

[54] **PLATE TYPE HEAT EXCHANGER AND PRODUCTION**

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[51] Int. Cl. **F28f 3/14**

[58] Field of Search **165/170; 62/523; 285/189, 285/286; 29/157.3 V**

[56] **References Cited**

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3,126,215	3/1964	Raskin	165/170 X
3,458,917	8/1969	Mueller	29/157.3 V

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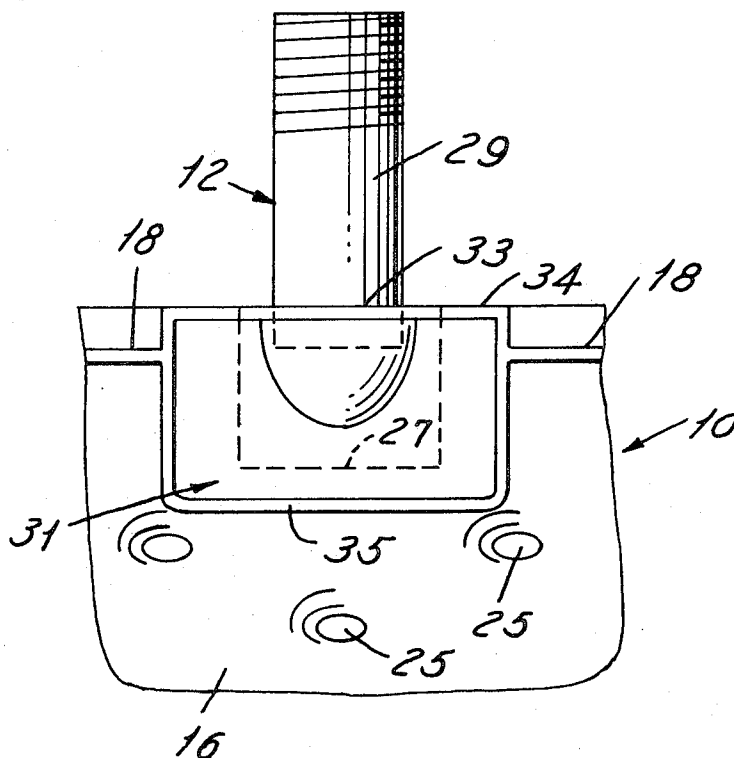
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[57] **ABSTRACT**

A pair of like flat rectangular steel sheets are superposed face-to-face and seam-welded together marginally, as well as being further united rigidly between

margins by a pattern of elongated seam weld and interrupted seam or spot weld-type unions. The latter are arranged in longitudinally extending rows paralleling horizontal and intermediate seam welds, the interrupted welds of successive rows being in a longitudinally and laterally staggered relationship defining a symmetric pattern of uniformly diamond-shaped areas between sets of four of the interrupted welds. Either before or after the sheets are weld-united in this fashion, they are punched to afford a pair of registering rectangular notches which are optionally located, depending upon the ultimate configuration of the product, at spaces at which a pair of special inlet and outlet pad sub-assemblies for the heat transfer fluid are to be applied. Each of these units consists of a nipple-like cylindrical pipe length about the circumference of which a pair of like stamped sheet metal pad-like plates are welded. Flat portions of these plates are in turn telescoped in parallel relation to and over a portion of the notched margin of the prior-welded heat transfer plate or sheet sub-assembly, spanning the respective notches, and are thereafter welded leaktight to said plates about the margins of the two fitting pad components. The full welded assembly is then clamped rigidly along outer margins in an expansion fixture, whereupon hydraulic pressure is applied to the inlet pad fitting (the other being plugged), thus to controllably inflate interior spaces not held by weldments, thus in turn to produce a multiplicity of identical and symmetrically distributed, staggered diamond-shaped pillow-like sub-volumes, as defined by the weld patterning described above; through these spaces a heat transfer fluid medium travels in a well distributed but generally serpentine, parallel flow path from inlet to outlet.

