Oct. 6, 1964 R. W. KRITZER 3,151,671

RADIATOR ASSEMBLY WITH BOOSTER CONTROL

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Fig. 1

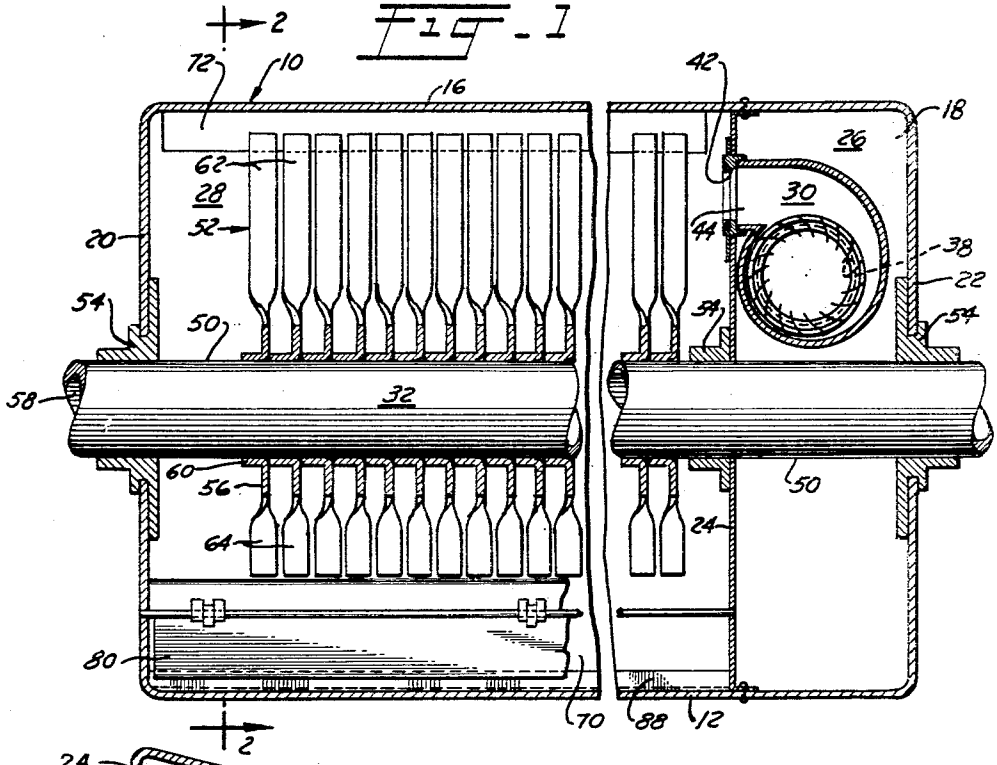


Fig. 2

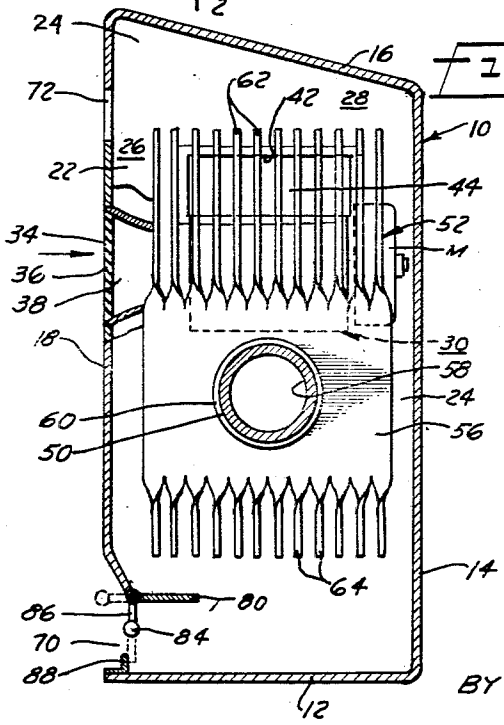
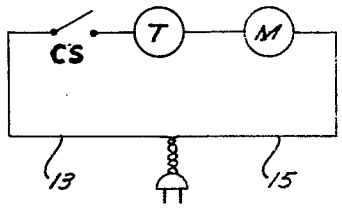


Fig. 3



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RADIATOR ASSEMBLY WITH BOOSTER CONTROL

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The present invention relates generally to radiator constructions and has particular reference to a radiator assembly which is designed essentially for heating an inhabitable enclosure and has associated with it booster control means whereby, when normal thermally induced air flows past the heat exchange surfaces of its heat exchange unit is insufficient to bring the temperature of air within the enclosure up to a desired maximum, a booster fan is set into operation and overrides the normal thermally induced air flow in such a manner that an appreciably greater amount of heat is extracted from the heat exchange surfaces of the heat exchange unit by the passing air and the latter is forced into the enclosure under superatmospheric pressure.

