June 5, 1934. C. W. STANCLIFFE 1,961,533

HEAT INTERCHANGER FOR HEATING AND COOLING OF FLUIDS

Filed March 18, 1932

Fig. 1.

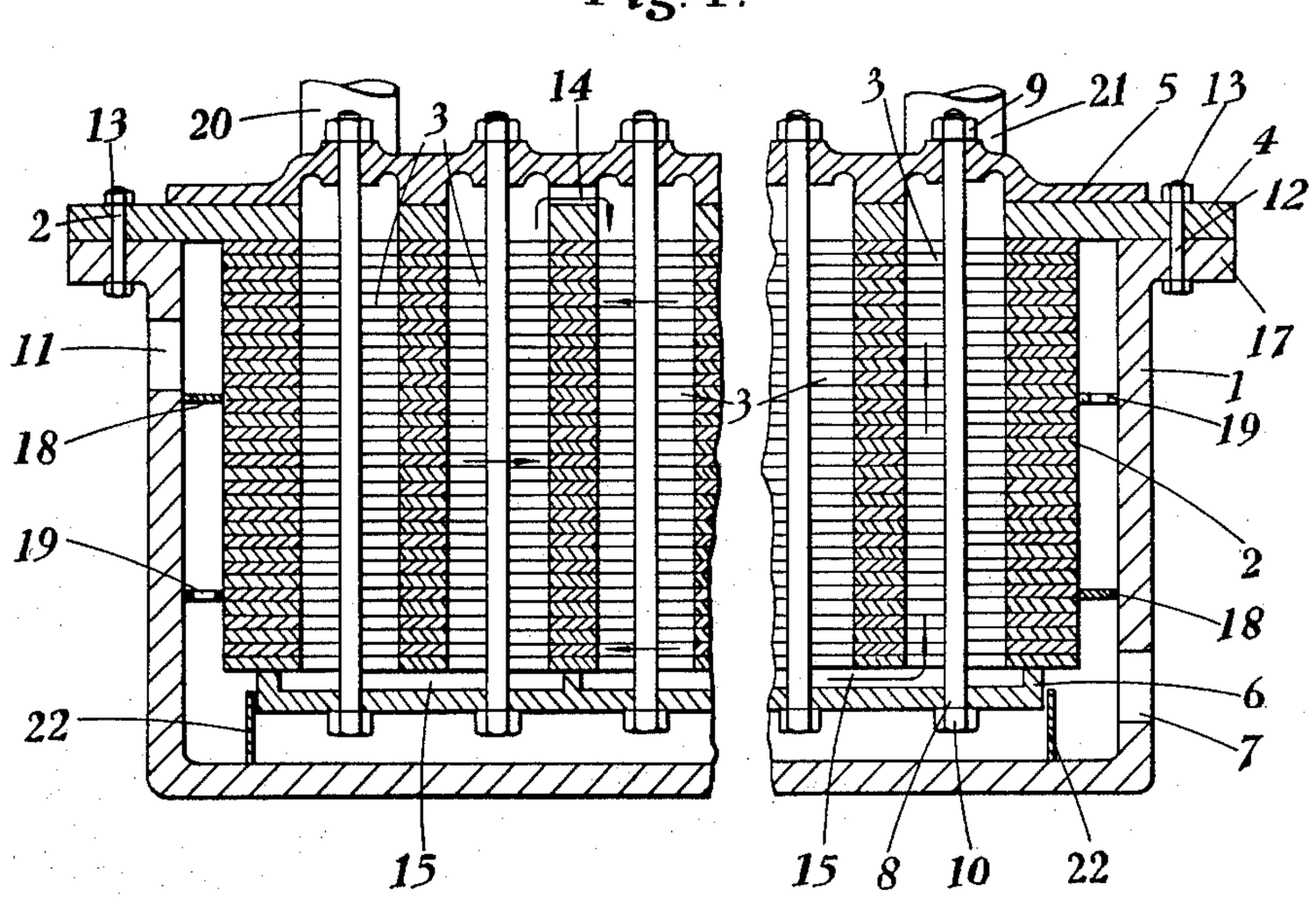


Fig. 2.

