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(54) **METHOD AND SYSTEM OF ENERGY CONTROL IN THE CENTRAL HEATING SYSTEM IN THE BUILDING AND/OR CENTRAL HOT WATER INSTALLATION**

(57) The subject of the invention is a method of controlling energy in a central heating system or a central hot water system in a building, characterized in that it comprises the following steps: a) initiation by the central unit of taking measurements, wherein for a central heating system, the measurement of temperature and flow is initiated by the heating medium temperature sensors, the outside air temperature sensor and the flow sensors in a continuous mode, while for a central hot water installation, the central unit initiates the measurement of the return temperature and the supply temperature; b) collecting data from the sensors by the data acquisition unit; c) sending data from the sensors to the analysis module, in which the first algorithm for controlling central heating and the central heating installation, for central heating, calculates on the basis of input data: the value of the supply temperature necessary to maintain thermal comfort in the building and the flow, and then calculates the basic relationship between the outside air temperature and the actual demand for thermal power of the building, wherein the input data are data obtained from the temperature and flow sensors and reference data including: calculations of the useful energy and thermal capacity of the building, the actual demand for thermal power of the building, the time needed to cool the building by 1 °C; the demand for thermal power of at least two of the most unfavourably located apartments; whereas for the central central hot water installation, the first algorithm calculates the supply temperature value necessary to maintain the temperature according to the Technical

Conditions, and then calculates the basic relationship between the supply and circulation temperatures at the appropriate hours of the day on individual days of the week; d) calculation by the first algorithm of the mixer operation schedule in order to regulate the heating medium in the building installation regardless of the temperatures supplied to the supplier; e) starting the mixer operation in accordance with the schedule calculated in stage d), wherein for central heating installations the mixer operation schedule includes its opening and closing depending on the data supplied from the temperature and flow sensors, where closing the mixer cuts off the heating medium from the heat source, preventing its heating, while for central hot water system the mixer operation schedule includes its opening and closing depending on the data supplied from the return temperature sensors, where closing the mixer cuts off the heating medium from the heat source, preventing its heating, f) controlling the mixer operation in real time, wherein for central hot water system the control is carried out by means of an algorithm that checks the return temperature (i.e. circulation) from the installation in real time and, based on the received data, determines the opening or closing of the mixer, thereby maintaining the desired temperature, while for central heating installations the control is carried out by means of an algorithm that checks the supply temperature, return temperature, heating medium flow, outside air temperature in real time and, based on the received data, determines the opening or closing of the mixer, thereby maintaining the desired temperature and flow.

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Description

[0001] The object of the invention is a method and a system for controlling energy in a central heating and/or central hot water system, where the housing cooperative/community/owner of the building is not the owner of the heat source.

[0002] A thermal energy management system these days is crucial for finding savings in a building. Existing thermal systems are only available to the owners of the heat source (owners of boiler houses, district heating centres, heat pumps or mixed systems). This means that many residential or commercial buildings are 'condemned' to the parameters provided by the owner of the heat source.

[0003] From the state of the art, various systems and methods for managing the energy consumption of a water system are known. In particular, from the Chinese application CN108256711, a method of evaluating the energy saving index system of a district with a central heating boiler is known, which includes the following steps: checking whether the basic data of the boiler plant meets the national basic requirements of environmental protection, safety and equipment; collecting the boiler parameters of the target boiler plant for a whole year and matching the weighted results of the existing evaluation indexes according to the two evaluation indexes of the boiler plant for a whole year; collecting the quality index data of the target boiler plant and obtaining the weighted results of the final quality evaluation index according to the five contents of the quality indexes. collection of the target boiler plant when the boiler is kept in normal operation for a certain period of time, the statistics of the value of the measured data on site according to the five items of the quantitative indicator, the final weighted result of the quantitative indicator is obtained; comprehensive qualitative and quantitative indicators to the comprehensive value of the single target furnace in the boiler plant to obtain the total thermal system result.

[0004] From the Chinese application CN107358328, a central heating pipe network performance analysis system is known which includes: a master data management unit configured to obtain and manage attribute information of each node type in the central heating pipe network and corresponding related information of each node; a thermal data collection unit configured to collect thermal energy information of each node in the central heating pipe network over a time interval; a performance analysis unit configured to use the attribute information of each node type and the corresponding related information of each node in the master data management unit and combine the thermal energy information of each node in the time interval collected by the thermal data collection unit to obtain the unit energy consumption of the heat rate of each node; and a threshold setting unit configured to set the performance threshold of each node type and combine the unit energy consumption and heat rate obtained by the performance analysis unit to determine the performance status of each node.

[0005] From the Chinese application CN108428040, an integrated Internet of Things application system for central heating is known. The disclosed system comprises a data collection system, a production safety monitoring system and a heat measurement management service platform, and both the data collection system and the production safety monitoring system are connected to the heat measurement management service platform. The data collection system includes a heat meter and an LSN sensor network, which are connected to each other; the production safety monitoring system includes a heating equipment management system, an intelligent inspection recording instrument, a production environment monitoring and alarm system and a transmission network, and the heating equipment management system, the intelligent inspection recording instrument and the production environment monitoring and alarm system are connected to the transmission network; and the heat measurement management service platform includes a query statistics system, an energy efficiency analysis system and an energy saving management system. The aforementioned system is an application of Internet of Things (IoT) technology to the central heating system, and as a result, heating efficiency and quality are improved, the risk of production safety accidents is reduced, and heating energy consumption is reduced.

[0006] From the Chinese application CN115471052, the method of intelligent regulation and control of the heat exchange station is known, which includes the following steps: acquiring the heat supply temperature and water flow data of each household in the current region together with the weather and temperature in the past five years; the average heating temperature of each household is calculated by removing incorrect data under different weather conditions and temperatures each year. According to the revealed method of intelligent regulation and control of the heat exchange station, the central heating mode is selected, the resources can be integrated, the energy utilisation rate is increased and the energy saving target is achieved. However, the central heating cannot change the heating temperature and the water flow rate according to the continuous temperature changes, the weather, the thermal protection layer of the user wall and the thermal protection of the pipeline. With the revealed regulation and control method combined with Big Data artificial intelligence, the heat exchange station can provide the most suitable heating temperature by calculating the related data of the past five years according to temperature and weather.

[0007] From the Chinese application CN114240012, a method for calculating the optimal energy flow in an integrated power distribution system is known, comprising: analysing unbalanced operation characteristics of an electricity network and establishing an unbalanced electricity network model; analysing characteristics of a gas network and a heat network and establishing a gas network model and a heat network model; establishing an optimal energy flow scheduling model

based on establishing an unbalanced network model and a gas network model and a heat network model; and then, a learning and learning optimisation algorithm solves the optimal energy flow scheduling model and obtains energy flow optimisation results of the integrated energy distribution system.

[0008] From the Chinese application CN114723221, a method for optimal scheduling of combined heat and power generation for an integrated central heating network and demand response is known, which includes establishing a dynamic heat exchange model of the integrated central heating network, which includes a dynamic heat exchanger model, a dynamic heat pipe network model, a dynamic radiator model and a dynamic heat building model; constructing a power demand response mechanism based on the cost of peak-to-valley difference and the adjustable electricity price at the time of use. Then, according to the heat storage capacity of the dynamic heat exchange model of the integrated central heating network in the heat exchange process, the heat demand response mechanism based on the rigid heating load and the translational heating load is constructed. The next step is to construct the aggregated demand response mechanism, including the power demand response mechanism and the heat demand response mechanism, and to obtain the network data and execute the optimal schedule of combined heat and power generation based on the aggregated demand response mechanism.

