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(54) MACHINE FOR DRY-CLEANING ARTICLES

MASCHINE ZUM CHEMISCH-REINIGEN

MACHINE DE NETTOYAGE A SEC D'ARTICLES

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Description

Technical Field

[0001] The present invention relates to a machine for dry-cleaning articles such as clothes, household linen, towels, curtains and the like.

[0002] In particular, the present invention relates to the drying circuit of such a machine which is also designed to simultaneously perform an action, also known as abatement, removing from the articles the solvent used for dry-cleaning.

[0003] Examples of such machines are known from documents EP 1584731, or JP 2006 181219, EP 1637641, GB 2060713, US 4494317, JP 08038791.

Background Art

[0004] There are prior art dry-cleaning machines comprising a drying and abatement circuit which, also integrating the drum in which the articles are treated, comprise a fan for circulation of the air, a condenser for condensing the solvent contained in the air and a heating element for heating the air before reintroducing it into the drum in which, thanks to its high temperature, it can remove the dry-cleaning solvent from the articles by vaporisation.

[0005] The condenser usually consists of the evaporator of a refrigeration circuit whilst the condenser of the same circuit forms the above-mentioned air heating element.

[0006] In order that the air circulating in the drying circuit reaches a temperature value sufficient to guarantee an effective drying action and abatement of the solvent from the articles, additional heating elements are used, positioned in series relative to the refrigeration system condenser.

[0007] Such additional heating elements are usually of the type with an electric heating element or steam powered.

[0008] The presence of the heating elements is not without disadvantages. Irrespective of the specific type selected, it involves considerable energy absorption with consequent increases in the costs per dry-cleaning cycle.

Disclosure of the Invention

[0009] The aim of the present invention is to overcome the above-mentioned disadvantage with a machine for dry-cleaning articles such as clothes, household linen, towels, curtains and the like, which allows the effective and economical execution of dry-cleaning and drying cycles for said articles, the machine being simple and economical to make and easy and practical to use.

[0010] The technical features of the present invention, in accordance with the above aims, are clear from the content of the claims herein, in particular claim 1, and from any of the claims directly or indirectly dependent on claim 1.

[0011] The present invention also relates to a method for dry-cleaning articles.

[0012] The method according to the present invention is described in claim 10 and any of the claims directly or indirectly dependent on claim 10.

Brief Description of the Drawings

[0013] The advantages of the present invention are more apparent in the detailed description which follows, with reference to the accompanying drawings which illustrate preferred, non-limiting embodiments of the invention, in which:

- Figure 1 is a schematic view of a preferred embodiment of the machine for dry-cleaning articles in accordance with the present invention;
- Figure 2 is a schematic view of an alternative embodiment of the machine of Figure 1.

Detailed Description of the Preferred Embodiments of the Invention

[0014] With reference to Figure 1, the numeral 1 denotes as a whole the machine for dry-cleaning articles in accordance with the present invention.

[0015] The machine 1 comprises a drum 2 or container in which the articles to be dry-cleaned are inserted.

[0016] The drum 2 rotates, driven by motor elements of the substantially known type not described or illustrated, about an axis of rotation A.

[0017] The machine 1 comprises a closed circuit 3 for the circulation of air for drying the articles contained in the drum 2 which are not illustrated. As Figure 1 clearly shows, the drum 2 is positioned in the closed circuit 3.

[0018] At the drum 2 outfeed, according to the direction of the air flow indicated by the arrows FA illustrated in Figure 1, the closed circuit 3 comprises a filtering zone 4 designed to catch any materials carried by the air flow, such as hairs and threads detached from the articles during drying.

[0019] Downstream of the filtering zone 4, on the circuit 3 there is a fan 5 for moving the air. Downstream of the fan 5, again according to the direction of the arrows FA, the circuit 3 comprises an ascending duct 6 which conveys the air to a condensation battery 7 and to a heating element 8.

[0020] The condensation battery 7 is designed to condense the solvent in vapour form transported by the flow of drying air, whilst the heating element 8 is designed to raise the temperature of the air circulating along the circuit 3.

[0021] At the condensation battery 7 there is a zone 9 for collection of the solvent condensed, which is fed to a collection tank 12 through a recovery duct 10 and a respective filter 11.

[0022] Using inlet and drainage means of the known

type and not illustrated, the solvent is sent to and drained from the drum 2 respectively from and to the collection tank 12.

[0023] Downstream of the heating element 8 the circuit 3 comprises a descending duct 13 which introduces the heated air into the drum 2, thus closing the circuit 3.

[0024] As illustrated in Figure 1, the machine 1 comprises a refrigeration system 14 along which a respective refrigerant flows.

[0025] The refrigeration system 14 comprises, positioned one after another, a refrigerant compressor 15, a first condenser 16, a refrigerant receiver 17, a filter 18 for catching any impurities, a refrigerant expansion valve 19 and a first evaporator 20 for the refrigerant.

[0026] The above-mentioned elements of which the refrigeration system 14 consists are in fluid connection with one another by means of a plurality of pipes having numerous on - off and check valves. Both the pipes and the valves are described in detail below.

[0027] In Figure 1 the above-mentioned pipes are labelled from T1 to T13, whilst the on - off valves are labelled V1 to V7. The check valves are labelled 21.

[0028] As is explained in more detail below, the first evaporator 20 and the first condenser 16 of the refrigeration system 14 are integrated in the closed circuit 3 to perform a heat exchange with the air circulating in it, and they respectively form the heating element 8 and the condensation battery 7. The first condenser 16 and the first evaporator 20 are therefore two heat exchangers which, in the circuit 3, form respective means for the treatment of the air circulating in the circuit 3.

[0029] The refrigeration system 14 also comprises an auxiliary heat exchanger 22 which is positioned outside the circuit 3, so that it does not perform any heat exchange with the air circulating in the circuit 3.

[0030] The auxiliary heat exchanger 22 comprises a respective fan, not illustrated, designed to increase the efficiency of the heat exchange by establishing a forced air flow.

