

(19) **DANMARK**

(10) **DK/EP 2453178 T3**



(12) **Oversættelse af
europæisk patentskrift**

Patent- og
Varemærkestyrelsen

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- (51) Int.Cl.: ***F 24 D 3/08 (2006.01)*** ***F 24 D 19/10 (2006.01)*** ***F 24 F 3/052 (2006.01)***
F 24 F 12/00 (2006.01)
- (45) Oversættelsen bekendtgjort den: **2021-01-04**
- (80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2020-09-30**
- (86) Europæisk ansøgning nr.: **11189152.9**
- (86) Europæisk indleveringsdag: **2011-11-15**
- (87) Den europæiske ansøgnings publiceringsdag: **2012-05-16**
- (30) Prioritet: **2010-11-15 DE 202010015516 U**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV
MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
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- (54) Benævnelse: **Styreindretning til et varmesystem og varmesystem**
- (56) Fremdragne publikationer:
EP-A1- 0 002 839
DE-A1- 2 524 426
US-A- 2 784 945
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US-A1- 2009 255 997

DESCRIPTION

[0001] The application relates to a control device for a heating system and further relates to a heating system provided with and controlled by a control device.

[0002] Frugal use of energy is critical to the economic efficiency of heating systems, particularly of heating systems for buildings. The room temperature is often regulated by means of controlled or regulated throttling of the fluid heating medium (heat exchange medium) being transported, such as water, that is fed into the radiators of each room, or in concrete slabs or other types of surface heating elements that form the walls, floors, and/or ceilings of the rooms.

[0003] The optimal flow rate of the fluid medium is often different in the various rooms of a building; it depends on the prescribed target temperature of the room (as a function of the time and day of the week), but also on the additional energy input or energy output due to sunlight, wind, soil temperature, manual or automatic ventilation, or other influences.

[0004] If a room is being heated but has ultimately reached and exceed its desired target temperature, the infeed of the fluid medium or its flow rate in the heating system of the room (or of its wall, ceiling, or floor) is conventionally throttled or interrupted. If this is not sufficient, then the room temperature can be decreased again by automatically ventilating the room. But even if the heated discharge air is recycled to recapture energy, then energy savings are limited. Particularly if heating is still performed in other rooms of the building, such on the north side or on the ground floor (that is the lowermost story above the ground) because the temperature there is below the provided target temperature, greater and more efficient energy savings would be desirable.

[0005] US 2009/0255997 A1 relates to a coordinated, flexible, agile, and energy efficient temperature variation among a plurality of rooms, as found in a hotel, an apartment building, or a group of exercise rooms, by transferring heat between the rooms. Air can be moved by fans and/or heat can be transferred by a heat pump. Heat transfer between exercise rooms can be powered partly by exertion of individuals in the rooms. Rapid air exchange can quickly equalize temperatures in adjacent rooms. Embodiments exchange heat between rooms and interior and/or exterior reservoirs of warmer and cooler air and/or water, and some embodiments move air from the reservoirs into and out of the rooms. Heat can be pumped into or out of the system, and air and/or water can be added or extracted from the reservoirs. In some embodiments heat is moved sequentially through a variable series of rooms, creating a monotonic variation of temperatures.

[0006] DE 25 24 426 A relates to an air conditioning system for buildings. A building air conditioning system has heat pumps situated in various rooms of the building. A heat exchanger is connected to a central fluid circulation system and has a second forced draught feed heat exchanger to heat or cool the room air which can be switched into the coolant

medium circulation of the heat pump. It has a third heat exchanger parallel to the first heat exchanger situated in the flow path of the coolant medium circulation insert second heat exchanger blower fan. The attachment ends of the first and third heat exchangers may be alternatively shut off by valves. The fluid circulation has auxiliary heating and cooling devices.

[0007] There is a need for a control device by means of which a heating system can be operated in a way saving even more energy and by means of which particularly local deviations from the target temperature in individual rooms or groups of rooms can be compensated for more quickly and efficiently.

[0008] The application provides a control device for controlling a heating system having at least one first heat exchanger disposed in a first part of a building, and at least one second heat exchanger disposed in a second part of a building as defined in claim 1.

