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(54) **Dryer with a heat pump and at least one secondary fluid circuit**

Trockner mit einer Wärmepumpe und mindestens einer sekundären Fluidschaltung

Séchoir avec pompe thermique et au moins un circuit fluide secondaire

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(56) References cited:
DE-U1-202007 000 825 **JP-A- 2003 265 880**

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Description

[0001] The invention relates to a dryer with a treatment chamber for articles to be dried, a process air circuit, wherein heated process air is moved by means of a blower above and through the articles to be dried, and a heat pump with a first heat exchanger, and with a secondary fluid circuit containing a secondary fluid provided between the process air circuit and the first heat exchanger.

[0002] Such dryer is apparent from DE 20 2007 000 825 U1. This document discloses a condensation dryer with a treatment chamber for items to be dried (in general wet clothes), a process air circuit in which a heating is disposed for heating the process air and wherein the heated process air can be led by means of a blower along the items to be dried, and a heat pump with an evaporator, a compressor and a condenser. Secondary fluid circuits are placed between the process air circuit and the heat pump circuit. Each secondary fluid circuit is provided for transfer of heat between the heat pump and the process air circuit and contains a secondary heat transfer fluid which is water kept at more or less normal ambient pressure.

[0003] DE 41 04 760 A1, EP 0 636 732 B1 and EP 0 695 826 B1 disclose washer-dryers that are machines which provide combinations of the functions of washing and drying in one machine.

[0004] In general, clothes dryers including washer-dryers that perform not only drying, but also washing of laundry, are used as exhaust air or circulating air dryers. In both cases, air (so-called "process air") is led by means of a blower over a heating and into a drum containing wet laundry, the drum being applied as a drying chamber. The hot air takes up humidity from the laundry to be dried. In the case of an exhaust air dryer, the air which is loaded with humidity upon exiting the drum is in general led out of the dryer with no heat energy being recovered. In the case of a circulating air dryer, however, the process air is moved in a closed circuit. Circulating air dryers are thus generally designed as condensation dryers.

[0005] Condensation dryers whose function is based upon the condensation of evaporated humidity from laundry do no require an exhaust hose for exhausted air and allow the recovery of energy from the heated process air, for example by using a heat pump. Condensation dryers are very popular, because they can be used in bathrooms which are located inside an apartment or laundries of larger condominium complexes.

[0006] An exhaust air dryer with recovery of energy is known from DE 300 00 865 A1 or from a document from the database Patent Abstracts of Japan and relating to the publication JP 2004 089 415 A. In an exhaust air dryer with recovery of heat energy, in general ambient air (of for example 20°C and 60% relative humidity; so-called "supply air") flows into an air-to-air heat exchanger or a heat source of a heat pump where it is heated through cooling of warm process air coming from the drying chamber. The already warmed air is again conducted to the heating and thereafter led into the drum. Depending on the cooling power and the heat exchange, respectively, condensed water is produced that is collected in a container for later disposal or pumped down. By using a heat pump as an alternative to the heat exchanger, a loss of energy can be reduced significantly. In a condensation dryer equipped with a heat pump, the cooling of the warm humid process air is effected mainly in a heat sink of the heat pump; such heat ink may be an evaporator, where the heat energy transferred is used for evaporating a refrigerant circulated through the heat pump. The refrigerant of the heat pump which has been evaporated due to the heating is led through a compressor to the condenser that is the heat source of the heat pump, where heat energy is set free on account of the condensation of the gaseous refrigerant. This heat energy is used for heating the process air before it is introduced into the drum.

[0007] In a common heat pump comprising an evaporator, a liquefier, a nozzle and a compressor, the compressor will operate optimally in a specific temperature range of the heat transfer fluid or refrigerant that is being circulated. Problematic during the use of such compressor heat pump in a condensation dryer is the often high temperature in the liquefier that may require that the compressor be turned off during the drying process and/or result in a worsening of the efficiency of the heat pump. This problem is more pronounced when the compressor is supported by an additional heating in the process circuit in order to achieve a faster heating of the process air and thus a shorter drying time. Controlling the heat pump (for example via a decrease of the refrigerant temperature) is thus cumbersome.

[0008] The commonly used air-to-air heat exchanger - in cross operation or in counter flow operation - and the electric heating are in general replaced in total by a heat pump. In this way, an improvement in energy efficiency by about 20 % to 50 % can be achieved. With a dryer of this type, very energy efficient drying is possible. Moreover, a dryer are known that employs a heat pump with a small compressor and a small refrigerant circuit, respectively. In this case, lack of heating or condensation heat is supplemented by means of an electric resistance heating and/or an air air-to-air heat exchanger. Such a dryer can be operated with a heat pump alone, with the heat pump and the electric resistance heating in combination, or with the resistance heating and/or the air to air heat exchanger.

[0009] Heat pump dryers and heat pump washer/dryers use heat exchangers made of tubes and fins. These heat exchangers are of the refrigerant-to-air type where refrigerant is inside the tubes and air is in contact with the fins. This type of heat exchanger shows in general a high resistance to airflow and produces a large pressure drop.

