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**15234**

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 [45] Patented **Mar. 2, 1971**

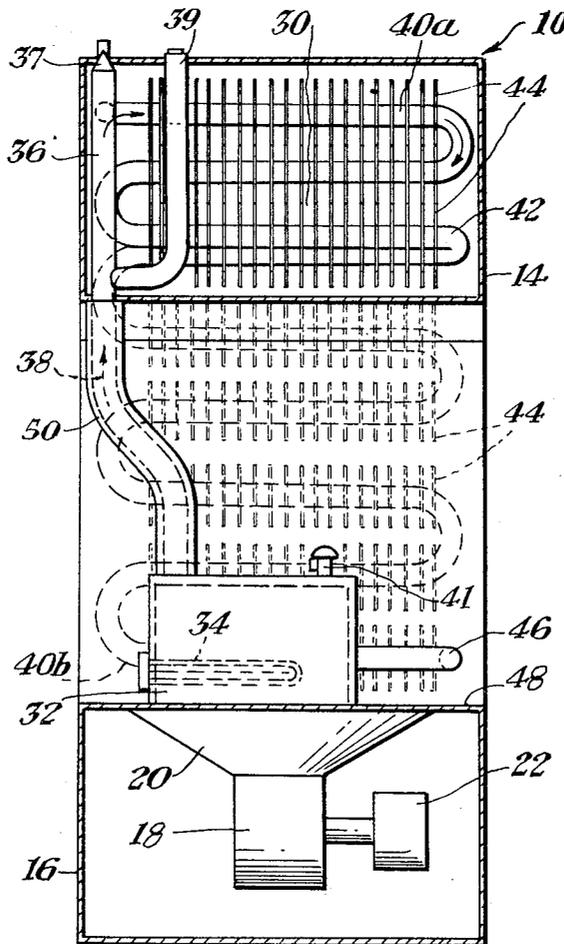
**ABSTRACT:** A hot water forced air circulation heater is disclosed and is particularly adapted for use with one or more electric immersion heating elements. The space heater includes a casing having an upper heat exchanger section and a lower blower section. A convector structure is mounted within the heat exchange section and arranged for the output of the blower to flow therearound. The convector is of serpentine or double serpentine construction and its ends are coupled to a reservoir for water or other heat exchange medium heated by one or more of the heating elements mounted in the reservoir. The convector-conduit and convecting fins associated therewith are sized such that heat exchange water is returned to the reservoir with a substantial quantity of sensible heat to minimize thermal cycling of the heating element or elements and to increase the effective heat transfer area of the convector. The blower output is blown longitudinally of the convector or upwardly through the heat exchange section to maximize contact between the air and the convector. In one arrangement the circulating water reservoir is mounted near the base of the convector on a projecting portion of the casing and is connected through a riser conduit to the inlet at the top of the convector. The upper portion of the convector can be arranged to overhang the reservoir to facilitate connection of the convector to the riser conduit and to give direction to hot air issuing from the space heater.

[54] **HOT WATER SPACE HEATER**  
 13 Claims, 5 Drawing Figs.

[52] U.S. Cl. .... **219/365,**  
 126/101, 219/341, 219/370, 237/16  
 [51] Int. Cl. .... **H05b 3/00**  
 [50] Field of Search ..... 219/341,  
 365, 366—368, 369, 370; 237/16—18; 126/101

[56] **References Cited**

<b>UNITED STATES PATENTS</b>			
2,290,402	7/1942	Witte.....	219/365X
2,491,849	12/1949	Broome.....	219/365
2,518,982	8/1950	Edwards.....	219/341X
2,553,508	5/1951	White.....	219/365
<b>FOREIGN PATENTS</b>			
1,118,759	3/1956	France .....	237/16



