

May 7, 1940.

R. ROYALL

2,199,840

HEATING SYSTEM

Filed Jan. 14, 1939

2 Sheets-Sheet 1

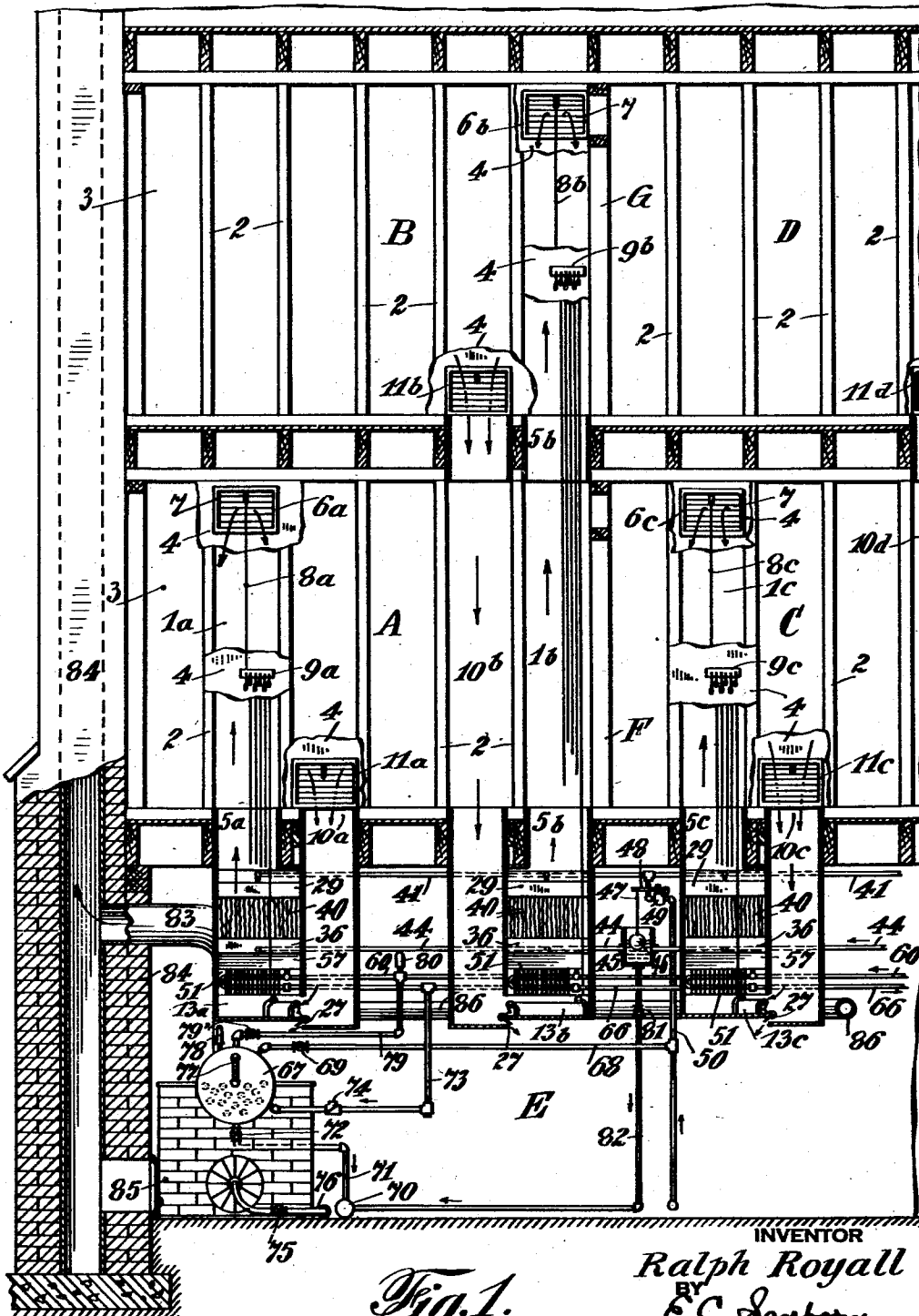


Fig. 1.