In its broadest aspect, the invention contemplates the provision of a radiator assembly, including a heat exchange unit, which is of the finned tubing type and has the fins thereof so designed and positioned within the associated casing that they offer a minimum resistance to the flow of air thereacross in any direction in which the air is capable of flowing through the casing. The casing opens into the associated inhabitable enclosure in such a manner that, normally, when a fluid heating medium is passed through the finned tubing of the heat exchange unit, the air within the casing is thermally induced to rise vertically and become discharged from the upper regions of the casing, thus pulling replacement air into the casing through the lower regions thereof. If the heated air thus introduced into the enclosure is sufficient to satisfy the demand for heat, the radiator continues to function in this manner indefinitely. However, if the thermally induced flow of air is insufficient to satisfy the demand for heat, a booster fan forming a part of the radiator assembly, is automatically set into operation, either manually or automatically, and air is drawn from the enclosure into the casing and caused to traverse the heat exchange surfaces (fins) of the heat exchange unit in a direction different from the direction of thermally induced air flow, the new path of air meeting the fins in an edge-on direction throughout a greater edge area, thereby increasing both the heat-exchange efficiency of the radiator assembly as a whole and the volume of air flow so as rapidly to bring the temperature of the enclosure up to the desired maximum.

It is further contemplated that, if desired, and in order more intimately to confine the blast of air from the booster fan to the region of heat exchange, a damper be provided to channel or guide the air issuing from the booster fan into close proximity to the heat exchange surfaces, principally the edge surfaces, and prevent drifting of the air stream away from these surfaces before all of them have been encountered.

The provision of a radiator assembly of the character briefly outlined above being among the principal objects of the invention, numerous other objects and advantages, not at this time enumerated, will become more readily apparent as the nature of the invention is better understood.

In the accompanying single sheet of drawings forming a part of this specification, one illustrative embodiment of the invention has been exemplified in the form of an elongated baseboard radiator assembly of small height and appreciable horizontal or longitudinal extent. It is to be distinctly understood, however, that the invention

is not necessarily limited to baseboard-type radiator assembly and that, if desired, the principles of the invention may be applied to various types of space heaters, whether the general direction of tubing extent be horizontal or vertical, whether the casing be elongated in one direction or the other, or whether the path of air flow be guided by dampers or not. Irrespective, however, of these specific details, the essential features of the invention are at all times preserved.

In the one sheet of drawings:

FIG. 1 is a sectional view taken substantially centrally vertically and longitudinally through a baseboard radiator assembly constructed according to the principles of the present invention;

FIG. 2 is a sectional view taken on the line 2—2 of FIG. 1; and

FIG. 3 is a circuit diagram of a thermostat control which may be employed in connection with the present invention when automatic operations of the booster fan is desired.

Referring now to the drawings in detail, the invention has been disclosed herein as being in the form of an elongated baseboard radiator assembly of the type which is adapted to extend horizontally along a floor surface at a region near the juncture thereof with an adjacent vertical wall surface. As previously stated, however, the invention is applicable to other types of radiator constructions, for example, a floor-to-ceiling radiator or other upright structure disposed wholly within the enclosure to be heated or disposed exteriorly of such enclosure and communicating therewith through suitable air passages or openings. The radiator assembly comprises a casing 10 which is generally in the form of a trapezium in transverse cross section and includes a bottom wall 12, a vertical back wall 14, a forwardly and upwardly inclined top wall 16, a front wall 18, and a pair of widely spaced end walls 20 and 22. A transverse partition wall 24 divides the casing 10 into a relatively short fan compartment 26 and a relatively long heating compartment 28, the compartment 26 being disposed adjacent to the end wall 22. The compartment 26 in the casing 10 has mounted therein a booster fan 30 in the form of a conventional motor-driven centrifugal blower assembly. The compartment 28 has mounted in it an elongated heat exchange unit 32. The top wall 16, the rear wall 14 and the bottom wall 12 of the casing are common to the two compartments 26 and 28 but the front wall of the fan compartment 26 is a full wall having a series of louvers 36 which admit air to the suction or intake side 38 of the booster fan 30. The partition wall 24 is provided with an opening 42 in communication with the discharge side 44 of the motor-driven booster fan 30. The direction of fan discharge is such that air is blown longitudinally through the heating compartment 28.

The heat exchange unit 32 is essentially of the fin and tube type and may assume various forms. However, in the illustrated form of the invention it consists of a length of cylindrical tube stock 50 (hereinafter referred to as tubing) and a series of closely spaced heat-radiating fins 52 which are secured to and extend generally radially outwardly of the tubing. The tubing 50 extends longitudinally through the casing 10 and is supported in the end walls 20 and 22 and in the partition wall 24 by suitable supporting heads 54. The tubing 50 is adapted to have a suitable fluid heating medium, such as steam or hot water, circulated through it.

