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UNDERCABINET ELECTRIC SPACE HEATER UNIT

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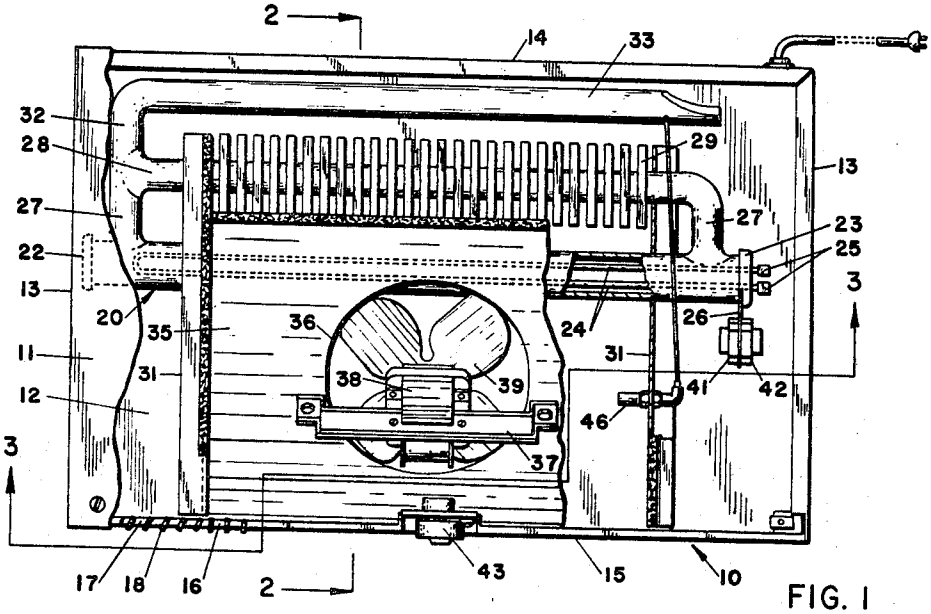


FIG. 1

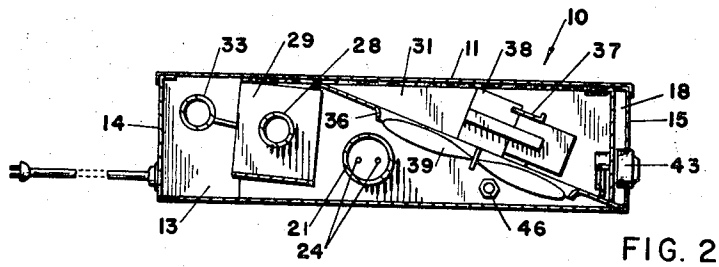


FIG. 2

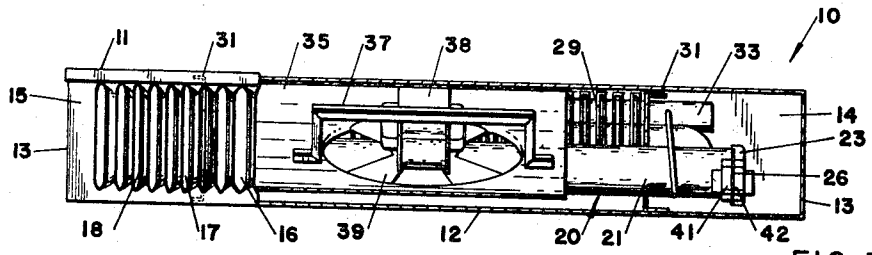
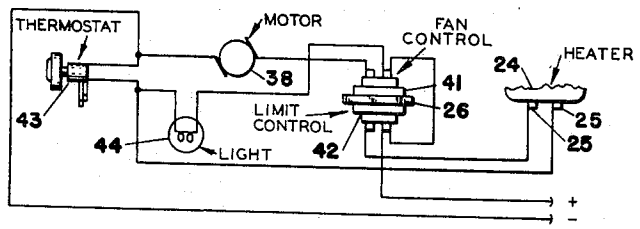


FIG. 3

FIG. 4



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UNDERCABINET ELECTRIC SPACE HEATER UNIT

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The present invention relates to electric heaters of the circulating hot water type, and specifically to the construction of the heater of unusually shallow design, utilizing the forced flow of air heated only to a comfortable exit temperature.

