

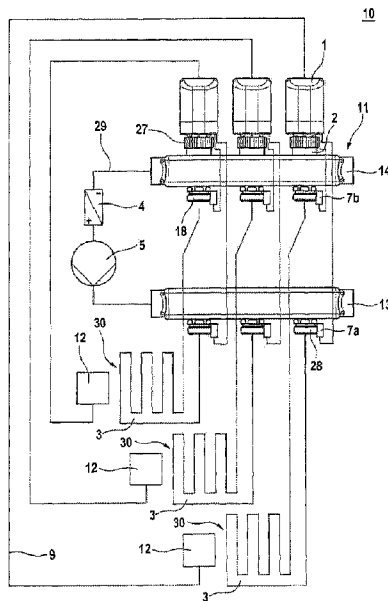


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(54) Titre : DISPOSITIF DE REGLAGE AUTOREGULATEUR POUR UNE SOUPAPE DE REGULATION DE DEBIT, SYSTEME DE MISE EN TEMPERATURE EN TANT QU'UN DISPOSITIF DE DISTRIBUTION POURVU DUDIT DISPOSITIF DE REGLAGE AINSI QUE PROCEDES CORRESPONDANTS

(54) Title: SELF-REGULATING ADJUSTMENT DEVICE FOR A FLOW CONTROL VALVE, A TEMPERATURE CONTROL SYSTEM AND A DISTRIBUTOR DEVICE HAVING THE SAME, AND ASSOCIATED METHODS



(57) **Abrégé/Abstract:**

The present invention creates, for the first time, an adjustment device for the self-regulating adjustment of a throughflow regulating valve of a consumer loop with heat exchanger, in particular in a temperature control system for buildings, having a temperature control source, a liquid heat carrier and a pump. The invention furthermore discusses a distributor device for the self-regulating distribution of a liquid heat carrier to at least two or more consumer loops with heat exchanger, which each comprise a throughflow regulating valve, in a temperature control system with a temperature control source and with a pump, wherein the distributor device has a feed distributor and a return distributor. At these, the consumer loops are connected together at the inlet side and outlet side, wherein the throughflow valves are arranged at the feed distributor or the return distributor. The invention finally proposes methods suitable for this purpose.

ABSTRACT

The present invention creates, for the first time, an adjustment device for the self-regulating
5 adjustment of a throughflow regulating valve of a consumer loop with heat exchanger, in
particular in a temperature control system for buildings, having a temperature control source,
a liquid heat carrier and a pump. The invention furthermore discusses a distributor device for
the self-regulating distribution of a liquid heat carrier to at least two or more consumer loops
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**SELF-REGULATING ADJUSTMENT DEVICE FOR A FLOW CONTROL VALVE,
A TEMPERATURE CONTROL SYSTEM AND A DISTRIBUTOR DEVICE HAVING
THE SAME, AND ASSOCIATED METHODS**

5 The present application relates to an adjustment device for the self-regulating
adjustment of a flow control valve of a consumer loop comprising a heat exchanger in a
temperature control system and a temperature control system with the same, as well as a
distributor device for the self-regulating distribution of a liquid heat carrier to several consumer
loops. The application furthermore relates to a corresponding method for the self-regulating
10 adjustment of a flow in a consumer loop and for the self-regulating distribution, which achieves
a demand-oriented balancing of partial flows of a liquid heat carrier to several consumer loops.

 A technical background of the invention lies in the application of heating and air-
conditioning systems for rooms, such as in particular underfloor heating, panel heating or
15 cooling ceilings installed in a building, in order to provide a selectable room temperature
independent of the weather.

 In the state of the art, numerous arrangements and control systems for the comfort and
efficiency-oriented distribution and control of heat energy through a hydraulic network in
20 buildings are known from the field of heating engineering, wherein similar installations in
buildings are also known for the distribution and control of air conditioning energy or heat
extraction from rooms.

 For example, WO 2015/142879 A1 discloses a retrofit for a system for heat transfer
25 through a fluid, wherein a thermostat is used for regulation. In the embodiment shown, the
retrofit has a circuit, a flow temperature sensor and a return flow temperature sensor. The
thermostat outputs a control signal for the valve. There is a hot and a cold set point for the
return flow temperature. If the return flow temperature is outside the range between the setting
points, i.e. is too hot or too cold, the circuit is overridden to modify the control signal from the
30 thermostat, otherwise it is left unchanged. If the flow temperature is known, the hot and cold
set points can be modified dynamically. This can be done using a readable table or based on a
formula based on the flow temperature. Feedback can also be provided, by which the circuit
achieves a degree of valve opening. Furthermore, a memory can be provided for data of a

course of temperatures, valve position etc. In this case, the thermostat outputs a control signal for the valve position, so that the room thermostat is a component specific to the retrofittable overall system, which is required for each room.

5 US 2009/0314484 A1 describes an independent flow rate control for a heat exchanger to provide a control signal for a control element of a flow valve. A first and second temperature sensor measure an input and an output temperature of a liquid at the heat exchanger. A control unit responds to a temperature difference between the input and output temperature to adjust the control signal so that the temperature difference is kept substantially constant. The control
10 unit can be a stand-alone device adapted for retrofitting to a conventional valve and actuator. Otherwise, the control unit and actuator may be integral with the valve to form an independent unit requiring only the installation and connection of temperature sensors. Control is performed according to an algorithm and the valve is operated independently of a central control, which is common in advanced building installations. The control keeps the temperature difference
15 (input/output of the heat exchanger) at a constant value. This value is preset using a DIP switch according to the capacity of the heat exchanger. The control of the system therefore does not offer any possibilities of adaptation to external or changing conditions or intelligent adaptation to individual user behavior after the presetting.

20 From DE 10 2006 052 124 A1, an adjustment system for a floor temperature control arrangement is known, in which on each return flow a return flow temperature controller with a temperature sensor that detects the temperature in the respective return flow is arranged, and in which all return flow temperature controllers have the same temperature control behavior. The return flow temperature controllers have the same characteristics depending on the
25 temperature and the flow rate. At an electric return flow temperature controller, the temperature sensor reports the temperature in the return flow to a controller which, in turn, adjusts an adjustable throttle means such as a valve. The return flow temperature controller ensures that the water leaving the heating circuit always has a predetermined temperature. In addition, a distributor or manifold is provided into which each return flow pipe has a connection. The
30 return flow temperature controller is assigned to the connection.

From DE 10 2009 004 319 A1 a method for carrying out hydraulic balancing is known in which the return flow temperature is measured at a heat exchanger and the volumetric flow rate through the heat exchanger is controlled as a function of the return flow temperature. A

control difference can be formed from the return flow temperature and a target value of the return flow temperature, and the volumetric flow rate through the heat exchanger can be controlled as a function of the control difference. Alternatively, a temperature difference between flow temperature and return flow temperature can be determined so that a control
5 difference is formed from the temperature difference and a target value of the temperature difference, and the volumetric flow rate through the heat exchanger is controlled depending on this control difference.

DE 10 2014 020 738 A1 describes a method for the automated hydraulic balancing of
10 a heating system. In this method, a mean heating period, in particular a mean heating period or heat-up time of all heat consumers and/or a mean heating period of all rooms by a fixed temperature value, is determined. Maximum flow openings of the valves are determined as a function thereof. It is determined whether a heating period exceeds or falls short of the mean heating period. In this way the heating system is hydraulically balanced step by step and
15 configured to changing conditions of the heating system. The heating period of the heat consumer or a room is the time required to heat the heat consumer or a room from an initial temperature to a target temperature. The average or mean heating period is then calculated as the sum of all heating periods divided by the number of heat consumers or rooms present. To form the sum of all heating periods, common communication between the heating circuits or
20 with a common controller as well as appropriate wiring and its installation or alternative communication interfaces are required.

DE 10 2015 222 110 A1 discloses a valve that determines a heating period of at least one heat consumer and/or a heating period of a room by a temperature difference, wherein the
25 valve has a controllable flow opening. A maximum valve position is set depending on whether an actual heating period exceeds or falls short of a presettable target heating period, whereby the heating system can be hydraulically adjusted and configured to changing boundary conditions. To determine the actual heating period, an instantaneous temperature is measured at a starting time and stored. After a unit of time, for example 10 minutes, has elapsed, the
30 current temperature is measured again and stored. The actual heating period is calculated by dividing the difference between the two measured temperature values by the unit of time which lies between the two temperature measurements. This means that the valve takes a temperature measurement at intervals along the heat exchanger section of a heating circuit and/or in the

room. Thus, two temperatures are measured, wherein the valve itself does not determine a heating period in relation to the course or development of these temperatures.

