

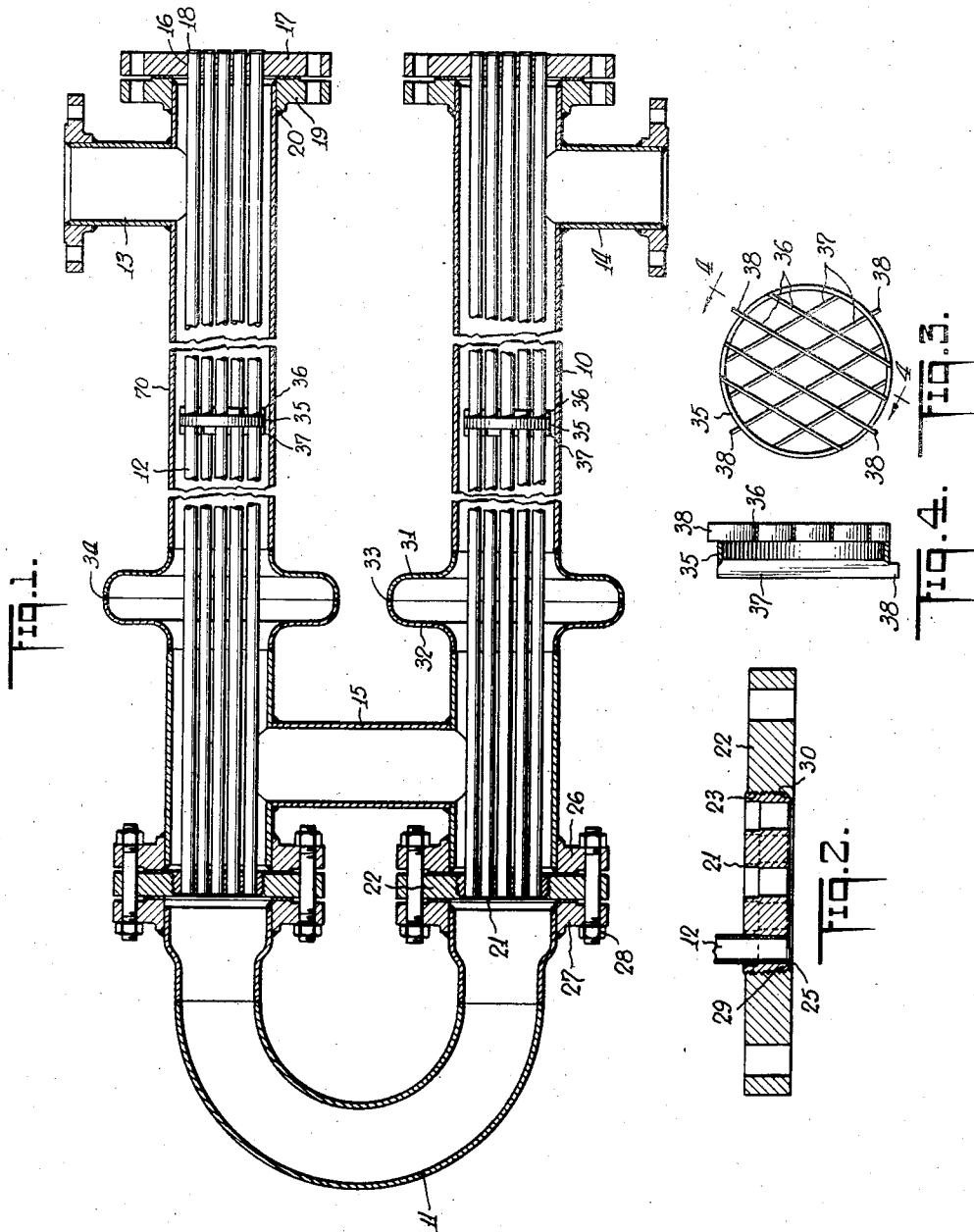
Jan. 21, 1941.

