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(71) Applicant: **Domotherm di Marco Giorgi**
26040 Bonemerse (CR) (IT)

(72) Inventor: **Giorgi, Marco**
26040 Bonemerse CR (IT)

(74) Representative: **Arena, Giovanni**
Viale Certosa 135
20151 Milano (IT)

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Amended claims in accordance with Rule 137(2) EPC.

(54) Rooms heating system of the type with centralized heat source and heat diffusers allocated in the various rooms of the environment

(57) The heating system comprises:
- a heating chimney (T) with a metal structure and closed hearth;
- a heat exchanger (3) suitable for conveying the air to be heated around the chimney's metal walls;
- a channel (5) suitable for introducing combustion air drawn from the environment and/or from outside the chimney hearth;
- hot air distribution channels (6) connected to the channels (4) leaving the heat exchanger, suitable for conveying the hot air leaving the heat exchanger and moving to the various rooms of the environment, in which the air enters through appropriate openings (7);
and is characterized by the presence of a combination of:
- a first solenoid valve (12) inserted in the channel (5) admitting combustion air to the chimney hearth, suitable for regulating the air flow in the channel;
- a first temperature sensor (13) present in the heat exchanger, suitable for detecting the passing air temperature;
- a unit (14), known in the following as a hygrothermostat, which is present in a room of the environment, fitted with humidity and temperature sensors, a microprocessor circuit board and a transmitting/receiving device and suitable for detecting the room's temperature and humidity levels and for comparing them with the preferred temperature and humidity values pre-set by the user, and
- a number of humidifiers (11) suitable for releasing humidity to the environment.

The system is further characterized by the following operating modes:
- the hygrothermostat (14) regulates the opening of the solenoid valve (12) depending on the temperature levels signalled by the sensor of the hygrothermostat and by the temperature sensor (13) of the heat exchanger, and keeps the solenoid valve (12) fully open, which regulates the flow of combustion air during the chimney's start-up phase.
- the hygrothermostat (14) takes care of emitting a low moisture level indicating signal as soon as the relative humidity sensor detects a humidity level below that preset by the user.

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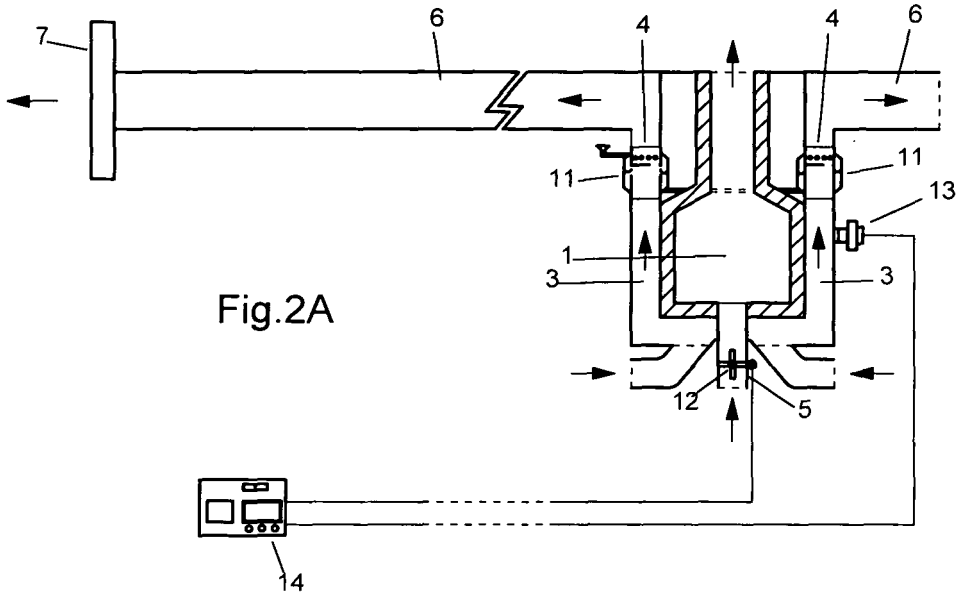

Fig.2A

Description

[0001] The object of the present invention is a heating system for environments of a type with a centralized heating source and heat diffusers allocated to the various rooms of the environment.

[0002] In the following, an example of the known system of the mentioned type is taken to be a forced circulation hot air channelling system powered by a solid fuel. Particular attention will be given to a closed-hearth heating chimney fired by wood. As schematically shown in the cross-sectional view of Fig. 1A, a heating chimney of the mentioned type T is essentially a chimney of a metal construction with the hearth 1 closed by a high temperature resistant ceramic glass plate and a heat exchanger 3. Electrical fans 2 mounted in the base of the chimney push the air (originating from the outside and/or from the environment) into the heat exchanger, where it is heated and then diffused to the various environments of the house through appropriate channels 6 connected to the outlets of the heat exchanger and ending at a number of openings 7 (refer to the Figures 1B and 1 C) present in the walls of said environments. A channel 5 open to the level below the hearth is connected to an air intake from the environment and/or the outside air and takes care of supplying combustion air to the hearth.

[0003] An electronic control panel (not shown in the figure) regulates the start-up and speed of the electrical fans 2, depending on the air temperature in the heat exchanger.

[0004] This type of heating chimney achieves yields in the order of 70-80%.

[0005] In addition to the forced circulation hot air channelling system, the market also offers a natural circulation version in which the electrical fans 2 are missing.

[0006] The channels connected to the outlet openings 4 may take various positions. Two typical positions are those shown in the Figures 1B and 1C, meaning one that provides independent channels connected to the outlets 4 (Fig. 1B), and another (Fig. 1C) in which the same channels reconnect to each other in a ring-shaped fashion, with hot air outlet openings 7 in the various rooms supplied by the nearby channel through fittings in the shape of a T or Y.

[0007] The known heating system mentioned above presents a number of drawbacks, including a low level of living comfort and a lack of consumption optimization.

[0008] The living comfort is in fact strongly influenced by the following factors:

- The uniformity of the temperature in the various rooms of the environment;
- The uniformity of the temperature in the various air layers of the same room (a modest or missing "air stratification");
- The optimum relative humidity in the various rooms.

[0009] As regards said factors affecting the living comfort, the known heating system mentioned above presents the following drawbacks:

- Lacking uniformity of the temperature of the various heated rooms, due to the impossibility of uniformly subdividing the hot air flow entering the various rooms, both because of the various lengths of the channel sections leaving the heating chimney and conveying the hot air to the various openings and because of the presence of the T- and Y-shaped fittings;
- Stratification of the air in the rooms wherein the outlet velocity of the air from the outlet openings (generally set up next to the ceiling) is insufficient;
- Lack of control and regulation of the relative humidity in the various rooms, with a frequent tendency of the air "to dry out";
- Lack of interfacing with other heating systems present.

[0010] The scope of this invention is to realize a heating system wholly or partly free from the mentioned drawbacks.

[0011] This scope is achieved in accordance with the solution concepts that are, in their most general formulation, outlined in the subsequent claims 1 and 9.

[0012] The characteristics of the invention will become better evident from the following description of a few non-limiting examples of embodiment referring to the enclosed drawings, which show:

Fig. 2A:	an example (concept diagram) of a heating system according to the invention, in its most simplified version;
Fig. 2B:	the most complex version of the system of Fig. 2A;
Fig.s 3A and 3B:	a simplified frontal and sectional view of an example of embodiment of the humidifier of Fig. 2A and Fig. 2B;
Fig. 3C:	a simplified top view of a heating chimney with four outlet channels from the heat exchanger and four humidifiers interconnected to each other;
Fig. 4:	the most complex version of the system of Fig. 2B, with a hygrothermostat present in each room

and a temperature sensor, a solenoid valve and an electrical fan associated with the relative hot air outlet opening;

Fig.s 5A, 5B and 5C: the preferred operating mode of the solenoid valve 9 of Fig. 4;

Fig. 6: an example of a system as in Fig. 4, with radio connections between the hygrothermostat in each room and the temperature sensor, solenoid valve and electrical fan associated to the relative opening or to the chimney;

Fig. 7: an example of a system as in Fig.4 showing two openings of two adjacent rooms, connected to the nearby distribution channel by a Y-shaped fitting;

Fig. 8: a variant of the system of Fig. 4, with a humidifier allocated just upstream of each opening;

Fig. 9: an example (concept diagram) of a solution according to the invention applied to the management of radiators fed by a boiler.