[0010] Another problem with a heat pump in a dryer is the pollution of the two heat exchangers in the heat pump (evaporator, condenser), in particular of the evaporator, by lint carried along by the process air. Fins tend to collect quite a lot of lint, due to the shape of the fin and the small spacing required between the fins. Unfortunately, the lint contained in the process air cannot be deposited totally in the lint filter, since an improvement of the filtering power of the lint filter is accompanied by an increase in the flow resistance. The lint deposits, for example as film on the cooling fins of the evaporator, and thus increases the heat volume resistance. This leads to a reduction of airflow and performance, and thus a worsening of the efficiency of the heat exchanger.

[0011] Since evaporator and condenser of the heat pump are in general soldered in tight fashion with the compressor and the nozzle to ascertain complete retention of the refrigerant, they cannot be removed from the heat pump for cleaning.

[0012] These problems are more pronounced when a heat pump is used in a combined washer/dryer. A washer/dryer has a more complicated construction with less available space for heat exchangers and with a higher pressure drop in the air channels. It is thus of great importance in a combined washer/dryer to have a heat exchanger with such a shape that produces a reduced pressure drop. The problem with the accumulation of lint in the heat exchanger of a washer/dryer is at least as big as in a pure dryer.

[0013] In normal practice, washing and drying of laundry are operated as a sequence of mutually independent processes. While some consideration has been made in view of providing links between the processes to allow for recycling of matter (water, predominantly) and energy (heat, predominantly) used in one process in another executed subsequently, no products that allow such recycling and dedicated to widespread use have established themselves in the market so far.

[0014] An object of the present invention in view of the above outlined is to provide a dryer with a heat pump that is dedicated to utilizing a resource from another process to improve a drying process executed in the dryer.

[0015] This object is achieved according to the present invention by means of the dryer with the features of the independent patent claim attached. Preferred embodiments of the dryer according to the invention are shown in dependent claims.

[0016] The invention is thus directed to a dryer with a treatment chamber for articles to be dried, a process air circuit, wherein heated process air is moved by means of a blower above and through the articles to be dried, and a heat pump with a first heat exchanger, and with a secondary fluid circuit containing a secondary fluid provided between the process air circuit and the first heat exchanger. Said secondary fluid circuit comprises a second heat exchanger to exchange heat from said secondary fluid to water flowing in a water guide of a water-processing machine associated to said dryer.

[0017] According to the invention, the secondary fluid circuit is used as a terminal to plant an amount of heat (which may be positive or negative) into the dryer, for use in a drying process performed in the dryer and to assist the heat pump in the dryer, the amount of heat being taken from water flowing in a water guide of a water-processing device associated to the dryer.

[0018] In the dryer according to the present invention, the heat pump thus dispenses its cooling or heating power via a secondary fluid in at least one secondary fluid circuit to the process air circuit of the dryer. In this way, the cooling and the heating power may be produced centrally in a heat pump which might be very compact in the dryer of the present invention.

[0019] In accordance with preferred embodiments of the invention, the water-processing device is a washing machine associated to the dryer. A washing machine and a dryer are often placed into mutual vicinity or integrated into one machine as a washer-dryer. In any case such washing machine uses fresh water drawn from a freshwater supply, such freshwater having a fairly low temperature somewhat below 10 °C and needing to be heated for use. According to the invention, such freshwater may be passed through the second heat exchanger in the secondary fluid circuit as coupled to the heat sink of the heat pump, to cool the secondary fluid and provide the heat pump with some additional cooling power. Likewise, hot suds from the washing machine may be passed through the second heat exchanger in the secondary fluid circuit as coupled to the heat source of the heat pump, to heat the secondary fluid and provide the heat pump with some additional heating. Most preferably, the cooling or heating of the secondary fluid is done prior to putting the dryer into operation, thus giving the dryer an advantageous preconditioning.

[0020] When, in an embodiment of the present invention, a secondary fluid circuit is placed between the process air circuit and the heat sink of the heat pump, the warm humid process air emerging from the treatment chamber through the process air circuit is cooled to such an extent that the humidity contained in the process air condenses and is in general collected in a suitable collection container, from where it can be disposed.

[0021] When, in another embodiment of the present invention, a secondary fluid circuit is placed between the process air circuit and the heat source of the heat pump, the dried and cooled process air is heated by the heat source of the heat pump. The heated process air is then again introduced into the treatment chamber. In front of this heat exchanger or preferably between this heat exchanger and the treatment chamber, the process air can be heated additionally by means of an electric heating.

[0022] In accordance with a preferred embodiment of the invention, a tank for the secondary fluid is placed in the secondary fluid circuit. The provision of a tank with a certain amount of secondary fluid has the effect that the secondary fluid in the secondary fluid circuit warms up less quickly as would be the case in the absence of the secondary fluid tank. The heat exchange between the process air circuit and the secondary fluid circuit namely leads to a warming of the secondary fluid. Due to the presence of the tank, i.e. an increased amount of secondary fluid in the tank, the transferred heat is distributed over a larger amount of the secondary fluid. Similarly, a heat energy transfer from the secondary fluid circuit to the heat pump circuit does not automatically result in a rapid cooling of the secondary fluid. As a result, the temperature conditions in the secondary fluid circuit and thus the temperature conditions in the heating pump circuit are more stable thus contributing to a longer lifetime of the dryer.

[0023] The heat pump in the dryer according to an embodiment of the present invention comprises an evaporator, a condenser, a throttle and a compressor. The compressor is in general located in the flow direction of the refrigerant between the evaporator and the condenser. In the heat pump, the throttle which may be a relaxation valve or throttle valve, a capillary, or a nozzle, is placed in general in flow direction of the refrigerant between the condenser and the evaporator.

