Dec. 27, 1966 A. F. BALJET 3,294,158

BASEBOARD HEATER

Filed Dec. 30, 1963

FIG. 1

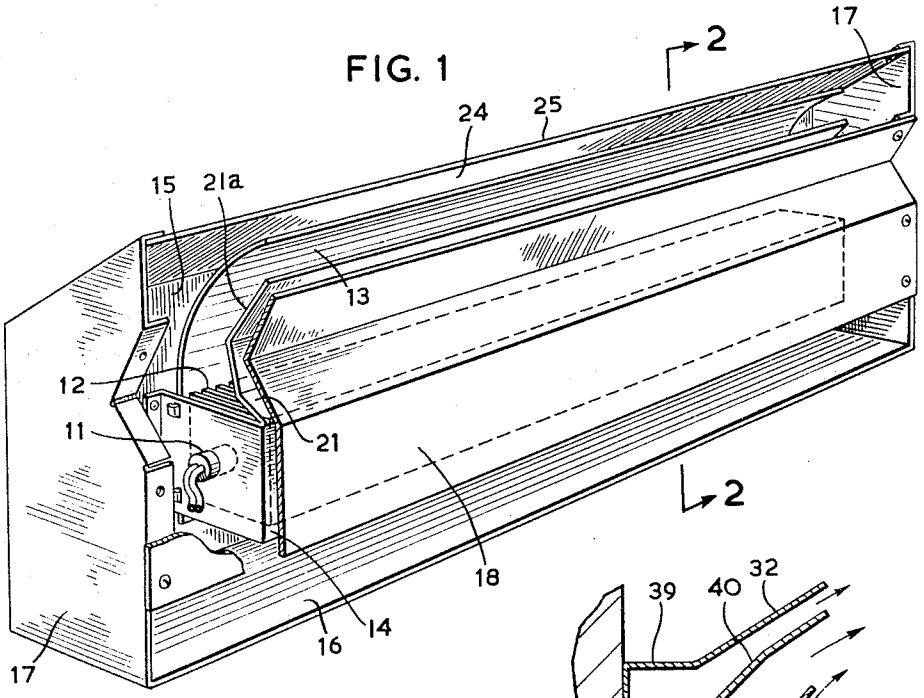


FIG. 2

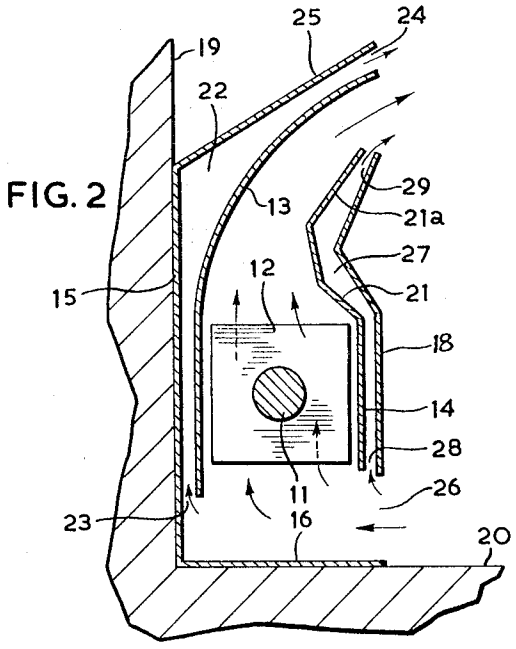
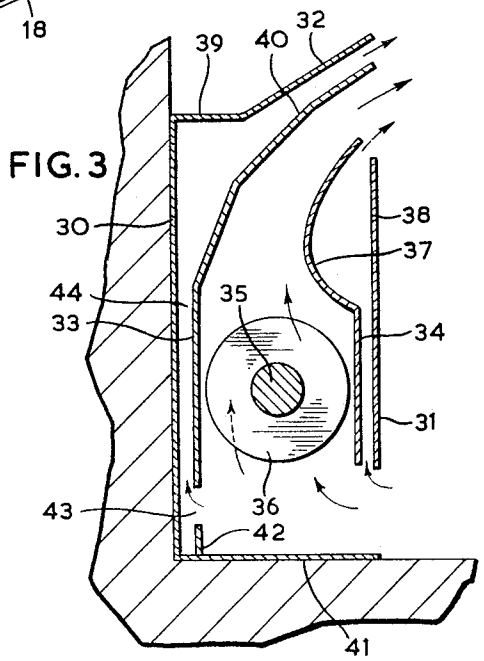


FIG. 3



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BASEBOARD HEATER

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The present invention relates to an improved baseboard heater and more particularly to a baseboard heater combining the features of efficient cooling of heater elements and minimized discoloration of wall surface above the heater.