[0009] The control device according to the application uses the fluid medium not only for heating, but also for cooling. However, no active cooling is used; rather the fluid medium is exchanged between at rooms, groups of rooms, sides or other parts of buildings having different temperatures. The control device measures opposing deviations from the target temperature provided in the different parts of the building (like a temperature too high in first, overheated rooms of the building as opposed to a temperature too low in further, second subcooled rooms of the building) and uses the fluid medium itself to adjust the room temperature. To this end, the flow streams of the fluid medium are diverted, that is re-routed, in a way that differs from the flow scheme in conventional operation.

[0010] The control device or its control station adjusts the heating system which it is a part of, such that a closed circuit of the fluid medium is established between a first and a second heat exchanger each associated with different parts of the building, which may for instance be different rooms, different groups of rooms, different floors or stories, or different sides of the building. In case that the heat exchangers are associated with different, opposite sides of the building, each side of the two opposite sides of the building may comprise a room or a groups of rooms arranged at that respective side of the building and/or having windows at that respective side of the building). In the closed circuit established between the first and the second heat exchanger, the medium circulates between both heat exchangers but remains separated or cut off from any remaining quantity of fluid medium and from active heat input. In place of the first and second heat exchangers, groups of first or second heat exchangers can also be provided, leading into a plurality of overheated or subcooled rooms at the same time.

[0011] The circulating partial circuit arising from simple recirculation of the medium, cut off from the other heat exchangers of the arrangement of heat exchangers, is automatically initiated and maintained by the control device whenever and as long as the first part of the building is heated above its target temperature and the second part of the building at the same time is colder than its target temperature. Preferably this temperature compensation is initiated and executed at least when and/or as long as overheated rooms and other subcooled rooms are present in the same time in the building, and it is particularly initiated and executed

between those rooms, groups of rooms, floors or sides of the building where the target temperature of the overheated rooms is greater than the target temperature of the subcooled rooms. The overheated rooms (excessively high temperature) is then cooled and the subcooled rooms are heated, exploiting merely the locally varying temperature of the fluid medium without consuming additional energy from a furnace, a heating or a cooling unit. Thereby temperature control can be effected merely by means of the continuous or intermittent recirculation of the fluid medium in the closed circuit between the first and the second heat exchanger. The local deviations from the target temperature in individual rooms or groups of rooms are thereby compensated for more quickly and efficiently, while saving more energy. Preferably the first part of the building in which the at least one first heat exchanger is disposed comprises a first room, a first group of rooms, a first story, or a first side of a building, whereas the second part of the building in which the at least one second heat exchanger is disposed comprises another second room, another second group of rooms, another second story, or another second side of a building, respectively. Preferably the first part and the second part are opposed to one another. For instance, the first part may comprise all rooms constituting the south side or façade of the building whereas the second part may comprise all rooms constituting the north side or façade of the building. Alternatively, the first part may comprise rooms on upper floors or stories whereas the second part may comprise rooms on lower floors or stories of the building, for instance. Accordingly, according to the present application the first and second heat exchangers are arranged distant from one another and are particularly arranged in different, preferably opposite parts of a building. In particular, for each room only one single heat exchanger or group of heat exchangers is provided which is usable, at a time, either as the first or as the second heat exchanger, depending on whether the respective room is to be momentarily cooled or heated. Thus the control device comprises just one single heat exchanger or group of heat exchangers in each room, which heat exchanger or group of heat exchangers is usable either as the at least one first heat exchanger or, alternatively, as the at least one second heat exchanger at a time. Thus there is no need for installing both first and second heat exchangers one and the same room. Instead, the heat exchangers installed in it or in its walls, its floor and/or its ceiling or its radiators temporarily can serve as the at least one first heat exchanger and, at other times, can serve as the at least one second heat exchanger, depending on whether the room is overheated or subcooled and on whether there are other rooms in the building which at the same time are subcooled or overheated. This preferably applies to all rooms of the building. Accordingly, there is no need to install two types of heat exchangers for heating and cooling (especially not in one and the same wall); instead the control station (particularly its distributor and/or its mixing valves) controls which heat exchangers are connected with one another, particularly in series, and thus effects cooling of the first and heating of the second room merely by circulation of the fluid medium. All features and positions enumerated in this paragraph for the first and second heat exchangers preferably likewise apply to the first and second temperature sensors. For instance, the first or, alternatively, second temperature sensors are installed in (and measure the temperature of) the first or, alternatively, second part of the building as defined above.

[0012] The features mentioned herein above are now described in some exemplary

embodiments with reference to the figures.

Figure 1 shows a heating system and a control device according to a first embodiment in a building,

Figure 2 shows a heating system and a control device according to a second embodiment, and

Figure 3 shows a schematic representation of the control device and the heating system.