[0024] In the dryer as outlined in the previous preferred embodiment of the invention, the refrigerant is selected from the group consisting of R134a, R152a, R290, R407C, and R410A. While R134a and R152a are fluorinated hydrocarbon compounds, and R407C and R410A are mixtures of such compounds, R290 is the hydrocarbon compound propane. While flammable, propane is a refrigerant that quite preferable for use in a dryer due to its combination of advantageous functional properties with environmental friendliness. R152a is also a preferable refrigerant for the present purpose, due to its reduced flammability in combination with relatively favourable environmental friendliness.

[0025] The secondary fluid in the secondary fluid circuit usually distinguishes over the refrigerant in the heat pump circuit. While a refrigerant needs to exhibit well-defined functional properties that are crucial to set proper working conditions for the heat pump, all the secondary fluid has to do is transfer heat without any necessity for a carefully balanced phase change or the like. Accordingly, the selection of the secondary fluid may be guided by simplicity and availability alone, which may well lead to select water simply.

[0026] In any embodiment of the invention, a second secondary fluid circuit in connection with another first heat exchanger may be used. Accordingly, the dryer may comprise a first secondary fluid circuit with a heat sink and a second secondary fluid circuit with a heat source of the heat pump. In such dryer, the heat pump unit can be prefabricated in a quite compact manner, for example from a compressor, evaporator, condenser and throttle. After the assembly, only the secondary fluid conduits must be connected. The heat pump unit may thus be produced much easier. This reduces manufacturing costs and allows for a higher, easier controllable manufacturing quality.

[0027] It is moreover preferred that the secondary fluid is a substance which is liquid at room temperature and atmospheric pressure. In particular, the secondary fluid is preferably at least one substance selected from the group consisting of water, single and multiple alcohols and glycol ethers. Suitable multiple alcohols are for example ethylene glycol and propylene glycol. Suitable glycol ethers are for example ethylene glycol dimethyl ether and propylene glycol dimethyl ether or the corresponding monoethers. Most preferably, the secondary fluid is water. As water can be used at practically zero pressure difference to the ambient and at each temperature that it will need to acquire during a drying process, the heat exchangers through which process air flows between the heat pump and the process air circuit can be connected for example by means of quick-release fasteners (as they are similarly used as articles for garden irrigation) with the heat pump.

[0028] The secondary fluid may be supplied in general by means of an external supply. In a preferred embodiment, in which water is used as secondary fluid, the condensed water which results from the drying process is used at least to some extent as secondary fluid.

[0029] The temperature of the secondary fluid as well as the temperature of the refrigerant is kept in the admissible range in general by means of the control of the heat pump. Since a heating is usually placed in front of the entrance into the drying chamber, the control of the heat pump is in general achieved in combination with the control of the heating.

[0030] In general, the secondary fluid conduits, except for the ones placed inside the corresponding heat exchangers are thermally isolated.

[0031] In an embodiment of the dryer according to the present invention, where an easily detachable connection of the secondary fluid delivery and removal is provided, the heat exchangers through which process air is flowing, can be dismantled and cleaned easily. In this way, the performance of the heat exchangers is maintained and the lifetime of the dryer as such increased.

[0032] In certain embodiments, the secondary fluid may also utilize the lost heat from the compressor of the heat pump and transfer it to the process air of the dryer. This further contributes to an increase in the overall efficiency of the heat pump process and thus the energy balance of the entire drying process.

[0033] Preferably, the dryer of the present invention comprises in the air process channel an additional heating, preferably an electrical resistance heating, for heating process air.

[0034] With an increasing degree of dryness of the articles to be dried, in particular clothes, a lower heating power or even an increasing cooling power is required. In particular, upon completion of a drying phase, the temperature in the process air circuit would increase strongly. Thus, in general, the heat pump and, if applicable, the (electrical) heating in the dryer are controlled such that a maximum admissible temperature in the drying chamber is not exceeded.

[0035] In accordance with a concomitant preferred embodiment of the invention, the treatment chamber is a rotatable drum.

[0036] Exemplary embodiments of dryers according to the present invention are explained hereinafter with reference to the accompanying drawing. In the drawing,

Fig. 1 shows a vertically cut condensation dryer wherein a heat pump is connected by means of two secondary fluid circuits with the process air circuit;

Fig. 2 shows schematically an arrangement of a heat pump circuit and a first secondary fluid circuit, wherein the process air circuit is connected through the first secondary fluid circuit with the heat pump. A second heat exchanger for the secondary fluid is provided in the first secondary fluid circuit;

Fig. 3 shows certain details of a washing machine or washer-dryer.