EP 2 653 789 A2 teaches a control system that includes a controller that measures a
 5 temperature difference between the flow temperature and the return flow temperature of a temperature control fluid. Based on this temperature difference, the controller causes the valve actuator to adjust the degree of opening of the valve in such a way that the average temperature difference between the flow temperature and the return flow temperature of the temperature control fluid lies within a predetermined value range. In addition, a thermostat can be provided
 10 to detect a room temperature and provide temperature data. In systems with several temperature control arrangements, a central controller with one regulator is provided for the several valves.

US 2014/321839 A1 describes a heating element control unit for a liquid heating system designed to: determine the operating cycle of a heating element by monitoring the waveform
 15 of electrical current to the heating element; modulate the timing of the start of heating by the heating element as a function of an expected duration of completion of the heating process and a required time at which the heating process is to be completed; said expected duration being determined as a function of said operating cycle.

20 EP 2 679 930 A1 describes a refrigeration circuit device with a compressor, heat exchangers and an expansion valve, wherein the refrigeration circuit device can control a valve in a bypass.

WO 2015/148596 A1 describes a control system that is flexibly designed for retrofit
 25 use with several types of boiler-based heating systems and that includes a thermostat device, a user interface, a processor, a memory and a temperature sensor. The control system is designed to selectively control activation of the boiler-based heating system.

EP 3 012 705 A1 describes a heat exchanger valve assembly, a heating system and a
 30 method of operating a heating system. The heat exchanger valve assembly has a pressure control valve comprising a valve element that interacts with a throttling element and controls a differential pressure. Detection means are further provided for detecting whether the differential pressure exceeds a predetermined minimum value.

Based on the aforementioned state of the art, the object of the present invention is to provide an alternative adjustment device and a method for a consumer loop with heat exchanger in a temperature control system, which self-regulatingly set an efficient volumetric flow rate of a heat medium through a heat exchanger and continuously adjust it based on previous start-ups.

A further aspect of the invention is to provide an alternative temperature control system, an alternative distributor device and a method which self-regulatingly distribute a volumetric flow rate of the heat medium to several consumers according to their needs.

In summary, the adjustment device for adjusting a flow control valve of a consumer loop with a heat exchanger in a temperature control system for rooms of a building with a temperature control source, a liquid heat carrier and a pump, inter alia comprises an electrically controllable actuator, temperature detection means, a calculation means and an interface for receiving an external activation signal, and is in particular characterized in that the adjustment device comprises time detection means and storage means which are configured to detect and store a previous or current activation period of said activation signal and/or a deactivation period between two activations; and in that said calculation means is configured to variably determine the temperature spread from an output-side return flow temperature to an input-side flow temperature based on the activation duration and/or the deactivation duration.

The adjustment device thereby forms the decisive inventive component of a temperature control system with an associated room thermostat, in which the corresponding inventive method is implemented, and is therefore also in need of protection as a separately tradeable unit.

A corresponding temperature control system for the self-regulating temperature control of rooms of a building with a temperature control source, at least one consumer loop with heat exchanger, which comprises a flow control valve, as well as a liquid heat carrier and a pump, comprises at least one thermostat arranged in a room, with input means for inputting a value indicative of a presettable room temperature, and an interface for outputting an activation signal

for at least one consumer loop in the room; wherein the thermostat is configured to respond to an actual room temperature by the thermostat outputting the activation signal as long as a deviation tolerance between the presettable room temperature and the actual room temperature is exceeded; and is in particular characterized in that for the at least one consumer loop an
5 adjustment device in accordance with the invention is provided, respectively, which is in operatively connected with the flow control valve of the consumer loop, and with which an activation signal or deactivation signal from the thermostat is associated, which is arranged in the same room as the consumer loop.

10 The corresponding method for adjusting a flow rate comprises the following steps: a) detecting an input-side flow temperature and an output-side return flow temperature of the heat carrier passing through the consumer loop; b) calculating a control difference between a temperature difference from the detected input-side flow temperature and the output-side return
15 flow temperature, and the predetermined temperature spread, that is the absolute value of the difference ΔT_{target} minus ΔT_{actual} ; and c) calculating and setting an adjustable flow cross-section in the consumer loop based on the control difference. The method is particularly characterized by the steps: d) detecting a previous or current activation period and/or a deactivation period of the consumer loop; and e) determining the variable temperature spread from the output-side
20 return flow temperature to the input-side flow temperature based on the activation period and/or the deactivation period.

An activation, as defined by the present disclosure, is a switch-on state or a start-up from a standby mode of the adjustment device or at least the calculation means in the adjustment device, which is supported by a continuous signal level, triggered by a signal pulse,
25 or activated by a control voltage or drive voltage applied in the form of a signal for switching a transistor at a power supply, a power supply directly supplied in the form of a signal, or the like. An activation duration, by definition, refers to the time period from the beginning to the end of the correspondingly triggered switch-on state or start-up from a standby mode, or the reception duration of a continuous signal level, control voltage, drive voltage or power supply,
30 or the time period between two signal pulses which cause a switch-on process and a switch-off process. A deactivation and a deactivation duration are accordingly the complementary state and duration in which there is no operation of the adjustment device or at least no calculation by the calculation means or control of the actuator.

In its most general form, the present invention thus provides for the first time for the regulation of a volumetric flow rate and a resulting temperature spread, i.e. an energy input or energy output between the source of temperature control and the room at the heat exchanger, or heating or cooling, respectively, decidedly on the basis of activation and/or deactivation durations detected during use, which in the intended case of application correspond to a heating or cooling time of the room concerned from an actual room temperature to a predetermined room temperature.

The self-regulation of the valve setting in line with the invention has the advantage of effectively determining and automatically adjusting itself to an optimum operating point in relation to an individual installation environment of the heat exchanger in a simple and easy way. This applies in particular to the application of a surface heating system in the form of a heating coil of an underfloor heating system, where the heating behavior varies due to partial insulation and heat transfer of the respective room in the building in a way that cannot be determined in advance by the installer, and is reflected in resulting room-specific heating periods. The present invention addresses this point by measuring heating periods and linking them in the self-regulation according to the invention with a control influence known from mentioned the state of the art, which serves to maintain an energy-efficient operating range. This control influence concerns the temperature difference before and after the heat exchanger, which results from a volumetric flow rate and a flow temperature in relation to the ambient or building temperature.

Furthermore, the inventive self-regulation of the valve setting has the advantage that it adapts intelligently to user behavior and independently optimizes the comfort of a fast-responding room temperature control within a range of efficient operating points. In this way, an actual heating period, which depends on the user profile, such as the temporal heating actuation and its temperature specifications, is continuously brought closer to heating periods that correspond to a reaction time of a room temperature adjustment that can be perceived as comfortable.

30

In addition, the self-regulating adjustment device in accordance with the invention has the advantage that it can be implemented using simple, cost-effective components with reliable operation and low wiring and installation costs. For example, there is no need for a central control unit, which would have to be connected to heat exchangers with temperature sensors,

actuators and valve position detectors of all consumer loops. Furthermore, neither room temperature detection nor temperature detection in general, nor communication of such temperature data to a central control unit is necessary, since a heating period is not determined by detecting a temperature curve but rather the activation or deactivation signal of the thermostat is required or processed by the dedicated calculation means of the adjustment device
5 which can be accomplished by a simple design of the room thermostat without sensors for the current room temperature. Thus, both the room thermostat and the transmission and reception of the signal can be implemented by simple components, as no data or calculated or modelled control signals need to be generated and transmitted by the room thermostat in each room.

10

The distributor device for the self-regulating distribution of a liquid heat carrier to at least two or more consumer loops with heat exchangers, each comprising a flow control valve, in a temperature control system with a temperature control source and a pump, has a flow distributor and a return flow distributor, at which the consumer loops are brought together on
15 the inlet side and on the outlet side, wherein the flow control valves are provided at the flow distributor or the return flow distributor; and is in particular characterized in that an adjustment device for the self-regulating adjustment of the consumer loops according to the invention is provided to each flow control valve.

20 The corresponding method for distributing a liquid heat carrier is in particular characterized in that the method for the self-regulating adjustment of a flow of a liquid heat carrier through an externally activatable consumer loop according to the invention is carried out independently of one another for each consumer loop.

25 The inventive self-regulation of the distribution of the liquid heat transfer medium or the distributor device are thus formed by a hydraulic parallel connection of consumer loops in each of which the self-regulation of the valve adjustment according to the invention is carried out independently.

