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(54) Heating system and method for heating a plurality of rooms

Heizsystem und Verfahren zum Heizen einer Vielzahl von Räumen

Système de chauffage et procédé de chauffage de plusieurs pièces

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Description

[0001] The invention relates to a heating system for heating a plurality of rooms according to the preamble of claim 1.

[0002] Furthermore, the invention relates to a method for heating a plurality of rooms according to the preamble of claim 10.

[0003] Most buildings comprise a plurality of rooms which are heated by means of a central heating system. Such a central heating system comprises a single heat source which supplies heating fluid to a plurality of heat exchangers wherein each heat exchanger is arranged in a room to be heated. Each heat exchanger should receive so much heating fluid that it heats the room to a predetermined temperature. The temperatures can differ between different rooms.

[0004] For this purpose, a temperature sensor (or any other sensor which can detect the heat demand) is arranged in each room and detects the actual temperature. The actual temperature is compared to a given temperature, i.e. a set point temperature. Depending on the difference between these two temperatures or any other criterion for a heat demand, the control valve is more or less opened. When the control valve is opened, heating fluid is running through the heat exchanger. When the control valve is closed, the flow of heating fluid stops.

[0005] In connection with a fluid driven heating system receiving the heating fluid from a heat pump, a buffer tank is often used. This buffer tank is used, because a heat pump will often require a minimum of flow in order to work correctly. As a buffer tank increases the costs of a heating system, there have been several suggestions for finding a different way of achieving a minimum flow.

[0006] WO 2010/095093 A2 describes a system that comprises a bypass loop in the heating system. When the rooms are sufficiently heated and a situation occurs, in which there is no heat demand, all valves but one are closed. The heat exchanger with the open valve is used as bypass loop in order to achieve the best possible operating conditions for the heat pump by having a minimum flow.

[0007] DE 10 2007 043 714 A1 deals with the same problem. However, the solution of this reference uses two sets of heat exchangers in each room, one for a "basic load" and one for a "full load". This is a rather expensive and difficult solution.

[0008] DE 10 2008 051 275 A1 describes another way of solving this problem, as it uses the temperature difference in the individual rooms (difference between actual temperature and set point temperature). The heat pump is then controlled on the basis of the room with the largest temperature difference. Pump and heat pump are turned off, when no room has a heat requirement.

[0009] WO 2010/095092 A2 discloses a hydronic heating/cooling system. The system comprises heaters and control valves that are controlled by a control means. A thermostat is arranged in each room together with each heater.

[0010] It is the task of the invention to heat rooms in an energy-saving manner.

[0011] This task is solved by a heating system mentioned above in that said control means opens said control valves in a timely distributed manner and wherein said control means opens each control valve during a fraction of a predetermined time period, said fraction being determined by the heat demand detected by said heat demand sensor.

[0012] The heat demand sensors in the individual rooms are used to determine the heat demand of each room. This can be achieved by comparing the actual temperature and the set point temperature in each room. The difference between these two temperatures indicates the heat demand. The heat demand of all rooms together gives the total heat requirement which must be satisfied by the heat source. However, the heat source does not supply the heating fluid to all heat exchangers at the same time. The control means make sure that the heating fluid is distributed over the time to different heat exchangers. This can lead to the situation, that at each time only one heat exchanger gets heating fluid while the control valves of all other heat exchangers are closed. It depends on the number of rooms whether it is necessary to open the control valves of two or more heat exchangers at the same time. When the rooms are sufficiently heated, i.e. they have the desired or set point temperature, there is no more heat demand. In this situation it is made sure that at least one valve is open simultaneously with the heat source or heat pump receiving a signal "no heat demand".

[0013] It is not in all cases necessary that the on-off-valves are completely open or completely closed. Even when control valves are partly open and others are partly closed the heat can be supplied to the rooms in a timely distributed manner. The term "controlling an open state" can be replaced with the term "controlling a closed state" having the same meaning in principle.

[0014] Furthermore the control means opens each control valve during a fraction of a predetermined time period, said fraction being determined by the heat demand detected by said heat demand sensor. The time period can for example be 30 minutes. Since the time constant of a heating system is rather large it is sufficient to open each control valve once during a period of e.g. 30 minutes. Such a pulse width modulation is simple to realize and gives the desired effect. The fractions of all control valves can be set so that each control valve is open over a sufficient time and all control valve of rooms having a heat demand are sufficiently open in order to satisfy the heat demand.

[0015] Preferably said control means open said control valves in a consecutive manner. This means that all control valves are opened one after the other. This is a simple way to ensure that at least one control valve is opened at a time and the other control valves are closed. However, since the control valves need a certain time to open

or close it is allowed that a slight overlapping of open conditions of control valves occurs during opening and closing the control valves.

[0016] In another preferred embodiment said control means divides said time period into a number of fractions, said number corresponding to the number of control valves of said plurality of control valves, each fraction being allocated to a specific control valve, and opens a control valve in the beginning of its fraction provided that the control valve of the previous fraction is still open, or opens said control valve during the previous fraction at the time at which the control valve of the previous fraction is closed. This is another possibility to ensure a uniform flow of heating fluid through the system although it is possible that two or more control valves are open at the same time. Nevertheless, heat transported by the heating fluid is spread over all heat exchangers which need heat.