[0013] Figure 2A is a simplified diagram of a first example of a heating system according to the invention, in its most simplified form.

[0014] This system is meant to refer to an environment including a number of rooms, but for simplicity the figure refers, apart from to the chimney room, to only one other room of the environment.

[0015] The system includes:

- A heating chimney (T) of a metal construction and with a closed hearth of a type powered by a solid fuel, for a natural circulation hot air channelling system;
- A heat exchanger (3) suitable for conveying the air to be heated around the metal walls of the chimney;
- A channel (5) suitable for introducing combustion air drawn from the environment and/or from the outside of the hearth (1) of the chimney;
- Hot air distributing channels (6) connected to channels (4) leaving the heat exchanger, suitable for conveying the hot air to the various rooms of the environment, from which the air exits through appropriate openings (7);
- A first solenoid valve (12) inserted into channel (5) conveying the combustion air to the hearth of the chimney, suitable for regulating the air flow in the channel;
- A first temperature sensor (13) present in the heat exchanger, suitable for detecting the temperature of the passing air;
- A unit (14), known in the following as a hygrothermostat, present in a room of the environment, equipped with humidity and temperature sensors, an electronic microprocessor circuit board and a transmitter/receiver device, suitable for detecting the temperature and humidity levels in the room and of comparing them with the preferred temperature and humidity values pre-set by the user.
- A number of humidfiers (11) suitable for releasing humidity into the air of the environment, realized with water reservoirs set up next to a respective channel (4) exiting the heat exchanger, and closed at the top by a perforated section of said channel.

[0016] The hygrothermostat (14) present in a room of the environment is connected by a cable to the temperature sensor (13) present in the heat exchanger and to the solenoid valve (12) regulating the flow of combustion air.

[0017] The hygrothermostat keeps the solenoid valve (12) regulating the flow of combustion air fully open during the heating chimney's start-up phase. It also provides for emitting a signal indicating a low humidity level, as soon as the relative sensor detects a humidity level below that pre-set by the user.

[0018] The appearance of the mentioned low humidity signal may be utilized to signal the user (through an appropriate signalling device, such as a led unit, a buzzer or other) the opportunity of making-up the water content of the humidifiers, or to signal the hygrothermostat (14) of the chimney room the need of controlling the water supply to the humidifiers, using an automatic feeding system (not shown in the figure) for the same. In this latter case the humidifiers are fitted with a sensor for the maximum allowable water level in the same, a sensor that provides, at the moment of activating it, a signal to the hygrothermostat (14) of the chimney room the need of interrupting the water flow at the humidifier inlet, a flow that is to remain interrupted up to the depletion of the water in the humidifier and the appearance of a new low humidity level signal.

[0019] Knowing the relative humidity and temperature signalled by the hygrothermostat and the temperature of the air leaving the heat exchanger, the system and in particular the hygrothermostat can, apart from informing the user when to add water to the humidifiers (if an automatic system feeding the same is lacking) inform the same when and how much wood to add to the hearth of the chimney.

[0020] The managing of the combustion air through the solenoid valve (12) also allows regulating the firing intensity in the hearth. The flame will be kept low (valve half closed) after the hygrothermostat has reported reaching the desired temperature, so as to prevent overheating and maintain the achieved condition as long as possible. As soon as the temperature drops, the user will be told to add fuel; if this is done the valve opens to revive the flame, it is otherwise deduced that the user is at the moment unavailable and the valve is closed to 90-80% to create an "embers" effect. In

a similar manner, if the user charges the heating chimney before going to sleep, a "night" program will be selected and the valve will be completely closed to again create an "embers" effect useful to maintain the temperature and re-lighting the fire the morning after.

[0021] The Figure 2B shows a more complex embodiment of the system of Figure 2A, equipped with a number of first electrical fans (2) inserted into an equal number of heat exchanger inlets, suitable for a forced introducing of external and/or environment air into the heat exchanger and a subsequent conveying of the air to the rooms of the environment, through the mentioned distributing channels (6). The hygrothermostat 14 is further connected to the temperature sensor (13) present in the heat exchanger by the solenoid valve (12) regulating the flow of combustion air and the electrical fan (2) in the heat exchanger inlet, through connections set up, in order to simplify installing operations, not via cable but via radio, while using a microprocessor circuit board 21 and a receiving and transmitting device associated with the chimney. The hygrothermostat (14) regulates the speed of the electrical fans (2) in the heat exchanger inlet, depending on the temperature level signalled by the temperature sensor (3) of the heat exchanger.

[0022] A preferred operating mode of the system of Fig. 2B provides that when the fire is lighted, the control panel of the chimney room detects the temperature increase of the heat exchanger, and when a temperature of 40°C is exceeded in the heat exchanger the electrical fans in the heating chimney start running at a speed proportional to the air temperature.

[0023] The Figures 3A and 3B represent a simplified frontal and sectional view of an embodiment example of each of the humidifiers (11) in the Figures 2A and 2B. It consists of a duct (15) of a cross section equal to that of the air channels leaving the heat exchangers, to be inserted in series with the same and in an external reservoir (16) to hold the water used for humidifying.

[0024] The upper portion of the duct is fitted with openings (17) suitable for bringing the duct itself in communication with the external reservoir (the reservoir portion not occupied by water) and from which the water vapour generated by the heating of the water can enter the hot air flow passing the duct and diffuse to the various rooms.

[0025] In its upper portion the external reservoir also presents an access opening (18) destined to allow the admission of water, and in the lower portion a number of access openings (19) destined to bring the humidifiers (11) in communication with each other through connecting tubes.

[0026] As an example, the Fig. 3C shows a topside view of a heating chimney fitted with four channels leaving the heat exchanger and four humidifiers interconnected to each other by tubes (20). Said connecting tubes serve to allow the water feed to the reservoirs of the four humidifiers to occur through the access opening (18) of only one of the four humidifiers.

[0027] The Fig. 4 shows a more complex version of the heating system of Fig. 2B in a simplified manner, with hygrothermostatic units present in each room and a temperature sensor, solenoid valve and electrical fan associated with the relative hot air emission opening.

[0028] Compared to the system of Fig. 2b, this system in fact presents the following variants:

- A number of second electrical fans (8) set up inside the distribution channels (6), each immediately upstream of each of said openings (7) destined for a forced hot air outflow from the opening;
- hygrothermostatic units (14) present in each room, each being fitted with humidity and temperature sensors, an electronic microprocessor circuit board and a transmitter/receiver device suitable for detecting the temperature and humidity levels of the room and comparing them with the preferred temperature and humidity levels pre-set by the user.
- A number of second solenoid valves (9), each being set up in a distribution channel immediately upstream in each opening, suitable for opening and closing the relative channel for supplying the air to the opening;
- A number of third temperature sensors (10), each set up immediately upstream of each opening, suitable for measuring the air temperature reaching the opening.

[0029] The hygrothermostat (14) of the chimney room is connected through a cable to the temperature sensor, the solenoid valve and the electrical fans associated with the channel, while the hygrothermostat of any other room is connected, via a cable, to the temperature sensor, the solenoid valve and the electrical fan of the relative opening. In addition, all hygrothermostats can exchange signals between them through radio connections (as shown in the figure) or over a cable.

[0030] The system is characterized by the following additional operating modes:

- The hygrothermostat (14) of each room regulates the speed of the electrical ventilator (8) of the relative opening, depending on the temperature of the incoming air, and commands the solenoid valve (9) of the relative opening to close when the temperature of the room has reached the level pre-set by the user.
- The hygrothermostat (14) of the various rooms provides for emitting a signal indicating a low humidity as soon as the relative humidity sensor detects a humidity level below that pre-set by the user.

[0031] Even in this system, the appearance of the mentioned low humidity signal can be utilized to inform the user of the opportunity to take care of making up the water content of the humidfiers, or to signal the hygrothermostat (4) of the chimney room the need to command a supply of water to the humidifiers through an automatic system supplying the same.