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2 Sheets-Sheet 2

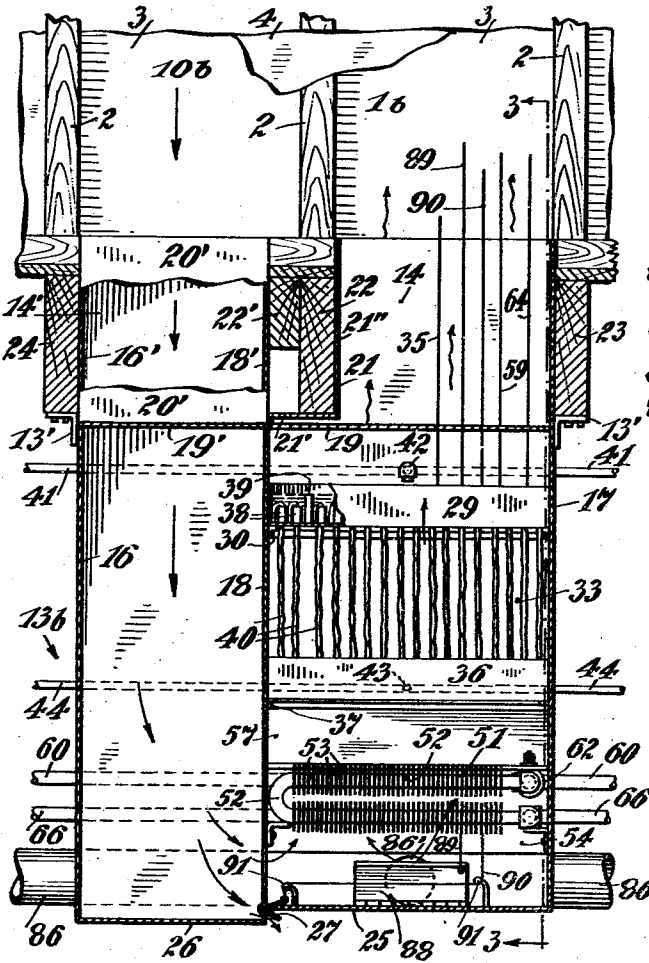


Fig. 2.

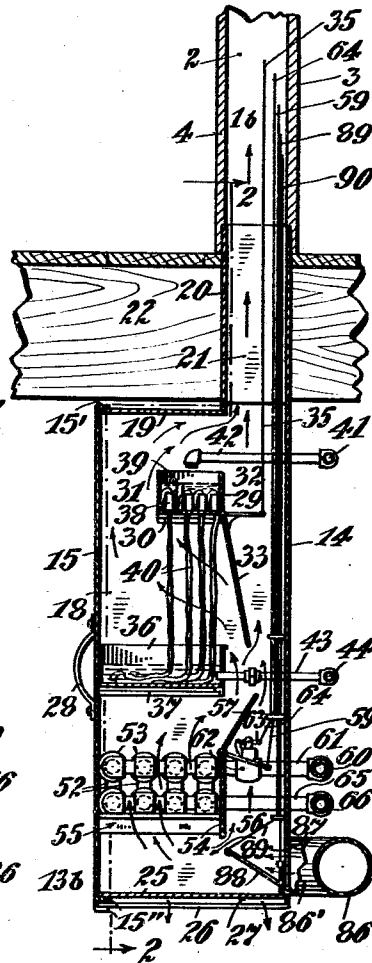


Fig. 3.

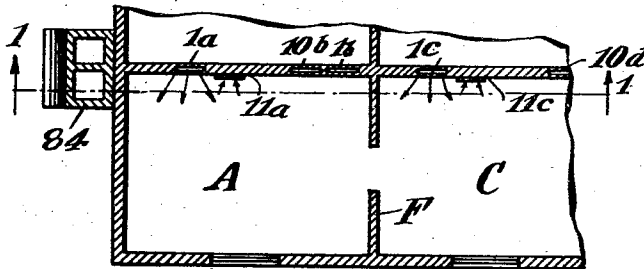


Fig. 4.

