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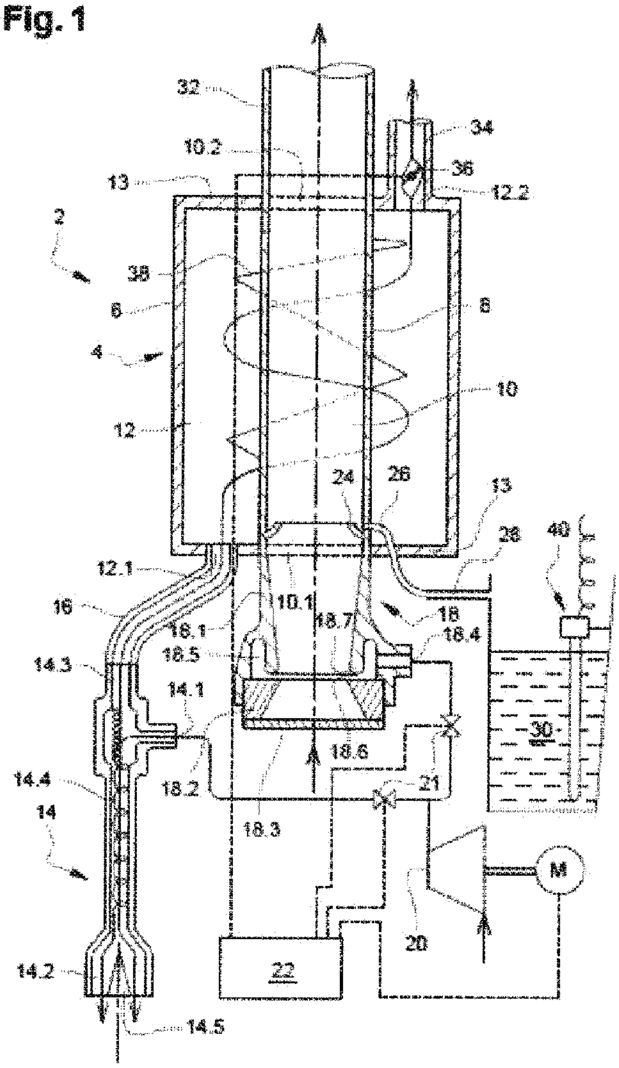
(54) **COMPACT AND PORTABLE AIR CONDITIONER.**

(57) The invention is directed to an air conditioning system (2) comprising an air compressor (20); a vortex tube (14) with an inlet (14.1) fluidly connected to an outlet of the air compressor (20), a warm air outlet (14.2) and a cold air outlet (14.3); an air blower (18); a heat exchanger (4) comprising an outer tubular wall (6) and an inner tubular wall (8) inside the outer tubular wall (6) and concentric with said wall so as to form a central passage (10) and an outer passage (12), one of said passages being fluidly connected to the outlet of the air blower (18) and the other one of said passages being fluidly connected to one of the warm air outlet (14.2) and the cold air outlet (14.3) of the vortex tube (14). The invention is also directed to a corresponding method.

Fig. 1



Description

COMPACT AND PORTABLE AIR CONDITIONER

Technical field

[0001] The invention is directed to the field of air treatment, more particularly air conditioning, e.g. conditioning the temperature and humidity of air. The invention is also directed to the field of production of water, for instance drinking water.

Background art

[0002] Prior art patent document published SK 7970 Y1 discloses an apparatus for producing drinking water using a vortex tube. It comprises an air suction pipe with a filter, a heat exchanger located in the pipe, and a fan air blower at the exit of said pipe. It comprises also an air compressor fluidly connected to a tank of compressed air, and a vortex tube fed with the compressed air. The latter is separated in the vortex tube into a flow of warm air at one outlet and a flow of cold air at another outlet. The outlet of cold air is fluidly connected to the heat exchanger in the pipe. In operation, the flow of compressed air is separated into a flow of cold air by the vortex tube and cools the heat exchanger. The ambient air aspirated by the fan blower into the suction pipe contacts the heat exchanger so that its humidity is condensed on said exchanger. A drip tray is provided below the heat exchanger so as to collect the condensed water. The latter can be disinfected by a UV lamp before being stored in a tank. This teaching is interesting in that it allows to produce water, for instance drinking water, with an air conditioning device free of refrigerant. Its water production productivity is however limited by the fan blower located at the exit of the suction pipe. It is driven by a larger wind turbine and is therefore directly dependent on the wind conditions. Also, the heat exchanger of the serpentine type causes important load losses prejudicing a proper functioning of the vortex tube.

