

June 2, 1942.

C. I. MURDOCK

2,284,674

HEATING SYSTEM

Filed Dec. 16, 1937

2 Sheets-Sheet 1

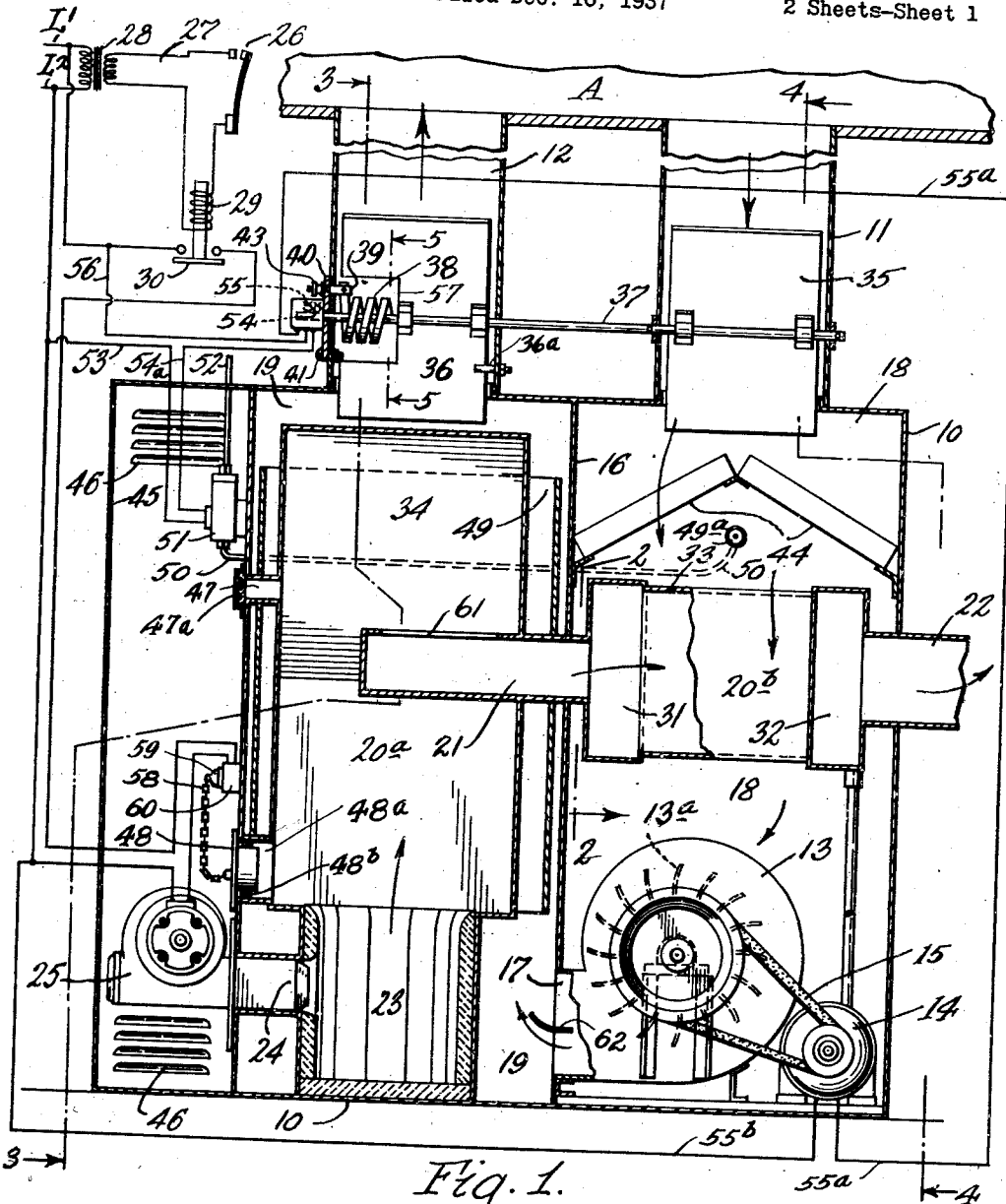


Fig. 1.

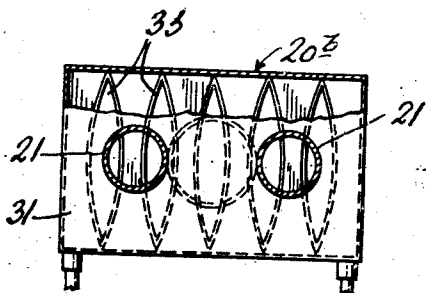


Fig. 2.

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2 Sheets-Sheet 2

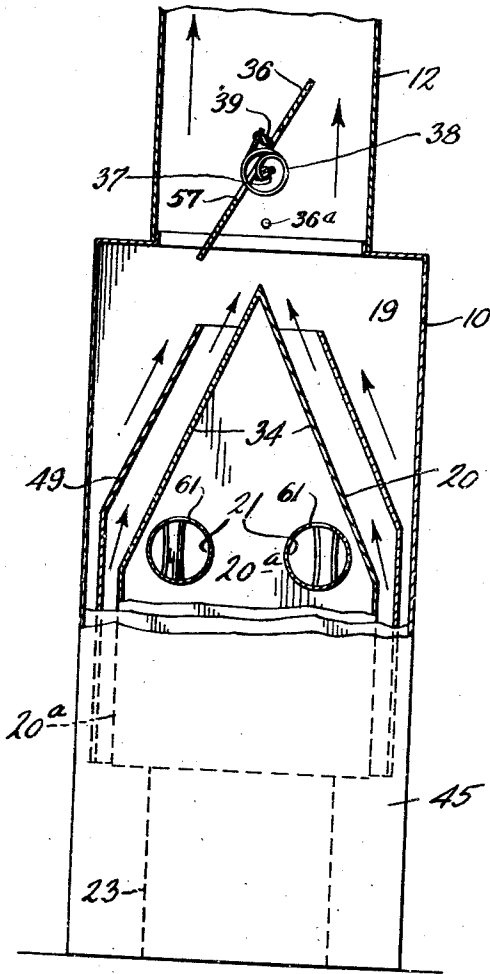


Fig. 3.

