United States Patent

[11] **3,633,661**

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[21] Appl. No. **63,820**
[22] Filed **Aug. 14, 1970**
[45] Patented **Jan. 11, 1972**
[73] Assignee **The Trane Company**
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[54] **CROSSFLOW PLATE-TYPE HEAT EXCHANGER WITH BARRIER SPACE**
6 Claims, 9 Drawing Figs.

[52] U.S. Cl. **165/70,** 165/166
[51] **Int. Cl.** **F28f 3/00**
[50] **Field of Search** 165/70, 166, 170

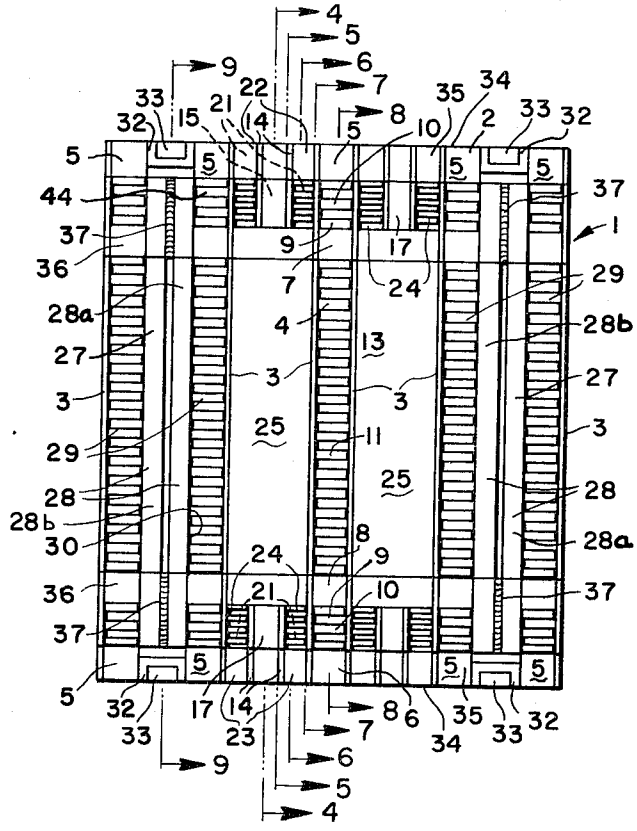
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ABSTRACT: A plate-type heat exchanger constructed of plural sections each having a plurality of interleaved rectangular flat first and second passages for conducting respectively first and second heat-exhange fluids in crossflow heat-exchange relationship. Barrier spaces extend between first and second passages as well as along the closed edges of the first and second passages. Barrier spaces also overly the welded joints connecting the plural sections. A specifically shaped barrier space-closing bar permits relatively easy construction and assembly of the heat-exchanger core.