[0003] Prior art patent document published US 2011/0214434 A1 discloses an air dryer for compressed air, e.g. industrial compressed air for driving pneumatic tools and various pneumatic actuators. The air dryer comprises a cyclone chamber using the coanda effect for separating the water vapour contained in the air circulating in that chamber. It comprises also a vortex tube fed by the air exiting the cyclone chamber. The cold flow of air exiting the vortex tube is fed into a serpentine tube in the cyclone chamber for increasing the humidity separation. This air dryer in interesting in that it provides a higher level of humidity separation by a rather simple construction, i.e. producing cold air without refrigerant. It is however specifically conceived for compressed air, i.e. between 6 and 10 bar, with a limited flow rate. Also, similarly to the previous teaching, the heat exchanger of the serpentine type is disadvantageous when fluidly connected to a vortex tube because such a tube requires a very limited, if any, backpressure for a proper functioning.

Summary of invention

Technical Problem

[0004] The invention has for technical problem to provide an efficient air conditioner of a simple and compact construction, more particularly an air conditioner working without refrigerant and still providing a satisfying air conditioning capacity, e.g. for heating or cooling purposes and/or for extracting water from ambient air.

Technical solution

[0005] The invention is directed to an air conditioning system comprising: an air compressor; a vortex tube with an inlet fluidly connected to an outlet of the air compressor, a warm air outlet and a cold air outlet; an air blower; a heat exchanger fluidly connected to an outlet of the air blower and to one of the warm air outlet and the cold air outlet of the vortex tube, so that the warm or cold air of the vortex tube conditions the air of the air blower; wherein the heat exchanger comprises an outer tubular wall and an inner tubular wall inside the outer tubular wall and concentric with said wall so as to form a central passage and an outer passage, one of said passages being fluidly connected to the outlet of the air blower and the other one of said passages being fluidly connected to one of the warm air outlet and the cold air outlet of the vortex tube.

[0006] According to a preferred embodiment, the central passage is fluidly connected to the outlet of the air blower and the outer passage is fluidly connected to one of the warm air outlet and the cold air outlet of the vortex tube.

[0007] According to a preferred embodiment, the heat exchanger is fluidly connected the cold air outlet of the vortex tube so as to cool the air of the air blower, and the heat exchanger is configured such that the outer and inner tubular walls are oriented with a vertical main component when the system is in an operative position. Alternatively, other orientations can be considered.

[0008] According to a preferred embodiment, the heat exchanger comprises a condensation water collecting conduit at a bottom position of the outer and inner tubular walls when the system is in an operative position.

[0009] According to a preferred embodiment, the heat exchanger further comprises a gutter on an inner side of the inner tubular wall, configured for naturally collecting the condensation water dripping by gravity along said inner side, said gutter being fluidly connected to the condensation water collecting conduit.

[0010] According to a preferred embodiment, the system further comprises a reservoir fluidly connected to the condensation water collecting conduit for collecting the condensed water.

[0011] According to a preferred embodiment, the system further comprises a UV disinfection unit configured to be in contact with the condensed water in the reservoir. Other and/or additional bacteriological treatment units can be provided for treating the condensed water.

[0012] According to a preferred embodiment, a nominal mass flow rate of the air blower is at least 5 times, preferably 7 times, more preferably 10 times, greater than a nominal mass flow rate of the air compressor.

[0013] According to a preferred embodiment, said system is configured for producing water out of ambient air.

[0014] According to a preferred embodiment, the air blower is an air amplifier fluidly connected to the outlet of the air compressor and configured for blowing air based on the coanda effect.

[0015] According to a preferred embodiment, the air amplifier comprises a main conduit, a side annular inlet chamber for the compressed air with an annular passage to the main conduit, said conduit having an annular convex guiding surface directly downstream of the annular passage for achieving a coanda effect.

[0016] According to a preferred embodiment, the heat exchanger further comprises at least one fin in the outer passage and/or in the inner passage, configured for increasing heat exchange.

[0017] According to a preferred embodiment, the at least one fin is spirally shaped so as to force the air flow in the outer and/or inner passage to swirl.

[0018] According to a preferred embodiment, the outer passage and/or the inner passage comprises one or more cool or heat packs configured for maintaining a low or high temperature.

[0019] According to a preferred embodiment, the one or more cool or heat packs are arranged on the inner tubular wall.

[0020] According to a preferred embodiment, the one or more cool or heat packs comprise a Phase Change Material PCM.

[0021] According to a preferred embodiment, the PCM is eutectic.

