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[54] **JUNCTION PLATES FOR MULTIPLE HEAT EXCHANGER UNITS**
9 Claims, 7 Drawing Figs.

[52] U.S. Cl..... 165/81,
 165/149
 [51] Int. Cl..... **F28f 7/00**
 [50] Field of Search..... 165/143.2,
 149, 81-83, 158; 285/187

ABSTRACT: The essential concept of this invention involves an improved arrangement of pairs of expansion module supports for the multiple section side frames for massive heat exchanger core units required for cooling engines for large size transport vehicles, which expansion modules accommodate the expansion-contraction differentials in the metals required for the core unit per se and the metals required for the supporting side frames and attached header plates.

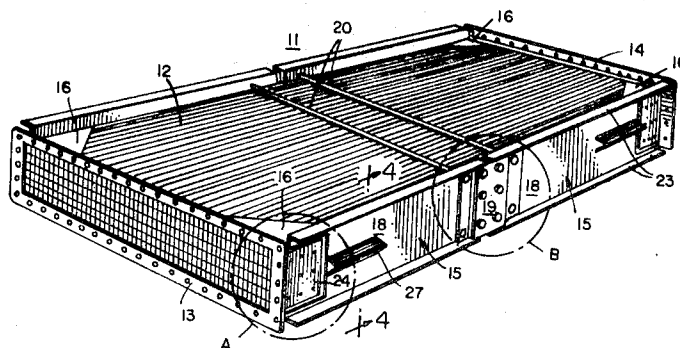


FIG. 7

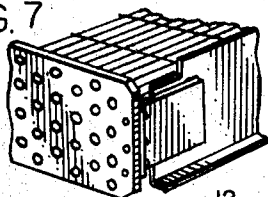


FIG. 1

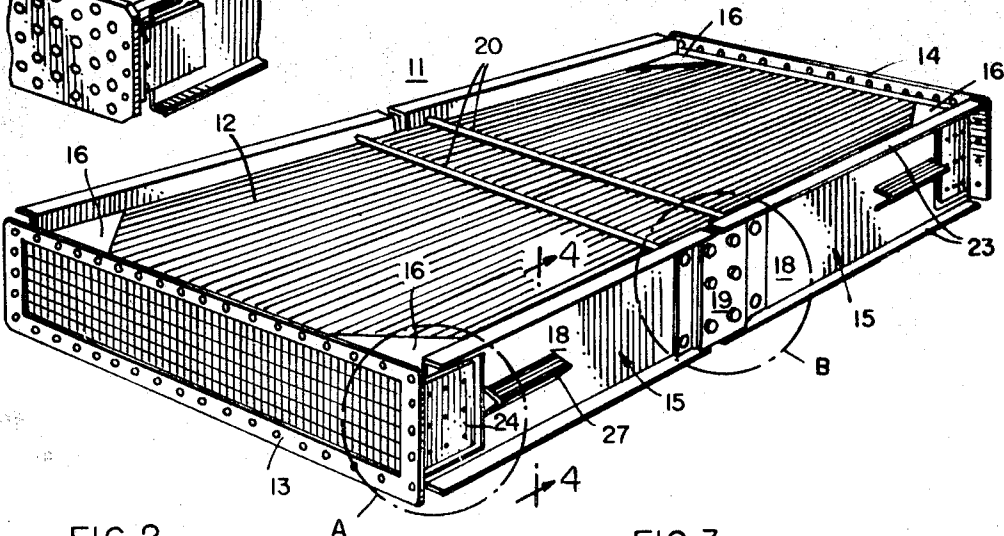


FIG. 2

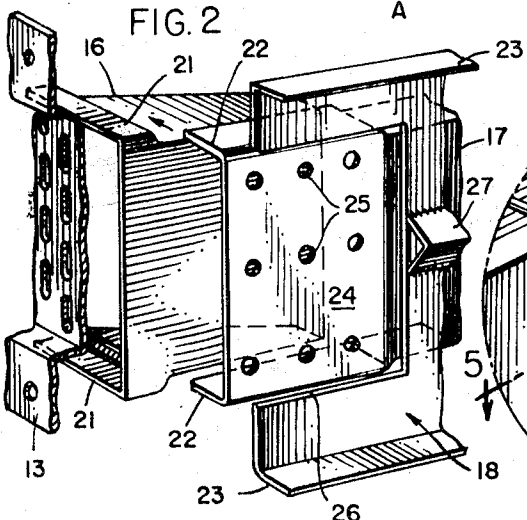


FIG. 3

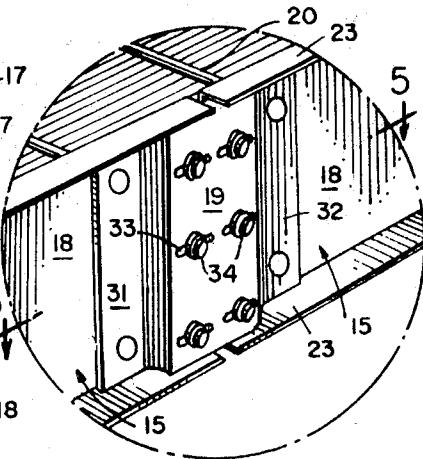


FIG. 4

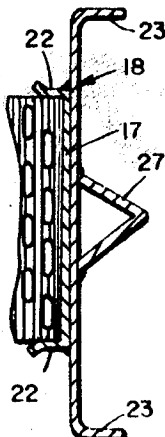


FIG. 5

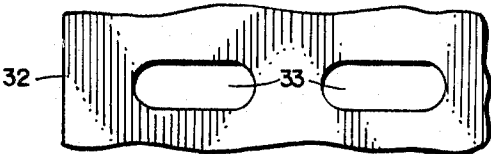
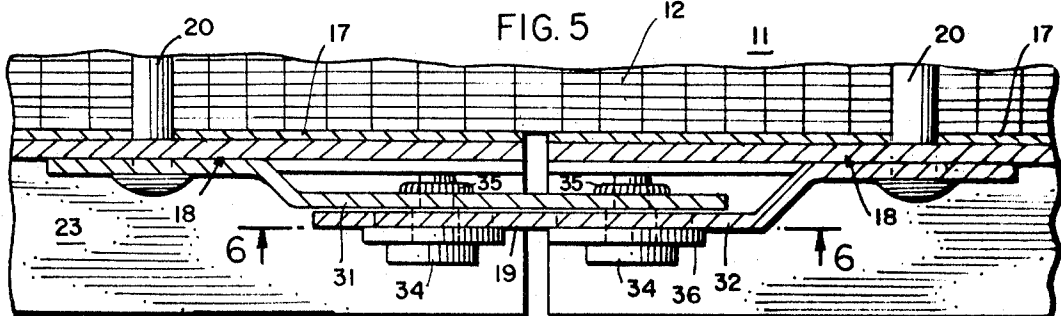


FIG. 6

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JUNCTION PLATES FOR MULTIPLE HEAT EXCHANGER UNITS

Diesel engines for large transport vehicles, especially such as currently are used for heavy-duty service, require heat exchangers of varying extensive dimensions.

A core unit for such heat exchangers, may be formed with either flat or round tubes. The tubes span the entire distance between a pair of header plates whereto the opposite ends of the tubes are bonded. The core unit has to be embracively supported within side frames spanning and anchored to the respective header plates. Obviously, such side frames have to be structured from metals more stable than that of the tubes.