[0017] Preferably said control means keeps open a control valve in case of no heat demand. When all heat demand sensors indicate that there is no more heat demand usually at least one control valve is open. The control means keeps this control valve open so that no further action is necessary.

[0018] Preferably the control means changes the output temperature of the heat source depending on the overall heat demand detected by all heat demand sensors. The control means does not only control the control valves, i.e. changes the opening degree and/or the opening time of the control valves. It influences furthermore the heat source. When the heat demand decreases the output temperature of the heat source is lowered. When the heat demand increases, the output temperature of the heat source is raised.

[0019] Furthermore, it is preferred that said heat source is a heat pump and said control means lowers the temperature set point of the heat fluid in case of no heat demand. This means that the heating fluid will still be pumped through the heating system, however, the heating fluid will not be heated anymore. Since at least one control valve remains open, there will be a flow of heating fluid which is often needed by the heat pump, however, this heating fluid will not be heated up.

[0020] Preferably said control means comprises a timer means controlling a minimum off-time of the heat pump. The timer means ensures that the heat pump has to rest for a minimum off-time once it has stopped delivering heating fluid. This stop can be a complete stop of the heat pump or it can be the lowering of the set point of the temperature of the heating fluid.

[0021] Furthermore, it is preferred that said control means comprises a delay means provoking a minimum restart time between consecutive starts of said heat pump. In other words the time between two starts of the heat pump must not fall below the minimum restart time.

[0022] Here it is preferred that said minimum off-time is in a range from 0 minutes to 30 minutes and/or said minimum restart time is in a range from 10 minutes to 60 minutes. These times are sufficient since the thermal time constant of the heating system is large enough.

[0023] The task is solved in a method mentioned previously in that said control valves are opened in a timely distributed manner depending on said heat demand wherein at least one control valve is controlled in an open state in case of no heat demand.

[0024] As outlined above in connection with the heating system it is possible to save energy by operating the valve so that a uniform temperature is obtained which can be kept as low as possible while the control valves are operated in a coordinated manner so that the flow of heating fluid through the heating system is as uniform as possible.

[0025] Preferably said control valves are pulse width modulated and a control valve which is open when there is no heat demand is kept open. This is a simple way of enabling operation of the control valves in a coordinated manner. Since a control valve is kept open which is already open there is no additional action required. The risks of faults is minimized.

[0026] In a preferred embodiment said control valves are opened one after the other. In this case the heat source has to supply only one heat exchanger at a time. The control valves of the other heat exchanger remain closed and the heating fluid in these heat exchangers can deliver the heat to the respective room. Since the thermal time constant of the heating system is large enough, a rather uniform temperature is achieved. Since the control valve needs a certain time to open or to close it is possible that during opening and closing of consecutive operated control valves a small timely overlap of consecutive operated valves occurs. However, this is acceptable.

[0027] In another preferred embodiment said control valves are controlled during a predetermined time period, wherein said time period is divided in a number of fractions, said number of fractions corresponding to the number of control valves, each fraction being allocated to a specific control valve, and a control valve is opened at the beginning of its fraction provided that the control valve of the previous fraction is still open, or the control valve is opened during the previous fraction at the time the control valve of the previous fraction is closed. This ensures a uniform flow of heating fluid through the system as well. The heating fluid can be kept at a rather low temperature to get the highest possible efficiency. Nevertheless it is always made sure that at least one control valve is open in order to establish a permanent flow through the heating system.

[0028] Preferably the output temperature of the heat source is changed depending on the heat demand of all rooms. When the heat demand becomes higher, the temperature is raised. When the heat demand becomes lower, the output temperature of the heat source is lowered.

[0029] Preferred embodiments of the invention will now be described in more detail with reference to the drawing, wherein

Fig. 1 is a schematic representation of a heating sys-

tem for three rooms,

Fig. 2 is a principle sketch for a first mode of operation,

Fig. 3 is a principle sketch for a second mode of operation,

Fig. 4 is a further representation of another mode of operation, and

Fig. 5 some signals in the heating system.

[0030] Fig. 1 shows schematically a heating system 1 for heating a plurality of rooms 2, 3, 4 in a building. The heating system comprises a heat source 5 in form of a heat pump, boiler or the like, outputting a heating fluid having an elevated temperature. Each room 2, 3, 4 is provided with a heat exchanger 6, 7, 8. In the present system, the heat exchangers 6, 7, 8 are in the form of floor heating lines. However, other types of heat exchangers can be used as well, e.g. radiators.

[0031] The flow of heating fluid through each heat exchanger 6, 7, 8 is controlled by means of a control valve 9, 10, 11. The control valves 9, 10, 11 can, for example, be wax actuators, motor valves, or the like. When the control valve 9, 10, 11 is opened, heating fluid flows through the respective heat exchanger 6, 7, 8. When the control valve 9, 10, 11 closes, there is no flow of heating fluid. The control valves 9, 10, 11 are operated in pulse width modulation (PWM), i.e. they are opened over a part of a predetermined period. The length of the part determines the opening degree of the respective control valve 9, 10, 11. When a control valve 9, 10, 11 is open over the entire period, this control valve 9, 10, 11 has an opening degree of 100%. When the control valve 9, 10, 11 is opened over the half of the period, the opening degree is 50%. In case of a floor heating heat exchanger 6, 7, 8 the predetermined period can have a length of 15 minutes, 30 minutes, or 60 minutes.

