Nov. 11, 1969 E. E. GOETZ 3,477,499

ROTATABLE THERMAL TRANSFER UNITS

Filed June 13, 1968 3 Sheets-Sheet 1

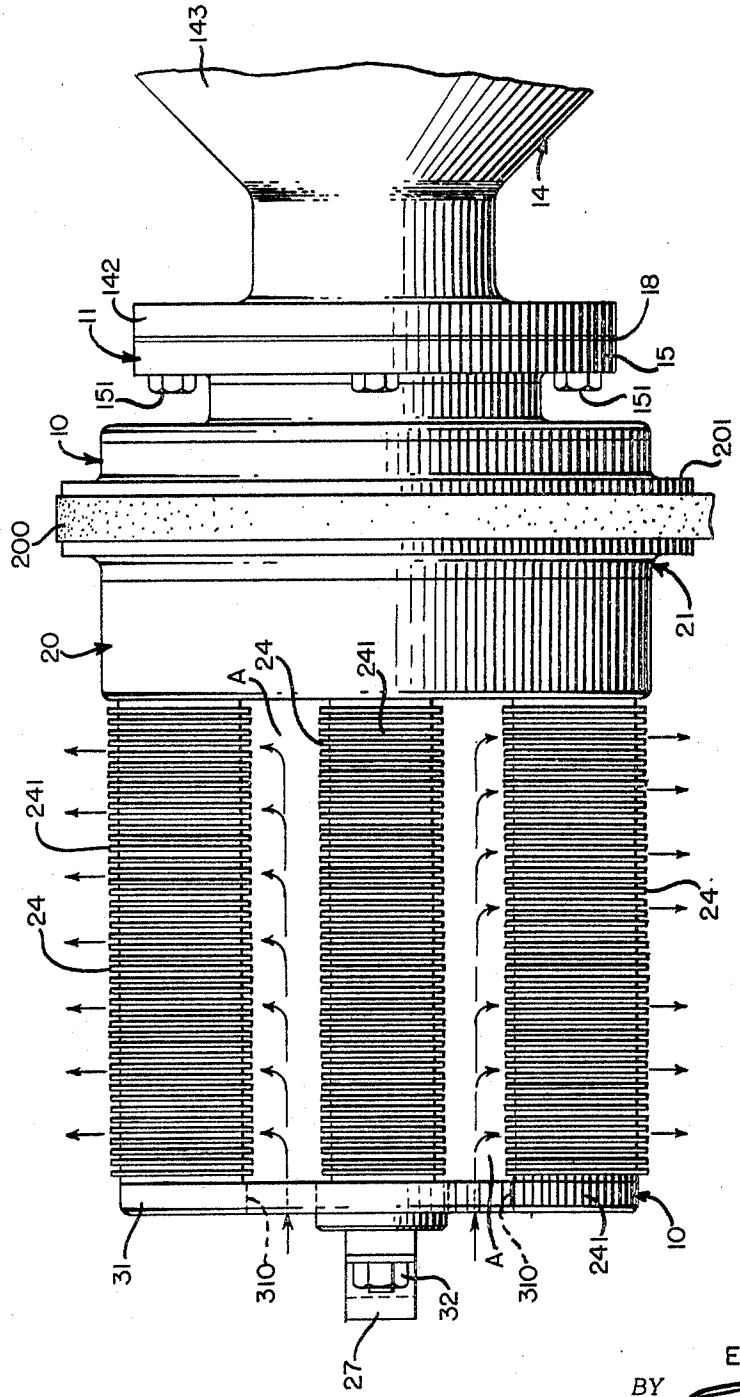


FIG. 1