[0009] From the Chinese application CN214670711, a smart heating monitoring device is known, characterised in that it comprises a control unit and a heat station unit, a secondary pipe network and a user unit connected sequentially. Whereby, the heat station unit is provided with a heat station water inlet and a heat station water outlet; the user unit is provided with a user water inlet and a user water outlet; and the heat station unit is connected to a heat exchanger. The control unit includes a temperature sensor, a pressure sensor, a flow sensor and a controller, and the controller is electrically connected to the temperature sensor, the pressure sensor and the flow sensor, respectively. The unit also includes several temperature sensors, pressure sensors and flow sensors; the thermal station water inlet, thermal station water outlet, user water inlet and user water outlet are equipped with temperature sensors, pressure sensors and flow sensors. The secondary pipe network, on the other hand, comprises the internal pipe network, the branch network and the building pipe network. The internal pipe network is set up in the heating station unit and the building pipe network is set up in the user unit. In turn, the branch pipe network has an inlet end and an outlet end, the inlet end is connected to the station pipe network and the outlet end is connected to the building pipe network.

[0010] From the Chinese application CN113095738, an intelligent heat supply monitoring device, method, system and equipment is known, and belongs to the field of urban central heating engineering. The intelligent heat supply monitoring device comprises a heat node unit, a secondary pipe network, a user unit and a control unit. The heat node water inlet, heat node water outlet, user water inlet and user water outlet are equipped with a temperature sensor, pressure sensor and flow sensor, so that temperature, pressure and flow can be monitored at all water inlets and outlets, and the operating states of the heat node and user unit can be assessed in real time. With the deployment of the secondary pipe network, the interior and exterior of the user unit can be managed and controlled, so that the fault branch is predicted and monitored in real time provided that the heat supply to other branches of other user units is not affected. The levels of computerisation, automation and intelligence of the existing urban central heating system have been improved and the goals of intelligence, energy savings, money savings and manpower savings have been achieved.

[0011] However, the state of the art known systems and methods do not allow the energy control of the heat source from the user level, i.e. independently of the heat source owners.

[0012] Therefore, the aim of the invention is to provide a method and system for controlling the energy in a hot water or central heating system in a building, independently of the parameters imposed by the owners of the heat source.

[0013] The owner of the heat source (usually the heat supplier) controls the most important parameters, i.e. the rated mass flux and the flow temperature and return temperature, in order to safeguard his interests - i.e. to sell as much heat energy as possible. Surprisingly, analyses carried out by the authors of this invention have shown that by being able to change the mass flow rate of the medium in the system and by being able to change the flow or return temperatures, we are able to influence the instantaneous heat output without worsening the thermal comfort in the building. The question arises - how to control these parameters without being the owner of the heat source.

[0014] The essence of the invention is a method of energy control for a central heating or central hot water system in a building, characterised in that it comprises the following steps:

- a) Initiation of measurement by the central unit, whereby for the central heating system the heating medium temperature sensors initiate the temperature and flow measurement, the outdoor air temperature sensor, and the continuous flow sensors, while for the central hot water system, the central unit initiates the measurement of the return temperature and the flow temperature;
- b) Collection of sensor data by the data acquisition unit;
- c) Sending the sensor data to the analysis module, where the first algorithm for the control of the central heating and the central heating system, for central heating, calculates from the input data: the value of the supply temperature necessary to maintain thermal comfort in the building and the flow rate, followed by the calculation of the basic relationship between the outside air temperature and the actual thermal power demand of the building, the input data

being the data acquired from the temperature and flow rate sensors and reference data including: the calculation of the usable energy and heat capacity of the building, the actual heat capacity demand of the building, the time required to cool the building by 1 °C; the heat capacity demands of at least the two most disadvantaged flats; while for the central hot water system, the first algorithm calculates the value of the flow temperature required to maintain the temperature according to the Technical Conditions, after which it calculates the basic relationship between the flow and circulation temperatures at the relevant hours of the day on particular days of the week;

d) Calculation by the first algorithm of the mixer operation schedule in order to regulate the heating medium in the building installation independently of the temperatures delivered to the supplier;

e) Commencement of mixer operation by the schedule calculated at step d), whereby for the central heating system the mixer operation schedule includes its opening and closing depending on the data provided from the temperature and flow sensors, whereby closing of the mixer cuts off the heating medium from the heat source preventing its heating, in the case of central hot water system, the mixer operation schedule includes its opening and closing, depending on data provided by return temperature sensors, where closing the mixer cuts off the heating medium from the heat source, enabling its heating;

f) Real-time control of mixer operation, while for the central hot water system the control is performed by an algorithm which checks the return (i.e. circulation) temperature from the system in real time and, based on the received data, determines whether to open or close the mixer, thus maintaining the desired temperature, while for the central heating system the control is performed by an algorithm which in real time checks the supply temperature, the return temperature, the heating medium flow rate, the outside air temperature, and based on the received data determines whether the mixer is opened or closed, thus maintaining the desired temperature and flow rate.

[0015] In one embodiment, in step c) the calculation of the basic relationship between the outside air temperature and the actual heat power demand of the building is based on at least one heating curve calculated by a second algorithm on the heat power demand of at least two unfavourably located premises, and then the results obtained are verified with the actual state of the heating installation in the unfavourably located premises, and if, adjusting for the most unfavourable result from the calculations obtained, a 'reserve' of thermal power is obtained, new heating curves will be created for different outdoor air temperatures in such a way that, each time, thermal losses are compensated for by thermal power.

[0016] In one embodiment, the angle of inclination of at least one heating curve calculated in step c) is variable and depends on the outside air temperature and on the capacity or size of the radiators in the building.

[0017] In one embodiment, it comprises a step g), wherein the third algorithm activates a pulse control, wherein it interval decreases at least one heating curve calculated in step c) of the method according to the invention by any smaller value and then, after a time less than time, increases at least one heating curve to return to the value calculated in step c), t being the time required to cool the building by 1 °C.

[0018] In one embodiment, in step e) at least one algorithm in real time checks the temperature of the return (i.e. circulation) from the installation and based on the received data determines the opening or closing of the mixer (8) thus maintaining the desired temperature at the return of the central heating or central hot water installation by closing the mixer (8), preferably maintaining the minimum flow rate, if the return temperature is higher than the temperature according to the schedule calculated at step d); or opening of the mixer (8) if the return temperature falls below the minimum temperature set in the schedule calculated at step d).

[0019] Another essence of the invention is an energy control system for a central heating and/or central hot water system in a building for integration into an existing hot water system in a building, comprising a pump, a mixer, first and second balancing valves, temperature sensors, flow sensors and a central unit, characterised in that the central unit comprises modules configured to perform the steps of the method specified in claims. 1-5, which include:

a) A memory and power module;

b) A data acquisition module configured to acquire and manage information from the mixer and temperature sensors and to transmit it to the analysis module;

c) A database that stores the reference data entered and the measurements and schedules set;

d) An analysis module configured to schedule the mixer based on an algorithm, calculating the mixer's operating parameters based on the data provided from the data acquisition module, with at least one algorithm checking the return temperature from the installation in real time and, based on the received data, determining the opening or closing of the mixer (8) thus maintaining the desired temperature at the return of the installation.

[0020] In one embodiment, at least one algorithm of the analysis module in real time checks the temperature of the return from the installation and, based on the received data, determines whether to open or close the mixer (8), thus maintaining

the desired temperature at the return of the central heating or central hot water installation by closing the mixer (8), maintaining the minimum flow rate, if the return temperature is higher than the temperature according to the mixer (8) operation schedule; or opening of the mixer (8) if the return temperature drops below the minimum temperature set in the mixer operation schedule (8).