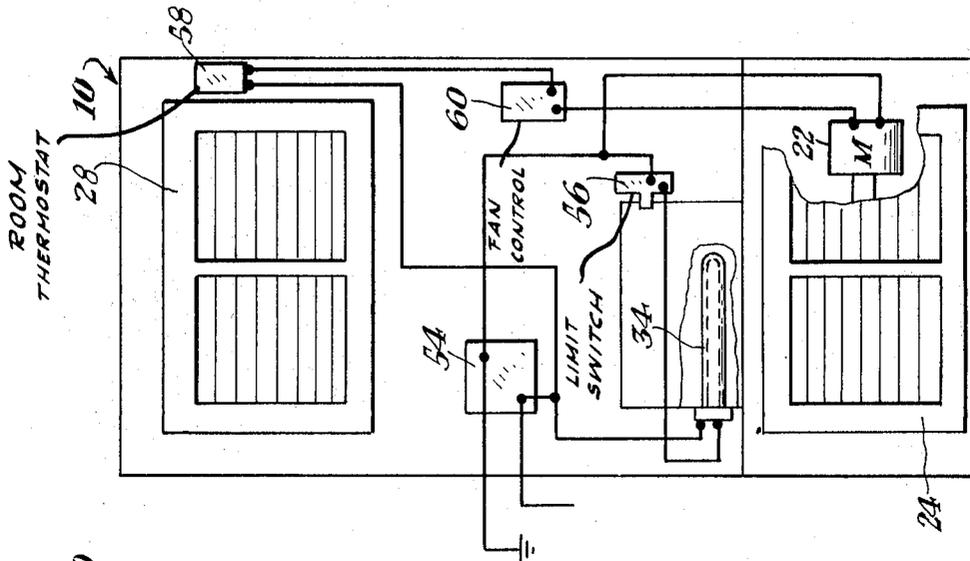


Fig. 3.

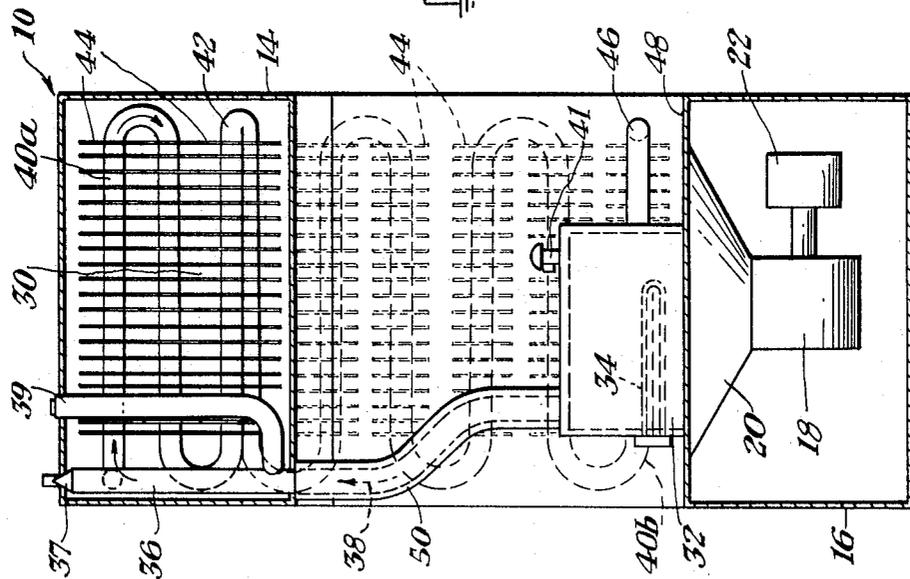


Fig. 2.

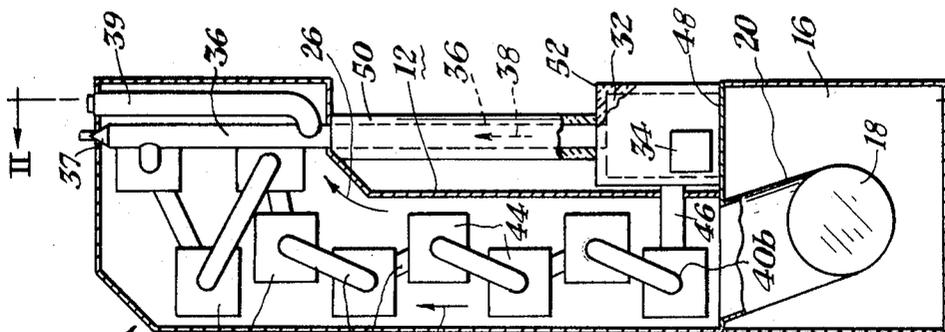


Fig. 1.

