

July 6, 1948.

F. R. HIGLEY
HEAT EXCHANGE ELEMENT

2,444,825

Filed Nov. 19, 1943

2 Sheets-Sheet 1

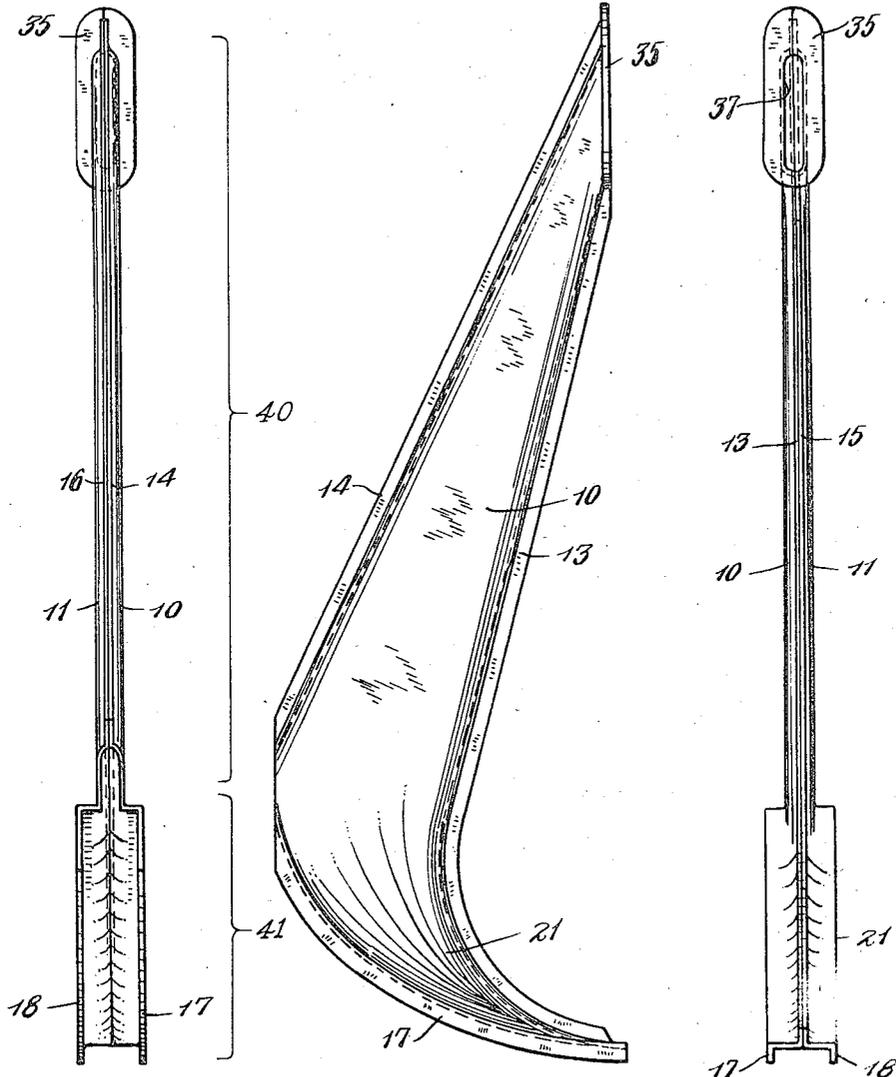


FIG. 3

FIG. 1

FIG. 2

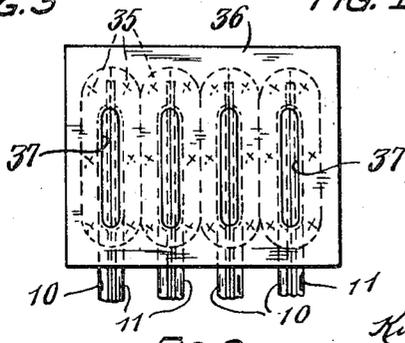


FIG. 9

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2 Sheets-Sheet 2

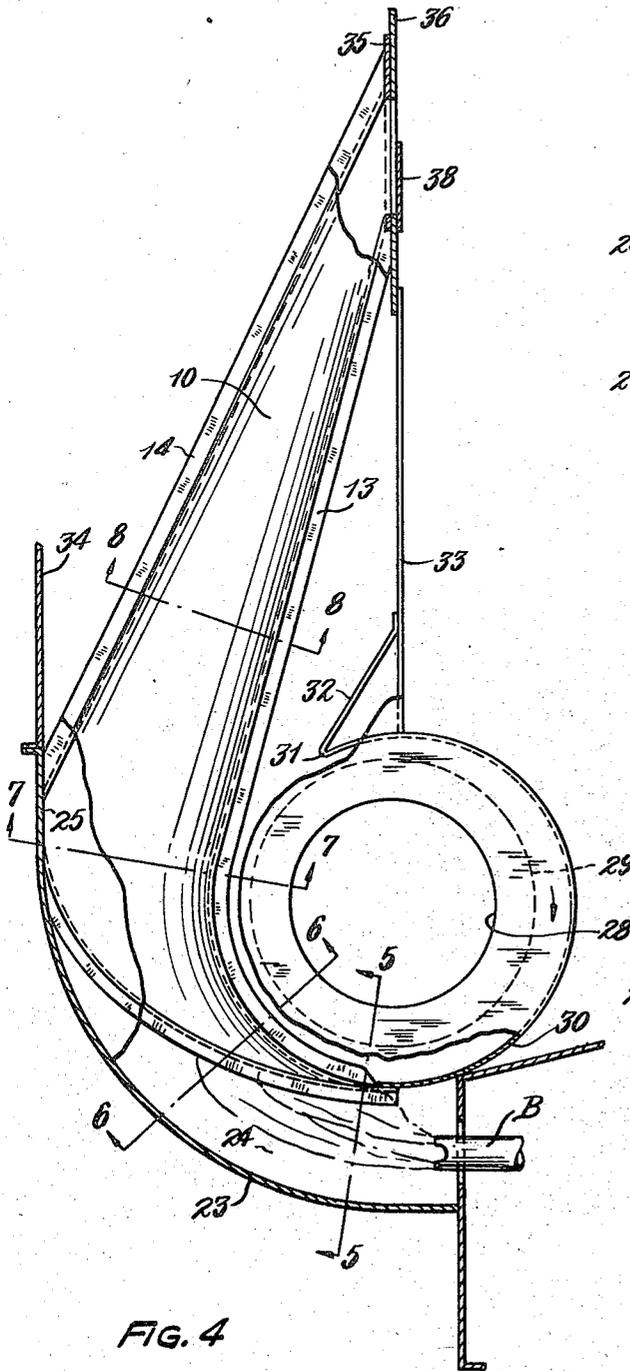


FIG. 4

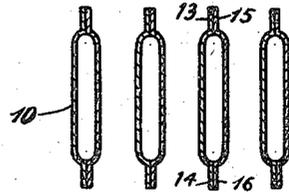


FIG. 8

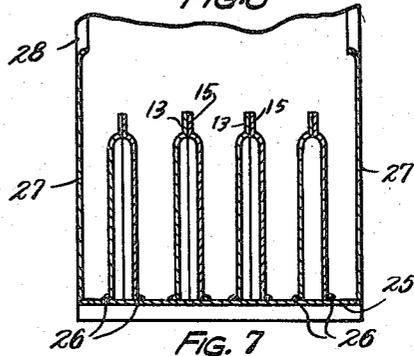


FIG. 7

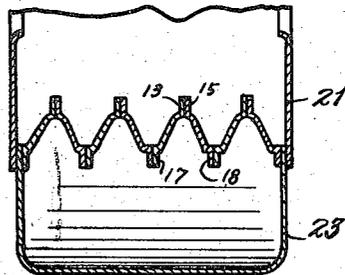


FIG. 6

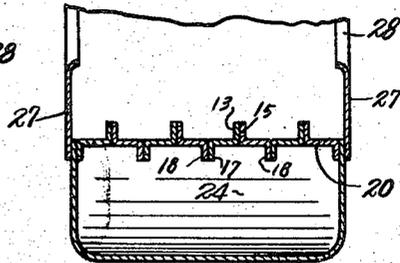


FIG. 5

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HEAT EXCHANGE ELEMENT

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Application November 19, 1943, Serial No. 510,862

3 Claims. (Cl. 257-245)

1 This invention relates to improvements in heat exchange elements of sheet metal, intended primarily for use in heating furnaces of the volute type such as that disclosed in my co-pending application, Serial Number 479,892, filed March 20, 1943.

