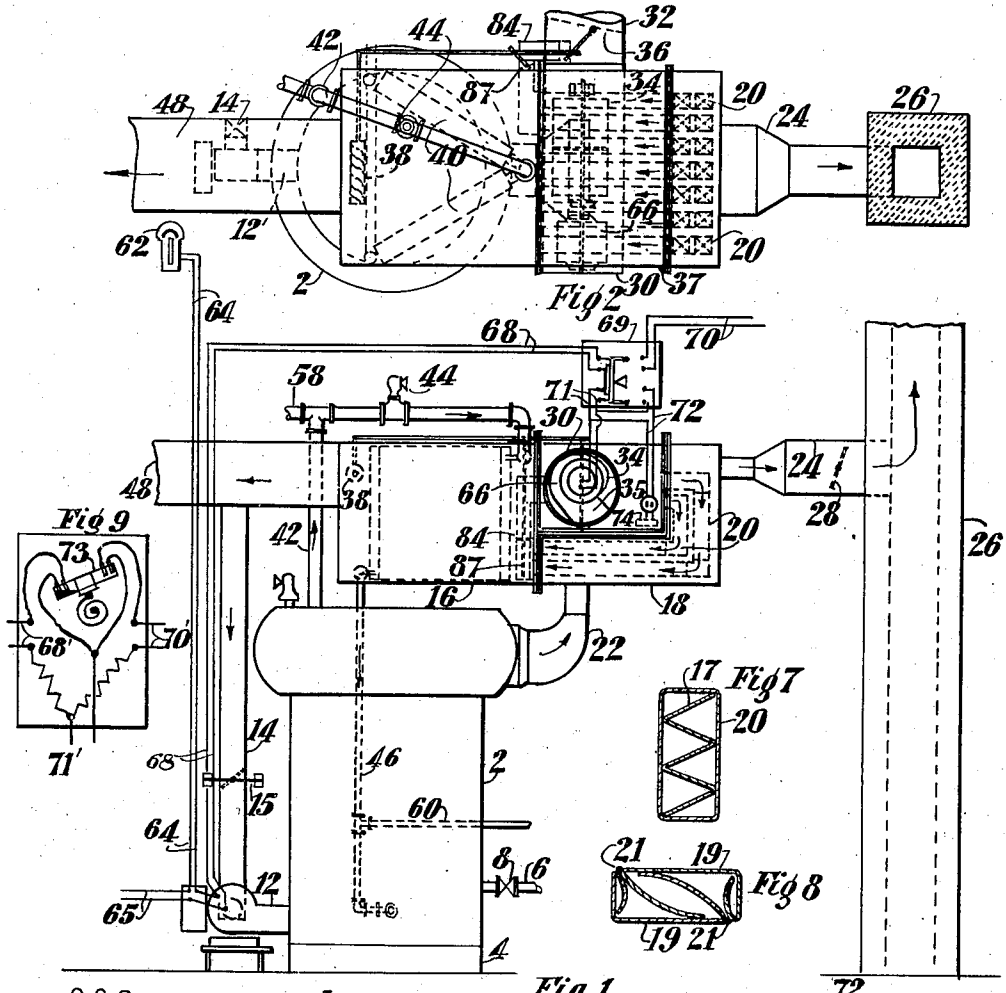
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METHOD AND APPARATUS FOR DOMESTIC HOUSE HEATING

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METHOD AND APPARATUS FOR DOMESTIC HOUSE HEATING

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This invention relates to a method and to an apparatus for heating domestic houses, and more particularly to improvements in connection with the use of automatically operated fluid fuel burning equipment.

This application is a continuation in part of application Serial No. 667,415, filed April 22, 1933.

In the heating of the ordinary house with steam or hot water, where an automatic oil or gas burner is used, the burner is off for relatively long periods of time and does not come on until the temperature in the house reaches a predetermined minimum. However, before the burner is able to heat the water or supply steam after it does come on, the temperature in the house falls considerably below the desired room temperature, and in fact, often becomes uncomfortably cold.

The primary object of the present invention is therefore to provide a method of heating and apparatus which are particularly adapted to supply heat almost instantly and to avoid the disadvantages referred to.

A further object of the invention is the provision of an efficient and centralized house heating apparatus with which the use of radiators distributed throughout the rooms of the house, is unnecessary.

A still further object of the invention is the provision of a heat exchange unit which may be inserted in existing hot water and steam heating systems as well as used in new installations, and provides a heating system adapted to furnish heat to rooms by using the waste heat in flue gas and the combination of forced circulation of hot air and steam heat from a single unit.