30 The self-regulating distributor device according to the invention has the advantage that it can be installed or retrofitted particularly easily to a temperature control system with several consumer loops. It can be supplied as a pre-assembled distributor or manifold set with the flow control valves and the adjustment devices, which simply needs to be connected to the installed consumer loops and interfaces of room thermostats. After that, the temperature control system,

like in particular an underfloor heating system, is not only completely assembled but is also hydraulically balanced as required from now on.

5 In a temperature control system with several consumer loops, the self-regulation of the distribution according to the invention provides the advantage that a result is achieved particularly simply, i.e. without further preparations and means, which is at least equivalent to or better than an automatic demand-oriented compensation of partial flows of the total volumetric flow rate of the heat transfer medium through the consumer loops. The self-regulation of the distribution in accordance with the invention thus achieves a result which is
10 at least equivalent to or better than a coordination of all consumer loops which are temporarily used in a common underfloor heating arrangement or the like.

The demand-oriented balancing achieved according to the invention corresponds to the objective of a “hydraulic balancing” of a heating system known in the state of the art. However,
15 this is achieved by a different approach based on an overall view of the system with comparative calculations between the parameters of the consumer loops. Such a hydraulic balancing is either carried out by a higher-level control system or, in hydraulic systems, is determined by a heating engineer or heating installer prior to commissioning and statically adjusted once. However, it has been found that the latter case is associated with a high rate of
20 misadjustment, and furthermore a static adjustment per se can only be adjusted to a basic state that serves as a model. In such hydraulic systems, the basic state serving as a model is often the maximum load case, which only occurs on very few days in a year, whereas the inventive self-regulation of the distribution enables continuous optimization independent of the maximum load case.

25

The inventive self-regulation of the distribution is dynamic, i.e. it automatically adapts to individually changing power requirements or switching on and off of consumer loops. This can be achieved in particular without a multi-wired central control unit and corresponding determinations and calculations for comparing parameters among the consumer loops, and only
30 by parallel operation or arrangement of the self-regulating valve settings. Even before commissioning, no potentially faulty intervention by an installer is therefore required, which also saves labor.

The self-regulation of the distribution according to the invention implements a demand-oriented distribution of the partial flows, the ratio of which is limited on the one hand by the independently self-regulated valve settings and by the flow resistances of the consumer loops defined by length and diameter, and on the other hand by the available total volumetric flow rate of the heat transfer medium.

In illustrative extreme cases, this prevents a small consumer loop with low flow resistance in a small room, such as a guest WC, from being hydraulically oversupplied, which leads to excessive or inefficient heat input with unnecessarily short heating period, and can lead to valve whistling due to the high volumetric flow rate, while heating period in larger rooms increases unnecessarily. If, on the other hand, all rooms are to be heated and the total volumetric flow rate is not sufficient for a short heating period in all rooms, a demand-oriented distribution is achieved, which is set in a proportional limitation of each partial flow of the consumer loops based on their valve position and flow resistance.

The control influence of the temperature difference before and after a heat exchanger or consumer loop compensates for the contradictory relationship that a large consumer loop with a high flow resistance, which is assigned to a large room with high energy demand, does not receive a smaller but a larger partial flow in comparison to small consumer loops with low flow resistance and low energy demand. However, this in turn takes place without any comparative positions or balances by a higher-level control system.

In addition, the inclusion of the resulting heating period in accordance with the invention compensates for conditions in the building, such as the floor, cellar location or external wall ratio, and the installation, such as unequal ratios of an installed panel heating system to the floor area, or the like in a room.

Advantageous further developments of the present invention are subject of the dependent claims.

According to one aspect of the invention, the adjustment device may be configured to output the electric trigger calculated by the calculation means to the actuator during an activation period, and to output no electric trigger or a predetermined electric trigger corresponding to the closed position of the flow control valve to the actuator during a

deactivation period. This will cause the consumer loop to be shut off after a heating operation, depending on the type of actuator, to prevent excessive energy input or temperature control overshoot.

5 According to one aspect of the invention, the adjustment device may be configured to switch off supply of electric power to the calculation means and/or to the adjustment device during a deactivation period. This saves electricity during deactivation periods, which may extend over a summer period, for example.

10 According to one aspect of the invention, the calculation means may be configured to store at least one value of a previous opening position of the flow control valve in the storage means. This means that when the adjustment device is activated, a valve position can first be approached as a starting point, which has already been determined in the course of previous heating periods, and only needs to be adjusted differently in the current heating period.

15 According to one aspect of the invention, the storage means may contain a pre-stored reference value for the activation period and/or a pre-stored reference value for the deactivation period. Thus, a time period for reaching a predetermined temperature, which is defined as convenient, is stored as an aspired reference value according to which self-regulation is based.

20 According to one aspect of the invention, the storage means may contain a pre-stored value range for the temperature spread. This makes it easy to ensure that the operating point of the heat exchanger is selected within an energy-efficient range.

25 According to one aspect of the invention, the storage means may contain a pre-stored map with associated values of activation and/or deactivation durations and predetermined temperature spreads for determining the temperature spread. Thus, a predetermined universal control can be implemented with lower processing power.

30 According to one aspect of the invention, the storage means may contain a pre-stored control logic for calculating the temperature spread. Thus, a more individual control can be implemented.

According to one aspect of the invention, the adjustment device may be configured to change the temperature spread depending on the flow temperature, and/or the adjustment device may be configured to change a bandwidth of the temperature spread depending on the flow temperature, and/or the adjustment device may be configured to receive, via the interface, further external signals with operating parameters from the temperature control system; and the calculation means may be configured to adjust the temperature spread depending on the operating parameters. In this way, a control can be implemented which detects weather fluctuations or seasons on the basis of a change in the flow temperature and adjusts an efficient operating point accordingly, or further comfort-oriented functions which can be specified on a multifunctional room thermostat can be incorporated into the control.

According to one aspect of the invention, one room of the building may contain the thermostat and two or more consumer loops or heating or cooling circuits. Thus, it is possible to supply large rooms by several installed heating or cooling coils with standardized diameters and a lower total flow resistance, which are controlled by their own adjustment devices but the same room thermostat.

According to one aspect of the invention, the thermostat may have a bimetallic element which responds to the actual room temperature and activates an output of the activation signal or deactivation signal. This makes it possible to achieve a particularly simple, reliable and cost-effective design of the room thermostat without electronics or sensors.

According to one aspect of the invention, the activation signal or deactivation signal can be a binary signal comprising an on-state with a signal level above a predetermined level value and an off-state without signal level or a signal level below the predetermined level value. This also makes signal generation and signal detection particularly simple and cost-effective.

According to one aspect of the invention, the thermostat may comprise a microcomputer and a temperature sensor for detecting the actual room temperature; wherein the thermostat detects and stores a course of the actual room temperature during and/or after the activation signal or the deactivation signal is output; and the thermostat and the adjustment device are configured to communicate data on a course of detected actual room temperatures. This realizes a multifunctional design of the temperature control system, which allows adaptive control to further comfort-oriented parameters, such as influencing a heating curve progression

depending on an initial and target temperature and/or an outside temperature or a time or the like.

5 According to one aspect of the invention, the activation signal and/or the deactivation signal can be communicated via wireless interfaces from the specific thermostat to the associated adjustment device. This eliminates the need for wiring from the room thermostat to the adjustment device and reduces installation effort. Furthermore, such a wireless interface can also be used to establish a connection between a smartphone, tablet PC or the like and an adjustment device or a thermostat, thus enabling the user to make further inputs to the system.

10

According to one aspect of the invention, a smaller temperature spread can be determined if at least one previous activation period is greater than a reference value, or a larger temperature spread can be determined if at least one previous activation period is less than the reference value. In this way, self-regulation is oriented to a time period which has been defined in advance as convenient for achieving a specified value.

15

According to one aspect of the invention, the temperature spread can be determined based on a course of successive, preceding activation durations. This enables a better adaptation of the self-regulation to user behavior, seasons and the like.

20

According to one aspect of the invention, the adjustment device may comprise a position detecting means configured to detect an actual position of the actuator. This enables a predetermined travel distance to be maintained, depending on the type of actuator.

25 According to one aspect of the invention, the position detecting means may be formed by a solenoid and a hall sensor associated with the solenoid. This enables an exact detection and execution of a predetermined adjustment travel.