17 Claims, 6 Drawing Figures



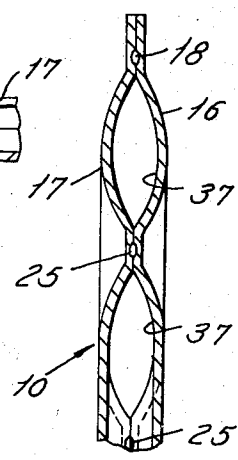
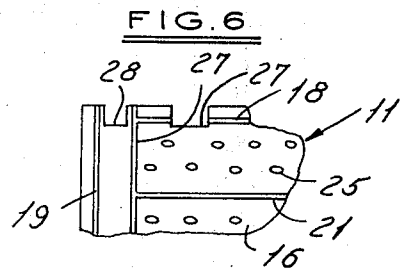
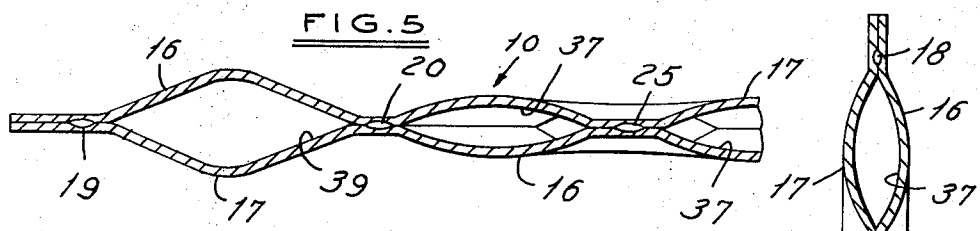
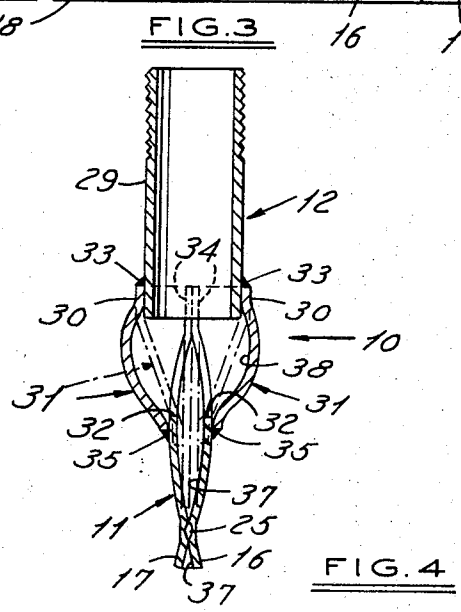
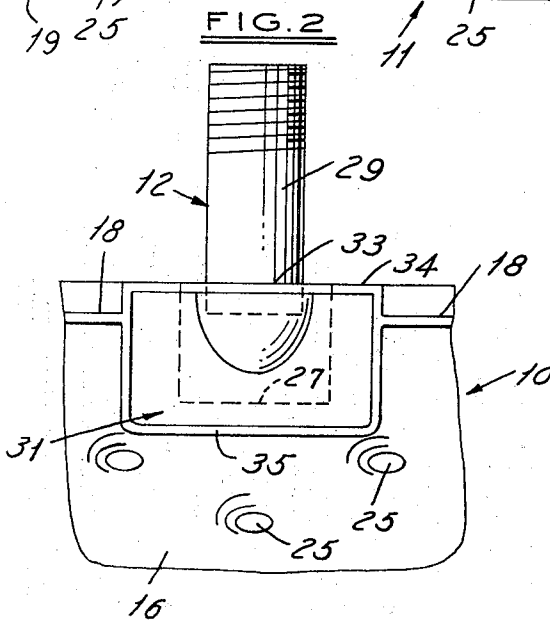
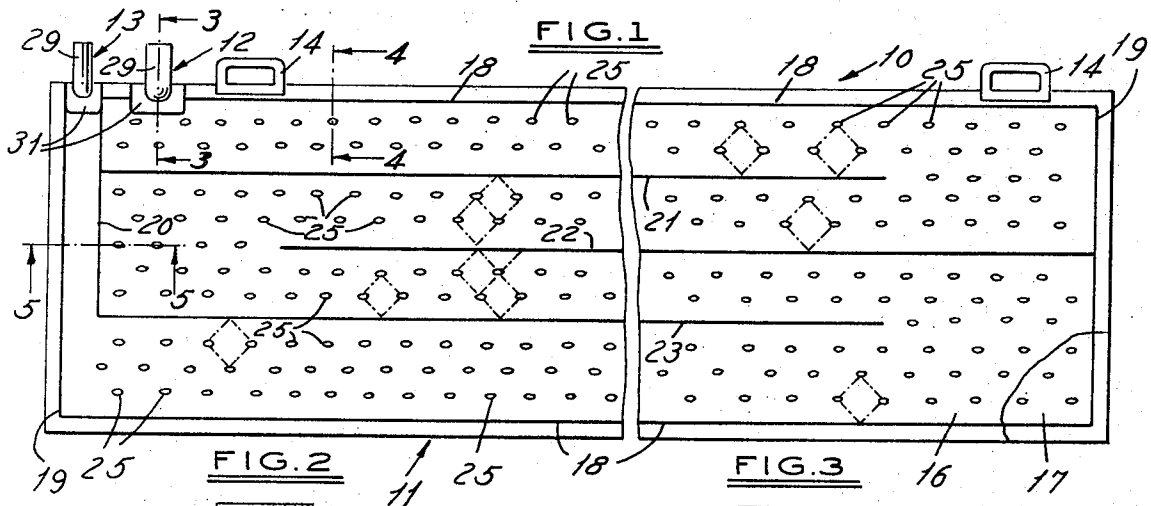


