

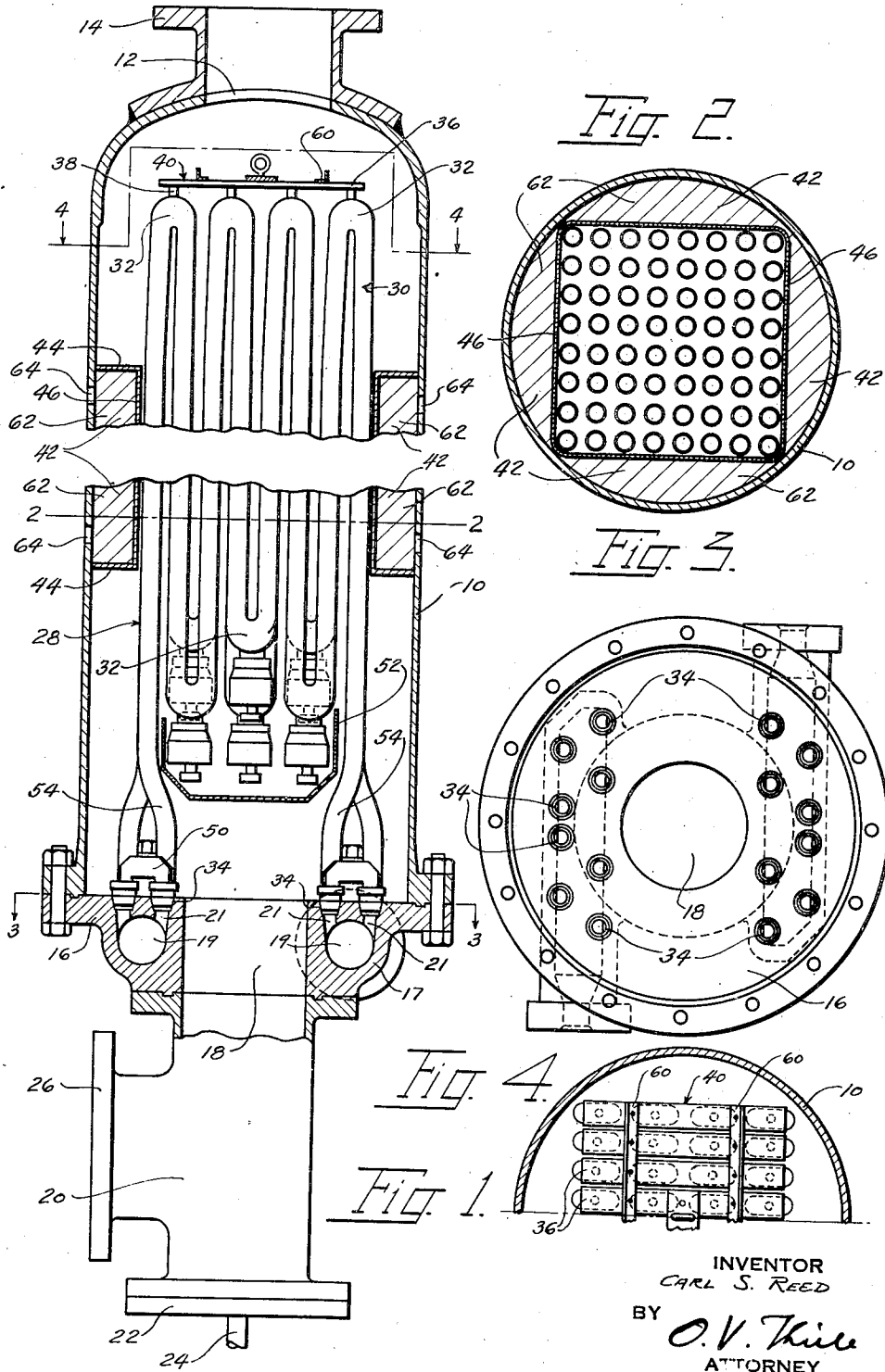
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SINGLE PASS HEAT EXCHANGER

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SINGLE PASS HEAT EXCHANGER

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My invention relates to heat exchangers and aims to provide a device of moderate cost but having a good heat efficiency.

In the art of petroleum distillation and cracking it is customary to preheat fluid moving towards the distilling and cracking zone by vapors and/or gases which have been produced therein. When cracking distillation occurs, the gases and vapors coming from the cracking zone often are under considerable pressure and at a high temperature.

It is an object of my invention to provide a heat exchanger adapted to receive vapors and/or gases under the conditions just mentioned and having good heat efficiency together with freedom from destructive strains and stresses under high differences of temperature, and unusual facility for disassembly and cleaning.

