Dec. 30, 1958 J. M. BAEZA 2,866,449

WARM AIR GAS-FIRED HEATING ELEMENT

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FIG-1

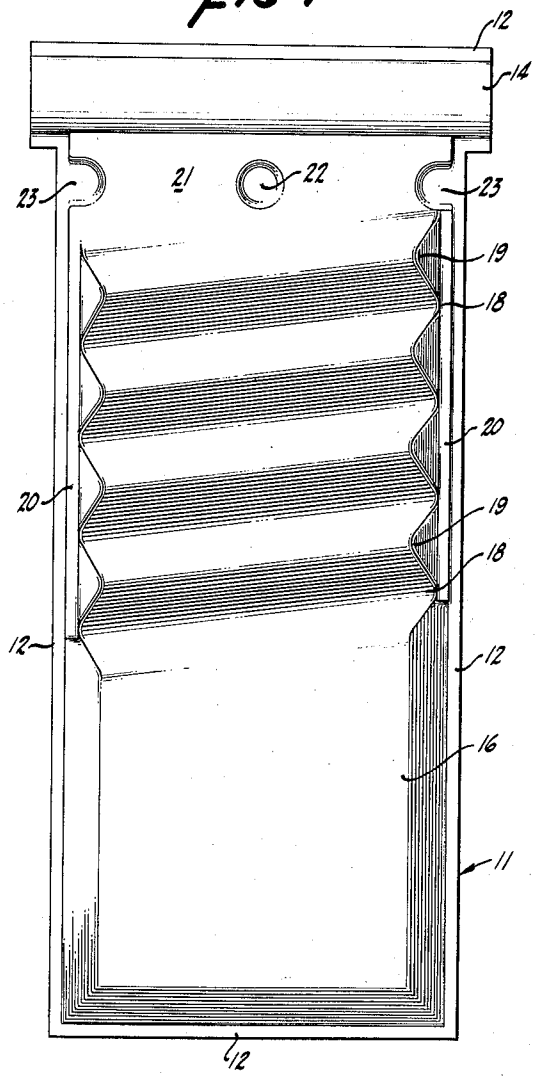
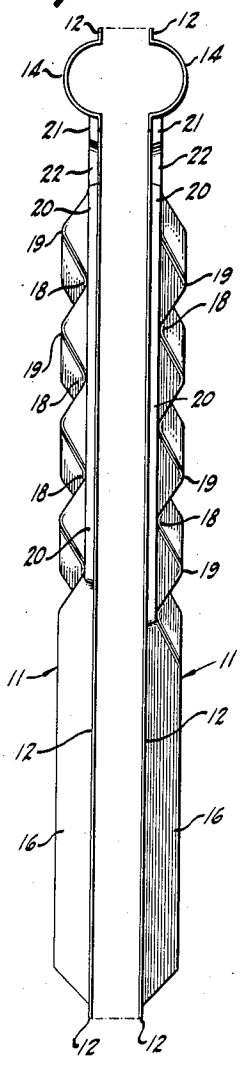