The invention becomes easier to understand by means of the following detailed description with reference to the accompanying drawing, wherein the same reference signs are used for the same elements, wherein:

30

Fig. 1 shows a cross-sectional view through an adjustment device according to the invention;

Fig. 2 shows a representation of a temperature control system with inventive adjustment devices in a distributor device, thermostats and other system components;

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Fig. 3 is a block diagram showing the system components for self-regulation according to the invention;

10

Fig. 4 is a flow diagram representing steps for a determination of the temperature spread in the self-regulation according to the invention; and

Fig. 5 is a finite state machine for the representation of logical links in the self-regulation according to the invention.

15

Below, an exemplary embodiment of the adjustment device 1 according to the invention is described with reference to Fig. 1.

20

The adjustment device 1 is mounted on a flow control valve 2. The adjustment device 1 is attached to flow control valve 2 by means of a flange 27. In the present embodiment shown, the flow control valve 2 is, in turn, installed in a return flow distributor 14. The return flow distributor 14 has a connection piece 18 screwed into it, which connects the return flow distributor 14 with a consumer loop 3 not shown in detail. The flow control valve 2 can also be installed elsewhere in the return flow distributor 14. The connection piece 18 can also be pressed, glued, soldered, welded or otherwise fastened into the return flow distributor.

25

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The adjustment device 1 comprises an electrically controllable actuator 6. In this example the longitudinal axis of the adjustment device 1 and of the actuator 6 coincide. The electrically actuated actuator 6 contains an actuation means 20 which is movable in the axial direction. The longitudinal axis of the actuation means 20 also coincides with the longitudinal axis of the electrically actuated actuator 6. The actuation means 20 is arranged inside the electrically controllable actuator 6, has a component 21 which is variable in length in the axial direction, for example an expansion element 21, in particular a wax cartridge, and is biased by a spiral spring 22 arranged concentrically and coaxially thereto. The length-adjustable component 21 can also be designed as an electric mini-actuator, although this is often not

considered for reasons of cost and the presumed noise development. Instead of the coil spring 22, another suitable means, such as a ring spring package or similar, can also generate a pretensioning.

5 Via electrical wirings 7, the electrically controllable actuator 6 receives signals from a not shown temperature sensor on the return flow distributor 14 relating to the output-side return flow temperature $T_{\text{return flow}}$ of a heat transfer medium or heat carrier flowing through. The electrically controllable actuator 6 also receives temperature signals from a temperature sensor at the flow distributor not shown here via the wirings 7, relating to an input-side flow
10 temperature T_{flow} of the heat carrier flowing through. In the present version, a further electrical wiring 9 forms an interface to a thermostat not shown in Fig. 1.

Calculation means 8 contained in the adjustment device 1 process the signals received via wirings 7 and 9 and issue corresponding commands or control signals to the electrically
15 controllable actuator 6, on the basis of which the expansion element 21 in actuation means 20 is activated or deactivated. In this way, a defined adjustment path or stroke of the actuation means 20 in the axial direction is ultimately realized. In doing so, the actuation means 20 presses in the axial direction on an actuating pin 23 of the flow control valve 2 and thus actuates the same. In the present embodiment, the longitudinal axis of the actuation means 20 and of
20 the actuating pin 23 as well as of the flow control valve 2 coincide.

By means of the axial actuation of the valve pin 23, a valve head designed as a valve disk 24 in the exemplary embodiment is lifted from a valve seat 25 and thus a valve position is defined which corresponds to a certain opening position of the flow control valve 2 or a certain
25 valve opening cross-section.

The respective stroke of the flow control valve 2 or the resulting opening cross section is detected by a position detection means 15 in the adjustment device 1. The position detection means 15 in present embodiment consists of a solenoid 16, which is assigned to the electrically
30 controllable actuator 6 via a cantilever 26 projecting radially outward and is connected to the actuation means 20. In this way, the solenoid 16 moves in the axial direction parallel to the expansion element 21 and parallel to the valve disk 24, respectively, follows the same stroke or adjustment path with these, and serves as a reference for the respective stroke. A hall sensor 17, arranged opposite the solenoid 16, is a further component of the position detection means

15. The position as well as the movement or stroke of the solenoid 16 is detected by the hall sensor 17 and based on this the stroke of the valve disk 24 relative to the valve seat 25 is detected or, finally, the cross-section of the flow control valve 2 is determined.

5 The inventive adjustment device 1 shown in Figure 1 is installed in multiple copies in the inventive temperature control system 10 explained in Figure 2. The exemplary embodiment of the temperature control system 10 as shown in Figure 2 contains a distributor device 11 with three adjustment devices 1, which are mounted on the respective associated flow control valve 2 by means of a respective flange 27. The respective flow control valves 2 are installed in the
10 one return flow distributor 14. The return flow distributor 14 has, on the opposite side of the adjustment device 1 or on its bottom side when viewed in the direction of installation, a connection piece 18, respectively, via which the connection to the respective consumer loop 3 is established. The respective consumer loop 3 forms a respective heat exchanger 30. A temperature detection means 7, for example a return flow temperature sensor 7b, is attached,
15 in particular clipped or glued, to each connection piece 18. The return flow temperature sensor 7b is used to measure the respective return flow temperature $T_{\text{return flow}}$ on the outlet side of the heat carrier flowing through the respective consumer loop 3. The return flow temperature sensor 7b could also be installed at another suitable location to measure the respective return flow temperature, for example, directly after the connection piece 18 on the pipe wall of the
20 consumer loop 3 shown in a line.

 The temperature control system 10 also has a flow distributor 13. The flow distributor 13 in the exemplary embodiment contains three connectors 28 for the three consumer loops 3 shown. A temperature detection means 7 is again attached to each connector 28, for example a
25 flow temperature sensor 7a, in order to detect the respective flow temperature T_{flow} of the heat transfer medium or heat carrier flowing through the respective consumer loop 3 on the input side. The flow temperature sensor 7a could also be installed at another suitable location to measure the respective flow temperature, for example, directly after the connection 28 on the pipe wall of the consumer loop 3 shown in a line.

30

 The flow distributor 13 is connected to the return flow distributor 14 via a line 29 containing a temperature control source 4 and a pump 5. The pump 5 can be used to circulate the liquid heat carrier that has been charged with thermal energy from the temperature control source 4 or, if necessary, cooled. The heat carrier flowing through is transported by the pump

5 to the flow manifold 13, where the heat carrier flows into the three consumer loops 3 shown here and back through them to the return flow distributor 14, wherein the respective flow rate is determined by the flow cross-section of the respective flow control valve 2 installed in the return flow distributor 14. From the return flow distributor 14, the heat carrier collected there
5 flows back to the pump 5 or to the temperature control source 4.

A thermostat 12 assigned to the respective consumer loop 3 sends a control signal when a temperature control requirement exists. The control signal is transmitted from thermostat 12, for example, via an interface 9, in this case a cable, to the adjustment device 1. The interface 9
10 could also be designed as a wireless connection. Using the respective calculation means 8, the respective adjustment device 1 determines the opening cross-section of the respective flow control valve 2 depending on the activation signal or deactivation signal of the respective thermostat 12 and the respectively assigned signals or data of the flow and return flow temperatures.

15

The adjustment devices 1 as shown in Fig. 1 installed in the temperature control system 10 as shown in Fig. 2 are illustrated again in Fig. 3 in a block diagram which shows the system components for the self-regulation according to the invention.

20 Heat or cold is emitted to the environment by consumer loop 3. A thermostat 12, especially a room thermostat in a living room of a building, outputs a signal. The signal from thermostat 12 is transmitted to an ECU of the adjustment device 1. The ECU also receives temperature signals or data, such as the return flow temperature $T_{\text{return flow}}$ and the flow temperature T_{flow} . A calculation means 8, which contains the ECU, is configured to carry out
25 an electric control of the actuator 6 of the adjustment device 1, which is not shown in detail here, in order to realize a stroke of the valve, or to set the predetermined opening position of the flow control valve 2, which is assigned to a certain flow cross-section.

The opening cross-section of valve 2 or its stroke is calculated based on a control
30 difference $\Delta T_{\text{control difference}}$, wherein the control difference $\Delta T_{\text{control difference}}$ to be calculated is formed between a temperature difference ΔT_{actual} from the detected input-side flow temperature T_{flow} and the output-side return flow temperature $T_{\text{return flow}}$, and a predetermined temperature spread ΔT_{target} from the output-side return flow temperature $T_{\text{return flow}}$ to the input-side flow temperature T_{flow} .

The adjustment device 1 further comprises a time detection means not further described herein and a storage means which are configured to detect and store a previous or current activation period of the activation signal from thermostat 12 and/or a deactivation period
 5 between two activations or deactivations, wherein the calculation means 8 with the ECU contained therein is configured to variably determine the temperature spread ΔT_{target} based on an activation period and/or a deactivation period.