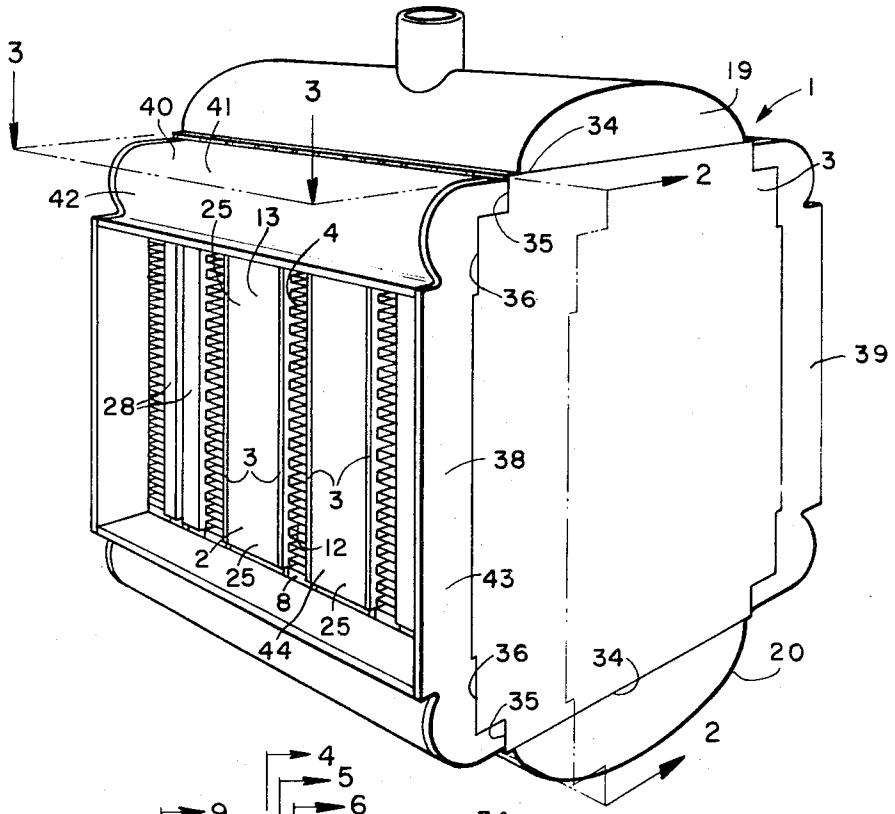


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SHEET 1 OF 5

FIG. 1



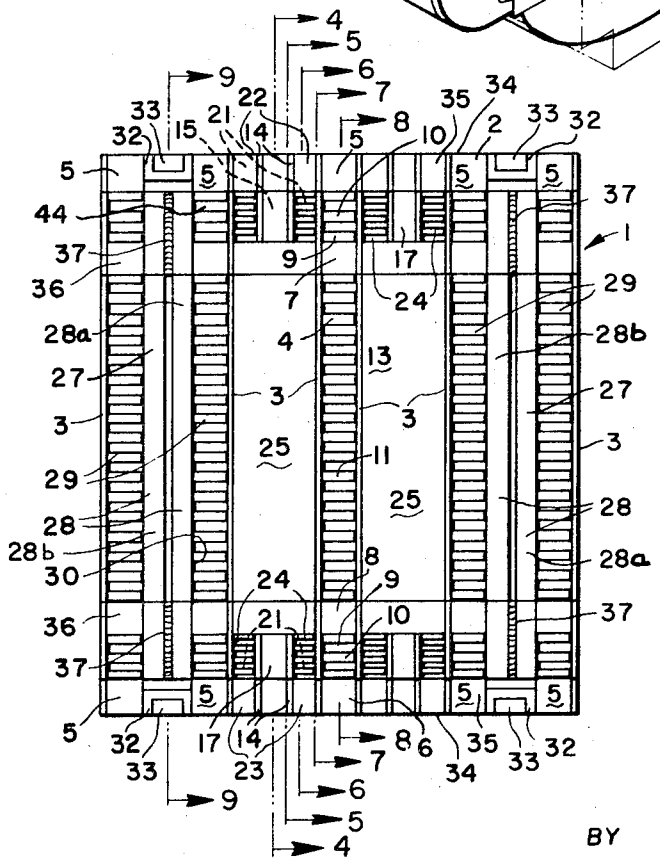
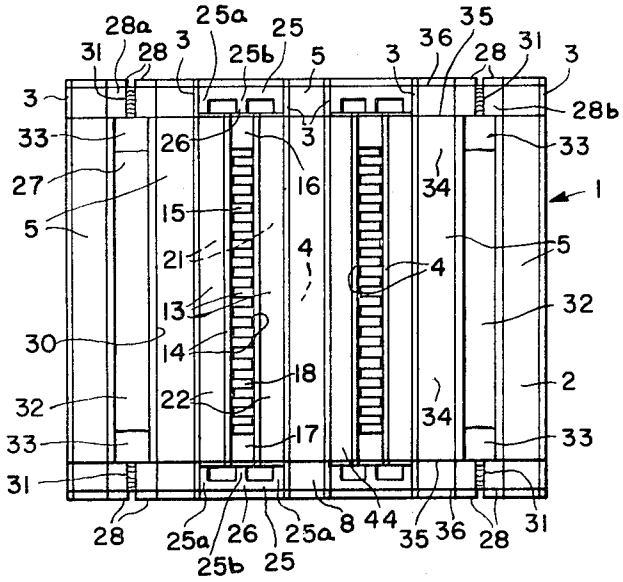