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2,199,840

HEATING SYSTEM

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5 Claims. (Cl. 237-49)

My invention relates to the heating of buildings and conditioning air for use therein. The invention is particularly applicable to residential houses, heated by steam or hot water radiators or convectors, although it may be applied to other types of buildings and to other methods of heating air.

One object of this invention is to eliminate from the rooms to be heated the use of radiators, convectors or other devices for heating the air. Such devices are usually unsightly and cause waste of space.

A further object is to eliminate the use of steam or hot water piping throughout the building to be heated and leading from the rooms to be heated to and from the heating unit located in the cellar or in some other part of the premises. Pipes running throughout the house for heating purposes are expensive to install.

A further object is to provide a closed circuit for each room so that the air may be circulated and recirculated in each room independently of other rooms.

Another object is to provide, in each closed circuit, heating means for the air which can be controlled separately for each room independently of other rooms, said heating means being placed outside of the room in a position in the circuit to induce circulation and recirculation of air in the room, and said heating means permitting control of the temperature of the air to the room without varying the amount of air circulated and recirculated.

Still another object is to provide, in each closed circuit, means for humidifying the heated air, by which means the humidity can be controlled separately for each room independently of other rooms.

The invention further provides in each closed circuit, means for introducing fresh air, by which means the extent of fresh air can be controlled separately for each room independently of other rooms.

Another object is to provide, in each closed circuit, means for discharging used or foul air, by which means the extent of used air discharged can be controlled separately for each room independently of other rooms.

The invention also provides, in each closed circuit, means for hand or automatic control in each room, independent of other rooms, so that the air circulated and recirculated in that room may be controlled independently for the amount of air circulated and recirculated, independently for the temperature of the air, independently for

the humidity of the air, independently for the amount of fresh air admitted, and independently for the amount of foul air discharged.

An additional object is to permit greater freedom of choice as to size, dimensions or design of the radiator or convector to be employed in heating the air for any particular room without said radiator occupying space in said room, and thus have it accord accurately with the requirements of the particular room to be heated.

The invention also comprises a novel duct unit connecting the air inlet and outlet passages for a room and containing means for heating the air. Said duct may also contain humidifying means and various air controls as hereinafter noted.

Other features and advantages of the invention will be hereinafter described and claimed.

My method for heating and conditioning air may be briefly outlined as follows:

A passage or flue for heated air, which may also be conditioned air, is made from the cellar to each room, preferably by use of the space within the walls in the rooms and between the studing or vertical beams of the house, with a passage or flue through or around each cross-beam which would interfere with such passage or flue. Each such passage may use only structural members and walls forming part of the house or may have special ducts between the walls to carry the heated air. Such passages may or may not be insulated, as desired. The opening of each such passage into a room may be made, as desired, with or without control of the opening. The opening of each such passage into a room may be at any height desired and in any location desired.

Another similar passage may in a similar manner lead from each room to the cellar to carry the heated air used in the room back to the cellar. The opening into the room of such passage may be of any height desired and in any location desired. Openings of the passages carrying heated air into each room are preferably located at high points in the wall while openings of passages carrying air from each room are preferably located at low points in the wall. Both passages may be located adjacent to each other, in an inside partition wall and opposite to a window. The passages to and from a room are connected together by a duct in the cellar to make a closed circuit. Any two passages may be employed from the room to the cellar for the purpose of the one to convey the heated air to the room and of the other to carry the air from the room back to the cellar. More than one passage may be used

for admitting hot air into the room, and more than one passage may be used for discharging cooled air from the room.

In each duct there is inserted a radiator, convector or other similar device for heating the air and causing the circulation of the air through the passage to the room to be heated and back through the other passage, such duct containing the radiator, convector or other device to constitute part of a closed circuit with the room to be heated. Devices such as water sprays or other apparatus may be put in each duct for humidifying or conditioning the air in each closed circuit, and devices may be put in each duct for the admission of the proper percentage of fresh air into the circuit and discharging excess air. Controls, direct or through by-passes, using such controls as dampers, valves or other devices may be put in each duct for separately regulating the degree of heat or humidity.

