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(54) **TECHNIQUE FOR HEAT TRANSFER USING AIR FLOW**

(57) The invention describes a system (1) for heat transfer comprising a fan (2) adapted to transfer heat between a first environment and a second environment by flowing air between the environments, and a fan position motor (3) adapted to change position of the fan (2) in a defined direction in a three-dimensional space, so that flow of the air is in the defined direction.

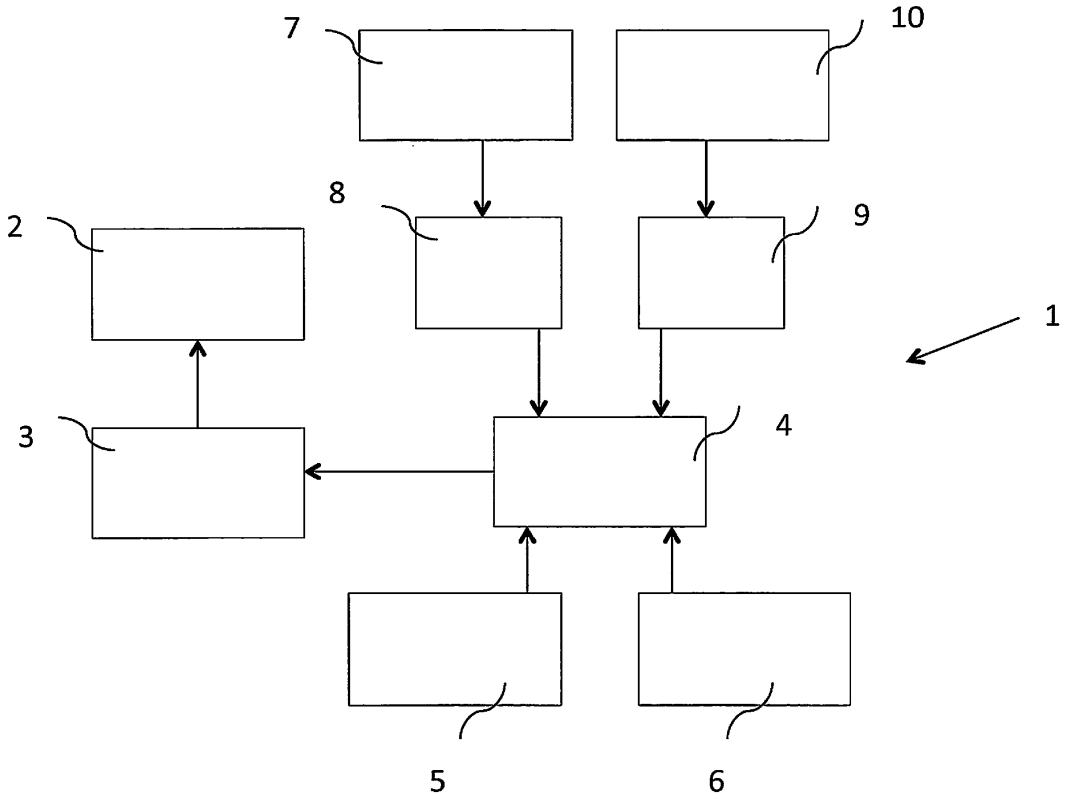

Fig. 1

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Description

[0001] This invention refers to a system for heat transfer according to claim 1, an air conditioner according to the claim 8, and a method for heat transfer according to claim 11.

Background of the Invention

[0002] In an air conditioner, conditioning is carried out by heat transfer from indoor unit to outdoor unit. In the heating mode, high pressure level occurs at indoor unit, and frost develops in condenser of the outdoor unit, so the frost causes the power loss. In cooling mode, high pressure occurs at outdoor unit, which results into consumption of more current and hotter solid-state materials due to heating of the elements. Increase in heat and abnormal current protection causes substantial power loss which is carrying out air conditioning functionality. Heat transfer is carried out by an outdoor fan by either adjusting speed or remaining at a constant speed. In general, the outdoor fan speed can only be adjusted to get more heat transfer, more power and efficiency. However, it has a limitation as the air flow in such air conditioners is unidirectional, which is directed by the nozzle and wing angle of outdoor fan in one direction. Hence, heat transfer is carried out from a limited area, and especially heat transfer does not occur properly from the side area. Moreover, if the condenser heat is not the same at all points, then the heat would not be properly transferred.