FIG. 2

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FIG. 3



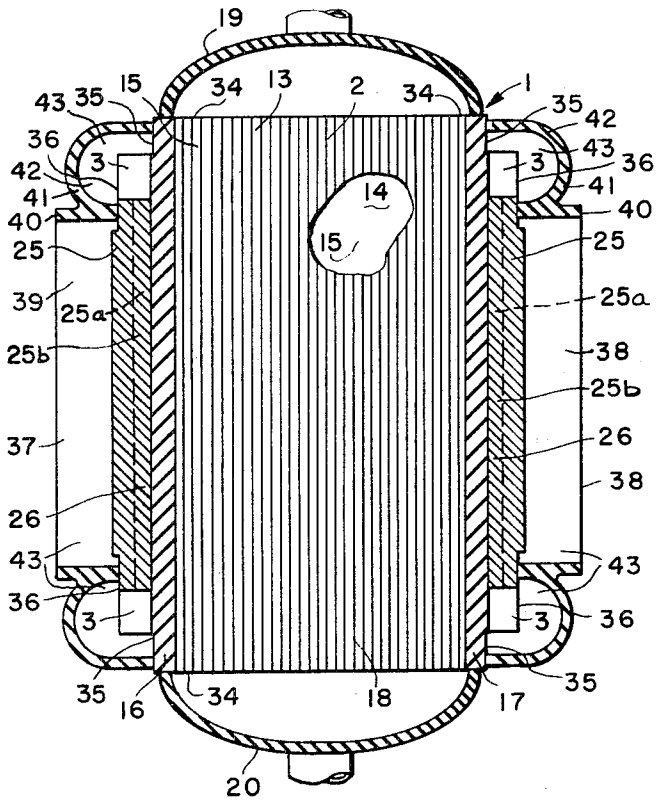
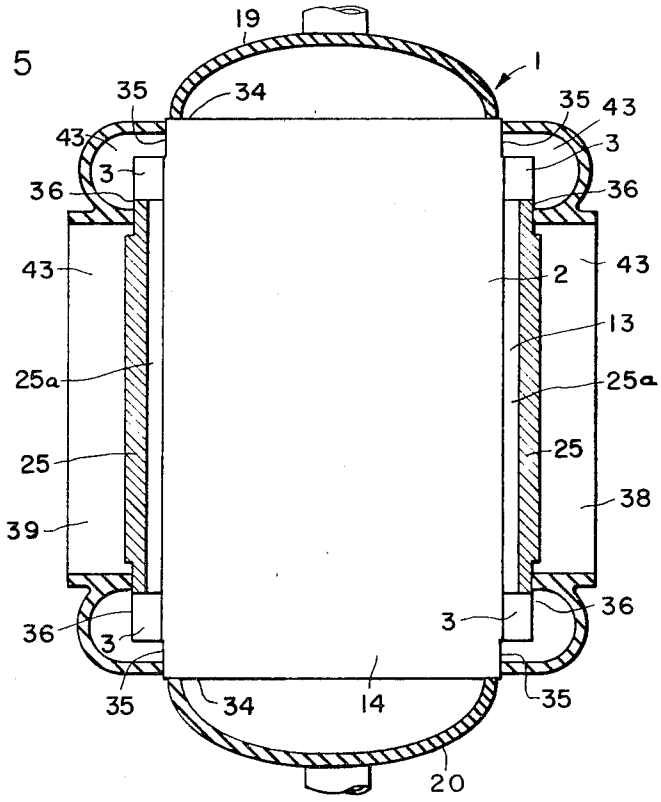