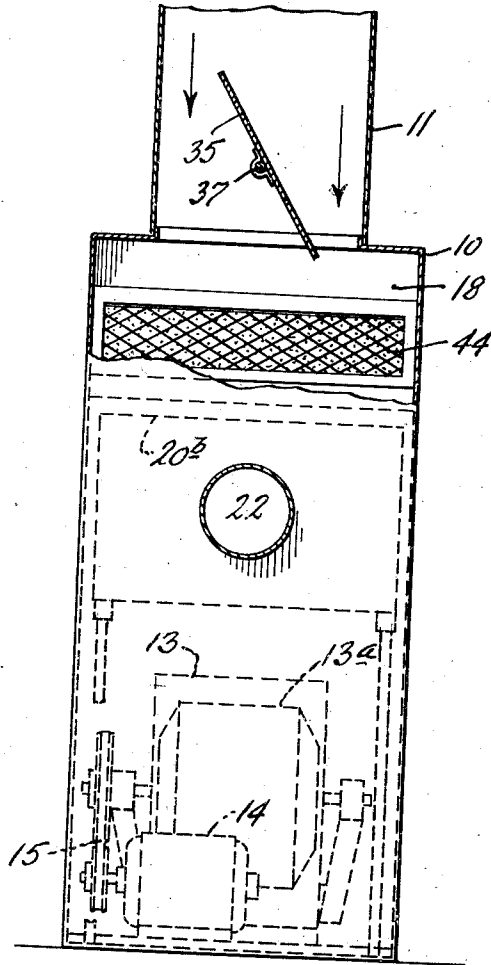


Fig. 4.

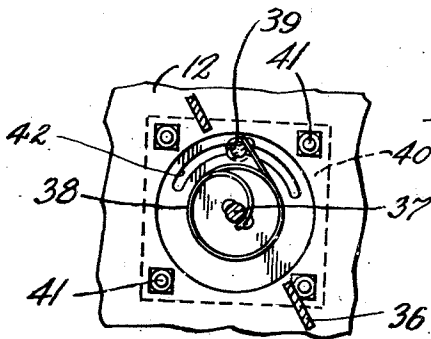


Fig. 5.

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2,284,674

HEATING SYSTEM

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22 Claims. (Cl. 237-2)

This invention relates to heating systems of the type in which heated air is circulated through a room or rooms and a heating unit, in succession, and is particularly useful in that type of heating system in which the air may also be conditioned. Heating units have recently come into extensive use of the type in which heat is applied intermittently under the control of a thermostat disposed either in a room being heated or in a position in which it is directly responsive to the temperature of the room. Due to such intermittent operation of the heater, that is, with respect to the intermittent supply of heat thereto, it follows that the temperature of the air delivered by the heating unit will be relatively high while the heat is being supplied to the unit and for a short time after the supply of heat is discontinued and while the heating unit is cooling off, and relatively lower while no heat is being supplied to the unit and after the unit has cooled.

If the difference in densities between the heated and normal air is relied on to cause circulation of the air through the heating unit, it follows that when no heat is supplied to the unit it will cause no appreciable movement of air through the room, with the result that the air in the room has a tendency to stratify into horizontal layers or zones of different temperatures. The coldest air settles to the bottom of the room, and the hot air rises to the top, with strata of intermediate temperatures between the two, so that a thermostat on the wall of the room intermediate the floor and ceiling will indicate a temperature which corresponds to the temperature of the air in that strata but not the strata at the bottom or upper part of that room. This produces an undesirable atmospheric condition which is not conducive to maximum comfort of people in the room.

To correct this difficulty blowers have come into common use. The blower is controlled by a thermostat element placed in the warm air chamber of the furnace. At the beginning of this practice the blower and burner were operated simultaneously. This method corrected the stratification while the blower was in operation. When the blower stopped the personal comfort in the room was less than with the heating system operating on a gravity basis. The common application today on the forced air or conditioned air system is to start the blower at about 115° at the bonnet of the heater and stop the same at 125°. This method does not function properly, for the short pipes feed warm air to the rooms where connected, and the rooms far from the

furnace are not supplied with air when the blower is stopped.

Attempts have been made to remedy this difficulty by circulating the air through the heating unit and a room or rooms continuously by a blower, which prevents stratification of the air and insures that all parts of the rooms will have the same temperature at the same time, but such devices have been unsatisfactory for the reason that as the air in a room cools, the circulation of air at the same rate often produces objectionable drafts of relatively cool air that strike people occupying the room. Attempts have been made to overcome this objection by using two speed motors for the blower, and special thermostats placed at various positions to control the speeds, but such controls have not been entirely satisfactory.

An object of this invention is to generally improve heating systems of this type, and provides a heating unit which will maintain the most desirable atmospheric conditions in said room or rooms at all times, and which will be relatively simple, compact, effective, efficient and inexpensive.

Another object of the invention is to provide an improved heating unit and heating method for systems of this type, with which stratification of the air in any room into different horizontal zones of different temperatures may be effectively prevented, and the movement of the air in the room so controlled as to prevent objectionable drafts of relatively cool air at all times, and yet with which the power consumption for creating the circulation of air in the room will be a minimum under all operating conditions.

Another object of the invention is to provide an improved and compact heating unit, with which maximum efficiency of heat transfer will be obtained in a simple and effective manner.

Another object of the invention is to provide improved and effective means and methods for adding moisture to the air being circulated through any room, with which waste of water will be reduced to a minimum, and vaporization accomplished efficiently in accordance with the activity of the heater.

Various other objects and advantages will be apparent from the following description of an embodiment of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

Fig. 1 is a sectional elevation through a heat-

ing unit constructed in accordance with this invention;

Fig. 2 is a sectional elevation through a part of the same, the section being taken approximately along the line 2—2 of Fig. 1, with portions broken away to show interior details;

Fig. 3 is a front elevation, partly in section, of the same, with the section taken approximately along the line 3—3 of Fig. 1;

Fig. 4 is an opposite, rear elevation of the same, partly in section, and with the section taken approximately along the line 4—4 of Fig. 1; and

Fig. 5 is a sectional elevation through a portion of the same, with the section taken approximately along the line 5—5 of Fig. 1.

In the illustrated embodiment of the invention, the improved heating unit includes a cabinet 10 of any suitable or desired shape into one zone of which the cold air return conduit 11 opens and into another zone of which a hot air supply conduit 12 opens. The conduits 11 and 12 may, if necessary, be branched and are connected to different zones of a room or rooms to be heated in a manner common with hot air heaters and air conditioning apparatus, one such room being designated "A" in Fig. 1. A blower 13 is associated with the cabinet and the conduits 11 and 12 for causing a circulation of air through the cabinet between the conduits 11 and 12 and thus through the room or rooms to be heated. When the temperature of the air delivered to conduit 12 is above approximately 80° F., blower 13 is operated continuously and at an approximately constant speed, in any suitable manner, such as by a motor 14 which is connected to the rotor 13a of the blower 13 in any suitable manner such as by a driving belt 15. The blower is illustrated as of the centrifugal type, which is preferred, but obviously other types of air circulating devices may be used within the broader concept of the invention.