The various heat-radiating fins 52 per se form no part of the present invention. Preferably, they are like those which are shown and described in United States Patent No. 2,903,246, granted to me on September 8,

1959 and entitled "Baseboard Radiators." The fins 52 are substantially identical and are in the form of sheet metal stampings of copper, brass, aluminum or other metal having high heat-conducting characteristics or properties. Each fin includes a central imperforate hub portion 56 having a central opening 58 which is surrounded by a laterally extending annular flange 60. The tubing 50 passes through the flanges 60 of the fins 52 and is expanded radially outwardly to effect such a union between the tubing and the fins as to insure high heat transfer properties between the parts. Relatively long heat-radiating fingers 62 extend upwardly from the upper regions of the hub portions 56 and relatively short-heat-radiating fingers 64 extend downwardly from the lower regions of the hub portions. The fingers 62 and 64 are twisted at an angle of 90° from the planes of the hub portions 56 so as to provide small spaces between adjacent fingers and thus enhance the flow of air along the tubing 50 in a longitudinal direction and transversely through and past the upper and lower regions of the fins 52 of the heat exchange unit 32.

It is to be noted at this point that whether the air within the casing 10 flows vertically upwardly through the casing or whether it flows longitudinally along the casing, the side edges of the twisted fingers 62 and 64 are disposed well within the paths of moving air with the result that heat extraction from these edges is enhanced. It is a matter of common knowledge that, in connection with any heat-radiating fin presenting linear edges, the amount of heat transfer which takes place at these edges is greater than the heat transfer which takes place at comparable areas along the planar force of the fin. Thus, the placement of these side edges of the fingers 62 and 64 well within the path of moving air contributes materially to the efficiency of the present radiator assembly.

As best shown in FIG. 2, means are provided whereby, when the fluid heating medium is supplied to the tubing 50, a thermally induced flow of air occurs within the heating compartment 28, this flow of air being directed generally upwardly through the compartment. Accordingly, the partial front wall 18 of the casing 10 provides an elongated air inlet opening 70 between the lower edge thereof and the forward edge of the bottom wall 12, and an air discharge opening 72 between the upper edge thereof and the front edge of the top wall 16. These openings 70 and 72 are substantially coextensive with the longitudinal extent of the heating compartment 28. Due to well known isothermal and adiabatic processes, when the air within the heating compartment and in close proximity to the heat-radiating fins 52 assimilates or absorbs heat from these fins, the air expands and consequently has a tendency to rise, thus drawing colder air inwardly through the inlet opening 70 and discharging heated air outwardly through the discharge opening 72. A reasonably free flow of air upwardly around the various fins 52 is assured by reason of the fact that this air is not appreciably obstructed by the lateral turning or twisting of the various heat-radiating fingers 62 and 64.

In the operation of the present radiator assembly, it is contemplated that the aforementioned thermally induced flow of heated air upwardly through the casing 10 and outwardly through the elongated discharge opening 72 will satisfy most moderate demands for heat so that the boosting effect of the booster fan 30 is not needed and this fan, which is electrically operated, may remain deenergized or idle. However, where there is a demand for more heat within the enclosure with which the radiator assembly is associated, the fan 30 will be set into operation in a manner that will now be described in detail.

The fan 30 is driven by an electric motor M which, as shown in FIG. 3, is operatively connected through leads 13 and 15 to a suitable source of current supply, such as a wall outlet leading from a 110 volt power line. An off-on control switch CS may be disposed in the lead 13 for manual control of the motor M if desired but, if automatic operation of the motor M is required, a conventional room thermostat T may be disposed in the lead 13 in series with the switch CS.