[0003] US Patent Publication No. US 2007/0091563 discloses an active heat sink which comprises a plurality of heat sink fins and multiple fans configured in a redundant arrangement coupled to the heat sink. First of all, the prior uses multiple fans which makes the system bulky and costly. Further, still the flow of air is unidirectional, hence proper heat transfer from all places from indoor do not properly occurs, especially from the side area the heat transfer cannot be properly carried out.

Object of the Invention

[0004] It is therefore the object of the present invention is to provide for a mechanism for heat transfer using air flow efficiently from all portions in a three dimensional space.

Description of the Invention

[0005] The before mentioned object is solved by a system for heat transfer according to claim 1, an air conditioner according to the claim 8, and a method for heat transfer according to claim 11.

[0006] The invention describes a system for heat transfer comprising a fan adapted to transfer heat between a first environment and a second environment by flowing air between the environments, and a fan position motor adapted to change position of the fan in a defined direction in a three-dimensional space, so that flow of the air is in the defined direction.

[0007] This provides a mechanism for optimally transferring heat using air flow efficiently from all portions in a three dimensional space where the fan is placed.

[0008] Further preferred embodiments are subject-matter of dependent claims and/or of the following specification parts.

[0009] According to a preferred embodiment of the system, the system comprises a microcontroller adapted to receive power consumption related to the heat transfer, and to compare the power consumption to a reference value, to determine a defined direction of the air flow based on the comparison, and to drive the fan position motor to change the position of fan based on the defined direction of flow of the air.

[0010] This embodiment is beneficial as it provides an automatic way to determine a direction in which the fan's position has to be changed. The automization of the control for trigerring fan position motor shall result in accurate movement of the fan, so as to achieve precise direction in which the fan should be moved to provide the maximum output for the power being consumed during heat transfer process.

[0011] According to a further preferred embodiment of the system, the system comprises a heat sensor adapted to identify a heat density in various parts of the three-dimensional space and to provide the heat density to the microcontroller, wherein the microcontroller is adapted to receive the heat density, to process the heat density, to determine the defined direction for the flow of air, and to drive the fan position motor to change the position of the fan based on the defined direction of the flow of air.

[0012] This embodiment is helpful, as it provides another mechanism to determine an optimal direction in which the position of the fan should be changed so that maximum efficiency in heat transfer can be achieved with minimal power consumption. If heat density is identified for a particular area in a three dimensional space in which the fan is kept, it could be identified which area is having higher heat density and requires attention while transferring the heat. Accordingly, the fan position motor can be triggered to change position of the fan.

[0013] According to another embodiment of the system, the system comprises a current sensor adapted to identify a current value related to consumption of the current at a point of time and to provide the current value to the microcontroller, wherein the microcontroller is adapted to receive the current value, to process the current value and to determine the defined direction for the flow of air, to drive the fan position motor to change the position of the fan based on the defined direction of the flow of air.

[0014] This embodiment is beneficial as it provides another mechanism to determine inefficiency of the heat transfer process, and further helps to identify a direction which is optimal to change the position of the fan, so that the heat transfer output can be maximum for a particulat

value of current consumption.

[0015] According to a further preferred embodiment of the system, the system comprises two fan position motors, wherein each of the fan position motor is adapted to change the position of the fan in one of the dimensions of the three-dimensional space.

[0016] This embodiment is helpful, as it provides for a mechanism to efficiently change position of the fan in multiple directions in a three dimensional space where the fan is kept.

[0017] According to a further embodiment of the system, wherein the fan position motor is a servomotor.

[0018] This embodiment is beneficial, as it provides for movement of the fan in angular as well as linear positions.

[0019] According to another embodiment of the system, wherein the fan position motor is a stepper motor.

[0020] This embodiment is beneficial, as it provides for a mechanism to incrementally change the position of the fan. This embodiment shall be especially helpful in cases where the power consumption is monitored at each incremental change in position of fan, so that the fan's position can be kept on changing till an optimal power consumption is received.

[0021] The before mentioned object is also solved by an air conditioner of television of the claim 8, the air conditioner comprising the system for the heat transfer according to any of the claims 1 to 7, wherein the air conditioner comprises the fan, wherein the fan is adapted to facilitate heat transfer between the first environment inside the air conditioner and the second environment outside the air conditioner.

