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Bimshas, Jr. et al.

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[54] **ROTATABLE FINNED HEAT TRANSFER DEVICE**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

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[52] **U.S. Cl.**..... **165/86,** 165/107, 165/185, 74/5 R

[51] **Int. Cl.**..... **F28f 5/00,** F28f 13/12

[58] **Field of Search** ..... 165/86, 106, 107, 185; 310/57, 60 R; 126/247

[56] **References Cited**

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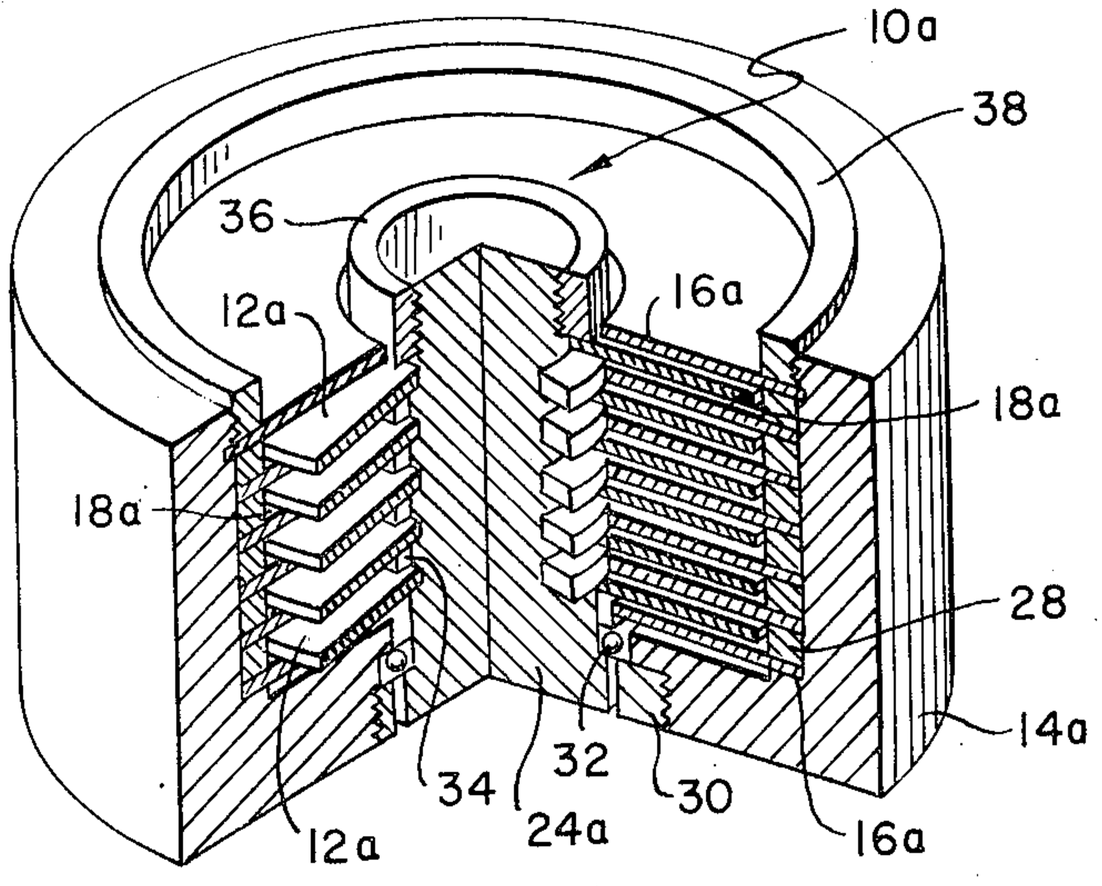
[57] **ABSTRACT**

A heat transfer device includes first and second members mounted for continuous relative rotation in either of a clockwise or a counterclockwise direction while maintaining substantially equally sized gaps between a plurality of equally spaced concentric fins which are alternately disposed in overlapping relationship.