In residential heating, electrically heated circulating hot water units are readily utilized for baseboard heating, provided the rooms have walls which are open over substantial lengths to the flow of convection air. This condition may not exist in certain rooms, especially kitchens, where much of the wall space is occupied by fitted cabinets, cooking stoves and the like.

One of the objects of the present invention is to provide a heater for kitchen use, consistent with a residential heating system which in other rooms utilizes such baseboard convection heaters. Another object is to utilize forced air heating by drawing air into the heater and forcing it out through registers in a single shallow wall immediately above the floor level. Another purpose is to achieve a comfortably low exit temperature of the air so forced from the heater, to insure comfort of persons standing immediately in front of the registered wall. Still another purpose is to utilize the shallow toe space under kitchen cabinets and the like for heating purposes, without excessively heating the cabinets above or the floor below.

Generally summarized, the present invention uses a shallow cabinet with both inlet and outlet registers in its front wall. Within the cabinet is a uniquely positioned hot water heater, which includes a closed heat-exchange loop of tubing. This is not positioned vertically, as in baseboard heaters, but slopes more aft than upward. An electric heater is immersed within the lower forward run of tubing; which communicates through sloping end connections to the aft run of tubing. Vertical fins on this aft run occupy most of the height between the top and bottom walls of the heater. The finned length serves as the exit of a plenum chamber, defined by a pair of side walls, by the top and bottom surfaces of the heater cabinet, and by a baffle forwardly of the heat-exchange loop. An air impeller, such as a fan so mounted in the baffle to direct air more downward than aft, keeps the plenum chamber under some positive air pressure, so that the air flows fairly evenly through the fins on the second tube. Air so escaping through the fins is directed to outlet registers in the front wall of the cabinet at each side of a central inlet register.

In the accompanying drawings:

FIG. 1 is a plan view of an undercabinet hot water heater embodying the invention, shown partly broken away. For clarity, electrical wiring connections are omitted.

FIG. 2 is a side section taken along line 2—2 of FIG. 1.

FIG. 3 is a front view partly in elevation and partly in section taken along line 3—3 of FIG. 1.

FIG. 4 is a schematic wiring diagram.

The heater of the present invention is self-contained in a shallow box or cabinet generally designated **10**, whose height is its least dimension. It includes a top wall **11**, removable for service, a bottom wall **12**, side walls **13**, a rear wall **14** and a front register-containing wall **15**. The front wall **15** includes a central inlet register **16** and outlet registers **17** which extend from the inlet register **16** to

the side walls **13**. The registers **16**, **17** have vertical vanes **18**; those of the inlet register **16** are directed substantially straight forward and aft where as those of the outlet registers **17** are slanted outward and sidewardly, to direct air sidewardly and thus minimize recirculation.

Located substantially in the rear half of the cabinet **10** is a sealed hot water heater unit generally designated **20**. It includes a first lateral horizontal tube **21** supported spacedly between the cabinet top **11** and bottom **12**. The tube **21** is of relatively large diameter. It is capped by left end cap **22** and the right end cap **23**, which supports an elongated U-shaped sheathed resistance heater **24** by its terminal ends **25**. A temperature-sensing flange **26**, projecting forward from the end cap **23**, supports two thermoswitches hereafter referred to.

Inwardly of the end caps **22**, **23**, aft-extending upward-sloping tubular connections **27** lead to a second lateral horizontal tube **28** which is of smaller diameter than the first tube **21**. Between the end connections **27** the second tube **28** is provided over the greater part of its length with heat-conductive vertical fins **29** which are spaced from the top and bottom walls **11**, **12**, but extend the greater portion of the depth of the cabinet **10**.

Just as the top and bottom walls **11**, **12** confine the air flow vertically, means are provided within the cabinet to confine the air laterally to the finned length of the tube **28**. In the embodiment shown this means consists of left and right vertical walls **31** which extend the full entire depth of the cabinet from the front wall between the inlet register **16** and outlet registers **17**, aft to the left and right sides of the finned length of the tube **28**, there stopping short of the rear wall **14**.

