March 12, 1935. E. W. PIERCE 1,994,026

HEATING APPARATUS

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Fig. 1.

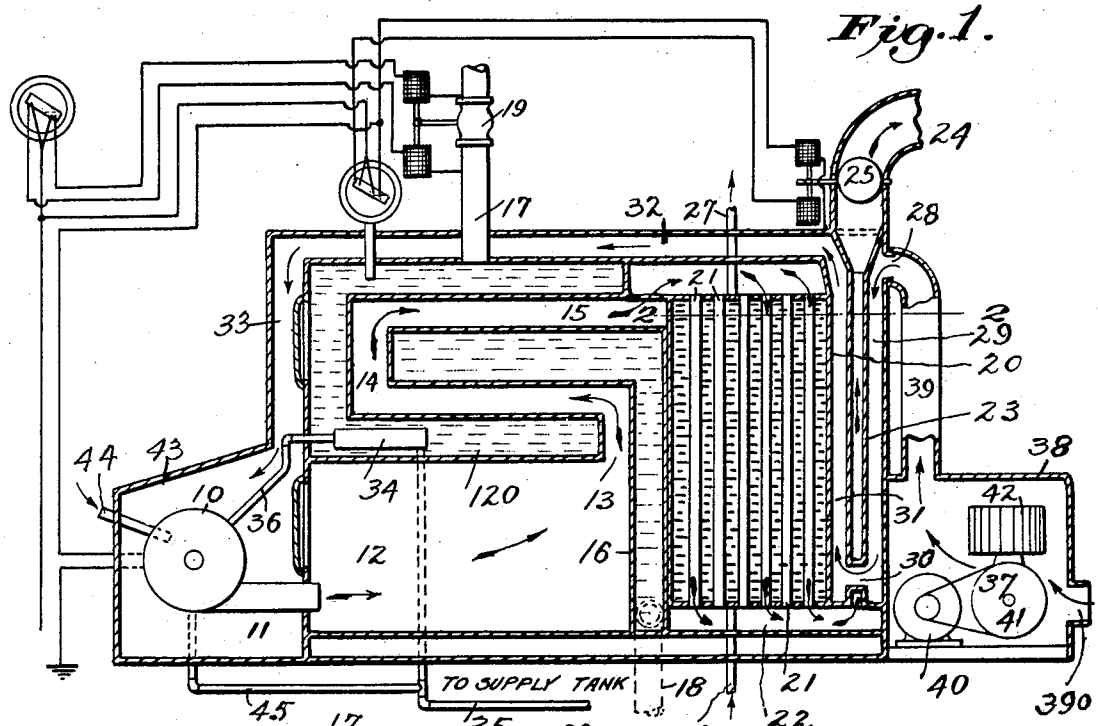

Fig. 3.

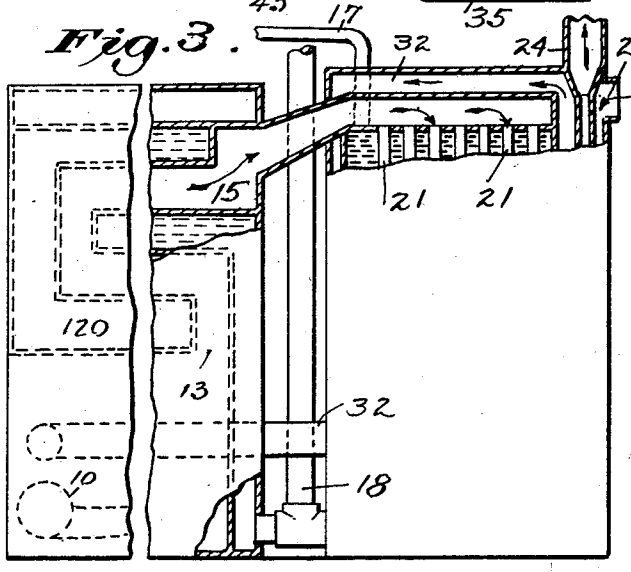

Fig. 2.

