

[54] **HEAT EXCHANGE WITH RESILIENT LIQUID ACCUMULATOR**

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[51] Int. Cl. **F28d 7/00**

[58] Field of Search. **165/164-165, 165/168-170, 83, 84**

[56] **References Cited**

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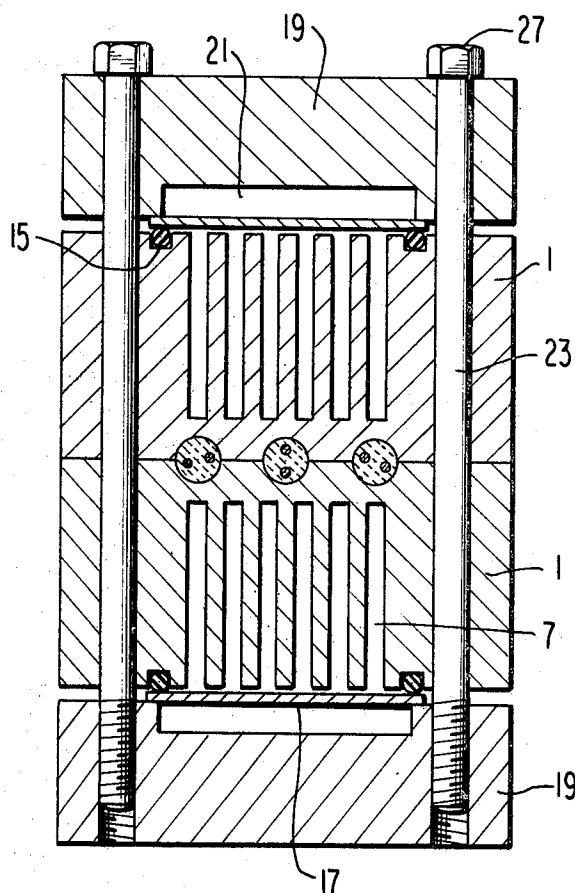
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[57] **ABSTRACT**

A heat exchanger with resilient liquid accumulator comprises a pair of heater blocks back-to-back on opposite sides of heater elements and having oppositely outwardly opening grooves for a liquid to be heated. The grooves are closed by spring metal plates that are held in place by cover plates. The cover plates are recessed on the outer side of the spring metal plates to permit expansion of the spring metal plates. The assembly is held together in sandwich fashion by tie bolts.