[0021] In one embodiment, the central unit is provided with means for data transmission to an external server providing remote control and management of the operation of the system via an external device selected from the group comprising a computer, tablet, smartphone.

[0022] The invention provides the following benefits:

- Enables energy control of the central hot water (CHW) system or central heating (CH) system in a building, regardless of the parameters imposed by the owners of the heat source or heat suppliers
- Enables control of the central heating and central hot water systems adapted to the actual needs of the occupants;
- Ensures savings through reduced flow rates and the possibility of setting temperatures by day and time of the week in the central heating system;
- Provides savings through advanced control algorithms for the operation of the central heating and central hot water system;
- Ensures separation of the water medium into that which will go to the heat source for heating and that which will go to the system without being heated;
- Ensures the provision of central hot water with less energy consumption;
- Connecting the system according to the invention to the Internet allows remote control of the algorithms;

Detailed description of the invention:

[0023] Unless otherwise specified, all technical and scientific terms used herein have the same meaning as commonly understood by a person of ordinary skill in the art.

[0024] Whereby, within the meaning of the invention, the phrase "in embodiment" is to be understood as in one or more executions. Furthermore, the features present in the various executions may be combined with each other. The descriptions of the executions of the invention in the present application are given by way of example and are not intended to limit the scope of the invention. The described implementations include various features, not all of which are required in all implementations of the invention. Unless otherwise indicated, the features described in the implementations may be freely combined with each other. Some implementations use only some of the features or possible combinations of features. The described variants of the executions of the invention and the executions of the invention comprising different combinations of the features mentioned in the described executions will come to the mind of experts in the field. The scope of the invention is limited only by the claims.

[0025] A thermal energy management system these days is crucial to finding savings in a building. Existing thermal systems are only available to owners of heat sources (owners of boiler houses, district heating substations, heat pumps or mixed systems). This state of affairs means that many residential or commercial buildings in Poland or Europe are 'condemned' to the parameters provided by the owner's heat source.

[0026] In practice, this means that according to the substituted formula for the rated thermal output of the heating system:

$$Q_n = m_w \cdot c_w \cdot (t_z - t_p)$$

[0027] Wherein:

Q_n - rated thermal output [kW]
 m_w - rated mass flow [kg/s]
 t_z - design flow temperature [K]
 t_p - design return temperature [K]
 c_w - specific heat of water [kJ/(kg K)]

[0028] The owner of the heat source (usually the heat supplier) controls the most important parameters, i.e. the rated mass flux and the flow and return temperatures, to safeguard his interests - i.e. to sell as much heat energy as possible. Therefore, by being able to change the mass flow rate of the medium in the system and by being able to change the flow or return temperatures, we are able to influence the instantaneous heat output without worsening the thermal comfort in the building. The question arises - how to control these parameters without being the owner of the heat source.

[0029] Unexpectedly, the inventors of the invention have developed a system and a way to effectively manage the thermal energy of a building that overcomes the above obstacles.

[0030] Therefore, in a first aspect, the invention relates to a method for controlling energy in a central heating or central hot water system in a building, which comprises the following steps:

a) Initiation of measurement by the central unit, whereby for the central heating system the heating medium temperature sensors initiate the temperature and flow measurement, the outdoor air temperature sensor, and the continuous flow sensors, while for the central hot water system, the central unit initiates the measurement of the return temperature and the flow temperature;

b) Collection of sensor data by the data acquisition unit;

c) Sending the sensor data to the analysis module, where the first algorithm for the control of the central heating and the central heating system, for central heating, calculates from the input data: the value of the supply temperature necessary to maintain thermal comfort in the building and the flow rate, followed by the calculation of the basic relationship between the outside air temperature and the actual thermal power demand of the building, the input data being the data acquired from the temperature and flow rate sensors and reference data including: the calculation of the usable energy and heat capacity of the building, the actual heat capacity demand of the building, the time required to cool the building by 1 °C; the heat capacity demands of at least the two most disadvantaged flats; while for the central hot water system, the first algorithm calculates the value of the flow temperature required to maintain the temperature according to the Technical Conditions, after which it calculates the basic relationship between the flow and circulation temperatures at the relevant hours of the day on particular days of the week;

d) Calculation by the first algorithm of the mixer operation schedule in order to regulate the heating medium in the building installation independently of the temperatures delivered to the supplier;

e) Commencement of mixer operation by the schedule calculated at step d), whereby for the central heating system the mixer operation schedule includes its opening and closing depending on the data provided from the temperature and flow sensors, whereby closing of the mixer cuts off the heating medium from the heat source preventing its heating, in the case of central hot water system, the mixer operation schedule includes its opening and closing, depending on data provided by return temperature sensors, where closing the mixer cuts off the heating medium from the heat source, enabling its heating;

f) Real-time control of mixer operation, while for the central hot water system the control is performed by an algorithm which checks the return (i.e. circulation) temperature from the system in real time and, based on the received data, determines whether to open or close the mixer, thus maintaining the desired temperature, while for the central heating system the control is performed by an algorithm which in real time checks the supply temperature, the return temperature, the heating medium flow rate, the outside air temperature, and based on the received data determines whether the mixer is opened or closed, thus maintaining the desired temperature and flow rate.

[0031] In one embodiment, in step c) the calculation of the basic relationship between the outside air temperature and the actual heat power demand of the building is based on at least one heating curve calculated by a second algorithm on the heat power demand of at least two unfavourably located premises, and then the results obtained are verified with the actual state of the heating installation in the unfavourably located premises, and if, adjusting for the most unfavourable result from the calculations obtained, a 'reserve' of thermal power is obtained, new heating curves will be created for different outdoor air temperatures in such a way that, each time, thermal losses are compensated for by thermal power.

[0032] In preferred embodiment, the angle of inclination of at least one heating curve calculated in step c) is variable and depends on the outside air temperature and on the capacity or size of the radiators in the building. Thanks to this solution, thermal comfort in the building will be maintained and on the other hand the mass flow of the medium will be smaller and the difference between supply and return will be different. All this will affect the savings of thermal energy in the building.

[0033] In one embodiment, it comprises a step g), wherein the third algorithm activates a pulse control, wherein it interval decreases at least one heating curve calculated in step c) of the method according to the invention by any smaller value and then, after a time less than time, increases at least one heating curve to return to the value calculated in step c), t being the time required to cool the building by 1 °C.

[0034] In a preferred embodiment, the pulse control from stage g) will depend on the outside air temperature (basic heating curve settings) and the building's thermal capacity on the one hand. All internal and external building partitions form a kind of heat accumulator (thermal capacity).

$$C_m = \sum_j \sum_i (C_{ij} \times p_{ij} \times d_{ij} \times A_j)$$

[0035] Wherein:

C_m - internal thermal capacity of a zone or the entire building [J/K]

C_{ij} - specific heat of the material of the i-th layer in the j-th element [J/kg x K]

p_{ij} - density of material of i-th layer in j-th element, [kg/m³]

d_{ij} - thickness of the i-th layer in the j-th element [m]

A_j - surface area [m²]

$$\tau = \frac{C_m/3600}{H_{tr}+H_{ve}} [h]$$

Wherein:

C_m - internal thermal capacity of a zone or the entire building [J/K]

H_{tr} - losses through building partitions

H_{ve} - losses through ventilation

[0036] Knowing the numerical parameter τ [h] will be calculated for individual outside air temperatures. τ is the time needed for the building to lose temperature, e.g. from 21 to 20 °C. Knowing the individual temperature loss times for a given building, an algorithm will be adopted that will lower the heating curves by a parameter of e.g. 10 °C for a shorter time than time τ and then the temperature in the installation will be achieved by the current heating curve for a time τ . Thanks to this, the temperature in the building will not drop and the thermal capacity of the building will be used to its maximum values. The consequence of this event will be almost zero flow between the mixer and the heat source, which means that for a time shorter than τ the heat meter will almost stop.