[0031] The machine 1 comprises a computerised control and operating unit for controlling the opening and closing of the on - off valves according to the different machine 1 operating steps.

[0032] Along the air circulation circuit 3, downstream of the fan 5, there is a first element 23 for detecting the air temperature, hereinafter indicated simply as the sensor 23.

[0033] In practice, after inserting the articles to be dry-cleaned in the drum 2, a dry-cleaning solvent is introduced into the drum 2.

[0034] There follows a step in which the drum 2 is made to rotate about its axis A so as to distribute the solvent effectively on the articles to be dry-cleaned.

[0035] Once the dry-cleaning operations are considered complete, the articles must be dried to remove the liquid solvent used for dry-cleaning from them.

[0036] To dry the solvent from the articles, the articles are struck by a flow of hot air.

[0037] Therefore, said air must be treated, both to heat it and to remove from it the solvent which, in the form of vapour, is removed from the articles.

[0038] The air treatment, that is to say, basically its heating and the removal from it, by condensation, of the vaporised solvent, involves special operating steps by the refrigeration system 14 described above.

[0039] In particular, a first step of heating the air from an ambient temperature to to a predetermined temperature t_1, is carried out by activating the passage of the refrigerant through the first condenser 16 forming the circuit 3 heating element 8, but without allowing the refrigerant to circulate through the first evaporator 20 forming the circuit 3 condensation battery 7. In this way, the air circulating in the circuit 3 is heated after the heat exchange which takes place at the heating element 8 and, therefore, its temperature is raised.

[0040] A second step with simultaneous heating of the air and condensing of the vapour contained in it takes place starting from the temperature t_1 until the air reaches a temperature t_2 higher than t_1.

[0041] In this second step the refrigerant passes through both the first condenser 16 to heat the air, and through the first evaporator 20 to condense the solvent contained in the air in vapour form.

[0042] The first step of only heating the air is therefore a transient step in which the air is heated from the temperature to to the temperature t_1.

[0043] During said first transient step of machine 1 starting, the refrigerant coming out of the compressor 15 flows along the pipe T1 as far as the point P1 of intersection with the pipes T2 and T3. From the point P1, with the valve V4 open and the valve V5 closed, the refrigerant flows to the first condenser 16, in the direction indicated by the arrow F1.

[0044] As it passes through the first condenser 16, the refrigerant is condensed, transferring heat to the air circulating in the closed circuit 3, therefore said air is heated.

[0045] As it comes out of the first condenser 16, the refrigerant flows along the pipe T4 according to the direction indicated by the arrow F2 until it reaches the point P2 of intersection of the pipe T4 with the pipes T5 and T6.

[0046] With the valve V2 open and the valve V3 closed, the refrigerant flows along the pipe T5 according to the direction indicated by the arrow F3 and reaches the receiver 17, passing through the point of intersection P3 towards which there also converges a pipe T6' from the auxiliary heat exchanger 22.

[0047] A check valve 21 is advantageously positioned on the pipe T5 close to the point of intersection P3.

[0048] The refrigerant receiver 17 is of the known type and therefore its functions in the refrigeration system 14 are not described in detail.

[0049] The refrigerant coming out of the receiver 17 flows along the pipe T7 according to the direction indicated by the arrow F4 and reaches the expansion valve 19. Positioned along the pipe T7 there is a filter 18 for filtering the refrigerant coming out of the receiver 17,

catching any impurities present in it.

[0050] The refrigerant which expands in the expansion valve 19, with the on - off valve V1 closed and the valve V6 open, passes through the point P5 of intersection between the pipes T8 and T9 and, flowing along the latter according to the direction indicated by the arrow F5, reaches the auxiliary heat exchanger 22. At the latter, the refrigerant performs a heat exchange with the outside air, absorbing heat from it and evaporating.

[0051] Therefore, during the present transient step of machine 1 starting the auxiliary heat exchanger 22 forms a second evaporator, alternative to the first evaporator 20. In said transient step, the refrigerant does not flow through the first evaporator 20.

[0052] During the transient step, the refrigerant comes out of the auxiliary heat exchanger 22 through the pipe T10 along which it flows according to the direction indicated by the arrow F6 to the point P4 of intersection with the pipes T3, T6 and T11.

[0053] With the valves V3 and V5 closed and the valve V7 open, the refrigerant reaches the point P6 of intersection between the pipes T11, T12 and T13, flowing along the pipe T11 according to the direction indicated by the arrow F7. Therefore, passing through the point P6, the refrigerant flows along the pipe T12 according to the direction indicated by the arrow F8 until it goes back into the compressor 15.

[0054] At the same time as the refrigeration system 14 transient step takes place, the air circulating in the closed circuit 3 is heated by heat exchange with the heating element 8 consisting of the refrigeration system 14 first condenser 16.

[0055] The transient cycle described above is repeated until the sensor 23 located downstream of the fan 5 detects air temperature values lower than a predetermined value t_2, for example between 30°C and 40°C. Reaching the temperature value t_2 confirms the end of the transient step and the start of a refrigeration system 14 regular operation step.

[0056] In particular, when the predetermined temperature t_2 is reached, the computerised control and operating unit referred to but not illustrated issues the command to close the valve V6 and simultaneously open the valve V1. In this way, the refrigerant which expanded in the expansion valve 19 flows along the pipe T8 according to the direction indicated by the arrow F9, reaching the first evaporator 20 integrated in the drying circuit 3.

[0057] In practice, whilst in the previous transient step the refrigerant was diverted at the point P5 towards the auxiliary heat exchanger 22, now, in the regular operation step, the refrigerant is directed towards the first evaporator 20.

[0058] At the first evaporator 20, the refrigerant evaporates, absorbing heat from the moist hot air circulating in the closed circuit 3 and so causing the vaporised solvent present in said hot air to condense.

[0059] Most of the thermal power removed from the air at the first evaporator 20 is the latent heat of vaporisation.

[0060] The refrigerant evaporated in the first evaporator 20 then flows along the pipe T13, according to the direction indicated by the arrow F10, towards the point P6 of intersection and from there, because the on - off valve V7 is closed, again into the compressor 15 through the pipe T12.