INVENTORS'  
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 BY  
 Buell, Shook & Zemanheim  
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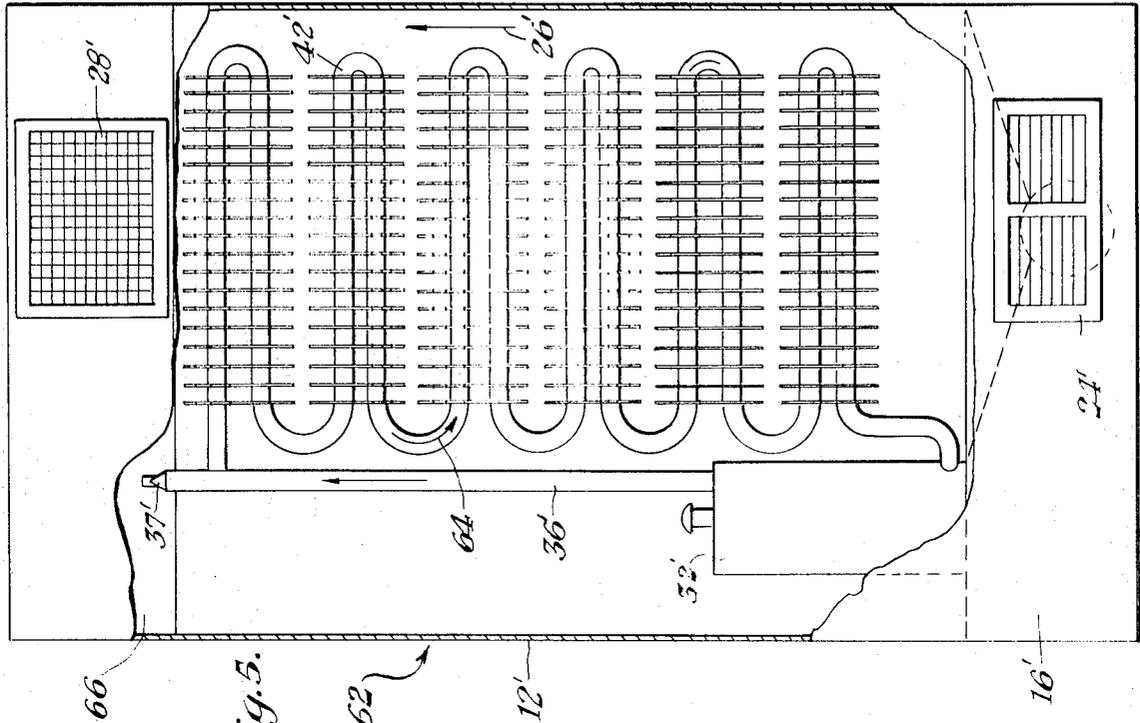


Fig. 5.