[0037] In one embodiment, in step e) at least one algorithm in real time checks the temperature of the return (i.e. circulation) from the installation and based on the received data determines the opening or closing of the mixer (8) thus maintaining the desired temperature at the return of the central heating or central hot water installation by closing the mixer (8), preferably maintaining the minimum flow rate, if the return temperature is higher than the temperature according to the schedule calculated at step d); or opening of the mixer (8) if the return temperature falls below the minimum temperature set in the schedule calculated at step d).

[0038] In another aspect of the invention is an energy control system for a central heating and/or central hot water system in a building for integration into an existing hot water system in a building, comprising a pump, a mixer, first and second balancing valves, temperature sensors, flow sensors and a central unit.

[0039] Wherein, a pump (heating pump, circulation pump) is a type of flow machine in which the rotor used increases the momentum of the liquid flowing through it. Its task is to give the heating medium flowing through it sufficient pressure to distribute it to the heat collection points (such as radiators, heaters). The pump consists of three main elements: the housing, the motor and the rotor.

[0040] In one embodiment, a gland pump can be used in the system according to the invention (where the motor is separated from the heating medium). In another embodiment, a glandless pump can be used in the system according to the invention (in which the rotating elements of the motor are immersed in the heating medium).

[0041] In turn, the basic task of the mixer is to mix the medium that flows through it. The use of the mixer in the system according to the invention installed in the building installation is to ensure the supply of the appropriate temperature to the heating circuit and its regulation. The mixer has three connection stubs.

[0042] In one embodiment, the mixer is equipped with a heating medium temperature sensor on the return from the installation (before the mixer) and a heating medium temperature sensor after the mixer. In another version, the mixer can be equipped with additional automation and one or more inputs/outputs such as:

- possibility of connecting to the Internet, which will allow for remote control of algorithms;

- possibility of equipping the mixer with automation, which will allow for its programming;
- possibility of equipping the mixer with an outside air temperature sensor. Thanks to this, it will be possible to program variable algorithms depending on the outside air temperature;
- possibility of equipping the mixer with dynamic valves that stabilize the pressure difference between the supply and return of the installation;
- possibility of equipping with valves that balance the flow between the secondary and primary supply.

[0043] The central unit is a device managing the operation of the entire system, which consists of modules configured to perform the steps of the method according to the invention, which include:

a) A memory and power supply module;

b) A data acquisition module configured to obtain and manage information from the mixer and temperature sensors and also to transmit it to the analysis module;

c) A database in which the entered reference data and measurements are collected and schedules are set;

d) An analysis module configured to establish a schedule for the mixer operation based on an algorithm calculating the mixer operation parameters based on data provided from the data acquisition module, wherein at least one algorithm checks the return temperature from the installation in real time and, based on the received data, determines the opening or closing of the mixer, thereby maintaining the desired temperature at the return of the installation.

[0044] The central unit has two basic functions:

- It enables the creation of different heating curves (at least two different ones) depending on the outside air temperature;
- It enables the creation of a schedule for lowering the temperature of the heating curves by any time (e.g. for 30 minutes a lower heating curve by e.g. 5 °C).

[0045] In a preferred embodiment, the central unit is connected to the Internet so that the algorithms can be managed remotely and in order to react quickly in crisis situations.

[0046] In one embodiment, at least one algorithm of the central unit analysis module checks the return temperature from the system in real time and, based on the received data, determines the opening or closing of the mixer, thus maintaining the desired temperature on the return of the central heating system or the central hot water system by closing closing the mixer while maintaining the minimum flow if the return temperature is higher than the temperature according to the mixer operation schedule; or opening the mixer if the return temperature drops below the minimum temperature set in the mixer operation schedule.

[0047] In a preferred embodiment, the central unit is provided with means for transmitting data to an external server ensuring remote control and management of the system operation via an external device. In preferred embodiments, the external device is selected from the group consisting of a computer, tablet, smartphone.

[0048] The invention is presented in examples of embodiments and in the drawing, in which Fig. 1 shows a diagram of the installation of a mixer and a pump of the system according to the invention in an existing central heating installation in a building; Fig. 2 shows the operation of the mixer in the system according to the invention; Fig. 3 shows a 90/70 heating curve; Fig. 4 shows a heating curve obtained by the method according to the invention.

Example 1.

[0049] The energy control method according to the invention allows for energy control in a central heating installation or a central central hot water installation in a building or both of these installations.

[0050] In this non-limiting embodiment, the method according to the invention allows for both energy control in a central heating installation and a central hot water installation in a building. Wherein, the method according to the invention comprises the following steps:

a) Initiation of measurements by the central unit, whereby for central heating installations, the measurement of

temperature and flow is initiated by the heating medium temperature sensors, the outside air temperature sensor and the flow sensors in continuous mode, while for central hot water installations, the central unit initiates the measurement of the return temperature and the supply temperature;

b) Collection of data from sensors by the data acquisition unit;

c) Sending data from sensors to the analysis module, in which the first algorithm for central heating control, based on input data, calculates: the value of the supply temperature necessary to maintain thermal comfort in the building and the flow, and then calculates the basic relationship between the outside air temperature and the actual demand for thermal power of the building, where the input data are data obtained from temperature and flow sensors and reference data including: calculations of usable energy and thermal capacity of the building, the actual demand for thermal power of the building, the time needed to cool the building by 1 °C; the demand for thermal power of at least two of the most unfavourably located apartments; while for controlling the central hot water installation, the first algorithm calculates the value of the supply temperature necessary to maintain the temperature according to the Technical Conditions, and then calculates the basic relationship between the supply and circulation temperatures at the appropriate hours of the day on individual days of the week;

d) Calculation by the first algorithm of the mixer 8 operation schedule in order to regulate the heating medium in the building installation regardless of the temperatures supplied to the supplier;

e) Starting the mixer 8 operation in accordance with the schedule calculated in step d), wherein for the central heating installation the mixer 8 operation schedule includes its opening and closing depending on the data supplied from the temperature and flow sensors, where closing the mixer 8 causes the heating medium to be cut off from the heat source 3, preventing its heating, while for the central hot water installation the mixer 8 operation schedule includes its opening and closing depending on the data supplied from the return temperature sensors, where closing the mixer causes the heating medium to be cut off from the heat source 3, enabling its heating;

f) Control of the mixer operation in real time, whereby for central hot water installations the control is carried out by means of an algorithm which checks the return temperature (i.e. circulation) from the installation in real time and, based on the received data, determines the opening or closing of the mixer, thereby maintaining the desired temperature, while for central heating installations the control is carried out by means of an algorithm which checks the supply temperature, return temperature, heating medium flow, outside air temperature in real time and, based on the received data, determines the opening or closing of the mixer, thereby maintaining the desired temperature and flow.

[0051] In this embodiment, the mixer 8, through the outside air temperature sensor, will adjust the supply temperature (after the mixer) in accordance with the adopted algorithm. Thanks to this algorithm, it will be possible to regulate the heating medium in the installation regardless of the temperatures supplied by the heat supplier. In addition, the mixer 8, measuring the temperature of the heating medium on the supply, will be able to close and not allow more of the medium to be heated. This will cause that not all of the heating water will not pass through the heat source for heating. Thanks to this, the amount of water that will be heated and the amount of water that will not be heated and will go directly to the installation will be divided.