[0061] Machine 1 operation involves transient safety steps during which the refrigeration system 14 cycle is subject to transient modifications compared with its regular operation just described, so as to bring within predetermined safety ranges several parameters such as the air temperature in the circuit 3 or the pressure of the refrigerant in the refrigeration system 14.

[0062] In a first transient safety step, starting with normal regular operation, if the refrigerant coming out of the compressor 15 reaches a pressure value greater than a predetermined calibration value p_1 of a first pressure switch 24, the computerised control and operating unit closes the valve V4 and, at the same time, opens the valve V5.

[0063] In this way, the refrigerant coming out of the compressor 15, having reached the point P1 of intersection, is diverted along the pipe T3 along which it flows according to the direction indicated by the arrow F11 and, having reached the point P4 of intersection, because the valves V3 and V7 are closed, it flows directly towards the auxiliary heat exchanger 22, through the pipe T10. This time, it flows along the pipe T10 according to the direction indicated by the arrow F12, that is to say, in the opposite direction to that during the transient starting step described above.

[0064] The simple flowing of the refrigerant along the exchange circuit in the auxiliary heat exchanger 22, usually of the coil type, generates, due to the pressure losses linked to the circuit, an inevitable reduction in the pressure of the refrigerant, irrespective of the heat exchange which takes place along the circuit and of the consequent condensation.

[0065] If the refrigerant reaches an even greater pressure value p2, of calibration of a second pressure switch 25, the computerised unit switches on the respective fan, not illustrated, belonging to the auxiliary heat exchanger 22, so as to make the release of heat to the outside even more efficient.

[0066] Therefore, during the present first transient safety step, the auxiliary heat exchanger 22 forms a second condenser for the refrigerant, alternative to the first condenser 16.

[0067] As it comes out of the auxiliary heat exchanger 22, the refrigerant flows along the pipe T6' according to the direction indicated by the arrow F13 and is reintroduced into the receiver 17. From the receiver 17, the refrigerant again flows through the pipe T7 and from there towards the expansion valve 19.

[0068] The first transient safety step is concluded as soon as the pressure switch 24 and/or the pressure switch 25 detect refrigerant pressure values less than their respective calibration values p_1 and p_2.

[0069] A second transient safety step is implemented, starting with normal regular operation, if a second temperature detection element 26 detects a temperature greater than a predetermined safety value t_s for the refrigerant entering the first condenser 16. For example, the value of t_s is advantageously approximately 95°C.

[0070] In the second transient safety step, if it is detected that the refrigerant has reached the temperature value t_s, the computerised control and operating unit, not illustrated, by closing on - off valve V2 and simultaneously opening valve V3, diverts the flow coming out of the first condenser 16 along the pipe T6 along which it flows according to the direction indicated by the arrow F13. Having reached the point P4 of intersection, since both of the valves V5 and V7 are closed, the refrigerant flows directly towards the auxiliary heat exchanger 22, through the pipe T 10, along which it flows according to the direction indicated by the arrow F12.

[0071] At the auxiliary heat exchanger 22, if necessary even by switching on the respective fan, not illustrated, the refrigerant transfers heat to the outside before returning to the receiver 17 and, from there, to the expansion valve 19.

[0072] In this way, the temperature of the refrigerant has been lowered by making it perform an additional heat exchange with the outside, not included in the normal regular operation cycle of the refrigeration system 14.

[0073] Therefore, as in the first transient safety step described above, in this second transient safety step the auxiliary heat exchanger 22 forms a second condenser for the refrigerant, **additional** to the first condenser 16.

[0074] As soon as the temperature of the refrigerant detected by the second detection element 26 returns to values lower than the predetermined valve t_s, the second transient safety step is ended and the computerised control and operating unit returns the valves V2 and V3 to their respective configurations adopted during regular operation of the refrigeration system 14, that is to say: valve V2 open and valve V3 closed.

[0075] The refrigeration system 14 comprises two additional pressure switches: a third safety pressure switch 27, positioned along the pipe T1, and a fourth pressure switch 28 for minimum pressure, positioned along the pipe T11, upstream of the compressor 15.

[0076] The third safety pressure switch 27 is designed, through the computerised control and operating unit with which it is connected, to stop machine 1 operation if the pressure of the refrigerant exceeds a predetermined safety pressure value.

[0077] The fourth pressure switch 28 is designed, through the computerised control and operating unit with which it is connected, to stop machine 1 operation if the pressure of the refrigerant is lower than a predetermined pressure value below which the refrigeration system 14 could be damaged.

[0078] The above-mentioned on - off valves V1, V2, V3, V4, V5; V6, V7, together with the check valves 21, form valve means for the refrigeration system 14.

[0079] Said valve means, together with the computerised control and operating unit referred to but not illustrated, form control means for regulating the flow of refrigerant in the refrigeration system 14.

[0080] Figure 1 does not illustrate means for introducing the solvent into and/or extracting it from the drum 2, since these are of the substantially known type and are not useful to an understanding of the present invention.

[0081] By way of example only, it was proven that using HFC 134a gas (commercially also known as Freon R134a) as the refrigerant, partly because of its low impact on the ozone, the machine operating temperatures, considering to to be ambient temperature, are as follows:

t_1 between 30 and 40 °C,
t_s between 90 and 100 °C.

[0082] Tests have shown optimum machine operation with the air temperature t_1 set at around 36 °C and the maximum temperature t_s of the refrigerant set at around 95 °C.

[0083] The value of temperature t_2 is closely linked to the type of articles being dry-cleaned and to the temperatures they can tolerate without deteriorating. An average drying air temperature t_2 able to allow effective drying of articles is, for example, around 70 °C.

[0084] Again by way of example, assuming that HFC 134a gas is used as the refrigerant, possible values for the calibration pressures p_1 and p_2 of the pressure switches 24 and 25 are, respectively, around 24 Bar and 24.5 Bar.

[0085] Therefore, advantageously, the present invention allows the treatment of the air for drying dry-cleaned articles without the need for thermal power in addition to that supplied by the refrigeration system normally coupled to the machine.