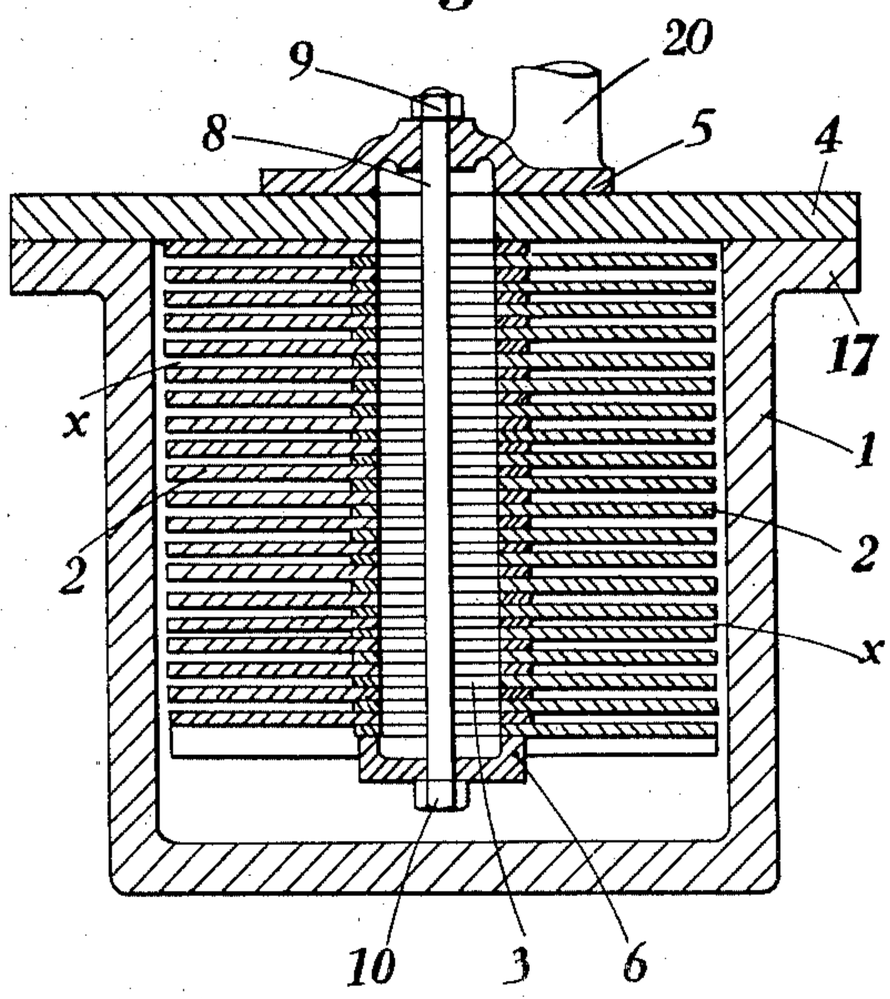
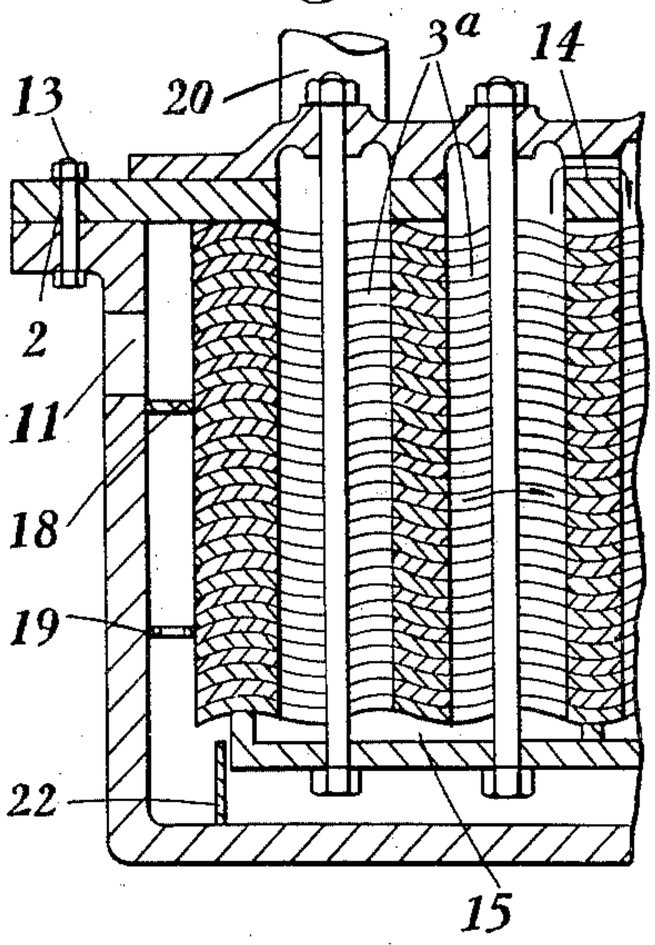


