United States Patent

Grimshaw

[15] **3,702,632**

[45] **Nov. 14, 1972**

[54] HEAT EXCHANGER CORE

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[52] **U.S. Cl.** **165/152,** 29/157.3

[51] **Int. Cl.** **F28f 1/22**

[58] **Field of Search** 165/148–152

[56] **References Cited**

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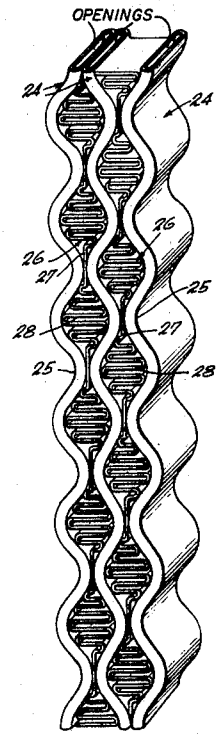
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[57] **ABSTRACT**

An air-cooled radiator core is described comprising a plurality of welded or soldered-together core elements. Each core element is fabricated of an elongated seamless loop of flat metal formed along its length with 90 degree out of phase sinuous side portions outwardly flanged along each edge, the sinuous side portions being in mutual abutment at out of phase node portions. Adjacent core elements are fitted flange-edge to flange-edge to define a honeycomb effect of core openings for the passage of cooling air; and abutting flanges are soldered or welded together along their outer edges to provide sinuous coolant flow paths between mutually adjacent core elements. In a modified form of the invention flat ribbons of sheet metal are folded back and forth along their lengths in a modulated pattern of such shape along their lengths as to fit snugly within and along the honeycomb openings to increase radiating surface areas and thereby improve the efficiency of air cooling action of a radiator core.

1 Claim, 7 Drawing Figures



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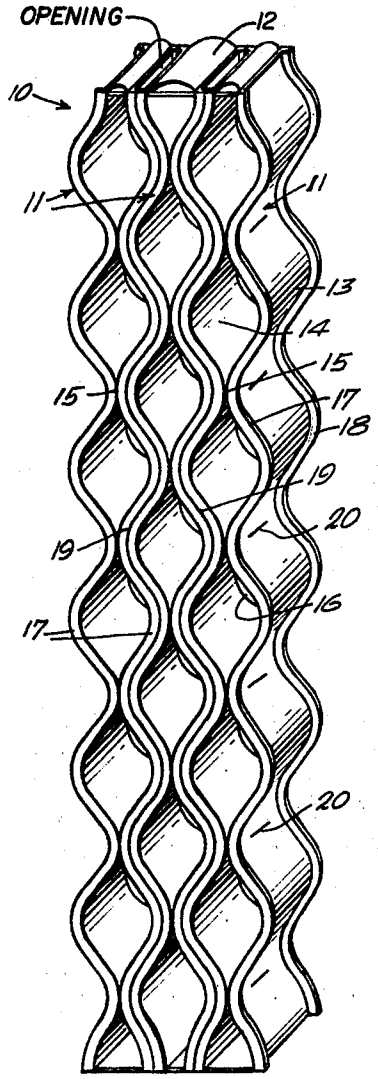


Fig. 1

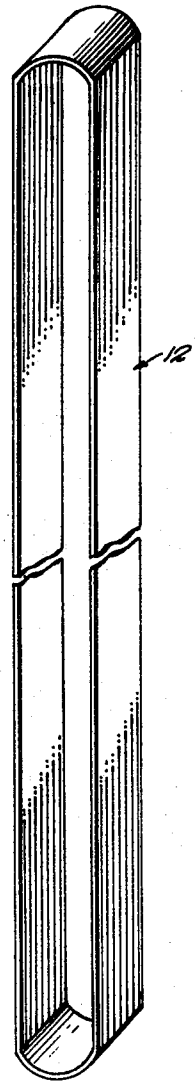


Fig. 2

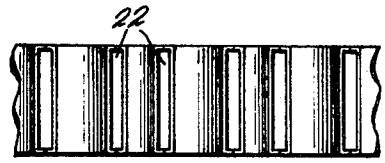


Fig. 3

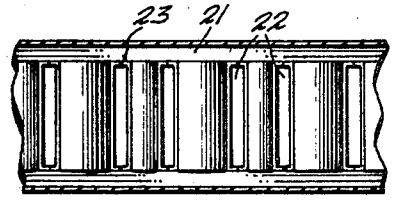


Fig. 4

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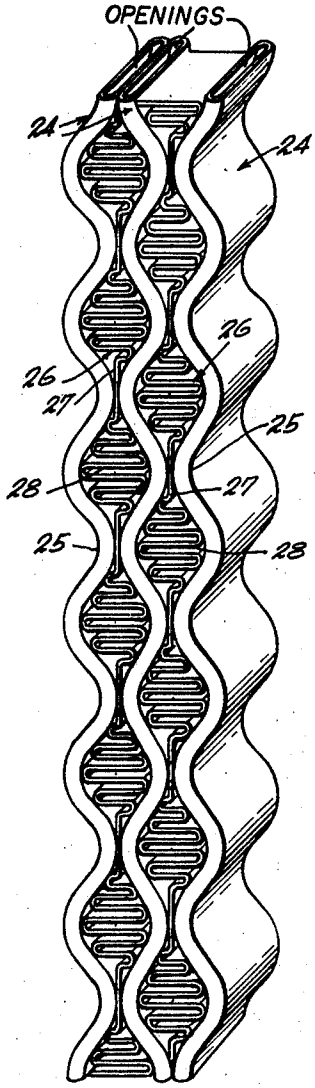