[0086] With the machine disclosed, the thermal power generated with the refrigeration cycle is sufficient to dry the articles. Tests have shown that, with the refrigerant indicated above, the air temperature on average reaches the value of 70 °C in very short periods of time and absolutely compatible with the duration of the dry-cleaning cycles currently used.

[0087] According to the alternative embodiment illustrated in Figure 2, the machine 1 comprises a circuit 100 for cooling the solvent fed to the drum 2, the circuit 100 extending from the pipe T7, downstream of the filter 18 according to the direction indicated by the arrow F4.

[0088] The circuit 100 comprises an on - off valve V8, a cooler 101 and, inserted between them, an expansion valve 102. The cooler 101 comprises a coil heat exchanger 103 outside which there flows the above-mentioned solvent to be sent into the drum 2. Figure 2 does not illustrate the respective solvent feed and extraction ducts to and from the cooler 101, since they are considered to be of the substantially known type. In practice, by means of the on - off valve V8, the refrigerant coming out of the filter 18 is diverted to the cooling circuit 100 and expands

at the expansion valve 102.

[0089] The refrigerant which expanded in the valve 102 flows along the circuit 100, reaching the cooler 101, where it evaporates, absorbing heat from the solvent circulating outside the coil heat exchanger 103, thus causing the solvent to cool. The circuit 100 joins the pipe T12 again and the refrigerant then flows towards the compressor 15.

[0090] Use of the solvent cooling circuit 100 disclosed by the alternative embodiment illustrated in Figure 2 advantageously allows the temperature of the solvent to be kept within required values, thus guaranteeing, when necessary, the availability of low temperature solvent, for example for dry-cleaning delicate articles.

[0091] The invention described above may be modified and adapted in several ways without thereby departing from the scope of the inventive concept. Moreover, all details of the invention may be substituted by technically equivalent elements.

Claims

1. A machine for dry-cleaning articles such as clothes and the like, comprising:

   a rotary drum (2) for containing the articles,
   means for introducing solvent into and draining it from the drum,
   a substantially closed circuit (3) for circulation of air for drying the solvent from the articles contained in the drum (2), the circuit (3) comprising at least one fan (5) for moving the air, a first evaporator (20) of a refrigeration system (14) for condensing the solvent contained in the air, and a first condenser (16) belonging to the refrigeration system (14) for heating the air to be reintroduced into the drum (2); the refrigeration system (14) comprising an auxiliary heat exchanger (22), outside the closed circuit (3) for circulation of the air and control means for feeding towards the auxiliary heat exchanger (22), at least for predetermined periods, the refrigerant normally flowing between the first evaporator (20) and the first condenser (16); **characterised in that** the machine is configured such that, depending on the working step of the machine itself, the auxiliary heat exchanger (22) forms a second evaporator, alternative to the first evaporator (20), or a second condenser, alternative or additional to the first condenser (16).

2. The machine according to claim 1, **characterised in that** the control means comprise valve means (V1, V6) for diverting towards the auxiliary heat exchanger (22) the refrigerant which normally flows towards the first evaporator (20) of the refrigeration system (14), when the auxiliary heat exchanger (22) forms a second evaporator, alternative to the first evaporator (20).

3. The machine according to claim 1, **characterised in that** the control means comprise valve means (V4, V5) for diverting towards the auxiliary heat exchanger (22) the refrigerant which normally flows towards the first condenser (16) of the refrigeration system (14), when the auxiliary heat exchanger (22) forms a second condenser, alternative to the first condenser (16).

4. The machine according to claim 1, **characterised in that** the control means comprise valve means (V2, V3) for diverting towards the auxiliary heat exchanger (22) the refrigerant coming out of the first condenser (16), when the auxiliary heat exchanger (22) forms a second condenser, in addition to the first condenser (16).

5. The machine according to any of the claims from 1 to 4, **characterised in that** the auxiliary heat exchanger (22) comprises a respective auxiliary fan designed to increase the efficiency of the heat exchange by means of a forced air flow.

6. The machine according to any of the claims from 2 to 5, **characterised in that** it comprises a computerised control and operating unit, the unit controlling the valve means (V1, V2, V3, V4, V5, V6, V7) and the auxiliary fan according to the achievement of predetermined temperature and/or pressure values by the refrigerant and/or the air circulating in the closed circuit (3).

7. The machine according to claim 6, **characterised in that** the computerised control and operating unit comprises a first element (23) for detecting the air temperature, positioned along the closed circuit (3).

8. The machine according to claim 6, **characterised in that** the computerised control and operating unit comprises at least a second element (26) for detecting the temperature of the refrigerant.

9. The machine according to any of the claims from 1 to 8, **characterised in that** it comprises a circuit (100) for cooling the solvent to be fed to the drum (2).

10. The machine according to claim 9, **characterised in that** the cooling circuit (100) comprises a further heat exchanger (103) along which refrigerant flows.

11. A method for dry-cleaning articles such as clothes and the like, comprising the steps of:

    introducing a dry-cleaning solvent into a drum (2) for containing the articles,

rotating the drum (2) to distribute the solvent on the articles,
making an air flow circulate along a substantially closed circuit (3) in which the drum (2) is integrated,
treating the air to dry the solvent from the articles, the method being **characterised in that** the air treatment step comprises a step of heating the air from **a** first temperature (t_0) to a second predetermined temperature (t_2) and a step of condensing the solvent contained in the air, the condensing step being implemented only from when the air has reached a predetermined intermediate temperature (t_1), between the first and second temperatures (t_0, t_2); a step of feeding an auxiliary heat exchanger (22), placed outside the closed circuit (3), forming a second evaporator, **alternative to the first evaporator (20),** or a second condenser, **alternative or additional to the first condenser (16),** of the refrigeration system (14) for heating or cooling the refrigerant depending on the working step of the machine itself.

12. The method according to claim 11, wherein the step of condensing the air is implemented by passing the air flow through a condensation battery (7) consisting of a first evaporator (20) of a refrigeration system (14) in which a refrigerant circulates, the method being **characterised in that** the refrigerant is fed to the first evaporator (20) only after the air has reached a temperature greater than or equal to the predetermined intermediate temperature (t_1).

