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T. W. HOLMES ET AL
HEATING SYSTEM

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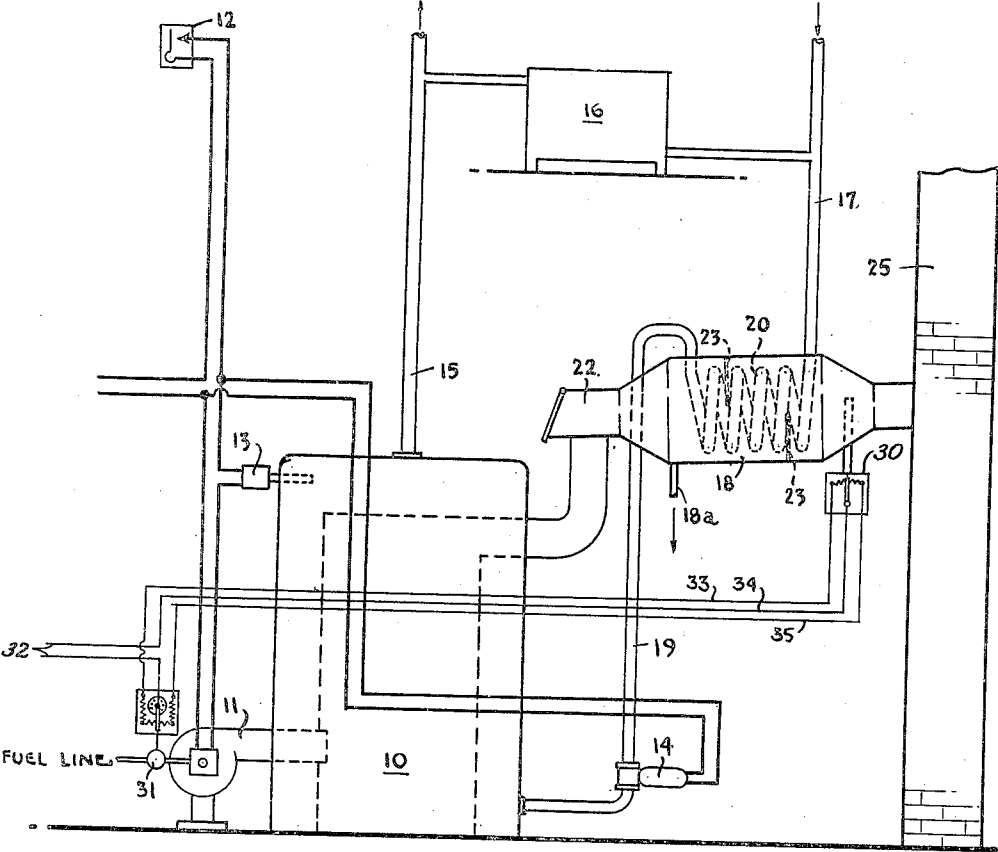


Fig. 1

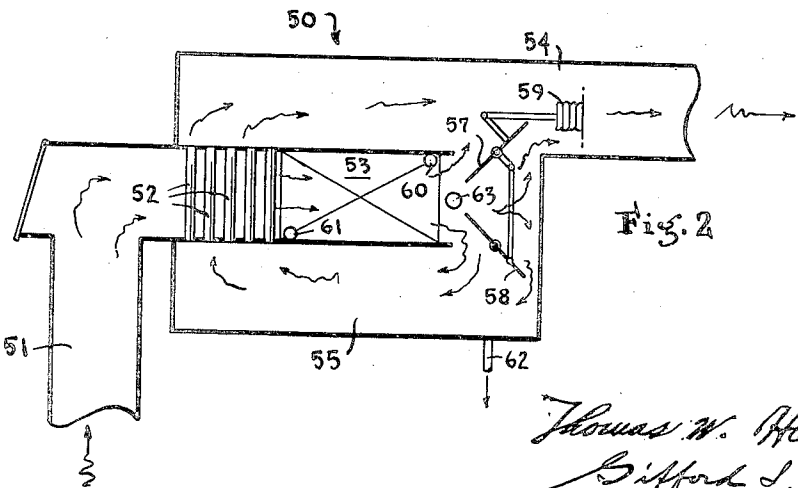


Fig. 2

INVENTORS
Thomas W. Holmes
Bifford L. Holmes

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HEATING SYSTEM

Thomas W. Holmes, St. Paul, Minn., and Gifford
I. Holmes, Detroit, Mich.