FIG. 4

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FIG. 5



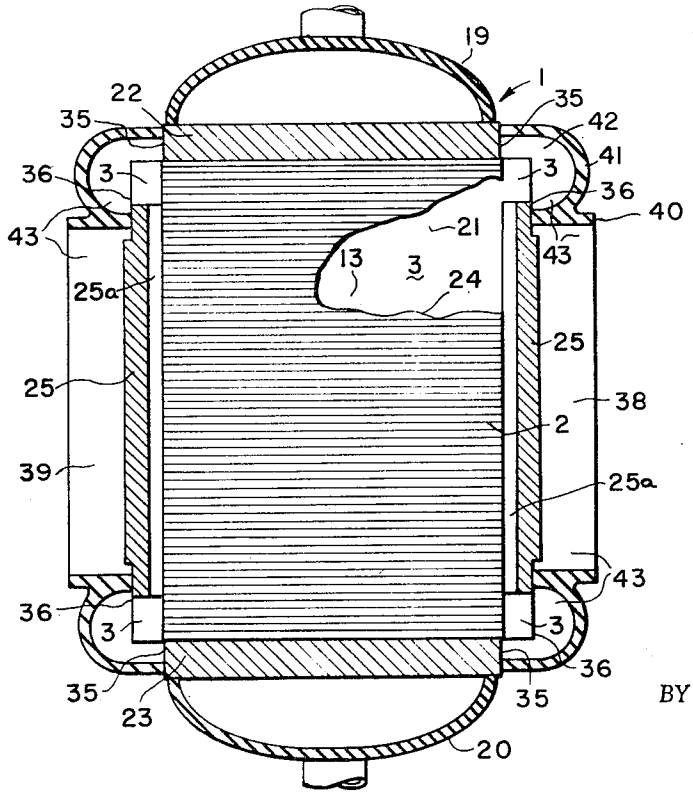
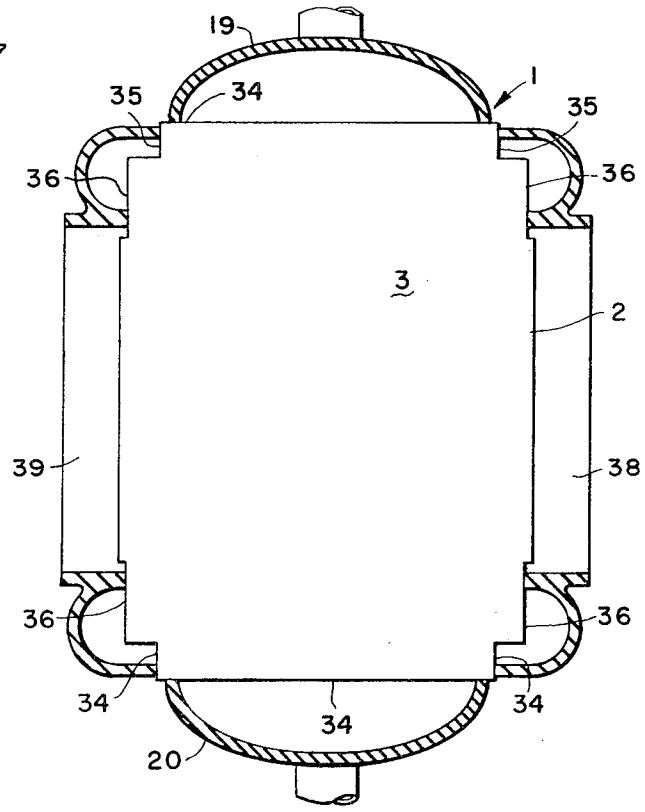