[0022] According to a preferred embodiment, the system further comprises an air filter upstream of the air blower.

[0023] According to a preferred embodiment, the inner tubular wall is corrugated along the outer tubular wall so as to increase the heat transfer between the inner and outer passages.

[0024] The invention is also directed to a process for conditioning air, comprising the following actions: separating with a vortex tube a flow of compressed air into a warm gas flow and a cold gas flow; producing a flow of air through a heat exchanger; feeding the heat exchanger with one of the warm gas flow and a cold gas flow, in order to condition the flow of air; wherein the heat exchanger comprises a central passage extending along a principal direction and an outer passage extending along said direction around the central passage, one of said passages being fed with the flow of air and the other one of said passages being fed with the warm gas flow and a cold gas flow.

[0025] Advantageously, the process is carried out with a system according to the invention. The above features relating to the system apply to the above process.

Advantages of the invention

[0026] The invention is particularly interesting in that it provides an air conditioning system with a heat exchanger that allows a better functioning of the vortex tube, i.e. a much reduced counter pressure, compared with conventional air conditioning systems. The construction of the heat exchanger is particularly interesting for it provides easily a large chamber for the warm or cold gas flow from the vortex tube, allowing a better heat exchange and permitting to place cold or warm packs configured to increase the thermal inertia of the warm or cold source. The use of an air amplifier as air blower is also particularly interesting for it makes use of the air compressor that is readily present for the vortex tube. The central passage is particularly adapted for the air flow from the air blower, for instance the air blower, because it causes nearly no pressure loss, if any.

Brief description of the drawings

[0027] The unique figure 1 is a schematic cross-sectional view of an air conditioning system according to the invention.

Description of an embodiment

[0028] The unique figure 1 illustrates a first embodiment of the invention. It shows in schematic cross-sectional view an air conditioning system 2. The system 2 comprises as central component a heat exchanger 4. The latter comprises essentially an outer wall 6 and an inner wall 8 located inside the volume delimited by the outer wall 6. Each of the outer and inner walls 6 and 8 shows a closed cross-sectional profile, said profile being preferably circular, being understood that other profiles, like an oval, can be considered. Both wall outer and inner walls 6 and 8 extend along a longitudinal axis that is for instance vertical in the illustration of figure 1. The inner tubular wall 6 is preferably concentric with the outer tubular wall. In any case, both outer and inner walls 6 and 8 delimit an inner passage 10 and an outer passage 12 that is annular and surrounds the inner passage 10. The heat exchanger 4 comprises also end walls 13 for longitudinally delimiting the outer passage 12.

[0029] The system 2 comprises also a vortex tube 14, also known as the Ranque-Hilsch vortex tube. It is a mechanical device that separates a compressed gas into hot and cold gas flows. It comprises a body with an inlet 14.1 a hot or warm gas outlet 14.2 and a cold gas outlet 14.3. The body delimits a swirl chamber 14.4 in fluid connection with the inlet 14.1 and the outlets 14.2 and 14.3. In operation, pressurised gas is injected via the inlet 14.1 tangentially into the swirl chamber 14.4 and accelerated to a high rate of rotation. Due to the conical nozzle 14.5 at the end of the tube, only the outer shell of the compressed gas is allowed to escape at that end to the outlet 14.2. The remainder of the gas is forced to return in an inner vortex of reduced diameter within the outer vortex to the outlet 14.3. Such a vortex tube is well known as such to the skilled person and is also commercially available from various suppliers. It does not therefore need to be further detailed.

[0030] As this is apparent in figure 1, the vortex tube 14 is fed at its inlet 14.1 with compressed air. The cold air outlet 14.3 is fluidly connected, e.g. via a pipe or conduit 16, to an inlet 12.1 of the outer passage 12. The warm or hot air outlet 14.2 outputs to the ambient atmosphere.

[0031] The system 2 comprises also an air blower 18, for instance an air amplifier 18 using the coanda effect for moving air, i.e. generating a flow of air to be conditioned in the heat exchanger 4. To that end, the air amplifier 18 has an outlet fluidly connected to an inlet 10.1 of the inner passage 10. In the present case, the air amplifier is directly connected to the inlet 10.1 of the inner passage 10, being however understood that it can be distant from said passage and fluidly connected with a pipe or any kind of conduit. The air amplifier 18 comprises a main body part 18.1 forming a generally circular wall forming a main conduit through which the air can pass, and a ring body part 18.2 mounted on the main body part 18.1. A filter 18.3 can be provided at the entry of the main conduit. The body parts 18.1 and 18.2 form a gas inlet 18.4 opening out to an annular chamber 18.5 which is in fluid connection with the an annular passage 18.6 to the main conduit. The main conduit has an annular convex guiding surface 18.7 directly downstream of the annular passage for achieving the coanda effect.