PLATE TYPE HEAT EXCHANGER AND PRODUCTION

CROSS-REFERENCE TO RELATED APPLICATIONS

The copending application of Sheldon J. Stowell Ser. No. 346,294, filed Apr. 3, 1973, discloses improved equipment by which the herein claimed method of producing the above-described heating transfer unit is carried out, as well as procedural operations of a more mechanical nature which are involved in the functioning of that equipment.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The heat transfer unit, handling steam or other fluid as a transfer medium, finds application in many heat transfer uses, as in chemical processing, metal working, paper and textile plants, and the like. A typical further application, as a heat exchange unit for transformer cooling oil, is as a less costly substitute for units as illustrated and described in the patent to McGuffey, U.S. Pat. No. 2,900,175, of Aug. 18, 1959 of common ownership. Another unit of similar function is the subject matter of McGuffey, U.S. Pat. No. 3,502,142, dated Mar. 24, 1970, also of common ownership.

2. Description of the Prior Art

The most pertinent prior art patents of which I am aware are Mueller U.S. Pat. No. 3,458,917 of Aug. 5, 1969, and Muffley, U.S. Pat. No. 1,709,865 of Apr. 23, 1929. These relate in the most general way only to the product and method of the present invention.

SUMMARY OF THE INVENTION

The invention affords a transfer unit which, as constituted in the manner described in the Abstract, may be marketed in a limited number of basic styles, each variable in respect to specific design, for example, as to the orientation on the expanded heat transfer sheet or plate sub-assembly of the two intake and outlet fitting pads, as well as in regard to the material and dimensioning of the structure as a whole to meet a wide range of heating and cooling applications of the nature referred to in the Field. It is a very economically produced and potentially low-priced unit, in general performing the functions of the structure of the first identified McGuffey patent.

The arrangement of the interrupted and staggered weld zones, preferably in a generally serpentine arrangement for a reversing parallel flow of the fluid transfer medium from inlet to outlet, plus the improved feature of stamped plate and nipple fitting sub-assemblies, affords ample and sufficient ingress and egress volume to efficiently and balancedly service the interior of the exchanger unit, with no local entrapment of the heat transfer medium, whether liquid or vaporous. The welds, as symmetrically arranged in a fixed parallel zonal relationship, enable an accurately predictable hydraulic pressure expansion of the unit in manufacture, without resort to the expedient of tensioning the component sheet metal plates during welding, as in the case of the prior art Mueller patent identified above.

It has been found that the improved unit effectively outperforms correspondingly simple heat transfer units

of even generally similar design and manufacturing characteristics.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view, partially broken, of a typical plate heat exchange unit in one of a few basic styles contemplated by the invention;

FIG. 2 is an enlarged scale fragmentary view in side elevation better showing the weldments which unite the fitting pad component to the welded plate component of the unit;

FIGS. 3 and 4 are similarly enlarged scale fragmentary views in vertical section along lines 3—3 and 4—4, respectively, of FIG. 1, FIG. 3 indicating in dot-dash line the sectional outline of a fitting pad prior to its expansion to the finished sectional configuration shown in solid line;

FIG. 5 is a similar view in horizontal section on line 5—5 of FIG. 1; and

FIG. 6 is a fragmentary elevational view of the welded plate assembly prior to application of the inlet and outlet fitting sub-assemblies and hydraulic pressure expansion of the unit.