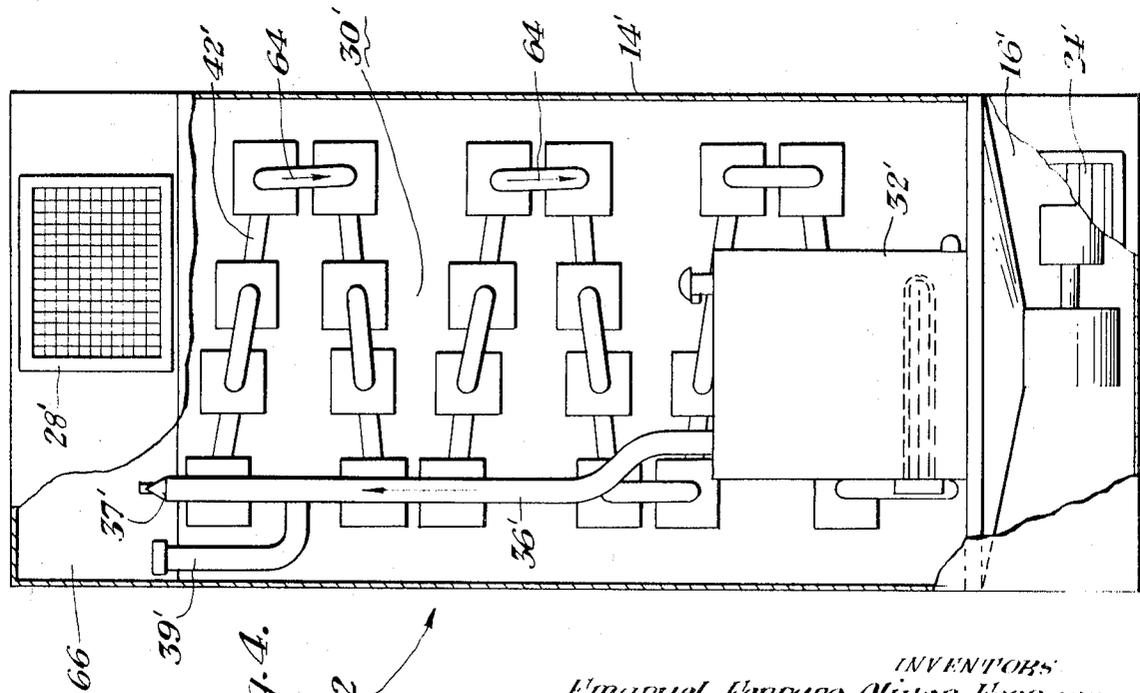


Fig. 4.

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## HOT WATER SPACE HEATER

## DESCRIPTION OF THE INVENTION

The present invention relates to hot water space heaters suitable for heating dwelling and office rooms and larger areas. More particularly the invention relates to a heater of the character described which exhibits a marked increase in efficiency in comparison to prior space heaters. The space heater of the invention is especially designed for use with an electric heat source, although other heat sources obviously can be used.

Previously there has been no effective means for converting electrical energy into heat with an efficiency in comparison to that of heating systems in which fossil fuels are directly combusted. The advantages of the economic use of electric energy for heating purposes are obvious. The dust, dirt, soot, ashes, combustion gases associated with burning fuels are largely eliminated in a properly constructed electrical heating system. The flue connections necessary with combustion-type heaters are also obviated.

Previously proposed electric space heaters employing water as a heat transfer medium have been ineffective largely because of their lack of acceptable conversion efficiencies. For example, in a prior electric hot water space heater, as proposed in U.S. Pat. No. 2, 197,298 to Cobb the air was force-circulated through the heat exchanger in a direction transverse to the flow of heat-exchange water therethrough. As a result, the air was subjected to differing temperatures existing across the heat exchange area, with the result that some of the air was heated sufficiently while other portions were barely heated at all. The Cobb heat exchanger was arranged such that the flow of water therethrough by gravity was largely ineffective. In the Cobb heater an attempt was made to remove as much heat as possible from the heat-exchange water by circulating the water through heat exchanging means having parallel, extremely tortuous paths with the result that the return water was too cold for efficient reheating. Not only was the heating element subjected to severe temperature cycling but also the element could not operate at its most effective level.

Other previously proposed electric spaced heaters have suffered from similar defects and need not to be specifically described.

We overcome these difficulties of the prior art by providing an electric hot water spacer which utilizes a convector rather than a heat exchanger for more effective water-to-air heat transfer. Our space heater is provided with a continuous full flow of water through the convector rather than through headers coupled to branched portions of a heat exchanger. As a result we advantageously utilize gravitational forces in circulating the water. This arrangement provides our space hot water heater with a quick recovery system and minimizes thermal cycling. We also provide a blower arrangement in which the air is propelled generally in the direction opposite to that of the flow of water through the convector so that the air is more gradually but more effectively warmed by first coming into contact with those portions of the convector containing the cooler portions of the heat-exchange water so that the heating air exits from the heater directly from the hottest portion of the convector. This heating and cooling arrangement of the air and water not only considerably increases the efficiency of heat transfer but also permits all of the heated air to exit at substantially the same temperature.

