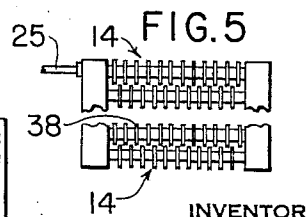
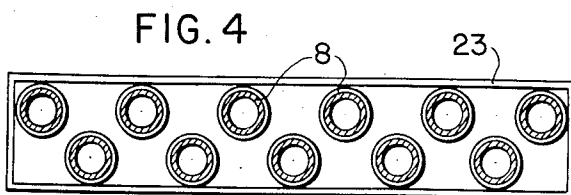
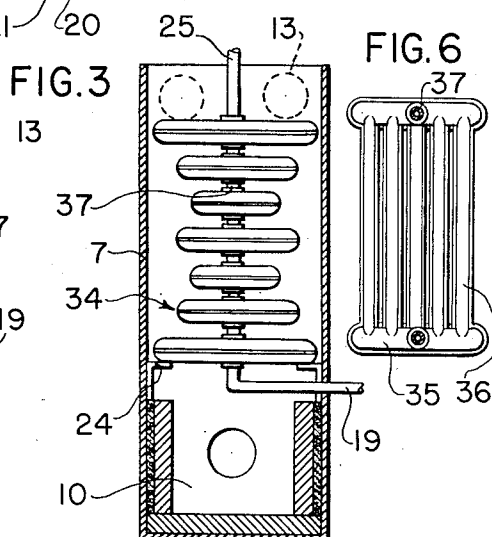
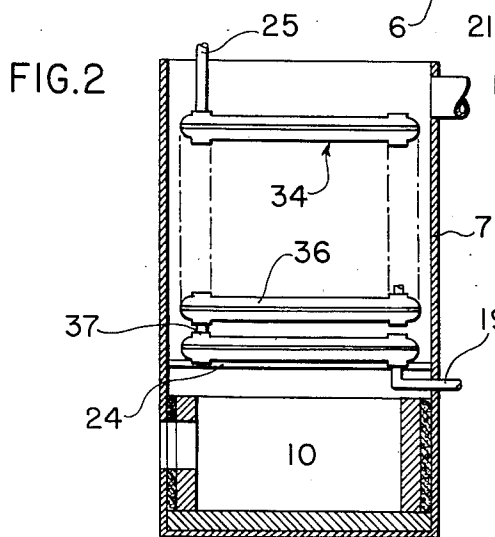
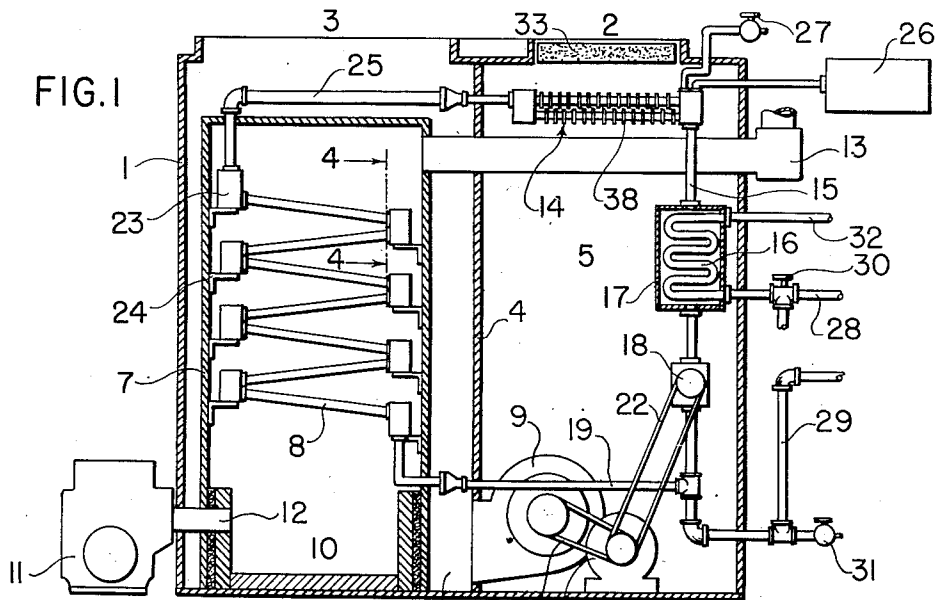


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INVENTOR

BY **John E. Scharff**  
*William F. Nickle*  
**ATTORNEY**

## UNITED STATES PATENT OFFICE

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AIR-HEATING FURNACE WITH LIQUID  
HEAT TRANSFER MEANS

John E. Scharff, New Rochelle, N. Y.