FIG-2



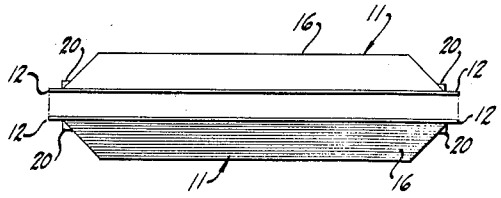


FIG-3

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FIG-4

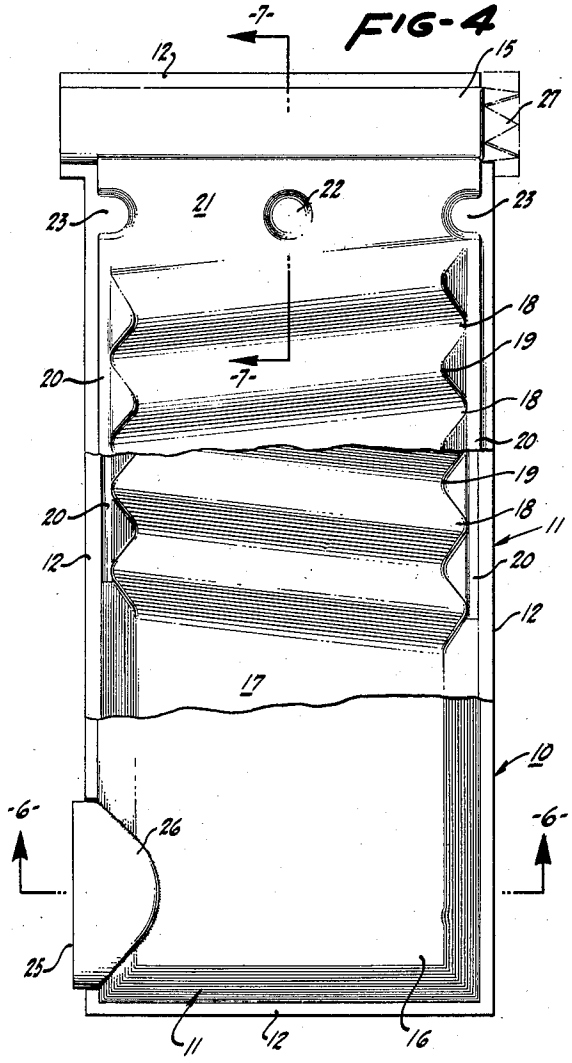


FIG-5

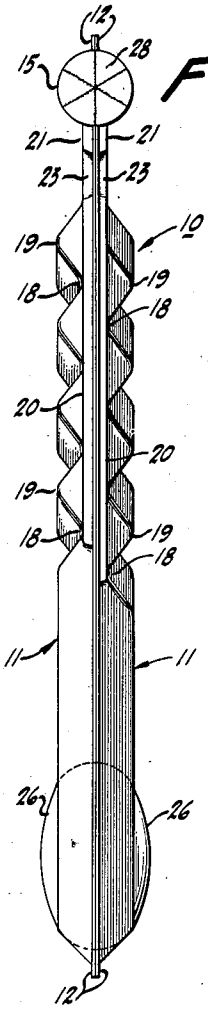


FIG-6

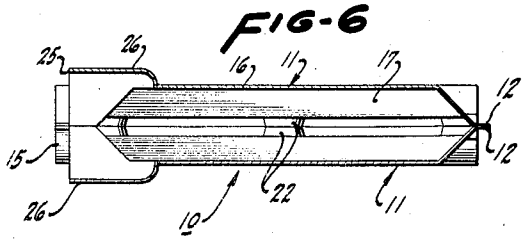
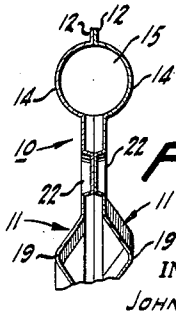


FIG-7



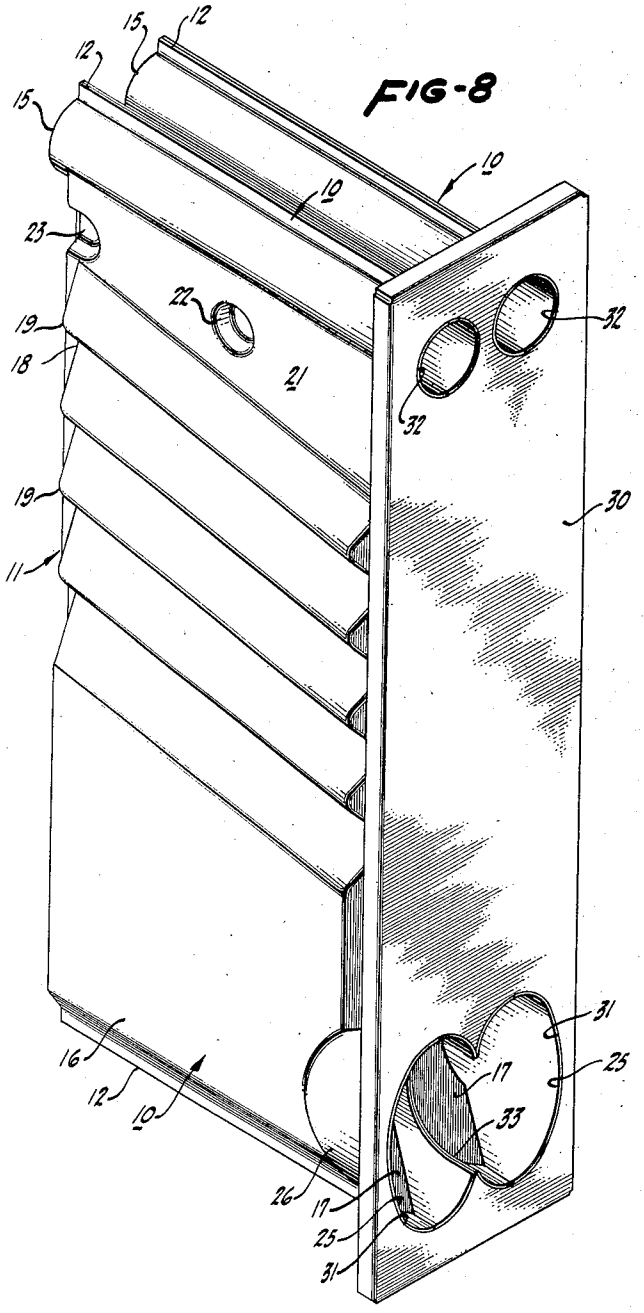
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WARM AIR GAS-FIRED HEATING ELEMENT