FIG. 6

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FIG. 7



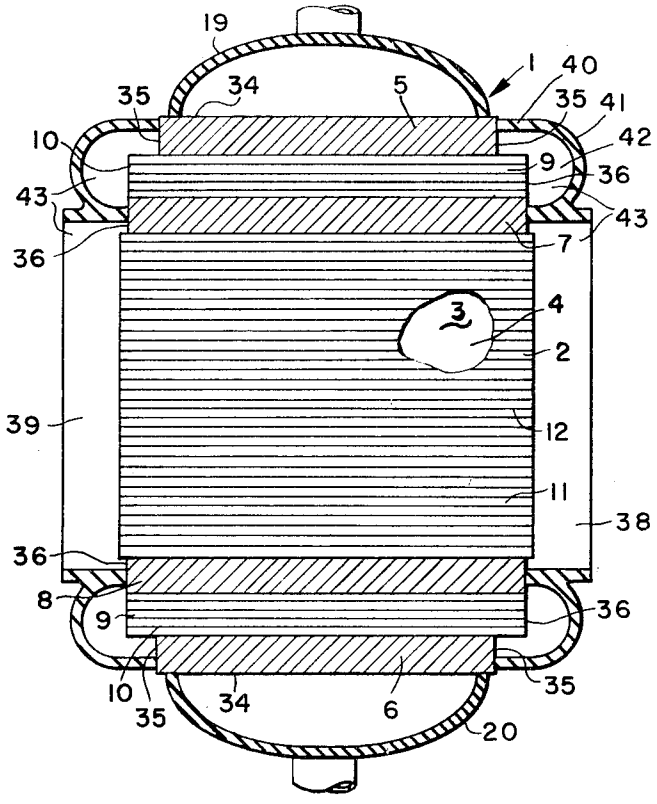


FIG. 8

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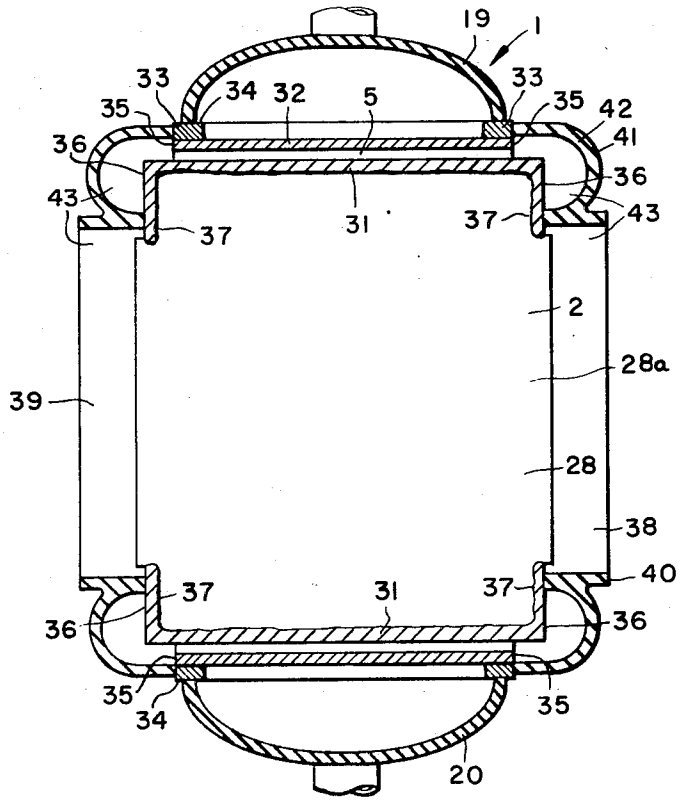


FIG. 9

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CROSSFLOW PLATE-TYPE HEAT EXCHANGER WITH BARRIER SPACE

BACKGROUND OF THE INVENTION

Heretofore air passage barrier space means have been provided in plate type heat exchangers. Such barrier spaces may extend along the edges of the passages as in U.S. Pat. No. 3,469,623. When a plate-and-bar construction is used, difficulty may be encountered during assembly of the components in supporting the closing bar at the edge of such passage. This difficulty is particularly acute in the assembly of large heat-exchanger cores in the order of 20 to 30 inches or more across the sides thereof.

SUMMARY OF THE INVENTION

It is thus an object of this invention to provide an easily assembled crossflow plate-type heat exchanger with barrier spaces intermediate the passages thereof.

It is a further object of this invention to provide a plate-type heat exchanger with a novel outer closing bar which positions an inner closing bar during assembly and brazing of the heat-exchanger core.

It is a further object of this invention to provide a plate-type heat exchanger with a plate-and-bar-constructed barrier system which substantially completely envelopes individually each of certain fluid-conducting passages thereof.

And it is still a further object of this invention to provide a means for connecting several individually brazed heat-exchanger core sections together wherein the connecting joint is enveloped within the barrier space. Specifically, this invention involves a plate-type heat-exchanger core comprising first, second, and third primary plates contraposed in substantially parallel-spaced relationship; said first primary plate having a margin coextensive with a margin of said second plate; first sealing means sealingly bridging between and extending along said coextensive margins of said first and second primary plates whereby a barrier space is defined between said first and second primary plates inwardly of said first sealing means; first and second secondary plates contraposed in substantially parallel-spaced relationship disposed between and spaced from said first and second primary plates; said first secondary plate having a margin coextensive with a margin of said second secondary plate disposed inwardly of said first sealing means; second sealing means sealing bridging between and extending along said coextensive margins of said secondary plates whereby a first heat-exchange fluid passage is defined between said first and second secondary plates within said barrier space; said second primary plate having a margin coextensive with a margin of said third primary plate; third sealing means sealingly bridging between and extending along said coextensive margins of said second and third primary plates whereby a second heat-exchange fluid passage is defined between said second and third primary plates; means within said barrier space defining a heat-conducting path between said first and second heat-exchange fluid passages.