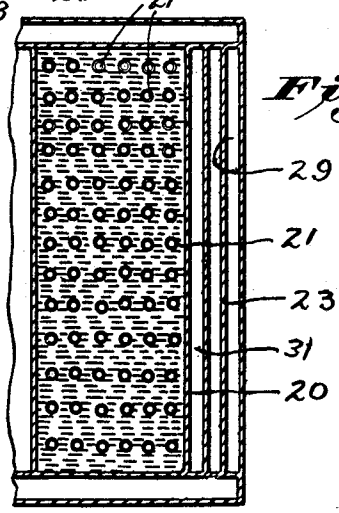

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Fig. 4.

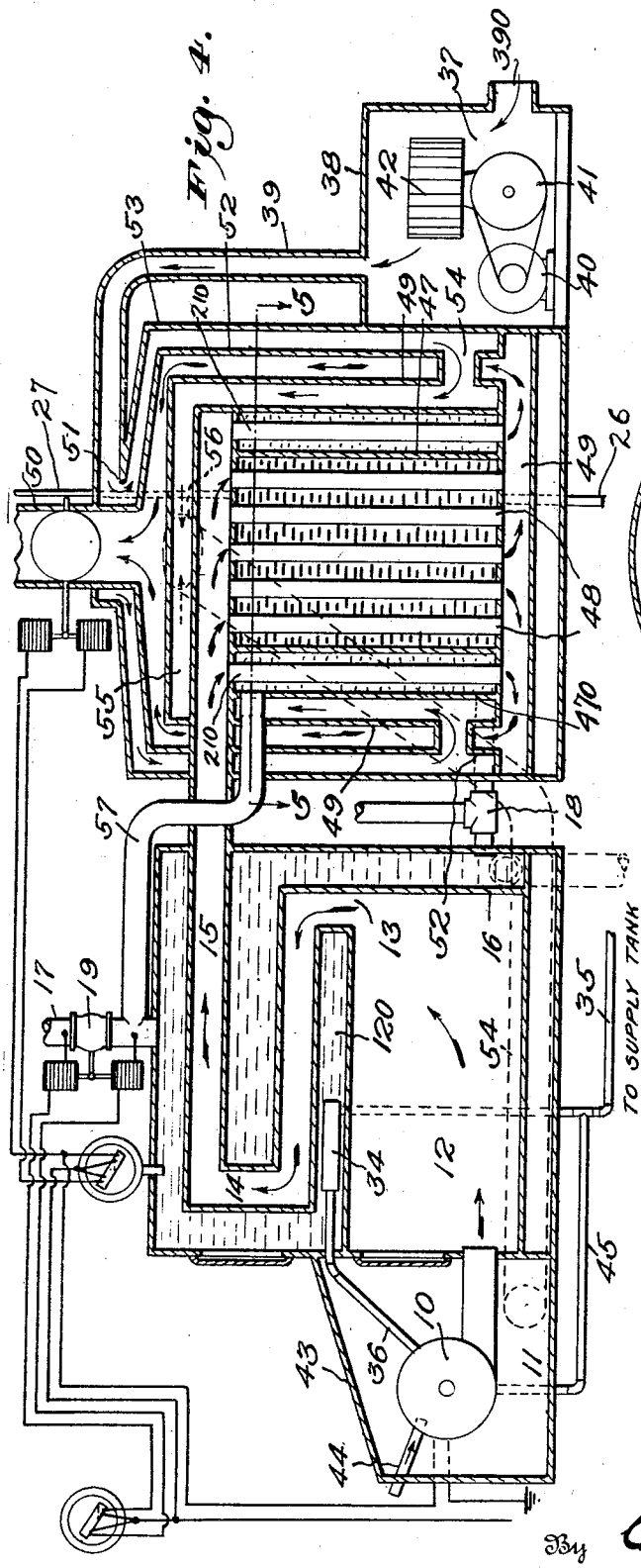
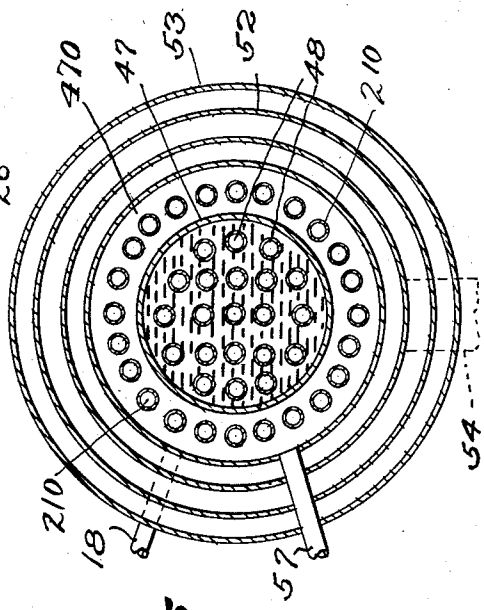