[0032] All control valves 9, 10, 11 are controlled by a common control means 12 which is connected to the control valve 9, 10, 11 via control lines 13, 14, 15. The control lines 13, 14, 15 can be made as electrical or optical conductors or they can be wireless.

[0033] Each room 2, 3, 4 is provided with a temperature sensor 16, 17, 18. The temperature sensors 16, 17, 18 are connected to the control means 12 and supply temperature information to the control means 12. The temperature information is information about a heat demand, so that the temperature sensors 16, 17, 18 can be regarded as heat demand sensors. Other kinds of heat demand sensors are possible. The temperature sensors 16, 17, 18 can be connected to the control means via physical lines or wireless. In some cases it is possible that a floor sensor could be used as the sensor providing the actual room/floor temperature.

[0034] The control means 12 is connected to the heat source 5 as well. Via one channel 19 the heat source 5 transmits information about the kind of heat source 5. The control means 12 uses a second channel 20 in order to adjust the temperature of the heating fluid supplied by the heat source 5.

[0035] The control means 12 controls the control valves 9, 10, 11 such that a preset temperature (also called set point temperature) for each room 2, 3, 4 is reached. The actual temperature detected by the temperature sensors 16, 17, 18 should coincide with the preset temperature.

[0036] Fig. 2 shows a mode of operation of the system described which is briefly called "pulse spreading".

[0037] Fig. 2 shows signals 13a, 14a, 15a on lines 13, 14, 15, respectively, showing an opening condition of the respective valve, when the signal has a high level. It can be seen that the valves 9, 10, 11 are opened in a consecutive order one after the other, i.e. when control valve 9 is opened, the control valve 10, 11 are closed. Control valve 10 (signal 14a) opens, when control valve 9 (signal 13a) closes. Control valve 11 opens, when control valve 10 closes. In this case, as shown with signal 20a on channel 20, the heat source 5 can be operated permanently. Such a mode of operation is advantageous for heat pumps, where it is essential to obtain a uniform output to get the highest possible efficiency. This uniform output can have a low temperature. The signal 20a often is briefly termed "boiler relay".

[0038] In this example, after three heating pulses the heat demand is satisfied in each of the rooms 2, 3, 4. Therefore, the control valves 9 and 10 are closed (cf. signals 13a, 14a). However, the last open control valve 11 is kept open (signal 15a) and the heat pump 5 stops generating heat (signal 20a). In order to prevent further heating of room 4 the control means 12 lowers the temperature set point for the heating fluid so that the heat pump 5 can still pump heating fluid through the system, however, the heating fluid will then not be heated anymore.

[0039] Fig. 3 shows a slightly modified example. The control valve 10 opens for a short instant before the control valve 9 closes (cf. signals 13a, 14a). In the same way control valve 11 (signal 15a) opens shortly before control valve 10 (signal 14a) closes. This is done because the control valves 9, 10, 11 need a certain time to fully open and close. As shown with signal 20a, the heat source 5 stops generating heat. This kind of operation achieves the same advantages as that of Fig. 2.

[0040] Fig. 4 shows a further mode of operation according to the principle of "pulse spreading". In this example the signal 20a for the boiler relay is not shown. However, in this example too over the whole time at least one of the control valves is kept open, even after satisfying the heat demand. In this case, there are six control valves. Therefore, the time period which is represented by the circle 21 is divided into 6 fractions T1, T2, T3, T4, T5, and T6. Each fraction of the time period is allocated to a control valve. The opening times are indicated by curved arrows V1, V2, V3, V4, V5, and V6.

[0041] It can easily be recognised that some of the opening times are longer than the respective fraction of the time period. This is true for control valves V1, V3, V4, and V6. The opening times for control valves V2 and V5 are shorter than the allocated fractions T2, T5 of the time period. This leads to the following mode of operation:

[0042] A control valve V1 is opened at the start or beginning of the fraction T1 of the period. The next control valve V2 in the order is opened or started at the beginning of the time fraction T2 of the period. Control valve V3 opens when control valve V2 is closed. Control valve V4 opens at the beginning of time faction T4. Control valve V5 opens at the beginning of time fraction T5. Control valve V6 opens when control valve V5 closes. In other words, control valves V1, V2, V4, V5 are opened at a time where the respective control valve V1, V3, V4 of the previous time Section T6, T1, T3, T4 is still open. In this case they open at the beginning of the fraction T1, T2, T4, T5 allocated to the respective control valve. When the control valve of the previous time fraction T2, T5 is closed within this respective time fraction, the following control valve V3, V6 is opened at the time, where the control valve V2, V5 in the preceding time fraction is closed.

[0043] This is another option to ensure a uniform operation of the heat source 5, e.g. a heat pump, which is a possibility to get the highest possible efficiency.

[0044] When the time in which a control valve 9, 10, 11 is open is not sufficient to deliver enough heat energy to the respective rooms 2, 3, 4, the desired temperature in each room 2, 3, 4 is not reached. This effect is detected by the temperature sensors 16, 17, 18. Based on this information, the control means 12 controls the heat source 5 in order to raise the temperature of the heating fluid.