[0037] Fig. 1 shows a vertically cut condensation dryer 1 (in the following abbreviated as "dryer"). The dryer 1 shown in Fig. 1 depicts a drum 3 as treatment chamber 3, which is rotatable around a horizontal axis. Within the drum 3, tappets 4 are fixed in order to tumble laundry to be dried during a rotation of the drum 3. An electrical heating 18, a first heat exchanger 11, 12, a heat pump 13, 14, 15, a second heat exchanger 16, 17 as well as a blower 19 are provided in a process air circuit 2. Warm process air is thus conveyed to the drum 3, cooled and loaded with humidity in passing through the drum 3, and warmed again after the condensation of the humidity contained in the process air in first heat exchanger 11, 12. The process air heated by heating 18 is led from the rear, i.e. from the side of the drum 3 opposite to the door 5, through its perforated floor into the drum 3, comes into contact with the laundry to be dried and flows through the opening for filling the drum 3 to a lint filter 6 within the door 5 that closes the opening for filling the dryer 1. Thereafter, the air stream in the door 5 is directed downwards and is moved within the process air circuit 2 to the heat exchanger 11, 12. There, the humidity taken up condenses due to the cooling, and condensed water is collected by a condensate container 22 which is shown in Fig. 1 by a dashed line. The condensate can be disposed of therefrom. The transfer of the heating power of the heat pump 13, 14, 15 occurs here by means of a secondary fluid circulating in a first secondary fluid circuit 12, 20, 23, preferably water. Reference numeral 26 indicates a second heat exchanger for the secondary fluid. Second heat exchanger 26 is a water to secondary fluid heat exchanger 26; its function will be explained in detail with reference to the subsequent figures of the drawing.

[0038] Behind heat exchanger 11, 12, the process air is moved by means of blower 19 again to heating 18. Between blower 19 and heating 18, a second heat exchanger 16, 17 is placed, wherein the process air is heated by means of the heat pump 13, 14, 15. The transfer of heat energy occurs herein via a second secondary fluid circuit 16, 21.

[0039] The drum 3 in the embodiment shown in Fig. 1 is supported at its rear bottom by means of a swivel and supported in front by means of an end plate 7, whereby the drum 3 bears with a brim on a sliding ribbon (striation) 8 at the end plate 7 and is thus kept at the front end. The control of the dryer 1 is achieved by means of a control device 10 which may be adjusted by a user by means of an operating panel 9.

[0040] The heated secondary fluid of the first secondary fluid circuit 20, 11, 12 is cooled in the evaporator 13 of the heat pump 13, 14, 15. In heat pump 13, 14, 15, the refrigerant is evaporated in evaporator 13 that forms a heat sink 13 according to this, compressed in compressor 14 and subsequently condensed in condenser 15 that forms a heat source 15 according to that. The heat set free in condenser 15 heats in a second secondary fluid circuit 16, 21 the process air led through the second heat exchanger 16, 17.

[0041] Fig. 2 shows schematically for a dryer according to the invention an arrangement of a heat pump 13, 14, 15, 25 and a first secondary fluid circuit 12, 20, 24, wherein the process air circuit 2 is connected only via the first secondary fluid circuit 12, 20, 24 with the heat pump 13, 14, 15, 25. Reference numeral 3 indicates the drying chamber, 2 the process air channel, 6 the lint filter, 12 the first heat exchanger in the first secondary fluid circuit 12, 20, 24, and 20 the second heat exchanger in the first secondary fluid circuit 12, 20, 24. In the heat pump, 13 is the evaporator, 14 the compressor, 15 the condenser and 25 a throttle, in particular a relaxation valve, a nozzle or a capillary. 24 indicates a pump for the movement of the secondary fluid, 19 indicates a blower. In the embodiment of Fig. 2 no extra electrical heating is used. 26 indicates a water to secondary fluid heat exchanger within the secondary fluid tank 23.

[0042] As to the function of the arrangement shown in figure 2, the second heat exchanger 26 could be deemed to be inoperative. Under such prerequisite, the arrangement is simply a condensing-type dryer 1 comprising a heat pump 13, 14, 15, 25, wherein transfer of heat between the heat sink 13 and the process air circuit 2 is done indirectly by circulating the secondary fluid through the secondary fluid circuit 12, 20, 24 by means of the secondary fluid pump 24.

[0043] In the present context however, the second heat exchanger 26 is applied to pump additional heat into the dryer 1 prior to starting a drying process. To this end, relatively cool water is guided through the second heat exchanger 26, to cool down the secondary fluid circulating through its own circuit by means of the secondary fluid pump 24. Thereby, the secondary fluid is cooled down prior to its application in the drying process, where the cooled secondary fluid will provide for an improved cooling of the process air passing through the first heat exchanger 12. Thereby, both the drying process can be accelerated and energy can be saved, because the cooling by means of the second heat exchanger 26 has removed heat from the secondary fluid which would otherwise have had to be removed by means of the heat pump 13, 14, 15, 25. The profit to be thus obtained is enlarged by using a dedicated tank 23 to offer an enlarged volume of the secondary fluid, thereby increasing the available heat capacity.

[0044] Of course, the configuration shown in figure 2 can be modified by attaching the secondary fluid circuit not to the heat sink 13 but to the heat source 15. In such case it will be additional heating of the secondary fluid instead of initial cooling as detailed above which will help to reduce the time needed and the efficiency attained for a drying process. Accordingly, such second heat exchanger would have to be attached to a water guide of a water-processing machine associated to the dryer 1 which guides warm, or even hot, water instead of cool water. More details of such consideration will be given subsequently.