Fig. 5



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1,994,026

HEATING APPARATUS

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Application February 19, 1932, Serial No. 594,060

16 Claims. (Cl. 122—23)

In furnaces or heating plants there are two major considerations. One of these is the utilization to the maximum of the heat generated by the combustion of the fuel, whether coal or oil or gas. The other is minimum space requirement and, therefore, the greatest practical compactness of the heat generating unit, especially when the latter includes besides the furnace proper supplemental or auxiliary members such as heat economizers and water heaters. One object of my invention is to secure the maximum utilization of the heat generated by combustion of the fuel. Another object is to secure more perfect fluid fuel combustion. Another object of my invention is to secure compactness and therefore minimum space requirement for the installation of the heat generating and conserving unit. Another object of my invention is to provide a construction which will contribute to both of the considerations just mentioned in the assembly of the members of the unit. Other objects and advantages of my invention will appear to those skilled in the art from a consideration of the embodiments of my invention hereinafter set forth in detail.

My invention consists in whatever is described by or is included within the terms or scope of the appended claims.

In the annexed drawings:

Fig. 1 is a vertical longitudinal section somewhat diagrammatic of one embodiment of my invention;

Fig. 2 is a horizontal section on the line 2—2 of Fig. 1;

Fig. 3 is in side elevation with parts broken away and in section of another embodiment thereof;

Fig. 4 is a vertical section of a cylindrical form combined hot water tank, hot water heater and air and oil pre-heating means;

Fig. 5 is a horizontal section thereof.

The embodiment of my invention shown in Figs. 1 and 2 includes a furnace with an oil burner 10, of standard or conventional construction situated in an air chamber 11, at the front in rear of which is a combustion chamber 12, from the top of which at the back extends forward a flue 13, that well towards the front has a vertical extension 14, that communicates with the front end of a horizontal rearward extension, 15. The back vertical wall 16, of the chamber 12, is hollow to provide a water space and the horizontal walls of the flues and the front wall thereof are hollow likewise to provide water spaces and through all of such water spaces, water to be heated and sent, as hot water or steam, to the radiators in the building is circulated, there being a riser pipe 17, from the top and a return pipe 18, that enters the water space in the back wall 16. In the riser pipe is a valve 19, which is automatically opened and closed by a room-temperature-operated mechanism which as shown diagrammatically in the drawings may be electrical and which need not be described in detail as it may be of standard or ordinary construction and in itself forms no part of my present invention. The circuit arrangement is such as to control the operation of the valve 19, and that need not be described in detail.