The blower 13 is preferably and conveniently disposed within the cabinet 10 at one side of a partition 16 which passes across the interior of the cabinet 10, but disposed between the conduits 11 and 12. This partition 16 has an aperture or opening 17 adjacent its lower end by which air may pass from one side of the partition to the other in its travel between the conduits 11 and 12. The blower 13 at its intake side opens into the compartment 18 of the cabinet at the side of the partition 16 into which the cold air conduit 11 opens. At its discharge side the blower 13 is connected to and fills the aperture or opening 17 of the partition 16 so that the blower draws air from the compartment 18 and delivers it under pressure through the opening 17 into the compartment 19 at the opposite side of the partition 16, and into which compartment 19 the hot air conduit 12 opens. The conduits 11 and 12 conveniently open into the cabinet at the upper part thereof.

Within the cabinet I provide a heat exchange device 20, one section 20a of which is disposed in the compartment 19 and another section 20b of which is disposed in the compartment 18, the sections 20a and 20b being connected in series to one another by a pair of conduits 21 which pass through the partition 16. A flue discharge pipe 22 connects the interior of the section 20b with the exterior of the cabinet, and as usual connects to a chimney or other flue discharge device. A heating medium is supplied to the section 20a of the exchange device in any suitable manner,

but is preferably of the type in which the heat is supplied only intermittently under a suitable control. In the example illustrated, the heating medium is supplied to the section 20a, at the bottom portion thereof, from a flame compartment 23 of a suitable burner 24.

This burner may operate with any desired fuel, but gas and oil burners are the most commonly employed in the intermittent type of heating unit. In the drawing an oil atomizing and air mixing or fuel supply unit 25 is illustrated conventionally and arranged to supply a combustible mixture of air and fuel to the flame compartment 23 where it is ignited and burned. The burning gases rise and pass through the section 20a which may be called the combustion chamber and thence pass through the pipes or conduits 21 into the section 20b and thence through the exhaust flue 22. The unit 25 is operated intermittently in any suitable manner, but a simple intermittent control therefor is illustrated diagrammatically in Fig. 1. In accordance with such control a thermostat 26, which may be conveniently disposed in the room to be heated, is included in a low voltage electric circuit 27 which also includes in series therein the secondary winding of a transformer 28 and the winding of an electromagnetic switch or relay 29. The relay 29, through its contact mechanism 30, controls a commercial line circuit represented by line wires L1, L2 running to the mixing unit 25, the switch device 30 being in series in the circuit to the unit 25. The primary of the transformer 28 is connected also to the line wires L1 and L2. The lines wires L1 and L2 may represent a standard commercial electric lighting circuit. The transformer 28 supplies a low voltage current of approximately 6 to 12 volts to the thermostatic circuit 27. Thus when the thermostat 26 closes its circuit, relay 29 will be energized and will close the circuit to the mixing unit 25 and cause the delivery of a supply of heat to the heat exchange device in the cabinet.

When the temperature in the room reaches the desired maximum, the thermostatic switch 26 opens its circuit 27 to cause a deenergization of the relay 29, an opening of the contact mechanism 30, and a shutting down of the mixing unit 25, with a resultant cutting off of the delivery of heat to the heat exchange device. Inasmuch as the thermostatic control of the operation of any such mixing unit 25 is well known in the art by itself, and per se is no part of the present invention, such control has been illustrated only diagrammatically, and it will be understood that any suitable thermostatic control, by which the mixing or fuel supply unit 25 is operated intermittently as needed to maintain a desired temperature in the room, may be employed. The fuel and air are discharged by the unit 25 into the flame compartment 23 which is lined with refractory material or any other suitable lining material, and this compartment 23 opens upwardly into the lower part of the section 20a which forms the combustion chamber where the combustion of the fuel is completed. The gases of combustion then pass through the pipes 21 and the heat exchange section 20b to the flue discharge pipe 22.

The section 20b, which may be termed a secondary heat exchange element, may be of any suitable design, but is preferably of the type having headers 31 and 32 which are connected by a plurality of thin flues 33, slightly spaced from one another, so that the air to be heated may pass

downwardly between the flues for a heat exchange with the gases of combustion. The flues 33 are preferably exteriorly convex so as to provide between them air passages that in cross section somewhat resemble Venturi tubes and reduce the resistance to air flow between them to a minimum. The compartment 19 is preferably generally rectangular in shape, and the section 20a is also rectangular in shape in cross section, but with upwardly tapered side walls 34 extending directly toward the opening into the hot air conduit 12 like the peak of house roof.

In one or both of the conduits 11 or 12 I place means for partially and materially restricting, but not fully obstructing, the flow of air through the cabinet 10. Preferably a damper 35 is placed in the cold air conduit 11, and a damper 36 is placed in the hot air conduit 12. Each damper may be of the butterfly type fitting loosely in its conduit and having sufficient clearance between its periphery and the conduit walls so that the conduit cannot be fully closed when the damper is in closed position. For example, a clearance of at least one-half inch may be provided between the periphery of each damper and the adjacent walls of the conduit in which it is placed. The dampers are both fixed on a shaft 37 so as to oscillate therewith, and the shaft 37 extends between and through both of the conduits and is rotatably supported by the conduit walls. The shaft 37 is controlled or operated in any suitable manner, either directly or by remote control, from a thermally responsive device 38 that is disposed in a position where it is directly responsive to the temperature of the air delivered by the cabinet 10 to the hot air conduit 12. This thermally responsive device 38 may advantageously be disposed within the hot air conduit 12, and operatively and directly connected or coupled in any desired manner to the damper shaft 37.

The thermally responsive device 38 may, for example, be a bimetallic spiral device or helix, one end of which is anchored to the shaft 37 which extends through the conduit 12, and the other end of which bimetallic element is anchored in any suitable manner. An example of such an element is shown in U. S. Patent No. 1,989,278 of January 29, 1935. In the present example the thermal element is anchored to a stud 39 which is clamped to a plate 40 provided on a side of the conduit 12. The plate 40 is releasably mounted on the conduit in any suitable manner such as by screws 41, and the stud 39 passes through a slot 42 in the plate 40. The slot 42 is arcuate with its center of curvature approximately at the axis of the shaft 37, so that by adjusting the stud 39 to different positions along the slot 42, the temperature at which the thermostatic device 38 closes the dampers 35 and 36 may be varied. The stud 39 carries a nut 43, which, being threaded on the stud 39, serves to clamp the stud releasably and adjustably to the plate 40.

It will be understood, however, that various other types of thermally responsive devices with means connecting the same with the damper for operating the same may be utilized. Many such devices are in common use in the air conditioning art, and my invention in its broader concept comprehends the utilization of any of those thermostatic controls by which the dampers may be controlled in accordance with the temperature of the air delivered through the conduit 12.

Suitable filters 44 may be disposed across the

upper part of compartment 18, so as to screen out dust from the relatively cold air entering the compartment 18 from the cold air conduit 11, but inasmuch as such filters are well known in the air conditioning art, they have been illustrated only diagrammatically or conventionally, and it will be understood that any of the usual types of such filters or screens may be employed. They are preferably made in sections disposed at an angle to one another, as shown in Fig. 1.

