Nov. 1, 1949. A. SOLOOS ET AL 2,486,501

AIR HEATER

Filed Sept. 3, 1946 2 Sheets-Sheet 1

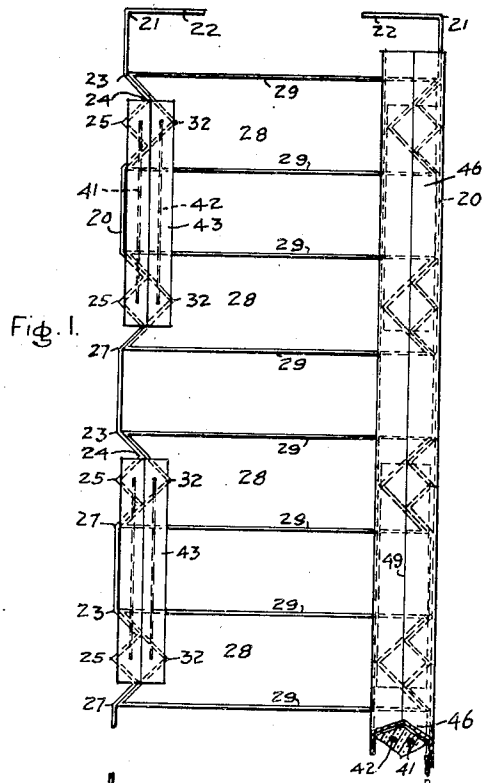


Fig. 1.

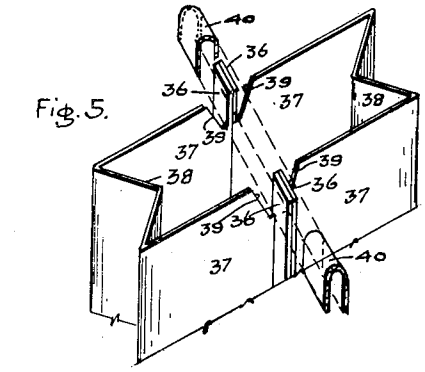


Fig. 5.

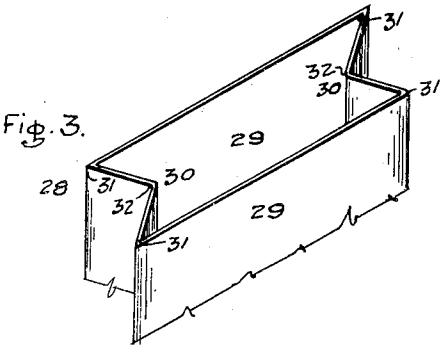


Fig. 3.

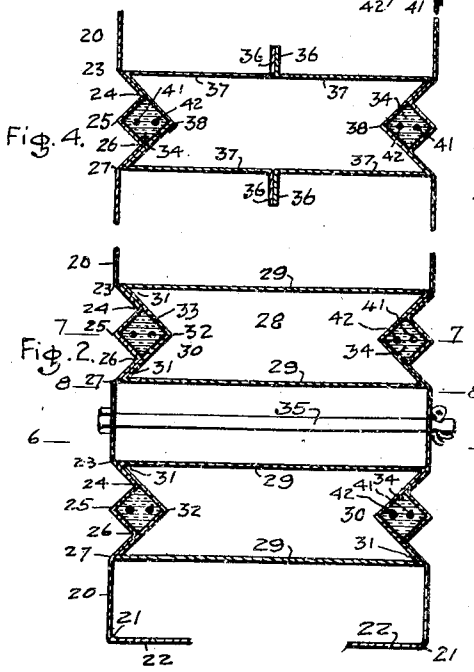


Fig. 4.

Fig. 2.