From this finned length, air outlet passages are defined by the outer sides of the vertical walls **31**, the top and bottom walls **11** and **12**, the rear wall **14** and each of the side walls **13**. As shown in FIG. 1, the portions of the lower tube **21** and upper tube **28** which project sideward beyond the finned length of the upper tube **28**, as well as the end caps **22** and the tubular connections **27**, all lie within the outlet passages so defined. Likewise lying within the outlet passage is a closed-end expansion tube **32** which, as shown in FIGS. 1 and 2, extends aft and upwardly from its juncture with the left end connection **27** and has a substantially horizontal expansion portion **33** within the outlet passage aft and somewhat above the the level of the second tube **28**. Water (with suitable antifreeze added) fills the lower tube **21**, the upper tube **28**, the end connections **27** and the lower part of the expansion tube **32**, leaving within its horizontal portion **33** a substantial sealed air space into which the water may expand when heated.

Extending aft from the juncture of the front wall **15** with the bottom wall **12** between the vertical-flow confining walls **31** is a baffle **35** having a central opening **36**. A mounting bracket **37** mounts a fan motor **38** and aligns its fan **39** with the baffle opening **36**. By reason of the slope of the baffle **35**, which is more aft than up, the fan **39** is directed downwardly and aft toward the bottom wall **12** at a point substantially forward of the finned length of the second tube **28**.

The structure thus described forms in effect a plenum chamber in which the finned length of the tube **28** is the outlet; the plenum chamber is otherwise defined by the vertical walls **31** at each side, the bottom wall **12** and the baffle **35** which extends aft to a point above the forward edges of the fins **29**. Air impelled by the fan **39** must escape rearwardly between the vertical walls **31** along the finned length of the tube **28**.

The electrical components and wiring diagram are shown in FIG. 4. On the inner side of the temperature-

sensing flange **26** is a fan control thermoswitch **41** which as shown is connected to the side of the wiring system marked positive (for convenient reference, it being understood that alternating current will usually be employed). When the temperature of the sensing flange **26** reaches a preset temperature, say 130° F., the fan control thermoswitch **41** will close, to make a circuit through the motor **38** to the negative terminal. The fan will continue to operate as long as the temperature of the sensing flange continues to be high, say above 110° F., at which point the fan control switch **41** will open to break the motor circuit.

The heater system circuit is essentially separate from the fan circuit. As shown in FIG. 4 the positive terminal is connected through a limit control thermo-switch **42** to the heater **24** and room thermostat **43** and thence to the negative terminal. The limit control thermo-switch **42** is a safety switch; it is normally closed; but if the temperature of the sensing flange **26** reaches say 280° F. the limit control switch **42** will open, breaking the circuit to the heater, and will remain open until the temperature drops to say 210° F.

The thermostat **43** senses room temperature at the inlet register **16**; when this temperature falls below a desired level, the thermostat **43** completes the circuit from positive through the limit control switch **42** through the heater **24** to the negative terminal. The signal light **44** is connected in a line from positive to the thermostat **43**; when closed the circuit to the negative terminal is completed.

As a safety provision in the event of malfunction of these electrical controls, a simple pressure relief valve **46** is connected by a pressure relief tube **47** to the extreme end of the horizontal portion **33** of the expansion tube **32**.

From the construction described, the functioning of the above embodiment of this invention will be apparent. When the temperature at the floor level falls below the preset temperature of the room thermostat **43**, the current will flow to the heater **24** through its terminals **25**, the water will begin to heat and circulate and the temperature of the sensing flange **26** will rise. After it has risen sufficiently, the fan control thermo-switch **41** will close, causing the fan **39** to raise the pressure of air in the plenum chamber, as heretofore described, slightly above atmospheric pressure, so filling it that air escapes through the fins **29** over the entire finned length of the second heater tube **28**. The exit air flows rearward through the fins **29** and outward to the left and right and forward, through the outlet passages as herein above defined, to and through the outlet registers **17**. The water heated by the heater **24** within the lower tube **21** rises to the finned tube **28**; cooling through the fins results in a constant circulating flow of liquid through the closed flow path made by the tubes **21, 28** and their end connections **27**. The interposition of the tube **21** in the plenum chamber forwardly of the finned length of the tube **28** itself carries away some of the heat.