Immediately adjoining the back wall 16, is an auxiliary heater or economizer. As shown is in the form of a hot water tank 20 through which from top to bottom run parallel vertical tubes 21. These tubes at the top open into the top of an extension of the smoke flue or chamber 15, and at the bottom open into the horizontally extending smoke flue or chamber 22, said chamber at the rear end by means of a narrow hollow wall 23, of the width of the unit that extends upward to the chimney stack or smoke pipe 24, which has an automatically controlled damper 25. It will be seen that heated products of combustion after passing from the upper horizontal flue 15 enter the upper ends of the vertical flues 21, and pass downward through the latter into the chamber, 22, and thence through the narrow but very wide passage or flue provided within the hollow wall 23 to the chimney stack, and, of course, in passing through such vertical tubes impart their heat to the water in the tank 20, surrounding them. Since the front wall of the tank 20 immediately adjoins the hollow water-filled wall 16 (indeed a single wall might be employed to answer for both if desired), it will be seen that there is a direct and immediate exchange of heat from one to the other, the one of higher temperature parting with its heat to the one of lower temperature. Thus the tank 20, becomes a heat economizer and, of course, the close relative positions of furnace and tank make for compact, space-conserving installation.

The auxiliary heater tank 20, has a capacity which constitutes of it a hot water reservoir for the supply of water to the various hot water faucets in the building and the water space at the bottom is connected by a pipe 26, with the city or municipal water supply and at the top there is an outlet pipe 27 for the hot water. Thus an ample supply of hot water is afforded, and there is the further advantage from using the munici-

pal water supply that it is under a pressure which raises the boiling point of the water to a degree that the water will not boil, and the water for the heating system, as usual, is at a lower pressure and there is entire independence of water for the heating system and water for the usual hot water supply to the faucets.

Those areas of the back of the furnace and the hot water tank that are contiguous are quite large or extensive and this assures rapid exchange of heat between the products of combustion passing through the furnace flues and the water in the hot water tank or economizer so that the temperature of the two would be about the same and yet if there are special demands on the system for hot water at the faucets, the furnace proper would contribute heat to produce the hot water for the faucet supply and thus assure at all times an adequate supply of hot water, and this may be assured even if the hot water faucet should be left open for an extended period, and especially is this the case when, as in the installation shown in the drawings, the electrical arrangement includes an aquastat by which the running of the oil burner is controlled, or is in accordance with the temperature of the water circulating through the furnace for the heating system. Again, if there is no demand for, or use of hot water at the faucets, the hot water in the tank may contribute its heat to the water for the heating system.

It will be seen that the tank 20, combines the functions of a hot water heater, a storage tank for hot water and a heat economizer. To utilize to the fullest extent the heat generated in the furnace, I connect the hot air chamber 11 by means of circuitous passages with an air inlet 28, adjacent the point where the smoke pipe 24, emerges, which is at the top and back of the unit, and which opens into an air passage 29, that extends vertically in rear of the wall 23, containing the smoke flue down to the bottom thereof contiguous to the chamber 22, and which air passage, at the bottom, is connected by ports or openings 30, at intervals through the flue wall 23, to an air passage 31, that extends vertically along the forward side of the wall 23, and at the top opens into a horizontally extending flue or chamber 32, that reaches to the front of the furnace and then by a suitable vertical passage, such as a vertical flue or flues 33, communicates with the hot air chamber 11, at the top and front. It will be seen that air flowing through the inlet 28, will be in contact with all the heated surfaces within the unit from the combustion chamber 12, to the point where the smoke pipe leaves the furnace, and thus to the maximum degree heat is extracted or taken so that by the time the products of combustion enter the smoke pipe 24, they are deprived of heat to the maximum degree. And, of course, the air which is supplied to the burner in the hot air chamber is in the heated condition important to the proper and efficient action of the burner.

The air passages which I provide from the inlet 28, to the hot air chamber 11, constitute an external air jacket for the heating unit which is highly useful as a heat insulator, as when the burner is turned off and the smoke flue damper is closed, for thereby an air blanket is provided. If desired to increase or extend the heat insulating effect the external air passage or chambers can be provided on all sides of the unit, including the bottom so as to conserve the heat that otherwise might be conveyed to the floor.