O. SCHNEIDER

2,229,344

COUNTERCURRENT HEAT EXCHANGER

Filed Nov. 19, 1933



INVENTOR
Otto Schneider
BY
Dean Sanford & Hirsch
ATTORNEYS

UNITED STATES PATENT OFFICE

2,229,344

COUNTERCURRENT HEAT EXCHANGER

Otto Schneider, New York, N. Y., assignor of one-half to Robert Schwarz, White Plains, N. Y.

Application November 19, 1938, Serial No. 241,479

2 Claims. (Cl. 257—236)

An object of the invention is to provide a countercurrent heat-exchanger, which may be readily disassembled for cleaning and repair and is readily reassembled and which involves individual elements of low cost and largely of standard construction.

Another object is to provide a heat exchanger of the above type in which relative expansion under temperature change is allowed for, without the possibility of leakage or undue strain on the connections, despite the elimination of the stuffing box commonly provided for that purpose.

In the accompanying drawing in which is shown one of various possible embodiments of the several features of the invention:

Fig. 1 is a view in longitudinal cross-section of one embodiment of heat exchanger.

Fig. 2 is a sectional view on a larger scale showing one of the connecting mounting elements for the inner tube,

Fig. 3 is a plan view of the tube spacing structure, and

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3.

Referring now to the drawing, the countercurrent heat exchanger shown illustratively as a two-section pre-heater, includes two outer tubes 10 of steel connected by a U-tube 11, each housing a bundle of smaller, inner pipes 12 of brass or copper, through which the water or other liquid to be heated is passed. The steam, water or other heating medium is admitted through an inlet duct 13 near one end of one outer tube 10 and escapes through an outlet duct 14 near the corresponding end of the other outer tube, a tube 15 of the diameter of said ports, being welded at its ends to said outer tubes near the U-tube connection therebetween. Accordingly the steam or hot water must pass substantially the lengths of the respective outer tubes for effective heating of the fluid passing through the inner tubes. The construction thus far described is that of a substantially conventional countercurrent pre-heater.

According to the present invention, the bundle of inner tubes 12 is attached at one end at corresponding holes 16 in a carrying disk 17, the extremities of said tubes being flanged or flared over as at 18. The disk 17 abuts a flanged ring 19 encircling and welded as at 20 to the extremity of the outer tube 10. The flanged ring 19 and plate 17 are connected by bolts (not shown) to the flange (not shown) of the inlet or outlet as the case may be, for the water or other fluid to be heated.

To render the assembly of inner tubes readily demountable from the outer tube, the opposite plate that carries the opposite ends of said inner tubes 12 is made up of two parts 21 and 22. The inner part constitutes a disk peripherally threaded at 23 and of diameter slightly smaller than the bore of the outer tube 10. That disk is encircled by an annulus 22 threaded over said carrying disk. The extremities of the inner tubes are flanged or flared over the disk 21 as at 25 exactly as at the opposite end. The annulus 22 rests against a flanged ring 26 corresponding to ring 19 at the opposite end. A similar flange 27 is welded to the end of the U member 11 and the two flanges 26 and 27 with the interposed annulus 22 are clamped together in a secure assembly by means of bolts 28.

In order to render the threaded connection between the disk 21 and the annulus 22 particularly secure, especially where high steam pressure is used, it is desirable to form a conical seat therebetween for which purpose, the end face of disk 21 is bevelled at 29 and seated against a corresponding conical ledge 30 at the inner periphery of the annulus 22. If desired a soft metal gasket (not shown) might be interposed. It is also desirable to cover the threads with graphite, which will serve to fill the minute interstices between the coacting threads 23 and to prevent binding or rusting together of the threaded connection.

The construction as thus far described, admits of ready disassembly by removal of the bolts 28 and of the U-connection 11. The annulus 22 may now be readily screwed off the threaded disk 21 and the entire assemblage made up of carrying plate 17 and the bundle of inner tubes 12 with carrying disk 21 may readily be withdrawn from the outer tube and cleaned and repaired as desired and may thereupon readily be re-assembled.