One or more heat generator units placed in the cellar or any other convenient spot and of any known design may be used to supply hot water or steam or other fluid or vapor to each radiator or convector or other similar device in each duct by a common form of pipe connection with a return line to the heat generator unit, and any such heat generator may use any type of fuel, such as coal, oil, gas, electricity.

In the preferred embodiment of my invention as illustrated in the following drawings:

Fig. 1 is a diagrammatic view in vertical section illustrating an embodiment of the invention.

Fig. 2 is a vertical section on a scale enlarged from that of Fig. 1 of a duct connecting an air inlet and return passage of one of the rooms, said section being taken on line 2—2 of Fig. 3.

Fig. 3 is a vertical section of said connecting duct taken on line 3—3 of Fig. 2.

Fig. 4 is a partial plan view illustrating an arrangement of rooms and air passages for the practise of the invention.

Referring to the drawings, the reference characters A, B, C, and D designate rooms in a house in conjunction with which the invention is illustrated; rooms A and C being on the first floor and rooms B and D on an upper floor. E refers to the cellar. Rooms A and C are separated by a partition F and rooms B and D by partition G. An embodiment of the invention will be described particularly in conjunction with rooms A, B, and C by way of illustration.

At 1a, 1b, and 1c there are shown passages for the inlet of hot air to the respective rooms A, B, and C. While these passages may consist of special ducts mounted within the walls, they are shown in Figs. 1, 2, and 3 as formed by the studding 2 and walls 3 and 4. In other words, in Figs. 1, 2, and 3, said passages are shown as comprising the space between adjacent studs 2 and the walls 3 and 4 on opposite sides of said studs. Said walls may be formed of lath and plaster, or plaster board, or in any other customary or desired manner. All horizontal cross-pieces which would interfere with said passages are cut away as indicated at 5a, 5b, and 5c.

In the walls 4, preferably near the ceilings of the rooms to be heated, there are shown registers 6a, 6b, and 6c, in communication with the respective passages 1a, 1b, and 1c. Said registers may be of any desired form, and any register may be located where desired for leading heated air to the room. The registers may be controlled in any suitable way to vary the amount of air delivered thereby to the respective rooms,

for which purpose each register may have movable vanes 7, and the vanes of each register may be operated by a control wire 8a, 8b, and 8c. The latter may be connected to manually operable levers on control panels 9a, 9b, 9c on the walls 4 in the respective rooms, or may be controlled in any other suitable manner.

At 10a, 10b and 10c there are shown passages for the discharge of cooled air from the rooms to the cellar. These passages may be formed in the same way as the passages 1a, 1b, and 1c. Near the floor of each room is an air register 11a, 11b, 11c, which, like the registers 6a, 6b and 6c, may have movable vanes. The registers 11a, 11b, 11c, when located within hand reach as shown, may be operated by hand directly instead of from the control panels.

It will be evident that by operating the controls of the air registers separately or together, any amount of air up to the maximum available may be allowed to circulate into and from each room independently of air circulation in any other room.

The outlet passages 10a, 10b and 10c, like the inlet passages 1a, 1b, and 1c, extend into the cellar as shown.

Each inlet and outlet passage for a room is in communication with a cross-connecting duct unit in the cellar. Thus, where the passages 1a and 10a enter the cellar there is inserted a cross-connecting duct 13a. A similar duct 13b connects the passages 1b and 10b; while the passages 1c and 10c are likewise connected by duct 13c. Since said ducts 13a, 13b and 13c are the same in construction, a description of the duct 13b will be sufficient. Reference may be had, in this connection, to Figs. 2 and 3, in which said connecting duct 13b is shown on a larger scale than in Fig. 1.