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FIG-8



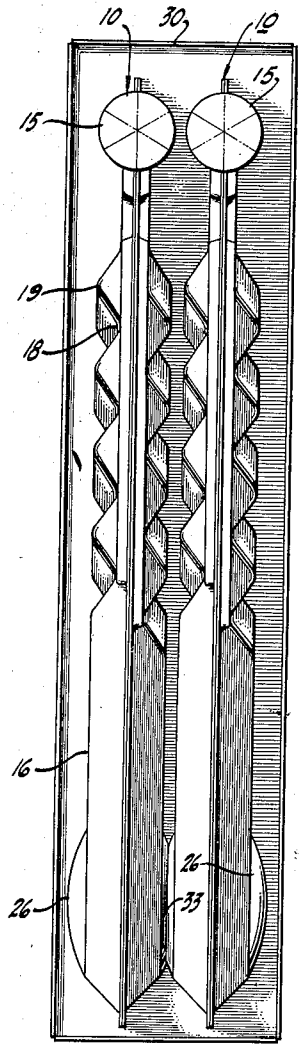


FIG-9

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2,866,449

WARM AIR GAS-FIRED HEATING ELEMENT

John M. Baeza, San Francisco, Calif.

Application November 25, 1955, Serial No. 548,859

4 Claims. (Cl. 126—91)

This invention relates to improvements in heating elements, particularly to heating elements used for gas-fired heaters and furnaces.

It is the recognized practice of the industry to use a standard design heating element for gas-fired heaters or furnaces and to vary the capacity of the heaters by adding units where more capacity is desired. Accordingly, it is essential that each heating element be of such basic and critical form that it will perform its required functions, not only as an individual unit, but in combination with multiples thereof. Accordingly, it is an object of the present invention to provide such a unit, but one which has rated efficiency far in excess of the minimum 75% required by the American Gas Association for approval of such equipment.

It is a further object to produce a gas-fired heating element, which, because of its greatly extended thermal efficiency, makes it possible to reduce the size of each element to do an equivalent job as compared with those customarily employed in the art at the present time. This means, in addition, that the smaller elements represent a substantial saving in metal and weight, and, further, reduce the over-all size of a furnace, making it possible to use the furnace in places which were impossible before because of the space limitations.

It is a further object of this invention to provide a heating element having a complex serpentine of flow of combustion products and gases, not only vertically, but laterally, without the necessity of baffles or other interrupting or directional members. Similarly, where multiples of the elements are used, it is an object to provide a furnace or heater where the air passing over the heating elements has a complex serpentine flow not only vertically but laterally without the necessity of baffles or other interrupting or directional members.

Another object of the invention is to produce a heating element which provides a reliable outdraft, but eliminates the possibility of a strong outdraft which would have a tendency to lift the flame from the burner with the consequent dangerous loss and escape of unburned gas.