13. The method according to claim 12, **characterised in that** during the step of heating the air from the first temperature (t_0) to the intermediate temperature (t_1), the refrigerant is fed to the auxiliary heat exchanger (22) outside the closed circuit (3), the auxiliary heat exchanger (22) forming a second evaporator of the refrigeration system (14), alternative to the first evaporator (20).

14. The method according to claim 12, **characterised in that** during a safety step for reducing the pressure of the refrigerant, the refrigerant is fed to the auxiliary heat exchanger (22) outside the closed circuit (3), the auxiliary heat exchanger (22) forming a second condensator of the refrigeration system (14), alternative to the first evaporator (20).

15. The method according to claim 12, **characterised in that** during a safety step for reducing the temperature of the refrigerant, the refrigerant is fed to the auxiliary heat exchanger (22) outside the closed circuit (3), the auxiliary heat exchanger (22) forming a second condensator of the refrigeration system (14), in addition to the first condensator (20).

Patentansprüche

1. Maschine zum chemischen Reinigen von Artikeln wie Kleidungsstücken u. Ä., umfassend:

eine Drehtrommel (2) zum Enthalten der Artikel, Mittel zum Einführen von Lösungsmittel in die Trommel und zu dessen Entleeren aus der Trommel,
einen im wesentlichen geschlossenen Kreislauf (3) für die Luftzirkulation zum Trocknen des Lösungsmittels auf den in der Trommel (2) enthaltenen Artikeln, wobei der Kreislauf (3) mindestens einen Lüfter (5) zur Bewegung der Luft, einen ersten Verdampfer (20) eines Kühlsystems (14) zum Kondensieren des in der Luft enthaltenen Lösungsmittels, und einen ersten Kondensator (16), der dem Kühlsystem (14) angehört, zum Erhitzen der Luft, die erneut in die Trommel (2) einzuleiten ist; das Kühlsystem (14) umfasst einen Hilfswärmetauscher (22) außerhalb des geschlossenen Kreislaufs (3) für die Zirkulation der Luft sowie Kontrollmittel, um dem Hilfswärmetauscher (22) zumindest in bestimmten Zeiträumen das Kältemittel zuzuführen, das normalerweise zwischen dem ersten Verdampfer (20) und dem ersten Kondensator (16) strömt;
dadurch gekennzeichnet, dass die Maschine so ausgestaltet ist, dass der Hilfswärmetauscher (22) je nach Arbeitsschritt der Maschine einen zweiten Verdampfer bildet, alternativ zum ersten Verdampfer (20), oder einen zweiten Kondensator, alternativ oder zusätzlich zum ersten Kondensator (16).

2. Maschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kontrollmittel Ventilmittel (V1, V6) umfassen, um das Kältemittel, das normalerweise zum ersten Verdampfer (20) des Kühlsystems (14) strömt, zum Hilfswärmetauscher (22) umzuleiten, wenn der Hilfswärmetauscher (22) einen zweiten Verdampfer bildet, alternativ zum ersten Verdampfer (20).

3. Maschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kontrollmittel Ventilmittel (V4, V5) umfassen, um das Kältemittel, das normalerweise zum ersten Kondensator (16) des Kühlsystems (14) strömt, zum Hilfswärmetauscher (22) umzuleiten, wenn der Hilfswärmetauscher (22) einen zweiten Kondensator bildet, alternativ zum ersten Kondensator (16).

4. Maschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kontrollmittel Ventilmittel (V2, V3) umfassen, um das Kältemittel, das aus dem ersten Kondensator (16) strömt, zum Hilfswärmetauscher (22)

umzuleiten, wenn der Hilfswärmetauscher (22) einen zweiten Kondensator zusätzlich zum ersten Kondensator (16) bildet.

5. Maschine nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** der Hilfswärmetauscher (22) einen jeweiligen Hilfslüfter umfasst, der ausgelegt wurde, um den Wirkungsgrad des Wärmetauschs mittels eines Zwangsluftstroms zu erhöhen.

6. Maschine nach einem der Ansprüche 2 bis 5, **dadurch gekennzeichnet, dass** sie eine computergesteuerte Steuer- und Betriebseinheit umfasst, wobei diese Einheit die Ventilmittel (V1, V2, V3, V4, V5, V6, V7) und den Hilfslüfter je nach Erreichen bestimmter Temperatur- und/oder Druckwerte durch das im geschlossenen Kreislauf (3) zirkulierende Kältemittel und/oder die Luft steuert.

7. Maschine nach Anspruch 6, **dadurch gekennzeichnet, dass** die computergesteuerte Steuer- und Betriebseinheit ein erstes Element (23) umfasst, um die Lufttemperatur zu erfassen, das entlang des geschlossenen Kreislaufs (3) positioniert ist.

8. Maschine nach Anspruch 6, **dadurch gekennzeichnet, dass** die computergesteuerte Steuer- und Betriebseinheit mindestens ein zweites Element (26) umfasst, um Kältemitteltemperatur zu erfassen.

9. Maschine nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet, dass** sie einen Kreislauf (100) zum Kühlen des Lösungsmittels, das in die Trommel (2) eingespeist wird, umfasst.

10. Maschine nach Anspruch 9, **dadurch gekennzeichnet, dass** der Kühlkreislauf (100) einen weiteren Wärmetauscher (103),entlang dessen das entsprechenden Kältemittel strömt, umfasst.