[0045] If, on the other hand, the control valves 9, 10, 11 are opened only over a rather short fraction of the time period, this is an indication that the temperature of the heating fluid supplied by the heat source 5 is too high. This small opening degree is detected by the control means 12 which in this case lowers the temperature of the heating fluid supplied by the heat source 5. Often, heat pumps have their own outdoor sensor, and based on the preset values they adjust the supply temperature on the basis of the measured outdoor temperature. The open time of the control valves 9, 10, 11 can be used additionally or alternatively to the outdoor sensor to adjust the supply temperature.

[0046] Fig. 5 shows a simplified diagram of signals, wherein the same reference numerals are used as in Fig. 2 and 3. However, the signals for only two control valves are shown for sake of simplicity.

[0047] Schematically shown is the heat demand 22 which is followed by the boiler relay 20a, i.e. the heat pump 5 is operated in accordance with heat demand 22.

[0048] As long as there is a heat demand, control valve 9 and control valve 10 are opened in a consecutive manner (cf. signals 13a, 14a). However, when the heat demand 22 goes to zero the control valve 10 must remain open (signal 14a) until control valve 9 opens again (signal 13a).

[0049] Fig. 5 furthermore shows a minimum off-time 23, i.e. a time which has to elapse after a stop of the heat pump 5 until the heat pump 5 can restart again. Such minimum off-time is ensured by a timer means which is part of the control means 12 (not shown in Fig. 1).

[0050] In a similar manner a minimum restart time 24 must be ensured, i.e. a time between two consecutive starts of the heat pump 5. To achieve such a minimum restart time a delay means is provided within the control means 12 (not shown in Fig. 1).

[0051] The minimum off-time is 5 minutes, for example, but can be adjusted in a range from 0 minutes to 30 minutes.

[0052] The minimum restart time is 20 minutes, for example, but can be adjusted in a range from 10 minutes to 60 minutes.

Claims

1. A heating system (1) for heating a plurality of rooms (2-4) comprising: a heat source (5), at least one heat exchanger (6-8) for each room (2-4), said at least one heat exchanger (6-8) being connected to said heat source (5) and being controlled by a control valve (9-11) controlling a flow of heating fluid through said at least one heat exchanger (6-8), a heat demand sensor (16-18) for each room (2-4), and a control means (12) controlling said control valves (9-11) depending on the heat demand detected by said heat demand sensors (16-18), wherein said control valves (9-11) are on-off-valves and the control means (12) controls an open state of each valve (9-11) depending on said heat demand, wherein said control means (12) controls at least one control valve so that it is open in case of no heat demand, **characterized in that** said control means (12) opens said control valves (9-11) in a timely distributed manner, and wherein said control means (12) opens each control valve (9-11) during a fraction of a predetermined time period, said fraction being determined by the heat demand detected by said heat demand sensor (16-18).

2. The system according to claim 1, **characterized in that** said control means (12) opens said control valves (9-11) in a consecutive manner.

3. The system according to claim 1, **characterized in that** said control means (12) divides said time period (21) into a number of fractions (T1, T2, T3, T4, T5, T6), said number corresponding to the number of control valves (V1, V2, V3, V4, V5, V6) of said plurality of control valves, each fraction being allocated to a specific control valve, and opens a control valve

(V1, V2, V3, V4, V5) at the beginning of its fraction (T1, T2, T3, T4, T5) provided that the control valve (V6, V1, V3, V4) of the previous fraction (T6, T1, T3, T4) is still open, or opens said control valve (V3, V6) during the previous fraction (T2, T5) at the time at which the control valve (V2, V5) of the previous fraction (T2, T5) is closed.

4. The system according to claim 1, **characterized in that** said control means (12) keeps open a control valve (9-11) in case of no heat demand.

5. The heating system according to any of claims 1 to 4, **characterized in that** the control means (12) changes the output temperature of the heat source (5) depending on the overall heat demand detected by all heat demand sensors (16-18).

6. The system according to any of claims 1 to 5, **characterized in that** said heat source (5) is a heat pump and said control means (12) lowers the temperature set point of the heat fluid in case of no heat demand.

7. The system according to claim 6, **characterized in that** said control means (12) comprises a timer means controlling a minimum off-time (23) of the heat pump (5).

8. The system according to claim 6 or 7, **characterized in that** said control means (12) comprises a delay means provoking a minimum restart time (24) between consecutive starts of said heat pump (5).

9. The system according to claim 7 or 8, **characterized in that** said off-time is in a range from 0 minutes to 30 minutes and/or said minimum restart time is in a range from 10 minutes to 60 minutes.

10. A method for heating a plurality of rooms by guiding a heating fluid from a heat source (5) through a heat exchanger (6-8) in each of said rooms (2-4) wherein the flow of the heating fluid through each heat exchanger (6-8) is controlled by a control valve (9-11) depending on a heat demand of each room (2-4), wherein said heat demand is detected by a heat demand sensor (16-18) in each room (2-4), wherein at least one control valve (9-11) is controlled in an open state in case of no heat demand, **characterized in that** said control valves (9-11) are opened in a timely distributed manner depending on said heat demand, and wherein a control means (12) opens each control valve (9-11) during a fraction of a predetermined time period, said fraction being determined by the heat demand detected by said heat demand sensor (16-18).

11. The method of claim 10, **characterized in that** said control valves (9-11) are pulse width modulated and a control valve (9-11) which is open is kept open when there is no heat demand.