The main objects of this invention are to provide; the improved structuring of massive-type heat exchangers for use with high-powered transport vehicles; to provide heat exchangers of this kind with improved means for accommodating the expansion-contraction differentials between the core unit per se and its supporting framework; to provide an improved form of pairs of expansion modules so incorporated into the frame work as to permit the requisite planar adjustment thereof to accommodate the above-noted expansion-contraction differentials; and to provide such an improved form and arrangement of such an expansion module support as will make the manufacturing and marketing of heat exchangers of this kind highly economical and effective and the use thereof gratifying to the purchasers.

In the adaption shown in the accompanying drawings;

FIG. 1 is a perspective view of a somewhat massive-type of heat exchanger core unit embodying the foregoing concept;

FIG. 2 is a enlarged, exploded, perspective view of the multiple piece corner structure shown in the circle A of FIG. 1;

FIG. 3 is an enlarged view of the expansion-contraction module shown in the circle B of FIG. 1;

FIG. 4 is a cross-sectional view taken on the plane of the line 4-4 of FIG. 1;

FIG. 5 is a much enlarged cross-sectional view taken on the plane of the line 5-5 of FIG. 3;

FIG. 6 is a side elevational view of the end of one of the module parts taken on the plane of the line 6-6 of FIG. 5, and

FIG. 7 is a reduced size, partial, perspective view showing the use of round tubes in a heat exchanger of the type herein set forth.

