

March 10, 1970

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3,499,484

TWO-FLUID HEAT EXCHANGER

Filed Nov. 13, 1967

2 Sheets-Sheet 1

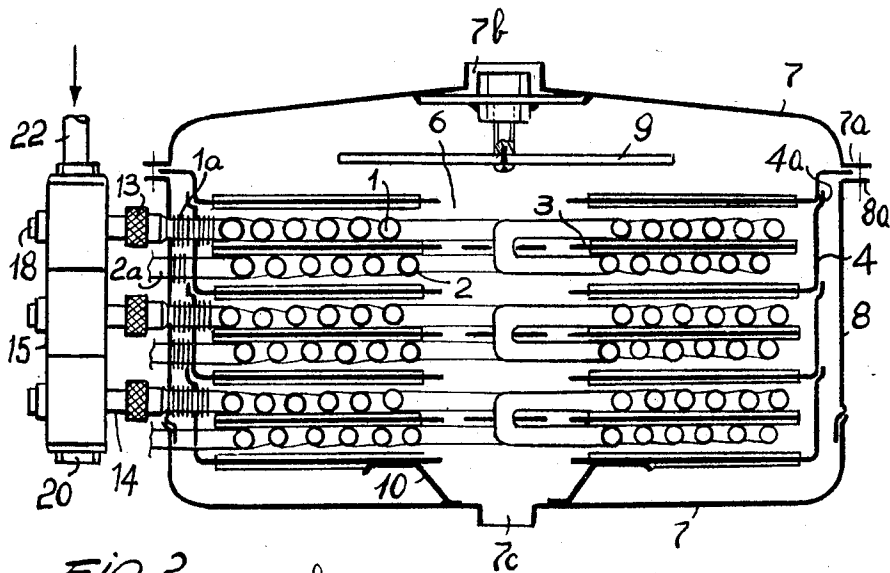


Fig. 2

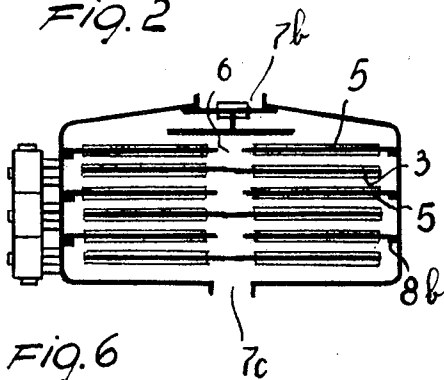


Fig. 6

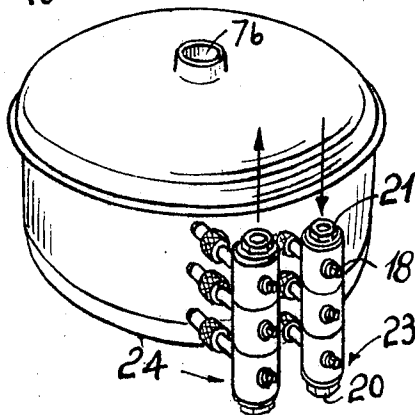


Fig. 3

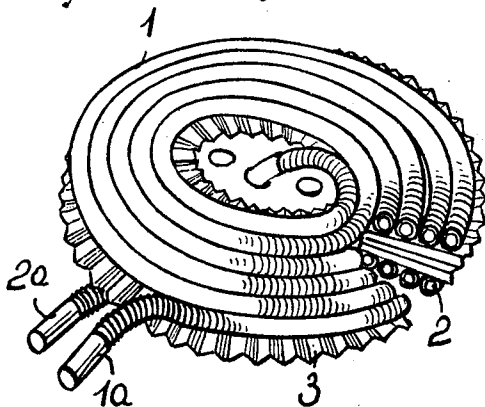


Fig. 1

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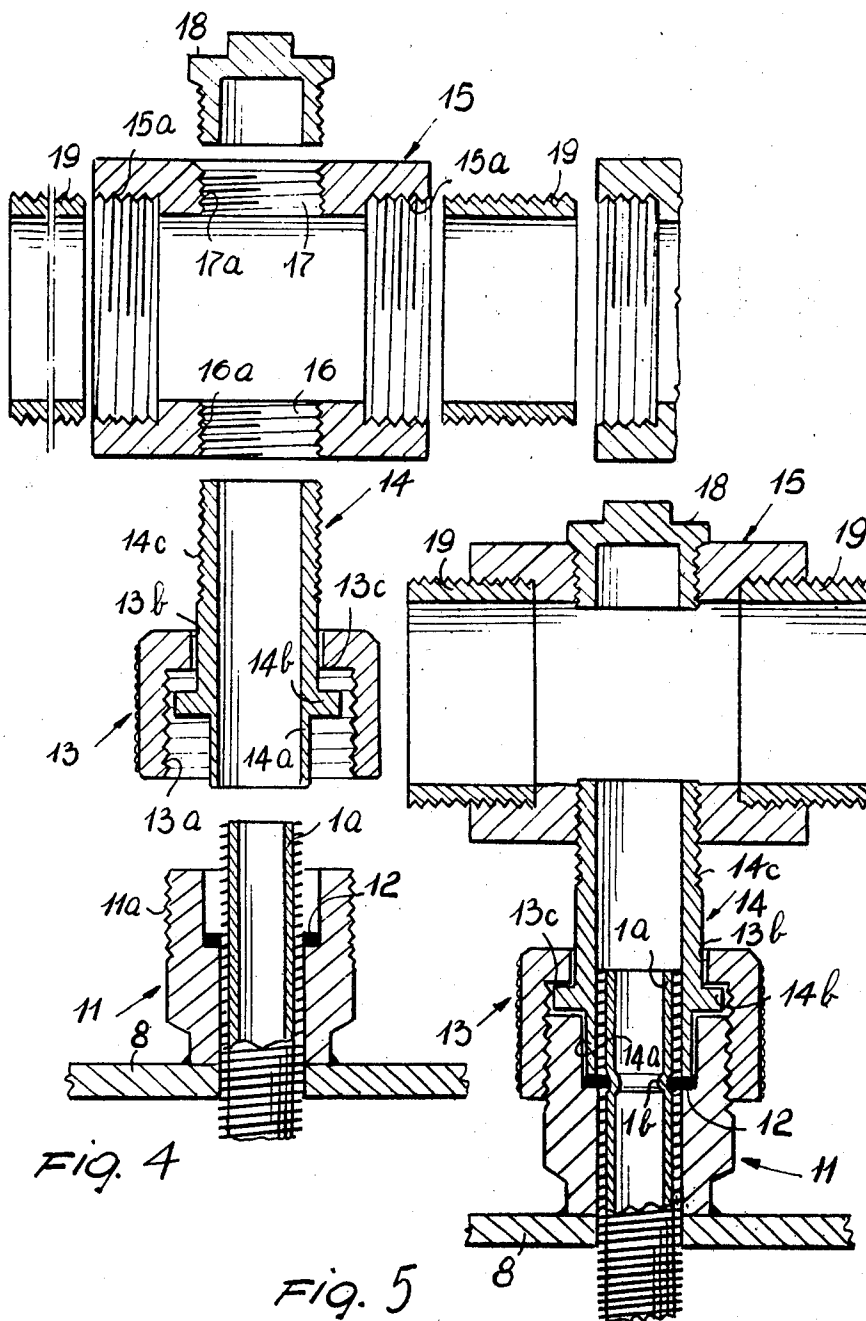
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TWO-FLUID HEAT EXCHANGER

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Filed Nov. 13, 1967, Ser. No. 682,002

Claims priority, application Italy, Nov. 24, 1966,
30,314/66

Int. Cl. F28d 7/00; F28f 7/00; F16l 47/00

U.S. Cl. 165—159

3 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a two-fluid heat exchanger comprising modular members each in the form of two superimposed plane spirals including a plate member therebetween, union means for connecting said spirals to an external circuit for a first fluid, an envelope enclosing said modular members and in communication with an external circuit for a second fluid.

Background of the invention

This invention relates to a heat exchanger.

It is known that in the planning of two-fluid heat exchangers it is necessary to know beforehand the exchange conditions—both as regards the temperatures of the fluids in entrance and exit and as regards their flow—in order to suitably dimension the exchanger. The dimensioning may be obtained by suitable combination of the characteristic parameters formed by the speeds of the fluids, the heat exchange surfaces as well as the type of material used.