[0022] This embodiment is helpful as it provides for an air conditioner where the heat transfer can efficiently occur between an outdoor unit and an indoor unit of the air conditioner.

[0023] According to a further embodiment of the air conditioner, the fan comprises a holder which holds the fan, and the fan position motor is placed in a space bottom to the holder.

[0024] This embodiment is beneficial, as it provides for an optimal location for placing the fan position motor, so that the motor remains in proximity of the fan, as well as do not hinder in movement or rotation of the fan.

[0025] According to a further preferred embodiment of the air conditioner, the fan comprises a motor which drives the fan, the motor is placed in a motor casing, the fan position motor is placed in proximity to the motor casing.

[0026] This embodiment is beneficial, as it provides for another optimal location for placing the fan position motor, so that the motor remains in proximity of the fan, as well as do not hinder in movement or rotation of the fan.

[0027] The before mentioned object is also solved by a method for heat transfer according to claim 11, the method for heat transfer comprising changing position of a fan in a defined direction in a three-dimensional space using a fan position motor; and flowing air between a first environment and a second environment for transferring heat by a fan.

[0028] According to another embodiment of the method, the method comprises receiving power consumption of the heat transfer by a microcontroller; comparing the power consumption with a reference value, and based on the comparison determining a defined direction of the air flow by the microcontroller; and driving the fan position motor by the microcontroller to change the position of the fan based on the defined direction of flow of the air.

[0029] According to a further preferred embodiment of the method, the method comprises driving a first fan position motor based on the comparison, to change position of the fan along a first axis based on the comparison, or driving a second fan position motor to change position of the fan along a second axis based on the comparison, or driving first fan position motor and second position motor both to change the position of the fan in a desired direction in three-dimensional space, wherein the first axis and the second axis are perpendicular to each other.

[0030] According to a further embodiment of the method, the method comprises incrementally changing position of the fan either along a first axis by driving a first fan position motor, or a second axis by driving a second fan position motor by a defined degree, wherein the first axis and the second axis are perpendicular to each other, and measuring power consumption of the heat transfer whenever the position of fan changed by the microcontroller, and comparing the power consumption either to the reference value or to previous value of the power consumption, and driving the fan position motors till the time an optimal power consumption is achieved.

[0031] Further benefits, goals and features of the present invention will be described by the following specification of the attached figures, in which components of the invention are exemplarily illustrated. Components of the devices and method according to the inventions, which match at least essentially with respect to their function, can be marked with the same reference sign, wherein such components do not have to be marked or described in all figures.

[0032] The invention is just exemplarily described with respect to the attached figure in the following.

Brief Description of the Drawings

[0033]

Fig. 1 illustrates a schematic diagram of a system for heat transfer.

Fig. 2 illustrates a partial inside view of an air conditioner showing placement of fan position motors inside the air conditioner.

Detailed Description of the Drawings

[0034] The present invention focuses on controlling position of a fan which is used to provide heat transfer

between two environments by flow of the air. The control in the position of the fan is carried out based on feedback related to heat density in a particular part of the environments, or current consumed while performing the heat transfer operation or any other feedback which can related to power consumption during the heat transfer operation.

[0035] To acquire maximum output from the power consumed during heat transfer operation, one or more additional motors are provided which control position of the fan to be in a particular direction, hence providing the ability of the fan to be in multiple direction as required to provide optimal output for a power consumed.

[0036] This manner is available for cooling, as well as heating functionality of an air conditioner too. For heating mode, heat from a condenser of an outdoor unit is very low due to high pressure inside the indoor unit. If this heat loss continues to be lower and lower, frost and ice can be formed around the condenser, and substantial power is lost during heat transfer operation. If the multi directional control of fan position is carried out for heating mode, frost and snow will be decreased by changing position of the fan, which changes air flow direction.

[0037] Fig. 1 shows a schematic diagram of the system 1 for heat transfer by way of flowing air from one environment to another. The system 1 includes a fan 2 and a fan position motor 3. When the fan 2 is actuated, it blows the air from one environment to another to transfer the heat between the environments. The fan position motor 3 is provided to change the position of the fan 2.