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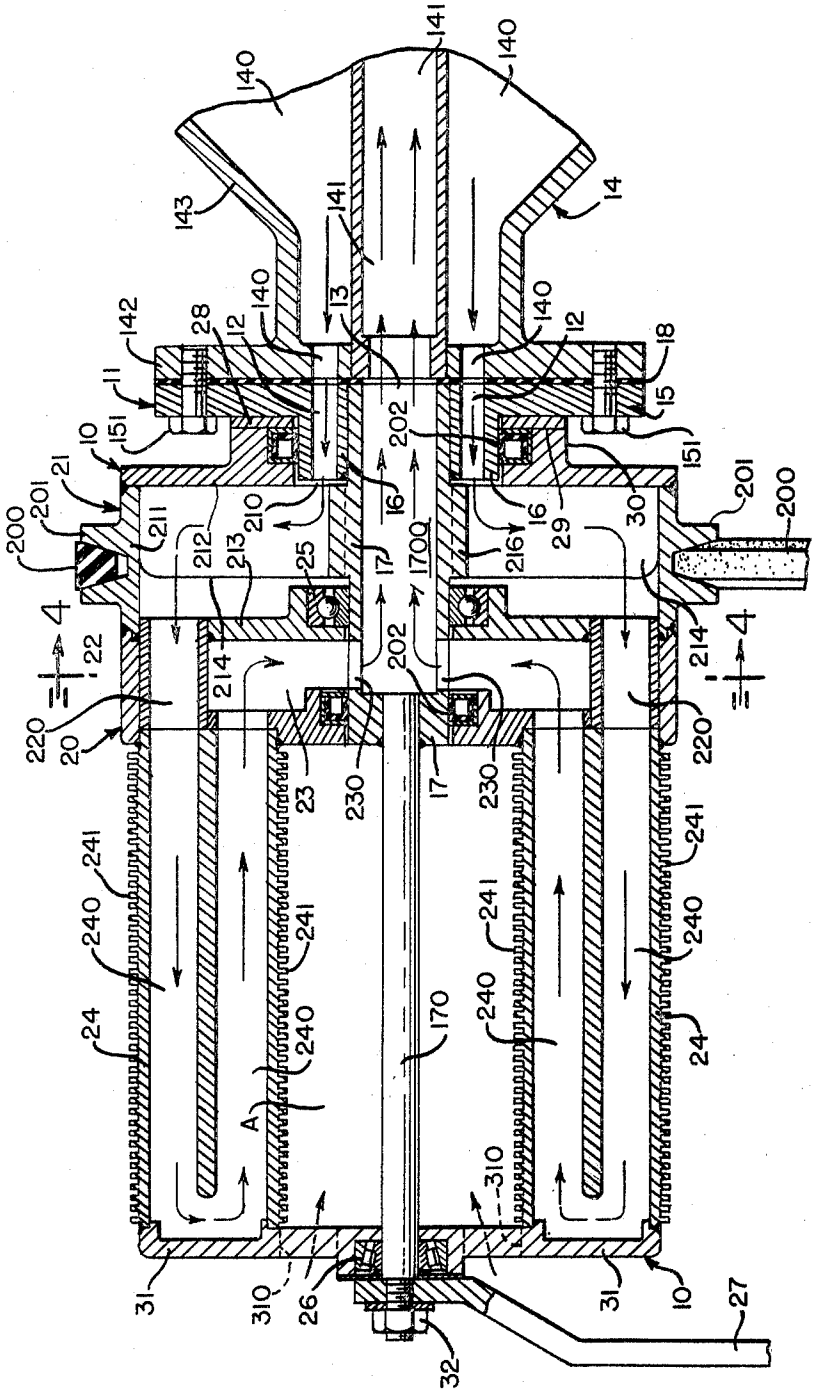


FIG. 2

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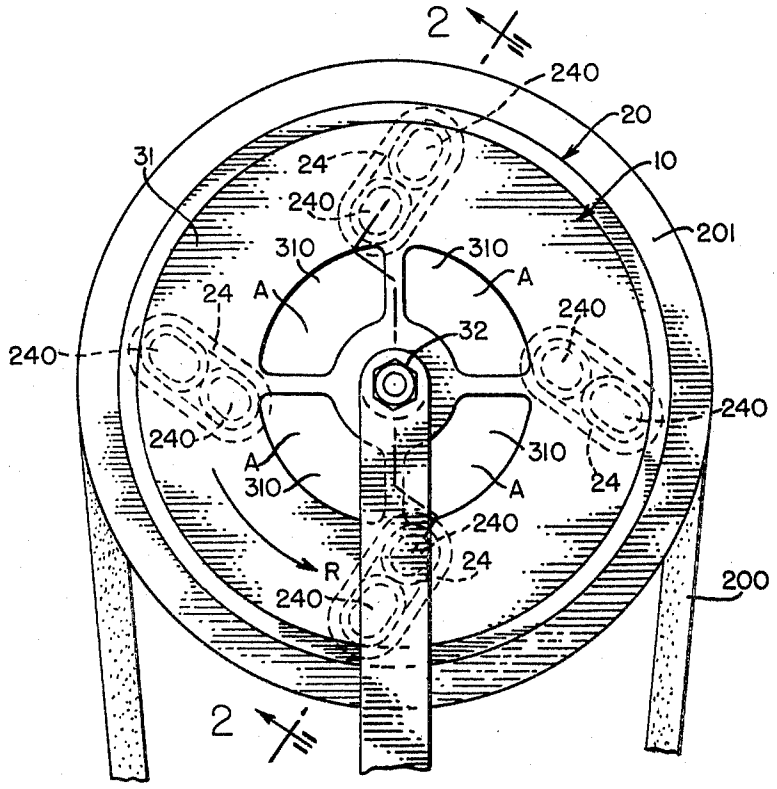