DESCRIPTION OF A PREFERRED EMBODIMENT

The improved unit, as generally designated by the reference numeral 10, essentially comprises a pair of identical weld-united sheet steel plates constituting an internally passaged fluid flow distributing panel or plate sub-assembly, generally designated 11, of unit 10, being equipped with a pair of intake and outlet fitting members or sub-assemblies 12, 13, respectively.

FIG. 1 shows a typical style in which these intake and outlet devices are disposed on a common longitudinal margin of plate component 11, adjacent an upper corner thereof. In other styles, depending upon space limitations or other practical considerations in use, said fittings might be applied in vertically spaced relation to one another at an extreme upright side margin of the plate structure, or otherwise. Handling grip elements 14 welded to the plate structure 11 are of secondary significance.

In the production of the transfer unit 10, a pair of like opposite side rectangular plates 16, 17 are, in a perfectly flat condition of each, disposed in registered side-by-side and face-to-face contact with one another and, as thus held tightly in an appropriate clamping fixture, subjected to welding thereof in this unitary condition, employing equipment and a mechanical procedure such as are the subject matter of my copending application, Ser. No. 346,294 referred to above.

This is done prior to the application of the padtype fittings 12, 13, and the weldments comprise continuous marginal seam welds 18, 19 about the respective pairs of horizontal and vertical sides of the assembled plates, being located well inwardly of the edges thereof, as indicated in FIGS. 2, 4 and 5. As appears in FIGS. 1 and 6, another upright seam weld 20 is made paralleling and in laterally inwardly spaced relation to the upright left-hand marginal seam weld 19, thus defining a vertical zone in which an upright fluid discharge header passage will be isolated from horizontal flow distribution passages, both later described, except the bottom one.

For the rest, plates 16 and 17 are continuously seam welded along lines parallel to and vertically spaced

from one another; and in the typical illustrated unit 10 the pattern of these continuous welds will include an internal seam weld 21 which commences from the left at upright weldment 20 and continues to the right a major portion of the horizontal length of the unit 10, but terminating well short of the right-hand vertical margin weld 19. This seam union 21 is spaced vertically from a second horizontal seam 22 of substantially the same length, but extending to the left from the right-hand upright seam 19 a distance generally corresponding to the length of seam 21, i.e., terminating well short of header weld 20; and a third horizontal seam weld 23 duplicates in relative position and extent the continuous weldment 21 commencing from the bottom of seam weld 20. However, the vertical spacing of weld 23 above bottom margin weld 18 somewhat exceeds the spacing of the three horizontal seams 21, 22, 23 from one another; the purpose being to outline an augmented initial horizontal flow distribution zone, as will appear.

At the time of making such parallel seam welds the plates 16, 17 are also intermediately welded and interiorly sub-divided in part into elongated horizontal pass areas generally separated from one another by seams 21, 22 and 23. This subdivision is afforded by a plurality of series of interrupted seam or spot-like welds individually designated 25, which are produced in a single welding cycle by the improved equipment referred to above. Thus, there will typically be, in a longitudinal horizontal area between continuous weld 21 and the seam weld 18, two parallel rows of said interrupted weldments 25 which generally define three distributional flow pass zones directly succeeding one another downwardly.

The patterning is such that the two rows of welds 25 above seam weld 21 are longitudinally and transversely staggered relative to one another. A similar pattern characterizes the zone between the pairs of seam welds 21, 22 and 22, 23, and by preference (as indicated above) the horizontal distribution area between continuous weld 23 and the bottom marginal weld 18 is sufficiently wider than the three above zones to accommodate four rows of the interrupted and staggered welds 25. The result is that, in each of these seam weldsubdivided zones there is a distinct patterning between continuous and interrupted weldments in a symmetrical diamond shape, as suggested at several places in dot-dash line in FIG. 1.

In practice, the lines of welding, continuous and interrupted, are machine-commenced at a central zone, being progressively outwardly produced in order to obtain an ironing effect maintaining true smooth flat-wise contact of the sheets 16, 17 as they are being welded and after welding.