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2 Claims. (Cl. 126—101)

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My invention is an improved heating apparatus, particularly a heater of large capacity in comparison with its size; and adapted to circulate warmed air for indoor spaces, such as offices, apartments and dwellings.

An important object of my invention is to provide a heater of unitary construction and design, simple and relatively inexpensive to produce and assemble, having a high operating efficiency, and easy to inspect and repair.

Another object is to provide a heater wherein the heating medium, such as air, is warmed in successive stages; thus utilizing to the greatest degree the fuel consumed in the process.

The nature and advantages of the invention are fully described herein, and the drawings illustrate one or more practical embodiments of the heater. But this disclosure is explanatory only, and variations in structural details can be adopted without deviation from the general plan that characterizes the improvement.

On the drawings:

Figure 1 is a vertical sectional view through a heating apparatus according to this invention.

Figure 2 is a section through a part of the apparatus, showing a modification seen from one side.

Figure 3 is a view of the same parts seen from one end; and

Figures 4, 5 and 6 show details of the heater.

The heater comprises a main housing 1, in which air enters by way of the inlet 2, and passes out through an opening 3. The openings 2 and 3 are shown as being located at the top of the housing, though of course they may be placed elsewhere. The housing has an interior partition 4, dividing the unit into two compartments 5 and 6; the air entering the former; and, after being heated to the required degree, being discharged from the latter. Within the outlet chamber 6 is the casing 7 of a heater unit containing water tubes or pipes 8, arranged in zig-zagging tiers between the bottom and the top of the casing 7. The other chamber 5 contains a blower fan or impeller 9, which effects the transfer of the air from the one chamber to the other; this fan causing a flow of air from the inlet chamber 5 to the chamber 6 through a suitable opening in the partition 4. In the casing 7 is a combustion chamber 10 at the lower end, the lower portion of the walls of the casing 7 having a suitable fire-resistant lining. A burner is shown at 11, with a nozzle 12 for liquid or gaseous fuel entering the space 10. I, of course, can use any heating unit that is the equivalent of that disclosed herein.

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Each tier of tubes 8 includes several tubes disposed side by side, the tubes of one tier being staggered with respect to the tubes in the tiers immediately above and below it. The casing 7 is closed at the sides, bottom and top, and the products of combustion are passed through a smoke flue 13 connected to the casing 7 at the top and passing through the partition 4 and across the housing 1 and out of the latter. This flue spans the chamber 5 just below the inlet 2. Between this flue and the inlet 2 is a heating member or radiator 14, consisting of a number of pipes connected to the uppermost tubes 8. To this radiator is coupled an outlet pipe 15 leading to a hot water heater 17; and beyond this heater 17 is a pipe leading to pump 18, and then to a pipe or conduit 19 coupled to the lowermost tubes 8.

The fan 9 and the pump 18 are both driven by an electric motor 20, which is connected to the fan and pump respectively by belts 21 and 22.

In operation, the fuel, such as oil or gas consumed in the space 10, heats the water in the tubes 8, and the burnt gases flow out through the flue 13. Hot water from the uppermost tubes 8 flows through the radiator 14. The incoming air comes into contact with the radiator 14 and its temperature is raised as a result. Reaching the flue 13, which acts as another heating member, the air now has its temperature further increased; and the warmed air next enters the fan casing and is forced through an opening in the partition 4 into the compartment 6. Here it absorbs more heat from the walls of the casing 7; and has its maximum temperature when the air passes out through the opening 3. This outlet may be connected to air flues to lead the air to points where heating is needed, or the heater may deliver the air directly into the space containing the housing 1. The air is thus heated in several stages as it flows through the heater, and the operation is very efficient. The maximum effect is obtained from the fuel burnt in the chamber 10. The fan of course delivers through the lowest part of the partition.