[0032] As this is apparent, the gas inlet 18.4 of the air amplifier 18 is fed with compressed air. In operation, compressed air fed through the inlet 18.4 and in the annular chamber 18.5 is throttled through the annular passage 18.6 so as to form a thin layer of accelerated air that adheres to the profile of the guiding surface 18.7 and that thereby turns of about 90°. The action of the high velocity of the supply air flowing along the profiles causes a pressure drop which induces a large flow of ambient air at the entry of the air amplifier. This induced flow is augmented and gains velocity by contact with the accelerated air.

[0033] As this is apparent, an air compressor 20 preferably driven by an electric motor supplies in compressed air the vortex tube 14 and the air amplifier 18. As illustrated, regulating valves 21 can be provided for varying the functional operation of each of the vortex tube 14 and the air amplifier 18. It is also conceivable to provide a specific air compressor for each of the vortex tube 14 and the air amplifier 18. The air compressor 20 can also be designed for being variable, i.e. with a variable output pressure and/or flow. The air compressor 20 and the regulating valves 21 can be controlled by a control unit 22. It is understood that the control unit 22 can be electrically connected to additional devices such as temperature and/or flow sensors at various places of the system, along the different air flows.

[0034] The inner wall 10 can comprise on its inner side, at a bottom position, a gutter 24 for collecting the condensed water flowing or dripping along said wall. A conduit 26 is provided for conveying the collected condensation water, via a pipe or any form of conduit 28, to a reservoir 30. The gutter 24 is circular and generally horizontal when the heat exchanger 4 is configured to be oriented vertically when in operation. It is however to be understood that other orientations are conceivable, in which case the gutter might need to be modified so as to be able to collect by gravity the condensed water on the inner side of the inner tubular wall 8. It might therefore take a different shape than a circular gutter as illustrated.

[0035] The heat exchanger 4 can comprise an exit pipe or conduit 32 at the outlet 10.2 of the inner passage 10 and/or an exit pipe or conduit 34 at the outlet 12.2 of the outer passage 12. For instance, the exit pipe or conduit 34 at the outlet 12.2 of the outer passage 12 can be provided with a regulating valve 36 for controlling the flow of cold air in the said passage.

[0036] The heat exchanger 4 can also be provided with one or more fins in the inner passage 10 and/or in the outer passage 12 for promoting heat exchange. For instance, a spiral-shaped fin 38 can be attached to the outer side of the inner wall 8 so as to extend in the outer passage 12 for guiding the flow of cold air and promoting heat exchange with the flow of air in the inner passage 10. This fin is preferable made of metal or at least of heat conductive material.

[0037] In operation, the air conditioning system of figure 1 functions as follows. The air compressor is in operation, i.e. its electric motor is supplied with electrical energy, so that it supplies the vortex tube 14 and the air amplifier 18 with compressed air. With reference to the above explanations, the flow of compressed air fed to the vortex tube 14 is separated into a warm or hot air flow to the outlet 14.2 and a cold air flow to the outlet 14.3. This flow of cold air enters the outer passage 12 and cools the inner wall 8 before exiting said passage via the outlet 12.2 and possibly the exit pipe or conduit 34. In parallel and with reference to the above explanations, the flow of compressed air fed to the air amplifier 18 generates a substantially more important flow of air towards the inner passage 10. This flow of air circulated along the inner passage 10, in contact with the inner side of the inner wall 8 which is cooled by the cold air flow of the vortex tube 14. The air circulating along and through the inner passage 10 is thereby cooled and possibly dehumidified, i.e. conditioned. The humidity contained in the air in the inner passage 10 can be condensed on the inner side of the inner wall 10 if the temperature of said wall is low enough, depending of course also of the temperature of the air and the concentration of water vapour in said air. The water condensed on the inner wall 8 will therefore flow and/or drip by gravity to the gutter 24 for being collected in a reservoir 30. The latter or any output conduit can be equipped with a disinfection unit, e.g. of the UV type, if the water is intended to be used, e.g. as drinkable water. Additional and/or alternative bacteriological water treatment units can also be used.

[0038] The above air conditioning system can therefore be used for producing cooled and dehumidified air, the condensed water being as such a by-product. It can also be used primarily for collecting water, the flow of cooled air being then a by-product. In certain applications, both collected condensed water and the flow of cooled air also be main products of the system.