FIG. 3

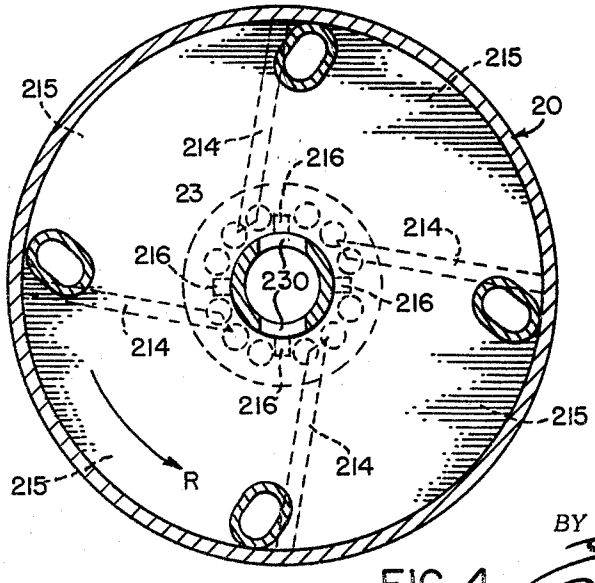


FIG. 4

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ROTATABLE THERMAL TRANSFER UNITS

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ABSTRACT OF THE DISCLOSURE

A thermal transfer unit for cooling or heating thermal fluid of the cooling or heating circulation system of other equipment, said thermal transfer unit comprising a fixed mounting means including a non-rotatable shaft extending therefrom, a pump element having a suitably vaned pump chamber and a thermal fluid collection chamber rotatably mounted on said fixed shaft, a plurality of suitably formed preferably finned thermal transfer elements having U-shaped thermal passages therein fixedly mounted on and extending axially outwardly from said pump element and disposed in annularly spaced relationship with respect to each other and the axis of rotation of said pump element, said thermal transfer elements being so shaped and oriented as to provide forced circulation of ambient air thereover whereby to increase the thermal transfer effectiveness thereof during rotation of said pump element on which they are mounted, the U-shaped thermal passage of each said thermal transfer element being connected through suitable passages at one end to said pump chamber and at the other end to said fluid collection chamber, said fixed mounting means having thermal fluid inlet passages therein communicating with said pump chamber and a thermal fluid outlet passage therein communicating with said thermal fluid collection chamber, said thermal fluid inlet and outlet passages of said fixed mounting means of said thermal transfer unit being connectable to thermal fluid outlet and inlet passages of said cooling or heating circulation system of said other equipment. If the thermal fluid of the circulation system of said other equipment is at a temperature higher than that of ambient air, then the thermal transfer unit functions to cool said thermal fluid. However, if the thermal fluid of the circulation system of said other equipment is at a temperature lower than that of ambient air, then the thermal transfer unit functions to heat said thermal fluid.

This invention relates to thermal transfer units of the type usable to cool or heat thermal fluids from other equipment.

The primary object of the instant invention is to provide a thermal transfer unit for thermal fluids from the cooling or heating fluid circulation systems of other equipment employing ambient air as the cooling or heating medium as the case may be, which heat transfer unit incorporates a pump and thermal transfer elements wherein the said thermal transfer elements are formed and oriented to increase their own effectiveness by providing circulation of ambient air thereover; the said ambient air may be at ambient temperatures or it may be cooled or heated to meet the requirement of particular installations.

