United States Patent [19]

Frost

[11] **3,763,930**

[45] **Oct. 9, 1973**

[54] **HEAT EXCHANGER**

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[73] Assignee: **Modine Manufacturing Company,** Racine, Wis.

[22] Filed: **Feb. 4, 1972**

[21] Appl. No.: **223,430**

Related U.S. Application Data

[62] Division of Ser. No. 23,192, Feb. 4, 1972, Pat. No. 3,688,372.

[52] **U.S. Cl.**..... **165/154,** 29/157.3 A, 29/476.5

[51] **Int. Cl.**..... **F28d 7/10**

[58] **Field of Search**..... 29/486, 476.5, 157.3 A; 165/184, 154

[56] **References Cited**

UNITED STATES PATENTS

2,752,128	6/1956	Dedo	165/155
2,720,022	10/1955	Snively	29/476.5

FOREIGN PATENTS OR APPLICATIONS

160,404	5/1941	Germany	29/476.5

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[57] **ABSTRACT**

A heat exchanger in which a continuous, integral, formed sheet of heat exchange material such as heat conducting metal is shaped to provide a first area and a second area spaced from each other to provide a fluid flow space and a third area in this flow space provided with displaced turbulence producing portions in the flow space.

Because all of these areas are parts of one integral sheet a preferred embodiment of the heat exchanger is the tubular concentric type in which the first and second areas are formed as concentric cylinders and the third area also has a curved cross section and occupies the space between these two areas. This invention also includes a method of making a heat exchanger of the tubular type in which a metal sheet is provided with spaced apart first and second areas and an intermediate third area having turbulence promoting projections and then rolling the sheet upon itself to form a tube of at least three concentric parts in which the inner and outer parts are solid and spaced from each other to provide an annular flow space and the third part is located in this space and contains the turbulence promoting projections to comprise a turbulator.