Said duct 13b may, as shown, comprise a casing of sheet metal or other suitable material, which casing includes front and rear walls 14 and 15, joined by side walls 16 and 17. A partition wall 18 also extends between the walls 14 and 15. The wall 15 is shorter than the wall 14 and connects at its upper edge with a top wall 19 which extends between the walls 17 and 18. The inner edge of the top wall 19, terminates short of the wall 14, as shown in Fig. 3, and from said inner edge of wall 19 there extends upwardly a wall or plate 20, which is spaced from wall 14 an extent substantially equal to the distance between the walls 3 and 4 of the passage 1b. An angle plate 21 secured to the partition 18 and comprising horizontal and vertical portions 21', 21'' is adapted to engage the inner face of the beam 22 underlying one of the studs 2, at the same time that the plate 17 engages the opposite inner face of the adjacent beam 23, which underlies the adjacent stud 2. Said plate 21 extends between plate 20 and wall 14. The upper portions of the casing walls 14 and 17, together with the plates 20 and 21 form a neck or channel from the casing which is adapted to enter the air inlet passage 1b with a snug fit and to provide communication between said passage and the portion of the casing between wall 17 and partition 18. The engagement of the horizontal portion 21' of the angle plate 21 with the bottom of the beam 22 may determine the extent of insertion of the casing neck into said passage 1b. The wall 14 is, of course, cut away between the angle plate 21 and extension 18' of the partition 18, to accommodate the beam 22 as well as the associated beam 22'. Similarly, 75

the plate 20 is cut away above the horizontal portion 21' of the angle plate 21 and to the left (as viewed in Fig. 2) of the vertical portion 21'' of said angle plate, to accommodate said beams 22, 22'. A top wall 19' (Fig. 2) in line with wall 19 projects inwardly from wall 15 to the same extent as wall 19 and extends between the partition 18 and the casing side wall 16. From the inner edge of said wall 19', a plate 20' similar to plate 20, extends upwardly across the space between the upper portions 16', 18' of wall 16 and partition 18. Said plate 20' is spaced from the opposite portion 14' of wall 14 to the same extent that plate 20 is spaced from wall 14, so that said plate 20' and the portion 14' of wall 14 may enter the passage 10b. At the same time, the upper portions 16', 18', respectively of the wall 16 and partition 18 engage snugly the opposite inner faces of the beams 22' and 24 as shown in Fig. 2. The aforesaid wall portions 14', 16', 18', and plate 20' thus constitute a neck or channel for fitting snugly into the air outlet passage 10b and providing communication between the latter and the space within the casing between the wall 16 and partition 18.

A bottom plate 25 extends from wall 17 and terminates at one end in line with and below the partition 18, said plate 25 also extending between the corresponding portions of walls 14 and 15. The partition 18 terminates at its lower end substantially above said bottom plate 25, thereby providing an opening for communication between the compartments of the casing on opposite sides of said partition. The wall 16 extends slightly below the wall 17, as do also the portions of plates 14 and 15 between wall 16 and partition 18; and between said wall 16 and associated portions of walls 14 and 15 there extends a bottom plate 26. A pivoted damper 27 extends between walls 14 and 15 and across the opening between the bottom plates 25 and 26 for a purpose hereinafter mentioned.

The various elements of the casing above described may be united in any suitable way as by welding or otherwise. Preferably, however, the wall or plate 15 is removable, for which purpose it may be flanged as indicated at 15', 15'', and may be provided with a handle 28.

The duct or casing 13b may be positively fastened in place by any suitable means, such as by angle brackets 13', 13'' welded or otherwise secured to said duct and bolted to the respective beams 23, 24.

Means are provided in the casing aforesaid for heating the air for the passage 1b; and means may also be provided in said casing for humidifying said air. The humidifying means may take any convenient form and may, for example, be constructed as follows:

Mounted in the upper portion of the space between partition 18 and wall 14 is a water pan 29, which may conveniently be supported on a bracket 30 suitably secured to said partition and wall. At opposite sides of said pan are passages 31, 32, controlled by a pivoted damper 33, so that heated air may be passed through either of said passages to the passage 1b, or partly through passage 31 and partly through passage 32. Damper 33 is connected to a wire 35 leading to a hand lever on the control panel 3b.

Below said pan 29, and separated therefrom, is a water pan 36, on a bracket 37 secured to wall 17 and partition 18; the space between said pans 29 and 36 being controlled by said damper 33.