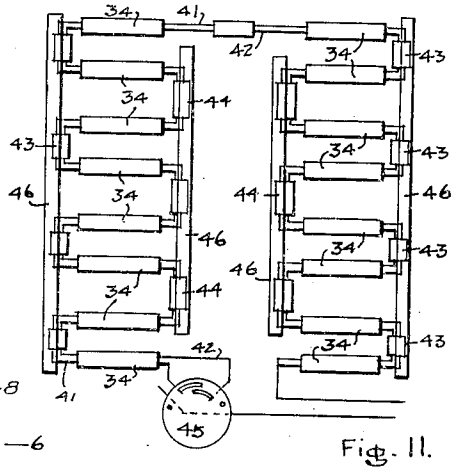


Fig. 11.

Alf Soloos

Silas E. Nelsen

INVENTORS.

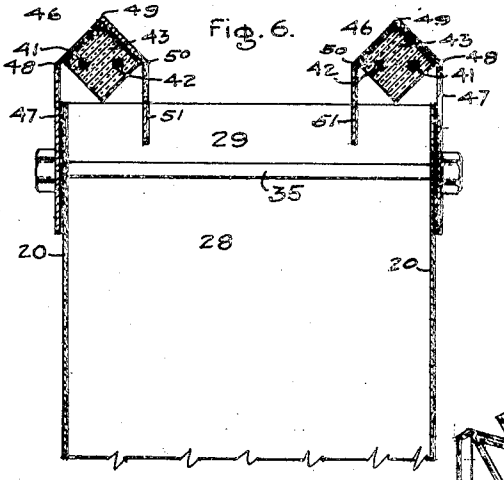
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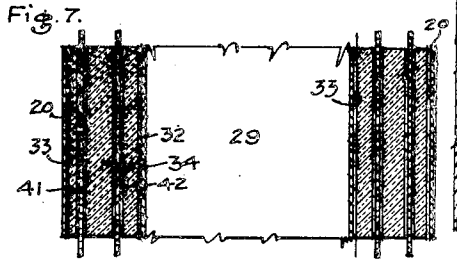
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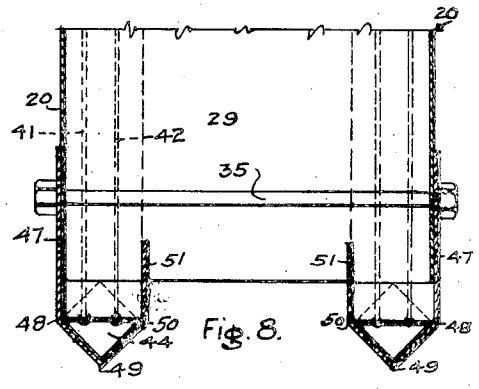
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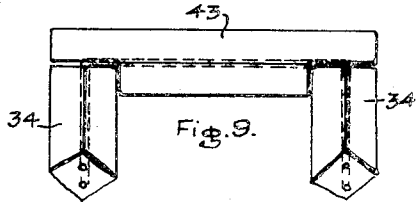
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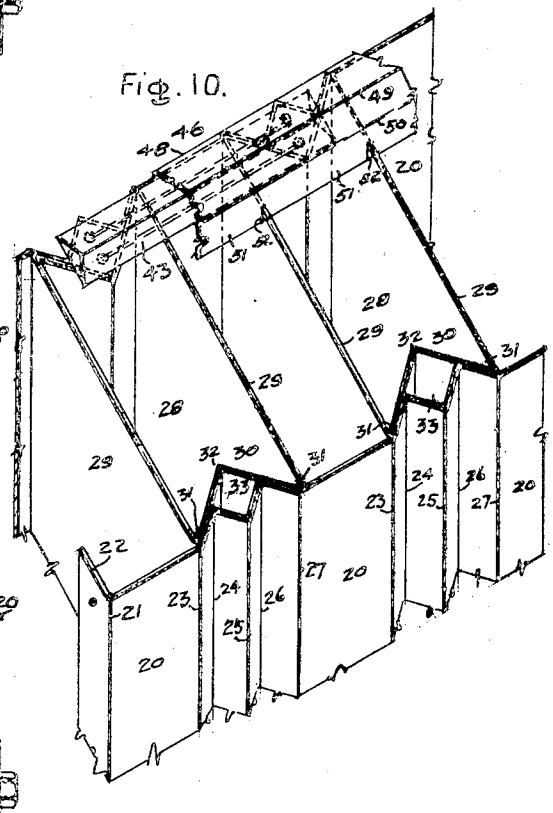
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Alf Soloos

Silas E. Nelsen

INVENTOR.

