May 14, 1957 C. C. WHISTLER, JR 2,792,201

HEAT EXCHANGER

Filed Aug. 19, 1954 2 Sheets-Sheet 1

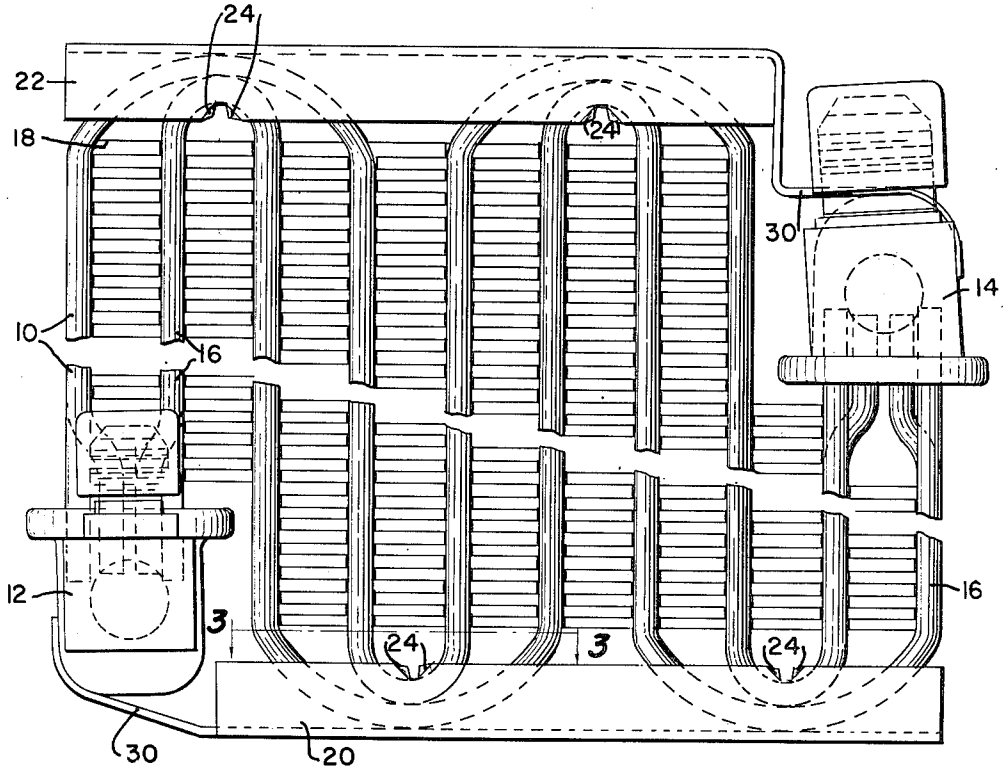


Fig. 1

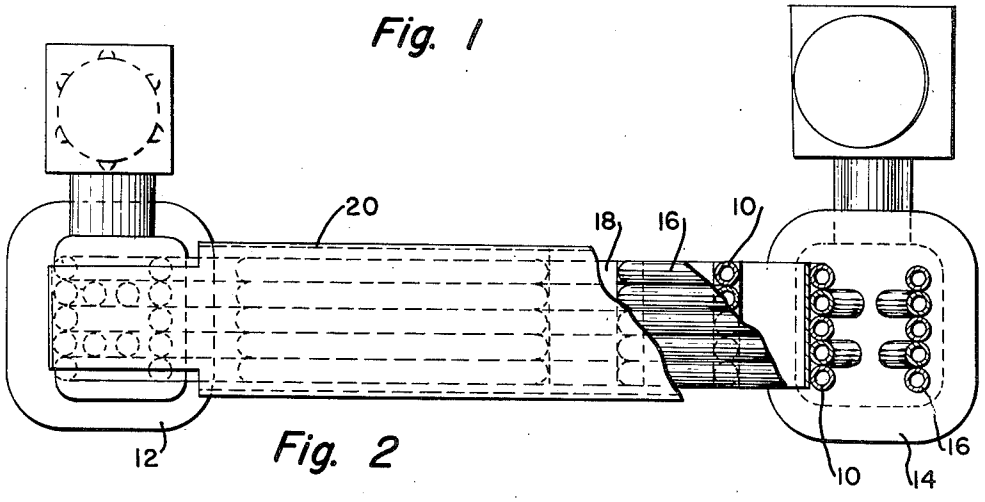


Fig. 2

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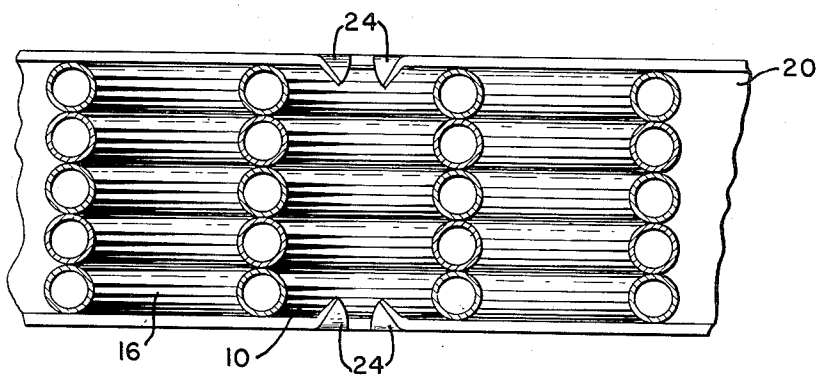


Fig. 3

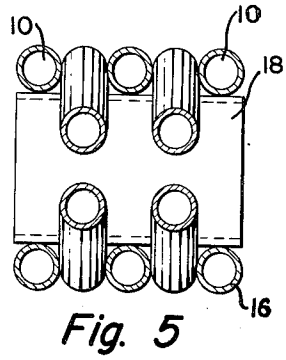


Fig. 5

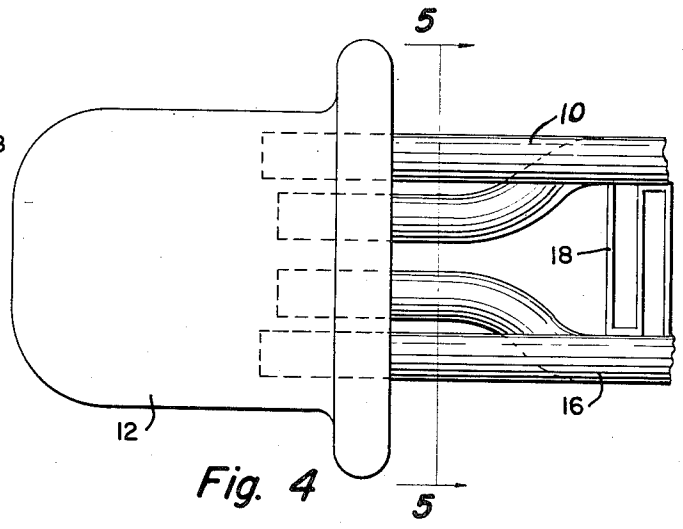


Fig. 4

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2,792,201

HEAT EXCHANGER

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Application August 19, 1954, Serial No. 450,962

2 Claims. (Cl. 257—255)

This invention relates to a refrigerating apparatus and more particularly to a refrigerant condenser.

It has generally been considered desirable to use flat tubing in the manufacture of condensers and the like but flat tubing cannot withstand high internal pressures due to the tendency of the flat walls to bulge outwardly at higher pressures. To overcome this bulging tendency it has been customary to form the tubing with corrugated strips within the flat tubing and to braze the corrugated strips to the walls of the tubing. This arrangement not only increases the cost of the tubing but also makes it impractical to bend the tubing due to the presence of the internal corrugated strip. This then makes it necessary to cut the flat tubing into short lengths and to attach special return bends at the ends of the tubing thereby further increasing the cost and running the risk of introducing dangerous leaks. It is an object of this invention to obtain the advantages of flat walled condenser tubing by placing several small round tubes in side-by-side relationship. With such an arrangement the return bends can be made integral with the straight sections.

It is another object of this invention to provide a rugged and efficient condenser which may be manufactured with a minimum of tooling costs.

Still another object of this invention is to provide a condenser which is small and compact but which does not unduly restrict the flow of refrigerant through the refrigerant passages.

More particularly it is an object of this invention to provide a refrigerant condenser having a plurality of passages which are connected in parallel in a novel manner.