[0013] Figure 1 shows a heating system 10 and a control device 20 according to a first embodiment, controlling the heating system 10. In this embodiment example, the rooms shown on the right in Figure 1, for example, represent the rooms on the sunlit south side (first part of the building 21), while the rooms shown on the left in Figure 1, for example, correspond to the cooler north side (second part of the building 22) of the building 25. Each of the building parts that can have separately controlled temperature can comprise a plurality of rooms, or just one room. The building 25 comprises surface heating elements 7, such as in the form of floors, ceilings, walls, or even the roof, permeated by heat exchanger lines. The heat exchangers 1, 2 disposed in the surface heating elements 7 (here the floors or ceilings) are indicated by spiral shapes and further shown as dashed lines in the section plane; they are connected to the heating system 10, which can be disposed at an arbitrary location in the building and which is shown only schematically, as is the control device 20. In both parts of the building, at least one temperature sensor 11, 12 is disposed; the first temperature sensor 11 measures the time dependent actual temperature T_1 in the first part of the building 21 and the second temperature sensor 12 measures the temperature T_2 in the second part of the building 22. Both sensors are connected to the control device 20 by connecting lines or in some other manner. The control device 20 compares each of the current temperatures T_1 , T_2 to the target temperature ST_1 , ST_2 for each room or part of the building, and particularly checks whether the actual temperature T_1 exceeds the first target temperature ST_1 in the first part of the building 21. It further checks whether the actual temperature T_2 in the second part of the building 22 is lower than the second target temperature ST_2 . Finally, the control device 20 also checks whether both events occur at the same time. If this is the case, that is, if and as long as both the condition $T_1 > ST_1$ and the condition $T_2 < ST_2$ are met, the control device 20 initiates the heating system 10 to produce a closed circuit between the first 1 and the second heat exchanger 2, separated from the other heat exchangers of the arrangement of heat exchangers, and decoupled from further heat input from a heat source, such as a furnace of the heating system 10. The control device 20 further activates the circulating pump of the heating system 10, whereupon the medium circulates in the closed circuit formed by the first heat exchanger 1 and the second heat exchanger 2 (and optionally short connecting lines in the distributor). This results in an exchange of the fluid heat exchanger medium between both heat exchangers 1, 2, wherein the warmer medium from the first heat exchanger 1 is pumped into the second heat exchanger 2, and in turn the cooler medium is pumped from the second heat exchanger 2 into the first heat exchanger 1. In this embodiment example, it is assumed that the first target temperature ST_1 is at least as high as the second target temperature ST_2 ,

so that each of the temperatures in the two rooms or parts of the building 21, 22 approach the corresponding target temperatures ST1, ST2 again. The rooms on the south side are thereby cooled and the rooms on the north side are heated, simply by circulating water or some other fluid medium in the heating system, without additional heating energy being consumed in the furnace or heating source. The first and the second heat exchanger 1, 2 can each also be a group of first and second heat exchangers 1, 2. The embodiment according to Figure 1 can further be combined with that according to Figure 2.

[0014] Figure 2 shows a heating system 10 and a control device 20 according to a second embodiment, controlling the heating system 10. In the example of Figure 2, the first heat exchanger 1 or the group of first heat exchangers 1 leads to the roof of the building 25. The second heat exchanger 2 or the group of second heat exchangers 2 leads to the floor of a lower story, or, as indicated by a first heat exchanger 2a shown in dashed lines, is located within a basement of the building (not shown) which may be provided beneath a floor slab of the ground story. First and second temperature sensors 11, 12 connected to the control device 20 (not shown) are further indicated.

[0015] The heating system 10 and the control device 20 function as in Figure 1, with the difference that in Figure 2 a temperature compensation takes place between two parts of the building at different heights in or on the building. Using the closed circuit between the first 1 and the second heat exchanger 2, for example, the roof story on which the sun shines is cooled during the day, and the lowest story is heated as soon as the temperature T1 on the roof has risen above the first local target temperature ST1 ($T1 > ST1$) and the temperature T2 at the ground story is simultaneously lower than the lower local target temperature ST2 ($T2 < ST2$).