Further objects and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawing in which:

Fig. 1 is an elevational view of an apparatus constructed in accordance with the features of the invention and adapted to carry out the improved process.

Fig. 2 is a plan view of the apparatus shown in Fig. 1.

Fig. 3 is a vertical view of a modified form of heat exchanger used in connection with the boiler shown in Fig. 1.

Fig. 4 is a plan view of the heat exchanger shown in Fig. 3.

Fig. 5 is an enlarged plan view of a thermostatic switch shown in Fig. 1.

Fig. 6 is a sectional view of the switch shown in Fig. 5.

Fig. 7 is an enlarged sectional view of one of the plurality of air heating ducts shown in Figs. 1 and 2.

Fig. 8 is a view similar to Fig. 7 showing a modified form of duct.

Fig. 9 is a diagrammatic view showing alternative form of control switch to be used instead of switch 69.

Referring to the drawing which illustrates somewhat diagrammatically a preferred form of the apparatus and certain modifications, the furnace 2 comprises a steam boiler of conventional design mounted on a base 4. Make up water is supplied to the boiler through a pipe 6 provided with a valve 8.

The boiler 2 is heated by means of a fluid fuel burner of any desired construction shown diagrammatically at 12. The burner may be either an oil or gas burner, and may be supplied with preheated air through a conduit 14 which is provided with a balanced valve 15 adapted to automatically open when the burner fan draws air for combustion.

Mounted above the boiler is a heat exchange unit 16 for heating air to be used for heating the house and for combustion. The unit 16 includes a heat exchange element comprising an L-shaped casing 18 in which is mounted a plurality of tubes 20 (Figs. 1, 2 and 7 and 8). Waste combustion gases from boiler 2 are conducted through a furnace outlet 22 into the lower portion of casing 18 around tubes 20, and out through a conduit 24, into a stack 26. The conduit 24 is provided with a damper 28. The air to be heated by heat exchange with waste products of combustion is induced into the unit 16, directly through the open end cylinder 30 or from outside the house through extension 32 of the cylinder 30. The air is drawn into the unit 16 by means of a fan or blower 34 mounted therein, and forced through a conduit 35 into a casing 37 then through tubes 20. The air conduit 32 is controlled by a damper 36 which is operated by a thermostatic element 38 mounted in the path of the air passing from around the tubes 20 in response to changes in the temperature of the air.

Mounted to the left of the fan 34 in the unit 16 are banks of steam tubes 40 adapted to further heat the air passed through the heating element comprising the tubes 20. The tubes of bank 40 may be provided with fins and supplied with steam from boiler 2 through a line 42 provided with an air release valve 44. Condensate produced in banks 40 is returned to the boiler through a line 46. The tube banks 40 may be

constructed in any desired manner to provide the necessary heating surface and the tubes may be finned.

From the heating unit 16 the air is conducted through a hot air distrbuting conduit 48 to one or more parts of the house to be heated. The hot air passed through this conduit may be humidified by spraying steam into the air from a distributor (not shown) which may be supplied with steam from line 42. The amount of steam introduced into the air may be controlled automatically from a humidity regulator (not shown) placed at a desired location in the house. A part of the air heated in unit 16 may be supplied to the burner 12 through conduit 14 which is connected into the unit 16 in advance of the steam distributor. Damper 15 in line 14 is adapted to admit air to the furnace only when the burner is in operation.

Since the heating unit 16 may be used in conjunction with existing steam and hot water systems, steam may be supplied to radiators throughout the house through a line 58 and the condensate returned through a line 60. The boiler may also be provided with the usual water and pressure gauges, relief valve and other usual equipment.

In the operation of the apparatus the functioning of the burner 12 is initiated by a room thermostat 62 which is electrically connected with the burner mechanism by wires 64. Electricity for operating the burner motor is supplied through lines 65. The blower 34 may be started at the same time as the burner since the blower is arranged to be operated by an electric motor 66 which may be connected in parallel with the burner 12 by wires 68 which connect with the wires 64 supplying current to operate the burner through lines 65 which are connected with the burner 12, and with a switch 69 or 73 (Fig. 9).