Fig. 3.



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HEAT INTERCHANGER FOR HEATING AND COOLING OF FLUIDS

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4 Claims. (Cl. 257—245)

This invention relates to heat interchangers for heating and cooling of fluid of that type which is built up of superposed sheets or laminations so arranged as to provide narrow passages between alternate sheets or sets of sheets along which fluid flows.

The object of the invention is to provide an improved construction of heat interchanger of this type which is particularly suitable for heat transfer to or from oils and other liquids which owing to their thermal or other properties present special technical difficulty in respect of the heat transfer.

A further object of the invention is to provide a heat interchanger unit comprising a series of perforated sheets assembled with the perforations in register providing longitudinal ducts for one fluid, said sheets being so shaped as to provide narrow transverse passages between sheets for a second fluid, headers at top and bottom causing the first-mentioned fluid to pass down one duct and up another, and means for clamping said headers and said plates tightly together.

A further object is to provide a heat interchanger unit of the type referred to in which the plates are corrugated, this term including any arrangement in which the narrow passages between the sheets are of tortuous form.

One or more units constructed in this manner are mounted in an appropriate casing and are preferably so mounted that they can readily be detached for cleaning or repair and have freedom for expansion and contraction in relation to the casing. The interchanger may comprise a number of separate units co-operating in the complete flow system, but each unit preferably has a plurality of ducts formed by registration of the perforations in the sheets and header plates are provided whereby the flow through this system may be alternately up and down, but any required number of the ducts can be connected in parallel.

Suitable diaphragms are preferably provided in the casing so that the fluid passing between the narrow passages is caused to flow from the inlet to the outlet in a tortuous path first in one direction across the apparatus and then back at a different level in the opposite direction.

In the accompanying drawing which illustrates the invention in a diagrammatic manner:—

Figure 1 shows a section of one form of apparatus according to the invention, taken through the centres of a line of perforation in the sheets.

Figure 2 is a section through the apparatus in a direction at right angles to the section shown in Figure 1 passing centrally through one of the registering perforations.

Figure 3 shows a part section of a modified form of apparatus taken through the centres of a line of perforation in the sheets.

The apparatus consists of a casing 1 through which the one fluid flows through an inlet 7 and an outlet 11. The casing 1 encloses a unit built up of plates or laminations 2 each provided with perforations made to register with one another to form ducts 3 as shown.

Each sheet has a number of holes in it similarly spaced in the longitudinal direction; as will be seen from Figure 2 the holes in the form illustrated are nearer one edge of the sheet than the other and alternate sheets are reversed so that every other sheet projects on one side in the form of a fin leaving between each pair of fins a narrow passage x along which the second fluid may flow.

The sheets are held together by bolts 8 with nuts 9 and heads 10, which also clamp top and bottom header plates 5, 6 against the ducts, and fix the built up unit to the cover plate 4 of the casing 1. This cover plate is secured to the casing at the flange 17 by bolts 12 with nuts 13. In order that the fluid may flow through the ducts 3 of the built up unit in a zig-zag manner, channels 14, 15 are formed in the header plates 5 and 6 respectively.