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8 Claims. (Cl. 237—8)

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The present invention relates to heating system and more particularly to a system wherein latent and sensible heat produced by combustion are caused to transfer an increased amount of heat over presently known systems.

The present system is adapted for existing heating plants to increase the efficiency to a substantial degree, and for new installations to obtain high thermal efficiency.

An object of this invention is to cause the cold return heating medium to contact the products of combustion at or near their coolest temperature at the outlet of the heater; whereby to condense a substantial part of the condensible water vapors therein to gain the latent heat of condensation and the sensible heat of further temperature reduction thereof.

Another object is to provide a novel control system responsive to the functions set forth in the preceding objects whereby to control the operation of said system in a manner to obtain the proper functions.

Other objects reside in features of construction, the method of operation of such systems, and arrangement of parts; and will be in part obvious or pointed out in the following specification and claims.

Figure 1 of the drawing diagrammatically discloses the invention incorporated into a hot water system and Figure 2 shows a modification thereof.

A furnace 10 is supplied with fuel and air from suitable supply means, manual or otherwise, for example, an oil burner 11. The burner 11 is controlled in operation by a space thermostat 12, influenced by a limit control 13 to maintain boiler temperature and/or pressure at desired levels, to cause operation of the burner 11 when the space temperature falls.

A water circulator 14 is also controlled by the thermostat in a manner whereby it operates during the period that the thermostat is calling for heat, independently of the action of the limit control 13.

Hot water from the furnace 10 is circulated through a header pipe 15 to radiators, only one of which 16 is shown, a return header 17 from the radiators, a secondary heater 18, a pipe 19, and the circulator 14 back to the furnace 10.

The heat exchanger 18 has suitable heat transfer surface arranged therein, for example the coil 20, and is incorporated into the flue 22 for the furnace 10 in a manner to cause the products of combustion to be slowed down to thereby enhance the heat exchange between such products

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and the return water. As shown, the exchanger 18 is enlarged and contains baffles 23 to slow the combustion gases. Other means could obviously be substituted without departing from the concept of the present system, for example, a deeper or differently shaped exchanger or the arrangement of the coils therein could slow the gases. It is also contemplated that extended (finned) surface coils could be used to good advantage. Steam from the combustion gases condenses in passing through the exchanger 18. The water of condensation may be carried away through a suitable drain 18a.

A chimney 25 carries away the uncondensed carbon compounds which result from combustion of fuels. These compounds will be at a relatively low temperature and of low specific heat so it becomes important that tight connections be made in the system, although this is not critical as regards the operation of the system.

A controller 30 is placed in the present system at a point wherein it will respond to a condition indicative of the condensing or potentiality to condense of the water vapors in the flue gases. These conditions could be any of the physical properties of the vapors, for example, humidity, pressure, temperature, vapor tension and pressure, or other gas analysis showing other products of combustion whereby water vapor content can be ascertained and hence controlled. Also some suitable combination of such controls could be used, hence the system should not be limited to the specific controller to be described.

The controller 30 may respond to temperature of the gases of combustion at a point after such gases have passed through the heat exchanger 18. With the control point set at 200 degrees Fahrenheit, for example, a substantial part of the condensible water vapor will be taken out in the exchanger 18. By lowering the temperature still further, even more vapor will be condensed to give up a portion of its latent heat of condensation to the heating medium (water) within the coils 20. For different installations, different control temperatures may be most suitable, hence the controller 30 may be of the adjustable type to vary this control point.

As shown, the controller 30 modulates a fuel valve 31 to increase the fuel supply, hence the total heat of the gases, as the temperature to which the controller 30 responds decreases; and to decrease the fuel supply as said temperature rises.

Power for operating the valve 31 responsive to the controller 30 is shown as comprising an elec-

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tric circuit fed by line wires 32, and responsive to impulses or current intensity in control wires 33, 34, and 35 under the influence of the controller 30 which, by a variable resistance, controls the potential between the common wire 34 and the legs 33 and 35 of a conventional bridge circuit. The motor for operating the valve 31 has a winding (or a relay control) in each of these legs, and a balancing resistance between the legs, to complete the circuit; all of which are well known in the art.