[0038] The system 1 also includes a microcontroller 4 which receives power consumption 5 related to heat transfer and compares it with a reference value 6 of power consumption. And based on this comparison, the microcontroller 4 determines a defined direction in which the flow of air is required, and accordingly it drives the fan position motor 3 to change the position of the fan 2 in the defined direction, so that the air flow in the defined direction can be achieved.

[0039] The system 1 also includes a heat sensor 7 which identifies heat density in various parts of the three-dimensional space in which the fan 2 is placed. The heat density 7 is further transferred by the heat sensor 7 to the microcontroller 4. The microcontroller 4 further processes the heat density 8 and determines the direction of flow of the air to achieve the maximum output for the heat transfer functionality. Accordingly, the microcontroller drives the fan position motor 3 to change the position of the fan 2, so that the fan 2 can be in the defined direction to allow air flow in the defined direction.

[0040] The system 1 also includes a current sensor 9 which identifies a current value 10 related to consumption of the current at a point of time during heat transfer operation. The current value 10 is further transferred by the current sensor 9 to the microcontroller 4. The microcontroller 4 further processes the current sensor 9 and determines the direction of flow of the air to achieve the maximum output for the heat transfer functionality. Accordingly, the microcontroller 4 drives the fan position motor 3 to change the position of the fan 2, so that the fan 2 can be in the defined direction to allow air flow in the defined direction.

[0041] The microcontroller 4 can use power consumption 5, current value 10, heat density 7 in alternatives or in combinations to determine the defined direction for the air flow, and accordingly drives the fan position motor 3.

[0042] In one embodiment, the fan position motor 3 can also be manually activated using a control for changing the position of the fan 2 in a defined direction in a three-dimensional space of the environment where the fan 2 is placed. This helps to blow the air in the defined direction.

[0043] In another embodiment, there can be two fan position motors 3, and each of these fan position motors 3 can change the position of the fan 2 in one of the dimensions of the three-dimensional space. So, whenever, the microcontroller 4 drives the fan position motors 3, it estimates the degree of movement trigger has to be given to each of the fan position motors 3, so that the defined direction of the fan 2 can be achieved. In cases, where the microcontroller 4 is not present, the fan position motors 3 are manually triggered through controls of each of the fan position motors 3, so that by moving the fan 2 in each of the dimensions, the desired direction of the fan can be achieved.

[0044] The fan position motor 3 can be a servomotor or a stepper motor. The fan position motor 3 can also be any Brushless DC motor, or a universal motor.

[0045] Fig. 2 shows a partial inside view of an air conditioner 11. The air conditioner 11 includes an outdoor fan 2 which blows air out of the air conditioner 11, so as to transfer the heat from inside the air conditioner 11 to outside. The fan 2 is placed in proximity to a condenser unit 19. The fan 2 is placed onto a holder 12 which is affixed from one of the wall of the air conditioner 11 or a fixture placed inside the air conditioner 11. The fan 2 is rotated by a motor which is placed inside a motor casing 14. To change the position of the fan 2, the air conditioner 11 is provided with two fan position motors 3, a first fan position motor 15, and a second fan position motor 16. The first fan position motor 15 changes the position of the fan 2 along a first axis 17, and the second fan position motor 16 changes the position of the fan 2 along a second axis 18. The first fan position motor 15 is placed in proximity to the motor casing 14 of the fan 2, and the second fan position motor is placed in a space 13 bottom to the holder 12 of the fan 2. Placement of these fan position motors 3, 15, 16 provides for an optimal space utilization to place mechanism for position changing for the fan 2, and also the location of placement further does not hinder in movement or rotation of the fan 2.

[0046] In one embodiment, on one of the fan position motor 3, 15, 16 is provided, and the fan is adapted to move along only one of the axis, either the first axis 17 or the second axis 18, according to which of the first fan position motor 15 or the second fan position motor 16 is

provided.

[0047] Also, in one embodiment, the fan position motor 3, 15, 16 can be placed at any of the locations available inside the air conditioner 11, such that the placement of the fan position motor 3, 15, 16 should not hinder in the movement or rotation of the fan 2.

[0048] These fan position motors 3, 15, 16 can be actuated manually or through a control mechanism. For control mechanism, a microcontroller can be provided which shall receive a power consumption parameter and compare it with a reference value of the power consumption parameter, and drives one of the fan position motors 15, 16 to change the position of the fan 2 into a desired direction.