Thus united in a two-ply, flat plate structure, the sheet or plate sub-assembly 11 is marginally cut as indicated in FIG. 6, to provide the respective larger and somewhat smaller rectangular edge notches 27, 28 at which the respective fitting pad units 12, 13 are to be applied, although the notching may, of course, be done prior to welding.

The structural composition of fitting sub-assemblies 12, 13 is the same save for size, being best depicted in FIGS. 2 and 3. It comprises an elongated tubular, nipple-like pipe length 29, threaded at an outer end for attachment in the circulating line of the heat transfer medium; and this fitting part is surrounded at its lower end

by semi-cylindrical formations 30 (FIG. 3) of a pair of identical sheet metal stampings 31. These, as prepared for application to the fitting length 29 and to sub-unit 11, have a downwardly tapered sectional configuration adjoining cylindrical portions 30 to their extremities 32 remote from the latter, at which said extremities the stampings 31 are sufficiently spaced laterally from and generally parallel to one another to fit slidably over the respective notches 27, 28 of plate sub-assembly 11, fully straddling across said notches as appears in FIG. 2.

But preferably prior to this assembling of the fitting component 12 or 13 to the plate sub-assembly 11 it is united as an integral combination of stamped plates and pipe 29 by seam-welding its semi-cylindrical plate formations to said fitting part 29 about the circumference of the latter, as at 33, and by further seam-welding the outer stamped plate margins to one another, as along an outer seam 34 paralleling the marginal plate seaming at 18.

The thus sub-assembled units 12, 13 are then straddled over the notched plate zones 27, 28 to span the latter and their welded final securement to the exterior plate surfaces of sub-assembly 11 is completed along the U-shaped seam contours 35.

Completion of the product 10 now requires only that the plate structure be placed in an appropriate fixture and physically expanded by the application of hydraulic pressure of, say, 750 p.s.i. to blow up its interior under the closely predictable control of the internal seam and spot welding pattern to produce pillow-like fluid distribution spaces 37 of the shape and sectional outline shown in FIGS. 1, 4 and 5. That is, in common with an ordinary pillow cushion, the spaces 37 are outlined on four sides in a general way by what amounts to equivalents of straight lines, as depicted in dot-dash in FIG. 1, said line sides or zones extending between corner connection points, like the cushion; and as inflated after blow-up, the spaces 37 have mildly rounded exterior surfaces resembling those of a cushion pillow, although lacking the latter's ready deformability. The diamond outline of spaces 37, as distinguished from a rectangular box-like outline characteristic of the product of the Mueller patent, affords full and direct unimpeded intercommunication of these spaces with one another along both diagonal and 90° related distribution paths, and throughout the length and breadth of the interrupted weld passes, yet with a very strong and unimpaired internal union of plates 16, 17 with one another, attributable to the staggered-row patterning.

The size of the inlet fitting header cross section or space 38 (FIG. 3) assures an ample, unthrottled admission of heating medium to the plate interior, free of any degree of trapping that fluid in this entry zone; and the proportioning of the other or outlet fitting 13, as communicated with the expanded discharge header 39 (FIG. 5) defined between the parallel upright seam welds 19 and 20, similarly accommodates an unrestricted exhausting of the transfer fluid to its circulation line.

As previously noted, the exchanger 10 is capable of inexpensive manufacture in a limited number of models, differing in size and internal capacity, specific location of inlet and outlet fittings, number of serpentine passes, etc., to satisfy many performance specifications. Indeed, there may be instances of which continuous internal seam welding, to define the illustrated ser-

pentine zones or passes, i.e., other than about the margins of the unit, is dispensed with, internal or intermediate welding being solely through the agency of the longitudinally interrupted, staggered row spot-like welds 25 in the above-described pattern of distribution.

What is claimed is:

1. A plate-type heat exchanger, comprising a pair of similar plates marginally seamed together in a unitary face-to-face relationship to constitute a plate sub-assembly having at least one flat edge margin, the exchanger being internally subdivided into a pattern of directly intercommunicating transversely expanded spaces for the internal distributed flow in the exchanger of a fluid heat transfer medium, and inlet and outlet means for said flow, comprising at least one fitting pad sub-assembly connectable to a circulation line for said exchanger and comprising a tubular member so connectable, and a connector pad member including at least two similar parts fluid tight-connected and sealed to and circumferentially of said tubular member, said pad member parts providing a space-affording portion of the pad member in communication with said expanded spaces of the plate sub-assembly and with said tubular member, said pad member parts being provided with flat plate-like portions extending laterally from said space-affording portion, said flat portions being straddled over said flat edge margin of said plate sub-assembly and unitarily welded to opposite sides of the latter along zones which are substantially spaced laterally from the sealed connections of said pad member parts about said tubular member.

