

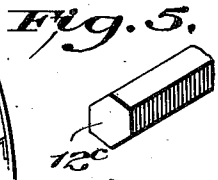
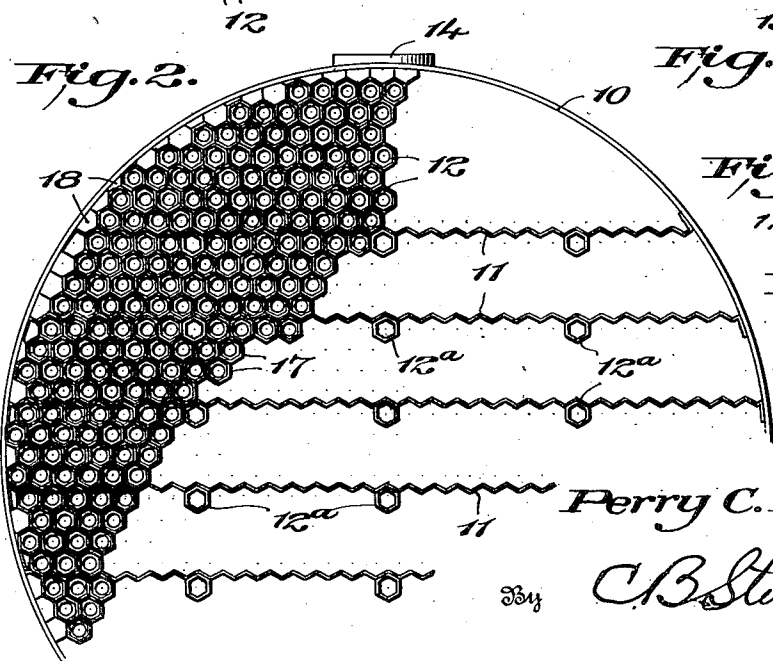
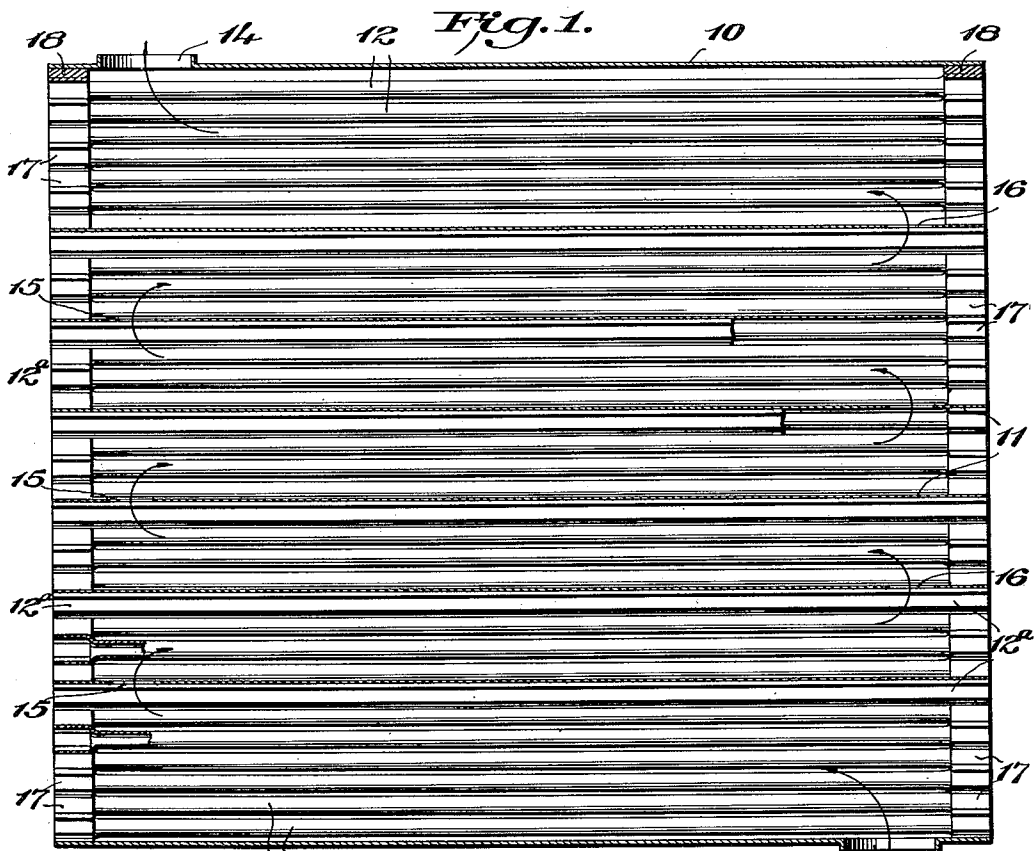
March 19, 1946.