[0039] The concentric construction of the heat exchanger is particularly interesting in that the passage, for instance the outer one, for the cold air flow does not generate a substantial counter pressure, thereby allowing a proper functioning of the vortex tube. Also, this passage forms a buffer volume providing a certain thermic inertia. For instance, that volume can contain elements configured for increasing the thermic inertia, e.g. cool packs, like those comprising a Phase Change Material PCM. Such materials use their latent heat, i.e. the heat corresponding to a change the state of said material at constant temperature, for keeping a low temperature as along as the above energy has not be transferred. Such elements or packs are as such known to the skilled person and commercially available. They can advantageously be provided directly at the inner wall 8, i.e. thermally as close as possible to the inner passage 10 but also the outer one 12. In operation, it is indeed conceivable that the system is a portable one that can be run initially at a higher power level when supplied by a strong external source, e.g. the home or domestic electrical network, and later on at a reduced power level when running on batteries or an electrical network of a reduced available power, while still providing a proper air conditioning. These elements or packs can also comprise a eutectic material, i.e. a homogeneous mixture of substances that melts or solidifies at a single temperature that is lower than the melting point of either of the constituents.

[0040] Various variations of the above configurations are conceivable, including the following ones, in any combination:

[0041] The inner and outer passages 10 and 12 can be reversed, i.e. the air flow produced by the air blower, for instance the air amplifier 18, could be fed to the outer annular passage 12 and the cold air flow of the vortex tube could be fed to the inner passage 10.

[0042] The above system is specially designed for cooling the air, in that the cold air flow of the vortex tube is fed to the heat exchanger. It is however clear that the fluid connection of the vortex tube can be reversed, i.e. the warm or hot air flow can be connected to the heat exchanger, meaning that the air moved by the air blower will be heated and not cooled anymore. Also both outlets of the vortex tube can be fluidly connected to the heat exchanger via a valve arrangement that allows switching between the cold air flow and the warm or hot air flow.

[0043] The inner wall 8 forming the barrier between the inner and outer passages 10 and 12 can be corrugated for increasing heat transfer. A corrugated profile of the wall will indeed generate turbulences in the air flow along said wall which are favourable for heat transfer.

Claims

1. Air conditioning system (2) comprising:
   - an air compressor (20);
   - a vortex tube (14) with an inlet (14.1) fluidly connected to an outlet of the air compressor (20), a warm air outlet (14.2) and a cold air outlet (14.3);
   - an air blower (18);
   - a heat exchanger (4) fluidly connected to an outlet of the air blower (18) and to one of the warm air outlet (14.2) and the cold air outlet (14.3) of the vortex tube (14), so that the warm or cold air of the vortex tube (14) conditions the air of the air blower (18);

   characterized in that

   the heat exchanger (4) comprises an outer tubular wall (6) and an inner tubular wall (8) inside the outer tubular wall (6) and concentric with said wall so as to form a central passage (10) and an outer passage (12), one of said passages being fluidly connected to the outlet of the air blower (18) and the other one of said passages being fluidly connected to one of the warm air outlet (14.2) and the cold air outlet (14.3) of the vortex tube (14).

2. Air conditioning system (2) according to claim 1, wherein the central passage (10) is fluidly connected to the outlet of the air blower (18) and the outer passage (12) is fluidly connected to one of the warm air outlet (14.2) and the cold air outlet (14.3) of the vortex tube (14).

3. Air conditioning system (2) according to one of claims 1 and 2, wherein the heat exchanger (4) is fluidly connected the cold air outlet (14.3) of the vortex tube (14) so as to cool the air of the air blower (18), and the heat exchanger (4) is configured such that the outer and inner tubular walls (6, 8) are oriented with a vertical main component when the system (2) is in an operative position.

4. Air conditioning system (2) according to one of claims 1 to 3, wherein the heat exchanger (4) comprises a condensation water collecting conduit (26) at a bottom position of the outer and inner tubular walls (6, 8) when the system (2) is in an operative position.

5. Air conditioning system (2) according to claims 1 and 4, wherein the heat exchanger (4) further comprises a gutter (24) on an inner side of the inner tubular wall (8), configured for naturally collecting the condensation water dripping by gravity along said inner side, said gutter being fluidly connected to the condensation water collecting conduit (26).

6. Air conditioning system (2) according to one of claims 4 and 5, wherein the system further comprises a reservoir (30) fluidly connected to the condensation water collecting conduit (26) for collecting the condensed water.