Heretofore in the art of baseboard heating, discoloration of walls immediately above a heater due to deposition of normal air contaminants thereon has been a serious problem. Attempts made to allieviate this problem by the use of baffle deflectors have met with varying degrees of success, but wall streaking has continued to be a serious drawback to the use of baseboard heaters. One of the requisites of any baseboard heater design has been the need of enclosure and baffle plates not only to protect the wall but also to afford protection against surfaces heated directly by air flowing around the heating element. At the same time the heating element itself must be made relatively inaccessible, thus to eliminate the risk of persons touching the hot element or the chance of combustible materials collecting thereon. Baffle and deflector designs previously used in the art have succeeded in providing the aforedescribed protection, but due to the positioning of these elements they have resulted in a substantial reduction in the velocity of the air currents leaving the heater, thereby adversely affecting the deflection of hot air away from the wall surface above the heater.

I have discovered that by proper design and positioning of both the front baffle and the back baffle in a baseboard heating unit, wall discoloration above the heater can be reduced to a minimum by attaining maximum deflection of warm air currents away from the wall in a compact, high velocity stream, while at the same time keeping heater elements adequately covered and protected and maintaining all exposed heater enclosure surfaces at low temperatures without the addition of grilles or baffles which partially obstruct the air flow through the heater.

It is an object of the present invention to provide a novel baseboard heater which combines the features of maximum air heating and element cooling efficiency with even, unobstructed air flow leading into and away from the heater element.

The invention also contemplates providing a special heating means of the baseboard type by which very rapid air heating may be atttained while at the same time wall discoloration from air contaminants is maintained at a very low level.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a broken-away, perspective view of a preferred form of baseboard heating apparatus embodying the invention;

FIGURE 2 is a view in vertical transverse section taken on line 2—2 of FIGURE 1; and

FIGURE 3 is a view in vertical transverse section of another form of heating apparatus embodying the invention.

The present invention proposes an improved baseboard heating design by which cold air is rapidly and efficiently heated and ejected from the apparatus in a smooth flowing, non-turbulent stream of relatively high velocity which is directed away from the wall against which the heater is mounted. This feature, which has never fully been attained by prior art baseboard heaters, is accomplished by

the use of specially shaped back and front baffles between which the heater element is mounted. At the same time, front and back enclosure plates are utilized which are shaped so as not to interfere with the stream of warm air leaving the heater while at the same time adequately protecting the hot surfaces of the baffle elements and the heating element itself.

Referring to the drawings, and in particular to FIGURES 1 and 2, which illustrate a preferred form of baseboard heater embodying the invention, a heater element **11** with cooling fins **12** attached to it and spaced along the length of the element is supported by suitable means between a rear baffle **13** and a front baffle **14** which also extends along the length of the heater element **11**. The rear and the front baffles **13** and **14** are in turn supported within a rear enclosure plate **15**, a bottom plate **16** and side enclosure plates **17** and a front enclosure plate **18** is at the front of the assembly. As may be seen from the drawings the rear enclosure plate **15** adequately covers and protects the rear baffle **13** while the front enclosure plate **18** adequately covers and protects the front baffle **14**. The whole assembly is positioned against a wall **19**, either on floor **20** or above, it is a substantially horizontal position.

The heater element **11** is advantageously an electrical element although it may be a hot water or steam element. The fins **12** placed along the element preferably are square in order to dissipate heat efficiently.

Important features of the invention are the shapes of the rear baffle **13** and of the front baffle **14** which together channel cool air upwardly and around the heater element **11** and the fins **12**, and also channel the heated air upwardly and away from the heater element surfaces. Referring in particular to FIGURE 2, it can be seen that the lower portions of the baffles **13** and **14**, located behind and in front of the heater element **11**, are substantially vertical and parallel to each other and that they are close to and substantially parallel to the edges of the cooling fins **12**, thus reducing to a minimum the leakage of unheated air past the heater element surfaces. It is to be noted that the lower edges of the baffles **13** and **14** are spaced from the bottom plate **16**. The upper portion of the rear baffle **13** forms a section which rises above the heater element **11** and its fins **12** and gradually extends toward the front of the heater. Advantageously, the upper portion of the rear baffle defines an unobstructed arc of a curve, substantially devoid of sudden changes in configuration, as shown in FIGURES 1 and 2, which serves to direct the convection currents leaving the heater outlet at a maximum velocity in a substantially non-turbulent flow away from the heater and the wall. A configuration of the rear baffle, however, as shown in FIGURE 3, described hereinafter, provides a smooth flowing and substantially non-turbulent air stream of high velocity directed away from the wall. Only after leaving the heater outlet does the current break up into turbulent flow to form a rising flow region next to the wall. This rising flow region is much deeper than any previously attained by the art, and consequently the velocity of air flowing next to the wall surface is much lower and less dirt deposition results.