The unit shown in FIG. 1 is a two-section development using flat tubes. This unit measures approximately $4\frac{1}{2}$ feet long, $2\frac{3}{4}$ feet wide, three-fourths of a foot high and weighs approximately 500 pounds before put into use. Other units, of such structure, have been produced with four sections, of length four times that of the two-section form and generally the same width and height. The weight of such larger units will approximate as much more than the two-section unit as the of each of the added sections. In any such unit the number of rows of tubes may vary. In the herein illustrated structure there are eight staggered horizontal rows of flat tubes. Heat exchangers of this type may be structured with round tubes as well as the herein illustrated flat tubes, and in an arrangement similar to that shown with the flat tubes.

Obviously, some form of supporting frames are required to span and to be anchored to these spaced header plates 13 and 14. There must be of a material and form such as will ensure of stable planar condition of the core unit per se, free of any radial strain on the tubes sufficient to materially effect their axial alteration. As herein shown these side frames are made of multiple parts and are of such a nature as will permit the use of such massive heat exchangers.

The herein illustrated core unit 11 comprises a battery of tubes 12. The opposite ends of which tubes 12 are inserted in multiple rows of closely arranged apertures and bonded to the header plates 13 and 14, which are spanned by and anchored to the side frames 15. This constitutes what generally is known in the trade as a heat exchanger core unit.

As clearly shown, in this exploded FIG. 2, these header plates 13 and 14 are of what is commonly designated as the "dish type." As herein shown the base part has the staggered series of elongated apertures for the insertion of the ends of flat

tubes 12 for bonding to the respective header plates 13 and 14.

In this particular adaption the battery of tubes 12, generally, are structured from what is commonly designated as "red brass." This is a composition of approximately 85 percent copper and 15 percent zinc. This material has an expansion-contraction coefficient of 0.0000104 per degree F. The supporting side frames 15 are structured from steel. This has an expansion-contraction coefficient of 0.0000056 per degree F. It is these factors that made imperative the gussets 16.

Each of these side frames 15 is a composite of pairs of gussets 16, pairs of superimposed inner and outer plates 17 and 18, and one or more pairs of what, hereinafter, is designated as "expansion modules" 19 and the upper and lower pairs of cross rods 20.

These gussets 16, with opposed tapered sides, have the longer, parallel base ends slightly offset, as shown at 21 (FIG. 2). This is to permit the gussets to fit closely over the opposite side portions of the respective dish-shaped header plates 13 and 14 whereto these gussets 16 are bonded. These plates 17 and 18 are formed with respective pairs of lateral, oppositely disposed flanges 22 and 23, as is most evident from FIG. 2 and 4.

The outer extremities of each of the side plates 17 has a rectangular portion 24 (offset from the remaining part) wherein are formed parallel series of small apertures 25. Such formed portions 24 permit their embracement over and bonding to the respective gussets 16. These inner sideplates 17 inwardly of the offset portion 24, have their flanges 22 disposed to embrace the core unit 11.

Each of these sideplates 18 has the outer extremities formed with rectangular cutouts 26 to fit over the rectangular portions 24 of the respectively opposed inner sideplates 17 (FIG. 2). At their inner opposed ends, these aligned pairs of sideplates are anchored to the pairs of cross rods 20. One or more side support pieces 27 are secured exteriorly to each of the plates 18. Those herein shown are of V shape.

The expansion modules 19 each comprise a pair of rectangular shaped plates 31 and 32, and associated rows of fasteners 34. Medially transversely thereof these plates 31 and 32 are offset to provide for the opposed overlapping portions spaced outwardly from the inner ends of the flanged side plates 18 (FIG. 5). These overlapping portions have pairs of aligned slots 33 through which the fasteners 34 extend. The fasteners 34 are in the nature of headed pins extending through the slots 33. Such fasteners 34 are anchored at their inner ends to the inner end of the plate 31 by welding or other suitable form of bonding 35 (FIG. 5). Washers 36 are interposed between the heads of these fasteners 34 and the plate 32.