In addition to the aforementioned novel features of our invention, we have also discovered that the efficiency of our space heater can be increased still further to a marked extent by arranging the water volume of the convector to be substantially equal to the water volume of the storage tank in which the heating element or elements are located. We have found that any substantial deviations from this volumetric relationship results in a significant loss in efficiency.

We accomplish these desirable results by providing a hot water space heater including a casing having a base section

and a heat exchange section, a heat-exchange water reservoir mounted on said casing, heat-producing means mounted in heat transfer relation to said reservoir, a convector mounted in said heat exchange section and substantially coexisting therewith for conveying heat-exchange water generally downwardly thereof, an upper inlet port of said convector coupled to a hot water outlet of said reservoir, a lower outlet port of said convector coupled to a return water inlet of said reservoir, said casing having a warm air outlet in the upper portion thereof communicating with said heat exchange section and a cold air return in the lower portion thereof communicating with said base section, and a blower mounted in said casing base section having its inlet communicating with said return opening and having its outlet communicating with said heat exchange section so that blower output air flows upwardly thru said heat exchange section and concurrently to the general flow direction of said heat-exchange water.

In certain advantageous forms of our hot water heater said base section projects outwardly of said heat exchange section, and said reservoir is mounted on the projecting portion of said base section, the outlet of said reservoir being coupled to the inlet of said convector through an external standpipe.

In cooperation therewith an upper air outlet portion of said heat exchange section overhangs said base extension and said reservoir, and the junction between said standpipe and said convector inlet is mounted within said overhanging portion.

For maximum efficiency of our space heater the size of said convector conduit and a number of cooling fins associated therewith are selected such that said water is returned to said reservoir with a substantial amount of sensible heat remaining therein; or the volume of water containable in said reservoir is between 40 and 50 percent of the total amount of water containable in said convector and in said reservoir; or both.

During the foregoing discussion, various objects, features and advantages of the invention have been alluded to. These and other objects, features and advantages together with structural details thereof will be elaborated upon during the forthcoming description of presently preferred embodiments of our invention and presently preferred methods of practicing the same.

In the accompanying drawings we have shown presently preferred embodiments of the invention and have illustrated certain presently preferred methods of practicing the same, wherein:

FIG. 1 is a side elevational view of one form of our novel hot water space heater, with parts being removed to show the invention more clearly;

FIG. 2 is a vertically sectioned view of the apparatus shown in FIG. 1 and taken along reference line II-II thereof;

FIG. 3 is a front elevational view of the apparatus shown in the preceding FIGS. and exemplarily incorporating a schematic electrical operating circuit;

FIG. 4 is a left side elevational view of another form of hot water space heater arranged in accordance with our invention with parts removed and other parts in section to illustrate the invention more clearly; and

FIG. 5 is a rear elevational view, with parts removed, of the apparatus as shown in FIG. 4.

Referring now more particularly to FIGS. 1-3 of the drawings, an exemplary form of our hot water space heater 10 shown therein comprises a casing 12 including a heat transfer section 14 and a base of air intake section 16. As better shown in FIGS. 2 and 3 a blower 18 is mounted within the air intake section 16, and has its outlet coupled to a baffle structure 20 to the lower end of the heat transfer section 14 as better shown in FIG. 1. The blower 18 is driven by motor 22, and its intake communicates thru to the interior of base section 16 and return or cold air grill 24 (FIG. 3) with the ambient. If desired, a suitable dust filter (not shown) or the like can be mounted between the blower intake and the cold air return grill 24. The blower output is directed generally countercurrently of the heat-exchange water flow, as explained below, and upwardly through the heat exchange housing section 14 as

denoted by flow arrow 26 and exits therefrom through the upper or warm air register 28 (FIG. 3).