It will be understood that pneumatic control, or other combinations, could be devised to perform the same function if desired.

Assuming the water from the radiating system returns to the header 17 at 100 degrees Fahrenheit, it will have the ability to pick up 50 B. t. u. per pound in raising to 150 degrees Fahrenheit. In the counter flow exchanger 18 the coldest water thermally contacts the coolest combustion gas, hence a more uniform and better rate of heat transfer exists in the exchanger 18. The gases of combustion may then leave the exchanger at about 200 degrees Fahrenheit and the water in pipe 19 will be at 150 degrees Fahrenheit.

With 200 pounds of water circulated an hour in the system, 10,000 B. t. u. can be picked up in the hour thereby. With a fuel that burns at 1500 degrees Fahrenheit and combines with air at a proportion of about 50 parts of air to 1 part of fuel, and the products of combustion comprise about 50% steam, only some 10 pounds of steam needs be available to heat the water because the latent heat of condensation will be about 1000 B. t. u. per pound in the example used. However, this much fuel will create about 20 pounds of gases at 1500 degrees Fahrenheit. Assuming a specific heat of .4, and a temperature drop down to 200 degrees Fahrenheit, the sensible heat pickup by the heating water will be approximately 10,000 B. t. u. Hence, it is seen that the latent heat of fuel is about equal to the sensible heat thereof.

It will be understood that the above figures are used only to illustrate the system, and that with different fuels these values may vary substantially. However, whatever fuel is used a high percentage of latent heat is present. The present system uses that latent heat, and also a higher percentage of sensible heat in performing the heating function. The control system also is subject to wide variation of means without departing from the basic function of the present system.

Referring now to Figure 2, a heat exchanger 50 is shown which embodies means for reheating the gases of combustion after the steam vapors therein have been condensed. This modification thereby prevents water vapors from the gases further condensing out to cause water deposits in the chimney.

The gases of combustion pass through a flue 51, around heat exchange tubes 52, a heat exchanger 53, and either directly out into a flue 54 or through a passage 55 through the heat exchange tubes 52 to the flue 54 in response to dampers 57 and 58 positioned by a temperature responsive motor 59 which by opening and closing the dampers in response to the temperature variations, controls the flue gas temperature at the point the motor 59 is located.

The heating medium may pass into the exchanger 53 through a pipe 60 and out by a pipe 61. A drain pipe 62 may carry away condensed prod-

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ucts of combustion. A control device 63 is inserted into the gas stream at the outlet from the heat exchanger 53 and may control combustion in a suitable manner so as to maintain a constant temperature, or humidity, etc., at the point it is mounted to insure proper condensation from the flue gases.

As the temperature to which the motor 59 responds decreases, the damper 57 will be closed and the damper 58 will be opened. By such action more gases will be caused to pass through the tubes 52 where a heat gain will occur in the cooler gases. As this temperature rises the opposite action will occur to bypass these tubes 52. Hence, a constant temperature for the gases may be maintained and condensation in the chimney prevented while still gaining the latent heat of condensing steam from the flue gases. In practice the latent gains will more than offset the slight sensible heat losses occurring at the tubes 52.

In either modification of the present invention, other heating mediums can be used. For example, return air could be used in a warm air system, or cool condensate from a steam system. Also only part of the return medium need be used and the furnace could be suitably by-passed so as not to impair the thermal efficiency of the furnace by supplying only heated medium thereto. The controllers could also work on draft and check dampers on some furnaces. Obviously many other changes and modifications will occur to those skilled in the art, hence, it will be understood that we are not to be limited in our invention only to the specific modifications shown, but by the scope of the appending claims.