BY

ATTORNEY.

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UNITED STATES PATENT OFFICE

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AIR HEATER

Alf Soloos and Silas E. Nelsen, Tacoma, Wash.

Application September 3, 1946, Serial No. 694,630

9 Claims. (Cl. 219—38)

1

This invention relates to electric convection air heaters and especially to the structural features thereof.

The objects of our invention are to improve the structure of such an electric air heater, whereby it may be more easily manufactured; whereby its heating efficiency is increased; whereby the obstructions to the flow of air therethrough are reduced to a minimum; whereby its overall size is reduced in proportion to its electric capacity; whereby its fabrication is simplified and its cost of assembly reduced; and whereby a structural unit of great strength and stiffness is attained without adding any material or weight, thus keeping down its cost.

We attain these and other objects as will be readily comprehended by those skilled in the art, by the devices and arrangements illustrated in the accompanying drawings, in which—

Fig. 1 is a plan view of a portion of our improved electric heater unit wherein the hood on the left side is omitted to show the parts thereunder; Fig. 2 is a horizontal section of a part thereof; Fig. 3 is a perspective view of a single separating and radiation unit; Fig. 4 is a horizontal section of a variation in the said separator and radiation unit; Fig. 5 is a perspective view thereof, showing the means of securing the parts thereof together; Fig. 6 is a vertical cross-section of the upper portion of our improved heater taken on the line 6—6 in Fig. 2; Fig. 7 is a similar view taken on the line 7—7 in Fig. 2; Fig. 8 is a section of the lower end of our improved electric heater; Fig. 9 is a side view of the connection between the vertical and horizontal insulators; Fig. 10 is a perspective view of a portion of the upper end of our improved electric heater, showing the near side without any heating elements; and Fig. 11 is a diagrammatic view of the electric wiring of the heater.

Similar numerals of reference refer to similar parts throughout the several views.

Our improved electric air heater is provided with two outer sheet metal plates 20, of identical form, each plate bent as follows: Beginning at one end there is a right angle bend to the left at 21, positioned about ¾" from the end to make a securing flange 22; thence about ¾" to a 45 degree bend to the left at 23; thence about ¼" to a right angle bend to the right at 24; thence about ¼" to a right angle bend to the left at 25; thence about ¼" to a right angle bend to the right at 26; thence about ¼" to left bend at 45 degrees at 27; thence about ¾" to a second series of similar left-right-left-right-left bends, and so

2

forth for the full length of the plate 20, the other end of the plate having a similar securing flange 22. Thus it will be seen that the plate is provided, between its ends, with a series of formed W shapes. It will also be observed that the said plates, which form the outer side boundaries of our heater, expose a generally flat surface, having inward-bent W-shaped vertical grooves equally spaced therein. This fact is important as the upper and lower edges of the said plates may be engaged by the vertical sides of the hereinafter described hoods by which the entire structure is secured together and which provide a stiffening element to the said plates 20.

Also, the above-described vertical W-shaped grooves formed by the bends at 23—27 are such as to locate the tubes, adapted to receive the heating elements, as hereinafter described, inward from the outer surfaces of the plates 20, thus enabling the said hoods to lie within the bounds formed by the said sides, and thus diminishing the dimensions of the heater, as is important in certain structural locations of the heater, as in submarines.

It is obvious that the central portion of the above-described W-shaped grooves may be substituted by a curved arc of about 180 degrees, of suitable radius, if it is desired to use insulators of round instead of square sections, as shown.

These plates 20 are separated and held in parallel position by a series of similar independent separators 28, each positioned at the center of said W shapes on the inner side of the plates. These separators 28, each comprises a pair of parallel sheet metal sides 29, connected by V-shaped ends 30 which are arranged to span the W shapes from the points 23 to 27 above described. Each said V-shaped end 30 is formed of two 135 degree bends 31, with a right angle bend 32 between them. The separators 28 are positioned opposite to the above central bend at 25, so that the two right-angles 25 and 32 stand at opposite corners of a square open tube 33, adapted to receive the insulation 34, of porcelain or other suitable material. The insulation 34 is therefore held between the plate 20 and the separator 28.