The switch 69 comprises terminals for the wires 68, terminals for a source of electricity through wires 70 and terminals for wires 71 leading to the motor 66. As shown in Fig. 1, the switch is thrown so that the motor 66 is connected in parallel with the burner 12 through wires 68 and 71. With the switch 69 in this position the thermostat 62 effects the simultaneous starting and stopping of the burner 12 and the motor 66, the current being supplied through the lines 65. The switch 69 also includes a lower right pair of terminals for connecting the motor in series through lines 72 with a thermostatic switch 74. When the switch 69 is thrown so as to connect lines 70 and 72 electricity is supplied for the motor 66 through the lines 70. But when the switch is in this position electricity is not supplied to the motor 66 unless the thermostatic switch 74 has been closed by a temperature rise at the point. The motor 66 is operated by power from the lines 70 under the control of the thermostatic switch 74 which is closed after the burner has been started by the thermostat 62. The lines 71 to the motor 66 are connected respectively to the lower right terminal and through one line 72 to the switch 74. With the switch 69 closed to the right the motor 66 runs independently of the burner circuit and stops only after the temperature around switch 74 becomes sufficiently low to stop the current from lines 70.

One form of switch 74 suitable for the purpose is illustrated in Figs. 5 and 6. The switch 74 as shown includes a pair of terminals 76 which are connected to wires 72. The wires 72 may be provided with plugs for inserting into the terminals 76. The switch 74 is provided with a simple common means for connecting terminals 76 when a certain predetermined temperature is reached. This includes an expansible bar or rod 78 fixed to the casing at one end and connected at the free end with an electrical insulator 80 with a metal bar 82 to connect the terminals 76. The bar 82 may always be in contact with one terminal but does not make the connection until the proper temperature is reached. The connection is broken when the temperature falls below a certain point, by contraction of the rod or bar 78. It is apparent that the motor 66 may be operated to drive the fan 34 either in response to the thermostatic switch 74 (resting on the top of flue gas casing 18 inside the housing) which acts in response to the temperature of the flue gases from the boiler, or when the burner 12 is operated in response to the thermostat 62.

Instead of using the above arrangements for operating the motor 66 it may be started by thermostat 62 (at the same time as the burner) and stopped by using the mechanism shown in Fig. 9 in place of switches 69 and 74. This mechanism comprises a control box in which power lines 68' enter from the oil burner circuit and lines 70' enter from the house circuit (as in Fig. 1). Lines 71' from the motor 66 enter the control box and one of these lines is connected to one of the lines of 68' and of 70', the other line 71' having two branches which connect into opposite ends of a Mercoid valve 73. The Mercoid valve 73 connects the oil burner circuit as shown (with mercury) when there is no heat in, or flue gas passing through unit 16. Valve 73 is mounted upon a spring. This spring is actuated by the heat passing through unit 18 (the valve 73 and spring is preferably mounted against casing 18) and when heated expands and automatically changes motor 66 to the house circuit 70' by tilting the valve in the opposite direction so that the mercury connects the lines 71' with the lines 70'. This house circuit then furnishes fan motor 66 with electrical energy. When the spring contracts due to no more heated air passing through unit 18, the valve 73 swings back and connects circuit 68' to motor 66. However, at this time this circuit is no longer alive as the thermostat 62 no longer calls for heat and the burner circuit is broken at that point. However, the fan will now start again on the oil burner circuit as soon as thermostat 62 calls for heat.

As soon as the room thermostat registers a demand for heat in the house the burner 12 is started and immediately gives a very hot fire in the furnace. Under ordinary conditions a considerable time elapses before steam or hot water heat can be supplied. The present invention avoids this condition because the blower 34 starts at the same time as the burner when switches 69 or 73 are in the positions shown or as soon as flue gas heats switch 74 when switch 69 is in the opposite position. Warm air is produced immediately by the heat from the otherwise waste gases of combustion passing around tubes 20, and supplied to the house through hot air conduit 48. Therefore there will be practically no temperature drop in the house below the temperature at the time when the burner was started.

In the construction illustrated in Fig. 1 with switch 69 thrown as shown, the blower 34 will stop at the same time the burner is turned off by the thermostat 62. However, air will continue to pass by natural convection through the tubes 20 and around tubes 40 so that warm air will be

supplied through 48 as long as any of these elements are warm. When switches 73 and 74 are used the blower 34 will run for some time after the burner has stopped.

It is understood that the temperature responsive element 38 closes damper 36 when the air coming in contact with element 38 is cool, so that no cold air will be taken from outside the house except when the air passing over element 38 is warm.