Fig. 5

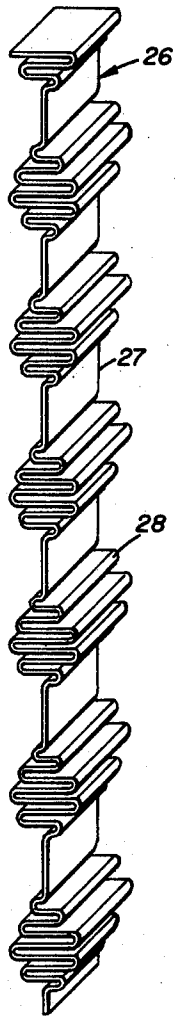


Fig. 6

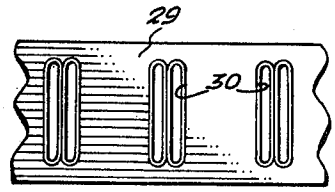


Fig. 7

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HEAT EXCHANGER CORE

This invention relates to fluid coolant heat exchangers and is directed particularly to a novel and improved radiator core construction of the type particularly well suited to use in the cooling systems of automobiles, aircraft or the like, although the device, in a broader sense, is also well adapted to use for cooling any liquid by the use of forced air conduction heat exchange.

The principal object of this invention is to provide a radiator heat exchange core structure of the character above described wherein all coolant flow path joints are external, thereby making possible the use of comparatively inexpensive metal, whether ferrous or nonferrous, such as stainless steel, aluminum or any other metal which can be welded, brazed or soldered.

Another object of the invention is to provide an improved radiator core structure comprising a plurality of like, sinuous ribbons of shaped core elements arranged in abutting vertical disposition in a honeycomb configuration to provide maximum exposure of radiating surface areas to forced flow heat exchange air directed through the radiator core in operation. In a modified form of the invention filler strips of side-to-side, reversely-bent ribbons of strip metal are provided within and along the openings of the honeycomb configuration to increase radiating surface areas and thereby increase radiating efficiency.

A more particular object of the invention is to provide a radiator core structure of the above nature wherein the core tubular elements are shaped of seamless elongated metal loops, which may be either of curved or rectangular loop shape before forming, and which, after forming, define 90 degree out of phase side portions that are outwardly flanged. The mutually adjacent in-phase sinuous side portions of adjacent core elements are externally welded flange-edge to flange-edge to provide sinuous top-to-bottom coolant flow paths between core elements.

Yet another object of the invention is to provide a radiator core construction of the above nature wherein the core tubular elements can all be formed with the same die to provide a straight, regular pattern of end juncture zones both at the top and bottom of the assembled radiator core, whereby they can readily be assembled and joined to top and bottom fluid reservoir members to permit soldering or welding together of a radiator in an expeditious and simplified manner.

It is still another object of the invention to provide an improved radiator core construction of the character above-described which, because of its use of metals that can be welded and because of its construction permitting all welds to be made from the outside, lends itself particularly well to use under higher internal pressures than can safely be withstood by ordinary radiator constructions of the type heretofore devised.

Other objects, features and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawings. In the drawings, wherein like reference numerals denote corresponding parts throughout the several views:

FIG. 1 is an oblique view, as seen from the front, of a portion of a typical radiator core embodying the invention, illustrating details of the assembly and the welding together of the sinuous ribbon elements;

FIG. 2 is a typical elongated loop of seamless metal suitable for use in shaping the sinuous, flanged, core fin elements;

FIG. 3 is a top view of the core portion illustrated in FIG. 1 before assembly of the top plate comprising the reservoir;

FIG. 4 is a view similar to that of FIG. 3 but illustrating the assembly thereto of the top end plate comprising a top reservoir;

FIG. 5 is an oblique view as seen from the front of a modified form of radiator core embodying the invention;

FIG. 6 illustrates, in oblique elevational view as seen from the front, a preformed filler strip comprising the radiator core illustrated in FIG. 7, shown separately; and

FIG. 7 illustrates a typical top or bottom closure plate for use in the core construction illustrated in FIG. 5.

