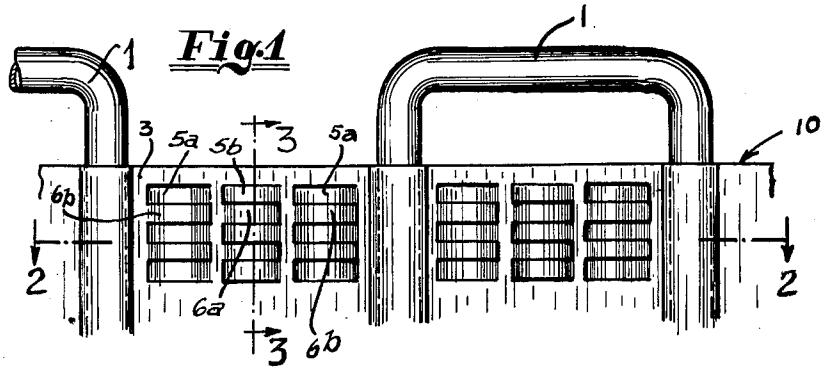
Dec. 21, 1965 A. KONANZ 3,224,503

HEAT EXCHANGER

Filed Dec. 6, 1961

Fig. 1



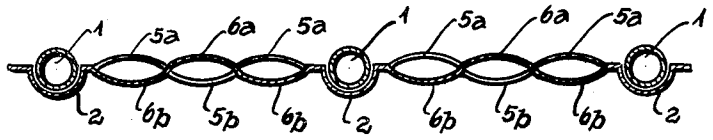


Fig. 2

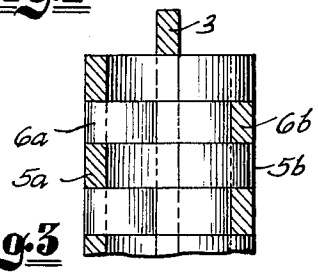


Fig. 3

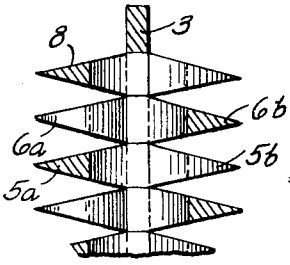


Fig. 3a

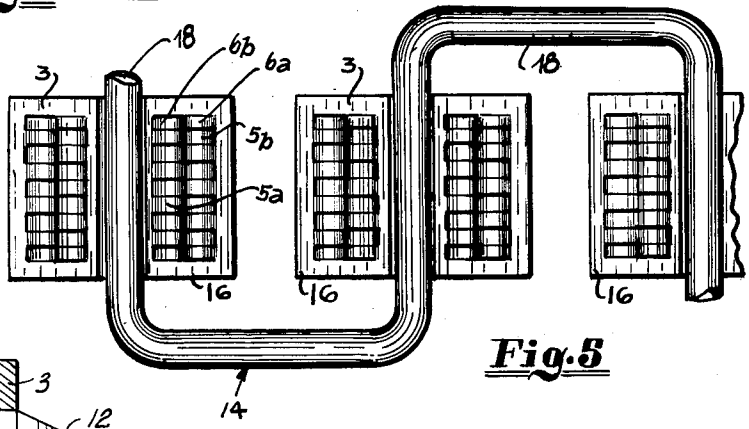


Fig. 5

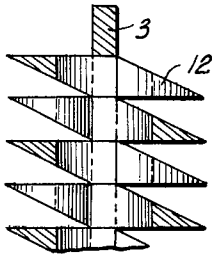


Fig. 4

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HEAT EXCHANGER

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A 36,254
6 Claims. (Cl. 165—171)

This invention relates in general to heat exchangers and in particular to a new and useful exchanger construction and to a method of producing same.

Heat exchangers are known, particularly for refrigerators, which comprise sheet members having fluid conducting coils embedded therein or connected thereto. In such instances the coils or pipes carry the refrigerant and are provided with the plate portions for carrying away heat from the refrigerant. Plates of this nature usually include separately secured projecting fins for aiding in the heat transfer or an arrangement in which the plates include outwardly extending formations on one side for aiding in the conducting away of the heat.

In accordance with the present invention, there is provided an improved heat exchanger construction which includes a substantially flat sheet member which is recessed to provide means for connecting a tube or conduit for the medium being affected and in which the sheet is provided with a multiplicity of strip portions which are bent away from the plane of the sheet in order to afford an increase in heat transfer in the overall grid structure. The bent sheet portions are preferably bent alternately outwardly to opposite sides of the sheet in order to insure adequate heat transfer on all of the surfaces of the sheet connecting the tubes or conduits.

In accordance with a preferred method, the plate is advantageously slit to form a multiplicity of strip portions between slits which are alternately bent away from the plane of the sheet, preferably while the sheet is being subjected to a stretching operation in order to enlarge the surfaces of the corrugations thus formed. In some instances the area defined between slits on the sheet material is advantageously subjected to a pressing force to effect the formation of desirable heat transfer configurations, such as a triangular-shaped corrugation on the plate member.

Accordingly, it is an object of this invention to provide an improved heat exchanger.

A further object of this invention is to provide a heat exchanger including a heat conductive sheet joining a series of coils of a primary fluid conduit which sheet includes a plurality of pairs of slits in which the material between the slits of the sheet is bent outwardly into a corrugated configuration.