7 Claims, 6 Drawing Figures

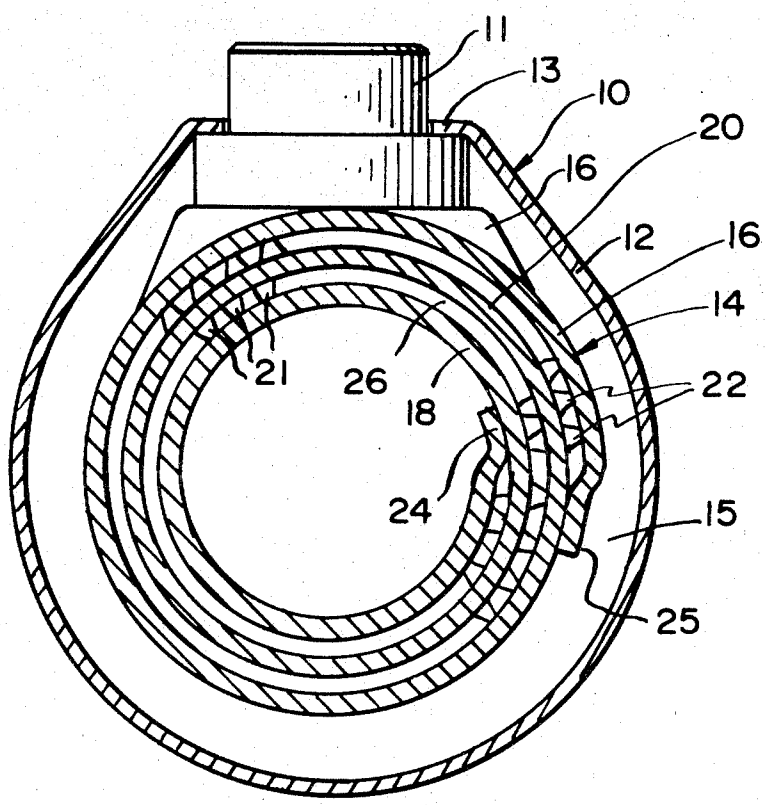


FIG.1

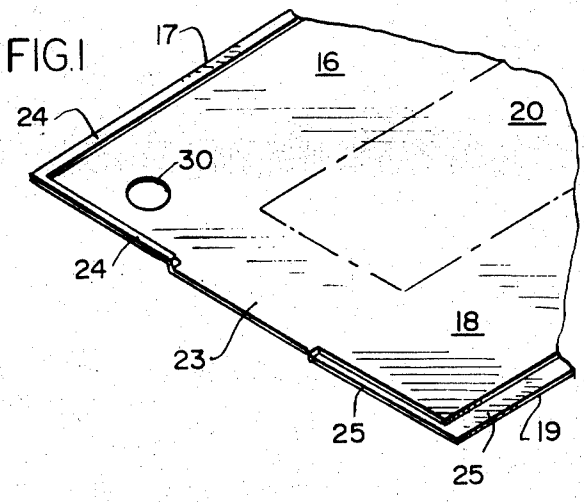


FIG.3

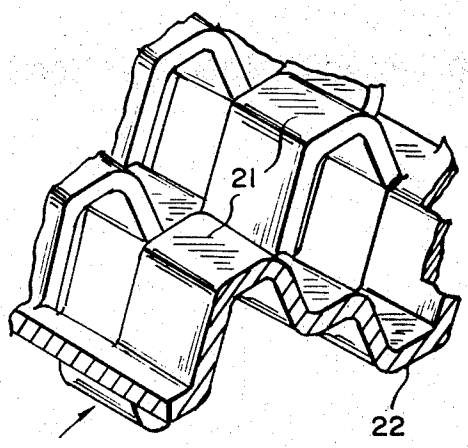


FIG.2

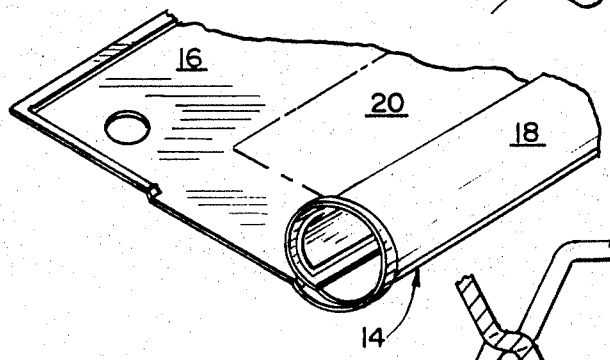


FIG.4

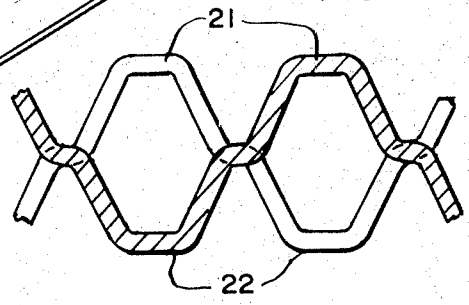
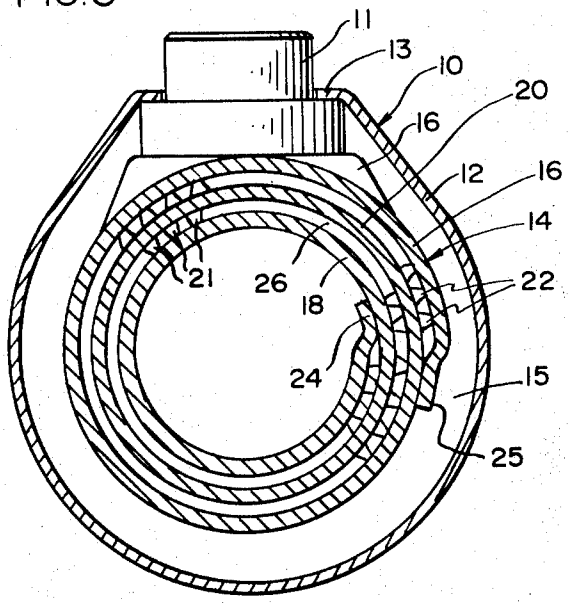


FIG.5



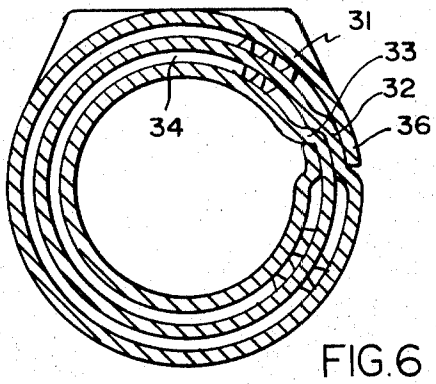


FIG.6

HEAT EXCHANGER

This application is a division of application Ser. No. 23,192, filed Mar. 27, 1970, now U.S. Pat. No. 3,688,372 issued Sept. 5, 1972.

Heat exchangers of this general type are disclosed, for example, in U. S. Pat. No. 2,752,128 assigned to the same assignee as the present application. These tubular heat exchangers are widely used as transmission oil coolers and particularly for cooling the oil of torque converters in automatic transmission vehicles.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary perspective view of a metal sheet used in making the heat exchangers of this invention.

FIG. 2 is a view similar to FIG. 1 but illustrating an intermediate arrangement in the method of manufacturing the exchanger.

FIG. 3 is a fragmentary perspective view of a portion of the turbulence producing third area 20.

FIG. 4 is a fragmentary sectional view through the turbulence producing portions taken along line 4—4 of FIG. 3.

FIG. 5 is a transverse sectional view through one embodiment of the completed tubular heat exchanger.

FIG. 6 is a view similar to FIG. 5 but showing a portion only of a second embodiment of a heat exchanger.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The completed oil cooler 10, as illustrated in cross section in FIG. 4, comprises a pair of end fittings 11 of which only one is illustrated but with these end fittings being provided at opposite ends of the exchanger to provide oil inlet and outlet passages. The completed oil cooler 10 comprises an outer housing 12 that is tubular with a flat top 13 through which extends the pair of fittings 11.