In order that the shell of the heat exchanger may be able to withstand the pressures and temperatures of the hot fluid without being so thick and heavy as to be both expensive and cumbersome, I prefer to make the heat exchanger of the single pass type, but this is not essential to the invention. The diameter of the shell can thereby be reduced sufficiently so the unit stress is within ordinary limits without making the shell unduly thick. The heat exchanger must then be made of considerable length relative to its diameter in order to provide sufficient heating surface in the tubular units used for the fluid to be heated. In such a design, I prefer also that the inlet and outlet for the heat exchanger both be on its longitudinal center line, but this also is not essential to the invention.

In order that my invention, together with the objects and advantages thereof, may be fully and readily understood, I will now describe in detail, and by way of example, the heat exchanger illustrated in the accompanying drawing and forming an illustrative embodiment of the invention. In the drawing:

Fig. 1 is a central longitudinal section thru a heat exchanger in accordance with my invention.

Fig. 2 is a section on the line 2—2 of Fig. 1,

Fig. 3 is a section on the line 3—3 of Fig. 1.

Fig. 4 is a section on the line 4—4 of Fig. 1.

The heat exchanger illustrated in Figs. 1 to 4 of the drawing is of the single pass type and comprises a cylindrical shell 10 closed at one end except for the aperture 12 and nozzle 14 for the admission or discharge of fluid. Preferably aperture 12 is used for the admission of fluid. As

shown, it is located on the longitudinal axis of the shell 10.

At the end opposite the aperture 12, shell 10 is closed except for the aperture therein by a thick head 16 removably connected to the shell 10 by bolts or similar connecting means. The head 16 is shown as having a comparatively thick annular portion 17 immediately surrounding the aperture 18 and in said portion 17 I prefer to place chambers 19, 19 for the receipt of fluid passing to and from the units 30. Chambers 19 are connected to the inner face of head 16 by apertures 21, 21, the inner ends of which are surrounded by the seats 34. Suitable means 50, 50 of any known or desired type may be used to secure the ends of the units 30 to the head 16 in cooperating relation to the seats 34. Preferably, chambers 19 are parallel to each other, as shown. The chambers 19 being parallel, the seats 34 are arranged in straight rows parallel to the chambers. In order to provide ligaments of maximum section between apertures 21 the seats for each chamber 19 are arranged in two rows and the seats in one row staggered as to those in the other. However, owing to the circular form of the inner face of head 16 I place two of the seats in each of the rows farther from the aperture 18 close together near the center of such row and space the other seats in the outer rows farther apart. The result is that the two seats nearer the center in each of the two inner rows are spaced far apart and avoid the edge of the aperture 18 while the end seats in each inner row are still a comfortable distance from the edge of head 16. Preferably the head 16 has a central aperture 18 therein for the intake or discharge of fluid and aperture 18 is shown as connected to a large T 20 closed at the end opposite the aperture 18 by plate 22 thru which is a discharge for liquid condensate by means of a pipe 24. The discharge from or intake to T 20 is at the side 26.

Within the shell 10 is a tube bundle 28 composed of a number of serpentine tubular units, one of which appears in elevation at 30. The units 30 are so arranged within shell 10 that the tube bundle 28 is square in cross section as appears in Fig. 2. Each unit 30, however, comprises a plurality of elements or tube lengths each substantially parallel to the axis of shell 10 and connected together at opposite ends by return bends 32. The two outer tube lengths of each unit 30 are longer than the intermediate ones and are extended into contact with seats 34, 34 in the head 16. When the axis of shell 10 is vertical, as

is usually the case, the weight of each unit 30 is supported by the outer legs on the seats 34 so that, when subjected to high temperatures, the weight of the central portions of the units might cause a tendency of the unit to sag. To avoid such tendency, I prefer to connect the bends 32 of each unit 30 along the side farther from the head 16 by a plate 36. As illustrated, each plate 36 is connected to the bends 32 at one side of its unit 30 by means of projections 38 fixed to the bends 32 and to the plates. As appears further in Fig. 4, the plates 36 are arranged to perform a double function in that they not only stiffen the units 30 to prevent their sagging but are arranged in one plane with their edges parallel and close together (Fig. 4) to serve as a shield 40 to check a blast of fluid passing from or to the aperture 12 so that the fluid must largely pass around the shield 40 so as to enter or leave the bundle 28 somewhat radially of the shell 10.

The shell 10 being cylindrical in order to resist efficiently the internal pressures and the tube bundle 28 preferably being rectangular in cross section, it is necessary that means be provided for preventing some of the fluid from by-passing practically all of the tube bundle by flowing along the outer segments 42, 42 not occupied by units 30. For this purpose, each of the vacant segments 42 outside the tube bundle 28 is closed at points somewhat removed from and lying between the planes of the two sets of bends 32 by segmental plates 44. However, each pair of plates 44 are connected by a flat plate 46 so that thruout most of the length of shell 10 the single gas or vapor pass has a rectangular cross section and is as fully occupied as practical by the units 30. Preferably thruout the zone in which the gas pass is rectangular in cross-section, due to the plates 44 and 46, the shell 10 acts as a mere tension member, the plates 44 and 46 confining the gases to the rectangular pass, and the spaces between the plates 46 and the member 10 being filled by bodies of filling material 62, 62 such as cement or the like for transmitting thrust from the plates 46 to member 10. In such case, member 10 may be perforate as shown at 64. While the use of perforations in the portion of member 10 covered by plates 46 is preferred, I do not limit myself to this, neither do I limit myself to the filler bodies 62.

