Dec. 18, 1962 C. R. FREEMAN 3,068,854

SPACE HEATER AND HEATING SYSTEM

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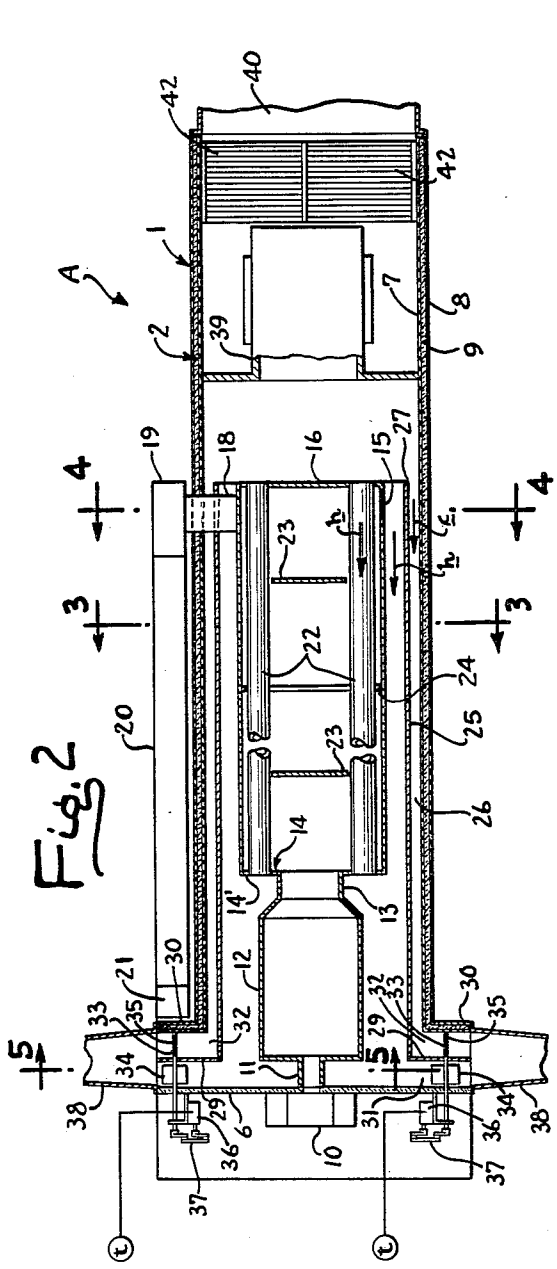