This makes it necessary to plan and construct exchangers different from one another in relation to said characteristic conditions of use.

This means that it is necessary to manufacture a wide range of heat exchangers, with obvious disadvantages both from the point of view of the rationalization of production and the stocking of parts and the consequent locking-up of capital.

The main object of this invention is that of providing a heat exchanger formed modular members, from the assembling which a wide range of heat exchangers may be obtained, adaptable to the most varied of requirements.

Another object of this invention is that of providing a heat exchanger formed of modular members in which the heat exchanger surfaces are particularly compact, so that the structure of the heat exchanger shall be of minimum encumbrance.

Another object of this invention is that of providing a heat exchanger formed of assemblable modular members which, once dimensioned for a particular use, may be easily adapted to different conditions of use.

A further object of this invention is that of providing a heat exchanger formed of modular members, which does not involve the use of parts of difficult manufacture or maintenance.

Summary of the invention

These and other objects, which will better appear hereinafter, are achieved by a heat exchanger characterized in that it comprises circuit means for a first fluid, said circuit means being substantially in the form of at least two superimposed plane spirals, a discoid member interposed between said spirals, union means for connecting said spirals to an external circuit, feeding and conveying means for a second exchange fluid, said feeding and conveying means being situated externally to said spirals.

Brief description of the drawings

Further characteristics and advantages will appear

more clearly from the following detailed description of embodiments of a heat exchanger according to the invention illustrated by way of example in the accompanying drawings in which:

FIG. 1 shows a possible embodiment of a modular member according to the invention;

FIG. 2 shows, the vertical section, a demountable heat exchanger formed by the assembling of three modular members;

FIG. 3 shows, diagrammatically and in perspective, the heat exchanger of FIG. 2;

FIG. 4 shows an exploded view of members forming the union of a modular member with an externally connected manifold;

FIG. 5 shows the same union in mounted position;

FIG. 6 shows, in vertical section, a further embodiment of a heat exchanger.

Description of the preferred embodiments

With reference to the above figures, the heat exchanger according to the invention comprises one or more modular members. In the embodiment of FIG. 1 said modular members are essentially formed by finned tubular pancake coils 1 and 2, said coils 1 being arranged in a superimposed plane with respect to the plane of said coils 2. Said coils 1 and 2 may be interconnected by sealing means or may be formed in one piece. Further, said coils 1 and 2 may be wound in the same direction or may be wound in opposite directions. The free ends 1a and 2a of the coils 1 and 2, respectively, are connected to an external circuit as will be seen hereinafter. Between the superimposed coils 1 and 2 is interposed a separator disc 3, said disc 3 being of reduced thickness and being formed with ribs or radial undulations or radial groove formations.

Each unit (formed by the coils 1 and 2 and the interposed disc 3 and hereinafter called the coil unit) is contained, in the demountable embodiment of FIG. 2, in a panlike member comprising an essentially cylindrical base 4 constituted of a bottom portion and a side wall portion provided with counter-sunk edges 4a providing a seat such that each base 4 fittingly receives, through its own edge 4a the upper base. In the monobloc embodiment (FIG. 6) each coil unit is contained between two separator discs 5. These discs 5 are provided, as are the bases 4, with radial ribs as described above. Said discs or bases are moreover provided with wide-sectioned central holes 6 to allow the passage of exchange fluid in discontinuous hydraulic conditions from one coil unit to the superimposed coil unit.

The coil units are together enclosed in a container or envelope formed of two ellipsoidal lids 7 joined to an intermediate cylindrical body 8 or, alternatively, directly connected to one another. The container may be in monobloc form, in which case the component parts are soldered together, or may be demountable, in which case one of the lids 7 is provided with flanges 7a and the cylindrical body with a counter-flange 8a of the clip or toggle lever type. In the demountable embodiment the cylindrical body is provided, near its ends, with pressure devices 9 and 10, for example of the leaf spring type, designed to maintain the coil units in superimposed position. In the monobloc embodiment the cylindrical body is provided with bands 8b, designed to maintain the discs 5 (for the coil units) in position and simultaneously prevent the passage of fluid at the edges of said discs 5. The cylindrical body and the lids are provided with apertures at the ends 1a and 2a of each coil 1 and 2, respectively. The lids are further provided, in the region of central holes 7b and 7c, with axial connections for the conveying of an exchange fluid in dis-

continuous hydraulic conditions. These axial connections are not shown in the drawings.