[0045] Figure 3 shows some pertinent features of a water-processing machine 3, 27, 28 that may be associated to a dryer 1 as detailed in figure 1 or figure 2. In particular, the machine 3, 27, 28 is a washing machine, and is in fact integrated into the dryer 1, thereby forming a machine which is commonly known as a washer-dryer. The machine has two water guides 27 and 28, namely an inlet 27 that will tap water from a public freshwater source, and an outlet 28 that will be used to dump used water or suds from the machine. The inlet 27 includes a detergent dispenser 30 that is commonly used to dispense a detergent into the freshwater drawn into the machine. The outlet 28 includes a suds pump 31, for dumping the used water or suds into a dump 32. Both the inlet 27 and the outlet 28 comprise a respective second heat exchanger 26, for transferring heat between the inlet 27 or the outlet 28 and a respective secondary fluid circuit as shown in figures 1 and 2 and coupled to the heat sink 13 or the heat source 15, respectively. Thereby, negative or positive heat energy present in the machine shown in figure 3 may be applied in the drying process executed in the dryer 1 from figure 1 or figure 2. As the machine shown in figure 3 is intended to be a washer-dryer, it may be noted that the rotatable drum 3 is disposed in a tub 29 that will hold the water or suds in use or rather being processed in a washing process or the like.

Claims

1. Dryer (1) with a treatment chamber (3) for articles to be dried, a process air circuit (2), wherein heated process air is moved by means of a blower (19) above and through the articles to be dried, and a heat pump (13, 14, 15, 25) with a first heat exchanger (13, 15), and with a secondary fluid circuit (12, 20; 16, 21) containing a secondary fluid provided between the process air circuit (2) and the first heat exchanger (13, 15), **characterized in that** said secondary fluid circuit (12, 20 16, 21) comprises a second heat exchanger (26) to exchange heat from said secondary fluid to water flowing in a water guide (27, 28) of a water-processing machine (3, 27, 28) associated to said dryer (1).

2. Dryer (1) according to claim 1, wherein said water-processing device (3, 27, 28) is a washing machine (3, 27, 28).

3. Dryer (1) according to claim 2, wherein said washing machine (3, 27, 28) is integrated into said dryer (1), and wherein said treatment chamber (3) is provided for consecutive use within the dryer (1) and the washing machine (3, 27, 28).

4. Dryer (1) according to one of the preceding claims, wherein said first heat exchanger (13, 15) is a heat sink (13), and wherein said water guide (27, 28) is an inlet (27) of said water-processing machine (3, 27, 28).

5. Dryer (1) according to claim 4, wherein said heat pump (13, 14, 15, 25) comprises a heat source (15), and wherein said heat source (15) is placed in said process air circuit (2).

6. Dryer (1) according to one of claims 1 to 3, wherein said first heat exchanger (13, 15) is a heat source (15), and wherein said water guide (27, 28) is an outlet (28) of said water-processing machine.

7. Dryer (1) according to one of the preceding claims, wherein second heat exchanger (26) is placed in a tank (23) for the secondary fluid, said tank (23) being comprised by said secondary fluid circuit (12, 20; 16, 21).

8. Dryer (1) according to any preceding claim, wherein said heat pump (13, 14, 15, 25) comprises a heat sink (13) which is an evaporator (13) for a refrigerant, a heat source (15) which is a liquefier (15) for the refrigerant, a compressor (14) and a nozzle (25) that are connected with said evaporator (13) and said liquefier (15) to form a closed circuit for circulating the refrigerant.

9. Dryer (1) according to claim 8, wherein the refrigerant is selected from the group consisting of R134a, R152a, R290, R407C, and R410A.

10. Dryer (1) according to any preceding claim, wherein said secondary fluid is a substance which is liquid at room temperature and atmospheric pressure.

11. Dryer (1) according to claim 10, wherein said secondary fluid is at least one substance selected from the group consisting of water, single and multiple alcohols and glycol ethers.

12. Dryer (1) according to claim 11, wherein said secondary fluid is water.

13. Dryer (1) according to any preceding claim, comprising in the air process channel (2) an additional heating (18) for heating process air.

14. Dryer (1) according to any preceding claim, wherein said treatment chamber (3) is a rotatable drum (3).

Patentansprüche

1. Trockner (1) mit einer Behandlungskammer (3) für zu trocknende Artikel, mit einem Prozessluftkreis (2), wobei die erwärmte Prozessluft mittels eines Gebläses (19) über und durch die zu trocknenden Artikel bewegt wird, und mit einer Wärmepumpe (13, 14, 15, 25) mit einem ersten Wärmetauscher (13, 15), und mit einem Sekundärfluidkreis (12, 20; 16, 21), der ein Sekundärfluid enthält, und zwischen dem Prozessluftkreis (2) und dem ersten Wärmetauscher (13, 15) versehen ist,
dadurch gekennzeichnet, dass
der Sekundärfluidkreis (12, 20 16, 21) einen zweiten Wärmetauscher (26) zum Austauschen von Wärme des Sekundärfluids mit Wasser umfasst, das in einer Wasserleitung (27, 28) einer Prozesswassermaschine (3, 27, 28) strömt, die dem Trockner (1) zugeordnet ist.

2. Trockner (1) nach Anspruch 1, wobei die Prozesswasservorrichtung (3, 27, 28) eine Waschmaschine (3, 27, 28) ist.

3. Trockner (1) nach Anspruch 2, wobei die Waschmaschine (3, 27, 28) in den Trockner (1) integriert ist und wobei die Behandlungskammer (3) für die nachfolgende Verwendung innerhalb des Trockners (1) und der Waschmaschine (3, 27, 28) versehen ist.