[0032] One preferred operating mode of the system of Fig. 4 provides that when the fire is lighted, the control panel of the chimney room detects the temperature increase in the heat exchanger and communicates it to the various openings that are in turn verifying the incoming hot air (by natural convection) through the temperature sensor. When the temperature of the heat exchanger exceeds 40°C, the electrical fan of the heating chimney starts running in proportion to the temperature of the air. The start and speed of the electrical fan is communicated to the various openings, which start their own fan in proportion. The speed of the opening fan is defined by the incoming air temperature, but is automatically limited for the purpose of preventing the sum of all the flow rates from exceeding the open-mouth flow rate of the heating chimney's electrical fan.

[0033] The Figures 5A, 5B and 5C show a preferred operating mode of the solenoid valve (9) of Fig. 4.

[0034] According to this preferred mode, the solenoid valve is susceptible of assuming three positions:

- A position (Fig. 5A) assumed when the electrical fan (8) is operating, which allows conveying the air flow originating from the distribution channel (6) toward the electrical fan;
- A position (Fig. 5B) assumed when the electrical fan (8) is shut down and a hot air flow to the room is impeded;
- A position (Fig. 5C) assumed when the electrical fan (6) is shut down, but it is desired to allow a flow of air to the room by bypassing the inlet to the fan, thus utilizing the chimney in a traditional manner (an operating mode useful at night time, so as to render the operation of the system as quiet as possible).

[0035] The Fig. 6 refers to another variant of the system of Fig. 4, regarding the realization of the connections of the hygrothermostat (14) of each room with the temperature sensor (10), the solenoid valve (9) and the electrical fan (8) set up upstream of the respective openings, as well as the execution of the connections of the hygrothermostat (4) present in the chimney room with the temperature sensor (13) present in the heat exchanger, the solenoid valve (12) regulating the flow of combustion air, and the electrical fans (2) in the inlet to the heat exchanger. According to this variant, said connections are in fact no longer carried out by cable but via radio, through a microprocessor electronic circuit board and a receiver-transmitter device associated with said respective opening or with the chimney.

[0036] The Fig. 7 concerns the case of the openings (7) of two adjacent rooms connected with the nearby distribution channel 6 through a Y-shaped fitting. In this case, when the air of one of the two rooms reaches the desired temperature pre-set by the user, the hygrothermostat (14) of said room takes care of closing the solenoid valve of the corresponding opening, while communicating it to the hygrothermostat (14) of the adjacent room, which attends to increasing the flow of air outgoing from the corresponding opening. A similar operation is to be envisioned in case the fitting to the nearby channel is of a T-shaped or similar type.

[0037] The Figure 8 refers to a variant of the system of Fig. 4 concerning the realization and allocation of the humidifiers (11). According to this variant, the humidifiers are in fact, instead of being allocated to the channels outgoing from the heat exchanger, realized in form of reservoirs, each of which is set up immediately upstream of each opening and closed at the top by a perforated section of said channel.

[0038] The Figure 9 is a simplified view of an example of a solution according to the invention that is applied to the managing of radiator areas supplied by a gas-fired boiler (22) and distributed to four rooms. According to this solution, each radiator is equipped with a battery-powered solenoid valve (23) controlled via radio (or optionally via cable), and is installed on the hot water discharge or return side or on the relative piping of the distribution collector, which allows interrupting its flow. Each radiator is also equipped with a humidifier (water container, not shown in the figure) placed in contact with the same.

[0039] Each room of the dwelling that includes one or more radiators (24) features an optionally battery-powered hygrothermostat (25) that keeps the temperature and humidity of the room under control and determines, based on the comfort settings inserted by the user, when it is necessary to command the opening or closing of the solenoid valves mounted on the radiators via radio (or eventually by cable) or to signal the user the opportunity of making up the humidifier's water content.

[0040] Each hygrothermostat is connected via radio (or eventually by cable) with a control panel (26) associated with the boiler, which informs the boiler when it should activate itself.

[0041] The boiler heats up the water as long as at least one radiator is open, and stops doing so only after all the radiators turn out to be closed (when all the rooms have attained the desired conditions).

[0042] The advantages of this arrangement can be summarized as follows:

- easy installation on existing systems, as the pitch of the solenoid valve is identical to that of today's commonly used mechanical valves, and as (in the version fitted with radio connections) no masonry works are needed;
- Energy savings up to 30% (typical of managing by areas);

- Room-by-room control of the relative humidity;
- Elimination of the problem of an operating temperature difference between the first and the last radiator served by the boiler;
- Possibility of installing it in any system based on radiators and boilers.
- Possibility of inserting into each hygrothermostat a timing clock suitable for allowing the user to program his time schedules for activating the solenoid valve.
- Modest energy consumption of the solenoid valves, with a duration of the power battery exceeding two years. In the case of environments equipped with both a hot air heating system (heating chimney) and a radiator system, the solenoid valve associated with each radiator allows closing the hot water flow when the room is heated by the heating chimney, as the solenoid valves and the control panel connected to the boiler communicate with each other and with the openings via radio (or eventually by cable).

[0043] With respect to the solutions already known, the system realized in this manner allows resolving all the problems previously outlined, in particular thanks to the following:

- Adaptability to various types of housing (even with multiple floors).
- Quick and easy installation, even on pre-existing systems.
- Possibility of managing channels up to 15 m length.
- Masonry works reduced to a minimum (non-existing for the radio version).
- System that automates the feeding of the solid fuel (wood) and the humidifiers (the user only has to follow the indications appearing on the display), thus reducing consumption up to 30% by managing the combustion air.
- Heat uniformly distributed throughout the house, with a total elimination of the so-called "cold areas", and a relative improvement of the living comfort.
- Strong reduction of the air stratification in the environments (constant temperatures from the pavement to the ceiling).
- Managing the relative humidity of the environments.
- Possibility of utilizing the heating system even in a traditional manner (useful over periods of long absences from the house).
- Application and adaptability to any pre-existing forced hot air heating system powered by solid fuel.
- Possibility of managing a traditional heating system by areas, even when the solid fuel heating chimney or boiler are shut down (the system openings 7 and the solenoid valve system to be applied to the radiator or heating manifold can operate separately; in dwellings with only a heating chimney or where there is no desire to operate the radiator system, the only system installed will be that with the openings; in dwellings without a heating chimney but only with a system fitted with radiators or similar bodies it will be possible to install the system based on a radio (or cable) controlled solenoid valve, while still enjoying the full range of advantages already mentioned.

[0044] It is evident that in all the examples of realization previously described for illustrative and non-limiting purposes, numerous modifications, adaptations, variants and substitutions of elements with others of an equivalent type may be applied without thereby abandoning the range of protection of the following claims.

Claims

1. A heating system for an environment of a type equipped with forced circulation hot air channelling and a heating source powered by solid fuel, comprising:

- A heating chimney (T) with a metallic construction and a closed hearth;
- A heat exchanger (3) suitable for conveying the air to be heated around the chimney's metal walls;
- A channel (5) suitable for introducing combustion air drawn from the environment and/or from outside into the chimney hearth;
- Hot air distribution channels connected to channels (4) leaving the heat exchanger, suitable for conveying the hot air leaving the heat exchanger toward various rooms of the environment, in which the air exits through appropriate openings (7);

characterized by a combination of:

- A first solenoid valve (12) inserted into the channel (5) supplying combustion air to the chimney hearth, suitable for regulating the air flow in the channel;
- A first temperature sensor (13) present in the heat exchanger, suitable for detecting the temperature of the

passing air;
- A unit (14) known in the following as a hygrothermostat, present in a room of the environment, equipped with temperature and humidity sensors, a microprocessor circuit board and a receiving and transmitting device, suitable for detecting the room's temperature and humidity levels and for comparing them with the preferred temperature and humidity levels pre-set by the user;
- A number of humidifiers (11) suitable for releasing humidity to the air in the environment;

where the hygrothermostat (14) is connected to the temperature sensor (13) present in the heat exchanger and to the solenoid valve (12) regulating the flow of combustion air; and further **characterized by** the following functional modes:

- The hygrothermostat (14) regulates the opening of said first solenoid valve (12) depending on the temperature levels signalled by the sensor of the same hygrothermostat and by the temperature sensor (13) of the heat exchanger, and keeps said first solenoid valve (12) fully open during the heating chimney's start-up phase.
- The hygrothermostat (14) takes care of emitting a signal indicating a low humidity, as soon as the relative humidity sensor detects a humidity level below that pre-set by the user.