A removable cover 45 may be applied over the unit 25, and this cover may have air admission louvres 46. A safety control passage 47 and a service door 48 may be provided on one side of the heat exchange section 20a and accessible when cover 45 is removed.

Within the chamber 19 I preferably provide a radiation shield 49 between the section 20a of the housing for the combustion chamber and the outer wall of the cabinet, and spaced from both. The upper part of the side walls of shield 49 converge towards the opening into the hot air conduit 12, so that the air ascending between the shield and the section 20a will wipe along the tapered or peak shaped top of the housing or section 20a as well as the shield and be discharged directly towards the opening into the conduit 12. Since the radiation shield is spaced from the outer walls of the cabinet 10, air may pass along all of its faces. The shield absorbs radiant heat from the heat exchange section 20a, and the air moving along the shield is directly heated by this radiant heat that has been absorbed by the shield. The temperature of the outside walls of the cabinet is thus kept low and a more effective and efficient heat exchange between the gases of combustion and the air passing through the cabinet is obtained. While one flue 21 may be provided between the sections 20a and 20b, I have advantageously utilized two of such flues 21, disposed as shown in Fig. 3, which appears to provide for a more uniform distribution of the gases of combustion across the header 21 of the heat exchange section 20b.

In order to supply the necessary moisture to the air delivered to the room A, I provide a spraying device 49a at any suitable point within the chamber 18, so as to discharge a fine spray of water into the air of the chamber 18 well above the heat exchange element 20b. Thus, the water is sprayed into the descending current of air, and the mixture of air and water is carried over and through the heat exchange element 20b where the heat vaporizes any water mechanically entrained in the air. The water is supplied to the spray device 49a by a pipe 50 which extends into the chamber between the front wall of the cabinet 10 and the cover 45, where it is connected to an electrically controlled valve 51 of any suitable construction. Water is supplied to the valve 51 by a pipe 52 from any suitable source of water under pressure. Wire 53 connects one side of the valve 51 to the line wire L2. Mounted upon the end of the damper shaft 37 which extends through the plate 40 are a pair of mercury tube switches 54 and 55. These mercury switches are very common in the art, and one is shown by way of example in U. S. Patent No. 1,989,278, issued January 29, 1935. A wire 56 leads from the line wire L1 to one contact of each of these mercury switches. The other contact of the switch 54 is connected by a wire 54a to the other side of the valve 51. The tube of the mercury switch 54 is so positioned on the damper shaft 37 that it closes the circuit between the line wires

and through the valve device 51, whenever the thermostatic device 38 operates the dampers 35 and 36 to any substantial extent away from fully open positions in the conduits 11 and 12, and keeps the circuit closed until the dampers return to approximately wide open positions. Thus, when the damper 36 is in fully open position, the mercury switch 54 will open the circuit to the valve device 51 and cause an operation of the latter to admit water from the pipe 52 to the pipe 50 and thence be discharged through the spray device 49a into the air descending in the chamber 18.

As soon as the damper 36 moves to any appreciable extent away from its open position, in a closing direction, the mercury switch 54 will close the circuit to the valve device 51 and cause an operation of the latter to cut off the supply of water to the spray device 49a. While the mercury switch 54 may be so positioned on the damper shaft, and the valve 51 so designed, that the valve 51 is operated to admit water to the spray device 49a when the circuit is closed, and causes a cutting off of the water by an opening of the circuit when the damper moves away from fully open position, the arrangement illustrated provides for the closing of the circuit to cut off the water spray when the dampers start to close. Thus water will be sprayed into the air only while the dampers are in fully opened positions, and the water supply will be cut off as soon as the dampers start to close. The other mercury switch 55 is connected, at the side opposite the connection to the common wire 56, by a wire 55a to one connection of the motor 14, and the other connection of the motor 14 is connected by a wire 55b to the line wire L2.

The switch 55 is so positioned on the damper shaft that it completes a circuit to the motor 14 as soon as the dampers begin to open from their straight across or relatively closed positions, and keeps the circuit closed as the dampers continue to open and while they are in fully open position. The thermal device 38 is so constructed as to cause a start of the opening movement of the dampers whenever the temperature rises above approximately 80° F. Thus when the dampers are fully closed, that is, in a position straight across the ducts, the switch 55 will open the circuit of the motor 14 and shut down the blower which will be whenever the temperature of the air being delivered by the furnace is approximately 80° F. or lower, but as soon as the furnace starts delivering heated air above 80° F., the dampers will start to open and the blower will be started so as to forcibly circulate air through the chambers 18 and 19 in succession.

The damper 36 in the hot air duct 12 is provided with a notch 57 which clears the thermostatic device 38 in all of the angular positions of the damper 36, and thus there will always be a portion of any air circulating through the duct 12, moving through and around the thermal device 38, thus making the thermal device at all times directly responsive to the temperature of the air delivered to the conduit 12, whether or not the dampers are open or closed. When the damper 36 reaches its fully open position, it engages a stop 36a on the wall of duct 12. This stop prevents further opening movements of both of the dampers in the same direction, even though the temperature of the air in the duct 12 may continue to increase through continued operation of the burner. The temperature of the air in the duct 12 which is necessary to cause a

full opening of the dampers is preferably around 125° to 130° F., but the dampers start to open when the temperature exceeds a particular temperature, such as about 80° F. The dampers start their closing movement under the action of the thermal device 38 as soon as the temperature falls below approximately 130° F.

The usual safety controls (not shown) may be applied to the combustion chamber in the usual manner through the passage 47, but if such controls are not employed, the passage 47 may be closed by a suitable window 47a. The service door 48 is forced slidably and snugly into the service passage 48a and held frictionally therein by an annular packing ring 48b of fire resisting material such as asbestos wicking, and is connected by a chain 58 to a removable switch plug 59 of a switch 60 which is included in series with the burner device or unit 25. This friction normally holds the door 48 in closed position in passage 48a. In the event of an explosion in the combustion chamber, the door 48 will be blown outwardly into the interior chamber of the cover 45 and through chain 58 will pull plug 59 and open switch 60. Thus whenever the door 48 is blown outwardly by an explosion, the circuit to the burner 25 will be opened and the operation of the burner shut down automatically. This is a simple but effective safety feature.

In order to insure maximum effectiveness in heat transfer within the unit 20a, the flue pipes 21 are preferably extended well into the combustion chamber of the heat exchange unit 20a, as shown clearly in Fig. 1, and these flue pipes are closed at the ends within the exchange unit 20a but are open through slots 61 in the upper side of the portion of the flue pipes within unit 20a. Thus the gases of combustion, in order to reach the flue passages 21, will be obliged to travel well up into the upper part of the combustion chamber and then descend through the slots 61 into the passages 21, in order to reach the other heat exchange section 20b.