To heat the fuel, as when the burner 10 is an oil burner, so that it will be in a heated condition at the time of delivery to the burner, the oil from the supply tank may be delivered to a tank or container 34, of suitable capacity which may be placed in the hot water tank or the economizer, or as shown in Fig. 1, in the chamber 120, and thereby heated, there being an inlet pipe 35, to such tank and an outlet pipe 36 which runs through the burner.

In the interest of utilizing sources of heat to the utmost, the heat generated in the operation of an electric refrigerator for example, may be utilized by locating the heat generating units or parts of the refrigerator apparatus 37, in a closed chamber 38, having an outlet flue or pipe 39 which leads to the air inlet 28 and which chamber 38 has an air inlet 390. The refrigerating apparatus as shown diagrammatically includes a motor 40, a compressor 41, and a heat radiator 42, all of which give off heat in the operation of the apparatus.

Taking the case of a furnace installation already in use which does not include my auxiliary heater or economizer and hot water tank, I provide in a form which can be applied thereto as an attachment, a water tank with vertical flues and air passages starting with an air inlet adjacent the point from which the smoke pipe leads, which attachment will be placed as close or contiguous as may be against the back wall of the furnace. I show in the drawings such an arrangement, in Fig. 3 and Figs. 4 and 5.

Referring to Fig. 3, it will be found that the construction of the furnace proper is in all substantial respects similar to that shown in Fig. 1 and for the corresponding parts, the same reference numerals are applied. However, the oil burner 10, is located within the furnace. The attachment includes parts similar to those shown in Fig. 1 and the similar parts have the same reference numerals as in Fig. 1.

When the oil burner, which as has been indicated, includes an electric motor is located as in Fig. 1, outside the hot air chamber, it is advantageously enclosed in a housing 43, the interior of which is in communication with the air passage or chamber which supplies heated air to the burner. Such housing of the burner has the advantage that I am able to utilize even the heat generated in the running of the electric motor. To prevent excessive heating of the motor, cooling air may be supplied thereto as by means of a pipe 44, extending from outside the casing 43, to those parts of the motor that are apt to heat up and, of course, such heat as is generated by the running of the motor will be radiated into the interior of the casing. When the burner is operating, air will be drawn into the casing through the pipe 44 by the chimney draft and also by the fan of the burner.

Inasmuch as some oil burners are supplied with a larger amount of oil from the supply tank than is consumed and a return pipe is supplied to take care of the surplus oil, there might be a disadvantage in preheating all this volume of oil before it is delivered to the burner, since the large volume of oil would not heat fast enough for the requirements of the burner and the surplus warmed oil if returned to the supply tank would means a loss of that much heat needlessly imparted thereto. In such case, I provide an oil return pipe 45, from the burner which connects with the oil supply pipe 35, leading to the oil heater chamber and thus the surplus warmed or

heated oil will circulate rapidly back to the burner and the oil consumed will be replaced by oil from the supply tank. Of course, care will be taken to prevent back flow from the oil supply pipe 35, to the return pipe 45.

Because of advantages in ease of construction and ability to stand internal pressure, the cylindrical construction, shown in Figs. 4 and 5 may be used which has the cylindrical internal vertical tank 47, for containing the water for faucet use, and through which from spaces at top and bottom, extend vertical flues 48, for the downward passage of the smoke, or products of combustion from the furnace, which passing from the space at the bottom enter the lower end of a cylindrical vertical flue 49, which is concentric with the tank 47, and surrounds the group of flues 48 and at its top opens into a space which leads to the smoke pipe or stack 50. The air inlet 51 (corresponding to the air inlet 28, in Fig. 1) enters a space at the top between the two cylinders 52 and 53, whose upper wall is a removable top for the cylinder, and the inflowing air descends through the annular space between the two cylinders 52 and 53 and at the bottom passes inward through ports or holes 54, in the wall of cylinders 49 and 52, and thence upward in contact with the interior of such wall to an air space 55, at the top from which it enters an outlet flue 56, that leads to the burner. The fuel supply pipe may pass through the air heating flues or through one of the water-heating flues 48 on its way to the burner and thereby the oil or fuel be preheated. It will be seen that the smoke or products of combustion on their way to the chimney entirely cover the tops of the tanks which provide the flues or passages passing through the flues of both tanks, entirely cover the bottom of both tanks and entirely surround the sides of the tanks and before passing to the chimney pipe or stack, go through the tank spaces at the top. When the burner is off and the smoke pipe damper is closed, the tanks are heat-insulated on the bottom by two air spaces, on the sides by three air spaces and on the top by four air spaces.