2. The exchanger of claim 1, in which said pad member parts are a pair of similar stampings having generally semi-cylindrical formations applied to diametrically opposite surfaces of said tubular member and providing said space-affording portion, said straddling portions being integral extensions of said formations.

3. The exchanger of claim 1, in which a part of the flat edge margin of said plate sub-assembly straddled by said flat portions of the pad member is locally notched to afford communication of said tubular member through said pad member with the interior spaces of the plate subassembly.

4. The exchanger of claim 2, in which a part of the flat edge margin of said plate sub-assembly straddled by said flat portions of the pad member is locally notched to afford communication of said tubular member through said pad member with the interior spaces of the plate subassembly.

5. The exchanger of claim 1, as internally subdivided into said pattern of spaces by parallel rows of interrupted, spot-like welds partially securing said plates in said face-to-face relationship, said last-named welds being longitudinally and laterally staggered in successive of said rows, whereby said expanded spaces have a generally diamond shape and are pillow-like in transverse outline.

6. The exchanger of claim 2, as internally subdivided into said pattern of spaces by parallel rows of interrupted, spot-like welds partially securing said plates in said face-to-face relationship, said last-named welds being longitudinally and laterally staggered in successive of said rows, whereby said expanded spaces have a generally diamond shape and are pillow-like in transverse outline.

7. The exchanger of claim 5, in which the exchanger is further subdivided as to said weld rows by at least one

continuous seam weld line paralleling the rows and separating a successive pair thereof from one another.

8. The exchanger of claim 6, in which the exchanger is further subdivided as to said weld rows by at least one continuous seam weld line paralleling the rows and separating a successive pair thereof from one another.

9. The exchanger of claim 5, in which said continuous seam weld line at least in part defines an overall path for the flow of said fluid medium from said inlet means to said outlet means which is serpentine in nature.

10. The exchanger of claim 6, in which said continuous seam weld line at least in part defines an overall path for the flow of said fluid medium from said inlet means to said outlet means which is serpentine in nature.

11. A plate-type heat exchanger, comprising a pair of similar plates marginally seamed together in a unitary face-to-face relationship to constitute a plate sub-assembly having at least one flat edge margin, the exchanger being internally subdivided by face-contacting welds into a pattern of uniform and directly intercommunicating, transversely expanded spaces for the internal distributed flow in the exchanger of a fluid heat transfer medium, and inlet and outlet means for said flow, comprising at least one fitting pad sub-assembly connectable to a circulation line for said exchanger and comprising a tubular member so connectable, and a connector pad member including at least two similar parts fluid tight-connected and sealed to and circumferentially of said tubular member in an externally telescoping relation to the latter, said pad member parts providing a space-affording portion of said pad member in communication with said expanded spaces of the plate subassembly and with said tubular member, said pad member parts being provided with flat plate-like portions extending laterally from said space-affording portion, said flat portions being straddled over said flat edge margin of said plate subassembly and unitarily welded to opposite sides of the latter along zones which are substantially spaced laterally from the sealed connections of said pad member parts about said tubular member.

12. The exchanger of claim 11, in which said pad member parts are a pair of similar stampings having generally semi-cylindrical formations applied to diametrically opposite surfaces of said tubular member and providing said space-affording portions, said straddling portions being integral extensions of said formations.

13. The exchanger of claim 11, in which a part of the flat edge margin of said plate sub-assembly straddled by said flat portions of the pad member is locally notched to afford communication of said tubular member through said pad member with the interior spaces of the plate subassembly.

14. The exchanger of claim 12, in which a part of the flat edge margin of said plate sub-assembly straddled by said flat portions of the pad member is locally notched to afford communication of said tubular member through said pad member with the interior spaces of the plate subassembly.

15. The exchanger of claim 14, as internally subdivided into said pattern of spaces by parallel rows of interrupted, spot-like welds partially securing said plates in said face-to-face relationship, said last-named welds being longitudinally and laterally staggered in succes-

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another.

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