Fig. 2

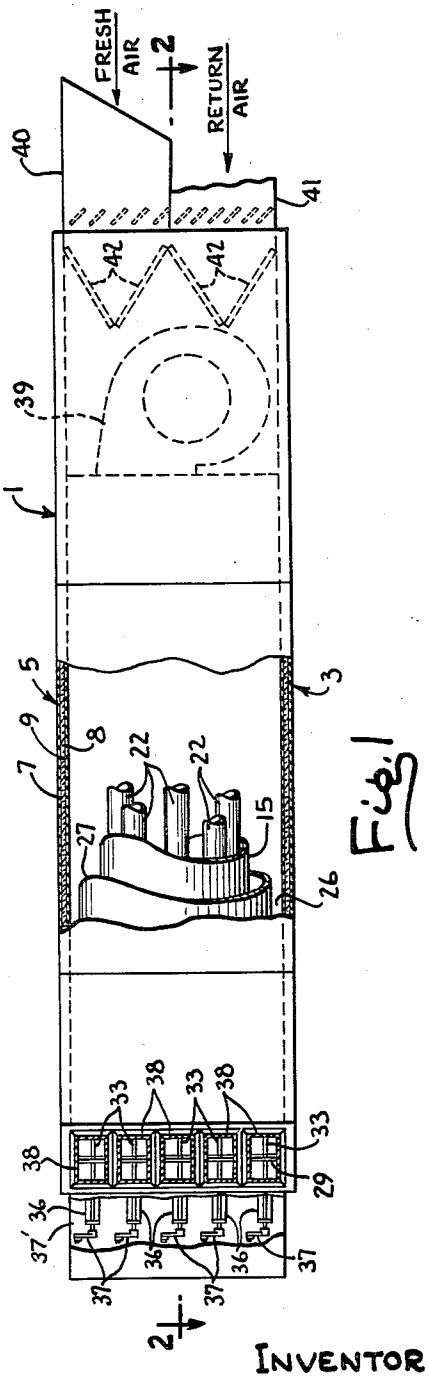


Fig. 1

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Fig. 3

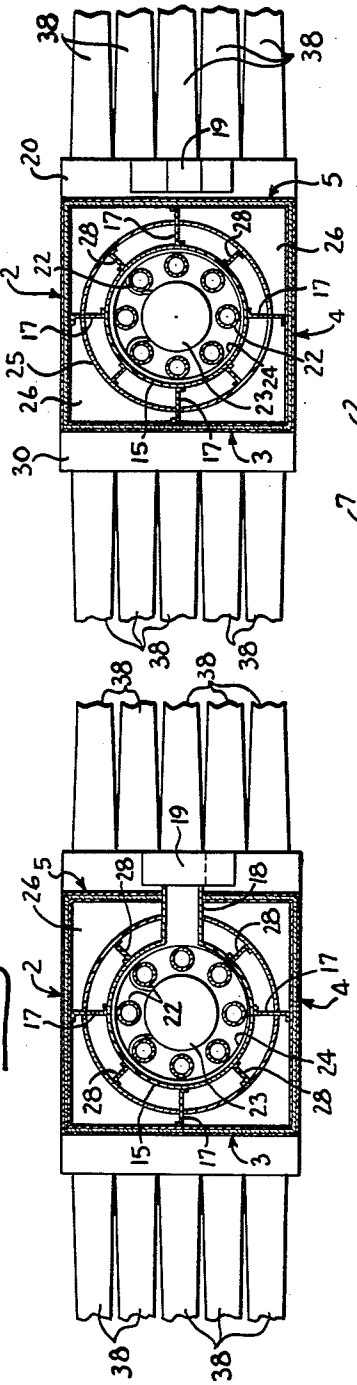
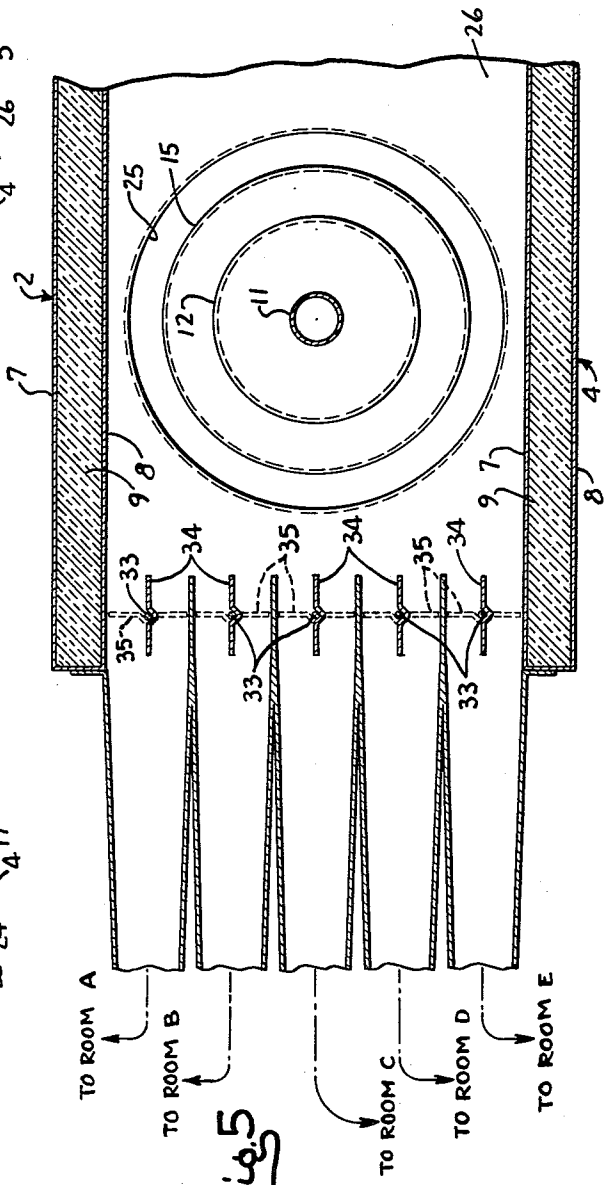


Fig. 4

Fig. 5



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SPACE HEATER AND HEATING SYSTEM

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2 Claims. (Cl. 126—110)

This invention relates to heating systems and, more particularly, to heating systems of the forced hot air type for space heating of buildings.