We claim as our invention:

1. In a heating system including a furnace to heat a heating medium by burning a fuel in air and forming products of combustion including water in a vapor state, a heat distributing radiator for using the heat of the medium, and a stack to carry said products of combustion away from said furnace, the arrangement with said stack of heat recovery means comprising, in combination, a first duct for receiving the products of combustion, a first heat exchanger forming a water condenser in said first duct, said first heat exchanger being adapted to exchange heat between said products of combustion and said heating medium, said medium normally being at a temperature below the condensing temperature of water within said first heat exchanger whereby to gain latent heat of condensation of said water, a second duct, and a second heat exchanger in said first duct in communication with said second duct, said second duct being arranged to receive said products of combustion after they have passed said first heat exchanger to cause at least a portion of said products of combustion to pass through said second heat exchanger, said second heat exchanger being arranged in said stack to receive said products of combustion prior to the arrival of said products of combustion to said first heat exchange means.

2. The combination of claim 1 wherein said system is a hot water heating system including a boiler, the heating medium being water normally maintained below the boiling point of water, and control means responsive to boiler temperature for controlling the operation of the furnace.

3. The combination of claim 1, and in addition thereto control means responsive to stack temperature for controlling the heat exchange function.

4. In a heat exchange system comprising a first

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heat exchanger for raising the temperature of a fluid and a second heat exchanger for lowering the temperature of said fluid to perform a heating function, wherein a heat exchange medium containing condensable substance raises the temperature of said fluid and said fluid at a predetermined point in said system attains a temperature value lower than the condensing temperature of said substance; the combination of first passage means constraining said medium to flow in a predetermined path, second passage means constraining said fluid to flow into heat exchange relationship with said medium to cause a heat exchange therebetween, said last heat exchange occurring at a point in said second passage means wherein said fluid is at a lower temperature than the condensing temperature of said substance, to condense at least a portion of said substance whereby the latent heat of condensation of said substance is gained by said fluid, third passage means constraining said medium to flow into heat exchange relationship to itself at a point before said last heat exchange whereby sensible heat is regained by said medium, and control means affected by said medium and responsive to a condition indicative of the condensing of said substance to control said condensing function.

5. The method of recovering heat from products of combustion containing steam comprising condensing the steam in said products by passing said products into heat exchange relationship with a heating medium which is maintained at a temperature below the temperature of condensation of the steam in the products of combustion, and thereafter passing said products into heat exchange relationship with itself at a point in the flow of said products before said products pass into heat exchange relationship with said heating medium, and controlling the temperature of said products of combustion in such manner that optimum condensation of said moisture occurs.

6. In a heating system comprising a furnace and boiler for heating a medium, fuel burning means in said furnace which produces steam as a product of combustion, boiler temperature responsive means, control means for said fuel burning means controlled by said boiler temperature responsive means, and a user of the heat of the heated medium, the combination of, means for returning the heating medium to the furnace after said medium has lost heat to said user, a flue for carrying products of combustion of said fuel away from said furnace, means for condensing said steam in said products comprising a shell portion in said flue for slowing the flow of said products, a heat exchange coil within said portion for carrying said medium in counterflow relationship to the flow of said products whereby the coolest medium receives heat from the coolest products, and thermostatic means responsive to the temperature of said products after they

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pass said coil, said thermostatic means being adjusted to control at a temperature below the temperature of condensing of steam.

7. In a heating system including a heater for heating a medium and a heat distributing radiator for using the heat of the medium, in combination, first heat exchange means for burning a hydrocarbon substance and air to form carbon compounds and steam as products of combustion, a stack for carrying said products therefrom, means associated with said stack for condensing said steam in said products comprising, second heat exchange means for directing the medium to be heated into heat exchange relationship with said products, and control means responsive to a condition indicative of the function of the heat exchange in said second means for controlling such heat exchange in a manner to cause said steam to condense, thereby transferring the latent heat of condensation of said steam to said medium to be heated.

8. A heat exchanger adapted to receive products of combustion containing steam and a medium to be heated comprising, in combination, means forming a first passage for the products of combustion and a second passage for the medium in heat exchange relationship with said products, automatic means for controlling the heat exchange function to cause the steam to form condensate thereby transferring the latent heat of condensation of the steam to the medium, means for carrying the condensate out of thermal transfer relationship with said products, and means forming a third passage connected with said first passage in heat transfer relationship for reducing the percentage of moisture in said products by adding heat thereto after said products have effected heat transfer with said medium.

THOMAS W. HOLMES.
GIFFORD I. HOLMES.

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