Within the pan 29 are short tubes 38, prefer-

ably closely spaced and arranged in staggered formation, and an overflow tube 39. All of said tubes are open at both top and bottom. Strips 40 of wicking or other suitable absorbent material are stuffed through the tubes 38, so that their upper ends are immersed in the water in the pan 29 and their lower ends extend into the pan 36. The pan 29 is supplied with water by pipe 41 and branch pipe 42.

The strips 40 of absorbent material absorb water from said pan and convey it into the pan 36. If the water level in pan 29 rises over the top of the tube 39 the excess flows directly through said tube and is received by said pan 36.

The pan 36 is provided with an outlet pipe 43 which is connected with a pipe 44 that is in communication with a tank 45 (Fig. 1) containing a float 46. The latter, through any conventional means, such as rod 47 and lever 48, operates a valve 49 in the pipe 50, connected to the city water line. Said pipe 50 is in turn connected beyond valve 49, as shown in Fig. 1, to the pipe 41 through which water is supplied to the pan 29.

When the water level in pan 36 falls below the desired height, the float 46 likewise falls and opens the valve 49, sending city water into the pan 29, whence it is supplied to pan 36 by absorption by the material 40, or by running down this material through the short tubes 38, or by overflowing through the overflow tube 39. The water level in the pan 36 thus rises until it reaches such height as to cause the float 46 to close the valve 49. By this arrangement air when passing through passage 31 travels past the wet absorbent material 40 and becomes humidified. Air passing through passage 32 is not humidified and by mixing the air in varying quantities from passages 31 and 32 humidity control can be obtained through use of damper 33.

The means for heating the air in the connecting duct above described and for thereby inducing circulation and recirculation of air through the passages 1b and 10b, may be of any suitable form and may utilize any desired heating medium such as gas, electricity, steam, or hot water. For example, the heating means take the form of a radiator or convector unit 51, comprising a series of coils 52 provided with metal fins 53. Said unit 51 is suitably mounted in a space between wall 15 and a partition 54, providing a passage 55 for the travel of air through the convector unit, and another passage 56 for air to travel to the side of said unit without being heated thereby. A pivoted damper 57 controls said passages, an arm 58 of said damper being connected by a wire 59 to a hand lever on the control panel 3b for manipulation as desired.

Through operation of said damper 57, cooled air received from passage 10b may be passed through passage 56 without heating or sent through passage 55 to be heated, or may be passed partly through passage 55 and partly through passage 56, thereby changing the air temperature without using the air register controls to change the amount of air circulated in the room.

In the present embodiment the convector unit 51 is supplied with steam from a pipe 60, through branch pipe 61. A valve 62 in said pipe 61 is operable to control the entrance of steam to the coils of said convector, said valve being actuated by a lever through a wire 64 connected to a hand lever on panel 3b. The return of said valve to closed position when wire 64 is released may be insured, if desired, by a spring (not shown) con-

connected to the lever 63, as will be readily understood. It will be evident that any amount of heat may be supplied to the convector unit 51 by operating the valve 62 from the associated control panel, thereby permitting variation of the temperature of the air supplied to the room without using the controls of the air registers to vary the amount of air in circulation in the room.

The condensate from the convector 51, is returned by pipe 65 to a pipe 66.

The connecting ducts 13a and 13c are similar in construction to that above described in conjunction with the duct 13b. Each of said ducts contains a convector, a humidifying means, and the valves and dampers previously described. The same reference numerals designate similar parts in all of the units 13a, 13b, and 13c aforesaid. In this connection it may be noted that the pipe 41 supplies water to the pans 29 in all of said units, and that each of the pans 36 is connected to the piping 44 in which the float tank 45 is inserted. Thus, in the embodiment here described, the water level in all of the pans 36 is the same, and the float 46 controls the supply of water to all of the pans 29, and thence to the pans 36. Also, the pipe 60 supplies steam to all of the convector units 51, while the pipe 66 receives condensate from all of said units. Said pipes 60 and 66 are shown connected to a suitable source of heat supply, such as the horizontal tubular boiler 67 of a steam generating furnace. Water may be supplied to said boiler from the city supply pipe 50 through pipe 68, under control of valve 69. A blow down valve to city drain 70 through pipe 71 is shown at 72. 73 designates the return drain piping from the convector units 51 to the boiler, entering the latter below the water line. A check valve in said return drain piping is indicated at 74. The furnace is indicated as of the oil-fired type, and as supplied with oil through valve 75 in piping 76 leading to an oil tank outside the house. The boiler may include the usual gage glass 77 and safety-valve 78, as well as a pipe 79 leading to the pipe 60 for supplying steam to the convectors 51. An air relief valve in the pipe 60 may be provided as shown at 80, while a hand valve 79' may control the supply of steam from the boiler through the pipe 79. If continuously running water is desired for the humidifiers, the tank 45 may, as shown, be connected through valve 81 and pipe line 82, with the city drain 70.