Fig. 4 shows a flow chart which shows steps for a determination of the temperature
 10 spread ΔT_{target} in the self-regulation according to the invention.

In function F1 it is checked whether the heating period Δt_{heat} is less than a predetermined time Δt_{target} , for example half an hour. In other words, it is checked whether:

$$\Delta t_{\text{heat}} < \Delta t_{\text{target}} \text{ with } \Delta t_{\text{target}} = \frac{1}{2} h$$

15 If this is the case, i.e. the answer is „Yes“, the target value ΔT_{target} is increased by two Kelvin or two degrees in step S100. If this is not the case, i.e. the answer is „No“, it is continued with function F2.

In function F2 it is checked whether the heating period is less than one hour. It is
 20 therefore checked whether:

$$\Delta t_{\text{heat}} < \Delta t_{\text{target}} \text{ with } \Delta t_{\text{target}} = 1 h$$

If this is the case, i.e. the answer is „Yes“, the target value ΔT_{target} is increased by one Kelvin or one degree in step S110. If this is not the case, i.e. the answer is „No“, it is continued
 with function F3.

25

In function F3 it is checked whether the heating period is less than two hours. It is therefore checked whether:

$$\Delta t_{\text{heat}} < \Delta t_{\text{target}} \text{ with } \Delta t_{\text{target}} = 2 h$$

If this is the case, i.e. the answer is „Yes“, the target value ΔT_{target} is increased by 0.5
 30 Kelvin or 0.5 degrees in step S120. If this is not the case, i.e. the answer is „No“, the routine continues with function F4.

In function F4 it is checked whether the heating period is longer than three hours. It is therefore checked whether:

$$\Delta t_{heat} > \Delta t_{target} \text{ with } \Delta t_{target} = 3h$$

If this is the case, i.e. the answer is „Yes“, the target value ΔT_{target} is reduced by one
 5 Kelvin or one degree in step S130. If this is not the case, i.e. the answer is „No“, the routine continues with function F5.

In function F5 it is checked whether the heating period is longer than four hours. It is therefore checked whether:

10
$$\Delta t_{heat} > \Delta t_{target} \text{ with } \Delta t_{target} = 4h$$

If this is the case, i.e. the answer is „Yes“, the target value ΔT_{target} is reduced by three Kelvin or three degrees in step S140.

In step S150, which follows steps S100 to S140, the possible values of the target value
 15 ΔT_{target} are limited to a temperature spread profile between five to fifteen Kelvin or five to fifteen degrees.

After that, the routine ends.

20 In Fig. 5, a finite state machine for the representation of logical links in the self-regulation according to the invention is explained.

In condition 1, the valve position of flow control valve 2 is controlled. The actual spread dT_{actual} or ΔT_{actual} is calculated or determined. Furthermore, the difference dT_{diff} or
 25 $\Delta T_{control}$ difference is calculated from the target spread dT_{target} or ΔT_{target} and the actual spread dT_{actual} or ΔT_{actual} . The valve opening cross section, the valve stroke or the valve travel distance sV is calculated, the latter is adjusted, for example, via a PID controller, in particular via an I controller, and the valve travel distance is limited to, for example, a minimum of 10 percent. This has the advantage that undesirable flow noise is minimized. Furthermore, the
 30 heating period is calculated in the controller cycle, which is set to 10 seconds, for example.

In condition 2, the valve position is maintained. The actual spread dT_{actual} or ΔT_{actual} is calculated. The duration or activation time is counted in the controller cycle. The controller

cycle is 10 seconds, for example. The heating period is also calculated in the controller cycle of 10 seconds. If condition 2 is left, an action is carried out to zero the time duration or set it to zero.

5 The controller clock can be set to integer seconds between 1 second and 30 seconds, preferably it is set to 5 to 15 seconds, especially 10 seconds.

In condition 3 the valve is closed. The valve travel distance sV is set to zero.

10 In condition 4, the target spread is calculated. The target dT_target or ΔT_{target} is calculated and the heating period is then reset to zero.

Condition 1 is linked in the direction of condition 2 via function F10. Function F10 checks whether the control difference $\Delta T_{\text{control difference}}$, i.e. the amount of the difference ΔT_{target} minus ΔT_{actual} or from $dT_{\text{target}} - dT_{\text{actual}}$ is smaller than $dT_{\text{diff_Max}}$, i.e. it is checked
15 whether:

$$|dT_{\text{target}} - dT_{\text{actual}}| < dT_{\text{Diff_Max}}$$

In other words, it is checked whether the control difference $\Delta T_{\text{control difference}}$ is within a maximum permissible control difference $\Delta T_{\text{control difference-max}}$.

20

Condition 2 is linked in the direction of condition 1 via function F20. In function F20 it is checked whether the absolute value of $dT_{\text{target}} - dT_{\text{actual}}$ is greater than twice $dT_{\text{diff_Max}}$ and at the same time the duration is greater than or equal to 10 minutes, i.e. it is checked whether:

25 $|dT_{\text{target}} - dT_{\text{actual}}| > 2 * dT_{\text{diff_Max}} \text{ AND } \text{duration} \geq 10 \text{ minutes}$

Condition 2 is linked in the direction of condition 4 via function F30 In function F30 it is checked whether RT is identical to 0 or whether the heating period is greater than 4 hours, i.e. it is checked whether:

30 $RT == 0 \text{ OR } \text{heating period} > 4 \text{ h}$

Condition 4 is linked to condition 3 via function F40. In function F40 it is checked whether RT is identical to 0, i.e. it is checked whether:

$$RT == 0$$

Here, RT again represents the control signal from the room thermostat.

Condition 3 is again linked to the direction of condition 2 via function F50. Here it is
5 checked whether RT is identical to 1, i.e. it is checked whether:

$$RT == 1$$

In other words, function F50 determines whether the room thermostat sends a control
or activation signal.

10 Condition 4 is linked to condition 1 via function F60. In function F60 it is checked
whether RT is identical to 1, i.e. it is checked whether:

$$RT == 1$$

or whether the room thermostat sends an activation signal.

15 Condition 1 is linked to condition 4 via function F70. In function F70 it is checked
whether the heating period is longer than 4 hours, i.e. it is checked whether:

$$\textit{heating period} > 4 \textit{ h}$$

The heating period specified by way of example as 4 hours can also be set to a suitable
20 value of 2 to 6 hours, for example 3, 4 or 5 hours.

The present invention thus provides for the first time an adjustment device 1 for the
self-regulating adjustment of a flow control valve 2 of a consumer loop 3 with heat exchanger
30, in particular in a temperature control system 10 for buildings with a temperature control
25 source 4, a liquid heat carrier and a pump 5.

Furthermore, the invention provides for the first time a distributor device 11 for the self-
regulating distribution of a liquid heat carrier to at least two or more consumer loops 3 with
heat exchangers 30, each comprising a flow control valve 2, in a temperature control system
30 10 with a temperature control source 4 and a pump 5, wherein the distributor device 11
comprises a flow distributor 13 and a return flow distributor 14. At these the consumer loops 3
are brought together or merged on the input side and on the output side, wherein the flow valves
2 are arranged at the flow distributor 13 or the return flow distributor 14.

Finally, the invention proposes for the first time suitable methods for this purpose.