One of the advantages of utilizing such a hot water circuit, as compared with an electrical resistance heater which heats the air directly, is that the hot water type heater need not be relieved of its heat evenly over the entire heated elements; the cooling air may be somewhat localized. In the embodiment illustrated I have taken advantage of this fact to minimize the lateral dimension of the heater. The plenum chamber extends only the finned length of the tube **28**, whereas the tube ends and end caps **22, 23** and the necessary end connections **27** are spaced within the air outlet passages leading forwardly to the outlet registers **17**. The lower temperature on that portion of the heater system within the plenum chamber will relieve the temperature in the end portion so projecting into the outlet passages. Thus the space needs of the hot water heater are accommodated, in the present invention, within an extremely compact cabinet, resting on the floor in the toe space beneath other cabinets.

The unique advantage of the present hot water heater system in such usage is, that the exit air does not reach a temperature so high as to be uncomfortable for persons standing close to the outlet registers **17**. The air circulated by the fan, when it commences to operate when the sensing flange **26** heats to close the fan control switch **41**, can never reach a high temperature, as would be the case with air flowing directly over an electrical resistance heater; and the heater cabinet keeps the top wall **11** relatively cool, so that the unit may be safely used under kitchen baseboard cabinets, etc. It is believed that this result has never been achieved heretofore with any type of self-contained heater.

The present heater is adapted for a variety of uses in restricted areas, as in offices on top of desks, in deep shelf installations, etc. Accordingly, the term "Undercabinet Hot Water Heater" as used in the claims is not to be considered as restrictive, but rather merely as indicative of one of the typical forms of installation of the apparatus otherwise defined.

Changes in details of construction and arrangement of the units in the system will be apparent to those familiar with the heat art. Accordingly, the present invention is not to be construed narrowly, but rather as co-extensive with the claims hereof.

I claim:

1. An undercabinet hot water heater of the type utilizing forced air flow over a heat exchanger in which electrical heating induces the circulation of heated liquid, comprising

a cabinet having top and bottom horizontal walls and whose height is its least dimension,

a first lateral horizontal tube supported therein spacedly above the bottom and below the top of the frame,

an electrical resistance heater within said first tube,

means providing a path for the flow of liquid through said tube and around said heater, said means including

a second lateral horizontal tube of smaller diameter and whose tube axis is above the level of said first tube, and aft-extending, upward-sloping tubular connections between said first and second tube adjacent to their ends,

heat-conductive vertical fins affixed to and along the length of said second tube intermediate said tubular connections,

air-impelling means,

and means to laterally confine the air impelled thereby to the finned length of the second tube,

whereby to define, in part, walls of a plenum chamber in which the finned length of the second tube is at the outlet and the first tube extends across the entire length thereof,

the cabinet further having a front register-containing wall including an inlet register communicating to the air-impelling means, and an outlet register sideward of the inlet register, and

an outlet passage from the finned tube to the outlet register.

2. An undercabinet hot water heater as defined in claim **1**, together with tubular expansion permitting means communicating with the path of flow of liquid and extending upwardly above the level of the second tube and aft of the fins thereon.

3. An undercabinet heater as defined in claim **1**,

the air-impelling means being a fan,

together with a baffle extending slopingly upward and aft from the bottom wall adjacent to the inlet register, whereby to serve as the forward wall of the plenum chamber,

the baffle having a central opening mounting the fan directed downwardly and aft toward the bottom wall forwardly of the finned length of the second tube.

4. An undercabinet heater as defined in claim **1**,

the cabinet including a rear wall spaced aft of the finned tube and a side wall outwardly of the outlet register, the said means to laterally confine the impelled air including a vertical wall extending aft from the front wall between the inlet register and outlet register, along a side edge of the sloping baffle and to one end of the finned length of the second tube, the said vertical wall stopping short of the rear wall, and

wherein the outlet passage is defined by the side of said vertical wall opposite to the baffle, and the top and bottom walls, rear wall, and side wall.

5. An undercabinet heater as defined in claim 4, wherein portions of the first and second horizontal tubes and the aft-extending tubular connection therebetween project sidewardly of said vertical wall and outward of the plenum chamber into the said outlet passage.

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U.S. Cl. X.R.

219—341, 370; 165—122, 106; 237—16; 126—101