As mentioned, the heat-exchange water medium is arranged to flow in generally the opposite direction to the blower output, i.e., downwardly through convector arrangement denoted generally by reference character 30. In furtherance of this purpose water is heated in reservoir tank 32 by suitable heat-producing means, for example, electric immersion heating element 34, with the heated water rising by convection through standpipe 36, as denoted by flow arrow 38.

From a point near the upper end of the standpipe 36 the heated water flows into the uppermost run 40a of the convector 30. Thence the heated water flows generally downwardly of the heat transfer section 14, along a serpentine path as defined by conduit 42. In this example, each horizontal run of the conduit 42 is provided with a relatively large number of convecting fins 44 to facilitate transfer of the heat from the convector 30 to the upwardly flowing air through the heat transfer housing 14. The lowermost run 40b of the serpentine conduit 42 is coupled through connecting conduit 46 to the water reservoir 32. For maximum efficiency the convector 42-44 desirably is coextensive with the heat exchange casing section 14.

The upper end of the standpipe 36 terminates in an air vent 37 which is removable for purposes of filling the convector 30 with water. The reservoir 32 is similarly filled through capped conduit 39 to permit the filling the reservoir 32 and convector 30 and other portions of the heat-exchange water system. The fill conduit 39 desirably is coupled to the standpipe 36 within the upper or heat transfer housing 14 in order to minimize the number of exposed conduits. Conduit 39 joins standpipe 36 below its junction with convector 30 so as not to interfere with the escape of air from the convector 30 during filling. As the system is filled with water the displaced air escapes through vent 37. The system also is provided with a relief valve 41 desirably mounted on the upper side of the reservoir 32.

The size of the serpentine conduit 42 and the number and size of convecting fins 44 are selected such that the water medium is returned through conduit 46 to the reservoir 32 with a substantial amount of its sensible heat remaining, in contrast to previous heating systems which attempted to wring all sensible heat out of the heat-exchange water by means of complicated heat exchange means. Our unique convector 30 is capable of transferring significant quantities of heat from the water to the upflowing air even in the lowermost region of the convector 30. Thus, by delivering the water from conduit 46 to reservoir 32 at a relatively warm temperature, we attain a correspondingly greater and more effective heat transfer area in the convector 30.

In order to provide a compact space heater we mount the reservoir tank 32 upon ledge 48 formed by the outwardly projecting portion of the base section 16. In this arrangement the standpipe 36 preferably is extended across the shorter, open distance from the top of the reservoir tank 36 to the uppermost run 40a of the serpentine conduit 42. To conserve heat and to prevent injury to personnel the standpipe 36 can be lagged with a suitable and known pipe insulation 50. Similar insulation 52 can be placed from reservoir chamber 32 if desired. Likewise the exposed portion of the conduit 46 can be lagged (not shown) if desired.

We have also found that the quantity of water contained in the convector conduit 42 must bear a definite relationship to the quantity of water contained in the reservoir 32, for maximum efficiency. Thus, we have found that when the volume of water in the convector 30 is about equal to the volume of water in reservoir 32, the electric hot water space heater 10 operates at maximum efficiency. A significant imbalance in this volumetric relationship introduces a marked decrease in heat transfer efficiency. Thus, if the volume of water in reservoir 32 is less than 40 percent or greater than 50 percent of the total water volume contained in reservoir 32 and convector 42, a significant impairment in operating efficiency results.

Referring now to FIG. 3 of the drawings a typical control system for our novel space heater is shown therein. A junction box 54 in this example is connected in the usual manner to a source (not shown) of line voltage. The fan motor 22 and heating element 34 are coupled in parallel to the junction box. An overload or upper limit switch 56 is coupled in the ground circuit of the heating element while a room thermostat 58 and fan control 60 are connected in series in the supply circuit of fan motor 22.