2. A heating system for environments as in claim 1, **characterized by** the presence of a number of first electric fans (2) inserted in an equal number of heat exchanger inlets, suitable for forcing the air from the outside and/or the environment into the heat exchanger and subsequently conveying the air toward the rooms of the environment, through the mentioned distribution channels (6), while the hygrothermostat (14) is connected to said electrical fans (2) in the inlet to the heat exchanger and regulates the speed of the same depending on the temperature levels signalled by the sensor of the same hygrothermostat and by the temperature sensor (13) of the heat exchanger.

3. A heating system for environments as in claim 1 or 2, **characterized by** the presence of said hygrothermostat unit (14) in each of said rooms, and by the further presence of a combination of:

- a number of second electrical fans (8) set up in the mentioned distribution channels (6), each immediately upstream of each of said openings (7), suitable for forcing the hot air out of the opening;
- a number of second solenoid valves (9), each being set up inside the distribution channels immediately upstream of each opening and suitable for opening and closing the relative channel supplying air to the opening;
- a number of third temperature sensors (10) each being set up immediately upstream of each opening and suitable for measuring the air that reaches the opening;

while the hygrothermostat (14) of said rooms is connected to the temperature sensors, the solenoid valve and the electrical fan of the relative opening;
and further **characterized by** the following functional modes:

- the hygrothermostat (14) of said rooms regulates the speed of the electrical fan (8) of the relative opening depending on the incoming air and commands the electrical valve (9) of the relative opening to close down when the temperature of the room has reached the level pre-set by the user;
- The hygrothermostat (14) of said rooms takes care of emitting a signal indicating a low humidity level, as soon as the relative humidity sensor detects a humidity level below that pre-set by the user.

4. A heating system for environments as in claim 1 or 2, wherein the mentioned humidifiers are realized in the form of water reservoirs, each set up next to a respective channel (4) leaving the heat exchanger and closed at its top by perforated section of said channel.

5. A heating system for environments as in claim 1 or 2, wherein the mentioned humidifiers (11) are realized by reservoirs, each set up immediately upstream of each opening next to the relative channel supplying air to the opening, and closed at its top by a perforated section of said channel.

6. A heating system for environments as in claim 3, wherein each of said second solenoid valves (9) can alternatively assume the following positions:

- a first position assumed when the corresponding electrical fan (8) is operating and allows conveying the air flow originating from the nearby distribution channel (6) toward the electrical fan;
- a second position that may be assumed when the corresponding electrical fan (8) is shut down, preventing

hot air from entering the environment;
- a third position that may be assumed when the corresponding electrical fan (8) is shut down and allows an air flow to enter the environment while bypassing the fan inlet.

7. A heating system for environments as in claim 3, wherein the connections of the hygrothermostat of each room with the temperature sensor, the solenoid valve and the electrical fan set up upstream of the respective opening are realized via radio, through an electronic microprocessor circuit board associated with said opening.

8. A heating system for environments as in claim 2, wherein the connections of the hygrothermostat present in the chimney room with the temperature sensor (13) present in the heat exchanger, the solenoid valve (12) for regulating the flow of combustion air, and the electrical fans (2) in the heat exchanger inlet are realized via radio, through a microprocessor circuit board associated with the chimney.

9. A heating system for environments as in claim 3 wherein, in case the openings of two adjacent rooms connect to the nearby distribution channel through a Y- or T-shaped or similar other fitting, when the air of one of the two rooms reaches the desired temperature pre-set by the user, the hygrothermostat of said room takes care of closing the solenoid valve of the corresponding opening while communicating it to the hygrothermostat of the adjacent room, which takes care of increasing the outlet air flow of the corresponding opening.

10. A heating system for an environment of a type fitted with radiators distributed in the various rooms and supplied by a centralized gas-fired boiler, wherein:

- each radiator is fitted with a battery-powered solenoid valve (23) which is controlled via radio and installed in the hot water discharge or return line or in the relative distribution manifold duct, that allows interrupting its flow, and is likewise fitted with a water container acting as a humidifier;
- a hygrothermostat (25) is installed in each room, that monitors the temperature and humidity of the room and determines, based on the comfort settings made by the user, when there's a need for a radio command to open or close the solenoid valves mounted on the room's radiators, or to signal the user the opportunity of making up the humidifier's contents;
- each of said hygrothermostats has a radio connection to a control panel (26) associated with the boiler that informs the boiler when to activate itself;
- the boiler heats up the water feeding the radiators as long as at least one radiator is open, and stops doing so only after all radiators are closed after all the rooms have reached the desired conditions.

11. A heating system for an environment according to claim 10,
characterized by the presence of a timing clock in each hygrothermostat, suitable for allowing the user to program the time schedules for actuating the solenoid valve.

Amended claims in accordance with Rule 137(2) EPC.

1. A heating system for an environment of a type equipped with forced circulation hot air channelling and a heating source powered by solid fuel, comprising:

- A heating chimney (T) with a metallic construction and a closed hearth;
- A heat exchanger (3) suitable for conveying the air to be heated around the chimney's metal walls;
- A channel (5) suitable for introducing combustion air drawn from the environment and/or from outside into the chimney hearth;
- Hot air distribution channels connected to channels (4) leaving the heat exchanger, suitable for conveying the hot air leaving the heat exchanger toward various rooms of the environment, in which the air exits through appropriate openings (7);
- A number of humidifiers (11) suitable for releasing humidity to the air in the environment;

characterized by a combination of:

- A first solenoid valve (12) inserted into the channel (5) supplying combustion air to the chimney hearth, suitable for regulating the air flow in the channel;
- A first temperature sensor (13) present in the heat exchanger, suitable for detecting the temperature of the

passing air;
- A unit (14) known in the following as a hygrothermostat, present in a room of the environment, equipped with temperature and humidity sensors, a microprocessor circuit board and a receiving and transmitting device, suitable for detecting the room's temperature and humidity levels and for comparing them with the preferred temperature and humidity levels pre-set by the user;

where the hygrothermostat (14) is connected to the temperature sensor (13) present in the heat exchanger and to the solenoid valve (12) regulating the flow of combustion air;
and further **characterized by** the following functional modes:

- The hygrothermostat (14) regulates the opening of said first solenoid valve (12) depending on the temperature levels signalled by the sensor of the same hygrothermostat and by the temperature sensor (13) of the heat exchanger, and keeps said first solenoid valve (12) fully open during the heating chimney's start-up phase.
- The hygrothermostat (14) takes care of emitting a signal indicating a low humidity, as soon as the relative humidity sensor detects a humidity level below that pre-set by the user.

2. A heating system for environments as in claim 1, **characterized by** the presence of a number of first electric fans (2) inserted in an equal number of heat exchanger inlets, suitable for forcing the air from the outside and/or the environment into the heat exchanger and subsequently conveying the air toward the rooms of the environment, through the mentioned distribution channels (6), while the hygrothermostat (14) is connected to said electrical fans (2) in the inlet to the heat exchanger and regulates the speed of the same depending on the temperature levels signalled by the sensor of the same hygrothermostat and by the temperature sensor (13) of the heat exchanger.

3. A heating system for environments as in claim 1 or 2, **characterized by** the presence of said hygrothermostat unit (14) in each of said rooms, and by the further presence of a combination of:

- a number of second electrical fans (8) set up in the mentioned distribution channels (6), each immediately upstream of each of said openings (7), suitable for forcing the hot air out of the opening;
- a number of second solenoid valves (9), each being set up inside the distribution channels immediately upstream of each opening and suitable for opening and closing the relative channel supplying air to the opening;
- a number of third temperature sensors (10) each being set up immediately upstream of each opening and suitable for measuring the air that reaches the opening;

while the hygrothermostat (14) of said rooms is connected to the temperature sensors, the solenoid valve and the electrical fan of the relative opening;
and further **characterized by** the following functional modes:

- the hygrothermostat (14) of said rooms regulates the speed of the electrical fan (8) of the relative opening depending on the incoming air and commands the electrical valve (9) of the relative opening to close down when the temperature of the room has reached the level pre-set by the user;
- The hygrothermostat (14) of said rooms takes care of emitting a signal indicating a low humidity level, as soon as the relative humidity sensor detects a humidity level below that pre-set by the user.