It is also advantageous to insure that some of the air delivered by the blower 13 through the opening 17 into the chamber 19 will pass around all parts of the fire box 23, and for this purpose a baffle plate 62 (Fig. 1) may be positioned across the opening 17 through which air is delivered by the blower 13. This baffle plate 62 extends horizontally across the opening 17 and within the chamber 19 may be curved upwardly slightly, as shown. Baffles of this shape and type and positioned in this manner aid in insuring the delivery of some of the circulated air around the fire box 23 before it rises through the chamber 19 to the duct 12.

The operation of the device should be clear from the foregoing description, but will be briefly summarized. The conduits 11 and 12 are connected to different zones of a room to be heated or air conditioned, or by branches to different rooms, as usual in this type of heater, and the thermostat 26 is set to maintain the desired temperature in the room. If the temperature falls below that for which the thermostat 26 is set, the latter will close the circuit 27 and through it and relay 29 will close a line circuit from line wires L1, L2 to the fuel supply unit 25. This unit 25 then supplies a combustible mixture of air and fuel to the flame compartment 23 and ignites it in a well known manner, and the burning fuel rises into the combustion chamber or section 20a where a heat exchange occurs through the walls

of the section 20a with the air surrounding it in the compartment 19.

The gases of combustion then pass through the section or element 20b where a further heat exchange occurs with the air from the cold air conduit 11. The motor 14 operates continuously at a constant speed whenever the dampers are open or partly open because the switch 55 on the damper shaft closes the circuit of the motor and keeps it closed whenever the dampers are away from approximately straight across or closed positions in the ducts. The blower, which is operated by the motor 14, draws air from the room or rooms through the conduit 11 into the compartment 18, where the air is partially heated by the outgoing flue gases in the section 20b, and then this partially heated air is forced under pressure through the compartment 19, and delivered under pressure through the hot air conduit 12 to the room or rooms to be heated. The air of course is further heated in the compartment 19 by heat exchange with the hotter gases in the section 20a. Any dust in the air is removed in the filter screens 44, and the air delivered into the compartment 19 by the blower will be at the bottom thereof, so that the air receives some heat by radiation and conduction from the flame compartment 23 as well as from the section 20a of the heat exchanger 20.

Whenever the temperature of the air delivered through the conduit 12 is above, say 80° F., the thermostatic device 38 will open the dampers 35 and 36, to increasing extents, with temperature increases, until fully open, so as to allow maximum air travel through the conduits 11 and 12 and the cabinet 10, and after the temperature of the room or rooms has been brought to that for which the thermostat or thermal device 26 is set, the circuit 27 will be opened, the relay 29 de-energized and the switch 30 opened, thus stopping the admission of fuel from the fuel supply unit 25 to the burner. Since the blower 13 continues to operate at the same constant speed, the circulation of air through the cabinet 10 will continue, but owing to the fact that the supply of fuel to the combustion chamber has been cut off, the heat exchanger 20 will soon cool off, and transfer of heat to the air passing through the cabinet will decrease.

The continued operation of the blower will maintain a circulation of air in the room so as to prevent stratification of the air of the room into zones of different temperatures, but as the air delivered through the conduit 12 cools off, such as below 130° F., the thermostatic device 38 will tend to close the dampers 35 and 36 and partially and materially restrict, but not fully obstruct, flow of air through the conduit 11. Thus sufficient air will be continuously circulated through the cabinet 10 and the room at all times, so as to prevent stratification of the air of the room, yet when the dampers are closed or partially closed the movement of the air will be gentle enough so that occupants of the room will not be annoyed by objectionable drafts of relatively cool air, and some of the moving air in conduit 12 will pass through notch 57 in damper 36 where it will affect thermal device 38. By determining the closeness of fitting of the dampers 35 and 36 in the conduit 11, the proportion of the air allowed to flow at any time through the cabinet 10 when the damper is closed or nearly closed may be predetermined to some extent. When the temperature of the air in duct 12 falls to, say, 80° F., the circuit to the

blower motor is cut off, because this temperature of air in duct 12 will be reached only when there is so little temperature difference over outside temperatures that no objectionable stratification of air will occur. This effects a saving in operating power costs when the outside temperature is mild and the forced circulation of air through the heater unit is unnecessary.

The reduction of air flow through the cold air conduit, by the operation of the damper 35, to approximately that which it is desired to pass through the cabinet, while the burner is shut off and blower 13 is still operating, reduces the load on the blower to a minimum, and consequently the motor 14 will require a minimum of current to maintain the blower at a constant speed under such conditions. While the damper 35 in the cold air conduit alone would regulate the amount of air passing through the cabinet, I have found that the use of dampers in both hot air and cold air conduits aids very materially in obtaining a very quiet operation, yet the load on the motor is kept to a minimum when the volume of air handled is reduced.

It will be understood that various changes in the details and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention, as expressed in the appended claims.

I claim as my invention:

1. An improved heating system of the type in which heated air is circulated through a room or rooms, comprising a heating unit having a cold air return conduit leading from one part of said room or rooms and opening into said unit at one point, and a hot air supply conduit opening out of the unit at another point and leading to another part of said room or rooms, a motor operated blower associated with said unit for circulating relatively cold air from said room through said cold air return conduit to said unit and after a heat exchange in said unit delivering it to said hot air supply conduit for return to said room, a temperature responsive device disposed in a position to be directly and immediately responsive to the temperature of the air in said unit which is delivered through said hot air supply conduit, a damper in one of said conduits and controlled by said heat responsive device for operation into flow restricting but not flow preventing position when the temperature of the air delivered by said unit falls below a selected temperature but above normal room temperature, and for opening it through increasing extents as the temperature of the air delivered from the unit rises above said selected temperature above normal room temperature, whereby whenever the temperature of the heated air delivered by the unit falls below a selected temperature, the flow of air through the unit automatically will be partially but not fully cut down in order that the stratification of the air in said room into different horizontal zones of different temperatures may be prevented and the movement of air in the room decreased to prevent objectionable drafts of relatively cool air, and means for keeping said motor operated blower continuously running whenever said damper is materially away from maximum restricting position

2. An improved heating system for an enclosure of the type in which heated air is circulated through said enclosure, comprising a heating

unit having a cold air return conduit leading from one part of said enclosure and opening into said unit at one point, and a hot air supply conduit opening out of the unit at another point and leading to another part of said enclosure, a motor operated blower associated with said unit for circulating relatively cold air from said enclosure through said cold air return conduit to said unit and after a heat exchange in said unit delivering it to said hot air supply conduit for return to said enclosure, means including a device directly responsive to the temperature of the air in said enclosure for controlling the heat in said unit, a different temperature responsive device disposed in a position to be directly and immediately responsive to the temperature of the air in said unit which is delivered through said hot air supply conduit, means controlled by said heat responsive device and including a damper in said cold air return conduit for operation into a position in which it partially but not fully restricts air flow through said unit between said conduits whenever the temperature of the air delivered by said unit is below a selected temperature but above normal room temperature, whereby objectionable drafts of relatively cool air and stratification of the air in an enclosure into different horizontal zones of different temperatures may be prevented, and means for keeping said motor operated blower continuously running when the temperature of the air delivered by the hot air conduit is above a desired temperature that is below said selected temperature.