[0052] Wherein, in this non-limiting example in step f) the first algorithm checks the return temperature (i.e. circulation) from the installation in real time and based on the received data determines the opening or closing of the mixer, thereby maintaining the desired temperature at the return of the central heating installation or the central central hot water installation by

- closing the mixer 8, preferably while maintaining the minimum flow, if the supply temperature is higher than the temperature according to the heating curve schedule calculated in step d);
- or
- opening the mixer 8 if the return temperature drops below the minimum temperature set in the schedule calculated in step d).

[0053] This solution will result in savings in the amount of purchased heat (the operation of the mixer 8 in the central hot water installation is shown in Fig. 2).

[0054] For central heating, it is possible to set the relationship between the outside air temperature and several heating curves in the building, which consists in calculating the heating power demand for the outside air temperature in

unfavourably located premises in the building according to the PN EN 12 831 Standard. Then, the obtained results are verified with the radiators installed in individual rooms in the given premises (these values are checked after lowering the basic heating curve). If for individual outside air temperatures it turns out that the radiator power exceeds the heating power demand at a given outside air temperature, then we determine to what outside air temperature value it will be possible to maintain a given supply temperature value.

Example 2.

[0055] The method is the same as in example 1, except that in stage c) the calculation of the basic relationship between the outside air temperature and the actual demand for thermal power of the building is based on at least one heating curve calculated by the second algorithm based on the demand for thermal power of at least two unfavourably located premises, and then the obtained results are verified with the actual state of the heating installation in the unfavourably located premises, and if from the obtained calculations, adjusting to the most unfavourable result, we obtain a "reserve" of thermal power, then new heating curves will be created for different outside air temperatures in such a way that each time the thermal losses are compensated by the thermal power.

[0056] Whereby, for a selected unfavourably located premises, it is necessary to perform calculations of heat losses according to the PN EN 12 831 standard for outside air temperatures from +14 °C to minus 24 °C. The obtained results of the demand for heat power expressed in "W" for a given outside air temperature are verified with the radiators that are located in the premises. If the radiator power is greater than the losses, then the heating curve must be selected so that it equals the losses, i.e. loss power = radiator power.

[0057] Whereby, in this example of implementation, in stage c) three heating curves are calculated: 90/70, 60/40 and 50/30, the angle of inclination of which is variable and depends on the outside air temperature and the capacity/size of the radiators in a given building.

[0058] The obtained results are presented in **Table 4** below.

Table 4. Summary of the results of the heating curves 90/70, 60/40 and 50/30.

Outside temperature [°C]	calculated thermal power [W]	Radiator power 90/70	Radiator power 60/40	Radiator power 50/30
14	963	2036	1413	819
13	1042	2114	1492	898
12	1120	2192	1570	976
11	1198	2270	1648	1054
10	1276	2348	1726	1132
9	1354	2426	1804	1210
8	1432	2504	1882	1288
7	1510	2582	1960	1366
6	1588	2660	2038	1444
5	1667	2738	2117	1523
4	1745	2816	2195	1601
3	1823	2894	2273	1679
2	1901	2972	2351	1757
1	1979	3050	2429	1835
0	2057	3128	2507	1913
-1	2135	3206	2585	1991
-2	2213	3284	2663	2069
-3	2291	3362	2741	2147
-4	2369	3440	2819	2225
-5	2447	3518	2897	2303
-6	2525	3596	2975	2381

(continued)

	Outside temperature [°C]	calculated thermal power [W]	Radiator power 90/70	Radiator power 60/40	Radiator power 50/30
5	-7	2603	3674	3053	2459
	-8	2681	3752	3131	2537
	-9	2759	3830	3209	2615
10	-10	2837	3908	3287	2693
	-11	2915	3986	3365	2771
	-12	2993	4064	3443	2849
	-13	3071	4142	3521	2927
15	-14	3149	4220	3599	3005
	-15	3227	4298	3677	3083
	-16	3305	4376	3755	3161
	-17	3383	4454	3833	3239
20	-18	3461	4532	3911	3317
	-19	3539	4610	3989	3395
	-20	3617	4688	4067	3473
25	-21	3695	4766	4145	3551
	-22	3773	4844	4223	3629
	-23	3851	4922	4301	3707
30	-24	3929	5000	4379	3785

[0059] According to the calculations performed, the 60/40 heating curve seems to be more appropriate than the 50/30 curve; in the case of the 50/30 parameter, the radiator power will be insufficient to cover the heat losses from the premises: power of losses > power of radiators.

Example 3.

[0060] The method is the same as in example 1, except that in stage c) the calculation of the basic relationship between the outside air temperature and the actual demand for thermal power of the building is based on at least one heating curve calculated by the second algorithm based on the demand for thermal power of at least two unfavourably located premises, and then the obtained results are verified with the actual state of the heating installation in the unfavourably located premises, and if from the obtained calculations, adjusting to the most unfavourable result, we obtain a "reserve" of thermal power, then new heating curves will be created for different outside air temperatures in such a way that each time the thermal losses are compensated by the thermal power.

[0061] The basic heating curve and outside air temperature for climate zone III (according to PN EN 12 831) is 90 °C on the supply and 70 °C on the return. According to the above, three types of heating curves can be used: the first heating curve 60/40 °C for outside air temperature from +15 (temperature at the beginning of the heating season) to 0 degrees C (for these values of outside air temperature and the heating curve value 60/40 °C. all radiators installed in rooms in unfavourably located premises had higher power than the power of heat losses. The results obtained are presented in Table 1.

Table 1 First heating curve

outside air temperature °C	supply temperature °C	return temperature °C	Was the power of the radiators higher than the heat losses?
0	42,2	32,2	tak
1	41,3	31,8	tak
2	40,3	31,3	tak

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(continued)

outside air temperature °C	supply temperature °C	return temperature °C	Was the power of the radiators higher than the heat losses?
3	39,4	30,9	tak
4	38,4	30,4	tak
5	37,4	29,9	tak
6	36,5	29,5	tak
7	35,5	29,0	tak
8	34,5	28,5	tak
9	33,4	27,9	tak
10	32,4	27,4	tak
11	31,3	26,8	tak
12	30,3	26,3	tak
13	29,2	25,7	tak
14	28,1	25,1	tak
15	26,9	24,4	tak

[0062] The analysis showed that for outside air temperatures from +15.0°C to 0.0°C, the heating curve of 60/40°C will be selected.

[0063] We repeat the same calculations for the next lower temperatures. As a result of the calculations, the second heating curve is 80/60°C for outside air temperatures from 0.0°C to -10°C (for these values of outside air temperature and the heating curve value of 80/60°C. All radiators installed in unfavorably located apartments had higher power than the power of heat losses. Below, Table 2 presents a summary of the obtained results.

Table 2. Second heating curve

outside air temperature °C	supply temperature °C	return temperature °C	Was the power of the radiators higher than the heat losses?
-10	67,2	52,2	tak
-9	65,9	51,4	tak
-8	64,6	50,6	tak
-7	63,3	49,8	tak
-6	61,9	48,9	tak
-5	60,6	48,1	tak
-4	59,2	47,2	tak
-3	57,9	46,4	tak
-2	56,5	45,5	tak
-1	55,1	44,6	tak
-0,1	53,7	43,7	tak

[0064] The analysis showed that for outside air temperatures from -0.1 °C to -10.0 °C, the heating curve of 80/60 °C will be selected.