At suitable intervals the said plates and separators are secured together by bolts 35 passing through the spaces between two separators 28.

In Figs. 4 and 5 is illustrated a variation in the form of separators, said variation being for convenience of manufacturing the said separators. In this case each separator consists of two identical parts, comprising an out-turned flange 36, parallel sides 37 and a V 38, corresponding with

the V-shaped ends of the separators **28**. Notches **39** are cut in the ends of the parallel sides **37** adjacent to the said out-turned flanges **36**. The two parts, thus formed, are held together by a channel **40** which passes over the ends of the flanges **36** and enters the said notches **39**. Said channel **40** extends from end to end of the heater covering all said flanges **36** and entering all said notches **39** and may have its sides clinched together from point to point. One such channel **40** is at the top of the heater, and another similar one is at the bottom thereof.

The insulators **34** comprise a series of porcelain pieces of square cross-section having two holes therein passing from end to end thereof, in which the wires **41** and **42** lie.

The electric resistance heating wires **41** and **42** of nicrome are strung through the holes in the insulators **34**, beginning preferably at the lower end of the first vertical insulator, passing upward therein, then passing from the top thereof through a short horizontal insulator **43** to the top of the second vertical insulator **34**; thence downward therethrough to the bottom thereof; thence through the lower horizontal insulator **44**, and so on in regular order from one end to the other on one side and returning on the other side to the starting end.

The said short insulators **43** and **44** are cut at their ends to overhang the wires **41** and **42** as they bend to or from the vertical insulators **34**.

The wire **41** is independent of the wire **42** though both pass through the holes in the same insulators thus giving two parallel circuits. The ends of the two circuits **41** and **42** connect with a suitable switch **45** which will connect the main circuit wire to either one of said wires or to both together. When the switch arm is in the position shown the current is turned off; if it is moved to its second position the current passes through the wire **41**, and the heater is on one-half capacity; if it is moved to its third or central position both wires **41** and **42** are energized in parallel and full heat capacity is used, while in its fourth position only the wire **42** is energized. It is to be understood that other arrangements of the two circuits may be used if desired.

As seen in Figs. 6 and 8, the horizontal insulators **43** and **44** are covered by hoods **46** which extend from end to end of the heater and are held in place by the same bolts **35** which secure the plates **20** together. Each hood comprises a vertical flange **47**, which lies outside of the plate **20**, a 45 degree bend **48**; followed by a right angled bend **49**, lying over the insulation **43**, or under the insulation **44**; followed by a 45 degree bend **50**, to the short vertical flange **51** which lies parallel with the part **47**. This part **51** is provided with slits **52** into which the upper and lower edges of the sides **29** or **37** of the separators fit. The side **51** lies against the inner angles **32** of the separators **28**, thus thoroughly protecting the wires **41** and **42** as they pass from a vertical insulator **34** to a horizontal insulator **43** or **44**. These hoods **46** are of extreme importance in this construction, as they not only protect the horizontal insulators **43** and **44** and stiffen the plates **20** but they hold the parts together, as readily seen in Fig. 1, pressing the plates **20** firmly against the separators **28** and tightly holding the insulators **34** in contact with both the plates and the insulators. The bolts **35**, which extend across the heater provide the pressure needed and the whole structure becomes firm, stiff, and rigid.

The above described heater may be enclosed in any suitable outer frame or structure and may be made of any convenient height and length. The dissipation of the heat from the wires **41** and **42** in any section of the heater is distributed evenly throughout the heater, each tube **33** heating one half of the separator sides **29**, the V sides **30**, the W sides between the angles **23** and **27**, together with one-half of the sides between the separators.

The dimensions which have been given in this specification are not intended to be either exact or limiting but only as examples such as are used in the heaters being manufactured and can be changed to suit the design of the heater.