11. Verfahren zum chemischen Reinigen von Artikeln wie Kleidungsstücken u. Ä., umfassend folgende Schritte:

Einführen eines Lösungsmittels für die chemische Reinigung in eine Trommel (2) zum Enthalten der Artikel,
Drehen der Trommel (2), um das Lösungsmittel auf die Artikel zu verteilen,
Erzeugung eines Lufstroms, der entlang eines im Wesentlichen geschlossenen Kreislaufs (3) zirkuliert,
in den die Trommel (2) integriert ist,
Behandlung der Luft, um das Lösungsmittel auf den Artikeln zu trocknen, wobei das Verfahren **dadurch gekennzeichnet ist, dass** der Schritt der Luftbehandlung einen Schritt des Erhitzens der Luft von einer ersten Temperatur (t_0) auf eine zweite vorgegebene Temperatur (t_2) und einen Schritt des Kondensierens des in der Luft enthaltenen Lösungsmittels umfasst, wobei der Kondensierungsschritt nur implementiert wird, wenn die Luft eine vorgegebene Zwischentemperatur (t_1) zwischen der ersten und der zweiten Temperatur (t_0, t_2) erreicht hat; einen Schritt zur Speisung eines Hilfswärmetauschers (22), der außerhalb des geschlossenen Kreislaufs (3) platziert ist und einen zweiten Verdampfer, alternativ zum ersten Verdampfer (20), oder einen zweiten Kondensator, alternativ oder zusätzlich zum ersten Kondensator (16), des Kühlsystems (14) bildet, um das Kältemittel abhängig von Arbeitsschritt der Maschine zu erhitzen oder zu kühlen.

12. Verfahren nach Anspruch 11, wobei der Schritt des Kondensierens der Luft dadurch implementiert wird, dass der Luftstrom durch einen Verflüssigersatz (7), bestehend aus einem ersten Verdampfer (20) eines Kühlsystems (14), in dem ein Kältemittel zirkuliert, strömt, wobei das Verfahren **dadurch gekennzeichnet ist, dass** das Kältemittel nur dann zum ersten Verdampfer (20) geleitet wird, wenn die Luft eine Temperatur erreicht hat, die höher oder gleich der vorgegebenen Zwischentemperatur (t_1) ist.

13. Verfahren nach Anspruch 12, **dadurch gekennzeichnet, dass** das Kältemittel während des Schritts des Erhitzens der Luft von der ersten Temperatur (t_0) auf die Zwischentemperatur (t_1) zum Hilfswärmetauscher (22) außerhalb des geschlossenen Kreislaufs (3) geleitet wird, wobei der Hilfswärmetauscher (22) einen zweiten Verdampfer des Kühlsystems (14) bildet, alternativ zum ersten Verdampfer (20).

14. Verfahren nach Anspruch 12, **dadurch gekennzeichnet, dass** das Kältemittel während eines Sicherheitsschritts zur Reduzierung des Drucks des Kältemittels zum Hilfswärmetauscher (22) außerhalb des geschlossenen Kreislaufs (3) geleitet wird, wobei der Hilfswärmetauscher (22) einen zweiten Kondensator des Kühlsystems (14) bildet, alternativ zum ersten Verdampfer (20).

15. Verfahren nach Anspruch 12, **dadurch gekennzeichnet, dass** das Kältemittel während eines Sicherheitsschritts zur Reduzierung der Temperatur des Kältemittels zum Hilfswärmetauscher (22) außerhalb des geschlossenen Kreislaufs (3) geleitet wird, wobei der Hilfswärmetauscher (22) einen zweiten Kondensator des Kühlsystems (14) bildet, zusätzlich zum ersten Kondensator (20).

Revendications

1. Machine de nettoyage à sec d'articles tels que des vêtements et similaires, comprenant :

   un tambour rotatif (2) pour contenir les articles, un moyen pour y introduire du solvant et le drainer à l'extérieur du tambour,
   un circuit essentiellement fermé (3) pour la circulation de l'air de séchage du solvant contenu dans les articles présents dans le tambour (2), le circuit (3) comprenant au moins une soufflante (5) pour brasser l'air, un premier évaporateur (20) d'un système de réfrigération (14) pour condenser le solvant contenu dans l'air, et un premier condensateur (16) faisant partie du système de réfrigération (14) pour chauffer l'air qui doit être introduit à l'intérieur du tambour (2) ; le système de réfrigération (14) comprenant un échangeur de chaleur auxiliaire (22), à l'extérieur du circuit fermé (3) pour la circulation de l'air et un moyen de commande pour alimenter l'échangeur de chaleur auxiliaire (22), au moins durant des périodes déterminées, avec le frigorigène s'écoulant normalement entre le premier évaporateur (20) et le premier condensateur (16) ; **caractérisé en ce que** la machine est configurée de sorte qu'en fonction de l'étape de fonctionner de cette dernière, l'échangeur de chaleur auxiliaire (22) forme un deuxième évaporateur, représentant une alternative au premier évaporateur (20), ou un deuxième condensateur, représentant une alternative au premier condensateur (16).

2. Machine selon la revendication 1, **caractérisée en ce que** le moyen de commande comprend des moyens à vanne (V1, V6) pour dévier vers l'échangeur de chaleur auxiliaire (22) le frigorigène qui s'écoule normalement vers le premier évaporateur (20) du système de réfrigération (14), lorsque l'échangeur de chaleur auxiliaire (22) forme un deuxième évaporateur, représentant une alternative au premier évaporateur (20).

3. Machine selon la revendication 1, **caractérisée en ce que** le moyen de commande comprend des moyens à vanne (V1, V6) pour dévier vers l'échangeur de chaleur auxiliaire (22) le frigorigène qui s'écoule normalement vers le premier condensateur (16) du système de réfrigération (14), lorsque l'échangeur de chaleur auxiliaire (22) forme un deuxième condensateur, représentant une alternative au premier condensateur (16).

4. Machine selon la revendication 1, **caractérisée en ce que** le moyen de commande comprend des moyens à vanne (V2, V3) pour dévier vers l'échangeur de chaleur auxiliaire (22) le frigorigène sortant du premier condensateur (16), lorsque l'échangeur de chaleur auxiliaire (22) forme un deuxième condensateur, représentant un supplément au premier condensateur (16).

5. Machine selon l'une quelconque des revendications 1 à 4, **caractérisée en ce que** l'échangeur de chaleur auxiliaire (22) comprend une soufflante auxiliaire respective conçue pour augmenter l'efficacité de l'échange de chaleur au moyen d'un flux d'air forcé.