It will be understood that the tops of the various cylinders shown in Fig. 4 may be constructed so as to be readily removable to give access to the interior for cleaning or repairs.

The water space between the cylinder, 47 and a surrounding cylinder 470 at the upper part is connected by a pipe 57, with the riser pipe 17, corresponding with the riser pipe 17 in Fig. 1, and at the bottom with the return pipe 18 corresponding with the return pipe 18 of Fig. 1. It will thus be seen that the water in the inner tank 47 for household or faucet use and the water which, by being heated or converted into steam to furnish the heating medium for the system, are, so to speak, side by side so that as in the arrangement shown in Fig. 1, there may be a direct and immediate exchange of heat from one body of water to the other with the advantages hereinbefore pointed out in connection with the description of what appears in Fig. 1. Through the water space between cylinders 47 and 470 pass vertical tubes, 210, for products of combustion.

It will be seen by a comparison of Figs. 1 and 4 that Fig. 4 includes parts described in detail hereinbefore in connection with Fig. 1 and the corresponding parts have the same reference numerals in Figs. 1 and 4. It will be understood that the oil burner illustrated in Figs. 1, 3 and 4 is merely typical and in an actual installation there may be either an oil burner or a gas burner, that is to say, the burner as far as the broad scope of my protection is concerned, is to be considered as a fluid fuel burner.

When the system embodying my invention is one using circulating hot water as a heating medium, the opening and closing of valve 19 in the riser pipe is under the control of a room thermostat set to operate at the desired temperature, and the fuel burner and the damper in the smoke pipe are under the control of the furnace aquastat which is set to operate at the proper limits of temperature.

When the system is one using steam as the heating medium, a valve such as 19 is not needed because no steam is generated unless the temperature of the water reaches boiling point and in this case, both liquid fuel burner and damper are operated from a room thermostat and the furnace aquastat is so wired as to operate both burner and damper. Thermostat and aquastat operate entirely independently of each other.

What I claim is:

1. In a heating system, in combination, a boiler, a burner for heating said boiler having means for inducing a flow of air for combustion purposes thereto, a refrigerating apparatus, said refrigerating apparatus being arranged so that the air drawn to said burner is heated by passing over said refrigerating apparatus.

2. A heating system as in claim 1 in which the refrigerating apparatus includes an electric motor.

3. A heating system, as in claim 1, in which the refrigerating apparatus includes an electric motor, and having an air chamber enclosing such apparatus.

4. In a heating system, in combination, a boiler, a burner for heating said boiler having means for inducing a flow of fluid for combustion purposes thereto, a refrigerating apparatus, said refrigerating apparatus being arranged so that the fluid drawn to said burner is heated by passing over said refrigerating apparatus.

5. In a heating system, in combination, a boiler, a burner for heating said boiler having means for inducing a flow of fluid for combustion purposes thereto, a refrigerating apparatus, said refrigerating apparatus being arranged so that the fluid drawn to said burner is heated by passing over said refrigerating apparatus, means for imparting supplemental heat to said fluid on its way from said refrigerating apparatus to said burner.

6. In a heating system, in combination, a boiler, a burner for heating said boiler having means for inducing a flow of fluid for combustion purposes thereto, a refrigerating apparatus, said refrigerating apparatus being so arranged that the fluid drawn to said burner is heated by passing over said refrigerating apparatus, means for imparting supplemental heat to said fluid on its way from said refrigerating apparatus to said burner, said supplemental heat emanating from said boiler, automatically operated means responsive to the boiler temperature which control the operation of the burner so that the boiler is kept continuously in a heated condition.