7 Claims, 2 Drawing Figures



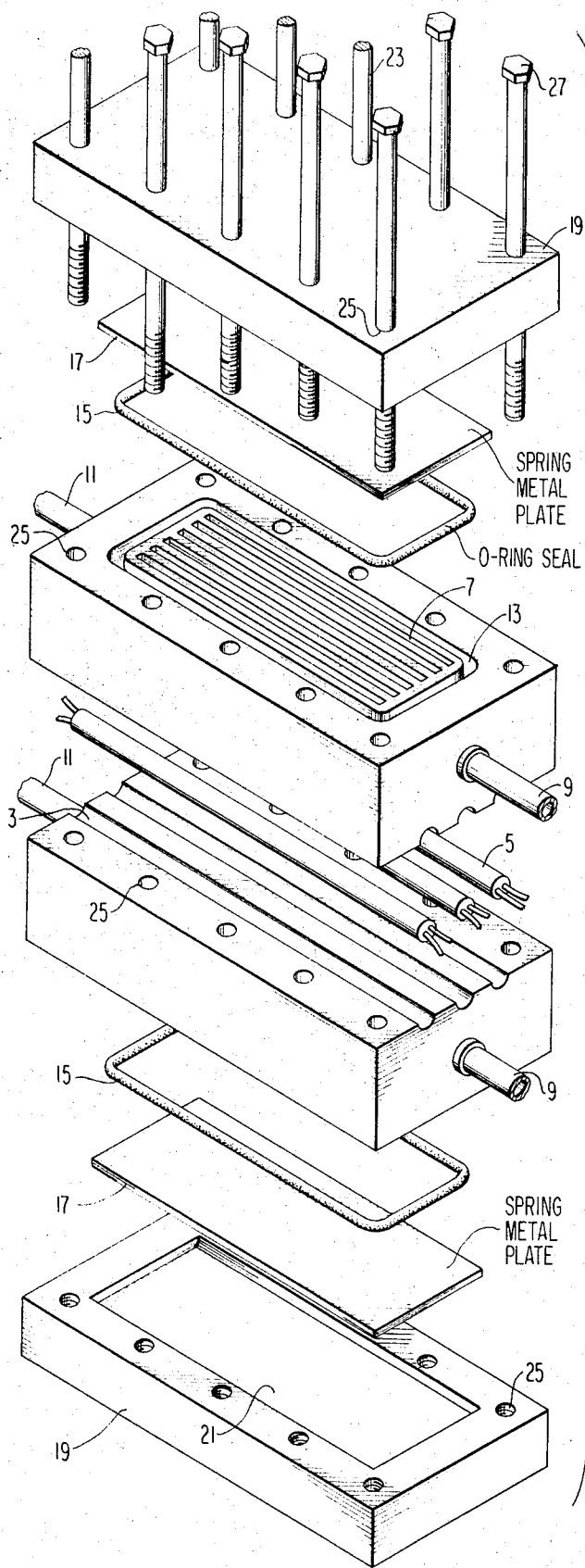


FIG 1

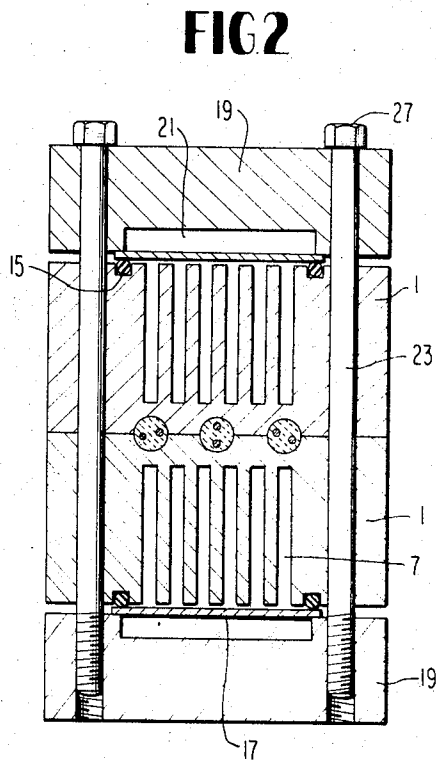


FIG 2

HEAT EXCHANGE WITH RESILIENT LIQUID ACCUMULATOR

The present invention relates to heat exchangers with resilient liquid accumulators.

It is an object of the present invention to provide such a heat exchanger, in which the accumulator will be frictionless.

Another object of the present invention is the provision of such a heat exchanger that is well adapted to accommodate variations in the volume of the liquid undergoing heat exchange.

Finally, it is an object of the present invention to provide such a heat exchanger, which will be relatively simple and inexpensive to manufacture, easy to install, operate, maintain and repair, and rugged and durable in use.

Other objects, features and advantages of the present invention will become apparent from a consideration of the following description, taken in connection with the accompanying drawing, in which:

FIG. 1 is an exploded perspective assembly view of the heat exchanger according to the present invention; and

FIG. 2 is an enlarged cross-sectional view thereof.

Referring now to the drawing in greater detail, there is shown a heat exchanger with resilient liquid accumulator, according to the present invention, comprising a pair of metal heater blocks 1 back-to-back. In describing the blocks 1, and the other elements of the apparatus according to the present invention, excepting only the tie bolts, it is to be understood that the apparatus according to the present invention is bi-symmetric about the horizontal midplane of FIG. 2; that is, the structure above the horizontal midplane of FIG. 2, except for the tie bolts, is the mirror image of the structure below the horizontal midplane of FIG. 2. Therefore, a description of one element will suffice for both.

Each heater block 1 has a plurality of semi-cylindrical grooves 3 extending lengthwise thereof and milled or otherwise formed in the inner surface thereof. The grooves 3 of the heater blocks 1 register with each other in the assembled position of the parts, to define between them cylindrical recesses extending lengthwise of the heat exchanger, in which cylindrical heater elements 5 are received in close heat exchange contact. Heater elements 5 are of any conventional type and are comprised by conventional nichrome or other resistance heating wires, extending lengthwise within a ceramic casing, in the manner of conventional fire rods and the like. Of course, the invention is not limited to electrical heating, and elements 5 can be replaced by heat exchange tubes in which a liquid passes; or alternatively, the side walls of grooves 3 can themselves provide heat exchange passages for a fluid.

It is further to be understood that, although the present invention is described and illustrated in connection with heating means in the grooves 3, the invention is equally applicable to the provision of cooling means in these grooves. Thus, the grooves 3 can emit heat or receive heat, and can contain elements that emit or receive heat, and/or can receive fluids that emit or receive heat.