Referring now in detail to the drawing, FIG. 1 illustrates a portion of a typical radiator core embodying the invention, being designated by reference numeral **10**, the same being comprised of a plurality of vertically-extending and mutually-abutting sinuous, ribbon-like, preformed tubular core elements **11**. The core elements **11** are die-formed, preferably, of seamless loops of flat metal stock, such as of lengths of metal loops elongated in a rectangular configuration, as illustrated in FIG. 2. As illustrated in FIG. 1, the longitudinally-extending portions of each metal loop **12** (FIG. 2) are formed to provide opposed, sinuous, ribbon-like sides **13, 14**, preferably sinusoidal along their lengths, which sides are mutually out of phase by 90 degrees so as to provide abutting node portions **15** between a plurality of vertically aligned front to back openings **16**. Outer marginal edge portions of each of the sinuous sides **13, 14** are bent outwardly to provide outwardly-turned flanges **17** and **18**. In the assembly of the radiator core, a plurality of formed tubular core elements **11** are interfitted in flange-edge to flange-edge mutual disposition, as illustrated in FIG. 1, in which position they are securely assembled by welding or soldering from the outside along the flange junctures, as indicated at **19**. For enhanced rigidity, each formed core element **11** is spot-welded at each of its abutting nodal surface portions, as indicated at **20**. In assembly, it will be noted that identical core elements **11** produced by the same die can be interfitted one to the other to provide even top and bottom end portions by reversing, from end to end, alternate core elements. It is also possible, of course, to employ two sets of dies for separately forming alternate core elements.

As illustrated at **21** in FIG. 4, a reservoir or header plate will be welded or soldered along the top and bottom of the assembled core to direct the flow of liquid coolant through the thin sinuous coolant flow passages **22** defined by the marginal flanges of adjacent, welded-together core elements. The end plates **21**, which form part of upper and lower reservoirs, (not illustrated), for directing the flow of fluid through the radiator core are provided with appropriate passages **23** communicating with the ends of the core element coolant flow passages.

Because of the particular conformation of the tubular core elements **11** and their assembly together to

define a honeycomb-like core structure, it is contemplated that a series of welding electrodes arranged in an appropriate matrix could be utilized to weld all core seams simultaneously, using high frequency techniques. It is further contemplated that in the use of core element metals of the type necessitating cleaning and welding in an atmosphere of inert gas such as Helium, Argon, or Freon, such operations could readily be carried out in a chamber filled with such an atmosphere and wherein the manufacturing operators are equipped with individual oxygen supplies.

The modified radiator core construction illustrated in FIG. **6**, **7** and **8** differs from that of FIGS. **1** through **4** in that the sinuous tubular elements of which the body of the core is constructed comprise flattened metal tubes **24** bent into substantially the same sinuous shapes along their lengths and secured together at out-of-phase node portions, as indicated at **25**, to substantially increase radiating surface areas without appreciably impeding the through flow of cooling forced air. Adjacent core tube elements **24** have interfitted therebetween appropriately shaped lengths of bent sheet metal **26** having straight flat portions **27** clamped and welded or soldered between the abutting node portions of said tubular core elements, and a plurality of reversely-bent portions or horizontal folds **28** of such contour as to extend from side to side in abutting engagement with side portions of the honeycomb openings along the length of the core. It will be understood that in the assembly process, the abutting surface portions of the folds **28** within their respective honeycomb openings will be welded or otherwise brought into firm abutting contact so as to provide for maximum heat transfer from the sinuous tubular core elements to the radiating filler ribbon **26** surface areas.

FIG. **7** further illustrates how the ends of the core are located at the zones of nodal abutment of adjacent core tube elements to facilitate welding or otherwise attaching thereto top and bottom plates **29** comprising the reservoir chambers (not illustrated). To this end, the reservoir bottom and top end plates will be provided with openings **30** conforming in shape with the adjacent twin openings at the ends of the core, as described above, to facilitate welding or soldering thereat.

While I have illustrated and described herein only two forms in which my invention can conveniently be embodied in practice, it is to be understood that these forms are given by way of example only and not in a limiting sense. The invention, in brief, comprises all the embodiments and modifications coming within the scope and spirit of the following claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a radiator core heat exchange structure adapted for use in radiators or the like comprising a plurality of tubular elements and fin elements in interfitting relationship, each tubular element being in the form of an elongated loop of substantially flat metal having opposed sinuous side portions mutually **90** degrees out of phase and having a plurality of mutually abutting out of phase node portions, each sinuous side portion being formed with laterally-opposed, outwardly projecting, substantially parallel sinuous flanges, mutually adjacent ones of said fin elements being arranged in flange-edge to flange-edge disposition to define a honeycomb-effect of core openings for the passage of cooling air and sinuous coolant flow paths between mutually adjacent tubular elements, said fin strips comprising side-to-side, reversely-bent portions within and along the openings of said honeycomb core openings to radiating surface areas and thereby increase heat exchange efficiency, wherein said core elements are secured together along the interfitting junctures of said flange edges by a welded seam, such that said core elements are additionally secured together by spotwelds between said mutually-abutting node portions, said opposed sinuous side portions of said core elements being substantially sinusoidal along their lengths.

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