4. A heating system for environments as in claim 1 or 2, wherein the mentioned humidifiers are realized in the form of water reservoirs, each set up next to a respective channel (4) leaving the heat exchanger and closed at its top by perforated section of said channel.

5. A heating system for environments as in claim 1 or 2, wherein the mentioned humidifiers (11) are realized by reservoirs, each set up immediately upstream of each opening next to the relative channel supplying air to the opening, and closed at its top by a perforated section of said channel.

6. A heating system for environments as in claim 3, wherein each of said second solenoid valves (9) can alternatively assume the following positions:

- a first position assumed when the corresponding electrical fan (8) is operating and allows conveying the air flow originating from the nearby distribution channel (6) toward the electrical fan;
- a second position that may be assumed when the corresponding electrical fan (8) is shut down, preventing hot air from entering the environment;

- a third position that may be assumed when the corresponding electrical fan (8) is shut down and allows an air flow to enter the environment while bypassing the fan inlet.

7. A heating system for environments as in claim 3, wherein the connections of the hygrothermostat of each room with the temperature sensor, the solenoid valve and the electrical fan set up upstream of the respective opening are realized via radio, through an electronic microprocessor circuit board associated with said opening.

8. A heating system for environments as in claim 2, wherein the connections of the hygrothermostat present in the chimney room with the temperature sensor (13) present in the heat exchanger, the solenoid valve (12) for regulating the flow of combustion air, and the electrical fans (2) in the heat exchanger inlet are realized via radio, through a microprocessor circuit board associated with the chimney.

9. A heating system for environments as in claim 3 wherein, in case the openings of two adjacent rooms connect to the nearby distribution channel through a Y- or T-shaped or similar other fitting, when the air of one of the two rooms reaches the desired temperature pre-set by the user, the hygrothermostat of said room takes care of closing the solenoid valve of the corresponding opening while communicating it to the hygrothermostat of the adjacent room, which takes care of increasing the outlet air flow of the corresponding opening.