It is a further object of the present invention to provide a heater where a straight flow of either combustion products or air either downwardly or upwardly cannot take place and where they will be well distributed over the entire surfaces at all times.

It is a further and important object of the present invention to produce all of these benefits by making the two main sections of the heating element from a single nonsymmetrical die, thus eliminating the expense of two dies, one for the right side and one for the left side, cutting die costs in half, and making it possible to stack uniform members in nested form, thus saving a great amount of floor space and storage.

Further objects are to provide a construction of maximum simplicity, economy, and ease of assembly and disassembly, also such further objects, advantages and capabilities as will fully appear and as are inherently possessed by the device and the invention described herein.

The invention further resides in the combination, construction and arrangement of parts illustrated in the accompanying drawings, and while there is shown therein a preferred embodiment thereof, it is to be understood that the same is merely illustrative of the invention and that the invention is capable of modification and change, and comprehends other details of construction without departing from the spirit thereof or the scope of the appended claims.

Referring to the drawings:

Figure 1 is a side elevational view of one of the two opposed nonsymmetrical metal stampings required to form a single heating element.

Figure 2 is a vertical end elevation showing two stamped members spaced and opposed to each other, in the manner in which they are to be joined together to form a single heating element.

Figure 3 is a bottom plan view of the elements shown in Figure 2.

Figure 4 is a completed heating unit with one side broken away to expose the inner surface of the opposed nonsymmetrical stamped member.

Figure 5 is a rear elevational view of a completed heating element, showing the two opposed members joined together.

Figure 6 is a transverse section taken on the line 6—6 of Figure 4 and looking in the direction of the arrows.

Figure 7 is a fragmentary vertical section taken on the line 7—7 of Figure 4.

Figure 8 is a perspectitve view of a two element heating unit.

Figure 9 is a rear elevation of the two element heating unit shown in Figure 8.

Referring now, more particularly to the drawings, in which like reference numerals indicate like parts of the several views, it will be observed that the heating element, generally designated **10** (see Figure 4), is made up of two initially identical nonsymmetrical stampings **11**, shown in Figure 1, which are uniform and interchangeable. Accordingly, only one die, i. e., that which forms the stamping shown in Figure 1, is required to form both sides of the heating element **10**. The stampings are nonsymmetrical because of the angularity of the upper heat exchange portion, so that when the stampings are placed in opposed position for joining to form a heating element, the upper portions do not register. The stamping has a flat marginal edge **12** which extends around the perimeter of the stamping **11**, with the exception of the semicylindrical portion **14**, which, in the opposed and faced position with a similar stamping **11**, joins to make the flue outlet **15**. The lower portion of the stamping **11** is raised a substantial distance above the marginal edge **12**, and in the opposed and faced position with an identical stamping **11**, forms the firebox **17**. From the raised portion **15** it leads directly into a series of lateral valleys **18** and hills **19**, which are angled upwardly from left to right at an angle of from 5° to 10°. It is these valleys and hills which make each stamping nonsymmetrical in form. The peaks of the hills **19** are substantially on the same plane as the plateau of the raised portion **16**. The valleys **18**, however, terminate slightly outward of the plane of the margin **12**, leaving a ridge **20** at both sides. Above the series of valleys **18** and hills **19** is a raised portion corresponding in height with that of the vertical side channels **20**. The raised portion **21** has a central depression **22**, the bottom of which is on the same plane as the marginal edge **12**. At either side thereof are semicircular depressions **23**, the bottoms of which merge with the marginal edge **12**, and, of course, are in the same plane.

Since only one nonsymmetrical die is required to make the stamping shown in Figure 1, it is apparent that they

may be stacked in nested form for storage or for further fabrication.

Since two of the stampings **11** are required for each heating element, their relationship in the opposed and faced position in which they are to be joined is clearly shown in Figures 2 and 3, so that when they are moved together and secured, the marginal edges **12** engage each other face to face as do the bottoms of the depressions **22** and **23**.

