Feb. 24, 1970 M. WEBER 3,496,997

HEAT EXCHANGER OF TUBULAR CONSTRUCTION

Filed Aug. 23, 1968

Fig. 1

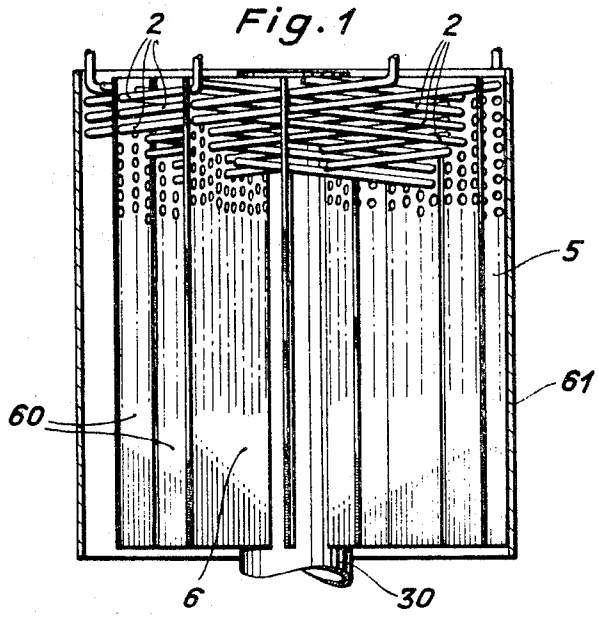
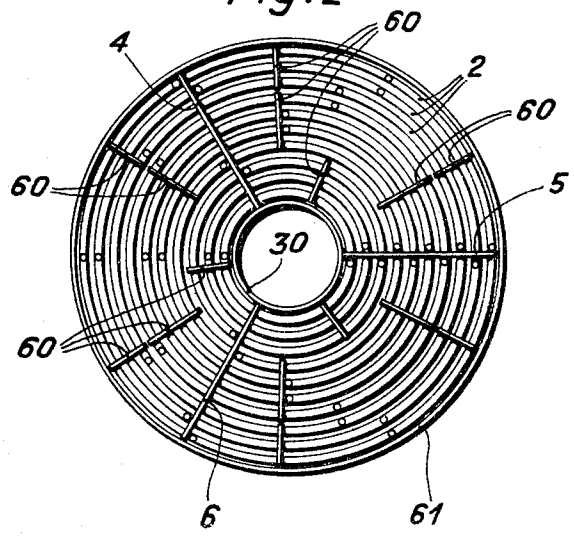


Fig. 2



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HEAT EXCHANGER OF TUBULAR CONSTRUCTION

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U.S. Cl. 165—163 7 Claims

ABSTRACT OF THE DISCLOSURE

The tube coil system is fed through and supported within three radially disposed retaining plates. In addition, a plurality of plates are disposed between the retaining plates in supporting relation to the tube coils which pass therethrough. These latter plates are of less radial length than the retaining plates and are secured to only one coil of the tube coils passing therethrough.

This invention relates to a tubular heat exchanger. More particularly, this invention relates to a tubular heat exchanger utilizing helically or spirally wound tubes for conveying a working medium.

Heretofore, heat exchangers and other heat transfer systems have been known wherein tube coils have been utilized to convey a working medium through an extended path within a heat exchange area. In some instances, these tube coils have been mounted in various types of radial members for support as well as for the prevention of unequal stresses due to differential thermal expansion. However, the various tube coils of these known heat exchangers have frequently been subjected to adverse bending or localized buckling between the radial support members, especially, under severe service conditions, such as during operation at very high temperatures e.g. above 500° C., or under conditions providing a high heat transfer rate from the medium flowing over the tube coil to the medium flowing through the tube coil.

Accordingly, it is an object of the invention to support the tube coils of a tubular heat exchanger during localized bending or buckling.

It is another object of the invention to accommodate for thermal expansion of the coils of a tube coil of a tubular heat exchanger.

It is another object of the invention to prevent substantial stressing of a tube coil during distortion under large temperature differentials between the mediums flowing over and flowing through the tube coil.