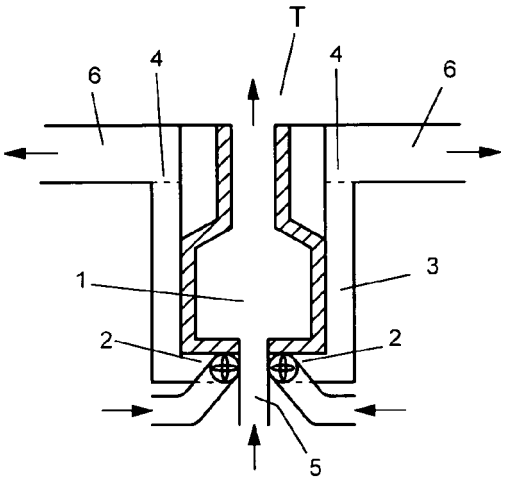

Fig.1A

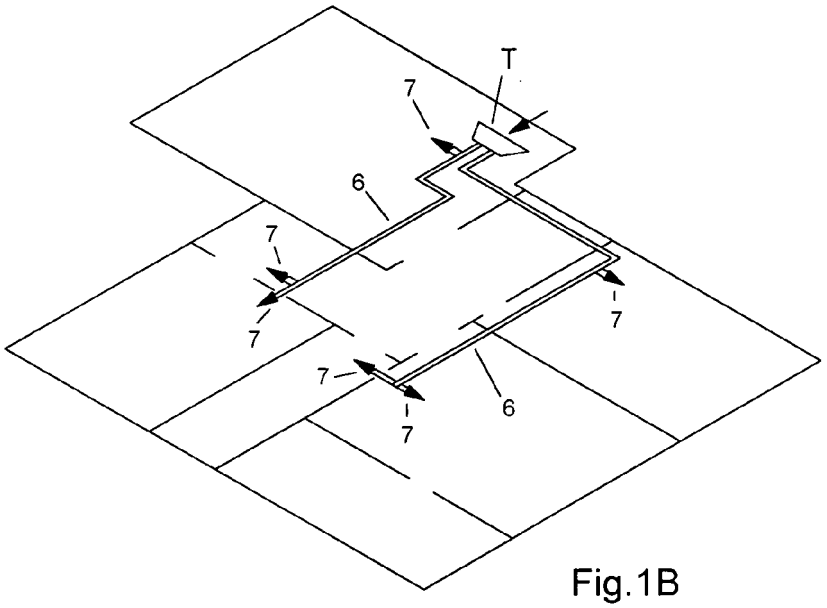

Fig.1B

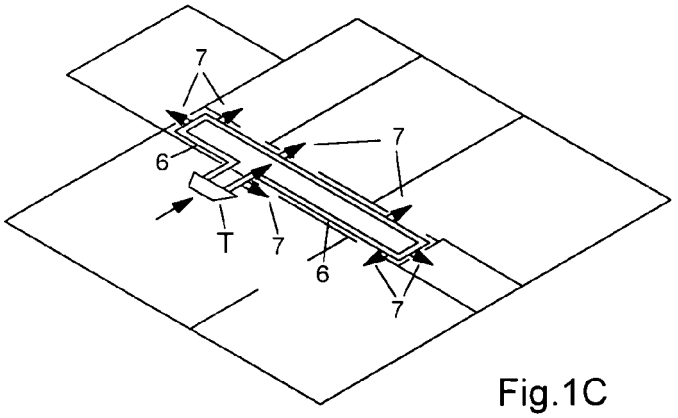

Fig.1C

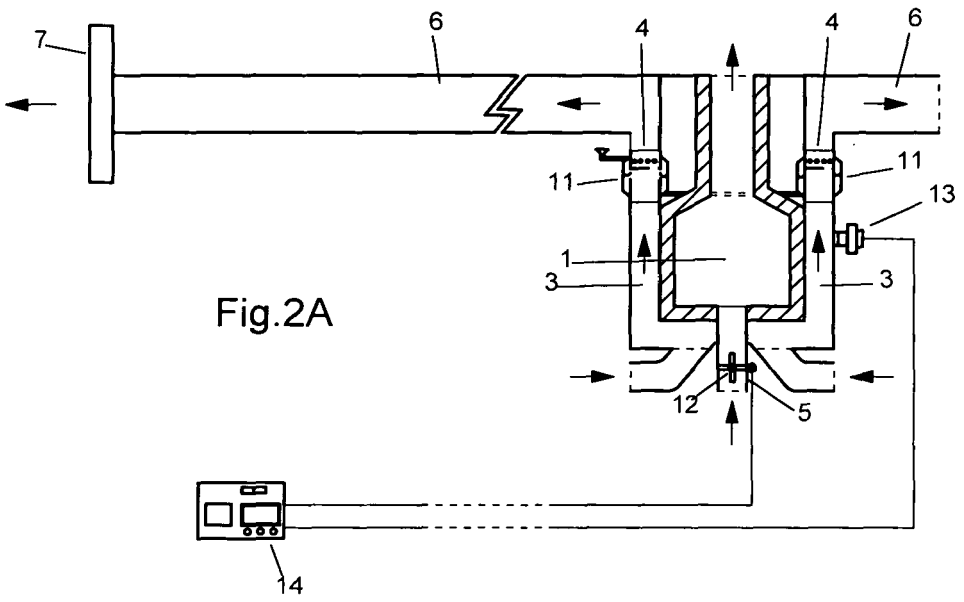

Fig.2A

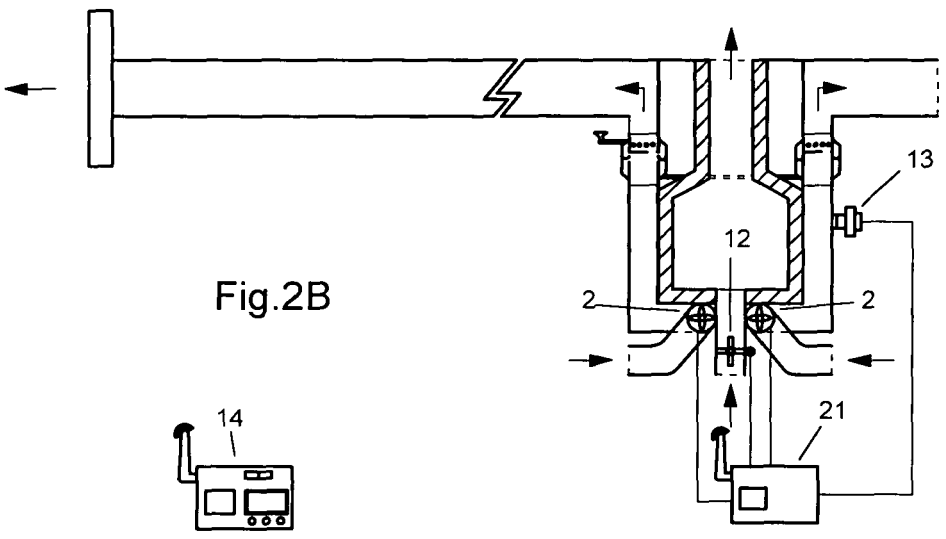

Fig.2B

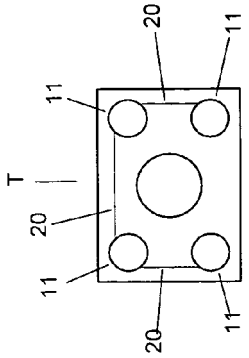

Fig.3C

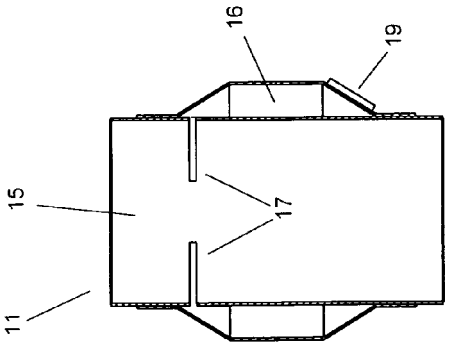

Fig.3B

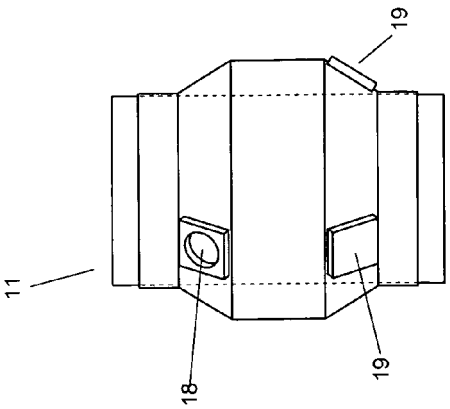

Fig.3A

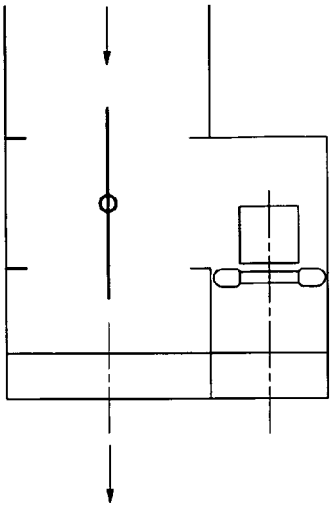

Fig.5C

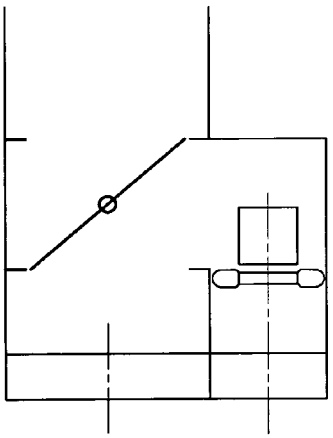

Fig.5B

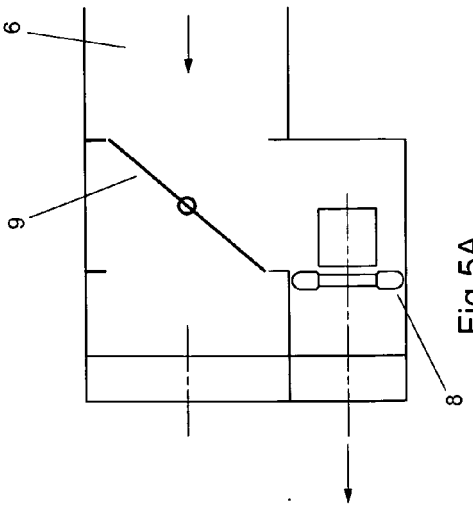

Fig.5A

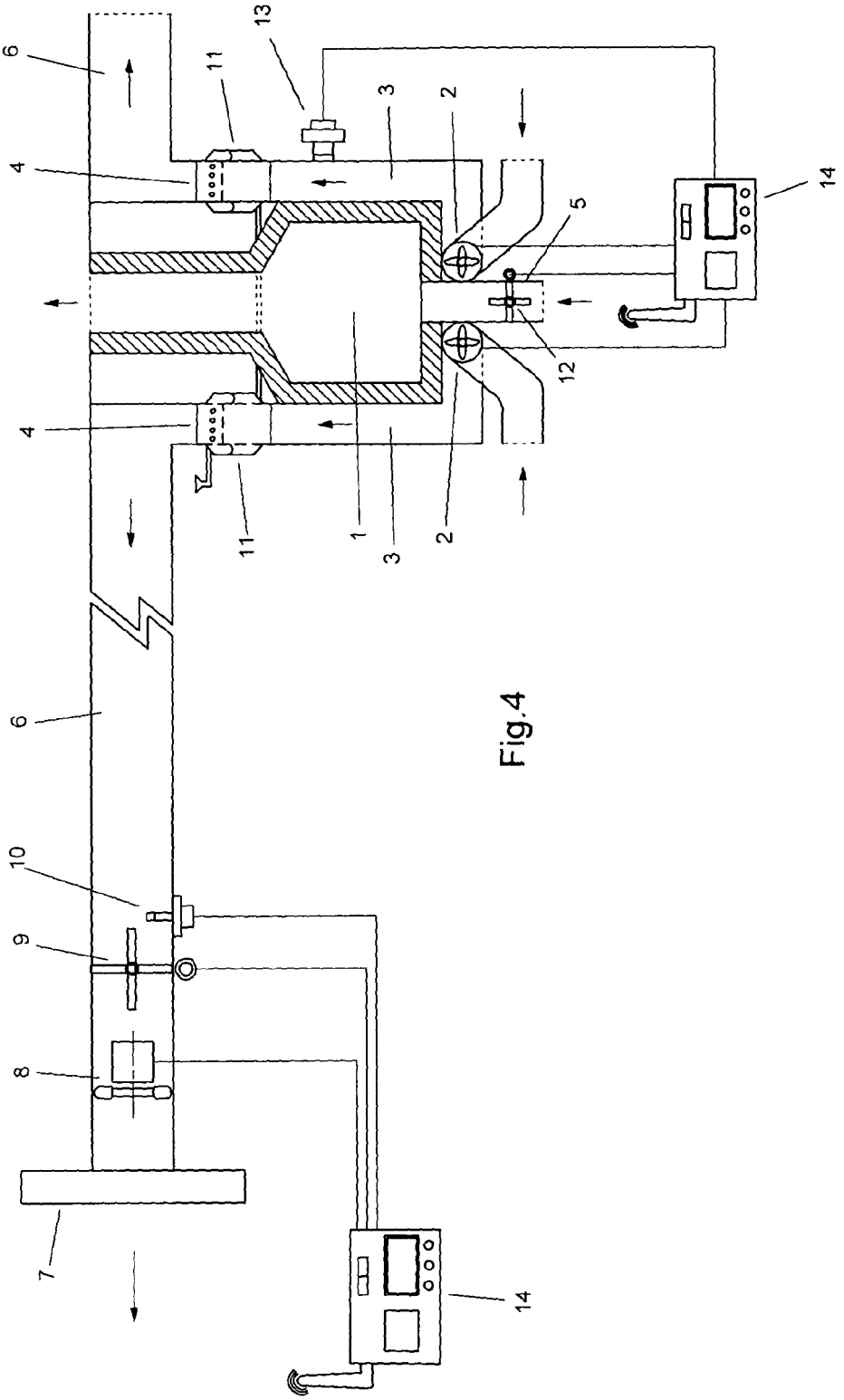

Fig.4

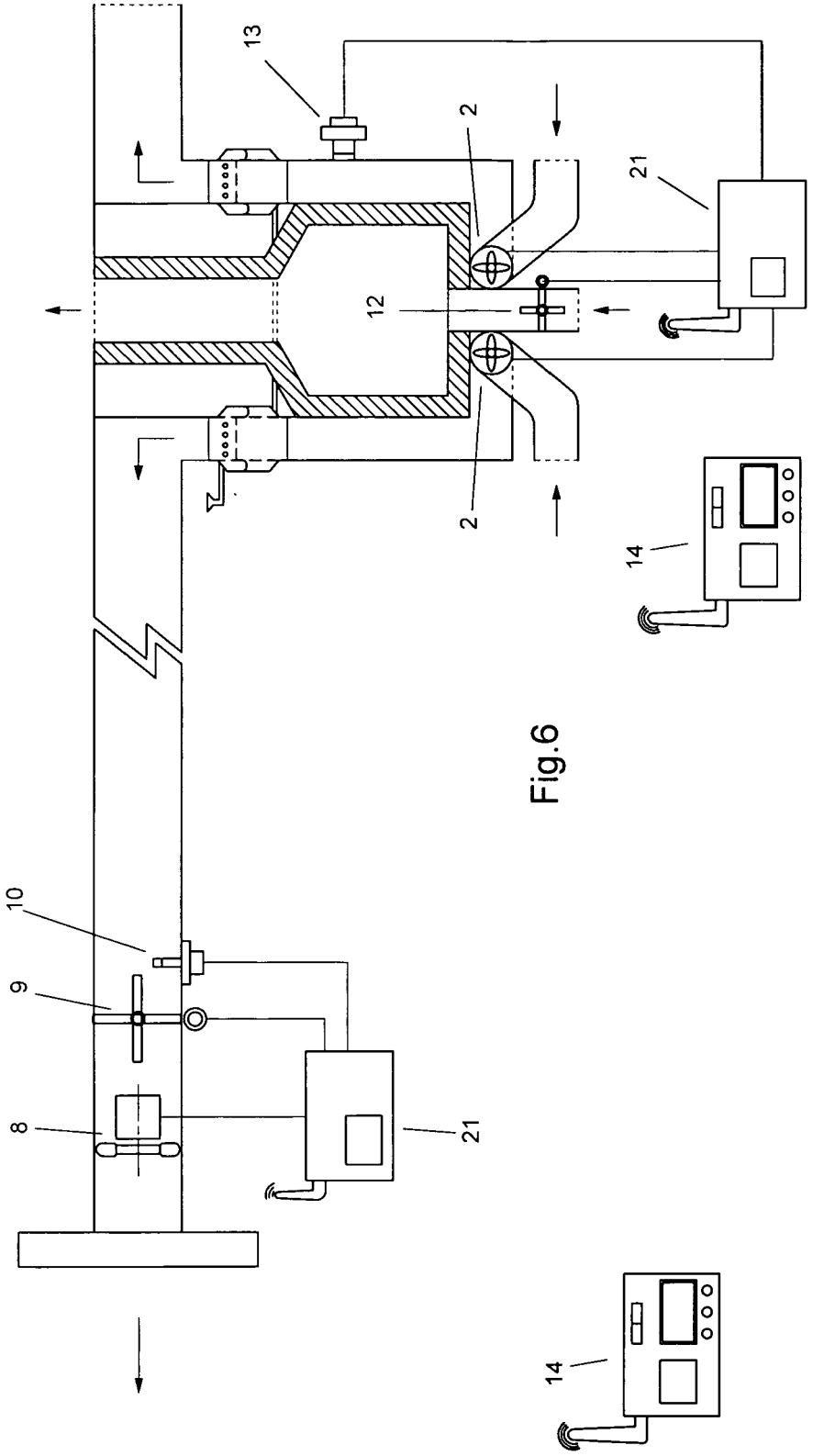

Fig.6

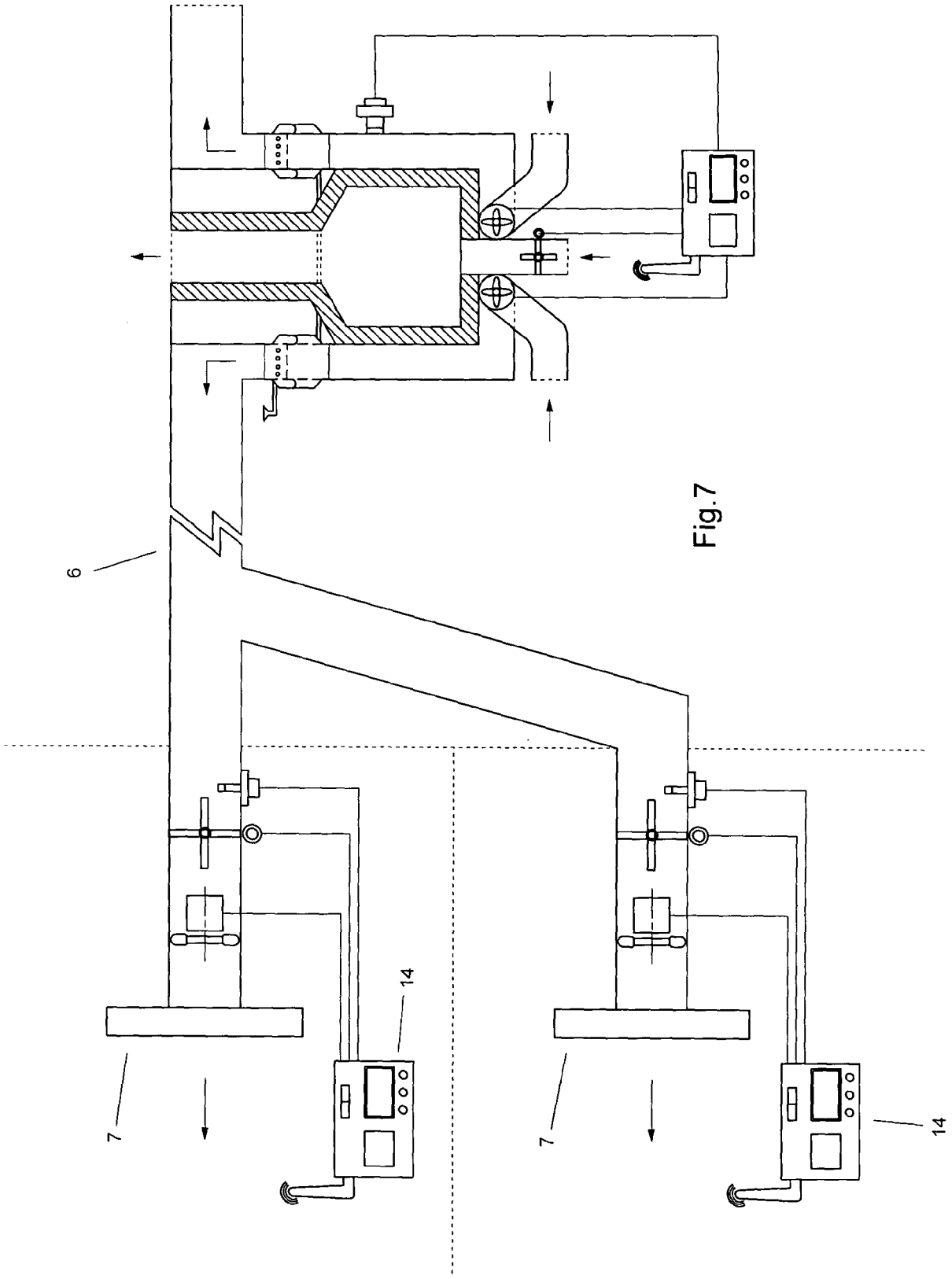

Fig.7

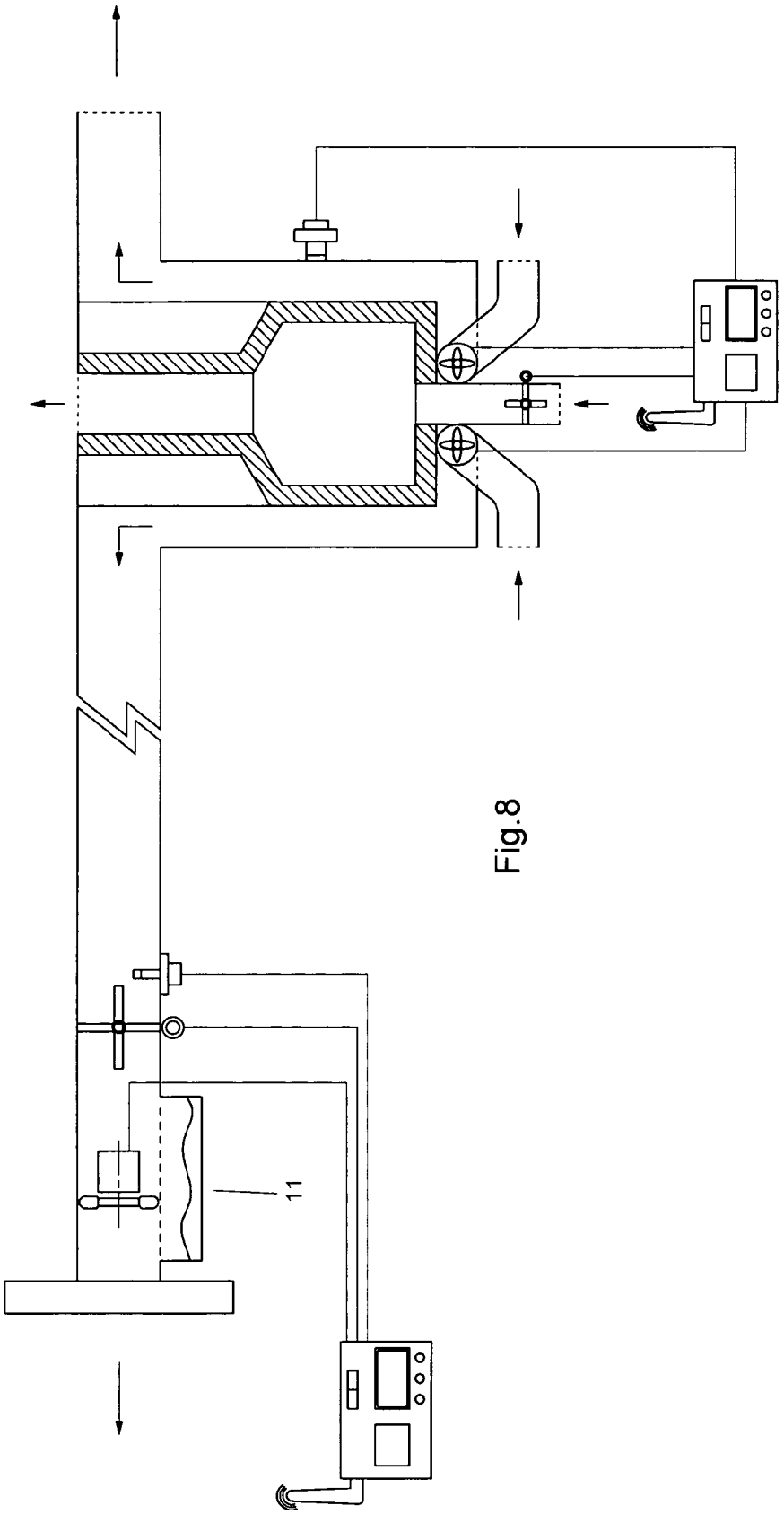

Fig.8

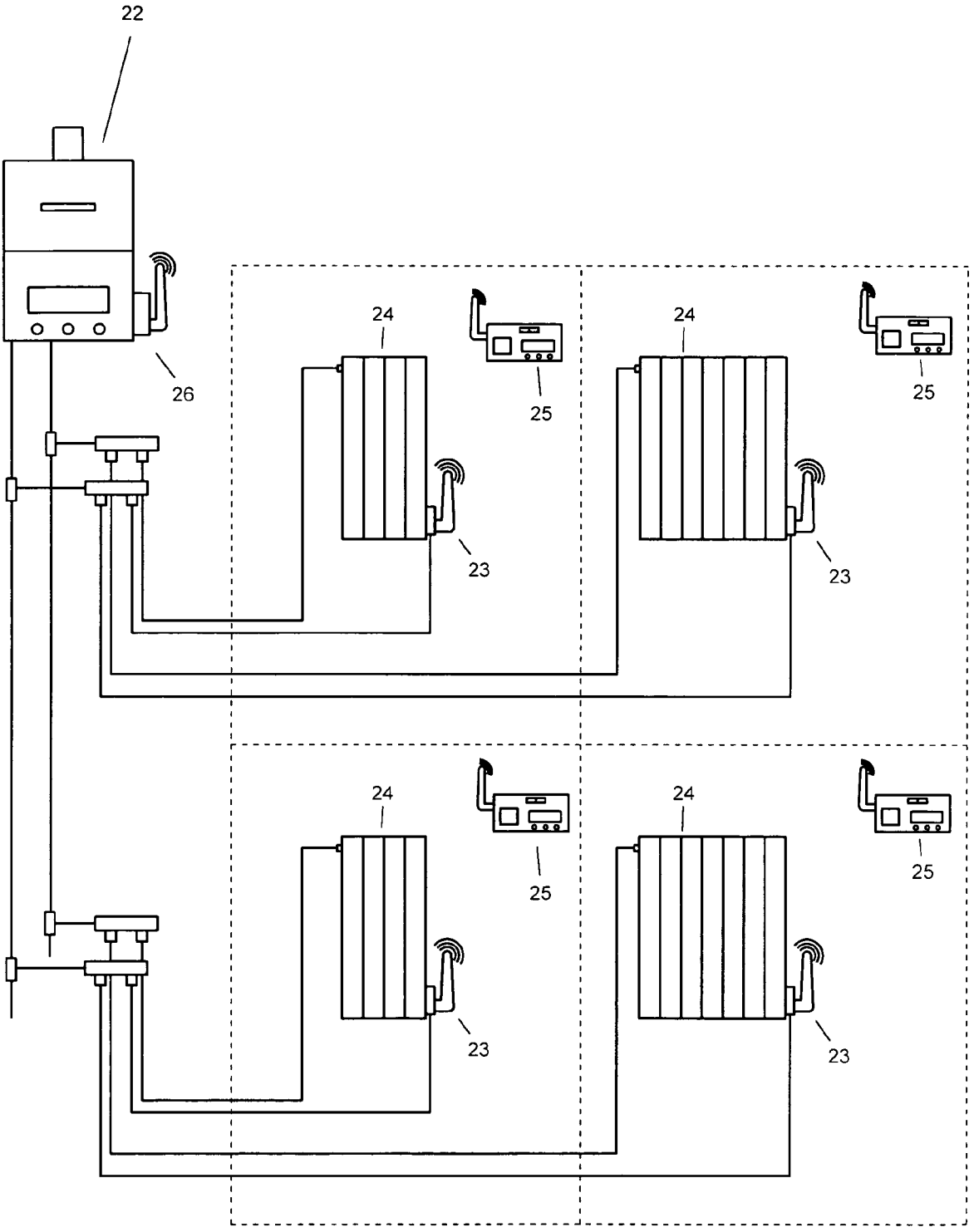