[0016] Figure 3 shows a schematic representation of an embodiment example of the control device 20 and the heating system 10, by means of which, for example, the temperature in the rooms of the building of Figures 1 and 2 can be controlled. The control device 20 measures the temperatures in at least two parts of the building by means of the temperature sensors 11, 12. The control device 20 or its control station 15 checks whether the temperature T1 in a first 21 of the building parts is above the target value ST1 set for this part of the building 21. A corresponding check is made as to whether the temperature T2 in the second part of the building is below the target temperature ST2 there. If and as long as both criteria are met, the control device 20 or its control station 15 initiates the closed circuit of the fluid medium in the first and second heat exchanger 1, 2, in that the distributor 5 is initiated to separate these heat exchangers 1, 2 from the remaining heat exchangers 8 of the arrangement of heat exchangers 9 and also from the heating source 3 or the furnace. This is done by means of the schematically represented switching elements (14) and/or actuating lines 18, or in another manner, such as actuators or the like. A mixer valve 6 or a group of mixer valves 6 can thus be set. The circulating pump 4 is further switched on and maintained in operation by means of schematically represented switching elements 13 and/or activation lines 17, so that the fluid medium contained in the heat exchangers 1, 2 can circulate therein. The surface heating elements 7 having heat exchangers 1, 2 (Figures 1 or 2) thereby adapt their temperatures,

leading to the actual room temperature T1, T2 approaching each target temperature. As soon as the temperature in even one of the two rooms or building parts 21, 22 is brought or returned to the local target temperature, the control device 20 or its control station 15 initiates the termination of the circulating closed circuit formed by the heat exchangers 1, 2 and sets the heating system 10 and the distributor 5 back to the original or previous operating settings.

Reference List

[0017]

- 1
First heat exchanger
- 2; 2a
Second heat exchanger
- 3
Heating source
- 4
Circulating pump
- 5
Distributor
- 6
Mixing valve
- 7
Surface heating element
- 8
Remaining heat exchangers
- 9
Arrangement of heat exchangers
- 10
Heating system
- 11
First temperature sensor
- 12
Second temperature sensor
- 13, 14
Switching element
- 15
Control station
- 16
Connecting line
- 17
Activation line
- 18

	Actuation line
20	
	Control device
21	
	First part of the building
22	
	Second part of the building
25	
	Building
30	
	Ground
ST1 ST2	
	Target temperature
T1, T2	
	Temperature

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- [US20090255997A1](#) [0005]
- [DE2524426A](#) [0006]

Patentkrav

1. Styreindretning (20) til styring af et varmesystem (10), som har mindst en første varmeveksler (1) anbragt i en første del af en bygning (21), og mindst en anden varmeveksler (2; 2a) anbragt i en anden del af en bygning (22),

5 hvilken styreindretning (20) omfatter mindst følgende:

- mindst en første temperatursensor (11) til at være associeret med den første varmeveksler (1) og til at måle en temperatur i den første del af bygningen (21),
- mindst en anden temperatursensor (12) til at være associeret med den
10 anden varmeveksler (2; 2a) og til at måle en temperatur i den anden del af bygningen (22),
- en styrestation (15) konfigureret til at indlede en temperaturkompensation ved ganske enkelt at recirkulere et fluidmedie, som skal anvendes til varmeveksling afhængigt af temperaturerne (T1, T2)
15 målt af den første (11) og den anden temperatursensor (12), hvor en mindst delvis veksling af fluidmediet finder sted mellem den første varmeveksler (1) og den anden varmeveksler (2; 2a); og
- omskifterelementer (13, 14) konfigureret til at tænde og slukke en cirkulationspumpe (4) og en blandingsventil (6), hvor blandingsventilen (6)
20 er tilvejebragt ved en varmekilde (3), ved styrestationen (15), eller ved en fordeler (5), hvor styrestationen (15) er specifikt konfigureret til at anvende omskifterelementerne (13, 14) til at indstille blandingsventilen (6) til en lukket kreds mellem den første og den anden varmeveksler (1, 2) og til at tænde cirkulationspumpen (4) for at indlede
25 temperaturkompensationen ganske enkelt ved cirkulation, **kendetegnet ved, at**

styrestationen (15) er konfigureret til altid automatisk at indlede og/eller vedligeholde et cirkulerende kredsløb mellem den første varmeveksler (1) og den anden varmeveksler (2; 2a) når som helst temperaturen (T1) i den første del af
30 bygningen (21) er større end en første måltemperatur (ST1) fastsat for den første del af bygningen (21) og på samme tidspunkt temperaturen (T2) i den anden del af bygningen (22) er mindre end en anden måltemperatur (ST2) fastsat for den

anden del af bygningen (22), hvor den anden måltemperatur (ST2) er mindre end eller lig med den første måltemperatur (ST1).