On the outer side of blocks 1, that is, the side opposite grooves 3, a plurality of parallel deep grooves 7 are milled, cast or otherwise formed in the material of blocks 1. Grooves 7 extend lengthwise of the exchanger in parallelism to each other and have as extended a sur-

face as is convenient, because the grooves 7 receive within them the liquid to be heated or cooled, which of course is to be heated in the illustrated embodiment. The grooves 7 all communicate at one end with a liquid inlet 9 and at the other end with a liquid outlet 11, the liquid to be heat exchanged passing from inlet 9 through grooves 7 and out the outlet 11 in each block 1. Conventional means (not shown) such as pumps or the like are provided for moving the liquids along this path; and it is particularly to be understood that the same or different liquids may be fed through the blocks 1. Thus, for example, if the same liquid is fed through both blocks, then it may traverse the blocks serially, in which case the outlet 11 of one block could be the inlet 9 of the downstream block.

Surrounding but spaced from the group of grooves 11, there is milled or cast or otherwise formed in the same surface of the block 1 a continuous groove 13 having rounded corners, in which is sealingly disposed a continuous O-ring seal 15 of complementary configuration. Seal 15 in its undeformed condition projects above the top of groove 13 and is in sealing contact with a spring metal plate 17 whose length and width are of course somewhat larger than the length and width of seal 15, so that seal 15 is in continuous sealing contact entirely about the periphery of plate 17. Plate 17 is preferably of steel, such as carbon steel or stainless steel, but may also be beryllium copper or other resilient heat resistant metal, and is sufficiently thin to flex outwardly and inwardly, out of its normal plane, upon changes in the volume of the liquid which is confined in grooves 7 by plate 17.

A cover plate 19 has a shallow recess 21 centrally thereof, of a length and width somewhat less than the length and width of plate 17. In assembled relationship, the margins of recess 21 bear against the edges of plate 17 continuously thereabout and on the outer side thereof, to maintain plate 17 in sealing relationship with its subjacent seal 15. Tie bolts 23 extend through holes 25 aligned in blocks 1 and cover plates 19 to maintain the assembly of the parts together in sandwich fashion. Bolts 23 have heads 27 at one end thereof that bear against the outer side of one cover plate 19 and are screw threaded at their opposite ends for screw-threaded engagement with the holes 25 of the other cover plate 19.

In operation, liquid is passed lengthwise through the grooves 7 in the manner described above at the same time that heat is supplied or abstracted in the grooves 3. To promote the heat exchange between the grooves 3 and 7, the blocks 1 are preferably of aluminum, although they may also be copper, brass, or even stainless steel, depending on the heat exchange requirements and the nature of the fluids handled. Variation in the volume of the liquids in and adjacent grooves 7 is accommodated by flexure of the plates 17 bowing inwardly or outwardly in a substantially frictionless manner. The central recesses 21 in cover plates 19 accommodate outward bowing of plates 17; while the marginal edges of grooves 7 are spaced inwardly from plates 17 in the undeformed condition of plates 17, to accommodate inward bowing of the plates 17. The changes in the volume of the liquid undergoing heat exchange, which may occur by virtue of pressure changes or temperature changes or for other reasons, are thus accommodated by the present invention by means of a

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structure which, in addition, to its other advantages, is quite simple and inexpensive.

From a consideration of the foregoing disclosure, therefore, it will be evident that the initially recited objects of the present invention have been achieved.

Although the present invention has been described and illustrated in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

Having described my invention, I claim:

1. A heat exchanger comprising a heat exchange member, said heat exchange member having a recess therein for receiving a liquid to be heat exchanged, means for passing a liquid to be heat exchanged through said recess, a spring metal plate separate from said heat exchange member and closing said recess, resilient sealing means disposed between said spring metal plate and said heat exchange member, and a cover plate detachably secured to said heat exchange member and bearing against said spring metal plate in a direction to compress said sealing means between said heat exchange member and said spring metal plate.

2. A heat exchanger as claimed in claim 1, said cover plate having a recess therein to accommodate outward

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deformation of said spring metal plate.

3. A heat exchanger as claimed in claim 2, the margins of said recess in said cover plate bearing against the margins of said spring metal plate.

4. A heat exchanger as claimed in claim 1, and bolt means extending through said heat exchange member and cover plate releasably to retain said heat exchange member and cover plate in assembled relation with said spring metal plate and sealing means therebetween.

5. A heat exchanger as claimed in claim 1, said recess comprising a plurality of parallel grooves in said heat exchange member, and a continuous groove in said heat exchange member surrounding but spaced outwardly from said parallel grooves and shallower than said parallel grooves, said sealing means being disposed in said continuous groove.

6. A heat exchanger as claimed in claim 5, the margins of said grooves being spaced from said spring metal plate in the undeformed condition of said spring metal plate.

7. A heat exchanger as claimed in claim 1, there being a pair of said heat exchange members disposed in back-to-back relation with said recesses opening outwardly away from each other, and means between said heat exchange members for establishing a temperature different from the temperature of the liquid in said recesses.

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