DESCRIPTION OF THE DRAWINGS

The structural means to achieve these objectives will be apparent from the detailed description of the drawings with the accompanying drawings in which:

FIG. 1 is a perspective of a crossflow plate-type heat exchanger incorporating the instant invention wherein the barrier system thereof is connected to a means for detecting the presence of heat-exchange fluid within the barrier spaces;

FIG. 2 is a side elevation viewed as indicated by line 2—2 of the heat exchanger of FIG. 1 having the headers removed;

FIG. 3 is a plan view as indicated by line 3—3 of the heat exchanger of FIG. 1 having the headers removed;

FIG. 4 is a vertical section taken at line 4—4 in FIG. 2 of the heat exchanger of FIG. 1;

FIG. 5 is a vertical section taken at line 5—5 in FIG. 2 of the heat exchanger of FIG. 1;

FIG. 6 is a vertical section taken at line 6—6 in FIG. 2 of the heat exchanger of FIG. 1;

FIG. 7 is a vertical section taken at line 7—7 in FIG. 2 of the heat exchanger of FIG. 1;

FIG. 8 is a vertical section taken at line 8—8 in FIG. 2 of the heat exchanger of FIG. 1; and

FIG. 9 is a vertical section taken at line 9—9 in FIG. 2 of the heat exchanger of FIG. 1.

DETAILED DESCRIPTION

Referring now to the drawings, it will be seen that crossflow plate-type heat exchanger 1 has a core 2 which includes a plurality of generally rectangular impervious metallic primary plates 3 of the same peripheral configuration contraposed in parallel-spaced relationship. The space 4 (see FIG. 3) between a certain pair of adjacent plates 3 is closed along its upper and lower margins respectively by outer upper and lower closing bars 5 and 6 (see FIGS. 2 and 8) brazed at their sides to and sealingly bridging between the plates 3 defining space 4. Spaced inwardly of and parallel to bars 5 and 6 are inner upper and lower closing bars 7 and 8 respectively brazed at their sides to and sealingly bridging between the plates 3 within space 4. The spaces 9 intermediate bars 5 and 7 and intermediate bars 8 and 9 within space 4 are each provided with a rectangular section 10 of corrugated metallic sheet fin material having its crests and valleys extending parallel to bars 5, 6, 7 and 8. The space 11 intermediate bars 7 and 8 within space 4 is provided with a large rectangular section 12 of corrugated metallic sheet fin material having its crests and valleys extending parallel to bars 5, 6, 7, and 8. The crests on opposite sides of fin sections 10 and 12 are brazed to plates 3 to impart structural and thermal integrity to heat exchanger core 2. The right and left side of spaces 9 and 11 (FIG. 8) are not closed so as to permit communication between these spaces and the interior of header means yet to be described. The space 11 defines a first passage for a first heat-exchange fluid. The spaces 9 define part of the barrier space system.

Within the space 13 (see FIGS. 2 and 3) between another pair of plates 3 is a pair of parallel-spaced impervious metallic secondary plates 14 of like rectangular configuration (see FIG. 5). Plates 14 are the same height but somewhat narrower than plates 3. Plates 14 are parallel to and spaced from plates 3. The space 15 which is within space 13 between the pair of plates 14 is closed at its vertical margins by closing bars 16 and 17 (see FIG. 4) brazed to and sealingly bridging between the plates 14. The space 15 intermediate bars 16 and 17 is provided with a rectangular section 18 (see FIG. 4) of corrugated sheet fin material having its crests and valleys extending parallel to bars 16 and 17. The crests on opposite sides of fin section 18 are brazed to plates 14 to impart structural and thermal integrity to heat-exchanger core 2. The top and bottom sides of space 15 are not closed as will be seen in FIG. 4 so as to permit communication between space 15 and the interior of inlet and outlet headers 19 and 20 respectively. The space 15 defines a second passage for a second heat-exchange fluid to be heat-exchanged with the first heat-exchange fluid in the first passage of space 11 aforementioned.