[0049] In another embodiment, when the microcontroller makes the comparison between a power consumption during the heat transfer at a particular point of time, and a reference value of the power consumption, the microcontroller can drive the first fan position motor 3, 15 to change position of the fan 2 along the first axis 17, or drives the second fan position motor 3, 16 to change position of the fan along a second axis 18, if the desired direction is such that the movement of the fan 2 is required along only one of the axis 17, 18. When a direction is such that the movement of the fan shall be required in both first axis 17 and the second axis 18, the microcontroller drives the first fan position motor 15 and second position motor 16 both to change the position of the fan 2 in the desired direction in three-dimensional space.

[0050] In one embodiment, the microcontroller incrementally changes position of the fan 2 either along a first axis 17 by driving a first fan position motor 15, or a second axis 16 by driving a second fan position motor 18 by a defined degree. The microcontroller shall regularly monitor the power consumption by measuring power consumption 5 of the heat transfer whenever the position of fan 2 changed, and compares the power consumption 5 either to the reference value 6 or to previous value of the power consumption 5. Based on the comparison, the microcontroller incrementally keeps on driving the fan position motors 15, 16, 3 till the time a desired direction is achieved, which results in an optimal power consumption during the heat transfer process.

[0051] The invention has application in any apparatus or system which required flowing air by mechanism of flow by a fan for heat transfer from one environment to another.

[0052] Thus, the present invention provides a system 1 for heat transfer. The system 1 includes a fan 2 which transfers heat between a first environment and a second environment by flowing air between the environments, and a fan position motor 3 which changes position of the fan 2 in a defined direction in a three-dimensional space, so that flow of the air is in the defined direction.

List of reference numbers

[0053]

1	system for heat transfer
2	fan
3	fan position motor
4	microcontroller
5	power consumption
6	reference value
7	heat sensor
8	heat density
9	current sensor
10	current value
11	air conditioner
12	holder
13	space bottom to the holder
14	motor casing
15	first fan position motor
16	second fan position motor
17	first axis
18	second axis
19	condenser unit

Claims

1. A system (1) for heat transfer comprising:

- a fan (2) adapted to transfer heat between a first environment and a second environment by flowing air between the environments; and
- a fan position motor (3) adapted to change position of the fan (2) in a defined direction in a three-dimensional space, so that flow of the air is in the defined direction.

2. The system (1) for heat transfer according to the claim 1 comprising:

- a microcontroller (4) adapted to receive power consumption (5) related to the heat transfer, and to compare the power consumption (5) to a reference value (6), to determine a defined direction of the air flow based on the comparison, and to drive the fan position motor (3) to change the position of fan (2) based on the defined direction of flow of the air.

3. The system (1) for heat transfer according to the claim 2 comprising

- a heat sensor (7) adapted to identify a heat density (8) in various parts of the three-dimensional space and to provide the heat density (8) to the microcontroller (4);

wherein the microcontroller (4) is adapted to receive the heat density (8), to process the heat density (8), to determine the defined direction for the flow of air, and to drive the fan position motor (3) to change the position of the fan (2) based on the defined direction

of the flow of air.

4. The system (1) for heat transfer according to any of the claims 2 to 3 comprising:

- a current sensor (9) adapted to identify a current value (10) related to consumption of the current at a point of time and to provide the current value (10) to the microcontroller (4);

wherein the microcontroller (4) is adapted to receive the current value (10), to process the current value (10) and to determine the defined direction for the flow of air, to drive the fan position motor (3) to change the position of the fan (2) based on the defined direction of the flow of air.

5. The system (1) for heat transfer according to any of the claims 1 to 4 comprising:

- two fan position motors (3), wherein each of the fan position motor (3) is adapted to change the position of the fan (2) in one of the dimensions of the three-dimensional space.

6. The system (1) for heat transfer according to any of the claims 1 to 5, wherein the fan position motor (3) is a servomotor.

7. The system (1) for heat transfer according to any of the claims 1 to 5, wherein the fan position motor (3) is a stepper motor.

8. An air conditioner (11) comprising the system (1) for the heat transfer according to any of the claims 1 to 7, wherein the air conditioner (11) comprises the fan (2), wherein the fan (2) is adapted to facilitate heat transfer between the first environment inside the air conditioner (11) and the second environment outside the air conditioner (11).