Further steps, however, are required in order to utilize the single stampings **11** in the final fabrication of the heating element and prior to their being secured together. A small die is used to form the elliptical opening **25** at one edge adjacent the bottom of the stamping and in the area **16**. It is apparent that the stamped portion **26** formed at one edge to make the elliptical firebox opening can be used to make either right hand or left hand stampings, depending upon the side from which the stampings **11** are fed to the die. In order to close the end of the flue channel **15**, a portion of the end on the opposite side from the molded portion **26** is cut away and crowned as at **27**, so that the various segments can be curved inwardly and joined to make a closed solid end **28**. The two opposed stampings **11**, when formed for juncture as shown in Figure 4, are held together in any suitable manner, preferably by spot welding along the marginal edges **12** and at the centers of the depressions **22** and **23**.

It will be observed that when the two members **11** are formed in the opposed manner shown in Figure 4, that the hill and valley formations do not correspond with each other due to the lack of symmetry, but are, in fact, inclined in opposite directions. This is clearly shown by the breakaway in Figure 4. However, it is to be observed, by reference to Figure 5 in particular, that at the edges the valleys of one side correspond with the hills of the other and vice versa for the duration of this formation. This produces an unusual spacing internally. At the center point where the angularity of the opposed sides cross, the separation is at a minimum, and gradually increases until it reaches the maximum at the marginal edges.

The complete heating element, as shown in Figure 4, is normally used in vertical position with the gas burning element inserted through the elliptical opening **25** and into the firebox chamber **17**. Combustion gases pass upwardly through the chamber **17**, formed by the opposing raised portions **16**, and into the series of valleys and hills **18** and **19** which are inclined upwardly. It will be apparent that these combustion gases not only have a serpentine flow in the vertical direction, but have a serpentine flow in a lateral direction. In this manner, as the hot combustion gases pass through these inclined valleys and hills in this compound serpentine flow, their contact with the metal causes them to continuously give up their heat. In addition, the spacing on the interior of the element will not permit a straight flow or chimney flow, either up or down, and insures an even and wide flow over the entire area. After the gases have passed through this serpentine formation and channel, which is completely unobstructed by baffles or any other channeling means, they pass upwardly through the narrow channel formed by the opposed raised portions **21** and into the flue **15** where they are exhausted in any proper manner.

The flow of the combustion gases is unrestricted, and follows a compound serpentine path, but constantly moves toward the lateral edges. This flow insures not only complete distribution over the surface, but extends the period of residence of the gases within the heating element, and is in a large measure responsible for the efficiency of this heating element. The curves of the stamping in the formation of these raised portions, as well as the valleys and hills **18** and **19**, are preferably in a gentle continuous curve, so that the flow at no time is required to turn any sharp angles which would set up eddies and interference with the smooth flow therethrough. The heat from

the burner is spread so evenly in the flow of the combustion gases and is retained so long within the heating element that when operated at the rated gas input, the temperature of the element does not even approach the point where deterioration of the metal starts to take place. Further, there is no opportunity for the metal to heat up or form hot spots during operation.

The extended surface provided by the valleys and hills **18** and **19** and the extended time of residence of the products of combustion and gases within the heating element, due to the compound serpentine travel, plus combustion gas distribution over the entire element, gives a thermal efficiency which is far in excess of the requirements for equipment approval of the American Gas Association. Because of this there is not only an increase in efficiency, but the increased efficiency permits the heating element **10** to be made in smaller sizes, reducing the over-all size of the furnace for any particular set of circumstances. Making the furnaces physically smaller, while doing precisely the same amount of space heating, permits use of the furnace in minimum space requirements. Such heating elements become small, powerful and quiet.

Heating elements are customarily not used alone, but are used in banks of two, three, five and six. A heating unit having two elements is shown in Figures 8 and 9. The elements are secured together side by side, and are maintained in this position by a face plate **30** which has openings **31** registering with the elliptical openings **25** and circular openings **32** for registering with the flue passage **16**. The elliptical openings are cut away at the side **33** where they abut the adjacent unit so that the outer surfaces of the plateau areas **16** are spaced only about three-quarters of an inch from one another. This arrangement, however, leaves plenty of space for the air surrounding or blown onto the heated surfaces to circulate and be heated for distribution through the ducts of the heating system. It will be observed, particularly from Figure 9, that the outer sides of the adjacent elements **10** have a spacing and serpentine flow for the air similar to that for the combustion gases on the interior of each element. What has been said supra with respect to the flow and path of the combustion gases, accordingly, applies with equal effect and pertinence to the flow of air over the outer surface of each element, thereby adding to the ability of the air flow to cool the element and increase the over-all heating efficiency greatly.