12. The method according to claim 10 or 11, **characterized in that** said control valves (9-11) are opened one after the other.

13. The method according to claim 11 or 12, **characterized in that** said control valves (9-11) are controlled during a predetermined time period (21), wherein said time period is divided in a number of fractions (T1, T2, T3, T4, T5, T6), said number of fractions (T1, T2, T3, T4, T5, T6) corresponding to the number of control valves (V1, V2, V3, V4, V5, V6), each fraction (T1, T2, T3, T4, T5, T6) being allocated to a specific control valve, opening a control valve (V1, V2, V3, V4, V5) at the beginning of its fraction (T1, T2, T3, T4, T5) provided that the control valve (V6, V1, V3, V4) of the previous fraction (T6, T1, T3, T4) is still open, or opening the control valve (V3, V6) during the previous fraction (T2, T5) at the time the control valve (V2, V5) of the previous fraction (T2, T5) is closed.

14. The method according to any of claim 10 to 13, **characterized in that** the output temperature of the heat source (5) is changed depending on the heat demand of all rooms (2-4).

Patentansprüche

1. Ein Heizungssystem (1) zur Heizung einer Vielzahl von Zimmern (2-4) mit: einer Wärmequelle (5), mindestens einem Wärmetauscher (6-8) für jedes Zimmer, der mit der Wärmequelle (5) verbunden ist und von einem Regelventil (9-11) geregelt wird, das einen Durchfluss an Heizungsflüssigkeit durch den mindestens einen Wärmetauscher (6-8) regelt, einem Wärmebedarfssensor (16-18) für jedes Zimmer (2-4), und Regelungsmittel (12) zur Regelung der Regelventile (9-11) in Abhängigkeit des von den Wärmebedarfssensoren (16-18) festgestellten Wärmebedarfs, wobei die Regelventile (9-11) Ein-/Aus-Ventile sind und die Regelungsmittel (12) einen offenen Zustand jedes Ventils (9-11) in Abhängigkeit des Wärmebedarfs regeln, wobei die Regelungsmittel (12) mindestens ein Regelventil derart regelt, dass es bei keinem Wärmebedarf offen ist, **dadurch gekennzeichnet, dass** die Regelungsmittel (12) die Regelventile (9-11) in einer zeitlich verteilten Weise öffnen, und wobei die Regelungsmittel (12) jedes Regelventil (9-11) für einen Bruchteil eines vorbestimmten Zeitraums öffnen, der von dem vom Wärmebedarfssensor (16-18) festgestellten Wärmebedarf bestimmt wird.

2. Das System nach Anspruch 1, **dadurch gekenn-**

zeichnet, dass die Regelungsmittel (12) die Regelventile (9-11) in einer aufeinanderfolgenden Weise öffnen.

3. Das System nach Anspruch 1, **dadurch gekennzeichnet, dass** die Regelungsmittel (12) den genannten Zeitraum (21) in eine Anzahl von Bruchteilen (T1, T2, T3, T4, T5, T6) aufteilt, die der Anzahl von Regelventilen (V1, V2, V3, V4, V5, V6) aus der Vielzahl von Regelventilen entspricht, wobei jeder Bruchteil einem spezifischen Regelventil zugeordnet wird und ein Regelventil (V1, V2, V3, V4, V5) am Anfang seines Bruchteils (T1, T2, T3, T4, T5) öffnet, vorausgesetzt dass das Regelventil (V6, V1, V3, V4) des vorherigen Bruchteils (T6, T1, T3, T4) noch offen ist, oder das genannte Regelventil (V3, V6) während des vorherigen Bruchteils (T2, T5) öffnet, zu dem Zeitpunkt wo das Regelventil (V2, V5) des vorherigen Bruchteils (T2, T5) geschlossen ist.

4. Das System nach Anspruch 1, **dadurch gekennzeichnet, dass** die Regelungsmittel (12) ein Regelventil (9-11) offenhalten, wenn kein Wärmebedarf besteht.

5. Das Heizungssystem nach jedem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die Regelungsmittel (12) die Ausgangstemperatur der Wärmequelle (5) in Abhängigkeit des von allen Wärmebedarfssensoren generell festgestellten Wärmebedarfs ändern.

6. Das System nach jedem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die Wärmequelle (5) eine Wärmepumpe ist und die Regelungsmittel (12) den Temperatureinstellpunkt-bei keinem Wärmebedarf senken.

7. Das System nach Anspruch 6, **dadurch gekennzeichnet, dass** die Regelungsmittel (12) Zeitmessmittel zur Regelung einer minimalen Aus-Zeit (23) der Wärmepumpe (5) umfassen.

8. Das System nach Anspruch 6 oder 7, **dadurch gekennzeichnet, dass** die Regelungsmittel (12) Verzögerungsmittel zum Erzwingen einer minimalen Neustartzeit (24) zwischen aufeinanderfolgenden Starts der Wärmepumpe.

9. Das System nach Anspruch 7 oder 8, **dadurch gekennzeichnet, dass** die die Aus-Zeit im Bereich zwischen 0 und 30 Minuten und die minimale Neustartzeit im Bereich zwischen 10 und 60 Minuten liegen.