Referring now to FIGS. 4 and 5 of the drawings another form of our novel hot water space heater is illustrated. Space heater 62 is arranged in this example for a substantially larger output than that shown in the preceding FIGS. In this arrangement the heat transfer housing section 14' is substantially increased in horizontal cross-sectional area in order to accommodate a convector 30' having a conduit 42' of double serpentine configuration as shown. A correspondingly larger water reservoir 32' is employed and in this example is entirely included within the furnace housing 12', as is standpipe 36'.

In the space heater 62 the principle of operation are generally the same as that of the heater 10 shown in FIGS. 1-3, with the blower output being directed upwardly as denoted by flow arrow 26' and the heat transfer medium or heat-exchange water flowing generally downwardly through convector 30' as denoted by arrow 64. Desirably the water volume of reservoir 32' is about equal to the water contained in conduit 42' of the convector 30'.

In the arrangement of FIGS. 4 and 5 however, the housing 12' includes an outlet plenum chamber 66 in the vertical sides of which one or more warm air registers 28' can be mounted. It also is contemplated that conventional heating ductwork (not shown) can be coupled to the plenum chamber 66 and that a cold air return duct (not shown) coupled to housing base section 16'. By the same token the return grill 24 and warm air register 28 of FIGS. 1-3 can be omitted, and the openings therefor coupled to conventional hot air and return ducts (not shown).

From the foregoing it will be apparent that we have disclosed novel and efficient forms of hot water space heaters. While we have shown and described certain presently preferred embodiments of the invention and have illustrated presently preferred methods of practicing the same it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

We claim:

1. A hot water heater including a casing having a base section and a heat exchange section, a heat-exchange water reservoir mounted on said casing, heat-producing means mounted in heat transfer relation to said reservoir, a convector mounted in said heat exchange section and substantially coextending therewith for conveying heat-exchange water generally downwardly thereof, an upper inlet port of said convector coupled to a hot water outlet of said reservoir, a lower outlet port of said convector coupled to a return water inlet of said reservoir, said casing having a warm air outlet in the upper portion thereof communicating with said heat exchange section and a cold air return in the lower portion thereof communicating with said base section, and a blower mounted in said casing base section having its inlet communicating with said return opening and having its outlet communicating with said heat exchange section so that blower output air flows upwardly through said heat exchange section and countercurrently to the general flow direction of said heat-exchange water through said heat exchange section, said reservoir being mounted on said casing adjacent the lower portion of said convector and having its hot water outlet coupled through a standpipe to the upper inlet port of said convector, said standpipe extending upwardly from the upper side of said reservoir, and said convector coextending substantially with the combined length of said reservoir and standpipe.

2. The combination according to claim 1 wherein the size of said convector conduit and a number of cooling fins as-

sociated therewith are selected such that said water is returned to said reservoir with a substantial amount of sensible heat remaining therein.

3. The combination according to claim 2 wherein the volume of water containable in said reservoir is between 40 and 50 percent of the total amount of water containable in said convector and in said reservoir.

4. The combination according to claim 1 wherein said convector includes a serpentine conduit.

5. The combination according to claim 1 wherein said convector includes a double serpentine conduit.

6. A hot water heater including a casing having a base section and a heat exchange section, a heat-exchange water reservoir mounted on said casing, heat-producing means mounted in heat transfer relation to said reservoir, a convector mounted in said heat exchange section and substantially coextending therewith for conveying heat-exchange water generally downwardly thereof, an upper inlet port of said convector coupled to a hot water outlet of said reservoir, a lower outlet port of said convector coupled to a return water inlet of said reservoir, said casing having a warm air outlet in the upper portion thereof communicating with said heat exchange section and a cold air return in the lower portion thereof communicating with said base section, and a blower mounted in said casing base section having its inlet communicating with said return opening and having its outlet communicating with said heat exchange section so that blower output air flows upwardly through said heat exchange section and countercurrently to the general flow direction of said heat-exchange water, said base section projecting outwardly of said heat exchange section, and said reservoir being mounted on the projecting portion of said base section, the outlet of said reservoir being coupled to the inlet of said convector through an external standpipe.