The configuration of the upper ends of the baffles is of considerable importance. I have observed that the presence of a "boundary" which projects into or in some way interferes with the natural, laminar-flow, convection current set up by the rear baffle **13** creates a low pressure area which results in a deflection of the air current toward this boundary, thus, interfering with the smooth, even flow, away from the wall, of the air current leaving the heater. Accordingly, I have found that careful design of the rear baffle and of the front baffle is necessary in order to avoid low pressure-producing boundaries adja-

cent to or projections into the warm air stream leaving the heater and to maintain the high velocity, non-turbulent current set up by the rear baffle. The front baffle **14** is shaped to follow as closely as practicable the configuration of the rear baffle **13**. The upper portion of the baffle **14**, above the fins **12**, has its lower end **21** inclined over the heating element toward the back of the heater and its upper end **21***a* inclined toward the front of the heater (see FIGURE 2) to substantially follow the directions of the rear baffle **13**. Ideally, the front baffle **14** is shaped to follow the path of the naturally converging warm air stream which is set up by the rear baffle in absence of any front baffle and has a curved configuration substantially matching the upper curved portion of the rear baffle **13** (see FIGURE 3), to provide a substantially smoothly curved passage for heated air, although the discontinuous shape shown in FIGURE 2, devoid of tubulence forming projections is found to be adequate to maintain substantially even flow. Together, the front and rear baffles define a converging funnel-like passage rising above the heater element and curving toward the front of the heater and produce a Venturi-like effect in the hot air stream produced by the heater.

As was previously mentioned, the baffles **13** and **14** with the heater element **11** and the fins **12** fixed therebetween are supported within an integral external casing comprising the bottom plate **16**, the side enclosure plates **17**, the rear enclosure plate **15**, and the front enclosure plate **18**. In cases where the heater is mounted on a wall, and somewhat above the floor, the bottom supporting plate **16** is not necessary. The rear enclosure plate **15** rises substantially vertically to define a first ventilated air space **22** between itself and the rear baffle **13** with an inlet **23** adjacent the lower edge and an outlet **24** adjacent the upper edge of the rear baffle. The upper portion of the rear enclosure plate **15** extends over and protects the rear baffle **13** to end smoothly in spaced and generally parallel relationship with the upper portion of the rear baffle. It is particularly important that upper portion **25** of the rear enclosure plate **15** does not project into, or form any disturbing boundary in, the line of flow of the air stream rising from the heater element **11** and flowing away from the rear baffle plate **13**.

The front enclosure plate **18** provides protection for the front baffle **14**. The bottom edges of the baffle **14** and the front enclosure plate **18** are spaced from the bottom plate **16** to define an air inlet opening **26** through which air enters the heater. The front enclosure plate **18** rises in spaced relationship from the front baffle **14** with which it provides a second ventilated air space **27** for ventilating air. The lower edges and the upper edges of the baffle **14** and of the front enclosure plate **18** define an inlet opening **28** and outlet opening **29**, respectively, for the air passage **27**. Cooling air entering the inlet **28** flows through the air passage **26** and out of the outlet **29**, thus to reduce the temperature of the front enclosure plate **18**. Again it is important, as with the rear enclosure plate **15**, that the front enclosure plate **18** at its upper edge does not project into the line of flow of warm air issuing from the outlet **29**.

FIGURE 3 depicts a vertical transverse section of another form of heating apparatus embodying the invention. In this apparatus a rear enclosure plate **30** and a front enclosure plate **31** are shown protecting a rear baffle **33** and a front baffle **34**. A heater element **35** is shown with cooling fins **35** attached to the element. These cooling fins are of different configuration than those shown in FIGURE 2. The rear enclosure plate **30**, the front enclosure plate **31**, the rear baffle **33** and the front baffle **34** are also shown to be of different configuration than that shown in FIGURE 2. Thus, the front baffle **34** is shown to have an upper, curved portion **37** adapted to substantially follow the path of the stream of heated air rising from the heater element and gradually directed in a converging stream toward the front of the heater by the rear baffle **33**. The front enclosure plate **31** is of flat configuration but with no upper boundary tending to interfere with the direction of the air streams flowing from the heater. The upper portion **32** of the rear enclosure plate **30** has a horizontal section **39**. The portion **32** is seen to have no boundary or projection which interferes with or disturbs the path of flow of the air stream rising from the heating element. In the embodiment shown in FIGURE 3, the rear baffle **33** is seen to have an upper portion **40** which gradually changes direction over the heater element toward the front of the heater in three straight line sections. The lower portion of the rear baffle **33** extends down to a bottom plate **41** at **42** and contains openings **43** along the length of the baffle for entry of cooling air into a ventilating space **44**.