Other objects of the invention will become apparent by reference to the following detailed description taken in connection with the accompanying drawings in which:

FIG.1 is a longitudinal elevational view of a thermal transfer unit embodying the invention.

FIG. 2 is a longitudinal sectional view taken on the line 2—2 of FIG. 3.

FIG. 3 is an end elevational view taken from the left hand end of FIGS. 1 and 2.

FIG. 4 is a cross sectional view taken substantially on the line 4—4 of FIG. 2.

Referring now to the drawings wherein like reference characters refer to like and coresponding parts throughout the several views, the embodiment of the thermal transfer unit **10** of the invention disclosed for illustrative purposes consists in general of a fixed or stationary mounting member **11** having an inlet **12** from and an outlet **13** to a thermal circulating system outlet **140** and inlet **141** respectively of other equipment **14** such as, for example, but not limiting, engines, chemical process elements, machine tools, reactors, or other equipment requiring either the cooling or heating of fluids therefrom or from the thermal fluid of the cooling or heating system thereof.

For convenience, the invention will be described as a thermal transfer unit for the cooling of thermal fluid of the cooling circulation system of any type of other equipment **14**; however, it is obvious that the use of thermal transfer units of the invention need not be so limited. Furthermore, ambient air at normal ambient air temperatures generally will be employed to cool thermal fluid from the said other equipment **14**; however, pre-cooled ambient air or pre-heated ambient air may be employed when and as it is required to cool or heat the thermal fluid from other equipment **14**.

In the particular embodiment of the invention shown in the drawings for illustrative purposes, the fixed or stationary mounting member **11** may be of any suitable design or detail. The particular mounting member **11** shown in the drawings consists of a flange **15** having an integrally formed central hollow collar **16** extending therefrom into which is fixed a central shaft **17** extending axially outwardly from said hollow collar **16**. The said flange **15** of the stationary mounting member **11** abuts a complementary flange **142** of a housing **143** of said other equipment **14** with a gasket **18** therebetween, and is preferably secured to said flange **142** of said other equipment **14** by suitable studs **151**.

The said thermal transfer assembly **20** is the rotating element of the thermal transfer unit **10** and broadly consists of a pump element **21** including an annular pump chamber **22**, an annular cooled thermal fluid collection chamber **23**, and a plurality of axially extending annularly arranged thermal transfer elements **24**. Each said thermal transfer element **24** has a U-shaped passage **240** therein which is connected at one end to and communicating with said annular pump element **21** preferably adjacent the outer periphery thereof, and the other end of said U-shaped passage **240** is connected to and communicates with the said annular cooled fluid collection chamber **23**. The said thermal transfer elements **24** are suitably finned at **241** whereby to provide effective thermal transfer from thermal fluid passing therethrough to ambient air.

The said pump element **21** is annularly formed to provide an annular pump chamber **22** having suitable passages **210** thereinto from the inlets **12** of the mounting member **11**. The pump element **21** is annularly formed with its annular pump chamber **22** defined by an annular outer wall **211** and end members **212** and **213**, and rotates around the fixed central shaft **17** as an element of the thermal transfer assembly **20**. The said fixed central shaft **17** which extends axially outwardly from the central an-

nular collar 16 of the mounting member 11 serves as the inner annular wall of the said pump element 21.

The said pump element 21 has a plurality of generally radially but slightly angularly disposed fixed vanes 214 therein dividing the said annular pump chamber 22 into four divisions or sub-chambers 215. The said fixed vanes 214 are secured at their radially outer ends to the outer annular wall 211 of the pump chamber 22, and the axially inner edges of the said fixed vanes 214 are secured to the axially inner end member 212 of the said pump chamber 22. The radially inner ends of the said fixed vanes 214 are spaced from the said fixed central shaft 17 as best shown in FIG. 4, while the axially outer edges of the said fixed vanes 214 are spaced from the said axially outer end member 213 of the said pump chamber 22 as best shown in FIG. 2.

By reference to FIGS. 2 and 4, it also will be noted that each fixed pump vane 214 is located adjacent an outlet 220 from the pump chamber 22 to the radially outermost leg of the U-shaped passage 240 of the thermal transfer element 24, the radially innermost leg of the said U-shaped passage 240 of the thermal transfer element 24 being connected to the thermal fluid collection chamber formed in the said thermal transfer assembly 20 axially adjacent the said pump element 21.