7. In a fluid heater, in combination, a boiler having an inlet and an outlet for a fluid to be heated, a member for heating said boiler, a refrigerating apparatus giving off heat during the operation thereof, means for imparting heat from said refrigerating apparatus to a flowable, heat-receiving medium, means subjecting said boiler fluid to the heating effect of said heated medium.

8. In a fluid heater, in combination, a boiler having an inlet and an outlet for a fluid to be heated, a member for heating said boiler, a refrigerating apparatus giving off heat during the operation thereof, means for imparting heat from said refrigerating apparatus to a flowable, heat-receiving medium, means imparting supplemental heat to said medium, means subjecting said boiler fluid to the heating effect of said heated medium.

9. In a fluid heater, in combination, a boiler having an inlet and an outlet for a fluid to be heated, a member for heating said boiler, a refrigerating apparatus giving off heat during the operation thereof, means for imparting heat from said refrigerating apparatus to a flowable, heat-receiving medium, means imparting supplemental heat to said medium, such supplemental heat having emanated from said member for heating the boiler, means subjecting said boiler fluid to the heating effect of said heated medium.

10. In a fluid heater, in combination, a boiler having an inlet and an outlet for a fluid to be heated, a member for heating said boiler, a refrigerating apparatus giving off heat during the operation thereof, means subjecting a flowable, heat-receiving medium to heat emanating from said refrigerating apparatus and to heat emanating from said boiler, automatically operated means responsive to said boiler temperature which control the operation of said heating member so that the boiler is kept continuously in a heated condition, means to deliver said heated medium to an element of said heater to impart heat thereto.

11. In a heating system, in combination, an apparatus which includes a boiler having an inlet and an outlet for a fluid to be heated for supplying building-heating devices, a member for heating said boiler, a refrigerating apparatus giving off heat during the operation thereof, means subjecting a flowable, heat-receiving medium to heat emanating from one of the said apparatus, means delivering said heat-receiving medium to the other said apparatus for imparting heat thereto.

12. In a heating system, in combination, an apparatus which includes a boiler having an inlet and an outlet for a fluid to be heated for supplying building-heating devices, a member for heating said boiler, a refrigerating apparatus giving off heat during the operation thereof, means subjecting a flowable, heat-receiving medium to heat emanating from one of the said apparatus and to supplemental heat, means delivering said heat-receiving medium to the other said apparatus for imparting heat thereto.

13. In a fluid heater, in combination, an apparatus which includes a boiler having an inlet and an outlet for water to be heated for a hot-water supply system, a member for heating said boiler, a refrigerating apparatus giving off heat during the operation thereof, means subjecting a flowable, heat-receiving medium to heat emanating from one of the said apparatus, means delivering said heat-receiving medium to the other said apparatus for imparting heat thereto.

14. In a fluid heater, in combination, an apparatus which includes a boiler having an inlet and an outlet for water to be heated for a hot-water supply system, a member for heating said boiler, a refrigerating apparatus giving off heat during the operation thereof, means subjecting a flowable, heat-receiving medium to heat emanating from one of the said apparatus and to supplemental heat, means delivering said heat-receiving medium to the other said apparatus for imparting heat thereto.

15. In a fluid heater, in combination, two apparatus each including a heat-receiving member having an inlet and an outlet for a fluid to be heated, at least one of such members being a boiler, means segregating the fluids in such members, a member for heating one of said heat-receiving members, refrigerating apparatus giving off heat during the operation thereof, means subjecting a flowable, heat-receiving medium to heat emanating from one of the said apparatus, and means delivering said heat-receiving medium to another of the said apparatus for imparting heat thereto.

16. A fluid heater, as in claim 15, in which the heating member is so arranged that it heats the two heat-receiving members.

ERNEST W. PIERCE.