It is one of the objects of the present invention to provide a space heating system that is applicable for heating a large number of rooms wherein there are variations in the relative heating requirements of the respective rooms. For instance, in the heating of rooms of a school building or the like, two different rooms may require approximately the same amount of heat at one time and under one set of conditions and require relatively different amounts of heat under different times and under different conditions. In accordance with the principles of the present invention, each room (or groups of rooms) is provided with one or more air supply ducts in the conventional manner. Each duct, however, receives its air from two sources, one of which supplies hot air and the other supplies cooler air. By mixing the two air supplies in varying amounts, as determined by the needs of each room, the supply of heat to each room may be regulated while maintaining a substantially constant air flow into the room as may be needed, for instance, for ventilation.

In accordance with the principles of the preferred embodiment of the persent invention, air, which may be return air from the rooms, outside fresh air, or a mixture of the two, is blown by a single blower along two separate paths. The air in one path passes through the heat exchanger, and the air in the other path substantially bypasses the heat exchanger. The air from each of the two paths is then merged under the control of a thermostatically controlled proportioning damper.

It is a further object of the present invention to carry the cooler air through a duct or conduit that surrounds the hot air duct of the heat exchanger and is in turn surrounded by heat insulation, particularly in the case where the heat unit or heat exchanger of the heat unit is itself in a location that is to all intents and purposes on the outside of the building. This renders the system particularly applicable to a "supplemental" heat unit that is frequently necessitated when an existing building is enlarged beyond the capacity of the heating system already installed. In the case of school buildings which of late have been enlarged this arrangement obviates the need of expensive replacement heating systems which might otherwise be necessary because of the increased heating demand.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawings:

FIG. 1 is a side elevational view partially broken away and in section of a heating apparatus constructed in accordance with and embodying the present invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIGS. 3 and 4 are fragmentary sectional views taken along lines 3—3 and 4—4 respectively, of FIG. 2; and

FIG. 5 is a fragmentary sectional view on an enlarged scale and taken along line 5—5 of FIG. 2.

Like reference numerals designate like parts throughout the drawings.

Referring now in more detail and by reference numerals to the drawings which illustrate a preferred embodiment of the present invention, A deisgnates a heating apparatus comprising an outer shell or casing 1, which, in the present embodiment, is shown as being of substantially

rectangular cross section and including marginally interconnected walls 2, 3, 4, 5 and an end wall 6. Preferably, each of the walls 2, 3, 4, 5, 6 are formed of inner and outer sheet metal members 7, 8 having suitable heat insulating material 9 confined therebetween. Mounted on the outside of the end wall 6 is a conventional oil or gas burner 10 which is provided with a tube 11 projecting through the end wall 6 a short distance into the casing 1. Within the casing 1 the tube 11 communicates with a combustion chamber 12, the latter, in turn, communicating through a short tube 13 with a relatively long heat exchanger 14.

The heat exchanger 14 includes a cylindrical wall 15 extending lengthwise of the housing 1 and spaced from the walls 2, 3, 4, 5 thereof. Adjacent to the combustion chamber 12, the heat exchanger 14 includes an end wall 14' and at its other end the heat exchanger 14 includes a closure plate 16. Rigidly attached at one end to the cylindrical wall 15 and extending radially outwardly therefrom are supporting fins 17 which are also each rigidly secured at their outer ends to the inside faces of the walls 2, 3, 4, 5 so as to hold the combustion chamber 12 and heat exchanger 14 substantially coaxial with the longitudinal axis of the casing 1. Adjacent to the closure plate 16 the cylindrical wall 15 is provided with a radially outwardly extending pipe 18 which projects through the wall 5 and communicates with the intake side of an induced draft fan 19. The discharge side of the fan 19 is connected to a duct 20 which preferably runs along the side of the casing 1 exteriorly thereof and is in turn connected to a vertical flue pipe 21. Consequently, when the fan 19 is in operation, hot gaseous products of combustion formed in the combustion chamber 12 will be drawn axially along the interior of the heat exchanger 14 in a direction towards the closure plate 16 and then radially outwardly thereof through the pipe 18 for delivery to the duct 20 and flue pipe 21.

Mounted within the cylindrical wall 15 and extending axially along the heat exchanger 14 is a plurality of circumferentially spaced air tubes 22 which extend from one end of the heat exchanger to the other and are open at the opposite ends thereof. The air tubes 22 are supported at their opposite ends in the end plate 16 and end wall 14', respectively. Circular or disc baffle plates 23 are suspended from the tubes 22 in spaced parallel relationship and between them there is provided an annular plate 24 surrounding the tubes 22 all for forcing the hot gaseous products of combustion to flow in a tortuous path around the tubes. Furthermore, the tubes 22 are spaced radially inwardly of the cylindrical wall 15 so that the gaseous products of combustion can flow completely around the air tubes 22 substantially throughout the entire lengths thereof.