[0065] The same calculations are repeated for the next lower temperatures. As a result of the calculations, the third heating curve is 90/70 °C (fig. 3) for outside air temperatures from -10.0 °C to -20 °C (for these values of outside air temperature and the heating curve value of 90/70 °C), all radiators installed in unfavorably located apartments had higher power than the power of heat losses. Below, in Table 3, a summary of the obtained results is presented:

Table 3. Third heating curve

outside air temperature	supply temperature °C	return temperature °C	Was the power of the radiators higher than the heat losses?
-20	90,0	70,0	tak
-19	88,5	69,0	tak
-18	87,1	68,1	tak
-17	85,6	67,1	tak
-16	84,1	66,1	tak
-15	82,7	65,2	tak
-14	81,2	64,2	tak
-13	79,7	63,2	tak
-12	78,2	62,2	tak
-11	76,7	61,2	tak
-10,1	67,2	52,2	tak

[0066] The final graph of the heating curves is shown in Fig. 4.

[0067] The operation of the algorithm in the method according to the invention will enable the regulation of the heating medium in the installation regardless of the temperatures supplied by the heat supplier. Different heating curves will ensure lower heat consumption than in the case of the standard solution with one heating curve for all outside air temperatures.

[0068] Furthermore, in this non-limiting embodiment, the method according to the invention comprises step g), in which the third algorithm activates the pulse control, in which it intervally lowers at least one heating curve calculated in step c) of the method according to the invention by any lower temperature value, and then in a time shorter than time t increases at least one heating curve back to the value calculated in step c). Wherein, t is the time needed to cool the building by 1 °C. In this embodiment, $t = 30$ min.

[0069] The detailed course of stage f) is described below:

Pulsed heating will consist in using the calculations from stage c) of the method according to the invention. After performing the calculations and determining the shortest time needed to reduce the temperature by one degree Celsius - e.g. 30 minutes. This means that 30 minutes are needed for the temperature in the building to be reduced by one degree Celsius. The pulse heating algorithm will consist in the fact that, e.g. at night from 10 p.m. to e.g. 5 a.m., an algorithm will be introduced consisting in the fact that in less than 30 minutes the heating curves will be reduced in relation to the curves established in accordance with stage c), by any lower value. And then in no less than 30 minutes the "normal" heating curve will be implemented. Thanks to this algorithm, it will be possible to obtain additional savings in thermal energy. Pulsed heating will not cause the building to cool down.

Example 4.

[0070] The method is the same as in Example 3, except that in stage c) the calculation of the basic relationship between the outside air temperature and the actual demand for thermal power of the building is based on at least one heating curve calculated by the second algorithm based on the demand for thermal power of at least two unfavourably located premises, and then the obtained results are verified with the actual state of the heating installation in the unfavourably located premises, and if from the obtained calculations, adjusting to the most unfavourable result, we obtain a "reserve" of thermal power, then new heating curves will be created for different outside air temperatures in such a way that each time the thermal losses are compensated by the thermal power.

[0071] In addition, in this non-limiting embodiment, the method according to the invention comprises step g), in which the third algorithm activates pulse control, in which it intervally lowers at least one heating curve calculated in step c) of the method according to the invention by any lower temperature value, and then in a time shorter than time t increases at least one heating curve back to the value calculated in step c). The pulse method of heating the building/object will depend on the outside air temperature (settings of the basic heating curve) and on the thermal capacity of the building on the one hand. All internal and external partitions of the building form a kind of heat accumulator (thermal capacity).

$$C_m = \sum_j \sum_i (C_{ij} \times p_{ij} \times d_{ij} \times A_j)$$

[0072] Wherein:

C_m - internal thermal capacity of a zone or the entire building [J/K]

C_{ij} - specific heat of the material of the i-th layer in the j-th element [J/kg x K]

ρ_{ij} - density of material of i-th layer in j-th element, [kg/m³]

d_{ij} - thickness of the i-th layer in the j-th element [m]

A_j - surface area [m²]

$$\tau = \frac{C_m/3600}{H_{tr}+H_{ve}} [h]$$

Wherein:

C_m - internal thermal capacity of a zone or the entire building [J/K]

H_{tr} - losses through building partitions

H_{ve} - losses through ventilation

[0073] Knowing the numerical parameter τ [h] will be calculated for individual outside air temperatures. τ is the time needed for the building to lose temperature, e.g. from 21 to 20 °C. Knowing the individual temperature loss times for a given building, an algorithm will be adopted that will lower the heating curves by a parameter of e.g. 10 °C for a shorter time than time τ and then the temperature in the installation will be achieved in accordance with the current heating curve for a time τ . Thanks to this, the temperature in the building will not drop and the thermal capacity of the building will be used to its maximum values. The consequence of this event will be almost zero flow between the mixer and the heat source, which means that for a time shorter than τ the heat meter will almost stop.

Example 5.

[0074] Energy control system in a central heating or central hot water system:

System 1 for controlling energy in a central heating or central hot water system in a building according to the invention is shown in Fig. 1, where: **1** denotes the system according to the invention; **2** circulation pump; **3** heat source; **4** outside air temperature sensor; **5** denotes the first balancing valves between the heat source and the mixer; **6** denotes the second balancing valves between the mixer and heat receivers; **7** denotes the heat receivers; **8** denotes the mixer; **9** the heating medium temperature sensor measuring the temperature behind the heat source; **10** denotes the heating medium temperature sensor behind the mixer on the supply; **11** denotes the heating medium temperature sensor on the return of the installation.

[0075] In addition, the system includes the following sensors:

- a heating medium temperature sensor located on the return before the mixer and before the heat source;
- a flow sensor located behind the mixer on the supply line
- an optional indoor air temperature sensor located in several apartments that are unfavorably located in the building;
- an outdoor air temperature sensor (mounted on the elevation on the north side);
- a heating medium temperature sensor located on the supply line between the heat source and the mixer;
- a heating medium temperature sensor located on the supply line behind the mixer;

Energy control system in a central hot water system:

[0076] System 1 according to the invention is intended for integration with the existing central hot water system in the building. The aforementioned system 1 consists of a heat pump, mixer 8, first and second balancing valves, temperature sensors, flow sensors and a central unit.

[0077] A heat pump (also known as a circulation pump) is a type of flow machine in which the rotor used increases the momentum of the liquid flowing through it. The task of the circulation pump is to give the heating medium flowing through it, pressure sufficient to distribute it to the heat collection points (radiators, heaters). Pumps consist of three main elements: the housing, the motor and the rotor. We distinguish gland pumps (the motor is separated from the heating medium) and glandless pumps (rotating elements of the engine are immersed in the heating medium). In this advantageous embodiment, a glandless pump is used.

[0078] Mixer 8 and its operation are shown schematically in Fig. 2. The basic task of mixer 8 is to mix the medium that flows through it. The use of mixer 8 is to ensure that the appropriate temperature is supplied to the heating circuit and to regulate the central heating or hot water installation of the building. Mixer 8 is equipped with a heating medium temperature sensor on the return from the installation (before the mixer) and a heating medium temperature sensor behind the mixer. Mixer 8 can be equipped with additional automation and inputs/outputs such as:

- possibility of connecting to the Internet, thanks to which it will be possible to remotely control algorithms;
- possibility of equipping the valve with automation, by means of which it will be possible to program the valve;
- possibility of equipping the valve with an outside air temperature sensor. Thanks to this, it will be possible to program variable algorithms depending on the outside air temperature;
- possibility of equipping with dynamic valves stabilizing the pressure difference between the supply and return of the installation;
- possibility of equipping with valves balancing the flow between the secondary and primary supply.

[0079] The central unit consists of the following modules:

- A memory and power supply module comprising memory in which instructions for performing the method according to the invention are stored;
- A data acquisition module configured to obtain and manage information from the mixer and temperature sensors, as well as to transmit it to the analysis module;
- A database in which the entered reference data is collected and measurements are taken and schedules are set.
- An analysis module configured to establish a mixer operation schedule based on an algorithm that calculates the mixer operation parameters based on data supplied from the data acquisition module, wherein the first algorithm checks the return temperature (i.e. circulation) from the installation in real time and, based on the data received, determines the opening or closing of the mixer 3, thereby maintaining the desired temperature at the return of the installation.