When air is taken from the outside through inlet 32 provision is made for recirculating a portion of the hot air leaving some of the tubes 20 as shown in Fig. 1. For this purpose a duct 84 covers the outlets of about four of the tubes 20 and directs the hot air therefrom into cylinder 32 where it mixes with the cold air. The duct 84 is provided with a damper 87 controlled by levers from temperature responsive element 38 the same as damper 36. When outside air is not supplied then hot air is not forced through duct 84.

The tubes 20 for heating air are preferably provided with extra internal heat transferring surface to more effectively conduct the heat from the flue gas to the air inside the tubes. This may be done in the manner shown in Fig. 7 in which a zigzag shaped or corrugated strip 17 of thin metal is inserted inside the tubes 20. The strip or strips should fit snugly in the tubes. The tubes 20 may be made in the form shown in Fig. 8 in which two similarly bent pieces of metal 19 are welded together as at 21 to form the tubes with inside heat conducting surface.

The heat exchange element shown in Figs. 3 and 4 may be used in place of the element 16 of Fig. 1. It comprises header boxes 86 between which is mounted a plurality of finned flue tubes 88. Waste combustion gases from the boiler enter the lower header through inlet 22' and discharge from the upper header 86 through conduit 24' into a stack 26.

The air to be heated is induced into the heat exchange unit directly through opening 90 (Fig. 3) or from outside the house through an inlet conduit 32', by means of a fan or blower 34' mounted in the unit and operated by a motor 66'. The motor may be operated the same as in Fig. 1. A bank of steam tubes (finned) 92 are mounted in the unit to the left of the blower 34'. Steam may be supplied to the tubes 92 through a steam inlet 94 and condensate discharged through an outlet 96.

A heating apparatus constructed or converted in accordance with the features of the present invention is adapted to provide almost instantaneous heating of a dwelling because of the heat exchange of air with waste products of combustion which usually have a relatively high temperature where oil or gas is used as fuel. This heat is augmented by heat from the radiator bank 40 which is supplied with steam after burner 12 starts.

The use of the combined apparatus of the present invention avoids the necessity of radiators in the rooms of the house to be heated as well as the usual waste of space and expenses connected therewith. The heating plant is all in the basement out of sight and out of the way, and in a new installation supplies the necessary heat at a material saving in equipment cost over furnace installations or conversion jobs now in use. The heat exchange unit shown in Figs. 1 to 4 may be constructed as a single piece of equipment and installed in new or old heating plants in the manner shown in Fig. 1.

Where the heat exchange unit is inserted in existing heating plants for the purpose of heating an added room or otherwise, the radiator bank 40 and its casing may be omitted unless a relatively large amount of additional hot air is desired. The use of the radiator element 40 in the heat exchange unit gives a very efficient quick acting combination because of its nearness to the boiler.

The heat exchange unit 16 shown in Figs. 1 and 2 may be readily constructed from sheet steel since as shown the various parts may be separately made and assembled. Note for example the L-shaped tube heat exchange section and the motor and blower housing which fits in the L to form a rectangular casing. The air enters the tubes 20 at the top, passes to the right, down and then to the left, into the part of the casing housing the steam radiator. Note that one Z-shaped tube sheet serves for the inlet and outlet of tubes 20.

The tubes 88 are staggered and the fins on adjacent tubes 88 are staggered as shown in the drawing. This arrangement provides a very compact heat exchange element and one in which excellent efficiency is obtained because of the high air velocity therethrough.

Hot air heating where the air is properly humidified is recognized as the most healthful method of heating. The improved process and apparatus of the present invention is particularly adapted to supply such heat in a very economical manner, both as to cost of fuel and for equipment.

It is to be understood that various modifications of the invention may be made without departing from the spirit and scope thereof as defined by the claims.

Having thus described the invention in its preferred form, what is claimed as new is:

1. A domestic house heating system for supplying an indirect fluid heating medium for heating the house, comprising a furnace for supplying said heating medium, means for conducting heating medium from the furnace to the house radiators, a fluid fuel burner for delivering hot products of combustion into said furnace, thermostatic means mounted in the house and interconnected with said burner for starting said burner in response to a demand for heat in the house and for stopping said burner, a heat exchange unit mounted directly in the path of waste flue gases from said furnace, said unit including an element for heating air by indirect heat exchange with waste flue gases from said furnace, a propelling means for forcing air through said unit and an automatically controlled damper for admitting fresh air to the unit when the air therein is warmed by the heat exchange element, and means for starting and stopping said propelling means when the operation of said burner is started and stopped by said thermostatic means.