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2,396,650

HEAT EXCHANGE UNIT

Filed Sept. 16, 1943



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UNITED STATES PATENT OFFICE

2,396,650

HEAT EXCHANGE UNIT

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Application September 16, 1943, Serial No. 502,660

5 Claims. (Cl. 257—128)

This invention relates to heat exchange units, such as are used for cooling the lubricating oil of aircraft and other internal combustion engines, and has particular reference to improvements in the core assembly for heat exchange units of the type disclosed in Dykeman et al. Patent No. 1,864,052, issued June 21, 1932, and which includes a casing through which the fluid to be cooled or heated is circulated, and a multiplicity of open-ended tubes extending through said casing for conducting therethrough a suitable cooling or heating medium, such as air, in heat exchange relationship to the fluid to be cooled or heated.

In heat exchange units of the type referred to, the tubes usually extend longitudinally through the casing from end to end thereof; at their ends the tubes are usually soldered or otherwise suitably fastened together and to the casing so as to close the ends of the latter. Between their ends said tubes are slightly spaced apart to provide therebetween a maze of narrow passageways through which the fluid to be cooled or heated flows in its passage through the casing. Moreover, the casing is provided with an inlet and an outlet usually though not necessarily located at substantially opposite points, and also with a series of longitudinally extending, spaced apart partitions defining a tortuous passageway extending therethrough between the inlet and the outlet thereof so that the fluid to be cooled or heated is required to flow along the outsides of substantially all of the tubes and throughout the effective lengths thereof in heat exchange relationship with the latter during its passage through the casing between said inlet and said outlet.

The end portions of the tubes usually are of enlarged, hexagonal form so as to fit flatly against the partitions and against one another and to hold the medial portions of the tubes spaced from the partitions and from each other. Moreover, the partitions usually are co-extensive in length with the casing and extend from side to side thereof, being unsupported except at their ends where they are confined between the enlarged end portions of the tubes while their sides are fastened to the casing.

Particularly in connection with heat exchange units that are designed for use on aircraft, lightness in weight is a prime constructional consideration. Therefore, the casing, the tubes and the partitions of heat exchange units of the type under consideration usually are constructed of material as thin and light as possible consistent with possession of requisite strength. In this con-

nection, if the partitions are thin and unsupported except at their margins, they may be unstable and subject to sagging and flexure under the pressure of the fluid circulated through the casing, with possibly early deterioration of the unit. Moreover, if the partitions are not rigid in the unit assembly, they are of little or no benefit as braces for the casing to assist in preserving the form thereof, when the same is subjected to pressure.

Accordingly, the general object of the present invention is to provide a heat exchange unit of the type under consideration in which the partitions, even though they may be formed of thin material and even though they may therefore be inherently unstable, are effectively supported against flexure to contribute toward a rigid structure and also to serve effectively as braces to assist in preserving the form of the casing.

More particularly, the object of the invention is to utilize certain of the tubes or their equivalents to hold the partitions against flexure and rigidly with respect to the casing so that, as compared with conventional units of the type under consideration, no additional parts are required to accomplish the purposes of the invention and no changes in manufacturing procedure nor additional expenses are involved in producing the improved unit.

With the foregoing and other objects in view, which will become more fully apparent as the nature of the invention is better understood, the same consists in a heat exchange unit of the type under consideration embodying the novel features of construction, combination and arrangement of parts as will be hereinafter more fully described, illustrated in the accompanying drawing and defined in the appended claims.

In the accompanying drawing, wherein like characters of reference denote corresponding parts in related views,

Figure 1 is a central, vertical, longitudinal section through a heat exchange unit, constructed in accordance with one practical embodiment of the invention.

Figure 2 is a fragmentary end elevation of the unit;

Figure 3 is a fragmentary perspective view of a partition supporting tube element of the unit, as shown in Figure 1;

Figure 4 is a fragmentary perspective view of a modified form of partition supporting element of the unit, and

Figure 5 is a fragmentary perspective view of

still another modified form of a partition supporting element.

Referring to the drawing in detail, and particularly to the core structure of a heat exchanger unit, 10 designates an open ended, horizontally disposed casing which may be of cylindrical or other desired shape in cross section and of any suitable dimensions, 11 designates a series of horizontally disposed, parallel, spaced apart partitions within said casing extending from end to end and from side to side thereof, and 12 designates a multiplicity of tubes extending longitudinally through said casing from end to end thereof and substantially filling the spaces between the partitions 11.