[0080] This solution causes the separation of the water flow returning from the system into a "part" of the flow, which will go to the heat source for heating, and the second part, which will bypass the heat source and return to the system. For this purpose, the first algorithm of the analysis module checks the return temperature (i.e. circulation) from the system in real time and, based on the data received, determines the opening or closing of mixer 8, thus maintaining the desired temperature at the return of the central hot water system by:

- closing the mixer 8 while maintaining the minimum flow, if the return temperature is higher than the temperature according to the mixer 8 operation schedule;
or
- opening the mixer 8 if the return temperature drops below the minimum temperature set in the mixer 8 operation schedule.

[0081] Wherein, the temperature at the return of the installation is selected in such a way that during morning and evening draw-off the maximum temperature is ensured by the Technical Conditions (TC) and at other times the temperature is minimally compliant with the TC. Wherein TC means technical conditions indicating the minimum and maximum amount of water in the installation (e.g. in the central hot water system).

[0082] Furthermore, in this non-limiting example of embodiment, the central unit is provided with means for transmitting data to an external server ensuring remote control and management of the system operation through access via an external device (e.g. tablet, computer, smartphone, application, website, etc.).

[0083] Wherein, before connecting the system 1 according to the invention to the central heating installation in a given building, the following measurements should be carried out in the given building:

a) calculate the demand for heat power for central heating according to PN EN 12 831 -to select the number and type of mixers for the central heating system. The number of mixers depends on the temperatures on a given line of the main supply and return collector. If the supply and return temperatures are the same, one mixer should be selected for a given supply and return collector. If the temperatures are different for two types of supply and return systems, two mixers should be selected;

b) calculate the usable energy and thermal capacity of the building according to the Regulation of the Minister of Infrastructure and Development of 27 February 2015 on the methodology for determining the energy performance of buildings or parts of buildings and building performance certificates. After calculating the usable energy and thermal capacity of the building, the time needed to cool the building by one degree (so-called "building cooling time" should be determined);

c) select the most disadvantageously located apartments in the building (it is enough to select two or three different apartments). Then, calculate the demand for thermal power in each room in a given apartment according to PN EN 12 831 - after performing the calculations, verify the maximum values of the heating curves according to the applicable contract with the heat supplier. According to these values, determine the maximum thermal power of the radiator installed in a given room. If the radiator power is greater than the heat losses in a given room, determine at what value of the heating curve (maximum new supply and return temperature) the radiator power will equal the losses in a given room in a given disadvantageously located apartment. Then select the value of the highest temperature obtained from the given calculations. This value will correspond to the maximum value of the new heating curve for the building.

d) perform calculations for the selection of the circulation pump for each mixer in the building to select the appropriate type of pump and mixer.

[0084] Connecting system 1 to the building installation consists of connecting the return installation with the supply one, in such a way as to place the mixer on the supply and connect the return to it. A circulation pump should be placed behind the mixer on the supply side. However, there is also the option of placing the mixer on the return and connecting it to the supply installation. In this way, two systems are created. The primary system between the heat source and the mixer and the secondary system, between the mixer and heat receivers (e.g. radiators).

Claims

1. A method of energy control for a central heating or central hot water system in a building, **characterised in that** it comprises the following steps:

f) Initiation of measurement by the central unit, whereby for the central heating system the heating medium temperature sensors initiate the temperature and flow measurement, the outdoor air temperature sensor, and the continuous flow sensors, while for the central hot water system, the central unit initiates the measurement of the return temperature and the flow temperature;

g) Collection of sensor data by the data acquisition unit;

h) Sending the sensor data to the analysis module, where the first algorithm for the control of the central heating and the central heating system, for central heating, calculates from the input data: the value of the supply temperature necessary to maintain thermal comfort in the building and the flow rate, followed by the calculation of the basic relationship between the outside air temperature and the actual thermal power demand of the building, the input data being the data acquired from the temperature and flow rate sensors and reference data including: the calculation of the usable energy and heat capacity of the building, the actual heat capacity demand of the building, the time required to cool the building by 1 °C; the heat capacity demands of at least the two most

disadvantaged flats; while for the central hot water system, the first algorithm calculates the value of the flow temperature required to maintain the temperature according to the Technical Conditions, after which it calculates the basic relationship between the flow and circulation temperatures at the relevant hours of the day on particular days of the week;

i) Calculation by the first algorithm of the mixer operation schedule in order to regulate the heating medium in the building installation independently of the temperatures delivered to the supplier;

j) Commencement of mixer operation by the schedule calculated at step d), whereby for the central heating system the mixer operation schedule includes its opening and closing depending on the data provided from the temperature and flow sensors, whereby closing of the mixer cuts off the heating medium from the heat source preventing its heating, in the case of central hot water system, the mixer operation schedule includes its opening and closing, depending on data provided by return temperature sensors, where closing the mixer cuts off the heating medium from the heat source, enabling its heating;

f) Real-time control of mixer operation, while for the central hot water system the control is performed by an algorithm which checks the return (i.e. circulation) temperature from the system in real time and, based on the received data, determines whether to open or close the mixer, thus maintaining the desired temperature, while for the central heating system the control is performed by an algorithm which in real time checks the supply temperature, the return temperature, the heating medium flow rate, the outside air temperature, and based on the received data determines whether the mixer is opened or closed, thus maintaining the desired temperature and flow rate.

2. The method according to claim 1, **characterised in that** in step c) the calculation of the basic relationship between the outside air temperature and the actual heat power demand of the building is based on at least one heating curve calculated by a second algorithm on the heat power demand of at least two unfavourably located premises, and then the results obtained are verified with the actual state of the heating installation in the unfavourably located premises, and if, adjusting for the most unfavourable result from the calculations obtained, a 'reserve' of thermal power is obtained, new heating curves will be created for different outdoor air temperatures in such a way that, each time, thermal losses are compensated for by thermal power.

3. The method according to claim 2, **characterised in that** the angle of inclination of at least one heating curve calculated in step c) is variable and depends on the outside air temperature and on the capacity or size of the radiators in the building.

4. The method according to claim 2 or 3, **characterised in that** it comprises a step g), wherein the third algorithm activates a pulse control, wherein it interval decreases at least one heating curve calculated in step c) of the method according to the invention by any smaller value and then, after a time less than time, increases at least one heating curve to return to the value calculated in step c), t being the time required to cool the building by 1 °C.

5. The method according to any of the preceding claims 1 to 3, **characterised in that** in step e) at least one algorithm in real time checks the temperature of the return (i.e. circulation) from the installation and based on the received data determines the opening or closing of the mixer (8) thus maintaining the desired temperature at the return of the central heating or central hot water installation by

closing the mixer (8), preferably maintaining the minimum flow rate, if the return temperature is higher than the temperature according to the schedule calculated at step d);

or

opening of the mixer (8) if the return temperature falls below the minimum temperature set in the schedule calculated at step d).

6. An energy control system for a central heating and/or central hot water system in a building for integration into an existing hot water system in a building, comprising a pump, a mixer, first and second balancing valves, temperature sensors, flow sensors and a central unit, **characterised in that** the central unit comprises modules configured to perform the steps of the method specified in claims. 1-5, which include:

a) A memory and power module;

b) A data acquisition module configured to acquire and manage information from the mixer and temperature sensors and to transmit it to the analysis module;

c) A database that stores the reference data entered and the measurements and schedules set;

d) An analysis module configured to schedule the mixer based on an algorithm, calculating the mixer's operating

parameters based on the data provided from the data acquisition module, with at least one algorithm checking the return temperature from the installation in real time and, based on the received data, determining the opening or closing of the mixer (8) thus maintaining the desired temperature at the return of the installation.