10. Ein Verfahren zur Heizung einer Vielzahl von Zimmern, indem eine Heizungsflüssigkeit aus einer Wärmequelle (5) durch einen Wärmetauscher (6-8) in jedes Zimmer (2-4) geleitet wird, wobei der Durchfluss der Heizungsflüssigkeit durch jeden Wärmetauscher (6-8) von einem Regelventil (9-1) in Abhängigkeit eines Wärmebedarfs jedes Zimmers (2-4) geregelt wird, wobei der Wärmebedarf von einem Wärmebedarfssensor (16-18) in jedem Zimmer (2-4) festgestellt wird, wobei mindestens ein Regelventil (9-11) bei keinem Wärmebedarf in einem offenen Zustand geregelt wird, **dadurch gekennzeichnet, dass** die Regelventile (9-11) in einer zeitlich verteilten Weise in Abhängigkeit des Wärmebedarfs geöffnet werden, und Regelungsmittel (12) jedes Regelventil (9-11) für einen Bruchteil einer vorbestimmten Zeitdauer öffnen, der von dem vom Wärmebedarfssensor (16-18) festgestellten Wärmebedarf bestimmt wird.

11. Das Verfahren nach Anspruch 10, **dadurch gekennzeichnet, dass** die Regelventile (9-11) pulsbreitenmoduliert sind und ein Regelventil (9-11), der offen ist, offengehalten wird, wenn kein Wärmebedarf besteht.

12. Das Verfahren nach Anspruch 10 oder 11, **dadurch gekennzeichnet, dass** die Regelventile (9-11) eines nach dem anderen geöffnet werden.

13. Das Verfahren nach Anspruch 11 oder 12, **dadurch gekennzeichnet, dass** die Regelventile (9-11) während eines vorbestimmten Zeitraums (21) geregelt werden, wobei dieser Zeitraum in eine Anzahl von Bruchteilen (T1, T2, T3, T4, T5, T6) aufgeteilt ist und die Anzahl von Bruchteilen der Anzahl von Regelventilen (V1, V2, V3, V4, V5, V6) entspricht, wobei jeder Bruchteil (T1, T2, T3, T4, T5, T6) einem spezifischen Regelventil zugeteilt wird, Öffnung eines Regelventils (V1, V2, V3, V4, V5, V6) am Anfang seines Bruchteils (T1, T2, T3, T4, T5, T6), vorausgesetzt dass das Regelventil (V6, V1, V3, V3) des vorherigen Bruchteils (T6, T1, T3, T4) noch offen ist, oder Öffnung des Regelventil (V3, V6) während des vorherigen Bruchteils (T2, T5) zu dem Zeitpunkt, wo das Regelventil (V2, V5) des vorherigen Bruchteils (T2, T5) geschlossen wird.

14. Das Verfahren nach jedem der Ansprüche 10-13, **dadurch gekennzeichnet, dass** die Ausgangstemperatur der Wärmequelle (5) in Abhängigkeit des Wärmebedarfs aller Zimmer (2-4) geändert wird.

Revendications

1. Système de chauffage (1) pour chauffer une pluralité de pièces (2-4) comprenant : une source de chaleur (5), au moins un échangeur de chaleur (6-8) pour chaque pièce (2-4), ledit au moins un échangeur de chaleur (6-8) étant raccordé à ladite source de chaleur (5) et étant régulé par une vanne de régulation

(9-11) régulant un écoulement de fluide de chauffage à travers ledit au moins un échangeur de chaleur (6-8), un détecteur de demande de chaleur (16-18) pour chaque pièce (2-4), et des moyens de commande (12) commandant lesdites vannes de régulation (9-11) en fonction de la demande de chaleur détectée par lesdits capteurs de demande de chaleur (16-18), dans lequel lesdites vannes de régulation (9-11) sont des vannes de marche-arrêt et les moyens de commande (12) commandent un état ouvert de chaque vanne (9-11) en fonction de ladite demande de chaleur, dans lequel lesdits moyens de commande (12) commandent au moins une vanne de régulation de sorte qu'elle s'ouvre en cas d'absence de demande de chaleur, **caractérisé en ce que** lesdits moyens de commande (12) ouvrent lesdites vannes de régulation (9-11) d'une manière répartie dans le temps, et dans lequel lesdits moyens de commande (12) ouvrent chaque vanne de régulation (9-11) pendant une fraction d'une période de temps prédéterminée, ladite fraction étant déterminée par la demande de chaleur détectée par ledit capteur de demande de chaleur (16-18).

2. Système selon la revendication 1, **caractérisé en ce que** lesdits moyens de commande (12) ouvrent lesdites vannes de régulation (9-11) d'une manière consécutive.

3. Système selon la revendication 1, **caractérisé en ce que** lesdits moyens de commande (12) divisent ladite période de temps (21) en un certain nombre de fractions (T1, T2, T3, T4, T5, T6), ledit nombre correspondant au nombre de vannes de régulation (V1, V2, V3, V4, V5, V6) de ladite pluralité de vannes de régulation, chaque fraction étant attribuée à une vanne de régulation spécifique, et ouvre une vanne de régulation (V1, V2, V3, V4, V5) au début de sa fraction (T1, T2, T3, T4, T5) pourvu que la vanne de régulation (V6, V1, V3, V4) de la précédente fraction (T6, T1, T3, T4) soit encore ouverte, ou ouvre ladite vanne de régulation (V3, V6) pendant la fraction précédente (T2, T5) au moment où la vanne de régulation (V2, V5) de la précédente fraction (T2, T5) est fermée.