The products of combustion from the furnace may be passed through the uptake 83 to the chimney 84, which may be provided with a cleaning door 85.

A pipe 86, which leads from the cellar to the outside air is connected to the space 87 in each of the ducts 13a, 13b, 13c, as, for example, by a branch pipe 86'. In each of said ducts there is provided a pivoted damper 88 for controlling the opening of passage 87 and hence the amount of fresh air which can enter the duct. Said damper in each unit is controlled by wire 89 leading to a lever on the control panel associated with said unit.

The bottom damper 27 previously noted is controlled in each unit by a wire 90 passing around suitable pulleys 91 and extending to a corresponding lever on the associated control panel. By pulling on the wire 90 of any of the ducts 13a, 13b, or 13c, the corresponding damper 27 may be opened to any desired degree, discharging used air either through piping to the outside air,

or directly into the cellar where it will be absorbed by the heat generating unit. By leaving the wire 90 loose, the damper 27 will act as a swinging check valve, allowing excess air in the closed circuit to escape at any time and closing if air tends to rise from the cellar into the duct which carries said damper.

By locating a convector 51 in each of the ducts 13a, 13b, 13c, for the respective rooms, the necessity for any radiators in the rooms is avoided. The same applies to the humidifying apparatus.

It will be observed from the foregoing description that I provide separate means for each room for circulating air independently of other rooms, and also for controlling the temperature and humidity of the air supplied to each room separately and independently from that of the air for other rooms. More specifically, the amount of air supplied to each room may be controlled by operating the registers for that room, independently of the amount of air furnished to any other room. By manipulating the wire 64 connected to valve lever 63, the temperature of the air supplied to any room may be controlled independently of the temperature of the air supplied to other rooms; and the heat supplied to any room may further be controlled independently of other rooms by operating the damper 57 through wire 59 for that room. Through the wire 35 connected to damper 33, the humidity of the air supplied to any room may be controlled as desired, irrespective of the air for other rooms. The damper 88, controlled through wire 89, enables the input of fresh air to be regulated separately and independently for each room. And through wire 90 and damper 27 the outlet of used air for each room may be separately and independently controlled.

To summarize, it will be apparent that I have provided a closed circuit for each room for circulating and recirculating air for that room irrespective of other rooms. Also, I have provided in each room means independent of other rooms, and independent of each other, for controlling (1) the amount of air circulated and recirculated in each room; (2) the temperature of air circulated and recirculated in each room; (3) the humidity of air circulated and recirculated in each room; (4) the input of fresh air circulated and recirculated in each room; and (5) the outlet of used air from each room. The desired characteristics of the air for any room may thus be accurately and expeditiously obtained without influencing, or being influenced by, the air supplied to other rooms. At the same time these objects are achieved without the provision of radiators, convectors, or humidifiers in the rooms themselves; and without the necessity of providing pipes running throughout the house to radiators or convectors in the various rooms thereof.

It will of course be understood that the other rooms of the house may likewise be each provided with an air inlet passage and an outlet passage connected in the cellar by a duct similar to the duct 13a, 13b, or 13c above described. In Fig. 1, for example, the upstairs room D may be provided with passages arranged in the manner illustrated in conjunction with room B, which passages may be connected by a duct which is the same as duct 13b. A portion of the air outlet passage from room D is shown at 10d, and a portion of the outlet register at 11d.