Adjacent the radially spaced inner ends of each of the fixed vanes 214 of the pump element 21, but spaced in offset relationship thereto, are baffles 216 radially extending from the said fixed central shaft 17. These baffles 216 are preferably employed to interrupt the tendency for free flow of thermal fluid around the fixed central shaft 17 between the free inner ends of the fixed vanes 214 forming the pump sub-chambers 215 as the thermal transfer assembly 20, including the pump element 21, is rotated with respect to the said fixed central shaft 17. While the hereinbefore described type of pump element 21 is preferred, it is obvious that other pump means preferably forming a part of the thermal transfer assembly 20 may be employed.

The said fluid transfer assembly 20 is rotatably mounted on the fixed central shaft 17 extending axially outwardly from the central collar 16 of the said mounting member, preferably employing a suitable ball bearing 25 as anti-friction means. In the particular embodiment of the thermal transfer unit disclosed herein, the said fixed central shaft 17 may be extended axially outwardly, either full size (not shown) or smaller as shown at 170. The outer end of the said shaft extension 170 is supported preferably in a combined thrust and radial bearing 26 where the said outer end of the said shaft extension 170 is supported on a suitable supporting arm or the like 27 as best shown in FIG. 2. A suitable annular thrust bearing plate 28 is disposed around the collar 16 of the mounting member 11 between the flange 15 of the said mounting member 11 and an annular bearing face 29 provided on the inner end of an axially inwardly disposed annular hub 30 formed on the said thermal transfer assembly 20. Suitable fluid seals 202 are provided between the rotatably mounted fluid transfer assembly 20 and the fixed mounting member 11 and its fixed central shaft 17. The said fluid transfer assembly may be rotated by any suitable means, not shown, which may employ a V-belt drive having a V-belt 200 running over a V-belt pulley 201 formed integral with the outer wall of the annular pump element 21.

Thermal fluid to be cooled enters the said pump element 21 through suitable passages 210 communicating with the inlet 12 in the mounting member 11 from the outlet 140 of the thermal circulating system of said other equipment 14. Cooled thermal fluid passes from the annular thermal fluid collection chamber 23 through suitable passages 230 to and through the hollow end 1700 of the said fixed central shaft 17 extending axially from the hollow collar 16 of the mounting flange 15, which in turn communicates

with the inlet 141 of the said thermal circulating system of said other equipment 14.

In the particular embodiment of the invention shown in the drawings for illustrative purposes, the thermal transfer elements 24 are tubular in shape, are provided with a longitudinal partition 242 therein, are suitably capped to provide the said U-shaped passage 240 therein, and are angularly oriented as best shown in FIG. 3 to assure the radial movement of the ambient air through the central space A defined by the said thermal transfer elements 24 as the thermal transfer assembly rotates. Air from the said central space A moves radially outwardly between the said thermal transfer elements 24. The capping of the said thermal transfer elements 24 is accomplished by a cover member 31 which is formed to cap all of the several thermal transfer elements 24 simultaneously and hold their extended ends firmly in their same annular arrangement as the inner ends thereof which are fixed to the annular pump chamber 22 and the annular fluid collection chamber 23 of the said pump element 21.

The outer race of the combined thrust and roller bearing 26 is fixed in a central hub 310 of the said cover member 31, while the inner race of the said bearing 26 is suitably mounted on the outer end portion of the extension 170 of the said fixed center shaft 17. The outer end of the said extension shaft 170 is preferably shouldered and threaded to accommodate a securing nut 32 which secures the cover member 31 in capped relationship with respect to the thermal transfer elements 24 and to the end of the shaft extension 170 at the supporting arm 27. Obviously, details of the construction and arrangement of the elements of the invention may be varied or altered to meet alternate design and mass production requirements.

The said cover member 31 is provided with a plurality of air intake apertures 310 therein through which ambient air passes longitudinally into the central space A generally defined by the thermal transfer elements 24 as the thermal transfer assembly rotates as indicated by the arrow R in FIGS. 3 and 4, which ambient air passes radially outwardly from the said space A through the space between said transfer elements as indicated by the dot and dash arrows in FIG. 3. Although not shown in detail, it is obvious that the size, shape and arrangement of the said thermal transfer elements 24 around the axis of rotation of the thermal transfer assembly and their selected angular orientation may be altered to suit specific design conditions and manufacturing preferences.