4. Trockner (1) nach einem der vorherigen Ansprüche, wobei der Wärmetauscher (13, 15) ein Wärmeableiter (13) ist und wobei die Wasserleitung (27, 28) ein Einlass (27) der Prozesswassermaschine (3, 27, 28) ist.

5. Trockner (1) nach Anspruch 4, wobei die Wärmepumpe (13, 14, 15, 25) eine Wärmequelle (15) umfasst und wobei die Wärmequelle (15) in dem Prozessluftkreis (2) angeordnet ist.

6. Trockner (1) nach einem der Ansprüche 1 bis 3, wobei der Wärmetauscher (13, 15) eine Wärmequelle (15) ist und wobei die Wasserleitung (27, 28) ein Auslass (28) der Prozesswassermaschine ist.

7. Trockner (1) nach einem der vorherigen Ansprüche, wobei der zweite Wärmetauscher (26) in einem Tank (23) für das Sekundärfluid angeordnet ist, wobei der Tank (23) in dem Sekundärfluidkreis (12, 20; 16, 21) enthalten ist.

8. Trockner (1) nach einem der vorherigen Ansprüche, wobei die Wärmepumpe (13, 14, 15, 25) einen Wärmeableiter (13), der ein Verdampfer (13) für ein Kältemittel ist, eine Wärmequelle (15), die ein Verflüssiger (15) für das Kältemittel ist, einen Verdichter (14) und eine Düse (25), die mit dem Verdampfer (13) und dem Verflüssiger (15) verbunden sind, um einen geschlossenen Kreis zum Zirkulieren des Kältemittels zu bilden, umfasst.

9. Trockner (1) nach Anspruch 8, wobei das Kältemittel ausgewählt ist von der Gruppe, bestehend aus R134a, R152a, R290, R407C und R410A.

10. Trockner (1) nach einem der vorherigen Ansprüche, wobei das Sekundärfluid ein Stoff ist, der bei Raumtemperatur und Luftdruck flüssig ist.

11. Trockner (1) nach Anspruch 10, wobei das Sekundärfluid mindestens ein Stoff ist, der ausgewählt ist aus der Gruppe, bestehend aus Wasser, Einfach- und Mehrfachalkoholen und Glykoläthern.

12. Trockner (1) nach Anspruch 11, wobei das Sekundärfluid Wasser ist.

13. Trockner (1) nach einem der vorherigen Ansprüche, umfassend in dem Prozessluftkanal (2) eine zusätzliche Heizvorrichtung (18) zum Erwärmen der Prozessluft.

14. Trockner (1) nach einem der vorherigen Ansprüche, wobei die Behandlungskammer (3) eine Drehtrommel (3) ist.

Revendications

1. Séchoir (1) avec une chambre de traitement (3) pour des articles à sécher, un circuit d'air de traitement (2), dans lequel l'air de traitement chauffé est déplacé au moyen d'une soufflante (19) au-dessus et à travers les articles à sécher, et une pompe à chaleur (13, 14, 15, 25) avec un premier échangeur de chaleur (13, 15), et avec un circuit de fluide secondaire (12, 20 ; 16, 21) contenant un fluide secondaire fourni entre le circuit d'air de traitement (2) et le premier échangeur de chaleur (13, 15), **caractérisé en ce que** ledit circuit de fluide secondaire (12, 20 ; 16, 21) comprend un deuxième échangeur de chaleur (26) pour échanger de la chaleur entre ledit fluide secondaire et l'eau circulant dans un dispositif de guidage d'eau (27, 28) d'une machine de traitement de l'eau

(3, 27, 28) associée audit séchoir (1).

2. Séchoir (1) selon la revendication 1, dans lequel ledit dispositif de traitement de l'eau (3, 27, 28) est un lave-linge (3, 27, 28).

3. Séchoir (1) selon la revendication 2, dans lequel ledit lave-linge (3, 27, 28) est intégré audit séchoir (1), et dans lequel ladite chambre de traitement (3) est prévue pour des utilisations consécutives à l'intérieur du séchoir (1) et du lave-linge (3, 27, 28).

4. Séchoir (1) selon l'une des revendications précédentes, dans lequel ledit premier échangeur de chaleur (13, 15) est un dissipateur de chaleur (13), et dans lequel ledit dispositif de guidage de l'eau (27, 28) est un orifice d'entrée (27) de ladite machine de traitement de l'eau (3, 27, 28).

5. Séchoir (1) selon la revendication 4, dans lequel ladite pompe à chaleur (13, 14, 15, 25) comprend une source de chaleur (15), et dans lequel ladite source de chaleur (15) est placée dans ledit circuit d'air de traitement (2).

6. Séchoir (1) selon l'une des revendications 1 à 3, dans lequel ledit premier échangeur de chaleur (13, 15) est une source de chaleur (15), et dans lequel ledit dispositif de guidage d'eau (27, 28) est un orifice de sortie (28) de ladite machine de traitement de l'eau.

7. Séchoir (1) selon l'une des revendications précédentes, dans lequel le deuxième échangeur de chaleur (26) est placé dans une cuve (23) pour le fluide secondaire, ladite cuve (23) étant constituée par ledit circuit de fluide secondaire (12, 20 ; 16, 21).