Fig.9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 42 5739

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 1 915 826 A (JENSEN ROBERT P) 27 June 1933 (1933-06-27) * the whole document * -----	1,4	INV. F24D5/00 F24F11/00 F24D19/10
A	GB 517 711 A (SIDNEY SUTTON; ARTHUR BOWEN; JOHN CECIL JOSEPH SMITH) 7 February 1940 (1940-02-07) * the whole document * -----	1,4	
A	GB 595 847 A (FRED HAINSWORTH) 18 December 1947 (1947-12-18) * the whole document * -----	1-3	

TECHNICAL FIELDS SEARCHED (IPC)

F24D
F24F

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	21 May 2008	van Gestel, Harrie

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 07 42 5739

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

see annex

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 07 42 5739

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-9

Heating system with forced circulation of hot air, a solid fuel fired heat source, a hygrothermostat in a room, humidifiers for humidifying the hot air.

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2. claims: 10-11

Heating system with forced circulation of water through radiators, a gas fired boiler, radio controlled battery-powered solenoid valves fitted to each radiator, a hygrothermostat in each room and control means.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 42 5739

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-05-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 1915826 A	27-06-1933	NONE	
GB 517711 A	07-02-1940	NONE	
GB 595847 A	18-12-1947	NONE	

EPO FORM P0459

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