3. An improved heating system for an enclosure comprising a heating unit having a cold air inlet conduit and a hot air outlet conduit opening into said unit at spaced zones thereof and connected to different parts of said enclosure, so that air passing between said enclosure and conduits must pass through said unit, said unit containing means for imparting heat to the air passing therethrough, means including a thermal device responsive to the temperature of the air in said enclosure for supplying heat to said unit intermittently as needed to maintain a desired temperature in said enclosure, a motor operated blower associated with said unit for forcing air through said unit from said cold air conduit to said hot air conduit, a damper in said cold air conduit operable into and out of a position in which it partially restricts but not completely obstructs flow of air through said unit between said conduits, additional thermally responsive means disposed in a position to be directly and immediately responsive to the temperature of the air in said unit which is delivered to said enclosure through said hot air conduit for controlling the operation of said damper and causing operation of the damper into its flow restricting position whenever the temperature of the air delivered by the unit falls below a selected temperature but above normal room temperature, progressively as said air temperature falls, whereby air will be continually moving through said unit and between said conduits sufficiently to prevent objectionable drafts of relatively cool air and stratification of the air in a room or rooms heated by said unit, and means for keeping said motor operated blower continuously running at constant speed whenever the temperature of the air delivered by said hot air conduit is above a desired temperature that is below said selected temperature.

4. An improved heating system of the type in which heated air is circulated through a room or

rooms, and comprising a heating unit, a cold air supply conduit connected to one part of said unit, a hot air delivery conduit connected to another part of said unit, a motor operated blower associated with said unit and conduits for forcing air through the unit from said cold air conduit to said hot air conduit, said unit having heat exchanging means therein for heating air passing therethrough, means for intermittently supplying heat to the heat exchanging means of said unit, a damper in each of said conduits operable between an open position in which it offers a minimum of resistance to air flow between the conduits through the unit and a restricting position in which it partially restricts but not fully obstructs air flow through the unit between said conduits, a thermally responsive device disposed in a position in which it is directly and immediately responsive to the temperature of the air delivered by said hot air conduit and operable to control said dampers and cause the operation of both dampers into flow restricting positions whenever the temperature of the air delivered by said unit falls below a selected temperature above normal room temperature, and means for keeping said motor operated blower continuously running when the temperature of the air delivered by the hot air conduit is above a desired temperature that is below said selected temperature.

5. An improved heating system of the type in which heated air is circulated through an enclosure, and comprising a heating unit, a cold air supply conduit connected to one part of said unit, a hot air delivery conduit connected to another part of said unit, a motor operated blower associated with said unit and conduits for forcing air through the unit from said cold air conduit to said hot air conduit, said unit having heat exchanging means therein for heating air passing therethrough, means for intermittently supplying heat to the heat exchanging means of said unit, a damper in one of said conduits operable between an open position in which it offers a minimum of resistance to air flow between the conduits through the unit and a restricting position in which it partially restricts but not fully obstructs air flow through the unit between said conduits, a thermally responsive device disposed in a position in which it is directly and immediately responsive to the temperature of the air delivered by said hot air conduit and operable to control said damper and cause the operation of the latter into flow restricting position whenever the temperature above normal room temperature of the air delivered by said unit falls below a selected temperature but above room temperature, and means for keeping said motor operated blower continuously running when the temperature of the air delivered by the hot air conduit is above a desired temperature that is below said selected temperature.

6. In an improved heating system, the combination of a cabinet, a cold air conduit opening into one part of said cabinet, a hot air conduit opening into another part of said cabinet, a motor operated blower associated with said cabinet and conduits and operable to forcibly circulate air through said cabinet from said cold air conduit to said hot air conduit, a heat exchanging device within said cabinet and having heat exchanging relation to air passing through the cabinet, means for intermittently supplying heat to said exchanger, a damper in each of said conduits and operable as a unit to restrict but

not fully obstruct the flow of air through said cabinet and conduits, a thermally responsive device disposed in a position in which it is directly and immediately responsive to the temperature of the air in said unit and delivered to said hot air conduit, means by which said thermally responsive device will cause the operation of said dampers into positions in which they partially restrict but do not fully obstruct the flow of air through said cabinet, whenever the temperature of the air delivered by said cabinet to said hot air conduit falls below a selected temperature above normal room temperature, and will cause the opening of both of said dampers when the temperature of the air delivered by the unit to the hot air conduit exceeds said selected temperature above normal room temperature, and means for keeping said motor operated blower continuously running when the temperature of the air delivered by the hot air conduit is above a desired temperature that is below said selected temperature.

7. In a heating system of the type in which heated air is circulated through a room or rooms and the heating unit, that improvement in a heating unit therefor which comprises a cabinet, a cold air conduit opening into said cabinet at one zone thereof and by which air from said room or rooms may be conducted to said cabinet, a hot air conduit opening from another zone to said cabinet and by which heated air may be delivered to said room or rooms, heat exchange means within said cabinet, a motor operated blower associated with said cabinet and conduits and operable to circulate air through said unit from said cold air conduit to said hot air conduit and in heat exchanging relation to said heat exchange means, means for intermittently supplying heat to said heat exchange means, damper means disposed to directly control the passage of air through said cabinet between said conduits and selectively operable to offer a minimum of resistance to flow through said cabinet or to restrict but not fully prevent flow of air through said cabinet between said conduits, means directly and immediately responsive to the temperature of the air delivered by said unit to said hot air conduit for controlling the operation of said damper means in a manner to restrict but not fully obstruct flow of air through said cabinet between said conduits, whenever the temperature of the air in said unit and delivered to said hot air conduit falls below a selected temperature above normal room temperature, said damper operation being approximately proportional in degree to the change in temperature in said delivered air, below a selected temperature above room temperature, and means for keeping said motor operated blower running continuously when the temperature of the air delivered by the hot air conduit is above a desired temperature that is below said last mentioned selected temperature.

8. In an improved heating system of the type in which heated air is circulated through a room or rooms and a heating unit in succession, that improvement in the heating unit thereof which comprises a cold air conduit by which air may be withdrawn from the room or rooms and conducted to said unit, a hot air conduit by which hot air may be delivered to said room or rooms from said unit, a cabinet into different zones of which said conduits open, a heat exchanging device in said cabinet and in contact with air passing through the cabinet, means for intermittently

supplying heat to said heat exchange device, means for continuously circulating air through said cabinet between said conduits whenever the temperature of the air delivered by the hot air conduit is above a desired temperature, and means directly and immediately responsive to the temperature of air delivered by said unit to said hot air conduit for restricting but not fully obstructing the flow of air through said cabinet when the temperature of the air delivered by the cabinet falls below a selected temperature above normal room temperature and above said desired temperature and operable progressively in degrees of change within a selected range of temperatures.