The stuffing box commonly used to allow for differential heat expansion between the outer steel tubes 12 and the inner copper or brass tubes 12 is eliminated by the present invention. Such relative expansion is allowed for, even though both ends of the outer and inner tubes are rigidly connected together, without possibility of relative movement thereat. According to the present invention, the simple expedient is resorted to, of outwardly bowing the metal of the outer tube 10 to form a narrow bead or hollow flange of greatly enlarged diameter, preferably of diameter approximately twice that of the outer tube. That flange may have parallel walls 31 and 32 with a toroidal perimeter 33. Preferably as shown, the tube 10 is made in two sections, flared at their

abutting ends and welded together at 34. Thus even in the absence of any relatively slidable parts, relative expansion and contraction are adequately allowed for without strain on any of the threaded connections.

The long, small inner tubes might in the absence of other precautions come into contact with each other with consequent reduction of the effective heating surface under the expansion thereof, due to heating and under the mechanical impact of the steam. To obviate this difficulty, one or more tube spacer units may be provided, preferably spaced about four feet apart. In the case of a tube eight feet long, a single spacer would be provided near the middle. This spacer is preferably made up of a narrow, thin metal ring 35 of diameter smaller than the inner diameter of the outer tube and larger than the bundle of inner tubes. That ring has welded to one edge thereof and in edge to edge relation thereto, a series of parallel narrow, thin metal strips 36 which extend as chords thereacross. A series of like strips 37 is similarly welded to the opposite edge of the ring, but said latter strips extend at an angle as shown to the first set of plates. Preferably a number of these strips protrude as at 38 beyond the periphery of the ring 35 and serve to sustain said ring in spaced relation relative to the outer tube. Each small, inner tube will be lodged near its middle in the rectangular frame determined between two pairs of intersecting metal strips 36, 37 as shown in plan view in Fig. 3. Accordingly, this spacer device will preclude any possibility of contact between the inner tubes.

The two sets of metal spacer strips 36 and 37 are spaced from each other as shown by the thickness of the ring 35, to avoid the greater reduction in cross-sectional area and impedance to steam flow which would be incurred if the two sets of strips were in a common plane.

The pre-heater though illustratively shown in the drawing as a two-unit device may, of course, be made with but a single outer tube section or with three or more such sections depending on requirements. The outer steel tube may be of inner diameter usually between two inches and twelve inches. The inner tubes of copper or brass are usually of $\frac{5}{8}$ inch outer diameter and wall thickness of .040 inch. The device may thus be embodied in preheaters of capacity as small as or smaller than 50,000 B. t. u. per hour and as large as or larger than 12,000,000 B. t. u. per hour.

With the use of the present invention, the removal of accumulation, such as boiler scale which impairs heat exchange and greatly lowers

the efficiency of the device is rendered so easy that in practice, cleaning may be resorted to at very frequent intervals and the device readily maintained at maximum efficiency.

The pre-heater may be used in a wide variety of applications and is advantageous as a hot water heater in dwellings, for hot water heating, baths and laundries among other relations.

The tube spacer as shown by itself in Figs. 3 and 4 is not claimed herein, but is part of the subject-matter of my copending application, Serial No. 369,589 filed Dec. 11, 1940.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A countercurrent heat exchanger of the type comprising an outer tube having flanges at the ends thereof, a bundle of smaller inner tubes having small clearance with respect to said outer tube, perforated end plates retaining said inner tubes, one of said end plates being larger than the bore of said tube and sustained by one of said flanges, the other plate being slightly smaller in diameter than the bore of said outer tube and slightly larger than that of said bundle and protruding in assembled relation beyond the other said flange, said smaller plate having an annulus threaded thereabout and bolts through said annulus firmly pressing the same against said latter flange.

2. A countercurrent heat exchanger of the type comprising an outer tube having flanges at the ends thereof, a bundle of smaller inner tubes having small clearance with respect to said outer tube, perforated end plates retaining the same, one of said end plates being larger than the bore of said tube and sustained by one of said flanges, the other plate being slightly smaller in diameter than the bore of said outer tube and slightly larger than that of said bundle and protruding in assembled relation beyond the other said flange, said smaller plate having an annulus threaded thereabout and bolts through said annulus firmly pressing the same against said latter flange, said annulus having a seat near its outer face snugly engaged by the corresponding beveled edge of the smaller plate.

OTTO SCHNEIDER.