4. Système selon la revendication 1, **caractérisé en ce que** lesdits moyens de commande (12) maintiennent une vanne de régulation (9-11) ouverte en cas d'absence de demande de chaleur.

5. Système de chauffage selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** les moyens de commande (12) changent la température de sortie de la source de chaleur (5) en fonction de la demande de chaleur globale détectée par tous les capteurs de demande de chaleur (16-18).

6. Système selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** ladite source de chaleur (5) est une pompe à chaleur et lesdits moyens de commande (12) abaissent le point de consigne de température du fluide thermique en cas d'absence de demande de chaleur.

7. Système selon la revendication 6, **caractérisé en ce que** lesdits moyens de commande (12) comprennent des moyens de minuterie commandant un temps d'arrêt minimum (23) de la pompe à chaleur (5).

8. Système selon la revendication 6 ou 7, **caractérisé en ce que** lesdits moyens de commande (12) comprennent des moyens de retardement provoquant un temps de redémarrage minimum (24) entre les démarrages consécutifs de ladite pompe à chaleur (5).

9. Système selon la revendication 7 ou 8, **caractérisé en ce que** ledit temps d'arrêt est dans une plage de 0 minute à 30 minutes et/ou ledit temps de redémarrage minimum est dans une plage de 10 minutes à 60 minutes.

10. Procédé pour chauffer une pluralité de pièces en guidant un fluide de chauffage d'une source de chaleur (5) passant par un échangeur de chaleur (6-8) dans chacune desdites pièces (2-4), dans lequel l'écoulement du fluide de chauffage à travers chaque échangeur de chaleur (6-8) est régulé par une vanne de régulation (9-11) en fonction d'une demande de chaleur de chaque pièce (2-4) dans lequel ladite demande chaleur est détectée par un capteur de demande de chaleur (16-18) dans chaque pièce (2-4), dans lequel au moins une vanne de régulation (9-11) est commandée dans un état ouvert en cas d'absence de demande de chaleur, **caractérisé en ce que** lesdites vannes de régulation (9-11) sont ouvertes d'une manière répartie dans le temps en fonction de ladite demande de chaleur, et dans lequel des moyens de commande (12) ouvrent chaque vanne de régulation (9-11) pendant une fraction d'une période de temps prédéterminée, ladite fraction étant déterminée par la demande de chaleur détectée par ledit capteur de demande de chaleur (16-18).

11. Procédé selon la revendication 10, **caractérisé en ce que** lesdites vannes de régulation (9-11) sont modulées par modulation delargeur d'impulsions et une vanne de régulation (9-11) qui est ouverte, est maintenue ouverte lorsqu'il n'y a pas de demande de chaleur.

12. Procédé selon la revendication 10 ou 11, **caractérisé en ce que** lesdites vannes de régulation (9-11) sont ouvertes l'une après l'autre.

13. Procédé selon la revendication 11 ou 12, **caractérisé en ce que** lesdites vannes de régulation (9-11) sont commandées pendant une période de temps prédéterminée (21), dans lequel ladite période de temps est divisée en un certain nombre de fractions (T1, T2, T3, T4, T5, T6), ledit nombre de fractions (T1, T2, T3, T4, T5, T6) correspondant au nombre de vannes de régulation (V1, V2, V3, V4, V5, V6), chaque fraction (T1, T2, T3, T4, T5, T6) étant attribuée à une vanne de régulation spécifique, ouvrant une vanne de régulation (V1, V2, V3, V4, V5) au début de sa fraction (T1, T2, T3, T4, T5) pourvu que la vanne de régulation (V6, V1, V3, V4) de la fraction précédente (T6, T1, T3, T4) soit encore ouverte, ou ouvrant la vanne de régulation (V3, V6) pendant la fraction précédente (T2, T5) au moment où la vanne de régulation (V2, V5) de la fraction précédente (T2, T5) est fermée.

14. Procédé selon l'une quelconque des revendications 10 à 13, **caractérisé en ce que** la température de sortie de la source de chaleur (5) est modifiée en fonction de la demande de chaleur de toutes les pièces (2-4).