Such a structured heat exchanger is subjected to temperature changes of the coolant in the battery of tubes between 35° and 210° F. during periods of idleness and use. Inevitably the resulting expansion-contraction between the battery of tubes 12 and the side frames 15 will be compensated for by the shifting of the fasteners 34 in the slots 33 of the modules 19.

Variations and modifications in the details and structure and arrangement of the parts may be resorted to within the spirit and coverage of the appended claims.

I claim:

1. A multiple section core unit of extended length comprising multiple rows of tubes formed of metal with a predetermined expansion-contraction coefficient and extending the full distance between and anchored to the pair of header plates, multiple piece supporting side frames, formed of metal with an expansion-contraction coefficient less than that of the tubes, arranged laterally of the rows of tubes with the outer extremities of the respective side frames anchored to the respective pairs of header plates, and having a space gap between the opposed and aligned inner extremities of the side frames to permit expansion and contraction of the battery of tubes relative to the side frames caused by the respective changes in the fluid flowing through the tubes, and means including over-

lapping plates secured to said side frames and extending outwardly spanning the space gap between the anchored to the supporting side frames, to retain the overall planar stability of the core unit during the temperature changes in the fluid flowing through the tubes.

2. A multiple section core unit as set forth in claim 1 wherein the means spanning the space gap between the side frames comprises a pair of said overlapping plates the respective outer portions of which are anchored to the adjacent aligned ends of the respective side frames, and fasteners fixed to the overlapping portion of one of the pair of plates are shiftable relative to the other of the pair of plates.

3. A multiple section core unit as set forth in claim 2 wherein the fasteners are multiple rows of bolts the stems of which extend through slots in the overlapping portion of the other of the pair of plates.

4. A multiple section core unit as set forth in claim 2 wherein upper and lower pairs of rods are disposed transversely above and below the tubes with the opposite ends of the rods anchored to the respective side frames on opposite sides of the respective space gaps between the inner extremities of the side frames.

5. A multiple section core unit as set forth in claim 1 wherein the side frames are pairs of channel-shaped frame members and are mounted back to back, the inner of which framed members embraces the opposite lateral portions of the core unit.

6. A multiple section core unit as set forth in claim 5 wherein the header plates are dish shaped and a pair of triangular shaped gussets embrace and are bonded to the opposite ends of the dish shaped portions of the header plate, and the respective ends of the inner channel shaped side frames embrace and are bonded to the respective gussets.

7. A multiple section, heat exchanger core unit comprising multiple rows of tubes anchored at their respective outer ends of a pair of header plates, pairs of aligned exterior supporting side frames anchored at their respective outer ends to the respective header plates on opposite side of the tubes and having gaps between their respective ends, pairs of other plates having overlapping portions extending outwardly and

spanning the gaps between the respective pairs of side frames, the outer ends of the respective other plates being attached to the inner ends of the side frames with the inner ends overlapping, and means for clamping the overlapping inner ends of the other plates to permit relative shifting thereof to accommodate the longitudinal expansion and contraction of the respective pairs of side frames during the use of the heat exchanger core unit.

8. A heat exchanger core unit as set forth in claim 7 wherein the overlapping ends of one of the other plates have elongated openings therein, and fasteners extending through the registering openings to permit relative shifting to the side frames.

9. A heat exchanger core unit of extended length comprising multiple rows of tubes anchored at their opposite ends to header plates, pairs of aligned exterior pairs of laterally flanged supporting side frames anchored at their respective outer ends to the respective header plates and having gaps between their respective inner ends, pairs of clamping plates extending outwardly having overlapping portions spanning each of the gaps between the respective pairs of side frames, the opposite outer ends of the clamping plates being bonded to the respective side frames with inner ends of the clamping plates overlapping, one each of the overlapping portions of the pair of clamping plates having elongated slots therein, the other of the overlapping portions of the pair of clamping plates having circular openings therein, bolts extending through the registering pairs of elongated slots and the circular openings of the clamping plates with the stems of the bolts bonded in the circular openings of the respective clamping plates and thereby permitting the relative longitudinal shifting of the clamping plates during the changing expansion and contraction of the pairs of side frames, a supplemental side frame structured with transversely spaced longitudinally disposed lateral flanges anchored to the inner face first mentioned side frame for support of the core unit on the first mentioned frame, and upper and lower pairs of rods disposed transversely above and below the tubes with the ends of the rods anchored to the respective side frames at opposite sides of the space gaps.

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