Enclosing the heat exchanger 14 and combustion chamber 12 is a cylindrical wall member 25 which is coaxial with the heat exchanger 14 and the combustion chamber 12 and lies in inwardly spaced relationship to the casing 1 so as to form with the casing 1 a conduit 26 which surrounds the heat exchanger 14 and combustion chamber 12. Preferably, one end 27 of the wall member 25 terminates in approximate alignment with the end plate 16, and the wall member 25 is held in spaced relationship with the cylindrical wall 15 by means of fins 28, the latter being mounted on the outside of the cylindrical wall 15 and extending radially outwardly therefrom for rigid connection with the wall member 25.

Adjacent to the end wall 6 the member 25 and walls 3, 5 are bent in the provision of lateral extensions 29, 30 to form with the end wall 6 a pair of discharge ducts 31, 32 on each side of the structure. Rotatably mounted in the extensions 29, 30 and end wall 6 is a plurality of spaced parallel shafts 33 upon each of which is mounted

a pair of dampers 34, 35 at right angles to one another. The dampers 34, 35 are located respectively in the discharge ducts 31, 32. Each shaft 33 is individually driven as by a suitable thermostatically controlled electric motor 36 which transmits power to the shaft 33 associated therewith, through its reduction gearing 37. The motors 36 and gearing 37 may be mounted on any suitable support 37'. Connected to the extension 30 and end wall 6 is a plurality of delivery ducts 38, one being associated with each pair of dampers 34, 35. Each delivery duct is adapted to transmit air to a desired room (or group of rooms) to be heated, as shown in FIG. 5 wherein the several rooms are designated as "Room A, Room B," etc. The thermostat *t* (FIG. 2) associated with the particular motor 36 will also be located in the corresponding room so that operation of one set of dampers will control the flow of air to one room, or to a group of rooms if the space to be supplied by one of the ducts 38 constitutes more than one room. In connection with the present invention, it should be understood that the delivery ducts 38 can be mounted in the building being heated in any conventional manner and, therefore, this arrangement is not shown in detail in the present application. Furthermore, the wiring diagrams for the thermostats, motors 36, and the like are not shown herein since motor-driven, thermostatically controlled dampers are known in the art.

Mounted within the housing 1 in forwardly spaced relation to the closure plate 16 is a fan 39 which draws air from two ducts 40, 41 through suitable air filters 42. The ducts 40, 41 are, respectively, for purposes of providing fresh air into the heating system and for drawing return or cold air from all of the rooms being heated.

In operation, the fan 39 draws air from the fresh-air intake and return-air ducts 40, 41, respectively, and forces it through the heat exchanger 14, that is, through the tubes 22 and through the space between the combustion chamber and the cylindrical member 25, and also the conduit 26 that surrounds the member 25, as illustrated by the arrows *h* and *c* in FIG. 2. The hot air path indicated by the arrows *h* is such that the air delivered from the fan 39 will flow on the outside of the cylindrical wall 15 and also through the air tubes 22 whereupon this air will be heated. The air will then flow outwardly through the heat exchanger and will be delivered to the discharge duct 31 which is in communication with the discharge side of the heat exchanger 14. The air flowing through the conduit 26, as indicated by the arrows *c*, will by-pass the heat exchanger and will, therefore, be relatively cool as compared to the air flowing through the heat exchanger. The cooler air will thus flow through the conduit 26 and into the discharge duct 32 which communicates therewith. The heated and unheated air will then pass across the dampers 34, 35 and will be blended as the two supplies of air enter each delivery duct 38. The proportions of hot and cool air entering each delivery duct 38 and delivered to the room associated therewith will depend upon the adjustment of the particular damper shaft 33. Thus, when the dampers 34, 35 are in the position shown in FIG. 2 and in full lines in FIG. 5, the cooler air supply will be cut off and all of the hot air will be delivered to the associated delivery duct 38. However, when the dampers 34, 35 are rotated 90° to the position shown in dotted lines in FIG. 5, the hot air supply will be cut off and only the cooler air will pass into the delivery duct 38. When the dampers 34, 35 are in any intermediate position, the hot and cold air will both enter the delivery duct 38, and the proportions of each will depend upon the amount each of the dampers is open. Since the motors 36 are ordinarily thermostatically controlled, it will be apparent that when a particular room temperature drops, the motor 36 will be rotated so as to open the damper 34 a greater amount and correspondingly close the damper 35. Similarly, if the room temperature should exceed the selected amount, the motor will rotate and cause the damper 34 to close and damper 35 to open, thereby increasing the amount of cold air passing into the delivery duct 38. Consequently, it is possible to mix the hotter and the cooler air in selected proportions while at the same time maintaining a relatively constant flow of air into and out of each room irrespective of the position of the dampers.