6. Machine selon l'une quelconque des revendications 2 à 5, **caractérisée en ce qu'**elle comprend une unité de contrôle et de fonctionnement informatisée, l'unité contrôlant les moyens à vanne (V1, V2, V3, V4, V5, V6, V7) et la soufflante auxiliaire selon l'obtention d'une température et/ou de valeurs de pression prédéterminées de la part du frigorigène et/ou de l'air circulant dans le circuit fermé (3).

7. Machine selon la revendication 6, **caractérisée en ce que** l'unité de contrôle et de fonctionnement informatisée comprend un premier élément (23) pour détecter la température de l'air, positionné le long du circuit fermé (3).

8. Machine selon la revendication 6, **caractérisée en ce que** l'unité de contrôle et de fonctionnement informatisée comprend au moins un deuxième élément (26) pour détecter la température du frigorigène.

9. Machine selon l'une quelconque des revendications 1 à 8, **caractérisée en ce qu'**elle comprend un circuit (100) pour refroidir le solvant qui doit alimenter le tambour (2).

10. Machine selon la revendication 9, **caractérisée en ce que** le circuit de refroidissement (100) comprend un échangeur de chaleur (103) supplémentaire le long duquel s'écoule le frigorigène.

11. Procédé de nettoyage à sec d'articles tel que des vêtements et similaires, comprenant les étapes de :

    introduire un solvant pour le nettoyage à sec à l'intérieur d'un tambour (2) destiné à contenir les articles,
    tourner le tambour (2) pour distribuer le solvant sur les articles,
    faire en sorte qu'un flux d'air circule le long d'un circuit essentiellement fermé (3) auquel est intégré le tambour (2),
    traiter l'air pour sécher le solvant contenu dans les articles, le procédé étant **caractérisé en ce que** l'étape de traiter l'air comprend une étape de réchauffer l'air de la première température

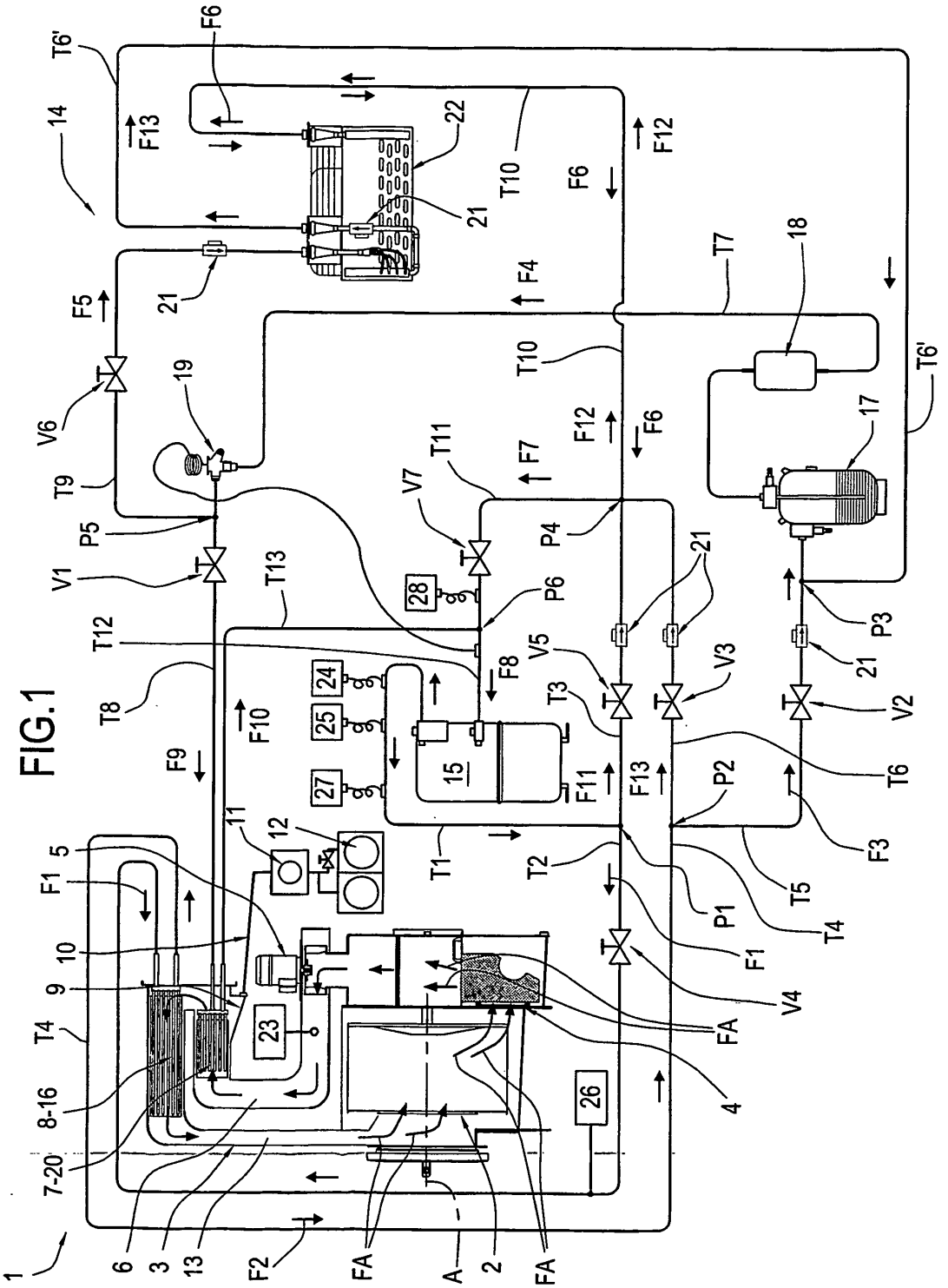
(t_0) à une deuxième température prédéterminée (t_2) et une étape de condenser le solvant présent dans l'air, l'étape de condenser étant exécutée uniquement lorsque l'air a atteint une température intermédiaire prédéterminée (t_1), entre la première et la deuxième température (t_0, t_2) ; une étape d'alimenter un échangeur de chaleur auxiliaire (22), placé à l'extérieur du circuit fermé (3), formant un deuxième évaporateur, représentant une alternative au premier évaporateur (20), ou un deuxième condensateur, représentant une alternative ou un supplément au premier condensateur (16), du système de réfrigération (14) pour réchauffer ou refroidir le frigorigène en fonction de l'étape de fonctionner de la machine.