9. The air conditioner (11) according to claim 8, wherein the fan (2) comprises a holder (12) which holds the fan (2), the fan position motor (3) is placed in a space (13) bottom to the holder (12).

10. The air conditioner (11) according to any of the claims 8 or 9, wherein the fan (2) comprises a motor which drives the fan (2), the motor is placed in a motor casing (14), the fan position motor (3) is placed in proximity to the motor casing (14).

11. A method for heat transfer comprising:

- changing position of a fan (2) in a defined direction in a three-dimensional space using a fan position motor (3); and
- flowing air between a first environment and a second environment for transferring heat by the fan (2).

12. The method according to the claim 11 comprising:

- receiving power consumption (5) of the heat transfer by a microcontroller (4);
- comparing the power consumption (5) with a reference value (4), and based on the comparison determining a defined direction of the air flow by the microcontroller (4); and
- driving the fan position motor (3) by the microcontroller (4) to change the position of the fan (2) based on the defined direction of flow of the air.

13. The method according to claim 12 comprising:

- based on the comparison, driving a first fan position motor (3, 15) to change position of the fan (2) along a first axis (17), or driving a second fan position motor (3, 16) to change position of the fan along a second axis (18), or driving first fan position motor (15) and second position motor (16) both to change the position of the fan (2) in a desired direction in three-dimensional space, wherein the first axis (17) and the second axis (18) are perpendicular to each other.

14. The method according to the claim 12 comprising:

- incrementally changing position of the fan (2) either along a first axis (17) by driving a first fan position motor (15), or a second axis (16) by driving a second fan position motor (18) by a defined degree, wherein the first axis (17) and the second axis (18) are perpendicular to each other; and
- measuring power consumption (5) of the heat transfer whenever the position of fan (2) changed by the microcontroller (4), and comparing the power consumption (5) either to the reference value (6) or to previous value of the power consumption (5), and driving the fan position motors (15, 16, 3) till the time an optimal power consumption is achieved.