Located within the outer housing 12 is a heat exchanger 14. This exchanger 14 is spaced from the housing 12 to provide an annular passage 15 for the liquid coolant.

In making the heat exchanger 14 itself there is provided a continuous, integral sheet of metal 23 as illustrated in FIGS. 1 and 2 with this sheet having a first area 16 at one longitudinal edge 17 and a second area 18 adjacent the opposite longitudinal edge 19. These areas 16 and 18 are imperforate and are spaced apart so as to provide an intermediate third area 20 between them. This third area is provided with laterally projecting turbulence producing portions 21 and 22 that are in staggered rows with the projections extending from opposite sides of the sheet 23. These projections are formed by slits in the sheet so that the oil during its flow through the cooler passes over, around and under them. Such an arrangement is illustrated in greater detail in the above U. S. Pat. No. 2,752,128.

The sheet 23 also contains opposite edge and end flanges 24 and 25 that are adjacent the edges 17 and 19, respectively. As can be seen in FIG. 1 these flanges are of generally right angular cross section so that the outer parts are generally parallel to the flat sheet 23.

In forming the heat exchanger 14 the sheet 23 is rolled upon itself as illustrated during a preliminary stage in FIG. 2. This forms a tube comprising the inner area 18, the turbulator intermediate area 20 and the outer area 16. As illustrated in FIG. 4 these areas 16

and 18 are spaced apart to provide the fluid flow space 26 in which is substantially centrally located the perforated turbulator third area 20. The projections 21 that provide the turbulence extend inwardly in the illustrated embodiment while the other projections 22 extend outwardly. Both sets of projections 21 and 22 have flat peaks 27 and 28 which engage the adjacent surface of the corresponding tubular areas 16 and 18. In sealing the sides of the heat exchanger 14 the above described edge flanges 24 and 25 are bonded to the rolled up tube as illustrated in FIG. 4.

As illustrated, the fitting 11 at each end of the cooler extends through the housing 12 and is held in an opening 30 at an end of the metal sheet first area 16.

FIG. 6 is similar to FIG. 5 but illustrates a second embodiment of the invention. Both embodiments are quite similar with the principal difference being the use of a flat edge 36 on the outer area 31 of the metal sheet and locating transversely curved portions 32 and 33 adjacent this flat edge to provide the flow and turbulator space 34.

After the tube has been rolled as described into the concentric portions as illustrated in FIGS. 4 and 5 the assembly is bonded together at contacting areas by any desired well known method.

The heat exchanger of this invention is adaptable to very high speed assembly and with greater accuracy in the mass production of the exchangers so that the cost of producing them is reduced. In producing the exchanger it is convenient to roll the sheet of metal 23 from a continuous coil of stock into a press where the sheet is formed and prepared for the rolling as illustrated in FIG. 2. After rolling the ends of each exchanger portion 14 and the longitudinal seams are sealed by a process which may be induction welding. The fittings 11 are then added before assembling within the housing 12 to make the oil cooler 10. It is not necessary to expand the inner diameter to provide a proper contact between the parts as this contact is achieved in the rolling process, as described.

Having described my invention as related to the embodiments shown in the accompanying drawings, it is my intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the appended claims.

I claim:

1. For use in a heat exchanger, means for disposing a first fluid to have heat exchange with a second fluid, comprising: a continuous, integral, formed sheet of heat exchange material having a first area, a second area spaced therefrom to provide a laterally bounded fluid flow space therebetween having inlet and outlet ends, and a third area in said flow space between said first and second areas having a first side portion contiguous with said first area and an opposite side portion contiguous with said second area, means providing displaced turbulence producing portions of said sheet at said third area in said flow space, and means adjacent said ends joining said first and second areas in fluid confining relationship enclosing said third area for causing said sheet to define an enclosed fluid passage between said inlet and outlet ends for conducting a first fluid to have heat transfer association with a second fluid through said formed sheet.

2. The heat exchanger of claim 1 wherein there are provided a plurality of said displaced portions on oppo-

site sides of said third area, some of said portions engaging said first area and others engaging said second area.

3. The heat exchanger of claim 2 wherein said displaced portions comprise projections having flat peaks engaging said first and second areas.

4. The heat exchanger of claim 1 wherein said means joining said first and second areas comprise flange areas on said formed sheet engaging adjacent portions of said sheet to enclose substantially said third area.

5. The heat exchanger of claim 1 wherein said heat exchanger is substantially tubular with said first, second and third areas being substantially concentric cylindrical sections.

6. The heat exchanger of claim 5 wherein there are provided a plurality of said displaced portions on opposite sides of said third area, some of said portions engaging said first area and others engaging said second area, and said displaced portions comprise projections having flat peaks engaging said first and second areas.

7. The heat exchanger of claim 6 wherein said means joining said first and second areas comprise flange areas on said formed sheet engaging adjacent portions of said sheet to enclose substantially said third area.

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