

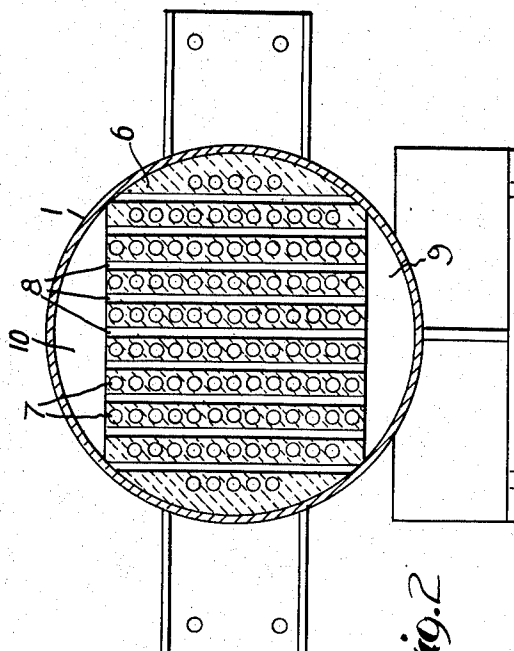
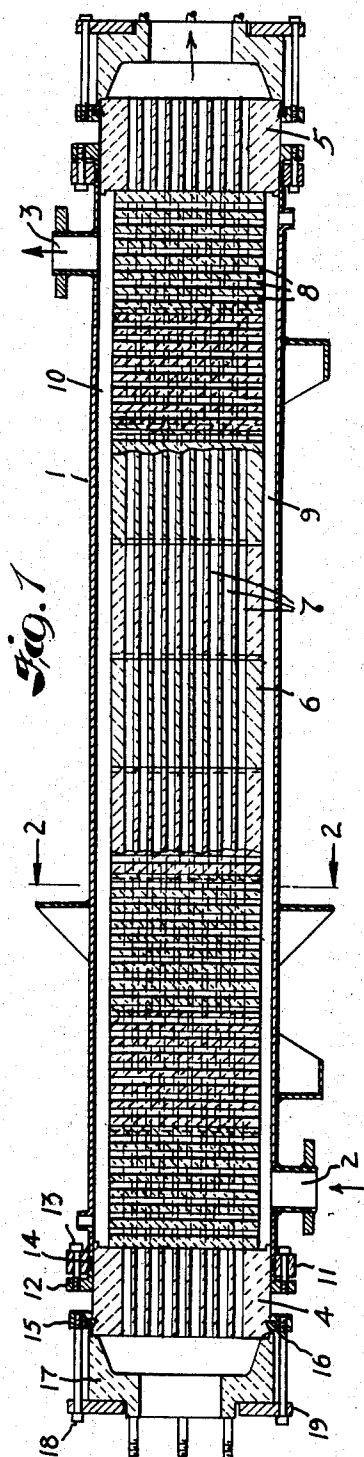
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HEAT EXCHANGER

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HEAT EXCHANGER

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2 Claims. (Cl. 257—241)

This invention relates as indicated to a novel heat exchanger, and more particularly to a heat exchanger having many of the advantages of the well-known type utilizing a plurality of elongated tubes passing through an enclosing housing but of more rugged construction particularly suited for the employment of chemically inert materials such as graphite where such may be required in view of the fluids to be handled.

Graphite has come to be employed for a variety of purposes where corrosive or highly reactive chemicals are handled, including heat exchangers. A preferred form of treated graphite now commercially available has the following physical properties:

Physical properties

Mechanical:

Density (lbs./cu. ft.)	109
Porosity (percent)—effective	none
Tensile strength (p.s.i.)	2600
Compressive strength (p.s.i.)	8900
Transverse strength (p.s.i.)	4650
Modulus of elasticity (10 ⁵)	23

Thermal:

Temperature resistance (° F.) Max.	340
Thermal expansion (in./in./° F. × 10 ⁻⁷)	25.4
Thermal conductivity (B.t.u./hr./sq. ft./° F./in.)	1020

Such treated graphite is immune to the effects of thermal shock, possesses an extremely high rate of thermal conductivity, is subject to minimum thermal expansion, and is inert to practically all corrosives except a few highly oxidizing agents. The foregoing characteristics are obviously highly advantageous and often essential in the handling of certain fluids, but unfortunately graphite tubes are relatively fragile and subject to damage not only during handling and cleaning but also when subject to physical shock such as water hammer or steam hammer in use, for example.

It is accordingly a principal object of my invention to provide a novel heat exchanger, the principal elements of which are adapted to be made of graphite and which will have the advantages of the usual heat exchanger employing tubes, without the disadvantages.

Another object is to provide such heat exchanger which may be constructed in units for convenient manufacture and assembly.

A further object is to provide such heat exchanger having end members or heads secured thereto in a novel manner to permit relative movement of the inner parts and the outer shell.