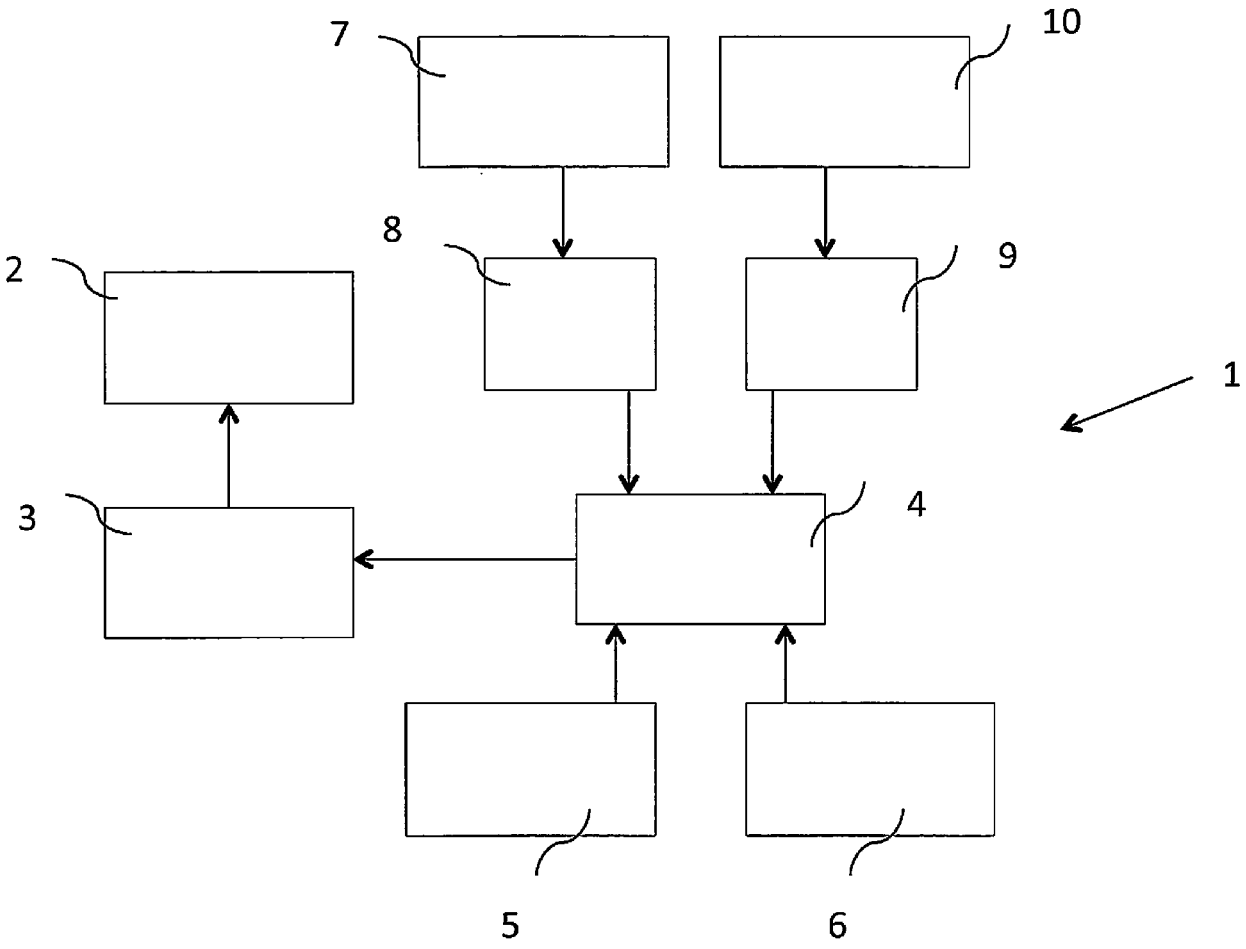

Fig. 1

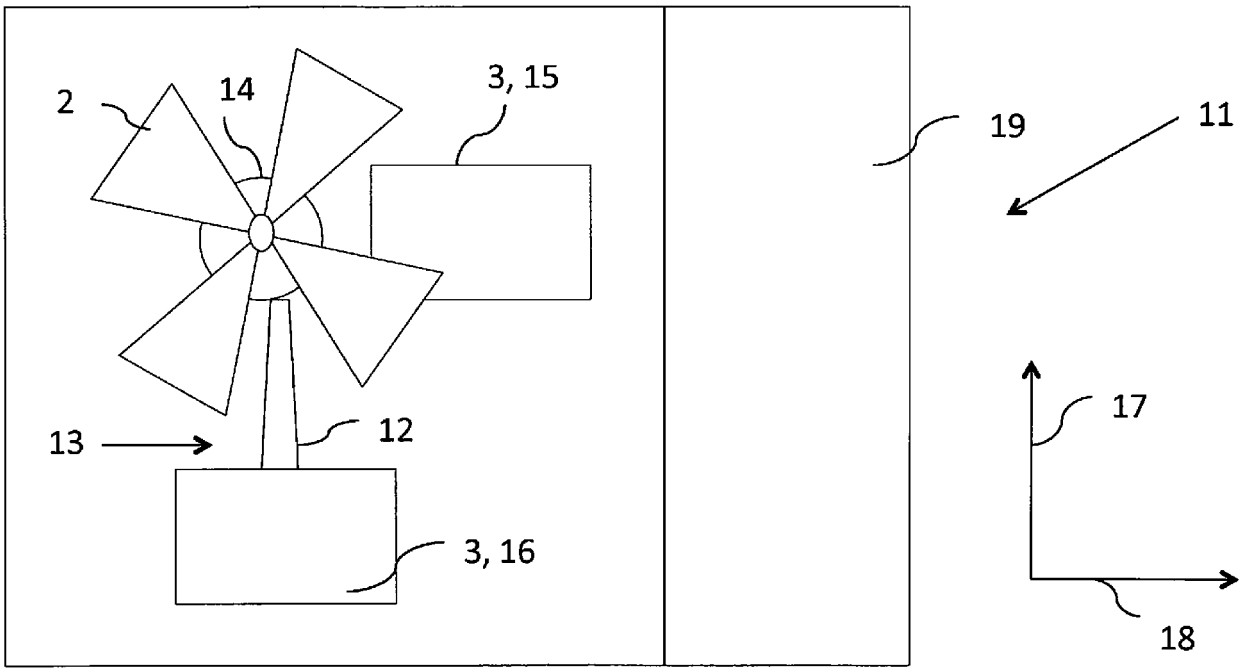

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 7556

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

F24F
F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 January 2018	Anconetani, Mirco

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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26-01-2018

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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