9. An improved heating system of the type in which heated air is circulated through a room or rooms and a heating unit in succession, that improvement in the heating unit thereof which comprises a cold air conduit by which air may be withdrawn from the room or rooms and conducted to said unit, and a hot air conduit by which hot air may be delivered to said room or rooms from said unit, a cabinet into different zones of which said conduits open, a heat exchanging device in said cabinet and in contact with air passing through the cabinet, means for intermittently supplying heat to said heat exchange device, means for continuously circulating air through said cabinet between said conduits whenever the temperature of the air delivered by the hot air conduit is above a desired temperature, and means directly and immediately responsive to the temperature of air delivered by said unit to said hot air conduit for restricting but not fully obstructing the flow of air through said cabinet when the temperature of the air delivered by the cabinet falls below a selected temperature above said desired temperature, said last named means including a damper disposed in said cold air conduit and another in said hot air conduit, said dampers being interconnected for concomitant operation, and a thermally responsive device disposed in said hot air conduit and operable upon said dampers to control their movements.

10. In an improved heating system of the type in which heated air is circulated through a room or rooms and a heating unit in succession, that improvement in the heating unit which comprises a cold air conduit by which air may be withdrawn from a room or rooms and conducted to said unit, and a hot air conduit by which hot air may be delivered to said room or rooms from said unit, a cabinet having different zones into which said conduits open, heat exchange means in said cabinet for heating the air passing through the cabinet, means for intermittently supplying heat to said heat exchange means, means for continuously circulating air through said cabinet between said conduits whenever the temperature of the air delivered from the cabinet exceeds a desired temperature, automatic means responsive to the temperature of the air delivered by said unit to said hot air conduit for materially restricting but not fully obstructing the flow of air through said cabinet whenever the temperature of the air delivered by the cabinet falls below a selected temperature that is above said desired temperature, means for supplying moisture to the air passing through said cabinet at a zone before it reaches said heat exchange means, and means also controlled by said temperature responsive means for rendering the moisture supplying means ineffective whenever

the flow of air through said cabinet is restricted by said temperature responsive means.

11. In an improved hot air heater, a cabinet having a cold air conduit connected to one zone thereof, and a hot air conduit opening out of another zone thereof, means for forcibly circulating air through said cabinet from said cold air conduit to said hot air conduit, means within said cabinet for heating the air passing there-through, a damper in one of said conduits, means responsive to the temperature of the air delivered to said hot air conduit for causing operation of said damper from an open position to a position in which it materially restricts but does not fully obstruct flow of air through said cabinet, means for spraying moisture into the air passing through said cabinet before said air reaches said air heating means, an electrically operated valve controlling the supply of moisture to said spraying means, and means including a switch operable by said temperature responsive means simultaneously with the operation of said damper into flow restricting position, for causing an operation of said valve to cut off the moisture supplied to said spraying means whenever the damper is operated into flow restricting position and re-establishing the supply of moisture to said spraying means automatically whenever the damper is operated to open position.

12. In an improved heating system of the type in which air is withdrawn from a room or rooms, circulated in heat exchanging relation to a heat exchange element and then returned to the room or rooms, and in which a heating medium is supplied to the heat exchange element in variable amounts in accordance with the temperature requirements of the air in the room, the improved method which comprises forcibly circulating the air from the room or rooms through said heat exchanging relation with said heat exchange element, partially restricting, but not fully obstructing, said circulation of air through said heat exchanging relation whenever the temperature of the air circulated past and leaving said heat exchange element falls below a selected temperature well above normal room temperature while continuing the circulation of air, and discontinuing the forced circulation of the air whenever the temperature of the circulated air leaving the heat exchange element falls below a still lower selected temperature which is above normal room temperature.

13. In an improved heating system of the type in which air is withdrawn from a room or rooms to be heated, circulated in heat exchanging relation with an intermittent source of heat and returned to the room or rooms to be heated, the improved method which comprises withdrawing air from a room or rooms to be heated, forcibly circulating it continuously in heat exchanging relation to an intermittent source of heat, and then returning it to the room or rooms from which it was withdrawn, supplying moisture to said withdrawn air before it is subjected to said heat exchanging relation, discontinuing the supply of moisture to the air when the temperature of the air, immediately after the heat exchanging relation, falls below a selected temperature and automatically in response to such fall of temperature, mechanically restricting, but not fully obstructing, the forced circulation of air through said heat exchanging relation automatically directly and immediately in response to the temperature of the air leaving such heat exchanging relation, whenever such temperature

falls below a selected temperature, and discontinuing the forced circulation of such air when the temperature falls below a still lower temperature, but still above normal room temperature, automatically in response to such further fall of temperature.

14. An improved heating system of the type in which heated air is circulated through a room or rooms, and comprising a heating unit, a cold air supply conduit connected to one part of said unit, a hot air delivery conduit connected to another part of said unit, a continuously operating blower associated with said unit and conduits for forcing air through the unit from said cold air conduit to said hot air conduit, said unit having heat exchanging means therein for heating air passing therethrough, means for intermittently supplying heat to the heat exchanging means of said unit, a damper in one of said conduits operable between an open position in which it offers a minimum of resistance to air flow between the conduits through the unit and a restricting position in which it partially restricts but not fully obstructs air flow through the unit between said conduits, a thermally responsive device disposed in a position in which it is directly and immediately responsive to the temperature of the air delivered by said hot air conduit and operable to control said damper and cause the operation of the latter into flow restricting position whenever the temperature of the air delivered by said unit falls below a selected temperature above normal room temperature, and automatic means also controlled by said thermally responsive device for stopping operation of said blower whenever the temperature of air in said hot air conduit falls below a still lower selected temperature and for starting it whenever the temperature of air in said hot air conduit rises above said still lower temperature.

15. In an improved heating system of the type in which heated air is circulated through a heating unit and a room or rooms in succession, that improvement in the heating unit thereof which comprises a cold air conduit by which air may be withdrawn from a room or rooms and conducted to said unit, a hot air conduit by which hot air may be delivered to said room or rooms from said unit, a cabinet into different zones of which said conduits open, a heat exchanging device in said cabinet and in contact with the air passing through said cabinet, means for circulating air through said cabinet between said conduits, a damper in said cold air conduit operable between open and closed positions, but in its closed position largely obstructing but not fully preventing movement of air therepast, a thermal device in said hot air conduit and causing operation of said damper into said closed position when the air temperature in the hot air conduit falls below a predetermined temperature above normal room temperature, and causing it to open when the temperature in the hot air conduit rises above said predetermined temperature, and means for preventing movement of said damper beyond open position when the temperature of the air in the hot air conduit rises above the temperature at which the damper is fully open but within the normal temperature range of operation of said unit.