The spaces 21 within space 13 disposed intermediate adjacent plates 3 and 14 on each side of space 15 are closed along their upper and lower margins respectively by upper and lower closing bars 22 and 23 (see FIGS. 2 and 6) brazed at their sides to and sealingly bridging between the adjacent plates 3 and 14. Each space 21 intermediate bars 22 and 23 is provided with a rectangular section 24 of corrugated metallic sheet fin material. The crests on opposite sides of fin section 24 are brazed to plates 14 and 3 to impart structural and thermal integrity to heat-exchanger core 2. The spaces 21 define interpassage barrier spaces intermediate the first passage of space 11 and the second passage of space 15.

The space 13 including spaces 15 and 21 is closed along the medial portions of its vertical margins by extruded E-shaped closing bars 25. Bar 25 has an E-shaped cross section normal to its longitudinal axis with the legs thereof facing inward of core 2 as is most clearly seen in FIG. 3. The outer surfaces of the remote legs 25*a* of the E-shaped bar 25 are sealingly

brazed to the plates 3 which define space 13 whereby bars 25 sealingly bridge between plates 3. The distal portion of intermediate leg 25*b* of bars 25 abut the outer side of closing bars 16 and 17 at 26 for the purpose of positioning bars 16 and 17 during assembly and brazing of the core elements. A brazed or sealed joint between legs 25*b* and bar 16 or 17 is not necessary.

Within another space 27 (see FIGS. 2 and 3) between a pair of plates 3 is a pair of substantially rectangular parallel-spaced impervious metallic coupling plates 28. Plates 28 may be thicker than, shorter than, and spaced from and parallel to adjacent plates 3. The spaces 29 within space 27 between a plate 3 and a plane coincident with surface 30 of an adjacent plate 28 may be provided with substantially identical fin section and bar structure as space 4 hereinbefore-described for the purpose of establishing a fluid passage therethrough. Plates 28 are brazed to the closing bars and fin sections within spaces 29 in the same manner as plates 3 are connected to the fin section and bar structure. The various sections 44 of core 2 between and including the coupling plates 28 identified as 28*a* and 28*b* (see FIGS. 2 and 3) thus may be furnace or bath-brazed together into an independent in a manner well known to the prior art. Coupling plates 28 provide the means by which plural core sections may be joined. To limit the space required for illustration, the outer core sections of core 2 are shown as including only one fluid passage.

The core sections are joined by welding or locally brazing plate 28*a* of one section to plate 28*b* of another section 44 along the upper and lower portions of their vertical margins as at 37 and along their horizontal margins as at 31 (see FIG. 9). Optionally weld 37 may extend along the entire margin of plates 28. A closing bar 32 having a channel-shaped cross section sealingly bridges between the closing bars 5 at each horizontal margin of each space 27 as will be seen in FIGS. 2, 3, and 9. At each end of each bar 32, the channel thereof is filled with weld material as at 33 (see FIGS. 2, 3 and 9) to permit the connection of a header to core 2.

After the elements of each core section 44 have been integrally brazed together and after the core sections 44 have been joined together as described above, the surfaces 34, 35, and 36 are machined or ground flat preparatory to connecting the headers. The inlet and outlet headers 19 and 20 respectively which communicate with the passages of spaces 15 may now be locally welded or brazed to surfaces 34 as shown in FIGS. 1 and 4–9. In like manner, inlet and outlet headers 38 and 39, respectively, which may take the form of ducts which communicate with spaces 11 are locally welded or brazed to surfaces 36 as seen in FIGS. 1 and 4–9. The upper and lower sides of each of headers 38 and 39 may be in the form of an elongated extruded member 40 having a generally N-shaped cross section, the generally curved leg 41 of which extends to surface 35 to define another header 42 at each corner of the core 2 which communicates with barrier spaces 9 as seen in FIG. 8 and barrier spaces 21 as seen in FIG. 6. The ends of headers 42 and the sides of headers 38 and 39 are formed by plates 43 welded or brazed in the position shown.