In figures 1 to 5 discussed above, the reference signs summarized below were used,
 5 although this list does not claim to be exhaustive:

	1	adjustment device;
	2	flow control valve;
	3	consumer loop;
10	4	temperature control source;
	5	pump;
	6	electrically controllable actuator;
	7	temperature detection means;
	7a	flow temperature sensor;
15	7b	return flow temperature sensor;
	8	calculation means;
	9	interface;
	10	temperature control system;
	11	distributor device;
20	12	thermostat,
	13	flow distributor;
	14	return flow distributor;
	15	position detection means;
	16	solenoid;
25	17	hall sensor;
	18	connection piece;
	20	actuation means;
	21	expansion element, especially wax cartridge;
	22	coil spring;
30	23	valve pin;
	24	valve disk;
	25	valve seat;
	26	cantilever;
	27	flange;
35	28	connector;
	29	line;
	30	heat exchanger;

	T_{flow}	input-side flow temperature of the heat transfer medium flowing through;
5	$T_{\text{return flow}}$	output-side return flow temperature of the heat transfer medium flowing through;
	ΔT_{actual}	temperature difference ;
	ΔT_{target}	temperature spread;
	$\Delta T_{\text{control difference}}$	temperature control difference;
	$T_{\text{room-target}}$	presetable room temperature;
10	$T_{\text{room-actual}}$	actual room temperature;

CLAIMS

1. An adjustment device (1) for the self-regulating adjustment of a flow control valve (2) of a consumer loop (3) with heat exchanger (30) in a temperature control system (10) for rooms in a building, having a temperature control source (4), a liquid heat carrier and a pump (5), wherein the adjustment device (1) comprises:

an electrically controllable actuator (6) configured to be coupled to the flow control valve (2) in such a way that an opening position of the flow control valve (2) can be adjusted and detected, gradually or stepwise, between a closed position and an open position by the adjustment device (1);

temperature detection means (7) which detect a flow temperature (T_{flow}) on the input side and a return temperature ($T_{\text{return flow}}$) on the output side with respect to the consumer loop (3) of the heat carrier flowing through;

calculation means (8) configured to calculate an electric trigger of the actuator (6), which corresponds to a predetermined opening position of the flow control valve (2) - associated with a specific flow cross-section - based on a control difference ($\Delta T_{\text{control difference}}$), wherein the control difference ($\Delta T_{\text{control difference}}$) to be calculated is formed between

a temperature difference (ΔT_{actual}) from the input-side flow temperature (T_{flow}) and the output-side return flow temperature ($T_{\text{return flow}}$) detected by the temperature detection means (7), and a temperature spread (ΔT_{target}) from the output-side return flow temperature ($T_{\text{return flow}}$) to the input-side flow temperature (T_{flow}) that is predetermined by the calculation means (8), that is the absolute value of the difference ΔT_{target} minus ΔT_{actual} ;

an interface (9) for receiving an external activation signal for activating the calculation means (8) and/or the adjustment device (1);

characterized in that,

said adjustment device (1) comprises time detection means and storage means configured to detect and store a previous or current activation period of said activation signal and/or a deactivation period between two activations; and

the calculation means (8) is configured to variably determine the temperature spread (ΔT_{target}) based on the activation duration and/or the deactivation duration.

2. The adjustment device (1) for the self-regulating adjustment of a flow control valve (2) of a consumer loop (3) according to claim 1, characterized in that

the adjustment device (1) is configured to output the electric trigger calculated by the calculating means (8) to the actuator (6) during an activation period, and to output no electric trigger or a predetermined electric trigger corresponding to the closed position of the flow control valve (2) to the actuator (6) during a deactivation period.

3. The adjustment device (1) for the self-regulating adjustment of a flow control valve (2) of a consumer loop (3) according to claim 1 or 2, characterized in that

the adjustment device (1) is configured to switch off supply of electric power to the calculating means (8) and/or to the adjustment device (1) during a deactivation period.

4. The adjustment device (1) for the self-regulating adjustment of a flow control valve (2) of a consumer loop (3) according to any one of claims 1 to 3, characterized in that

said calculation means (8) is configured to store at least one value of a previous opening position of said flow control valve (2) in said storage means.

5. The adjustment device (1) for the self-regulating adjustment of a flow control valve (2) of a consumer loop (3) according to any one of claims 1 to 4, characterized in that

the storage means contains a pre-stored reference value for the activation duration and/or a pre-stored reference value for the deactivation duration.

6. The adjustment device (1) for the self-regulating adjustment of a flow control valve (2) of a consumer loop (3) according to one of claims 1 to 5, characterized in that

the storage means contains a previously stored value range for the temperature spread.

7. The adjustment device (1) for the self-regulating adjustment of a flow control valve (2) of a consumer loop (3) according to any one of claims 1 to 6, characterized in that

the storage means contains a previously stored map with associated values of activation durations and/or deactivation durations and predetermined temperature spreads (ΔT_{target}) for determining the temperature spread (ΔT_{target}).

8. The adjustment device (1) for the self-regulating adjustment of a flow control valve (2) of a consumer loop (3) according to any one of the claims 1 to 7, characterized in that

the storage means contains a pre-stored control logic for determining the temperature spread (ΔT_{target}).

9. The adjustment device (1) for the self-regulating adjustment of a flow control valve (2) of a consumer loop (3) according to any one of claims 1 to 8, characterized in that

the adjustment device (1) is configured to change the temperature spread (ΔT_{target}) depending on the flow temperature (T_{flow}), and/or

the adjustment device (1) is configured to change a bandwidth of the temperature spread (ΔT_{target}) depending on the flow temperature (T_{flow}), and/or

the adjustment device (1) is configured to receive, via the interface (9), further external signals with operating parameters from the temperature control system (10); and the calculation means (8) is configured to adjust the temperature spread (ΔT_{target}) depending on the operating parameters.

10. A temperature control system (10) for the self-regulating temperature control of rooms of a building with a temperature control source (4), at least one consumer loop (3) with heat exchanger (30), which comprises a flow control valve (2), as well as a liquid heat carrier and a pump (5), comprising:

at least one thermostat (12) provided in a room, having input means for inputting a value which is indicative of a presettable room temperature ($T_{\text{room-target}}$), and an interface (9) for outputting an activation signal for at least one consumer loop (3) in the room; wherein

the thermostat (12) is configured to respond to an actual room temperature ($T_{\text{room-actual}}$) by the thermostat (12) outputting the activation signal as long as a deviation tolerance between the presettable room temperature ($T_{\text{room-target}}$) and the actual room temperature ($T_{\text{room-actual}}$) is exceeded;

characterized in that

the temperature control system (10) respectively comprises, for the at least one consumer loop (3), an adjustment device (1) according to any one of the claims 1 to 9, which is operatively connected to the flow control valve (2) of the consumer loop (3), and with which an activation signal or deactivation signal from the thermostat (12) is associated, which is arranged in the same room as the consumer loop (3).

11. The temperature control system (10) for the self-regulating temperature control of rooms of a building according to claim 10, characterized in that

the thermostat (12) and two or more consumer loops (3) are provided in a room of the building.

12. The temperature control system (10) for the self-regulating temperature control of rooms of a building according to claim 10 or 11, characterized in that

the thermostat (12) comprises a bimetallic element which responds to the actual room temperature ($T_{\text{room-actual}}$) and actuates an output of the activation signal or the deactivation signal.

13. The temperature control system for the self-regulating temperature control of rooms of a building according to any one of claims 10 to 12, characterized in that

the activation signal or deactivation signal is a binary signal comprising an on state (I) with a signal level above a predetermined level value and an off state (0) without a signal level or with a signal level below the predetermined level value.

14. The temperature control system for the self-regulating temperature control of rooms of a building according to any one of claims 10 to 13, characterized in that

the thermostat (12) comprises a microcomputer and a temperature sensor for detecting the actual room temperature ($T_{\text{room-actual}}$); wherein

the thermostat (12) detects and stores a course of the actual room temperature ($T_{\text{room-actual}}$) during and/or after the activation signal or the deactivation signal is output; and

the thermostat (12) and the adjustment device (1) are configured to communicate data on a course of detected actual room temperatures ($T_{\text{room-actual}}$).

15. The temperature control system for the self-regulating temperature control of rooms of a building according to any one of claims 10 to 14, characterized in that

the activation signal and/or the deactivation signal is communicated by means of wireless interfaces (9) from the thermostat (12) to the associated adjustment device (1)

16. A distributor device (11) for the self-regulating distribution of a liquid heat carrier to at least two or more consumer loops (3) with heat exchanger (30), each comprising a flow control valve (2), in a temperature control system (10) with a temperature control source (4) and a pump (5), comprising:

a flow distributor (13) and a return flow distributor (14), at which the consumer loops (3) are merged on the input side and on the output side, wherein the flow control valves (2) are provided at the flow distributor (13) or the return flow distributor (14);

characterized in that

the distributor device (11) comprises an adjustment device (1) for the self-regulating adjustment of the consumer loops (3) according to any one of claims 1 to 9 for each flow control valve (2).