It will be observed that the compound serpentine travel within the element is effective in preventing both a back draft or a too rapid out draft.

I claim:

1. A vertical heating element for gas-fired heaters comprising in combination two initially identical metal stampings each faced with abutting marginal edges secured together and with their raised portions outwardly forming a burner firebox, a combustion gas passage and a flue outlet, all intercommunicating, said metal stampings each having an extensive raised area in its lower portion forming one-half of the firebox, a uniform series of rounded hills and valleys in a substantial area above said raised area, all angled upwardly from the horizontal from 5° to 10° in the same direction forming one-half of a nonsymmetrical serpentine gas duct, and a rounded horizontal raised portion adjacent the top marginal edge thereof which is joined with the opposite stamping and closed at one end to form the flue outlet, said burner firebox being cut along one vertical marginal edge and fitted with an entrance collar to receive a burner therethrough.

2. A vertical heating element for gas fired heaters comprising in combination two initially identical metal stampings each faced with abutting marginal edges secured together and with their raised portions outwardly forming a burner firebox, a combustion gas passage and a flue outlet, all intercommunicating, said metal stamp-

ings each having an extensive raised area in its lower portion forming one-half of the firebox, a uniform series of rounded hills and valleys extending substantially the full width of the stampings in a substantial area above said raised area, all angled upwardly from the horizontal from 5° to 10° in the same direction forming one-half of a nonsymmetrical serpentine gas duct, and a rounded horizontal raised portion adjacent the top marginal edge thereof which is joined with the opposite stamping and closed at one end to form the flue outlet, said burner firebox being cut along one vertical marginal edge and fitted with an entrance collar to receive a burner therethrough, said raised firebox area, said hill and valley area and horizontal rounded portion all having substantially the same altitude from the marginal edge.

3. A heating unit for gas-fired furnaces comprising a plurality of heating elements arranged side by side, each of said heating elements comprising in combination two initially identical metal stampings each faced with abutting marginal edges secured together and with their raised portions outwardly forming a burner firebox, a combustion gas passage and a flue outlet, all intercommunicating, said metal stampings each having an extensive raised area in its lower portion forming one-half of the firebox, a uniform series of rounded hills and valleys in a substantial area above said raised area, all angled upwardly from the horizontal from 5° to 10° in the same direction forming one-half of a nonsymmetrical serpentine gas duct, a rounded horizontal raised portion adjacent the top marginal edge thereof which is joined with the opposite stamping and closed at one end to form the flue outlet, said burner firebox being cut along one vertical marginal edge and fitted with an entrance collar to receive a burner therethrough, and a face plate at right angles to the said marginal edges of the units having

openings therethrough in which the said burner inlet collars and the flue outlets are secured.

4. A heating unit for gas fired furnaces comprising a plurality of heating elements arranged side by side, each of said heating elements comprising in combination two initially identical metal stampings each faced with abutting marginal edges secured together and with their raised portions outwardly forming a burner firebox, a combustion gas passage and a flue outlet, all intercommunicating, said metal stampings each having an extensive raised area in its lower portion forming one-half of the firebox, a uniform series of rounded hills and valleys extending substantially the full width of the stampings in a substantial area above said raised area, all angled upwardly from the horizontal from 5° to 10° in the same direction forming one-half of a nonsymmetrical serpentine gas duct, a rounded horizontal raised portion adjacent the top marginal edge thereof which is joined with the opposite stamping and closed at one end to form the flue outlet, said burner firebox being cut along one vertical marginal edge and fitted with an entrance collar to receive a burner therethrough, said raised firebox area, said hill and valley area and horizontal rounded portion all having substantially the same altitude from the marginal edge, and a face plate at right angles to the said marginal edges of the units having openings therethrough in which the said burner inlet collars and the flue outlets are secured.

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