One of the objects of the invention is the provision of sheet metal heat exchange elements for forced air furnaces of the type stated.

Another object is the provision of a sheet metal element of a character such that heating units of different capacities may be made up of two or more such elements, in order that furnaces of different sizes may be constructed economically from a minimum number of different parts.

A further object is the provision of an element of the character stated adapted for assembly into units with a minimum of effort and time.

Still another object is the provision of an element of the character stated so designed and proportioned that the sheet metal of which it is constructed is subjected during formation to a minimum of stretch, whereby the tendency toward warpage in use is minimized.

Other objects and features of novelty will appear as I proceed with the description of that embodiment of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which

Fig. 1 is a side view of a sheet metal heat exchange element embodying the invention.

Figs. 2 and 3 are front and rear elevational views of the same.

Fig. 4 is an elevational view, partly in vertical section, of a portion of a furnace in which my heat exchange elements are incorporated.

Figs. 5 to 8 inclusive are detail sectional views, taken substantially on the lines 5-5, 6-6, 7-7 and 8-8 of Fig. 4, showing the cross-sectional contours of a four element heating unit, and

Fig. 9 is a fragmental elevational-view showing means for interconnecting the upper extremities of the tubular conductors constituting the upper portions of the elements.

In Figs. 1, 2 and 3 an individual heat exchange element is illustrated. As shown each element comprises two sheet metal stampings 10 and 11 which are identical except as to rights and lefts, each stamping constituting one-half of the complete element.

The upper portion of each of these elements has spaced walls as shown particularly in Fig. 8, with edge flanges 13, 14, 15 and 16. Flanges 13 and 15 are welded together, as are also flanges 14 and 16. Thus a tubular conductor 40 is formed,

2 which in this instance is shown as having parallel side walls and as tapering somewhat toward its upper end.

The lower or base portion 41 of the element is closed along its front edge only, that is to say the flanges 13 and 15 continue beyond the bottom of the tubular portion of the element, curving downwardly and forwardly toward the toe of the element. Behind the curved portions of these flanges the element has a curvature of anticlastic characteristics. This lower or base portion is open toward the bottom and the rear, and its sides are warped surfaces which extend laterally and are provided with downturned flanges 17 and 18 which are disposed in planes parallel to the plane of symmetry of the element, that is to say the plane lying between the flanged edges of the two halves of the tubular part of the element. The warped surfaces on the sides of the flanges 13, 15 extend from a substantially straight transverse line 20, Fig. 5, at the toe of the element rearwardly through the anticlastic portion 21, the curvature of the latter portion changing gradually to meet and merge with the flat sides of the tubular portions 10 and 11. The curved base thus extends transversely and longitudinally of the element, the term "transverse" as herein used referring to the direction from front to rear of the element or parallel to the plane of symmetry, while "lateral" refers to the direction at right angles to the plane of symmetry.

The back of the element near the juncture of the tubular and base portions is unclosed, and this unclosed back portion is made to conform with a plane at right angles to the plane of symmetry of the element in order that the opening may be closed by a flat sheet. It is within the purview of the invention however to shape this back opening to receive a cover sheet which, instead of being flat, is straight in the lateral direction and curved from front to rear, that is, in a direction parallel to the plane of symmetry.

Figs. 4 to 9 inclusive illustrate an application of my novel heat exchange element to a forced air furnace burning fluid fuel, that is gas or oil, such a burner being indicated at B in Fig. 4. The illustration of the furnace is more or less diagrammatic. A unit of four heat exchange elements is shown, the adjacent flanges 17, 18 of the elements being welded together and their outermost flanges 17, 18 being welded to the side walls of a bottom cover or pan 23 which, with the curved bases of the elements, constitutes a combustion chamber 24. This burner has lateral dimensions such as to project flame well across

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the width of the combustion chamber. This chamber, at the point where the flame enters it, is approximately rectangular in vertical section, as indicated in Fig. 5. The upper wall of the chamber gradually changes in cross-section in the direction of flame propagation, the straight edge portions 20 of the individual elements changing to anticlastic portions 21 of gradually increasing height, the unit spacing of the elements being maintained constant.