17. A method for self-regulating adjustment of a flow of a liquid heat carrier through a consumer loop (3) with heat exchanger (30) in a temperature control system (10) for buildings with a temperature control source (4) and a pump (5);

the method comprising at least the following steps:

- a) detecting an input-side flow temperature (T_{flow}) and an output-side return temperature ($T_{\text{return flow}}$) of the heat carrier passing through the consumer loop (3);
- b) calculating a control difference ($\Delta T_{\text{control difference}}$) between a temperature difference (ΔT_{actual}) from the detected input-side flow temperature (T_{flow}) and the output-side return flow temperature ($T_{\text{return flow}}$), and the predetermined temperature spread (ΔT_{target}), that is the absolute value of the difference ΔT_{target} minus ΔT_{actual} ;
- c) calculating and setting an adjustable flow cross-section in the consumer loop (3) based on the control difference ($\Delta T_{\text{control difference}}$);

characterized by the steps:

- d) detecting a previous or current activation period and/or a deactivation period of the consumer loop (3); and
 - e) determining the variable temperature spread (ΔT_{target}) from the output-side return flow temperature ($T_{\text{return flow}}$) to the input-side flow temperature (T_{flow}) based on the activation duration and/or the deactivation duration.
18. The method for the self-regulating adjustment of a flow of a liquid heat carrier through a consumer loop (3) according to claim 17, characterized in that
- a smaller temperature spread (ΔT_{target}) is determined if at least one previous activation or deactivation period is greater than a reference value, or
- a greater temperature spread (ΔT_{target}) is determined if at least one previous activation or deactivation period is less than the reference value.
19. The method for the self-regulating adjustment of a flow of a liquid heat carrier through a consumer loop (3) according to claim 17 or 18, characterized in that

the temperature spread (ΔT_{target}) is determined based on a course of successive, preceding activation and/or deactivation durations.

20. A method for the self-regulating distribution of a liquid heat carrier to at least two or more consumer loops (3) with heat exchanger in a temperature control system (10) for buildings with a temperature control source (4) and a pump (5);

characterized in that

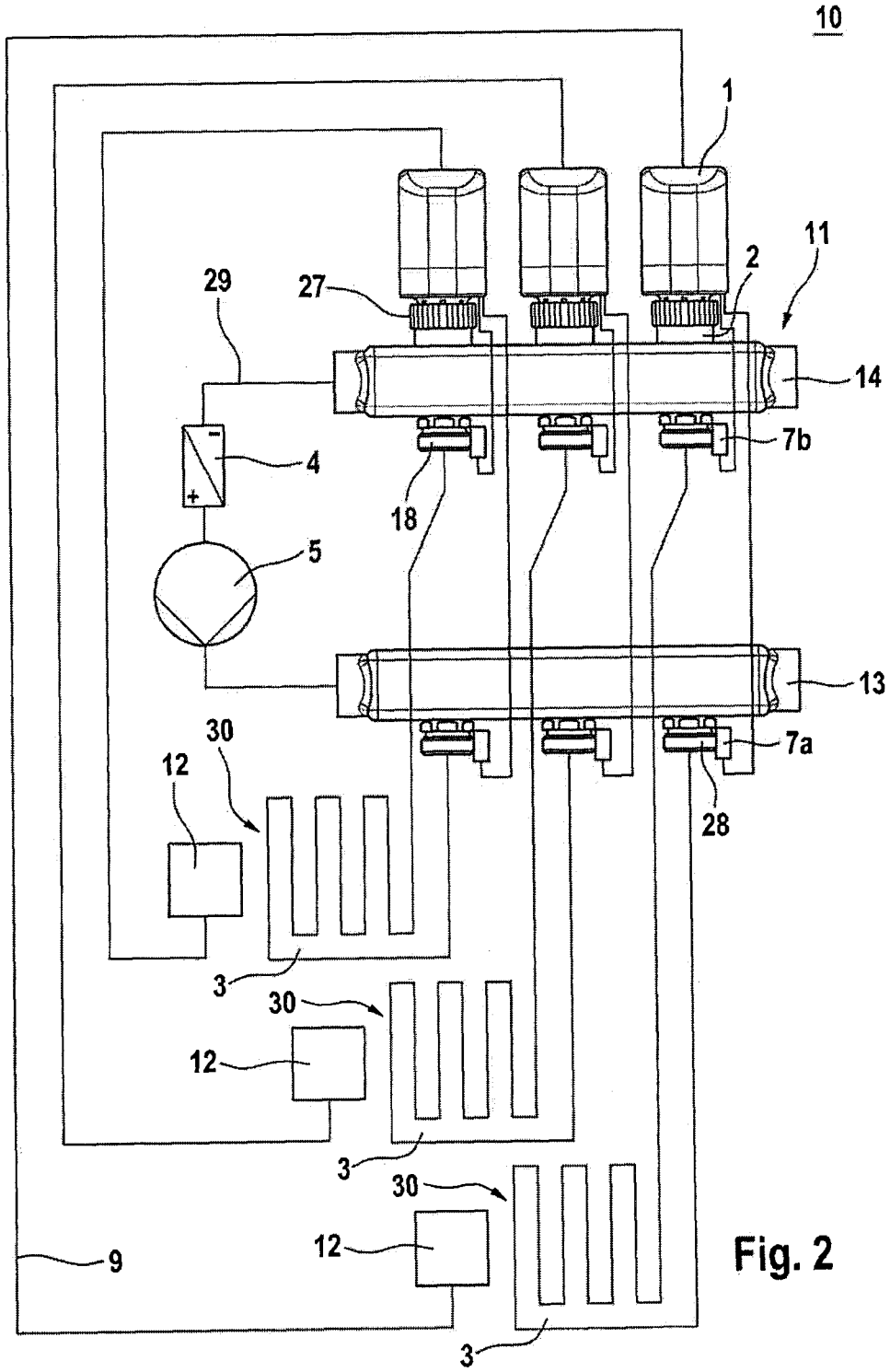
the method for the self-regulating adjustment of a flow of a liquid heat carrier through an externally activatable consumer loop (3) according to one of claims 17 to 19 is carried out for each consumer loop (3).

21. An adjustment device (1) for the self-regulating adjustment of a flow control valve (2) according to any one of claims 1 to 9, wherein the adjustment device (1) further comprises:

a position detection means (15) configured to detect an actual position of the actuator (6).

22. The adjustment device (1) for the self-regulating adjustment of a flow control valve (2) according to claim 21, characterized in that

the position detection means (15) is formed by a solenoid (16) and a hall sensor (17) associated with the solenoid (16).