Within the casing 7, and affixed to opposite walls thereof are horizontal supports in the form of brackets or angle irons 24 for headers 23 connected to both ends of the tubes 8 of each tier thereof. From the header coupled to the pipe 19, the lower most tubes cross at an incline to the lowest header on the opposite wall of the casing; being connected to this header adjacent the bottom. Other tubes of this header are connected thereto near the top and lead across the casing at an upward incline to the lower part of the next

header, just above the first. As indicated on Figure 4, the tubes of one tier are staggered with respect to the tubes above and below; so that some of the tiers have one more tube than the rest. Thus the hot gases of combustion which flow upward in the casing 7, make contact with an aggregate heating surface of the maximum extent, and the water in the tubes 8 is quickly heated to the required degree. The pipe 25 connects the header of the uppermost tubes 8 to the member 14.

The radiator 14 is connected to an expansion tank 26, and has a vent cock 27 at the top. In the tank 17 is a coil 16, that is supplied with water through an inlet pipe 28; and the contents of this coil 16 are discharged as hot water for domestic use from an outlet pipe 32 coupled to the coil 16 at the top. To the pipe 19 is joined a feed pipe 29 having a relief feed and relief valve. A three way cock 30 is used to cut off the pipe 28 so that the coil 16 can be back-flushed and cleaned of sediment. The pipe 29 has a drain cock 31. Preferably an air filter 33 is in the inlet opening 2.

In Figures 1 and 4 the heater sections made up of the tubes 8 and the headers 23 are of steel, and are joined by welding. On Figures 2 and 3, the heater members have the form of cast iron sections 34, and each includes headers 35 joined by water pipes 36. The sections are joined by coupling or push nipples 37 in such a way that the water in the sections flows in zigzag fashion as before through them from bottom to top. The width and depth of the casing 7 are as indicated in Figures 2 and 4, the depth being somewhat greater than the width. All of the sections 34 have the same length as shown in Figure 2, but some may be narrower, as indicated on Figure 3. The top and bottom sections 34 may have seven tubes each, for example, the middle section six; and the sections adjacent top and bottom sections may also have six tubes each. Between the last named sections and the central section, the two remaining sections have five tubes each, such a section being indicated on Figure 6. The tubes of the successive sections are staggered as before, with respect to the tubes above and below them. This construction is just as efficient and advantageous as the first design above described. The headers are spaced from the casing 7, and the heating medium therein, passing into the radiator 14, acts only on the air entering the compartment 5 to raise its temperature. The burner 12 also heats the walls of the casing 7, and the air impelled by the blower into the compartment 6 is forced into contact with the casing 7 and its temperature is increased again. This construction is very efficient. With one actual installation for example, the incoming air had a temperature of 60 degrees F. at the inlet, and this was raised to 127 degrees by the radiator 14. At the outlet 3 the air after contact with the casing 7, had a temperature of over 160 degrees. When the blower 9 is not operating the casing 7 acts to prevent loss of heat from the pipes 8 and headers 23.

The radiator 14 also comprises headers joined by pipes in two layers, and these pipes may carry outside fins 38.

Other appliances than oil or gas burners for heating may be employed.

Having described my invention, what I believe to be new is:

1. Heating apparatus comprising a housing having a vertical partition therein dividing it into two compartments, one having an outlet at the top and the other an inlet at the top, a casing containing heater sections including hollow headers spaced from the walls of the casing and conduits connecting said headers in the one compartment, a burner located within the casing and adjacent the sections for heating the same, a hollow heater member comprising conduits in the other compartment adjacent the inlet thereof and conduit means connecting the heater member to said sections, a smoke flue connected to the top of the casing and extending through the other compartment at the top thereof adjacent said heater member to the outside of the housing, the partition having an opening adjacent burner end of the casing, an impeller mounted to discharge through the opening in said partition, and a return line connecting the heater member to said sections adjacent said burner end of said casing, a pump in said return line, and a motor in the housing connected to the impeller and the pump.

2. Heating apparatus comprising a housing having a partition therein dividing it into two compartments, one having an outlet and the other an inlet, a casing containing heater sections including hollow headers spaced from the walls of the casing and conduits connecting said headers in the one compartment, a burner located within the casing and adjacent the sections for heating the same, a hollow heater member comprising conduits in the other compartment adjacent the inlet thereof and conduit means connecting the heater member to said sections, a smoke flue connected to the casing and extending through the other compartment thereof adjacent said heater member to the outside of the housing, the partition having an opening adjacent the burner end of said casing, an impeller mounted to discharge through the opening in said partition, and a return line connecting the heater member to said sections adjacent said burner end of said casing, a pump in said return line, and a motor in the housing connected to the impeller and the pump.

JOHN E. SCHARFF.

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