1 Claim, 4 Drawing Figures



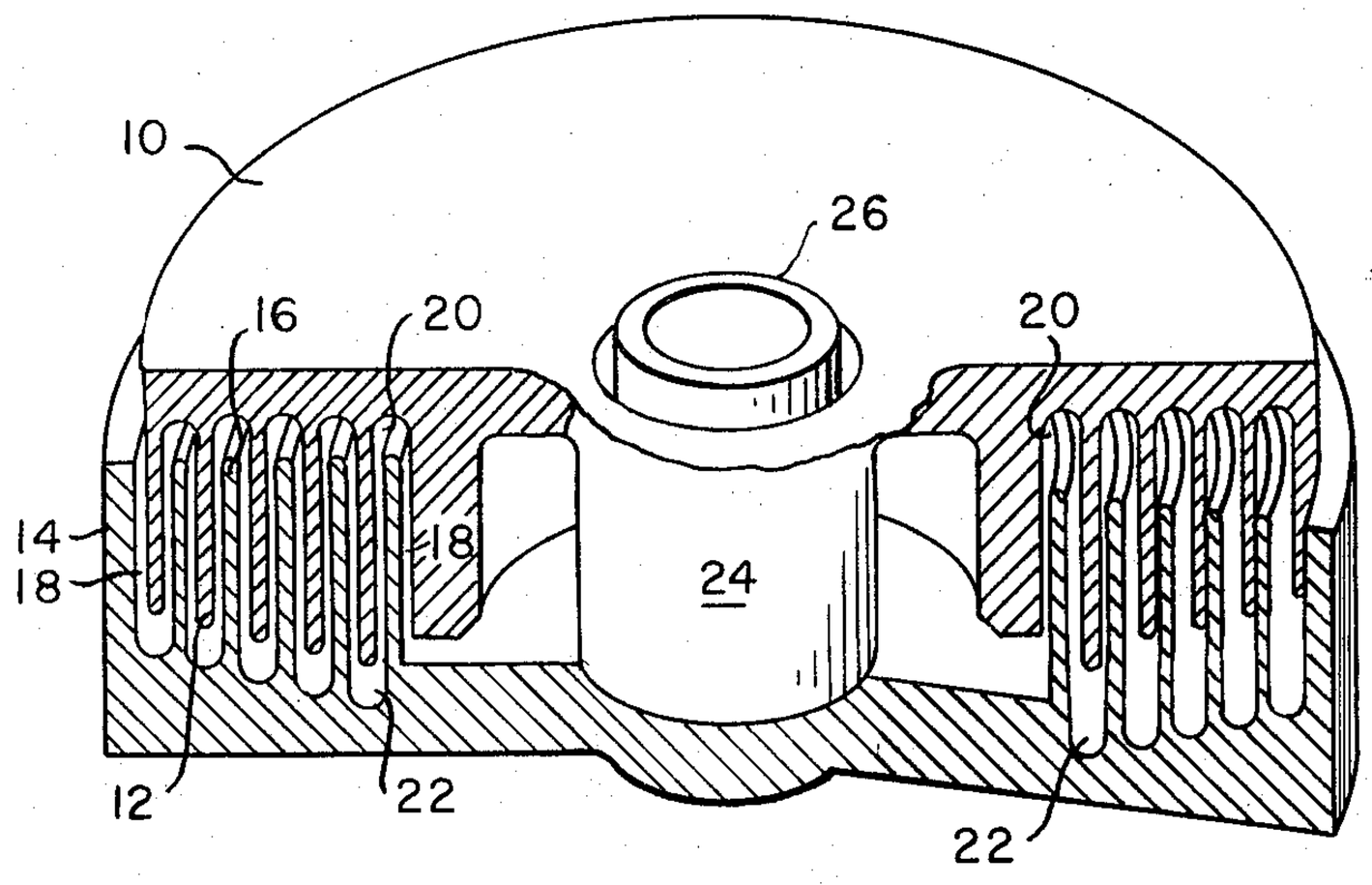

10
26
16
20
20
14
18
18
24
12
22
22

FIG. 1.