7. Air conditioning system (2) according to claim 6, wherein the system further comprises a UV disinfection unit (40) configured to be in contact with the condensed water in the reservoir (30).

8. Air conditioning system (2) according to one of claims 1 to 7, wherein a nominal mass flow rate of the air blower is at least 5 times greater than a nominal mass flow rate of the air compressor.

9. Air conditioning system (2) according to one of claims 6 and 7, and according to claim 8, wherein said system is configured for producing water out of ambient air.

10. Air conditioning system (2) according to one of claims 1 to 9, wherein the air blower is an air amplifier (18) fluidly connected to the outlet of the air compressor (20) and configured for blowing air based on the coanda effect.

11. Air conditioning system (2) according to claim 10, wherein the air amplifier (18) comprises a main conduit, a side annular inlet chamber (18.5) for the compressed air, with an annular passage (18.6) to the main conduit, said conduit having an annular convex guiding surface (18.7) directly downstream of the annular passage (18.6) for achieving the coanda effect.

12. Air conditioning system (2) according to one of claims 1 to 11, wherein the heat exchanger (4) further comprises at least one fin (38) in the outer conduit (12) and/or in the inner conduit (10), configured for increasing heat exchange.

13. Air conditioning system (2) according to claim 12, wherein the at least one fin (38) is spirally shaped so as to force the air flow in the outer and/or inner passages (12, 10) to swirl.

14. Air conditioning system (2) according to one of claims 1 to 13, wherein the outer passage (12) and/or the inner passage (10) comprises one or more cool or heat packs configured for maintaining a low or high temperature.

15. Air conditioning system (2) according to claim 14, wherein the one or more cool or heat packs are arranged on the inner tubular wall (8).

16. Air conditioning system (2) according to one of claims 14 and 15, wherein the one or more cool or heat packs comprise a Phase Change Material PCM.

17. Air conditioning system (2) according to claim 16, wherein the PCM is eutectic.

18. Air conditioning system (2) according to one of claims 1 to 17, further comprising an air filter (18.3) upstream of the air blower (18).

19. Air conditioning system (2) according to one of claims 1 to 18, wherein the inner tubular wall (8) is corrugated along the outer tubular wall (6) so as to increase the heat transfer between the inner and outer passages.

20. Process for conditioning air, comprising the following actions:
    - separating with a vortex tube (14) a flow of compressed air into a warm gas flow and a cold gas flow,
    - producing a flow of air through a heat exchanger (4);
    - feeding the heat exchanger (4) with one of the warm gas flow and a cold gas flow, in order to condition the flow of air;

    characterized in that

    the heat exchanger (4) comprises a central passage (10) extending along a principal direction and an outer passage (12) extending along said direction around the central passage (10), one (10) of said passages (10, 12) being fed with the flow of air and the other one (12) of said passages being fed with the warm gas flow and a cold gas flow.

Revendications LU101051

1. Système de conditionnement d'air (2) comprenant :
   - un compresseur à air (20) ;
   - un tube vortex (14) avec une entrée (14.1) reliée de manière fluidique à une sortie du compresseur à air (20), une sortie d'air chaud (14.2) et une sortie d'air froid (14.3) ;
   - un souffleur d'air (18) ;
   - un échangeur de chaleur (4) relié de manière fluidique à une sortie du souffleur d'air (18) et à l'une des sortie d'air chaud (14.2) et sortie d'air froid (14.3) du tube vortex (14), de sorte que l'air chaud ou l'air froid du tube vortex (14) conditionne l'air du souffleur d'air (18) ;

   caracterisé en ce que

   l'échangeur de chaleur (4) comprend une paroi tubulaire externe (6) et une paroi tubulaire interne (8) à l'intérieur de la paroi tubulaire externe (6) et concentrique à ladite paroi de manière à former un passage central (10) et un passage externe (12), l'un desdits passages étant connecté de manière fluidique à la sortie du souffleur d'air (18) et l'autre desdits passages étant connecté de manière fluidique à l'une des sortie d'air chaud (14.2) et sortie d'air froid (14.3) du tube vortex (14).

2. Système de conditionnement d'air (2) selon la revendication 1, dans lequel le passage central (10) est relié de manière fluidique à la sortie du souffleur d'air (18) et le passage externe (12) est connecté de manière fluidique à l'une des sortie d'air chaud (14.2) et sortie d'air froid (14.3) du tube vortex (14).