8. Séchoir (1) selon l'une quelconque des revendications précédentes, dans lequel ladite pompe à chaleur (13, 14, 15, 25) comprend un dissipateur de chaleur (13) qui est un évaporateur (13) pour un réfrigérant, une source de chaleur (15) qui est un liquéfacteur (15) pour le réfrigérant, un compresseur (14) et une buse (25) qui sont reliés audit évaporateur (13) et audit liquéfacteur (15) pour former un circuit fermé pour faire circuler le réfrigérant.

9. Séchoir (1) selon la revendication 8, dans lequel le réfrigérant est sélectionné dans le groupe constitué par le R134a, le R152a, le R290, le R407C et le R410A.

10. Séchoir (1) selon l'une quelconque des revendications précédentes, dans lequel ledit fluide secondaire est une substance qui est liquide à température ambiante et à la pression atmosphérique.

11. Séchoir (1) selon la revendication 10, dans lequel ledit fluide secondaire est au moins une substance sélectionnée dans le groupe constitué par l'eau, un seul et plusieurs alcools et éthers de glycol.

12. Séchoir (1) selon la revendication 11, dans lequel ledit fluide secondaire est l'eau.

13. Séchoir (1) selon l'une quelconque des revendications précédentes, comprenant dans le canal de traitement d'air (2) un dispositif chauffant supplémentaire (18) pour chauffer l'air de traitement.

14. Séchoir (1) selon l'une quelconque des revendications précédentes, dans lequel ladite chambre de traitement (3) est un tambour rotatif (3).

Fig. 1

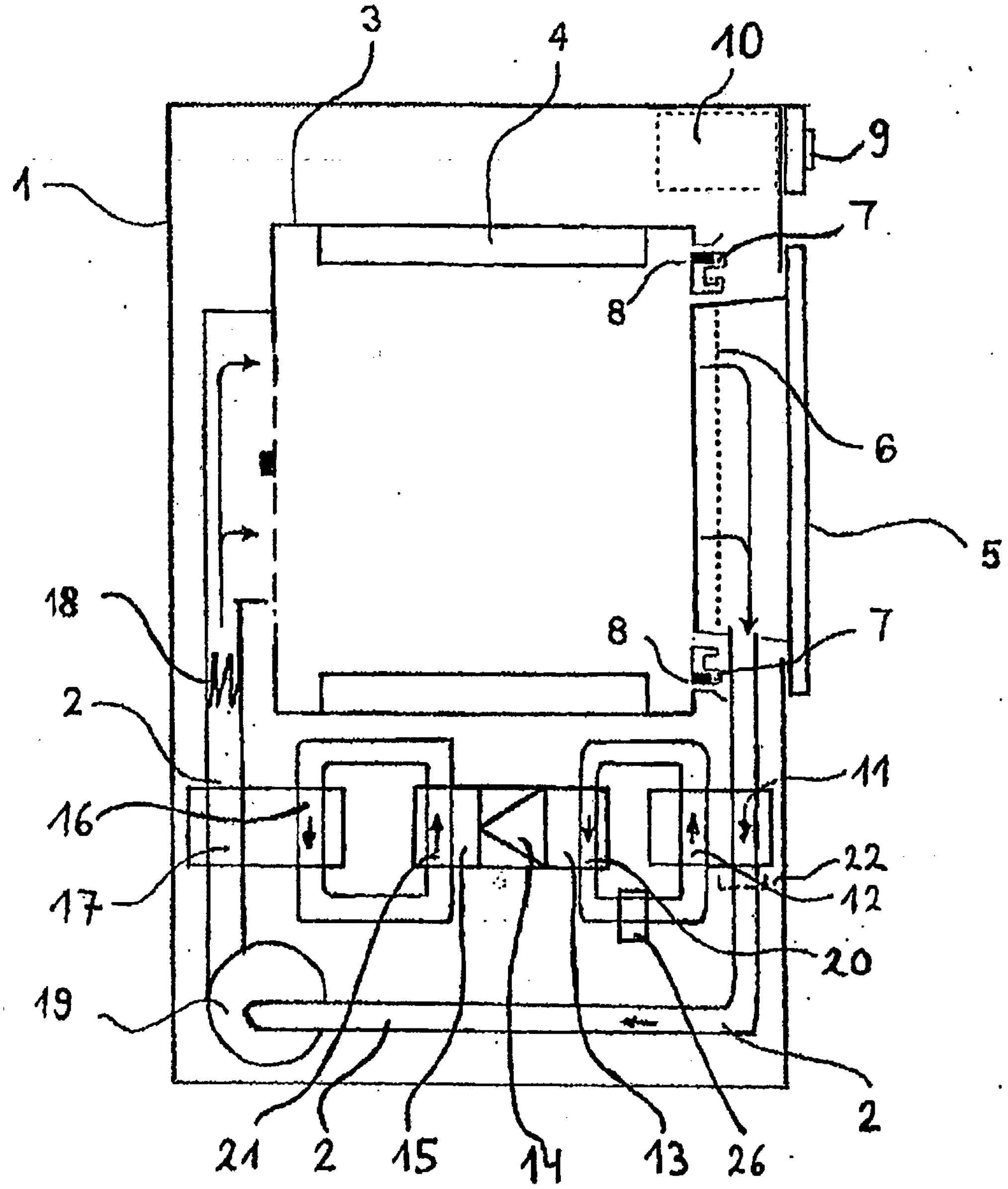
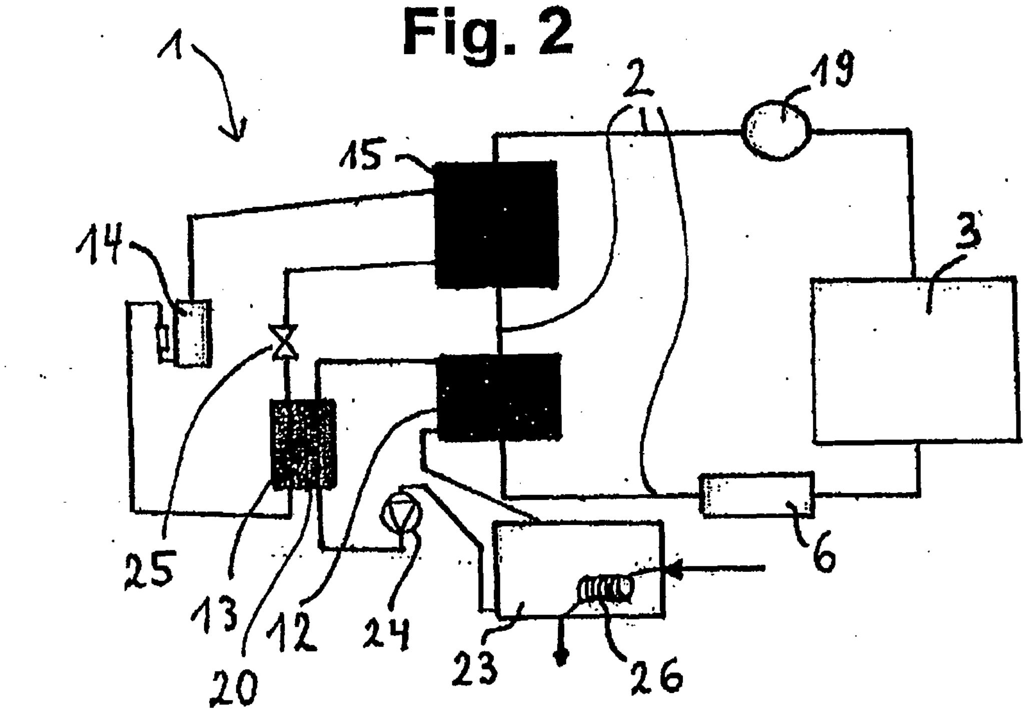