Barrier space headers 42 may be provided with means for supplying an inert fluid to the barrier space at a pressure higher than that of spaces 11 and 15 so that all leaks are into rather than from these spaces. In the alternative means may be provided to detect the presence in headers 42 of a fluid leaking from either of spaces 11 or 15 into the barrier spaces.

Having now described the preferred embodiment of our invention, we contemplate that many changes may be made without departing from the scope or spirit of my invention and I accordingly desire to be limited only by the claims. I claim:

1. A plate-type heat-exchanger core comprising first, second, and third primary plates contraposed in substantially parallel-spaced relationship; and first primary plate having a margin coextensive with a margin of said second plate; first sealing means sealingly bridging between and extending along said coextensive margins of said first and second primary plates whereby a barrier space is defined between said first and second primary plates inwardly of said first sealing means; first and second secondary plates contraposed in substantially parallel-spaced relationship disposed between and spaced from said first and second primary plates; said first secondary plate having a margin coextensive with a margin of said second secondary plate disposed inwardly of said first sealing means; second sealing means sealing bridging between and extending along said coextensive margins of said secondary plates whereby a first heat-exchange fluid passage is defined between said first and second secondary plates within said space; said second primary plate having a margin coextensive with a margin of said third primary plate; third sealing means sealingly bridging between and extending along said coextensive margins of said second and third primary plates whereby a second heat-exchange fluid passage is defined between said second and third primary plates; means within said barrier space defining a heat-conducting path between said first and second heat-exchange fluid passages.

2. An apparatus as defined by claim 1 wherein said first, second and third sealing means are metallic closing bars brazingly bonded to the heat-exchanger plates.

3. The apparatus as defined by claim 1 wherein said first sealing means is a metallic closing bar having an E-shaped cross section wherein the remote legs of thereof are brazingly bonded to the margins of said first and second primary plates and wherein the intermediate leg abuts said second sealing means.

4. A plate-type heat-exchanger core comprising first and second metallic plates contraposed in substantially parallel-spaced relationship; said first plate having a pair of opposed margins coextensive with a pair of opposed margins of said second plate; first and second inner closing bars extending along paths substantially parallel to and spaced inwardly of said opposed margins sealingly bridging between said first and second plates to thereby define a heat-exchange fluid passage intermediate said first and second plates and intermediate said first and second inner closing bars; first and second outer closing bars extending along said opposed margins sealingly bridging between said first and second plates to thereby define a barrier space between adjacent inner and outer closing bars intermediate said first and second metallic plates; a section of corrugated metallic sheet fin material having crests extending generally parallel to said inner and outer closing bars disposed in abutting relation intermediate said inner closing bars whereby said inner closing bars are positioned from their inner side; and a section of corrugated metallic sheet fin material having crests extending generally parallel to said inner and outer closing bars disposed in abutting relation intermediate adjacent pair of inner and outer closing bars whereby said inner closing bars are positioned from their outer side whereby the spatial relationships between said inner bars and the other elements of said heat-exchanger core are maintained during brazing of said closing bars to said plates.

5. A plate-type heat exchanger comprising: a first integral brazed plate-and-fin core section; a second integral brazed plate-and-fin core section; each of said core sections having a plurality of first passages for passage of a first heat-exchange fluid; each of said core sections having a plurality of second passages for passage of a second heat-exchange fluid; a welded joint connecting together said first and second core sections; and mean enclosing a barrier space overlying said welded joint whereby leaks at the joint connecting said integrally brazed core sections may be detected.

6. A plate-type heat exchanger comprising: a first integrally brazed plate-and-fin core section; a second integrally brazed plate-and-fin core section; each of said core sections having a plurality of first passages for passage of a first heat-exchange fluid; each of said core sections having a plurality of second passages for passage of a second heat exchange fluid; each of said cores having barrier spaces intermediate the first and second passages thereof; a welded joint connecting together said first and second core sections; a first header connecting the first passages of said first and second core sections; a

second header connecting the second passages of said first and second core sections; means defining a barrier space overlying said welded joint; and a header connecting the barrier spaces of said first and second core sections and said barrier space overlying said joint between said core sections whereby leaks from said first and second passages and at said joint may be detected.

* * * * *