5 7. The system according to claim 6, **characterised in that** at least one algorithm of the analysis module in real time checks the temperature of the return from the installation and, based on the received data, determines whether to open or close the mixer (8), thus maintaining the desired temperature at the return of the central heating or central hot water installation by closing the mixer (8), maintaining the minimum flow rate, if the return temperature is higher than the temperature according to the mixer (8) operation schedule;

10 or

opening of the mixer (8) if the return temperature drops below the minimum temperature set in the mixer operation schedule (8).

15 8. The system according to claim 6 or 7, **characterised in that** the central unit is provided with means for data transmission to an external server providing remote control and management of the operation of the system via an external device selected from the group comprising a computer, tablet, smartphone.

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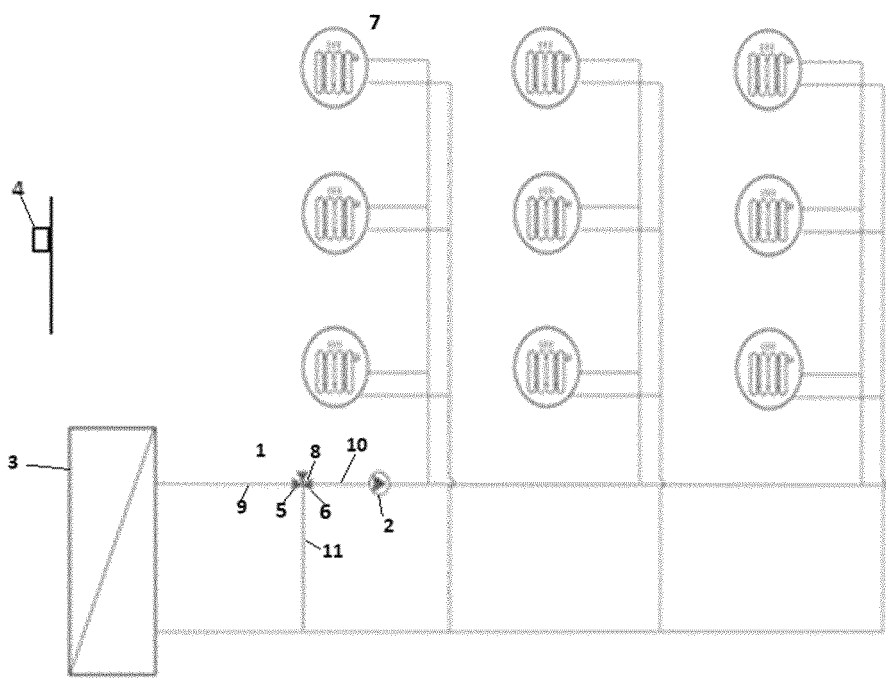


Fig. 1

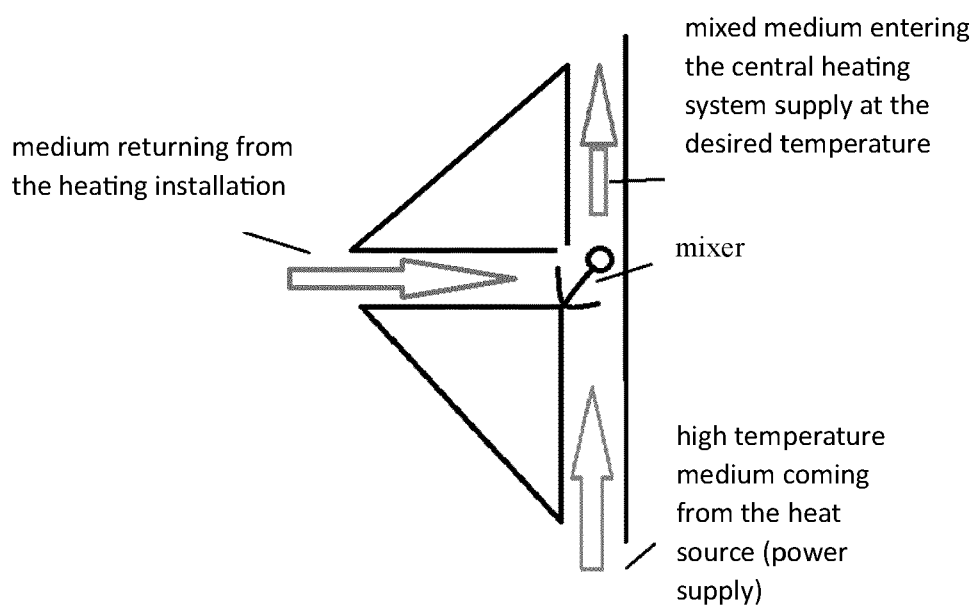


Fig. 2

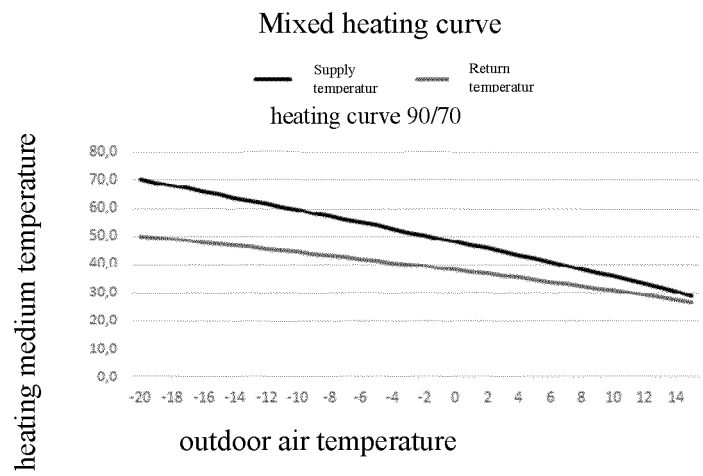


Fig. 3

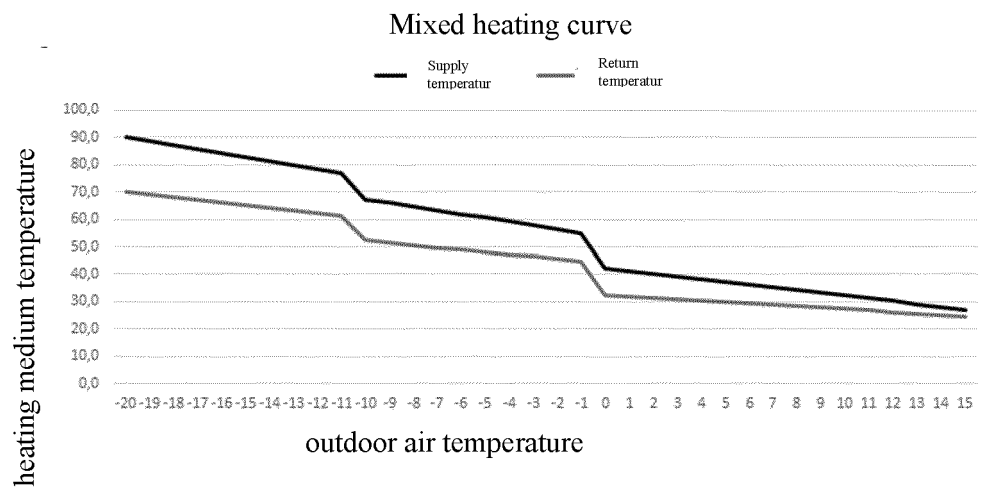


Fig. 4



EUROPEAN SEARCH REPORT

Application Number

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Munich		15 April 2025	Reino, Bernardo
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