2. Styreindretningen ifølge krav 1,

5 kendetegnet ved, at

styrestationen (15) er konfigureret til at frembringe en lukket kreds mellem den første varmeveksler (1) og den anden varmeveksler (2; 2a) til at cirkulere, i hvilken fluidmediet båret i den første og den anden varmeveksler (1, 2) cirkulerer, på grund af cirkulationen, mellem den første (1) og den anden varmeveksler (2; 2a) og forbliver afskåret fra det resterende fluidmedie og/eller fra et aktivt varmeinput.

3. Styreindretningen ifølge et af kravene 1 til 2,

kendetegnet ved, at

15 den mindst ene første temperatursensor (11) er konfigureret til at måle en temperatur i det første rum eller første gruppe af rum af bygningen (21), og den mindst ene anden temperatursensor (12) er konfigureret til at måle en temperatur i det andet rum eller anden gruppe af rum af bygningen (21) .

20 **4.** Varmesystem (10) til en bygning (25), omfattende mindst de følgende:

- en anordning (9) af varmevekslere, hvilken anordning (9) omfatter mindst en første varmeveksler (1) egnet til at blive anbragt i en første del af bygningen (21) og mindst en anden varmeveksler (2) egnet til at blive anbragt i en anden del af bygningen (22),
- 25 - en varmekilde (3) til at opvarme et fluidmedie af varmesystemet (10) anvendt til varmeveksling,
- en cirkulationspumpe (4) til at cirkulere fluidmediet i varmesystemet (10),
- mindst en fordeler (5) til at fordele fluidmediet i varmesystemet (10),

30 kendetegnet ved, at

varmesystemet (10) omfatter en styreindretning (20) ifølge et af kravene 1 til 3.

5. Varmesystemet ifølge krav 4,

kendetegnet ved, at

den mindst ene første varmeveksler (1) og den mindst ene anden varmeveksler (2; 2a) hver omfatter en eller flere varmevekslere installeret i betonplader eller i
5 andre overfladevarmeelementer (7).

6. Varmesystemet ifølge krav 4 eller 5,

kendetegnet ved, at

den mindst ene første varmeveksler (1) og den mindst ene anden varmeveksler
10 (2; 2a) er egnet til at blive anbragt i den samme etage eller gruppe af etager af bygningen (25), men i rum på modstående sider af bygningen (25), eller ved forskellige højder, inkluderende et tag, et loft eller en kælder af bygningen (25).

7. Varmesystemet ifølge et af kravene 4 til 6, **kendetegnet ved, at**

15 den mindst ene første varmeveksler (1) er serieforbundet til den mindst ene anden varmeveksler (2; 2a).

8. Varmesystemet ifølge et af kravene 4 til 7, **kendetegnet ved, at**

fluidmediet, i den lukkede kreds mellem den første varmeveksler (1) og den
20 anden varmeveksler (2; 2a), vekslende passere igennem den første varmeveksler (1) og den anden varmeveksler (2; 2a).

9. Varmesystemet ifølge et af kravene 4 til 8, **kendetegnet ved, at** den mindst

ene første varmeveksler (1) er egnet til at blive anbragt i et første rum eller en
25 første gruppe af rum af bygningen (21), hvorimod den mindst ene anden varmeveksler (2; 2a) er egnet til at blive anbragt i et andet rum forskelligt fra det første rum eller i en anden gruppe af rum forskelligt fra den første gruppe af rum.

10. Varmesystemet ifølge et af kravene 4 til 9, **kendetegnet ved, at**

30 den mindst ene første temperatursensor (11) er anbragt i en øvre etage, i et tag eller i et loft af en bygning (25), hvorimod den mindst ene anden temperatursensor (12) er anbragt i en nedre etage eller i en kælder af bygningen.

11. Varmesystemet ifølge et af kravene 4 til 10, **kendetegnet ved, at** omskifterelementerne (13, 14) af styrestationen (15) er forbundet til fordeleren (5) ved hjælp af aktiveringsledninger (17) til at tænde og vedligeholde drift af cirkulationspumpen (4) og aktueringsledninger (18) til at separere de første og 5 anden varmevekslere (1, 2, 2a) fra enhver resterende varmevekslere (8) af anordningen af varmevekslere (9) og også fra varmekilden (3) af varmesystemet (10) .

DRAWINGS

Fig. 1