There now follows the description of junction means which connect the coils to an external circuit: such a junction is designed to provide a hydraulic seal between the interior of the coil and the outside atmosphere, and between the interior of the coil and the cylindrical body. This hydraulic seal is obtained by means of a single hydraulic seal packing gasket.

The junction comprises a member 11 (FIG. 4) provided at an end with a tang secured, for example by soldering, to the cylindrical body 8 and in communication with the interior of the latter. The junction is provided, at its opposite end, with a male threading 11a and a zone of greatest internal diameter designed to constitute a seat for an annular packing gasket 12. Inside said member 11 is inserted the end, for example 1a of the finned coil. Said end 1a may be slidably adjusted within the member 11. A locking union 13, internally provided with a female threading 13a is adapted to engage said threading 11a. Said union 13 is externally knurled in order to permit its gripping and tightening on said member 11.

The upper end of said union 13 is provided with a small-diameter hole 13b such as to define a stop 13c.

A hollow end essentially cylindrical member 14 is adapted to slidably and adjustably house said end 1a of the coil. Said member 14 comprises an end part 14a, adapted to act as packing for the gasket 12, a central flange 14b adapted to engage said stop 13c of the union 13 and suitably shaped for a tightening key. The end of said member 14 opposite the end 14a is provided with a male threading 14c. Said threading 14c is adapted to associate the described junction to a modular collector member or header 15 by engaging in a hole 16 thereof provided with an internal threading 16a conjugate to the threading 14c of said member 14.

Said modular collector member 15 is constituted of a hollow cylindrical body or sleeve member provided at its ends with female threading 15a. Symmetrically with respect to the axis of said hole or bore 16 the body 15 is provided with a hole 17 with internal female threading 17a designed to engage a locking cap 18. Said cap 18 allows the inspection of the coil as well as the introduction of members which close the coil and isolate it from the rest of the circuit. Successive modular collector members (of the same type as the collector 15) are arranged co-axially with respect to one another. To each of said collector members is connected an entrance or exit end respectively of the coils of successive modular units. Said collector members are associated to one another by threaded connection members 19. The collector unit thus obtained by the association of a plurality modular collectors (of the type 15) is closed at an end by a cap 20 (FIGS. 2 and 3). The other end of said collector unit is provided with a member 21 adapted to reduce the threading diameter for connection to external circuits 22. It will be appreciated that in the mounting of the above-described junction, the gasket 12, contained between three rigid surfaces, tends to expand centripetally, and this occurs readily if the coil is produced in ductile material such as annealed copper or the like. In such manner the annular indentation 16, caused by the deformation of the wall of the end of the coil, helps to achieve the desired seal between the members of the junction.

Naturally both an inlet collector, indicated with reference numeral 23, and an outlet collector indicated with reference numeral 24 (FIG. 3) may be provided. Advantageously for temperature measurement purposes collector 23 and 24 may communicate to one another.

Preferably the heat exchanger container is covered with a heat insulating material.

The working of the heat exchanger according to the invention is as follows:

Through the aperture 7b of the container a first exchange fluid of discontinuous flow is passed. Said fluid is conveyed through the labyrinth formed by the ribs or radial undulations, provided on the discs 3 or 5, and on the bottom surfaces of the bases 4 and flows over the external surface of the coils. The fluid passes from one coil unit to the coil unit beneath through the central holes 6 or the like. The fluid finally discharges through the hole 7c provided in the bottom of the container.

Inside the coils a second exchange fluid in continuous flow is passed. Said second exchange fluid passes through the inlet collector 23 to which are connected the corresponding ends, for example 1a, of the coils forming the superimposed modular members. The second exchange fluid is evacuated through the outlet collector 24 which receives the flow coming from the coils through the outlet ends 2a.