3. Système de conditionnement d'air (2) selon l'une des revendications 1 et 2, dans lequel l'échangeur de chaleur (4) est relié de manière fluidique à la sortie d'air froid (14.3) du tube vortex (14) afin de refroidir l'air du souffleur d'air (18), et l'échangeur de chaleur (4) est configuré de sorte que les parois tubulaires extérieure et intérieure (6, 8) soient orientées avec une composante principale verticale lorsque le système (2) est dans une position opérationnelle.

4. Système de conditionnement d'air (2) selon l'une des revendications 1 à 3, dans lequel l'échangeur de chaleur (4) comprend un conduit de collecte d'eau de

condensation (26) en position basse des parois tubulaires extérieure et intérieure (6, 8) lorsque le système (2) est en position de fonctionnement. LU101051

5. Système de conditionnement d'air (2) selon les revendications 1 et 4, dans lequel l'échangeur de chaleur (4) comprend en outre une gouttière (24) sur une face interne de la paroi tubulaire interne (8), configurée pour collecter naturellement de l'eau de condensation gouttant par gravité le long de ladite face interne, ladite gouttière étant connectée de manière fluidique au conduit de collecte d'eau de condensation (26).

6. Système de conditionnement d'air (2) selon l'une des revendications 4 et 5, dans lequel le système comprend en outre un réservoir (30) relié de manière fluidique au conduit de collecte d'eau de condensation (26) pour collecter l'eau condensée.

7. Système de conditionnement d'air (2) selon la revendication 6, dans lequel le système comprend en outre une unité de désinfection par UV (40) configurée pour être en contact avec l'eau condensée dans le réservoir (30).

8. Système de conditionnement d'air (2) selon l'une des revendications 1 à 7, dans lequel le débit massique nominal du souffleur d'air est au moins 5 fois supérieur au débit massique nominal du compresseur d'air.

9. Système de conditionnement d'air (2) selon l'une des revendications 6 et 7, et selon la revendication 8, dans lequel ledit système est configuré pour produire de l'eau à partir de l'air ambiant.

10. Système de conditionnement d'air (2) selon l'une des revendications 1 à 9, dans lequel le souffleur d'air est un amplificateur d'air (18) relié de manière fluidique à la sortie du compresseur à air (20) et configuré pour souffler de l'air en fonction de l'effet coanda.

11. Système de conditionnement d'air (2) selon la revendication 10, dans lequel l'amplificateur d'air (18) comprend un conduit principal, une chambre d'entrée annulaire latérale (18.5) pour l'air comprimé, avec un passage annulaire (18.6) vers le conduit principal, ledit conduit ayant une surface de guidage annulaire

convexe (18.7) directement en aval du passage annulaire (18.6) pour obtenir l'effet coanda. LU101051

12. Système de conditionnement d'air (2) selon l'une des revendications 1 à 11, dans lequel l'échangeur de chaleur (4) comprend en outre au moins une ailette (38) dans le passage externe (12) et/ou dans le passage central (10), configuré pour augmenter l'échange de chaleur.

13. Système de conditionnement d'air (2) selon la revendication 12, dans lequel l'au moins une ailette (38) est en forme de spirale de manière à forcer le flux d'air à tourbillonner dans les passages externe et/ou interne (12, 10).

14. Système de conditionnement d'air (2) selon l'une des revendications 1 à 13, dans lequel le passage externe (12) et/ou le passage interne (10) comprend un ou plusieurs packs de refroidissement ou de chauffage configurés pour maintenir une température basse ou élevée.

15. Système de conditionnement d'air (2) selon la revendication 14, dans lequel le ou les packs de refroidissement ou de chauffage sont disposés sur la paroi tubulaire interne (8).

16. Système de conditionnement d'air (2) selon l'une des revendications 14 et 15, dans lequel le ou les packs de refroidissement ou de chauffage comprennent un matériau à changement de phase MCP.

17. Système de conditionnement d'air (2) selon la revendication 16, dans lequel le MCP est un eutectique.

18. Système de conditionnement d'air (2) selon l'une des revendications 1 à 17, comprenant en outre un filtre à air (18.3) en amont du souffleur d'air (18).

19. Système de conditionnement d'air (2) selon l'une des revendications 1 à 18, dans lequel la paroi tubulaire interne (8) est ondulée le long de la paroi tubulaire externe (6) de manière à augmenter le transfert de chaleur entre les passages interne et externe.