2. A domestic house heating system for supplying an indirect fluid heating medium for heating the house, comprising a furnace for supplying said heating medium, means for conducting heating medium from the furnace to the house radiators, a fluid fuel burner for said furnace controlled by a thermostat mounted in the house, whereby hot products of combustion are supplied to said furnace at intervals to produce said heating medium for the house radiators when the temperature in the house reaches a predetermined minimum, an air heating unit including an air propeller and a heat exchange element

mounted directly in the path of the hot waste flue gases from said furnace, said element being adapted to heat air by indirect heat exchange with waste flue gases, means for starting said propeller at the time said burner is started, whereby hot air is supplied to said house for a substantial period of time before said heating medium can be supplied after the starting of said burner, and means for stopping said propeller after the stopping of said burner in response to a drop in temperature in the flue gases from said furnace below a predetermined minimum temperature.

3. A domestic house heating system for supplying an indirect fluid heating medium for heating the house, comprising a furnace for supplying said heating medium, means for conducting heating medium from the furnace to the house radiators, a fluid fuel burner for delivering hot products of combustion into said furnace, thermostatic means mounted in the house and interconnected with said burner for starting said burner in response to a demand for heat in the house and for stopping said burner, a heat exchange unit mounted directly in the path of waste flue gases from said furnace, said unit including an element for heating air by indirect heat exchange with waste flue gases from said furnace, said element comprising a plurality of air heating tubes mounted in a casing, means for forcing air through said tubes in a path countercurrent to the flow of combustion gases therethrough, means for automatically starting said air forcing means at the time said burner is started, and separate means for automatically stopping said air forcing means a short time after said burner is stopped.

4. A domestic house heating system as defined by claim 3 in which the air forcing means is started automatically at the same time as the starting of said burner and in which said air forcing means is stopped automatically in response to a drop in temperature of the flue gases from the furnace below a predetermined minimum temperature.

5. A domestic house heating system as defined by claim 2 in which said propeller is started automatically at the same time as said burner, and in which said propeller is stopped automatically after the stopping of said burner in response to a temperature drop in the flue gases from said furnace below a predetermined minimum temperature.

6. In the method of heating a house in which an indirect heating medium is supplied to house radiators from the house furnace, which in turn is intermittently operated to burn fluid fuel therein at intervals when the temperature in the house reaches a predetermined minimum, the improvement which comprises automatically initiating the combustion of fluid fuel in said furnace to produce and supply said indirect heating medium to the house radiators in response to a demand for heat in the house when the temperature in the house falls to a predetermined minimum, avoiding the usual temperature drop in the house following said demand by immediately automatically initiating the passage of a stream of air in indirect heat exchange with hot waste combustion gases discharged from said furnace at the time and by said demand to produce hot air quickly following the starting of combustion in said furnace, conducting the resulting hot air into the part of the house desired to be heated thereby avoiding said temperature drop, and automatically discontinuing the positive passage of air in heat exchange with hot waste combustion gases after the combustion of fluid fuel has ceased in said furnace in response to a temperature drop in the waste combustion gases leaving said furnace.

7. In the method of heating a house in which an indirect heating medium is supplied to the house radiators from the house furnace, which in turn is operated at intervals by the automatic operation of a fluid fuel burner in said furnace when the temperature in the house reaches a predetermined minimum, the improvement which comprises automatically starting and stopping the operation of said burner according to the temperature in the house, avoiding the usual temperature drop in the house after the starting of said burner by substantially immediately initiating the positive passage of air in indirect heat exchange with hot products of combustion discharged from said furnace at the same time as the starting of said burner to produce hot air quickly following the starting of said burner, forcing the resulting hot air to the part of the house desired to be heated thereby avoiding said temperature drop, automatically stopping the operation of said burner when the temperature in the house reaches a desired predetermined point, and automatically stopping the positive passage of hot air to the house from said heat exchange after the operation of said burner is stopped in response to a drop in temperature of the products of combustion from said furnace.

8. A domestic house heating system as defined by claim 3 in which said element for heating air by indirect heat exchange with waste flue gases comprises a plurality of air heating tubes of substantially L-shape mounted in an L-shaped casing through which the flue gases are conducted.

9. In the method of heating in which air is heated in a heating unit by the intermittent operation of a fluid fuel burner, the improvement which comprises starting the operation of the burner to supply heat as required, at the time of starting said burner simultaneously initiating the positive passage of air through said unit to be heated by hot products of combustion from said burner, stopping the operation of said burner when the required heat has been supplied, and stopping the positive passage of air to said unit after stopping the operation of said burner in response to a drop in temperature of the products of combustion from said burner.

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