Fig. 2



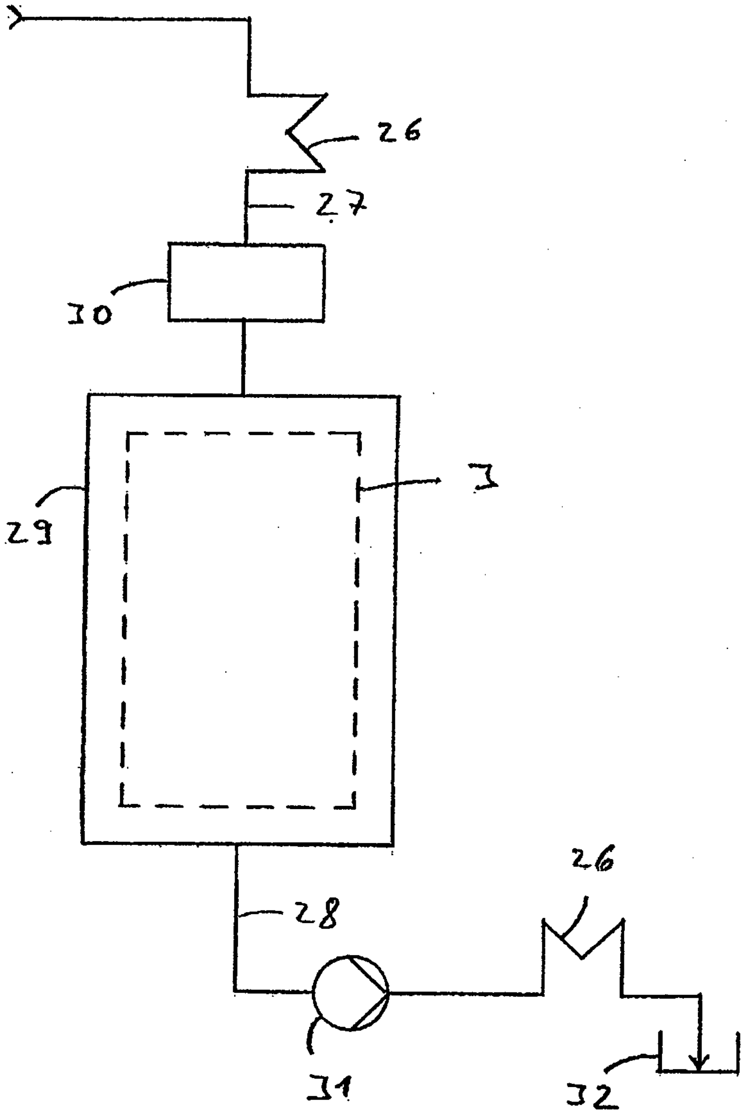


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 202007000825 U1 **[0002]**
- DE 4104760 A1 **[0003]**
- EP 0636732 B1 **[0003]**
- EP 0695826 B1 **[0003]**
- DE 30000865 A1 **[0006]**
- JP 2004089415 A **[0006]**