Assuming now that automatic operation is desired, and also assuming that it is required that the enclosure with which the radiator assembly is associated be maintained at an even temperature of 70° F., if the temperature within the enclosure is at or above this rating, the thermostat T will cause the circuit for the motor M to be open so that the fan 30 is inoperative and a thermally induced flow of air upwardly through the casing 10 will obtain in the manner previous described. If this flow of thermally induced heated air is sufficient to maintain the required temperature, the thermostat will maintain the motor M deenergized and the flow of air upwardly through the casing and past the various fins 52 will continue indefinitely. However, if the temperature drops below the required or desired temperature of 70° F., the thermostat T will close the electric circuit for the motor M, thus enregizing the same and causing the fan 30 to be set into operation. The fan will then draw air through the louvers 36 in the front wall 34 of the compartment 26 and discharge it under pressure through the opening 42 in the partition wall 24 and into the adjacent end of the elongated heating compartment 28. This air will be forcibly projected endwise against the heat exchange unit 32 and will pass between the spaces existing between the various pairs of adjacent heat-radiating fingers 62 and 64. After passing through the first few fins in this manner, some of the heated air will spread laterally and, under the confining influence of the various casing walls, will flow both upwardly and out of the discharge opening 72 and downwardly and out of the opening 70 which, normally is an air inlet opening for thermally induced air flow as previously described. Some of the air also will contiuue to flow longitudinally through the casing 10 and strike the fins 52 more remote from the partition wall 24 and this air also will spread laterally and pass outwardly through the elongated openings 72 and 70. It is contemplated that the fan 30 will be so designed that its displacement rating is sufficiently high as to force some of the air completely along the longitudinal extent of the compartment 28 in order to extract heat from the endmost fin remote from the partition wall 24. It is to be noted at this point that, because of the relatively large volume of air which is displaced under the influence of the fan 30, normal flow of air under the influence of adiabatic and isothermal processes will be overridden and the fan 30 alone will control the volume of air leaving the casing 10.

As an alternative means for overriding the thermally induced flow of air upwardly through the heating compartment 28, and in order to enhance the action of the booster fan 30 and make possible the use of a lower powered fan, a pivoted damper 80 of elongated design may be mounted within the air intake opening 70. This damper is adapted to be closed across the opening when the fan 30 is in operation. If desired, the damper may be manually controlled but, to render the radiators assembly fully automatic in its operation, the damper is preferably pivoted to the lower edge of the partial front wall 18 as shown in FIG. 2 and is balanced by means of a weight 84 which is carried at the outer end of a torque arm 86. In its free state, the damper 80 assumes the substantially horizontal open position in which it is shown in full lines in FIG. 2. When the fan 30 is set into operation, the pressure of air established within the compartment 28 will tend to force some of this air downwardly and outwardly through the opening 70 and the rush of air past the damper 80 and against the same will automatically swing the damper to its closed position against a fixed limit stop 88 on the bottom wall 12. After the damper

30 has thus been closed, the pressure of air within the compartment 28 will serve to maintain the damper closed as long as the fan is in operation. During such operation of the fan, the full volume of air will pass upwardly and outwardly through the air discharge opening 72 and into the associated enclosure.

The above-described booster effect which obtains as a result of energization of the motor M and consequent operation of the fan 30, will extract a considerable amount of heat from the various heat-radiating fins 52. The amount of heat thus extracted will be appreciably greater than the amount of heat which is extracted by the upward flow of air when a thermally induced flow of air through through the compartment 28 is in effect. This is because the relatively long side edges of the various laterally turned heat-radiating fingers 62 on one side of each finger are presented head-on, so to speak, to the oncoming air passing the fins. The total or combined length of these side edges is greater than the total or combined length of such edges as are presented in head-on fashion to the air when it flows upwardly through the heating compartment 28 during normal thermally induced air flow.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit or scope of the invention. For example, although the damper 80 has been shown and described herein as being balanced for automatic operation under the influence of air flow thereagainst and of the pressure of air maintained within the compartment 28, it is contemplated that this damper may be solenoid-actuated under the control of the thermostat T if desired. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. A radiator assembly comprising a casing providing a horizontally elongated internal heating chamber, a heat exchange unit of the finned tubing type disposed within said chamber extending from one end thereof to the other, and including a length of tubing from which there projects generally radially outwardly therefrom a series of closely spaced heat-radiating fins, said chamber being provided with an elongated air inlet opening in the lower regions thereof substantially coextensive with the length of the chamber and a similarly elongated air discharge opening in the upper regions thereof, said air discharge opening being substantially coextenhive with the length of the heating chamber so that when a heating media is supplied to the length of tubing, air will be constrained to enter the air inlet opening and flow generally upwardly and into heat exchange relationship with all of said series of fins and from thence through said discharge opening outwardly of the chamber, each of said fins including a generally planar hub portion secured to said length of tubing and extending radially thereof, and a series of peripheral heat-radiating fingers which are turned out of the plane of the hub and extend in parallelism longitudinally of the length of tubing, a power-operated fan disposed within the casing adjacent to one end of the heating chamber and having its intake side in communication with the air exteriorly of the chamber and having its discharge side in communication with the adjacent end of said chamber for directing a stream of air longitudinally of the chamber and between adjacent pairs of laterally turned heat-radiating fingers, an elongated damper substantially coextensive with and positioned in said intake opening for selectively closing and opening the same, and means for selectively energizing and deenergizing said fan.

2. A radiator assembly as set forth in claim 1 and wherein said damper is operable in response to superatmospheric pressure of the air within the chamber due to fan operation to effect closing of said air intake opening.

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