In the bottom of the casing 10 is an opening 13 for inlet of fluid thereto and in the top of said casing is an opening 14 for outlet of fluid therefrom, while in alternate of the partitions 11, adjacent to one end of the casing, are openings 15 and in the remaining alternate partitions, adjacent to the other end of the casing, are openings 16. Accordingly, the spaces or passes between the partitions 11 are in communication with each other through the partition openings 15 and 16 and said spaces or passes, in conjunction with said partition openings, collectively constitute a single, continuous passageway extending through the casing successively in opposite directions from end to end thereof and progressively from bottom to top thereof. It follows, therefore, that fluid admitted to the casing through the inlet openings 13 is required to flow first in one direction and then in the opposite direction and so on through the casing from end to end thereof before it can escape therefrom through the outlet opening 14.

Most of the tubes 12 have enlarged end portions of hexagonal shape in cross section and medial portions of cylindrical or other suitable form in cross section and of lesser cross sectional area than their hexagonal end portions. The flat faces of the enlarged end portions 17 of these tubes engage flatly against one another in honeycomb fashion whereby their medial portions of lesser cross sectional area than their end portions are held spaced apart to provide therebetween a maze of narrow spaces through which fluid circulated through the casing may flow. Moreover, the enlarged end portions of such of said tubes as are disposed directly adjacent to the partitions 11 have their flat faces nearer said partitions engaged flatly against said partitions whereby their medial portions are held spaced from said partitions. In this connection, the partitions may be either flat or corrugated, but preferably they are longitudinally corrugated as shown to best interfit at their ends with the said enlarged hexagonal end portions of the tubes.

At points where the enlarged end portions 17 of the tubes 12 do not fit closely against the casing 10, suitable filler pieces 18 are employed to close the voids between said enlarged end portions and the casing. Moreover, the enlarged end portions of the tubes and said filler pieces are soldered to one another and to the partitions and the casing so as to close the ends of the narrow spaces between said tubes and the partitions and the casing.

As thus far described, the unit is of conventional construction with the partitions 11 unsupported except at their ends where they are confined between the enlarged hexagonal end portions 17 of the tubes 12 and at their sides where they are soldered or otherwise suitably fastened

to the casing 10. It is manifest, therefore, that in a conventional unit the partitions are free to flex and sag and, consequently, detract from desired rigidity of the unit and fail to act effectively as braces to assist in preserving the form of the casing 10, all of which is quite undesirable.

Now, in accordance with the present invention, not all of the tubes 12 have enlarged end portions, or, in other words, medial portions which are of lesser cross sectional area than their end portions. On the contrary, certain of the tubes, designated as 12a, are of the same cross sectional size and shape throughout their lengths or at least at their ends and at one or more spaced points along the lengths of their medial portions, as the enlarged hexagonal end portions 17 of the first mentioned tubes, and these tubes 12a are located at points directly adjacent to the partitions 11 either to one side thereof as shown or, if desired, to both sides thereof. Therefore, not only the end portions, but also the medial portions of the tubes 12a engage the partitions 11 and as a consequence said tubes 12a act effectively to hold the medial portions of said partitions against flexure or sagging with the result that they are stable and rigid in the assembly and act effectively as braces to assist in preserving the form of the casing 10.

If desired, all of the tubes that engage the partitions 11 may be of the form of the tubes 12a. This, however, is unnecessary and it is preferred to employ only a minor number of the tubes 12a in conjunction with any given partition, said tubes 12a being employed at suitably spaced apart intervals sufficient to afford the desired support for the partitions and the spaces between them being occupied by tubes of the form of the tubes 12 to afford spaces between the same and the partitions.

Preferably the tubes 12a are somewhat heavier, stiffer and stronger than the tubes 12, particularly if the latter tubes are thin and flexible, but, of course, the tubes 12a may be formed from the same stock or they may even be formed from lighter stock than the tubes 12 if desired, the only essential being that they be amply stiff and strong so as to effectively support the medial portions of the partitions against flexure or sagging.

If desired, the tubes 12a, instead of being of one-piece construction, may be composed of two or more mating sections 12b as illustrated in Figure 4, this construction contributing toward economical production in certain instances.

The sections 12b may be of semi-hexagonal form in cross section and each section may be a complete tube in itself as shown, the adjacent walls of the two sections, when said sections are mated to provide in effect a tube of hexagonal shape in cross section, constituting a beam to afford firm support for the partition element.

Also, solid rods 12c as illustrated in Figure 5 may be used in lieu of the tubes 12a if desired, and these rods may be either of one piece or of mating section construction.