The one fluid which passes along the tube-like ducts 3 has an entry pipe 20 and then passes down the first duct 3 from the left hand side, along the first passage 15 in the lower header plate 6 to the bottom of the second duct; up the second duct and so on as indicated by the arrows, finally passing up the last duct 3 and into the outlet pipe 21. To cause the other liquid to pass in a tortuous path between groups of narrow passages x a suitable number of horizontal diaphragm plates 18 with passages 19 at alternate ends are provided, the resulting flow being indicated by the small horizontal arrows. To prevent passage of much fluid along the bottom of the casing suitable means such as baffles 22 are provided, the units being capable of movement relatively to these to allow for expansion and contraction.

The construction thus illustrated diagrammatically can easily be dismantled for cleaning the plates or the container or damaged parts and the suspended construction minimizes internal stresses.

In order to prevent leakage from the ducts in the laminated unit, the whole unit may be tinned

before or after assembly or both and sweated together, or entirely or partially coated with a suitabel varnish such as artificial resin (for instance "Bakelite") which is baked after the sheets have been clamped together; or again, metal tubes may be expanded inside the ducts.

It is also to be understood that the sheets are not restricted to the simple plane form shown but may be corrugated, or otherwise shaped to give a restricted flow in a tortuous path thus increasing the heat transfer. Alternatively, the projecting edges may be perforated or have baffles attached to them.

Figure 3 illustrates a part section of a heat interchanger, wherein the sheets 3*a* are corrugated, the heat interchanger in other respects being similar to that illustrated in Figure 1.

By suitable arrangement of the diaphragms and separate inlets and outlets two different kinds of fluid can be caused to flow through the narrow passages *x* on the two sides of the apparatus as viewed in Figure 2. When the apparatus is so arranged alternate sheets can be made of different metals having properties appropriate to those of the fluids; for instance, one set can be acid-resisting, and the other alkali resisting. Moreover, the flow speeds on the two sides can be adjusted to suit the thermal properties of the fluids.

In the apparatus illustrated, one unit only is mounted in the casing but a number of units can equally well be arranged in one casing and more than one unit can be attached to one header plate; moreover, each unit may have more than one row of perforation ducts and any appropriate number of ducts can be connected up in parallel.

In the form illustrated perforated plates with registering holes are shown abutting each other, but I may introduce spacing collars or the like between the plates with holes registering therewith.

Generally the perforations will be of circular form but any other shapes, including shapes with re-entrant portions giving increased contact surface may be employed.

With the above and other objects in view, the invention consists in the novel arrangements and combinations of parts set out in the claims which follow.

I claim:—

1. A heat exchanger unit comprising a series of perforated sheets assembled with the perforations in register to provide longitudinal ducts of substantially uniform diameter and relatively smooth unbroken wall, said sheets in one direction beyond the perforations providing narrow transverse passages closed against the ducts, means extending longitudinally of the ducts for securing the sheets as a unit, a casing in which the unit is supported, and means forming part of the unit for compelling alternately reverse flow of fluid through the ducts.

2. A heat exchanger unit comprising a series of perforated sheets assembled with the perforations in register to provide longitudinal ducts of substantially uniform diameter and relatively smooth unbroken wall, said sheets in one direction beyond the perforations providing narrow transverse passages closed against the ducts, bolts extending longitudinally of the ducts for securing the sheets as a unit, a casing in which the unit is supported, and means forming part of the unit for compelling alternately reverse flow of fluid through the ducts.

3. A heat exchanger unit comprising a series of perforated sheets assembled with the perforations in register to provide longitudinal ducts of substantially uniform diameter and relatively smooth unbroken wall, said sheets in one direction beyond the perforations providing narrow transverse passages closed against the ducts, means extending longitudinally of the ducts for securing the sheets as a unit, a casing in which the unit is supported, means forming part of the unit for compelling alternately reverse flow of fluid through the ducts, and means in the casing for compelling alternate flow of fluid through the passages.

4. A construction as defined in claim 1, wherein the perforated plates are corrugated to define said passages as of tortuous formation.

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