A further object of the invention is to provide a heat exchanger including a grid comprised of a heat conductive sheet recessed to accommodate the successive coil windings of a primary fluid conduit and having a multiplicity of slits cut therethrough to define areas between adjacent slits which are bent outwardly to form corrugations, and preferably including adjacent areas which are bent outwardly from the plane of the sheet in alternately opposite directions.

A further object of the invention is to provide a heat exchanger which is simple in design, rugged in construction and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

In the drawings:

FIG. 1 is a fragmentary elevation of a heat exchanger constructed in accordance with the invention;

FIG. 2 is a section taken on the line 2—2 of FIG. 1;

FIG. 3 is a section taken on the line 3—3 of FIG. 1;

FIGS. 3*a* and 4 are views, similar to FIG. 3, of alternative embodiments of the invention; and

FIG. 5 is a fragmentary elevation of still another embodiment of the invention.

Referring to the drawings in particular, the invention embodied therein includes a heat exchanger grid structure generally designated **10** in FIG. 1. The grid structure **10** comprises a continuous length of a primary fluid conduit or coil **1** for the inner fluid medium, and a heat conducting plate generally designated **3** which is provided with a series of grooves **2** for receiving the coil **1** in tight conductive contact therewith.

In accordance with the invention, the conductive plate **3** between every adjacent pipe coil section is provided with adjacent embossed areas or corrugations **5** and **6**. In a preferred arrangement the plate **3** is slit at laterally spaced locations across its width and the areas between sets of parallel strips are alternately bent outwardly from the plane of the sheet **3**. As indicated in FIGS. 2 and 3, the upper portions **5***a* are bent outwardly in one direction while the subjacent portions **6***b* are bent outwardly in an opposite direction. Similarly, the portion **5***b* is bent in a direction opposite the direction of the portion **5***a* and the portion **6***a* is opposite to the direction of bend of the portion **6***b*. As indicated in FIGS. 2 and 3, portions **5***a* and **6***a* are indicated bent in one direction and portions **6***b* and **5***b* are bent in an opposite direction.

The heat exchanger of the invention may also be produced by rolling together two plates while interpositioning separate layers therebetween which cause the formation of a channel. Due to the position of the separating layers, predetermined channels are widened while the separating layer expands.

The advantages of a good heat conductive structure produced by the construction set forth may be still further enhanced by straightening or stretching the individual corrugations formed during the corrugating procedure to thereby obtain a surface enlargement. Thus, for example, the corrugations **5***a*, **5***b* and **6***a*, **6***b* may be carried out while simultaneously straightening to cause a surface enlargement of the overall heat conductive area while at the same time reducing the thickness of the sheet.

While, in the embodiment of the invention shown in FIG. 3, the corrugations have a substantially rectangular cross section, in the embodiments indicated in FIGS. 3*a* and 4, the corrugations are formed by means which upset the metallic material in the sheet area to form thickened triangular portions **8** at the outer edge, for example, as indicated in FIG. 3*a*. It is also advantageous in some instances to bend the areas between adjacent slits to define offset right triangular projections or corrugations as indicated at **12** in FIG. 4.

As indicated in FIG. 5, there is provided a heat exchanger structure generally designated **14** which includes a series of heat exchanger plates **16** which are joined to a conduit for the inner medium **18** similar to the manner indicated in FIGS. 1 and 2. Each of the plates **16** is provided with corrugations **5***a* and **5***b* and **6***a* and **6***b* in the same manner indicated in FIGS. 1 to 4 and may advantageously include the oblique configuration such as indicated in **12** of FIG. 4.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A heat exchanger comprising, in combination, a metal plate having at least one substantially rectilinear, substantially semicircular cross-section groove extending thereacross in a first direction; and a conduit having at least one substantially rectilinear portion extending conformingly within said groove; said plate being formed with aligned series of parallel longitudinally spaced slits extending substantially perpendicular to the axis of said groove to define strip sections in adjacent relation in said first direction, said strip sections being aligned in rows extending in said first direction with the rows extending substantially perpendicular to the lengths of said strip sections; adjacent strip sections in each series and in each row being offset from respective opposite surfaces of said plate, whereby each series of strip sections has the nature of an undulating strip extending substantially normal to the axis of said groove; adjacent rows of strip sections being separated by relatively narrow planar strip portions of said plate extending in said first direction.

2. A heat exchanger, as claimed in claim 1, in which said strip sections are longitudinally arcuate.

3. A heat exchanger, as claimed in claim 2, in which said strip sections have a triangular cross section with the apices of the triangles facing away from the surfaces of said plate.

4. A heat exchanger, as claimed in claim 3, in which the cross-section of said strip sections is substantially an isoceles triangle.

5. A heat exchanger, as claimed in claim 4, in which said strip sections are further offset, in a direction parallel to said first direction, whereby the cross sections of said strip sections are substantially right triangles; strip sections offset from opposite surfaces of said plate being offset in respective opposite directions.

6. A heat exchanger, as claimed in claim 1, wherein said conduit includes a plurality of substantially rectilinear portions, each extending conformingly within a respective plate groove; said conduit further having sections interconnecting said substantially rectilinear portions to form a continuous flow path extending in opposite directions in laterally adjacent rectilinear portions.

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