It will be observed that the spaces between the sides **29** or **37** form passages for the free movement of the heated air extending from the bottom to the top substantially without any obstruction and that each plate of the heater is exposed on both sides to the air so that the efficiency of the heater is very high and quickly transfers its heat to the air surrounding it both by contact and by radiation.

It is, of course, understood that many changes in the heater details of construction to suit special cases may be made without departing from the spirit of our invention as outlined in the appended claims.

Having described our invention, what we claim and desire to secure by Letters Patent, is:

1. In an element of an air heater, the combination of a metal separator comprising a sheet metal body having two parallel sides and two inward bent V-shaped ends; heating means mounted in both the V-shaped ends; and a pair of parallel metal sheets having inward bent W-shaped grooves spanned by the V-shaped ends of said separator body, and forming a tube therewith, wherein said heating element is enclosed.

2. In an air heater, the combination of a plurality of independent elements of a heater, each element comprising a sheet metal separator formed of two sides and two inward bent V-shaped ends with heating means in both said V-shaped ends; and two parallel metal plates, each plate having spaced complementary W-shaped inward bends fitting in and spanned by the respective V ends of said separators, and joining said elements of the heater together.

3. A separator for the side plates of an air heater comprising a sheet metal body forming a vertical air circulating tube, having inward V bends in its vertical ends, said V bends each being adapted to form one-half of an outer vertical tube adapted to receive an electric heating means, said separator extending at right angles from the side plates and acting in conjunction with a plurality of similar separators to form a series of vertical air circulating tubes between the side plates.

4. A separator for the side plates of an air heater comprising a body forming a vertical air circulating tube, said body being formed of two similar plates, each plate having flanges and being in reversed positions with said flanges in contact with each other to form a single body, each plate having at its center an inward V bend, said V bends each being adapted to form one-half of a vertical tube adapted to receive an electric heating means; together with a means engaging all said flanges to fasten them together in pairs.

5. In an air heater, the combination of two similar parallel vertical plates; a plurality of spaced vertical separators extending at right angles to said vertical plates and held between

said plates and in contact therewith; said plates being bent inward at each said separator and said separators being bent inward to span the inward bends of said plates, said contacting inward bends being bent away from each other at their central parts to form two rows of vertical tubes located inward of the planes of said plates; electrical heating elements enclosed in insulating material and mounted in said vertical tubes; similar horizontal heating elements arranged alternately above and below said vertical tubes, all said heating elements being connected together in series; and metal hoods covering said horizontal heating elements and attached to said plates.

6. An air heater as set forth in claim 5, wherein the insulating material of said horizontal elements is cut away at its ends to cover the otherwise exposed parts of the vertical heating elements with insulating material.

7. An element of an air heater comprising in combination a separator comprising a sheet metal body bent to have two parallel sides and two inward bent ends, thereby forming a vertical air circulating tube between said parallel sides and said ends; heating means mounted in said inward bent ends; and a pair of parallel sheets of metal, each engaging one end of said first body and closing said inward bent ends to enclose said heating means.

8. An electric air heater comprising two parallel metal plates with similar separated vertical inward extending grooves formed therein; a plurality of sheet metal separators mounted at said grooves and extending across said heater between said metal plates and at right angles thereto, one said separator at each said pair of grooves; a pair of metal hoods each engaging the outer side of one of said plates and each spanning all said grooves of said plate and engaging said separators; and means extending across said heater and engaging both said hoods, whereby the several parts of said heater are secured together.

9. In an air heater, the combination of a pair of similar outer parallel vertical plates; a plurality of independent spaced vertical separators, each separator comprising a pair of similar plates, each plate in said pair of separators having flanges at their edges and being in reversed positions with said flanges in contact with each other to form a single body, each plate of the separator having at its center an inward bend, said bends each being adapted to form the inner wall of an outer vertical tube; each said first outer plates having complementary bends cooperating with said bends in the separator plates to complete the said outer tubes; and means to secure the flanges of said separator bodies together in pairs.

ALF SOLOOS.
SILAS E. NELSEN.

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