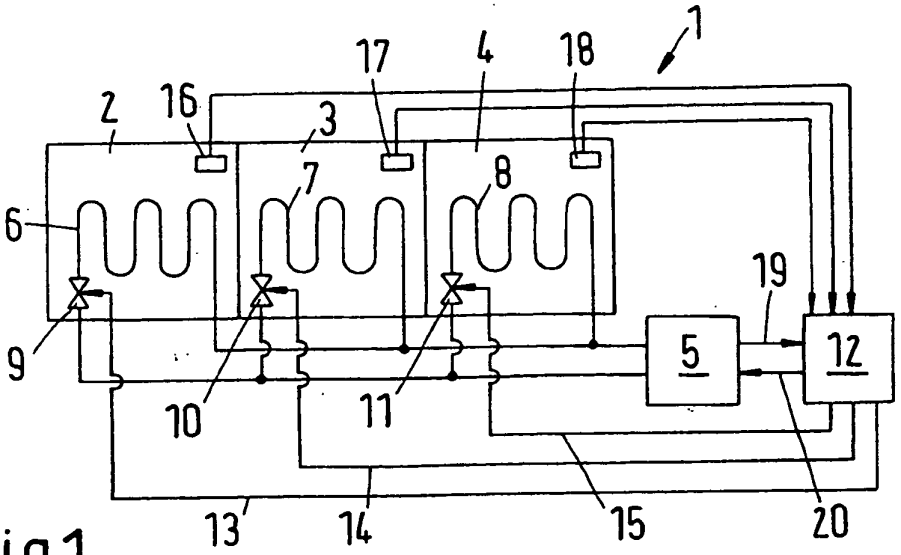

Fig.1

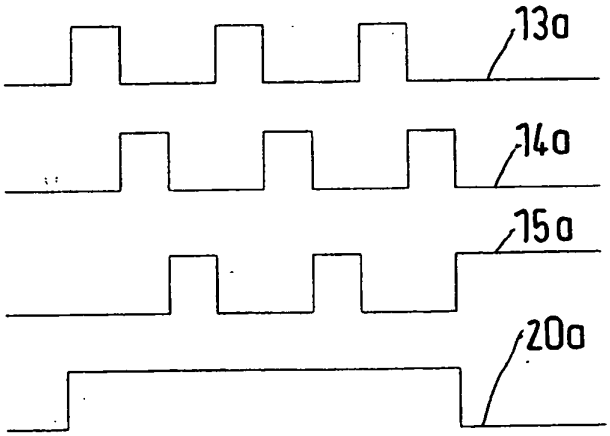

Fig.2

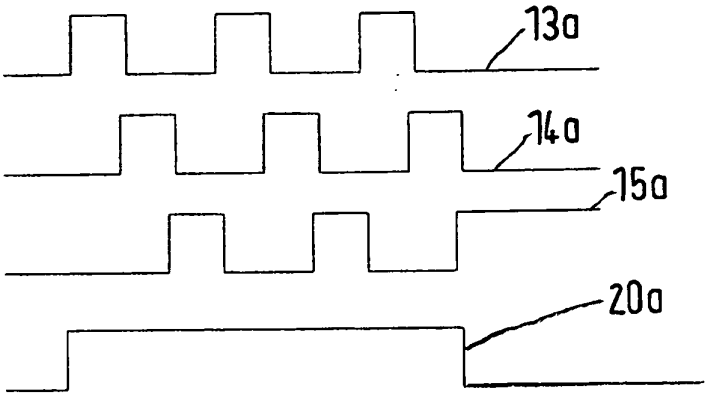

Fig.3

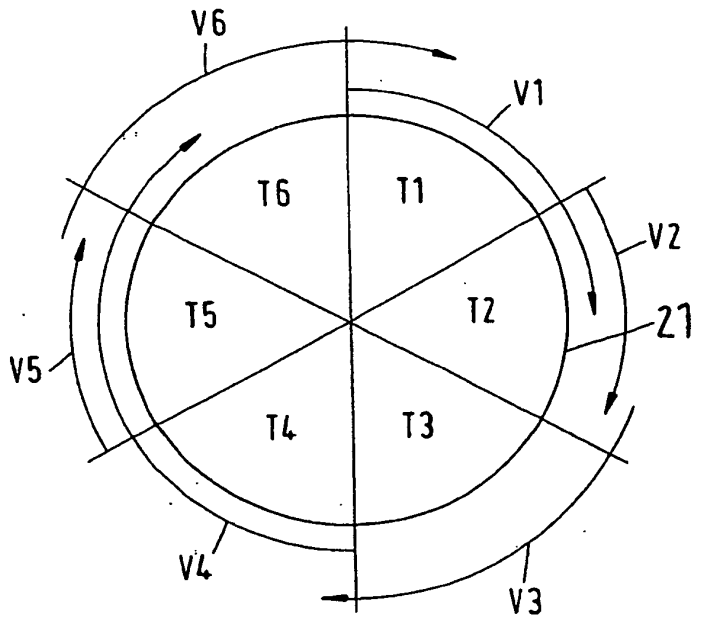

Fig.4

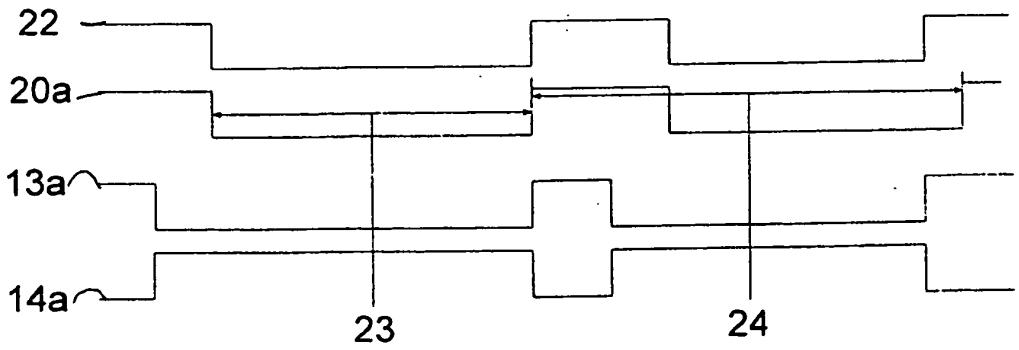

Fig.5

REFERENCES CITED IN THE DESCRIPTION

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