Other objects of the invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but

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a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

Fig. 1 is a longitudinal section through a heat exchanger embodying my new invention partly further broken away in places to disclose the disposition of both the longitudinal and transverse bores; and

Fig. 2 is a transverse section taken on the line 2—2 on Fig. 1.

Referring now more particularly to the embodiment illustrated in such drawing, the form there shown comprises an elongated cylindrical shell 1 ordinarily of carbon steel but which may, for example, be of stainless steel, aluminum, copper, plastic, special alloys, or graphite, and may be plastic or lead lined. An inlet 2 and an outlet 3 communicate laterally with such cylinder adjacent opposite ends of the same and at diametrically opposite sides thereof. Within the respective ends of cylinder 1 are graphite head members 4 and 5 forming a tight but sliding fit within the cylinder. Extending between them is a graphite heat exchanger one-piece "bundle" 6. Such bundle is formed of a number of individual blocks or segments which are drilled to provide longitudinal passages such as 7 and cross-passages such as 8 before being aligned and bonded together with a suitable heat resistant resin. Such bundle is similarly bonded to the head members 4 and 5 with the aligned passages 7 extending through the entire assembly from end to end. While the side portions of bundle 6 are shaped to conform to and fit against the inner periphery of cylinder 1, such bundle is cut away on its upper and lower sides as shown in the drawing to leave cavities 9 and 10 communicating with inlet 2 and outlet 3 respectively. Fluid may accordingly enter through such inlet into cavity 9 and then pass through transverse passages 8 to cavity 10, leaving the latter through outlet 3. Passages 7 and 8 are relatively close together as best shown in Fig. 2 to facilitate heat transfer. In a typical construction the device is capable of withstanding 150–200 p.s.i. operating pressures and is also much more resistant to mechanical shock than are conventional graphite tubes. All of the holes are easily cleaned and since both heads float, the one-piece "bundle" may easily be withdrawn from the cylinder or shell for cleaning of the cross-bores 8.

The respective head assemblies are identical in construction so that only one will be described in detail. A heavy flange 11 is welded to the end of cylinder 1 and a follower gland 12 is secured thereto by means of bolts such as 13. Packing 14 is interposed between the end of cylinder 1 and gland 12, being compressed by a tightening of bolts 13 to form a tight seal. Axially spaced from gland 12 is a flange 15 retained about head member 4 by means of a split ring 16 engaged in a notch in such head member. A graphite end member 17 is held clamped tightly against the end of head member 4 by means of bolts such as 18 passing through flat ring 19 and flange 15. It will accordingly be apparent that a degree of relative axial movement is permitted between cylindrical shell 1 and the respective widely spaced head members 4 and 5. Relative transverse expansion and contraction is, of course, of a much smaller degree adequately accommodated by packing 14.

It will be seen from the foregoing that I have provided a novel form of heat exchanger adapted to take full advantage of the desirable attributes of graphite and the like for the purpose and yet avoid the disadvantages normally inherent in the use of relatively fragile materials. My new construction, moreover, is of a type permitting wide variation in the length of the heat exchanger unit, a series of identical segments being bonded together as may be required. The unit is easy to assemble and dis-

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assemble for installation, cleaning and other maintenance, and provision of the floating head assemblies substantially eliminates any difficulty from differences in expansion and contraction of the shell and bundle or core components. The resin employed for bonding the graphite sections together may be either commercially available phenolic or furane base resins, depending on the chemicals to be handled.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A heat exchanger comprising an elongated cylindrical shell, an elongated body of impervious graphite fitting therein with a substantial portion of its surface in contact with said shell but having a pair of opposite sides spaced from said shell to leave two diametrically opposite cavities between said body and said shell, said cavities extending along substantially the entire longitudinal length of said body, said body being free to move longitudinally of said shell, end portions of said graphite body closing the ends of said cavities, an inlet through said shell to one said cavity, an outlet through said shell from the other said cavity spaced longitudinally of the shell from the inlet, a plurality of spaced rows of pas-

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sages extending transversely through said body connecting said cavities, and a plurality of spaced rows of passages extending longitudinally through said body and said end portions intermediate said transverse rows, the peripheral surfaces of said end portions of said graphite body contacting said shell for relative longitudinal sliding movement to accommodate relative expansion and contraction, packing sealing the contact between said shell and said end portions, and manifolds secured to said graphite body end portions spaced from the ends of said shell, the composition of said graphite body in the area of said passageways being homogeneous.

2. The heat exchanger of claim 1 wherein said impervious graphite body is formed of a plurality of segments longitudinally thereof, said segments being rigidly bonded together with said longitudinal passages aligned and the bonds between said segments being spaced from said transverse passages.

References Cited in the file of this patent

UNITED STATES PATENTS

1,571,068	Stancliffe	Jan. 26, 1926
2,496,301	Meixl	Feb. 7, 1950
2,643,862	Stelling	June 30, 1953

FOREIGN PATENTS

665,899	Great Britain	Jan. 30, 1952
233,950	Switzerland	Dec. 1, 1944