Fig. 4 shows diagrammatically in horizontal section the adjoining rooms A and C together with

the air inlet passages 1a and 1c and the outlet registers 11a and 11c, as well as the inlet and outlet passages 1b and 10b, respectively, which lead to the upper room B of Figure 1. A portion of outlet passage 10d which leads to room D is also shown. As previously noted, said passages to the various rooms may either be formed as spaces between adjacent vertical studs and the walls on opposite sides thereof, or may consist of special ducts of metal or other suitable material. Said passages may, of course, if desired, be insulated by suitable non-heat-conducting material, as may also the connecting duct units 13a, 13b, and 13c.

It will further be clear that, if desired, two adjacent rooms having a common partition wall may be supplied with air from a common duct in the cellar having a single radiator or convector and/or humidifier, said duct connecting an air inlet and an air outlet passage in the common partition wall, the air inlet passage having an opening into each room and the air outlet passage also having an opening from each room. Such arrangement may be employed when the same temperature and humidity conditions are to prevail in said adjacent rooms. At the same time it should be noted that the embodiment illustrated presents distinct advantages over the modification above described, since said illustrated embodiment enables the air conditions for each room to be controlled expeditiously and precisely without being affected by conditions in another room, so that the optimum conditions for any particular room may be attained with particular accuracy and facility.

It will be apparent that, if desired, a blower or other forced draft means may be placed in each air inlet passage 1a, 1b and 1c, or in each duct 13a, 13b, and 13c (as for instance in or adjacent to the lower end of the neck or channel which fits into the passage 1a, 1b, or 1c) for creating a forced draft of air through said inlet passages into the respective rooms. However, the draft induced by the heater 51 in each duct, and the resulting convection currents, may be utilized without forced draft for the circulation and recirculation of air through the passages and room connected thereto. In either case the heated air issues from the inlet register 6a, 6b or 6c, and spreads therefrom through the room, while the cooled air passes downwardly and thence into the outlet duct 10a, 10b, or 10c into the passage between the walls 16 and 18 of the associated duct 13b, whence it travels into the compartment of said duct which contains the heating unit and then rises into and through the inlet passage 1a, 1b, or 1c.

The terms and expressions which I have employed are used as terms of description and not of limitation, and I have no intention, in the

use of such terms and expressions, of excluding any equivalents of the features shown and described or portions thereof, but recognize that various modifications are possible within the scope of the invention claimed.

The term "basement" employed in the ensuing claims refers to any space beneath the main or primary floor structure of the building.

I claim:

1. In a system for heating a plurality of rooms in a building; a plurality of vertically extending channel means for the ascent of heated air, one for each of said plurality of rooms; a plurality of vertically extending channel means for the descent of cooled air, one for each of said plurality of rooms; a plurality of cross-connecting ducts in the basement of the building, each of said ducts connecting the heated and cooled air channels of a corresponding room and completing a circuit for circulation and recirculation of air through the room; a plurality of heating units, one in each of said ducts for heating the air therein and inducing circulation of air through the channel means connected to said duct; a source of heat supply common to said heating units and connected thereto; and means connected to each of said heating units for controlling the amount of heat supplied thereto.

2. A heat supply system as defined by claim 1, in combination with means mounted in the respective rooms and connected to the controlling means of the respective heating units for enabling operation of the controlling means for said units from the corresponding rooms.

3. A heat supply system as defined by claim 1, in combination with means in each of said ducts for humidifying air passed therethrough, means for controlling each of said humidifying means, and means mounted in said rooms and connected to the controlling means of the respective humidifying means for enabling operation of the respective controlling means from the corresponding rooms.

4. A heat supply system as defined by claim 1, in combination with means cooperating with each of said ducts for controlling the admission of fresh air thereto, and means mounted in said rooms and connected to the controlling means of the respective ducts for enabling operation of the respective controlling means from the corresponding rooms.

5. A heat supply system as defined by claim 1, in combination with means cooperating with each of said ducts for controlling the escape of used air therefrom, and means mounted in said rooms and connected to the controlling means of the respective ducts for enabling operation of the respective controlling means from the corresponding rooms.

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