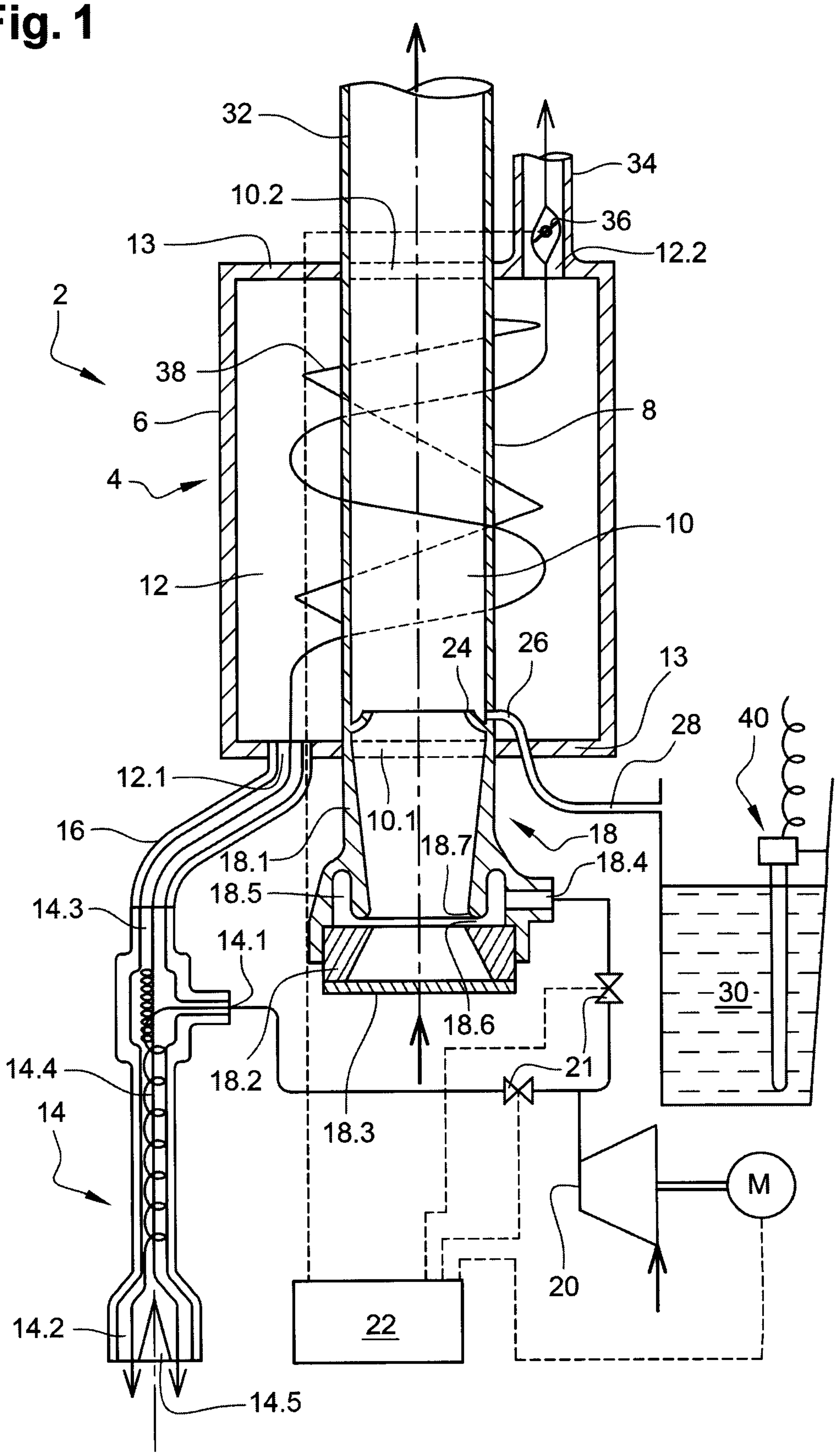
20. Procédé de conditionnement de l'air comprenant les actions suivantes :

- séparer avec un tube vortex (14) un flux d'air comprimé en un flux de gaz chaud et un flux de gaz froid, LU101051
- produire un flux d'air à travers un échangeur de chaleur (4);
- alimenter l'échangeur de chaleur (4) avec l'un des flux de gaz chaud et flux de gaz froid, afin de conditionner le flux d'air ;

caracterisé en ce que

l'échangeur de chaleur (4) comprend un passage central (10) s'étendant le long d'une direction principale et un passage externe (12) s'étendant le long de ladite direction autour du passage central (10), l'un (10) desdits passages (10, 12) étant alimenté avec le flux d'air et l'autre (12) desdits passages étant alimenté avec le flux de gaz chaud ou le flux de gaz froid.

Fig. 1


32
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