16. In an improved heating system of the type in which heated air is circulated through a heating unit and a room or rooms in succession, that improvement in the heating unit thereof which comprises a cold air conduit by which are may

be withdrawn from a room or rooms and conducted to said unit, a hot air conduit by which hot air may be delivered to said room or rooms from said unit, a cabinet into different zones of which said conduits open, a heat exchanging device in said cabinet and in contact with the air passing through said cabinet, means for circulating air through said cabinet between said conduits, a damper in said cold air conduit operable between open and closed positions, but in its closed position largely obstructing but not fully preventing movement of air therepast, a thermal device in said hot air conduit and causing operation of said damper into said closed position when the air temperature in the hot air conduit falls below a predetermined temperature, and causing it to open when the temperature in the hot air conduit rises above said predetermined temperature, means for preventing movement of said damper beyond open position when the temperature of the air in the hot air conduit rises above the temperature at which the damper is fully open but within the normal temperature range of operation of said unit, and another damper in said hot air conduit approximately at said thermal device and connected for concurrent operation with said other damper into similar positions, and having an opening therethrough in air flow alignment with and adjacent said thermal device for directing a substantial part of the air which is moving in said hot air conduit when the damper in that conduit is partially or fully in closed position, into close proximity to said thermal device to affect its operation directly and make the thermal device directly responsive to even minor changes in the temperature of the air in said hot air conduit when said dampers are in closed positions.

17. In a domestic heating device, a cabinet having inlet and outlet connections by which air may be circulated therethrough, and to and from an enclosure to be heated, a heat exchange element in said cabinet for heat exchange with said air circulating through said cabinet, means for supplying heat to said element in variable amounts, a motor operated blower for forcibly circulating said air through said cabinet and continuously operating whenever the temperature of the air leaving said cabinet is above a desired temperature, damper means for controlling the air flow through said cabinet and operable between an open, flow permitting condition and a condition in which it partially but not fully restricts said air flow, and thermally responsive means directly, immediately and automatically responsive to the temperature of said circulating air leaving said heat exchange element for causing a movement of said damper means to said flow permitting condition whenever the temperature of said air leaving heat exchanging relation to said element exceeds a selected temperature well above ordinary room temperature and above said desired temperature, and for causing said damper means to move to said flow restricting condition automatically whenever the temperature of said air leaving said element falls below said selected temperature.

18. In a domestic heating device, a cabinet having inlet and outlet connections by which air may be circulated therethrough, and to and from an enclosure to be heated, a heat exchange element in said cabinet for heat exchange with said air circulating through said cabinet, means

for supplying heat to said element in variable amounts, a motor operated blower for forcibly circulating said air through said cabinet and continuously operating whenever the temperature of the air leaving said cabinet is above a desired temperature, damper means in said inlet connection for controlling the air flow through said cabinet and operable between an open, flow permitting condition and a condition in which it partially but not fully restricts said air flow, and thermally responsive means directly, immediately and automatically responsive to the temperature of said circulating air leaving said heat exchange element for causing a movement of said damper means to said flow permitting condition whenever the temperature of said air leaving heat exchanging relation to said element exceeds a selected temperature well above ordinary room temperature and above said desired temperature, and for causing said damper means to move to said flow restricting condition automatically whenever the temperature of said air leaving said element falls below said selected temperature.

19. In a domestic heating device, a cabinet having inlet and outlet connections by which air may be circulated therethrough, and to and from an enclosure to be heated, a heat exchange element in said cabinet for heat exchange with said air circulating through said cabinet, means for supplying heat to said element in variable amounts, a motor operated blower for forcibly circulating said air through said cabinet and running continuously whenever the temperature of the air delivered from the cabinet exceeds a desired temperature, damper means in both of said inlet and outlet connections for controlling the air flow through said cabinet and operable between an open, flow permitting condition and a condition in which it partially but not fully restricts said air flow, and thermally responsive means directly, immediately and automatically responsive to the temperature of said circulating air leaving said heat exchange element for causing a movement of said damper means to said flow permitting condition whenever the temperature of said air leaving heat exchanging relation to said element exceeds a selected temperature well above ordinary room temperature and above said desired temperature, and for causing said damper means to move to said flow restricting condition automatically whenever the temperature of said air leaving said element falls below said selected temperature.

20. In a hot air heating system of the forced air circulation type in which air to be heated is taken into a heat exchange cabinet through one duct and delivered from the cabinet through another duct, the improved automatic control for the flow of air through the cabinet which comprises a section of each of said ducts, a shaft extending across both of said duct sections transversely thereof, a damper vane in each duct section secured to said shaft for movement therewith, one of said vanes having an opening therethrough from face to face adjacent said shaft, and a thermally responsive member disposed partially across said opening so as to be responsive to the temperature of the air passing through and close to said opening and operable on said shaft and said vane with the opening to shift said vanes simultaneously into and out of different positions regulating air flow through said duct sections, the other of said vanes only partially restricting air flow through

the duct section in which it is disposed when in straight across position in its related duct section.

21. In a hot air heating system of the type in which air to be heated is taken into a heat exchange cabinet through one duct and delivered from the cabinet through another duct, the improved automatic control for the flow of air through the cabinet which comprises a section of each of said ducts, a shaft extending across both of said duct sections transversely thereof, a damper vane in each duct section secured to said shaft for movement therewith, one of said vanes having an opening therethrough from face to face adjacent said shaft, a thermally responsive member disposed partially across said opening so as to be responsive to the temperature of the air passing through and close to said opening and operable on said shaft and said vane with the opening to shift said vanes simultaneously into and out of different positions regulating air flow through said duct sections by degrees depending upon temperature changes, the other of said vanes only partially restricting air flow through the duct section in which it is disposed, when in straight across position in its related duct section, one end of said shaft extending exteriorly of the adjacent duct section, and electric switch means connected to and operable by said shaft at its said exterior end.

22. In a hot air heating system of the type in which air to be heated is circulated through a heat exchange cabinet under the action of a motor driven blower that is running continuously at uniform speed when the temperature of the air leaving said cabinet is above a predetermined temperature, that improvement which comprises a cold air supply duct by which air to be heated is delivered to said blower for redelivery to said cabinet, a hot air duct through which heated air is delivered from said cabinet, a flow controlling damper in each duct and when in flow restricting position causing a major, but not complete, restriction in air flow through that duct, means connecting said dampers for corresponding simultaneous movements into and out of flow restricting positions, means directly responsive to the temperature of the air delivered by said hot air duct, substantially above said predetermined temperature, for automatically operating said dampers into and out of flow restricting positions through degrees of movement depending upon temperature changes, and with movement towards flow restricting position upon fall of temperature of the delivered air in the hot air duct, whereby noise will be minimized and power required for operating said blower will be a minimum when said dampers are positioned to restrict air flow through said cabinet.

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