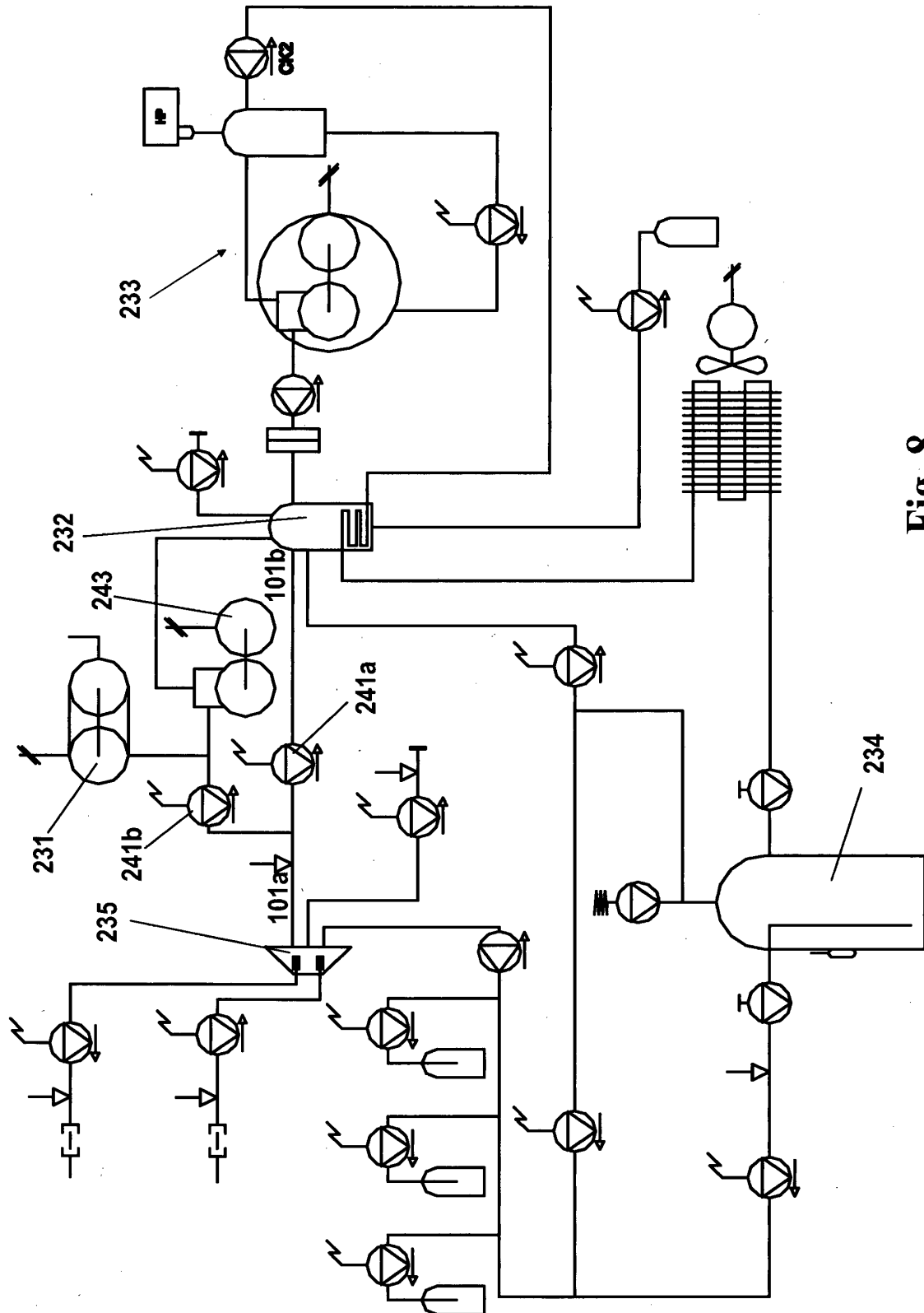


Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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