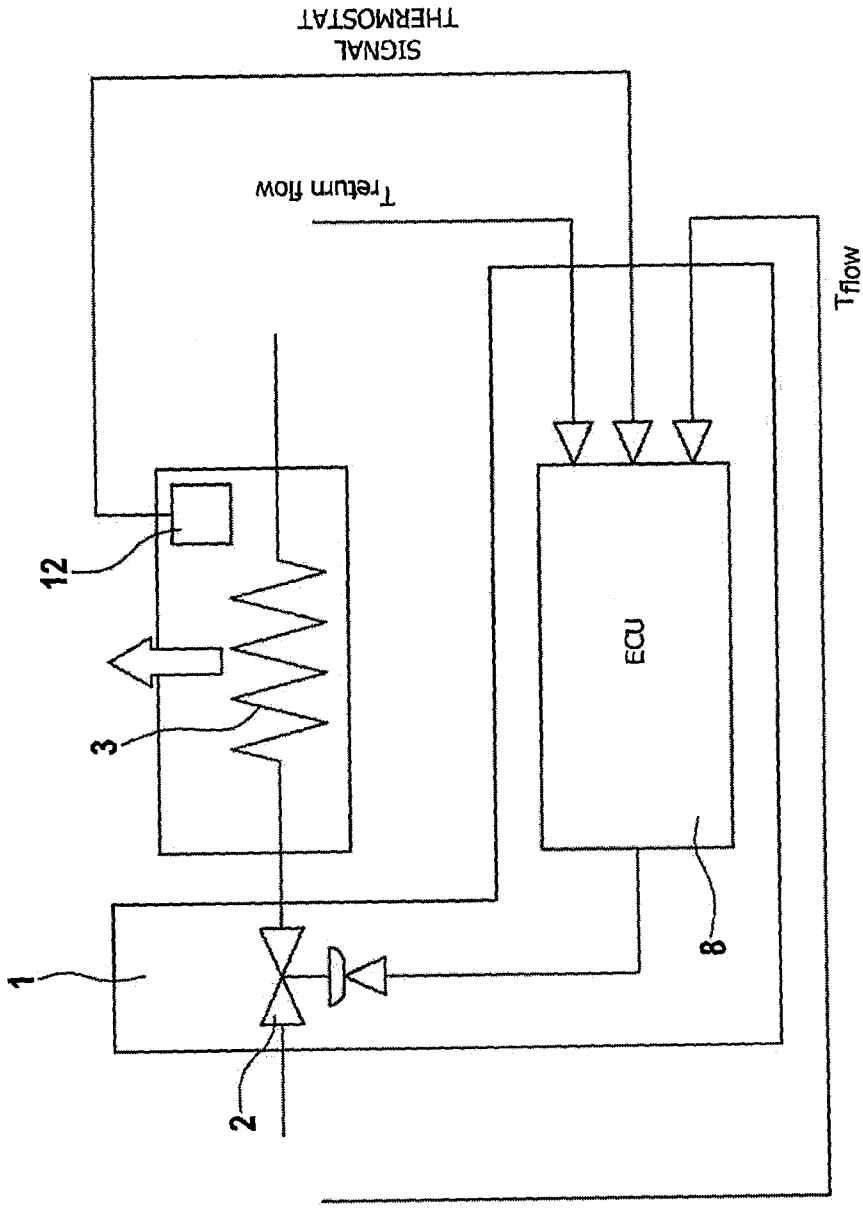


Fig. 3

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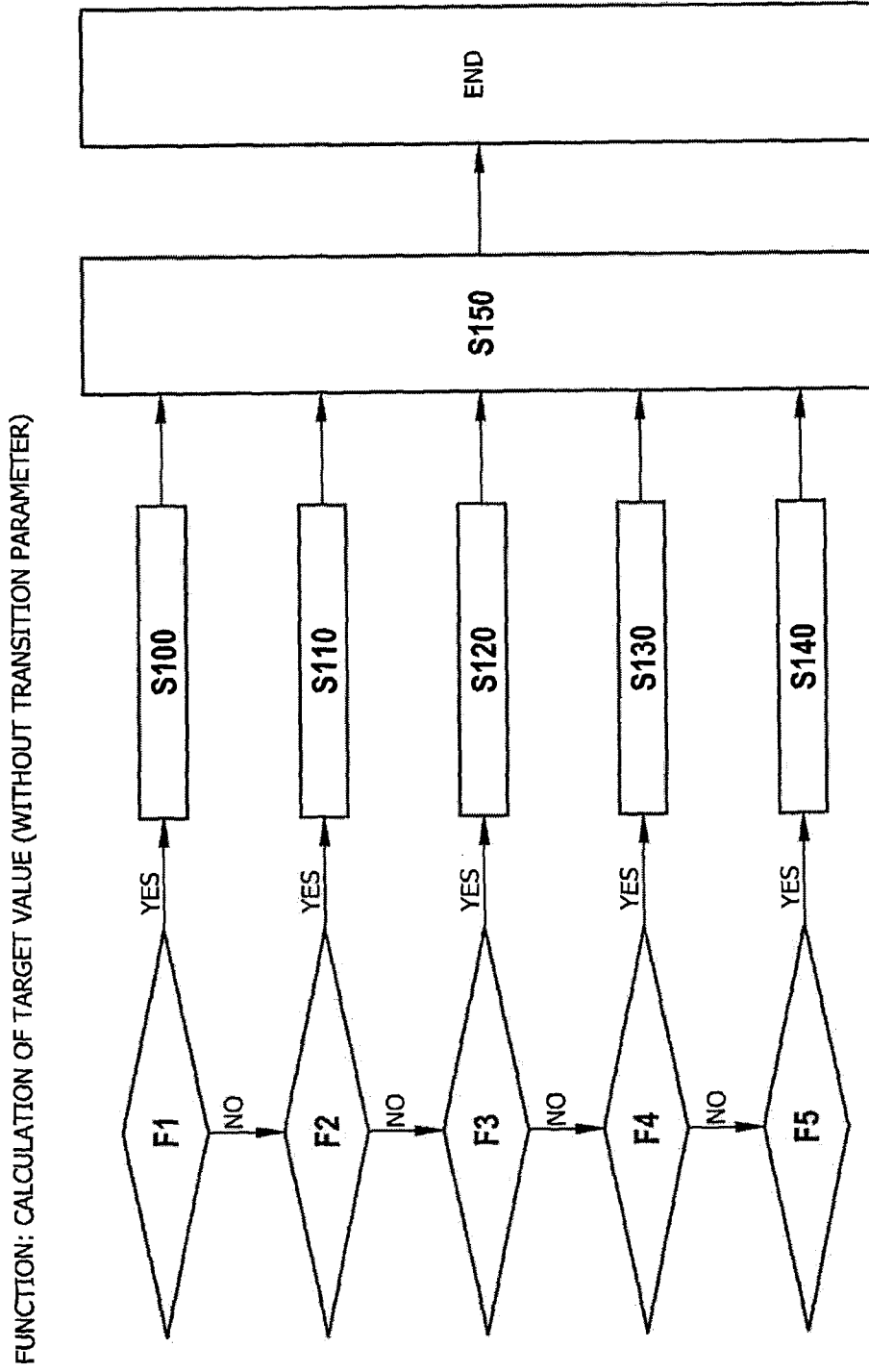


Fig. 4

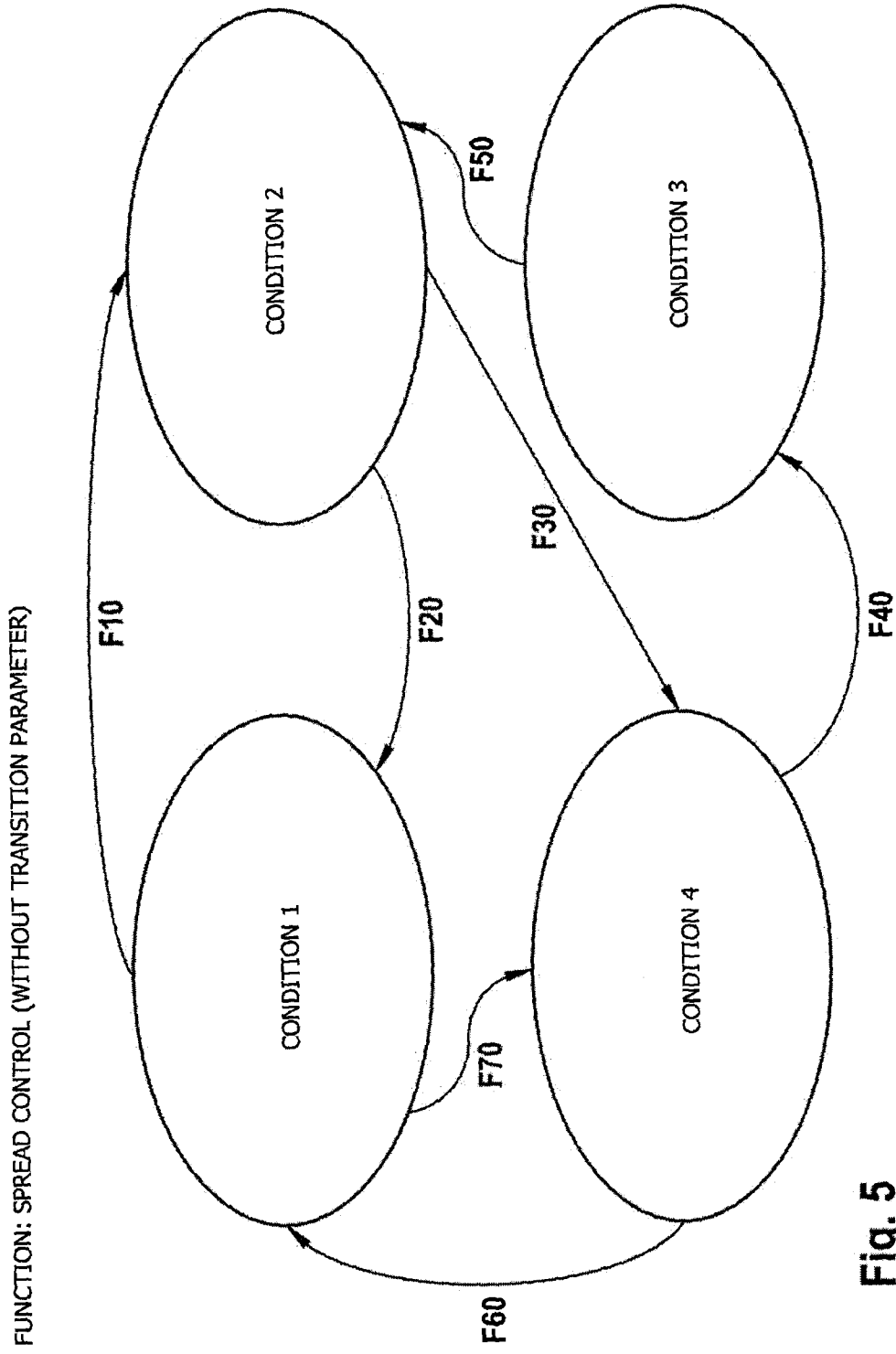


Fig. 5