Although but a single embodiment of the invention has been disclosed and described in detail herein, it is obvious that many changes may be made in the size, shape, detail and arrangement of the various elements thereof, all without departing from the scope of the invention as defined by the appended claims.

I claim:

1. A thermal transfer unit for cooling or heating thermal fluid from the cooling or heating circulation system of other equipment comprising

a mounting member fixable to a suitable support having an inlet from and an outlet to the thermal fluid circulating system of said other equipment,

a thermal transfer assembly rotatably mounted on said mounting member and means rotating the same,

said thermal transfer assembly including

a pump element having its inlet communicating with the thermal fluid inlet of said mounting member,

an annular fluid collection chamber having its outlet communicating with the thermal fluid outlet of said mounting member,

said pump element having a plurality of axially outwardly disposed outlets therefrom annularly arranged adjacent its outer periphery and equidistant from the axis of rotation of said thermal transfer assembly, and

axially disposed thermal transfer elements extend-

ing axially outwardly from said pump element, each partitioned to provide a longitudinal U-shaped circulation chamber therethrough communicating at its inlet end with one of said thermal fluid outlets of said pump and at its outlet end with an inlet provided in said annular thermal fluid collection chamber.

2. A thermal transfer unit as claimed in claim 1 wherein

a cover member is provided over said thermal transfer elements having apertures therein admitting ambient air axially in the longitudinal axially central space generally defined by said thermal transfer elements as the said thermal transfer assembly rotates from whence it passes radially outwardly between said thermal transfer elements.

3. A thermal transfer unit as claimed in claim 1 wherein

said pump element includes a plurality of generally radially disposed fixed vanes dividing said pump chamber into a like number of sub-chambers having their radially inner ends spaced from the said central shaft,

each of said thermal outlets from said pump chamber communicating with one of said pump sub-chambers.

4. A thermal transfer unit as claimed in claim 1 wherein

said pump element includes a plurality of generally radially disposed fixed vanes dividing said pump chamber into a like number of sub-chambers with their radially inner ends spaced from the said central shaft and their radially outer ends disposed adjacent an outlet from said pump chamber,

each of the said thermal outlets from said pump chamber communicating with one of said pump sub-chambers,

said central shaft having an axially disposed baffle extending radially into each said sub-chamber located in spaced relationship from the radially inner end of one of said pump vanes and substantially radially opposite a thermal outlet from said pump.

5. A thermal transfer unit for cooling or heating thermal fluid of the cooling or heating circulation system of other equipment, said thermal transfer unit comprising

a fixed mounting member having an inlet from and an outlet to said thermal fluid circulation system of said other equipment,

a pump element rotatably mounted on said fixed mounting member including suitably formed and finned thermal transfer elements extending therefrom disposed in annular spaced relationship with respect to each other and the axis of rotation of said element,

each said thermal transfer element and said pump element being formed to provided for circulation of thermal fluid therethrough from said inlet from and to said outlet to said thermal circulation system of said other equipment, and

means rotating said pump element including said thermal transfer elements extending therefrom,

said thermal transfer elements being formed to serve as means for providing forced circulation of ambient air thereover.

6. A thermal transfer unit for cooling or heating thermal fluid from the cooling or heating circulation system of other equipment comprising

a mounting member fixable to a suitable support having an inlet from and an outlet to the thermal fluid circulating system of said other equipment,

a pump element including an annular pump chamber and an annular fluid collection chamber,

means rotatably mounting said pump element on said fixed mounting member having the inlet to said pump chamber communicating with said thermal fluid inlet of said mounting member,

means rotating said pump element,

said pump element having a plurality of annularly arranged axially disposed thermal fluid outlets from said pump chamber, and

axially disposed thermal transfer elements mounted on and extending axially outwardly from said pump element each partitioned to provide a longitudinal U-shaped circulation chamber therethrough communicating at its inlet with one of the thermal fluid outlets from said pump chamber and at its outlet end with said annular thermal fluid collection chamber,

said thermal fluid collection chamber communicating with said outlet in said mounting member,

said thermal transfer elements being formed and oriented with respect to the axis of rotation of said pump element to provide movement of ambient air thereover whereby to cool or heat the thermal fluid passing through said thermal transfer unit as the case may be.

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MEYER PERLIN, Primary Examiner

U.S. Cl. X.R.

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