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HEAT EXCHANGER

Filed Jan. 3, 1929

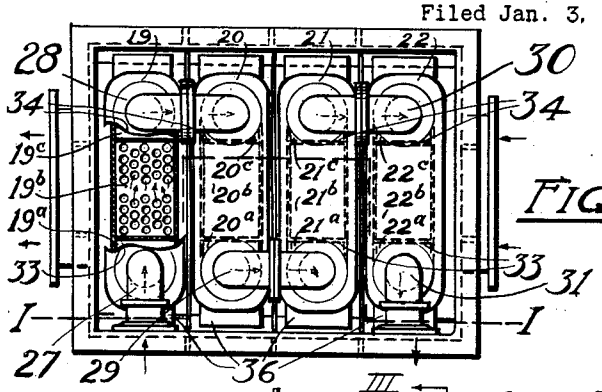


FIG.-2

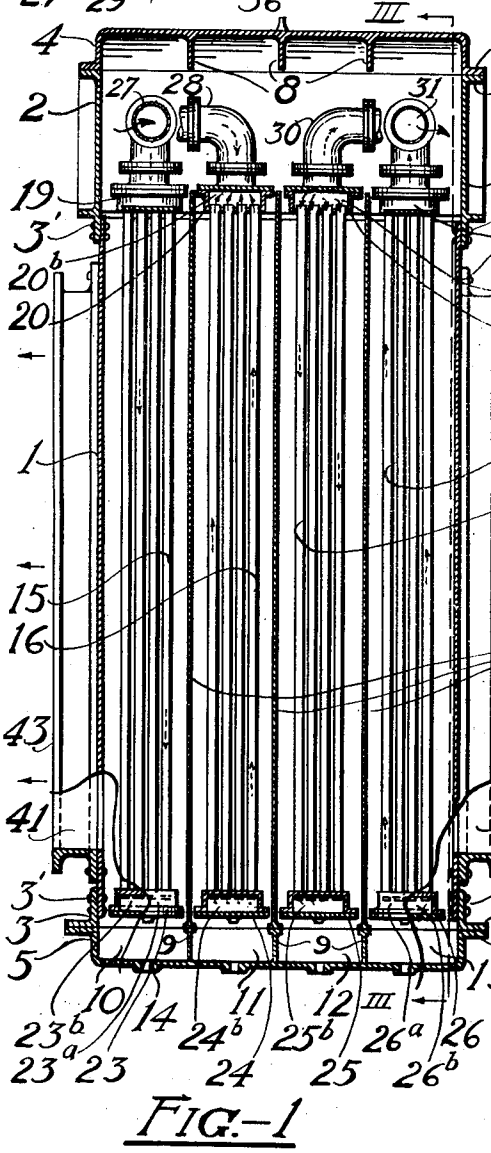


FIG.-1

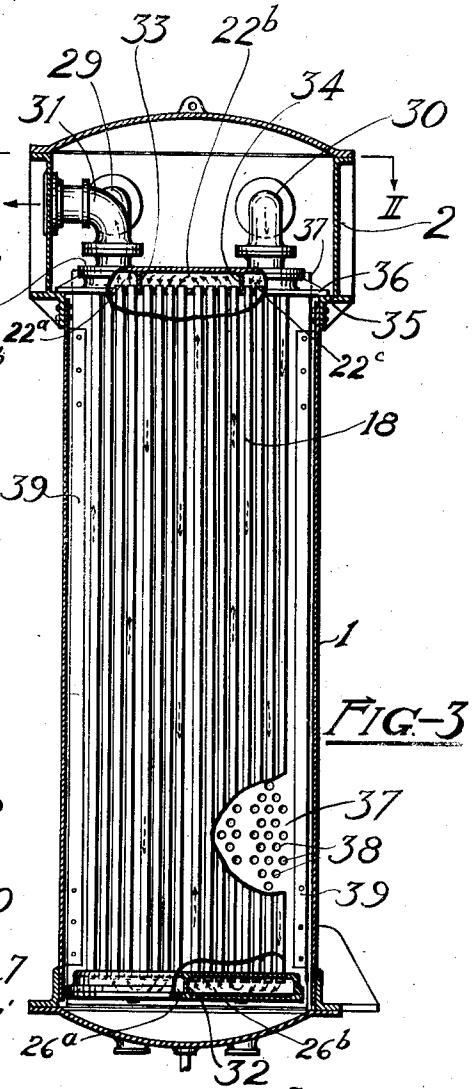


FIG.-3

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# UNITED STATES PATENT OFFICE

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## HEAT EXCHANGER

Application filed January 3, 1929. Serial No. 330,012.

This invention relates to improvements in heat exchange apparatus of the type in which fluids flow through and about tubes arranged in so-called bundles, banks or nests. Our improvements comprise tube bundles which are arranged for easy removal from the surrounding shell or casing. The tubes are swept throughout their exterior by a stream of heat exchange fluid moving substantially at right angles to the tubes. The invention is particularly useful in connection with the vacuum distillation of hydrocarbon oils and it will be described in connection with that use, although by no means limited thereto.

In the accompanaying drawings, Fig. 1 is a vertical longitudinal section of a preferred type of our heat exchanger or condenser, the section being taken on the line, I—I of Fig. 2;

Fig. 2 is a top plan view of the equipment shown in Fig. 1;

Fig. 3 is a vertical transverse section on line III—III of Fig. 1.