Oil or other fluid or liquid to be cooled or heated is required by the partition 11 to flow in a tortuous path through the casing 10 along and between the tubes 12 and 12a or equivalently, the rods 12c substantially throughout the lengths thereof, and as will of course be understood, the medium, such as air, for cooling or heating the oil or other fluid flows through the tubes 12, 12a in effective heat exchange relationship of the fluid to be cooled or heated.

While the casing 10, the partitions 11 and the

tubes 12 have been illustrated and described as disposed horizontally, it will be understood of course that the unit may be used in any desired position and that the appended claims are to be construed accordingly.

From the foregoing description considered in connection with the accompanying drawing it is believed that the novel constructional features of the invention will be clearly understood and their advantages appreciated. It is desired to point out, however, that while only certain constructional forms of the invention have been illustrated and described, the same may readily be embodied in various specifically different constructional forms within the spirit and scope as defined in the appended claims.

What is claimed is:

1. A heat exchange unit comprising a casing having an inlet and an outlet for a fluid to be circulated therethrough, a multiplicity of parallel heat exchange elements substantially filling said casing and extending substantially from end to end thereof, at least one partition in said casing being substantially parallel to said elements and extending from side to side and substantially from end to end of said casing and requiring the fluid circulated through said casing to follow a tortuous path therethrough in heat exchange relationship to said elements substantially throughout the lengths thereof, certain of said elements having enlarged end portions abutting one another and said partition to space the medial portions thereof from one another and from said partition, other of said elements being composed of separate mating sections and being of the same size throughout their lengths as the enlarged end portions of said first mentioned elements and having their end portions abutting said enlarged end portions of said first mentioned elements and their medial portions disposed in contacting supporting relationship with said partition, and means fastening the end portions of said elements together and to said casing and said partition to close the ends of the casing, certain of said elements being of tubular form for flow therethrough of a fluid medium in heat exchange relationship to the fluid circulated through said casing.

2. A core section for a heat exchange unit or like device, comprising an assembly of elongated tubes, said assembly being partitioned by a baffle which extends longitudinally through the assembly, said assembly of tubes including a first type having ends which are expanded with respect to the medial body portions thereof and which are in engagement with the ends of adjacent tubes, the expanded ends of some of the tubes of said first type further engaging respective ends of said baffle thereby to provide limited support for the baffle, and said assembly of tubes further including tubes of a second type having the same cross sectional area throughout their lengths, the ends of said second type tubes being nested among the expanded ends of the tubes of said first type and

the medial portions of the tubes of said second type being in continuous contact with the baffle, whereby to provide a support for said baffle intermediate its ends.

3. A core section for a heat exchange unit or like device, comprising an assembly of elongated tubes, said assembly being partitioned by a baffle which extends longitudinally through the assembly and is approximately co-extensive in length with said tubes, said assembly of tubes being grouped with their ends in nested relation and including tubes of first and second types, some of said first and second types of tubes contacting and supporting said baffle, the tubes of said first type having ends expanded with respect to their medial body portions whereby those in contact with said baffle provide support therefor only at the ends of the baffle, and the tubes of said second type having the same cross sectional area throughout their lengths whereby continuous contact with said baffle all along the length thereof is enabled and support provided for the baffle from end to end thereof.

4. A heat exchange unit of the character described including a casing having an inlet and an outlet, a plurality of spaced partitions in said casing extending from end to end and side to side thereof and formed to cause liquid in the casing to flow in a tortuous path between the inlet and outlet, a multiplicity of open ended heat exchange elements disposed within said casing between said partitions, said elements having enlarged ends and reduced medial portions so as to permit the flow of liquid around the latter, said elements having their enlarged end portions in contacting relation with each other and with the partitions, and means for engaging and supporting said partitions, said means having a uniform diameter throughout their entire length substantially equal to the diameter of the enlarged ends of the heat exchange elements so as to interfit therewith.

5. A heat exchange unit of the character described including a casing having an inlet and an outlet, a plurality of spaced partitions in said casing disposed so as to cause liquid flowing through the casing to follow a tortuous path between the inlet and outlet thereof, a plurality of spaced supporting members disposed beneath and engaging said partitions, said members being substantially hexagonal in cross-section and of a uniform size throughout their lengths, and a plurality of open-ended heat exchange elements disposed within said casing between said partitions and supporting members, said heat exchange elements having enlarged hexagonal shaped ends interfitting with each other and with the supporting members adjacent the ends of the latter and reduced medial portions so as to provide a passage around adjacent elements for liquid flowing through the casing from the inlet to the outlet thereof.

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