The present invention may be used as the sole source of heating a building having a plurality of rooms. Furthermore, the heating apparatus of the present invention may also be used as a supplemental heating unit in an existing building to enlarge the heating capacity thereof.

In connection with the present invention it should be noted that the cooler air in the conduit 26 forms an insulating means surrounding the heat exchanger 14 which supplements the insulation in the walls of the housing 1. This is of particular advantage when the apparatus is mounted on the outside of a building as, for example, on the roof thereof, in which case the outside of the housing is exposed to ambient air temperatures considerably lower than the temperature of the air within the system. Furthermore, when the dampers are adjusted so that air is flowing through the conduit 26 and into one or more of the delivery ducts 38, the insulating effectiveness of the flowing air in the conduit 26 is actually increased in proportion to the rate of air flow through the conduit 26. Consequently, some of the heat loss transferred from the heat exchanger to the conduit 26 will be absorbed by the air flowing in the conduit 26, thereby reducing the total heat ultimately lost through the insulated casing.

In compliance with the requirements of the patent statutes I have herein shown and described a preferred embodiment of the invention. It is, however, to be understood that the invention is not limited to the precise construction herein shown, the same being merely illustrative of the principles of the invention. What is considered new and desired to be secured by Letters Patent is:

1. Heating apparatus comprising a housing having an insulated housing wall for reducing the heat loss from the inside of the housing to the outside thereof, a heat exchanger mounted within and surrounded by the housing wall, said heat exchanger including a combustion chamber and a wall member adjacent to and in communication with said combustion chamber and forming tubular means for the passage of heated products of combustion in one direction axially therethrough, said heat exchanger also including a plurality of axially extending tubes in said member and through which passes air to be heated, the tubes being so arranged that the heated products of combustion can flow substantially completely therearound, a second wall member enveloping the wall member of the heat exchanger, said second wall member lying between the wall member of the heat exchanger and the housing wall and in spaced relation to each, the second wall member and housing wall forming a conduit for the flow of air therethrough by-passing the heat exchanger, air circulating means for delivering a flow of air simultaneously through the tubes, the space between the two wall members, and the conduit in a direction substantially opposite to the flow of heated products of combustion through the tubular means, the air in said conduit forming a heat insulating layer between the tubular means and the insulated wall so that the heat losses from the heat exchanger to the outside of the housing are reduced by supplying a quantity of heat to the air flowing in said conduit, a pair of discharge ducts in communication, respectively, with the discharge ends of the conduit and heat exchanger, a delivery duct in communication wtih the outlet sides of the discharge ducts, a damper in each of said discharge ducts, said dampers being rotatable about a common axis and lying in planes intersecting each other, and means for rotating the dampers together to blend the air from the discharge ducts in selected proportions, one of said dampers being fully closed when the other is fully open.

2. Heating apparatus comprising a housing having an insulated housing wall for reducing the heat loss from the inside of the housing to the outside thereof, a heat exchanger mounted within and surrounded by the housing wall, said heat exchanger including a combustion chamber and a wall member adjacent to and in communication with said combustion chamber and forming tubular means for the passage of heated products of combustion in one direction axially therethrough, said heat exchanger also including a plurality of axially extending open-ended tubes in said member and through which passes air to be heated, the tubes being spaced inwardly of the wall member and having axially spaced baffle plates adjacent thereto so that the heated products of combustion can flow substantially completely around the tubes in a tortuous path, a second wall member enveloping the wall member of the heat exchanger, said second wall member lying between the wall member of the heat exchanger and the housing wall and in spaced relation to each, the second wall member and housing forming a conduit for the flow of air therethrough by-passing the heat exchanger, air circulating means for delivering a flow of air simultaneously through the tubes, the space between the two wall members, and the conduit in a direction substantially opposite to the flow of heated products of combustion through the tubular means, the air in said conduit forming a heat insulating layer between the tubular means and the insulated wall so that the heat losses from the heat exchanger to the outside of the housing are reduced by supplying a quantity of heat to the air flowing in said conduit, a pair of discharge ducts in communication, respectively, with the discharge ends of the conduit and heat exchanger, a delivery duct in communication with the outlet sides of the discharge ducts, a damper in each of said discharge ducts, and means for operating the dampers together to blend the air from the discharge ducts in selected proportions.

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