Referring to the drawings, 1 denotes a shell preferably of cast iron, rectangular in cross-section, and supported at the top and bottom by sleeves 2 and 3, which are advantageously steel castings. These are secured to the shell by rivets 3, by welding, or other suitable means. Sleeve 2 is closed by a cover 4 and sleeve 3 by a base 5. The cover and base are also preferably steel castings. They have flanges 6 and 7 which match with flanges 6′ and 7′ on the sleeves 2 and 3. The matched flanges are secured together by bolts or other removable means, not shown. Strengthening ribs 8 run transversely of cover 4. Similar ribs 9 are provided in base 5 and form condensate basins 10, 11, 12 and 13 therein. An outlet 14 is provided in each of the basins.

Within the shell 1 are tube bundles 15, 16, 17 and 18 arranged in a compact row. It will be understood that a greater or less number of tube bundles may be used. The tubes in each bundle are set in upper tube headers 19, 20, 21 and 22 and lower tube headers 23, 24, 25 and 26. A pipe 27 leads into upper header 19, a cross-over pipe connection 28 connects the upper headers 19 and 20, and similar cross-over connections 29 and 30 connect headers 20 and 21, 21 and 22, respectively. A pipe 31 connects with the end of header 22, opposite from the cross-over connection.

Each bottom header has a central longitudinal partition 32, dividing the header into chambers 23*a*, 23*b*; 24*a*, 24*b*; 25*a*, 25*b*; 26*a*, 26*b*. Each upper header has two longitudinal ribs 33 and 34 dividing the header into three chambers—19*a*, 19*b*, 19*c*; 20*a*, 20*b*, 20*c*; 21*a*, 21*b*, 21*c*; 22*a*, 22*b*, 22*c*.

Shoulders 35 are formed on sleeve 2 and flanges 36 on the upper headers rest on the shoulders. The lower headers are not secured, but hang freely in the shell. The pipes 27, 28, 29, 30 and 31 are mounted so that they may be easily disconnected. When this is done, any tube bundle can be readily lifted out of the shell when required and replaced with a new one.

Plates 37 having a number of relatively large perforations 38 therein are placed between the tube bundles and preferably extend from end to end of the same. The plates are secured by riveting, or the like, to strips 39 attached to the shell and have enlarged bottoms which rest on ribs 9. Large rectangular openings 40 and 41 extend nearly to the top and bottom of the shell on opposite sides of the same. Castings 42 and 43 are secured to the shell about the margins of these openings. It will be understood that suitable vapor connections (not shown) are attached to the castings 42 and 43.

In one mode of operating the heat exchanger, relatively cool oil is pumped into the first compartment 19*a* of header 19 through pipe 27, the oil flows down through the first section of tubes in the tube bundle 15 and enters the first compartment 23*a* in the bottom header 23. The oil then flows upward through the second group of tubes in tube bundle 15 into the intermediate compartment 19*b* of header 19, thence downward through the third group of tubes into the second compartment 23*b* of the bottom header 23 and finally upward through the last group of tubes in tube bundle 15 into the third compartment 19*c* of header 19, and out through pipe 28 to the tube bundle 16. A similar circuitous flow takes place in each

of the bundles and the oil is finally discharged through pipe 31.

Vapors to be condensed or cooled enter through the rectangular opening 40 and flow in a substantially horizontal direction across the tube bundles. The plates 37 between the bundles serve to strengthen the structure. They are perforated throughout their extent sufficiently to permit the vapors to flow readily through them. Condensates are drawn off through the openings 14 in the bottom casting 5. Any vapors which are not condensed pass out through the rectangular opening 41 to a second condenser of the same type, or any other suitable equipment.

It will be understood that the invention is not limited to the particular method of connecting the tube bundles nor to the use of oil as a cooling medium. If desired, two or more different cooling media may be used in the same exchanger.

Various changes and alternative arrangements may be made within the scope of the appended claims, in which we desire to claim all novelty inherent in the invention as broadly as the prior art permits.

We claim:

1. Heat exchange equipment comprising a shell rectangular in cross section, tube bundles arranged vertically therein, rectangular fittings on opposite sides of the shell and adapted for connection to vapor lines, said fittings having substantially the same vertical cross-sectional area as said tube bundles, and perforated plates separating the tube bundles without substantially impeding the flow of the vapors.

2. Heat exchange equipment comprising a shell, separate tube bundles disposed in the shell and each including groups of substantially parallel tubes connected at opposite ends in series, the connection at one end of the bundle being a chambered header, pipes within the shell detachably connecting the headers in series and including an inlet and an outlet for the series, a portion of the shell opposite the headers being detachable to permit removal of the bundles, and means for passing fluid across the exterior of the tube bundles.

3. Heat exchange equipment comprising a shell, shoulders within and spaced from the upper end of the shell, separate tube bundles disposed in the shell and each including groups of substantially parallel tubes connected at opposite ends in series, the connection at the upper end of the bundle being a chambered header supported by the shoulders within the shell, the lower end of each tube bundle being suspended freely within the shell, pipes within the shell detachably connecting the headers in series and including an inlet and outlet for the series, a portion of the shell opposite the headers being detachable to permit removal of the bundles, and means for passing fluid across the exterior of the tube bundles.

4. Heat exchange equipment comprising a shell, separate tube bundles disposed in the shell and each including groups of substantially parallel tubes connected at opposite ends in series, the connection at one end of the bundle being a chambered header, pipes within the shell detachably connecting the headers in series and including an inlet and an outlet for the series, a portion of the shell opposite the headers being detachable to permit removal of the bundles, means for passing fluid through the shell exteriorly of the tube bundles, and substantially uniformly perforated plates extending across the shell between adjoining bundles transversely of the path of the fluid throughout substantially the extent of the bundles whereby channelling of the fluid is prevented.

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