12. Procédé selon la revendication 11, où l'étape de condenser l'air est exécutée en faisant passer le flux d'air à travers une batterie de condensation (7) consistant en un premier évaporateur (20) d'un système de réfrigération (14) dans lequel circule un frigorigène, le procédé étant **caractérisé en ce que** le frigorigène alimente le premier évaporateur (20) uniquement après que l'air a atteint une température supérieure ou égale à la température intermédiaire prédéterminée (t_1).

13. Procédé selon la revendication 12, **caractérisé en ce que**, durant l'étape de réchauffer l'air de la première température (t_0) à la température intermédiaire (t_1), le frigorigène alimente l'échangeur de chaleur auxiliaire (22) à l'extérieur du circuit fermé (3), l'échangeur de chaleur auxiliaire (22) formant un deuxième évaporateur du système de réfrigération (14), représentant une alternative au premier évaporateur (20).

14. Procédé selon la revendication 12, **caractérisé en ce que**, durant une étape de sûreté de réduire la pression du frigorigène, ce dernier alimente l'échangeur de chaleur auxiliaire (22) à l'extérieur du circuit fermé (3), l'échangeur de chaleur auxiliaire (22) formant un deuxième condensateur du système de réfrigération (14), représentant une alternative au premier évaporateur (20).

15. Procédé selon la revendication 12, **caractérisé en ce que**, durant une étape de sûreté de réduire la température du frigorigène, ce dernier alimente l'échangeur de chaleur auxiliaire (22) à l'extérieur du circuit fermé (3), l'échangeur de chaleur auxiliaire (22) formant un deuxième condensateur du système de réfrigération (14), représentant un supplément au premier condensateur (20).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T4
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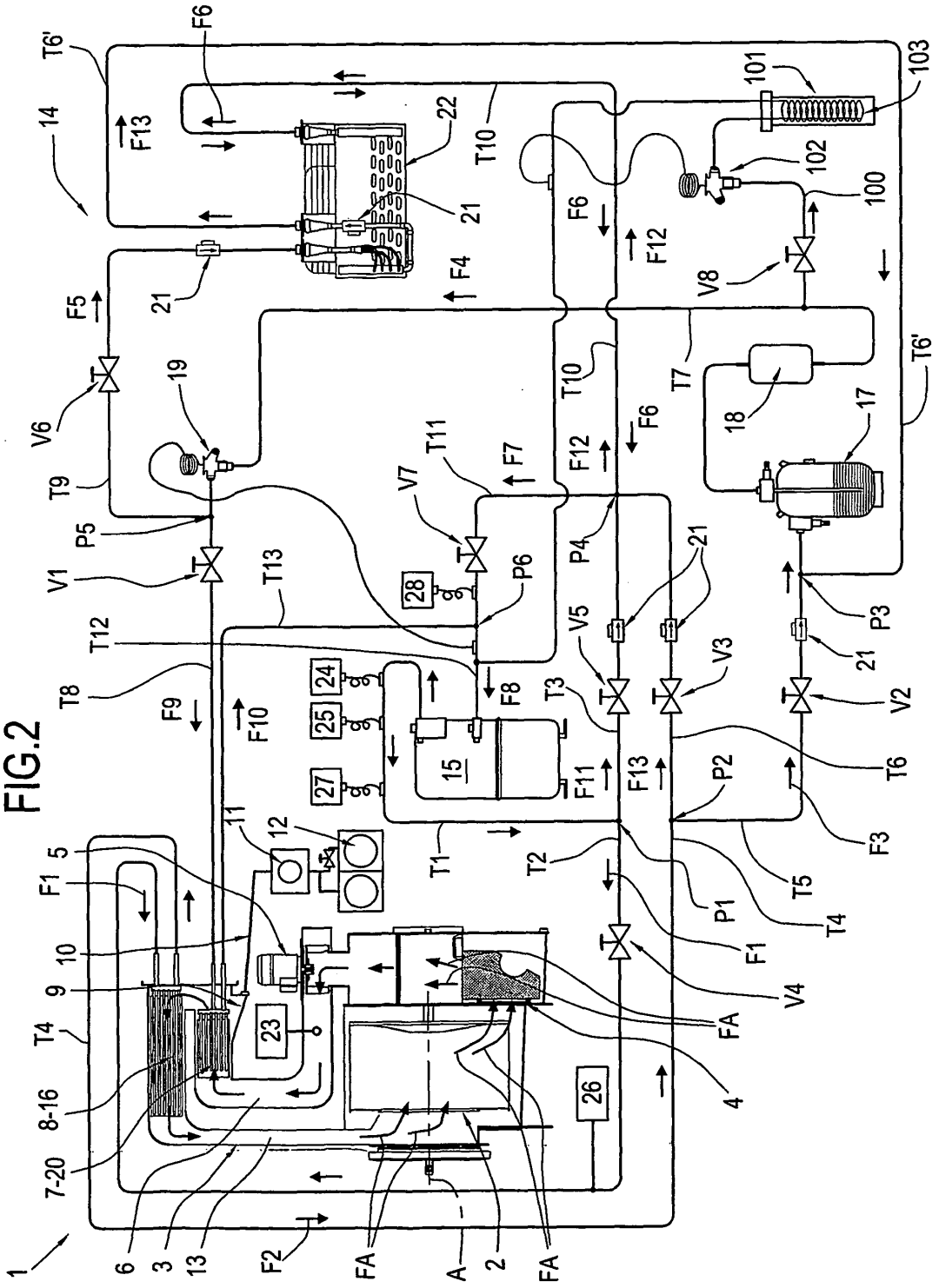
FIG.1

FIG.2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REFERENCES CITED IN THE DESCRIPTION

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