7. The combination according to claim 6 wherein an upper air outlet portion of said heat exchange section overhangs said base extension and said reservoir, and the junction between said standpipe and said convector inlet is mounted within said overhanging portion.

8. A hot water heater including a casing having a base section and a heat exchange section, a heat-exchange water reservoir mounted on said casing, heat-producing means mounted in heat transfer relation to said reservoir, a convector mounted in said heat exchange section and substantially coextending therewith for conveying heat-exchange water generally downwardly thereof, an upper inlet port of said convector coupled to a hot water outlet of said reservoir, a lower outlet port of said convector coupled to a return water inlet of said reservoir, said casing having a warm air outlet in the upper portion thereof communicating with said heat exchange section and a cold air return in the lower portion thereof communicating with said base section, and a blower mounted in said casing base section having its inlet communicating with said return opening and having its outlet communicating with said heat exchange section so that blower output air flows upwardly through said heat exchange section and countercurrently to the general flow direction of said heat-exchange water, said reservoir being mounted on said casing adjacent the lower output portion of said convector and being coupled through a standpipe to the upper inlet portions of said convector,

the upper end of said standpipe projecting above its junction with said convector inlet and through the adjacent portion of said casing and terminating in an air vent for said liquid system.

9. The combination according to claim 8 wherein a capped fill pipe is mounted in said casing with its capped end projecting through the upper end thereof and the lower end communicating with said standpipe at a point below the junction of said standpipe and said convector inlet so as not to interfere with the escape of air from said convector.

10. The combination according to claim 9 wherein a portion of said heat exchange section overhangs said base section, said fill pipe and its junction with said standpipe are enclosed within said overhanging heat exchange portion.

11. A hot water heater including a casing having a base section and a heat exchange section, a heat-exchange water reservoir mounted on said casing, heat-producing means mounted in heat transfer relation to said reservoir, a convector mounted in said heat exchange section and substantially coextending therewith for conveying heat-exchange water generally downwardly thereof, said reservoir being mounted on said casing adjacent the lower output portion of said convector and being coupled through a standpipe to the upper inlet portion of said convector, an upper inlet port of said convector coupled to a hot water outlet of said reservoir, a lower outlet port of said convector coupled to a return water inlet of said reservoir, said casing having a warm air outlet in the upper portion thereof communicating with said heat exchange section and a cold air return in the lower portion thereof communicating with said base section, said reservoir being mounted on said casing adjacent the lower portion of said convector and having its hot water outlet coupled through a standpipe to the upper inlet port of said convector, said standpipe extending upwardly from the upper side of said reservoir, and said convector coextending substantially with the combined length of said reservoir and standpipe, the volume of water containable in said reservoir being about equal to the volume of water containable in said convector.

12. A hot water heater including a casing having a base section and a heat exchange section, a heat-exchange water reservoir mounted on said casing, heat-producing means mounted in heat transfer relation to said reservoir, a convector mounted in said heat exchange section and substantially coextending therewith for conveying heat-exchange water generally downwardly thereof, an upper inlet port of said convector coupled to a hot water outlet of said reservoir, a lower outlet port of said convector coupled to a return water inlet of said reservoir, said casing having a warm air outlet in the upper portion thereof communicating with said heat exchange section and a cold air return in the lower portion thereof communicating with said base section, the volume of water containable in said reservoir is about equal to the volume of water containable in said convector.

13. The combination according to claim 9 wherein a blower is mounted in said casing base section and has its inlet communicating with said return opening and its outlet communicating with said heat exchange section so that blower output air flows upwardly through said heat exchange section and countercurrently to the general flow direction of said heat-exchange water through said heat exchange section.

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No 3,567,905 Dated March 2, 1971

Inventor(s) Emanuel Ferraro et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Abstract, line 4, "exhanger" should read -- exchanger --; line 22, after "the", third occurrence, insert -- heat exchange compartment and the adjacent portion --.

Signed and sealed this 20th day of July 1971.

(SEAL)  
Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

WILLIAM E. SCHUYLER, JR.  
Commissioner of Patents