Still another object of this invention is to provide an improved return bend and frame construction for use in a multiple passage refrigerant condenser.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a vertical elevational view showing a preferred embodiment of the invention;

Figure 2 is a plan view with parts broken away;

Figure 3 is a fragmentary sectional view taken substantially on line 3—3 of Figure 1;

Figure 4 is a fragmentary elevational view showing the arrangement of the tubes at the point where they enter the header; and,

Figure 5 is a fragmentary sectional view taken substantially on line 5—5 of Figure 4.

Referring now to the drawings wherein a preferred embodiment of the invention has been shown, reference numeral 10 designates a first set of five parallel tubes arranged in side-by-side relationship and which have been bent into serpentine shape so as to convey refrigerant to be condensed from an inlet header 12 to an outlet

header 14. Reference numeral 16 designates a somewhat similar set of five parallel tubes also located in side-by-side relationship and which likewise serve to convey refrigerant to be condensed from the inlet header 12 to the outlet header 14. The arrangement is such that refrigerant flows through all ten tubes in parallel whereby the restriction to the flow of refrigerant through the condenser is very small in comparison to the size of the tubing used in making the condenser.

The novel arrangement of the return bends of the two sets of tubes 10 and 16 makes it possible to arrange the two sets of tubes in parallel and to form the return bends integral with the straight portions of the tubes. It will be noted that at each return bend the one set of tubes is provided with a relatively sharp bend whereas the other is provided with relatively wide bends. Corrugated fin elements 18 are disposed between the adjacent straight portions of the sets of tubes 10 and 16 so as to facilitate the transfer of heat between air circulated over the condenser and the refrigerant flowing through the internal refrigerant passages formed by the sets of tubes 10 and 16. It will also be noted that the straight portions of the tubes are spaced from one another but that the tubes 10 contact the tubes 16 at each of the return bends.

Stamped sheet metal frame members 20 and 22 are constructed and arranged as shown and serve to hold the adjacent tube sections in proper assembled relationship with one another prior to the brazing operation which serves to braze the tubes, the fins and the headers into a single unitary device. The frame members 20 and 22 are U-shaped in cross section and are provided with inturned ears 24 at the return bends which help to hold the frame members in proper assembled relationship relative to the return bends of the tubes.

As best shown in Figures 4 and 5 of the drawings there are ten individual tubes connected to each of the headers and in order to prevent undue weakening of the header at the point where these ten tubes enter the header, the points of entry for the tubes are arranged in staggered relationship as shown. By virtue of this construction, it is possible to drill holes into the header wall without having the holes contact one another. The headers 12 and 14 cooperate with the brackets 20 and 22 to hold the individual tubes in proper assembled relationship prior to the brazing operation. Each of the brackets include an integral projecting arm 30 in contact with the adjacent header.

While the construction described hereinabove was developed for use as a refrigerant condenser in an automobile air conditioning system wherein it is desirable to use a relatively thin condenser of light-weight construction, it is obvious that certain aspects of the invention are equally applicable to refrigerant evaporators, oil coolers and any other type of heat exchanger.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. In a heat exchange device, a first set of parallel tubes located in side-by-side relationship, a second set of parallel tubes located in side-by-side relationship, header means for connecting the respective ends of said tubes, said tubes being arranged in a serpentine shape with the one set of tubes arranged in parallel spaced relationship to the other set of tubes throughout the straight portions of said sets of tubes, corrugated fin means interposed between said adjacent straight portions of said sets of tubes, said straight portions being connected by return bends, said first set of tubes being

arranged to contact aid second set of tubes at each of the return bends, and stamped sheet metal channel members engaging opposite sides of said sets of tubes at said return bends, said channel members having integrally formed ears projecting into said return bends to hold said set of tubes in contact with one another at said return bends.

2. In a heat exchange device, a plurality of sets of parallel tubes in which the tubes in each set are located in side-by-side relationship, header means for connecting the ends of said tubes, said tubes being bent into serpentine shape with the straight portions of one set of tubes arranged in parallel spaced relationship to the straight portion of another set of tubes, individual strips of corrugated fins interposed between adjacent straight portions of said sets of tubes, said straight portions being connected by return bends, the return bends of one set of tubes being arranged to contact with the return bends of another set of tubes at each return bend, end brackets contacting said return bends, said end brackets being substantially U-shaped in cross section with the arms of the U contacting opposite sides of said set of tubes so as to hold the tubes in each of said sets in contact with the tubes in each set, integral tongues provided on said arms and projecting into the bight of the return bends so as to hold said brackets in assembled relationship relative to said return bends.

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