Briefly, the invention provides a tubular heat exchanger having a tube coil system consisting of at least one helically or spirally wound tube and at least three retaining plates disposed radially of the tube coil and secured to each other in supporting relation to the tube coil system, for example, as described in U.S. patent application, Ser. No. 626,453, filed Mar. 28, 1967, with at least one additional plate. This additional plate is disposed to lie approximately in the plane of the tube coil axis so as to receive and secure at least some of the turns of the tube coil. Additionally, the plate is sized to be of a radial width which is smaller by at least one radial pipe pitch than the radial width of the tube coil system.

These and other objects and advantages of the invention will become more apparent from the following detailed descritpion and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates an axial section through a tubular heat exchanger according to the invention; and

FIG. 2 illustrates a plan view of the tubular heat exchanger of FIG. 1.

Referring to FIG. 1, the heat exchanger includes a central core **30** within a housing **61** to which three one piece retaining plates **4**, **5**, **6** are fixed to extend radially outwards in planes containing the axis of the heat exchanger. A plurality, for example, ten, of helical coils **2** of progressively increasing coil diameter are mounted concentrically in the plates **4–6** to form the tubes of the tube coil system of the heat exchanger. In order to mount the coils **2**, the retaining plates **4–6** have holes to receive the coils **2** and the tubes are threaded through the holes by rotating the coils **2** about the common axis to produce a screwing action.

The sector-shaped spaces between the retaining plates **4–6** have additional plates **60**, for example, a total of fifteen, which are distributed around the circumference of the heat exchanger at different angles with respect to the retaining plates **4–6** to form different sector angles between adjacent plates. Each of these additional plates **60** has holes therein through which the tubes of the coils **2** pass and each is secured to at least one of the coils **2**, as by welding. The plates **60** are sized to be of a width smaller than the radial width of the tube coil system by at least one radial pipe pitch and of a length in the axial direction equal to that of the retaining plates **4–6**. The plates **60** are located between the core **30** and housing **61** without being rigidly joined thereto. Since the plates **60** are also not rigidly joined to the retaining plates **4–6**, the tube lengths between two retaining plates can become distorted in the event of large temperature differences between the primary and secondary media and in the event of a high heat transfer rate. The resulting deviation of the tube length from the ideal shape of the tube coil; however, occurs without substantial stresses occurring in the tubes.

As the sectors between adjacent retaining plates **4–6** are divided into unequal angles by the plates **60**, the lengths of the tubes between the plates are unequal. The spacing of the plates are selected such that the free tube length between two adjacent plates cannot be excited into resonant oscillation.

It is noted that the tube coils **2** of the heat exchanger are constructed in helical form. However, the tube coils can also be formed spirally or disposed on a conical envelope.

Further, it is noted that the plates **60** are secured to the tube coils in a manner so that the plates **60** cannot move relative to the tube coils extending therethrough. To this end, instead of welding the plates **60** to the tube coils, resilient rods can be used to join each plate **60** to an adjacent retaining plate **4**, **5**, **6**. Such resilient rods will accommodate the expansion movements of the tube coils due to temperature changes and, therefore, also permit corresponding motion of the plates **60**.

What is claimed is:

1. A heat exchanger comprising

at least three retaining plates disposed in fixed spaced apart radial disposition to each other;

a tube coil system including at least one wound tube coil having a plurality of coil turns passing through and secured in said retaining plates, said tube coil having an axis disposed in the axial plane of each of said retaining plates; and

at least one additional plate disposed radially of said tube coil axis, said additional plate receiving at least some of said coil turns of said tube coil in fixed relation and being of a radial width less than the radial width of said tube coil system by at least one radial tube coil pitch.

2. A heat exchanger as set forth in claim **1** wherein said tube coil is helically wound.

3. A heat exchanger as set forth in claim 1 wherein said tube coil is spirally wound.

4. A heat exchanger as set forth in claims 1, 2 or 3 which contains a plurality of said additional plates spaced between said retaining plates to form sectors of unequal angles between each pair of adjacent retaining plates.

5. A heat exchanger as set forth in claim 1 wherein said tube coil system includes a plurality of said wound tube coils disposed in concentric relation to each other, and which includes a plurality of said additional plates, each additional plate receiving the tube coils of at least some of said wound tube coils and being of a radial width less than the radial width of said tube coil system by at least one radial tube coil pitch.

6. A heat exchanger as set forth in claim 5 wherein said additional plates are disposed between said retaining plates

to form sectors of unequal angles between each pair of adjacent retaining plates.

7. A heat exchanger as set forth in claim 5 wherein said additional plates are of equal axial length to said retaining plates.

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