The apparatus shown in FIGURE 3 has the same advantageous operational features as the apparatus shown in FIGURE 2 and provides efficient heating of cold air with hot baffles and heating elements being adequately protected. At the same time a smooth-flowing and non-turbulent hot air stream of relatively high velocity is obtained which is effectively directed away from the wall against which the heater is mounted, thus maintaining wall discoloration at a low level.

The novel configuration of front and rear baffle elements and the special design and positioning of front and rear enclosure plates in the hereindescribed baseboard heater provide a combination of advantages not heretofore attained in the art. The velocity of vertical convection currents in immediate contact with the wall surface is reduced to a level not found with prior art baseboard heaters of comparable heat output. This is accomplished by directing the heated air in a non-turbulent air stream through a smoothly converging passage provided between a rear baffle and a front baffle and gradually changing direction away from the wall toward the front of the heater, with neither baffle having obstructions or boundaries interfering with the flow of hot air from the heater. At the same time enclosure plates for the baffles are provided which also have no obstructions tending to interrupt the smooth flow of heated air or surfaces tending to interfere with the direction of the air flow. The heated air is ejected from the heater away from the wall in a relatively narrow, high velocity stream which eventually breaks up in turbulent flow but in a deep layer of slowly rising warm air in front of the wall in the order of twice the depth of the heater. The velocity of air actually flowing over the wall is much lower than that produced by prior art heaters with resultant reduction in deposition of airborne particles on the wall.

By utilization of the "shadowgraph" technique, described in conference paper number CP–63–291 entitled Technique for Observing Air Flow Around Electric Heaters presented by the present inventor to the Institute of Electrical and Electronic Engineers in January of 1963, comparative photographs show that the depth of the warm air layer rising from an operating baseboard heater of the present invention is greater than the rising warm air layer resulting from the operation of any prior art heater.

The efficient cooling of the heater element is attained in the present novel heater by the elimination of obstructing objects, such as grilles, in the air stream, which tend to reduce the velocity of the air stream through the heater. Cooling is further improved by eliminating any sudden changes of direction in or obstructions on baffles which also tend to slow down air currents. By substantially eliminating the admission of cold air into the air stream above the heater element suction of air through the bottom of the heater over the cooling fins is maintained at a high level. Due to efficient cooling of heater element surfaces provided by the present heater, pyrolysis of normal contaminants present in the air is maintained at a low level with resulting substantial elimination of wall discoloration caused by the deposition of the products of such pyrolysis. I have found that the maximum enclosure

temperature reached under continuous operation of the present heater in a 75° F. ambient temperature is 140° F., a temperature lower than that obtained, insofar as is known, with any baseboard heater of the prior art of comparable heat output.

A further advantage of the hereindescribed wall heater is its ability to maintain all exposed heater surfaces at low temperatures. This is accomplished by providing efficiently ventilated air spaces between the front enclosure plates and the front baffle and between the rear enclosure plate and the rear baffle through which cooling air passes in even, unobstructed flow. At the same time the heater element and fins, as well as the front and rear baffles in direct contact with heated air currents, are adequately covered and protected without the addition of grilles or baffles which would partially obstruct the air flow through the heater.

What I claim as my invention is:

A baseboard heater comprising rear and front enclosure plates, front and rear baffles supported between said enclosure plates, a heater element supported between said front and rear baffles and means for supporting said heater in a substantially horizontal position, said rear baffle having a lower, substantially vertical portion located behind said heater element with a bottom edge spaced from the bottom of the heater and an upper portion rising above and gradually extending over said heater element away from the back and toward the front of said heater and being substantially devoid of sudden changes in configuration, said front baffle having a lower, substantially vertical portion located in front of said heater element with a bottom edge spaced from the bottom of the heater to define an air inlet for said heater and having an upper portion with a lower end rising above and inclined over the heater element toward the back of the heater and an upper end inclined toward the front of the heater to substantially match the front boundary of the path of the warm air stream set up by the rear baffle, the upper portions of said front and rear baffles defining a gradually converging, funnel-like passage rising above said heater element and gradually changing direction from a path directed to the top of the heater to a path directed substantially to the front of said heater and ending in a heater outlet which is devoid of obstructions to the flow of warm air from said outlet with the heater in operation and which directs warm air outwardly from the front of the heater, the lower portions of the front and rear baffles being closely adjacent to the heater element to reduce cold air flow around and past said heater element to a minimum, said rear enclosure plate substantilly covering but positioned in spaced relationship from said rear baffle to define a first ventilated air space therewith, said front enclosure plate substantially covering but positioned in spaced relationship from said front baffle to define a second ventilated air space therewith and the upper ends of said front and rear enclosure plates being substantially devoid of any obstructions interrupting flow of air from the passage between the front and rear baffles, the upper portions of the front and rear baffles being of substantially smoothly curved configuration to provide a substantially smoothly-curved passage for heated air between the upper portions of the front and rear baffles.

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