It has been ascertained in practice that the heat exchanger according to the invention achieves all the predetermined objects. In fact the heat exchanger according to the invention is especially compact due to the composition and form of the modular members and is of substantially sub-spherical shape.

A high flow rate and a copious sub-division of the threads of the exchange fluids is obtained as a result of the arrangement of the coils, the guide ribs and the compactability of the coil units. The heat exchanger according to the invention enables the interchangeability of the series and parallel connections of the coils in manner such as to ensure the best flow conditions for the continuous flow exchange fluid. Moreover there exists the possibility of recirculation of the exchange fluid in intermediate exchange zones, of counter-current or equi-current heat exchange, of manual as well as automatic adjustment of the continuous flow fluid, of separation of the continuous flow of the fluid in a plurality of independent hydraulic zones, as well as the use of different fluids.

The invention thus conceived may be subject to numerous modifications and variations within the scope of the appended claims.

Thus for example in a single heat exchanger it is possible, by suitably pre-arranging each modular collector member 15, to heat or cool two or more different fluids flowing through respective coils 2 and 3 by making use of a single first exchange fluid.

Furthermore, by assembling in a container a few spare-modular members, the need for disassembling the heat exchanger unit is avoided, if some of the coils 2 and 3 should become obstructed. The obstructed coils can be readily cut-off and brought into use again in a conventional manner, simultaneously bringing the spare modular members into use as required.

When the heat exchanger according to the invention is used in a fluid heating plant, e.g. a water heating plant, where a high supply heated water is required at predetermined time intervals, a number of modular members may be directly connected to a heated fluid storage reservoir. Thus with a single heat exchanger unit employing a single first exchange fluid both the characteristics of immediate heat exchange and heat storage are achieved in the heating plant.

It should be noted that, for the sake of convenience, in the accompanying drawings (see FIGS. 1, 2 and 6, for example) the heat exchanger according to the invention is shown in vertical cross-section as having the assembled modular members provided with central passages. In practice, such passages are of negligible diameter and provided in the disc element 3 for mounting the latter in a coil winding mechanism (not shown). Such passages or holes may also be closed, if desired. The heat exchange fluid entering the heat exchanger is thus caused to cascade across the pile of modular members and discs 5, following a zig-zag path from the central portion to the periph-

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ery of said modular members and discs and vice versa, alternatively.

I claim:

1. A heat exchanger including a container member, superposed pancake coils within said container member, said pancake coils having an inlet and an outlet end connected with respective inlet and outlet header members for the first heat exchanging fluid arranged outside said container member, an inlet and an outlet opening in said container for the second heat exchanging fluid, wherein according to the improvement the heat exchanger comprises further, between said pancake coils, a plurality of disc-like separator members extending parallel to the pancake coils and having groove formations extending in a radial direction from the center of the pancake coils towards the periphery thereof, one set of alternate separator members having openings in the center portion thereof and being sealed at the periphery thereof to the container member, the other set of alternate separator members being spaced peripherally from the container member thereby to induce a flow of said second heat exchanging fluid along said groove formations.

2. A heat exchanger according to claim 1, wherein said pancake coils are grouped in pairs of superposed pancake coils forming coil units, each of said coil units including a pan like member having a bottom wall portion and a cylindrical side wall portion, said bottom wall portion having radial groove formations and said side wall portion having groove formations extending transverse to

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said bottom wall portion, said side wall portion having an upper edge defining a seat for the periphery of the bottom portion of a contiguous superposed coil unit, locking means being provided for said superposed coil units.

3. A heat exchanger according to claim 1, wherein said header member comprises a plurality of composable sleeve members having threaded openings and connector members for connecting the composable sleeve member at the threaded openings thereof and wherein according to the improvement each of said sleeve members has a threaded bore opposite and aligned with one of said threaded openings opening into a respective of said coils, and a removable cap member closing said threaded bore.

References Cited

UNITED STATES PATENTS

1,946,118	2/1934	Stockdale	-----	165—163 X
3,147,800	9/1964	Tadewald	-----	165—164

FOREIGN PATENTS

179,793	12/1906	Germany.
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U.S. Cl. X.R.

165—76, 163, 176, 178; 285—131, 179, 220