It will be understood that the shell 10 is actually relatively quite long compared to its diameter, although it does not so appear in Fig. 1 on account of a large intermediate portion of the shell being broken away.

Furthermore, the units 30 preferably are connected to head 16 by readily releasable joints, known means 50 adapted to be easily removed being shown for forcing the ends of the units against seats 34.

Within shell 10 I provide also preferably a shield 52 along the side of the tube bundle 28 adjacent the aperture 18 so that the fluid passing to or from the aperture 18 must needs pass into or out of the tube bundle 28 in a somewhat radial direction. No means of support is shown for the shield 52 for the reason that the ends of some of the units 30 near the head 16 are preferably bent as appears at 54, 54 to form shoulders projecting towards the axial plane lying centrally of the two chambers 19 and on which the shield 52 may rest.

If desired, the plates 36 may be connected by a frame 60 of I-beams, or other suitable members, so that the units 30 may all be lifted as a whole, if desired. However, this subject matter is disclosed in a prior application by Swartz and Reed

filed December 31, 1931, Ser. No. 584,238 and is not claimed herein.

When it is desired to partially or wholly dismantle a heat exchanger of the type herein disclosed, it is necessary only to disconnect the shell 10 from the head 16 and remove the shell from the bundle 28 whereupon the units 30 may be disconnected from the head 16 and removed individually or collectively as desired.

While I have described my improved heat exchanger with particular reference to the art of cracking petroleum, I do not limit myself to any particular use for my invention. It will be understood further that certain features of my invention are not limited to single pass exchangers but may be used also in double or multiple pass exchangers.

What I claim is:

1. A single pass heat exchanger having an elongated cylindrical shell provided with an axially located aperture at one end, means fixed to said shell for giving said pass a rectangular internal cross section thru its central portion, a thick head for closing said shell at the end opposite said aperture, said head having a central aperture and parallel inlet and outlet chambers therein as well as apertures connecting with said chambers and extending to its inner face, a group of serpentine tubular elements in said shell extending thru said rectangular portion and having their ends seated on the end of said head at said last mentioned apertures so as to communicate with the said chambers, and means for releasably securing said elements to said head.

2. The heat exchanger as set forth in claim 1 and in which the elements extend beyond the rectangular portion of the pass at each end thereof together with shields within the shell in alignment with the aperture in the end of the shell and that in the head, said shields spaced from the shell and head to permit fluid to pass therearound and into and out of the tube bundle.

3. A head for the shell of a heat exchanger having parallel chambers one on each side of its center, passages running from said chambers to the inner face of the head, and seats at the ends of said passages adapted to receive the ends of tubular elements.

4. A circular head for a heat exchanger having parallel inlet and outlet chambers arranged therein and having apertures connecting said chambers with its inner face, said apertures for each chamber arranged in two parallel rows and each row having an equal number, the row farther from the center of the head having two apertures relatively close together at its center and the apertures in the row closer to the center of the head staggered with respect to those in the other row.

5. A heat exchanger having a cylindrical shell with an axial aperture at one end, a plurality of serpentine tubular elements forming a tube bundle within said shell and having their bends nearer said aperture connected by plates arranged to form a shield in front of said aperture.

6. A heat exchanger having a cylindrical shell of relatively great length with respect to its diameter and having central inlet and outlet apertures, one at each end of the exchanger, and a tube bundle composed of serpentine elements and having a rectangular cross section.

7. A head for the shell of a heat exchanger and having a central aperture therein for gases or vapors and having also parallel chambers on opposite sides of said central aperture, passages running from said chambers to the inner face of

the head, and seats at the ends of said passages adapted to receive the ends of tubular units.

8. A heat exchanger having an outer cylindrical stress member, plates within said member arranged to form a gas pass of rectangular cross-section, fluid conducting tubular units in said gas pass, and a filling between said plates and said member for transmitting stress from said plates to said member.

10 9. A heat exchanger having a cylindrical shell and a member normally connected thereto at one end, said member having a central aperture and a portion forming a flat inner surface, parallel chambers one on each side of said aperture.
15 passages running from said chambers to said surface and seats in said surface adapted to receive the ends of tubular units at the ends of said passages.

10. In a device of the class described, the combination of a cylindrical shell, a member normally connected thereto at one end and forming a circumferential joint with such shell, said member having parallel spaced chambers therein, one on each side of its center, and having portions provided with flat inner surfaces and forming parts of the walls of said chambers, said flat surfaced parts having apertures therein, and serpentine units arranged to connect with said chambers through said apertures, said end member having an opening therethrough whose axis passes through the space between said chambers.

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