Beyond the upper edges of the flanges 17, 18 the walls of each element become parallel, as illustrated in Fig. 7, and merge with the parallel side walls 10, 11 of the upper or tubular portions of the element. At this juncture of the base portions with the tubular portions it is necessary to close the openings at the rear of the unit, and this is effected by carrying the bottom wall of the closure 23 up along the back of the unit as shown at 25, the joint between the elements and the flat sheet 25 being completed and sealed by welds, as indicated at 26 in Fig. 7.

The sides of the unit are closed by plates 27 provided with openings 28 through which air to be heated may enter the ends of a blower rotor, not illustrated, the perimeter of which is indicated at 29.

An unheated part of the scroll of this blower is constituted by a metal sheet 30 which is welded at one end to the transversely flat toe edges 20 of the heat exchange elements, and extends upwardly with spiral curvature to the cutoff 31, from which a bent back portion 32 extends to an air conduit wall 33, thereby forming a braced support for the upper end of the scroll. The heated part of the scroll is constituted by the base portions of the heat exchange elements joined together as previously described. The effective curvature of this portion of the scroll is somewhere between that of the radially inner and outer portions of the base. For more detailed description of the action and effect of this type of scroll reference may be had to my copending application Ser. No. 479,892, filed March 20, 1943.

The tubular portions of the elements extend upwardly and preferably diagonally through an air conduit, the front wall 33 of which has been referred to above. This conduit may have a rear wall 34 and side walls (not illustrated), flush with the side plates 27. Air delivered by the blower flows over the highly heated base portions of the elements, being guided by the curvature of the latter transversely and longitudinally of the tubular conductors.

In order that a heating unit such as described may be assembled and handled as a rigid entity it is desirable to rigidly interconnect the upper extremities of the tubular conductors. For this purpose I may form each half of a tubular conductor at its upper extremity with a flange 35 disposed to be parallel with the air conduit wall 33. These flanges are welded to a flat sheet metal frame 36 having openings 37 therethrough conforming to the openings at the upper extremities of the conductors. A removable apron 38 may be so positioned as to cover the lower parts of the openings 37, thereby controlling the effective flue passage. The removal of this apron permits the introduction of a cleaning brush into the conductors. The lower portions of the ele-

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ments may be cleaned by introducing a brush through the front end of the combustion chamber 24. When the heating unit is installed in a furnace the frame 36 is welded to the conduit wall 33, with which may be connected a flue manifold and diverter of any suitable character such for example as that shown in my copending application above identified.

While in the present disclosure each element is made of two halves the invention contemplates elements made of a single sheet of metal where conditions call for suitable proportions.

Having thus described my invention, I claim:

1. A sheet metal heat exchange element for the purpose described, symmetrical about a central plane, a portion of said element being formed to constitute a tubular conductor with a cross section elongated in the direction of said plane, and a portion extending laterally thereof and transversely therefrom to form an offset base for connection with the bases of similar elements, said base portion comprising a warped surface extending divergently from said tubular conductor and thence transversely beyond the conductor, and comprising also an intermediate portion of substantial area having divergently related walls effecting anticlastic characteristics merged with the tubular conductor and said walls having gradually increasing divergence decreasing in height away from said conductor until attaining disposition in a straight laterally extending line.

2. A sheet metal heat exchange element for the purpose described, symmetrical about a central plane, a portion of said element being formed to constitute a tubular conductor with a cross section elongated in the direction of said plane, and a portion extending laterally thereof and transversely therefrom to form an offset base having down-turned flanges adapted for connection with the bases of similar elements, said base comprising a warped surface having divergently related walls which increase in divergence as they recede from said conductor.

3. A sheet metal heat exchange element for the purpose described, and formed to constitute a tubular conductor symmetrical about a central plane with a cross section elongated in the direction of said plane, with a base for connection with the bases of similar elements, and having divergently related walls of curved outline merged with the tubular conductor, said walls having gradually increasing divergence along said curved outline of said base until attaining disposition in a straight laterally extending line at one extremity.

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