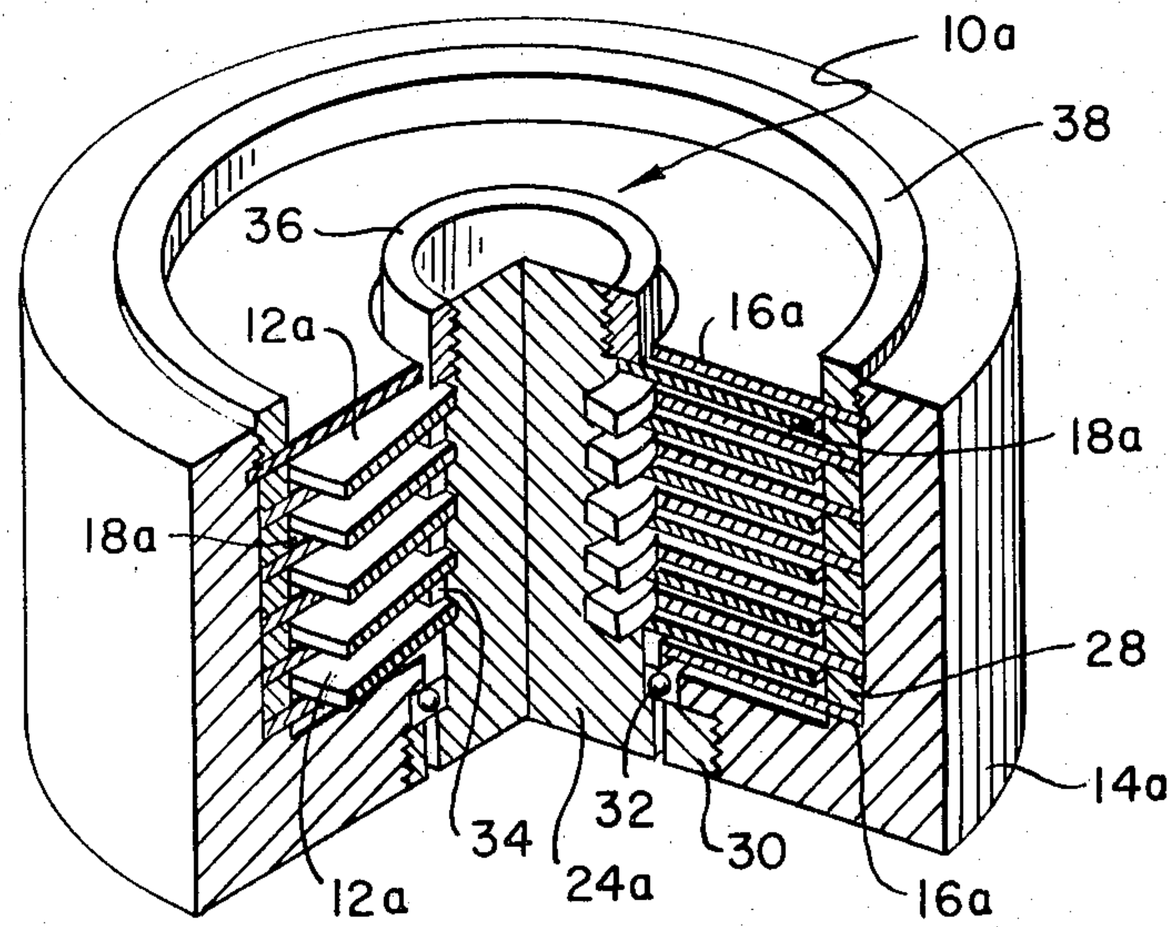

10a
38
36
12a
16a
18a
18a
28
14a
34
32
30
12a
24a
16a

FIG. 2.

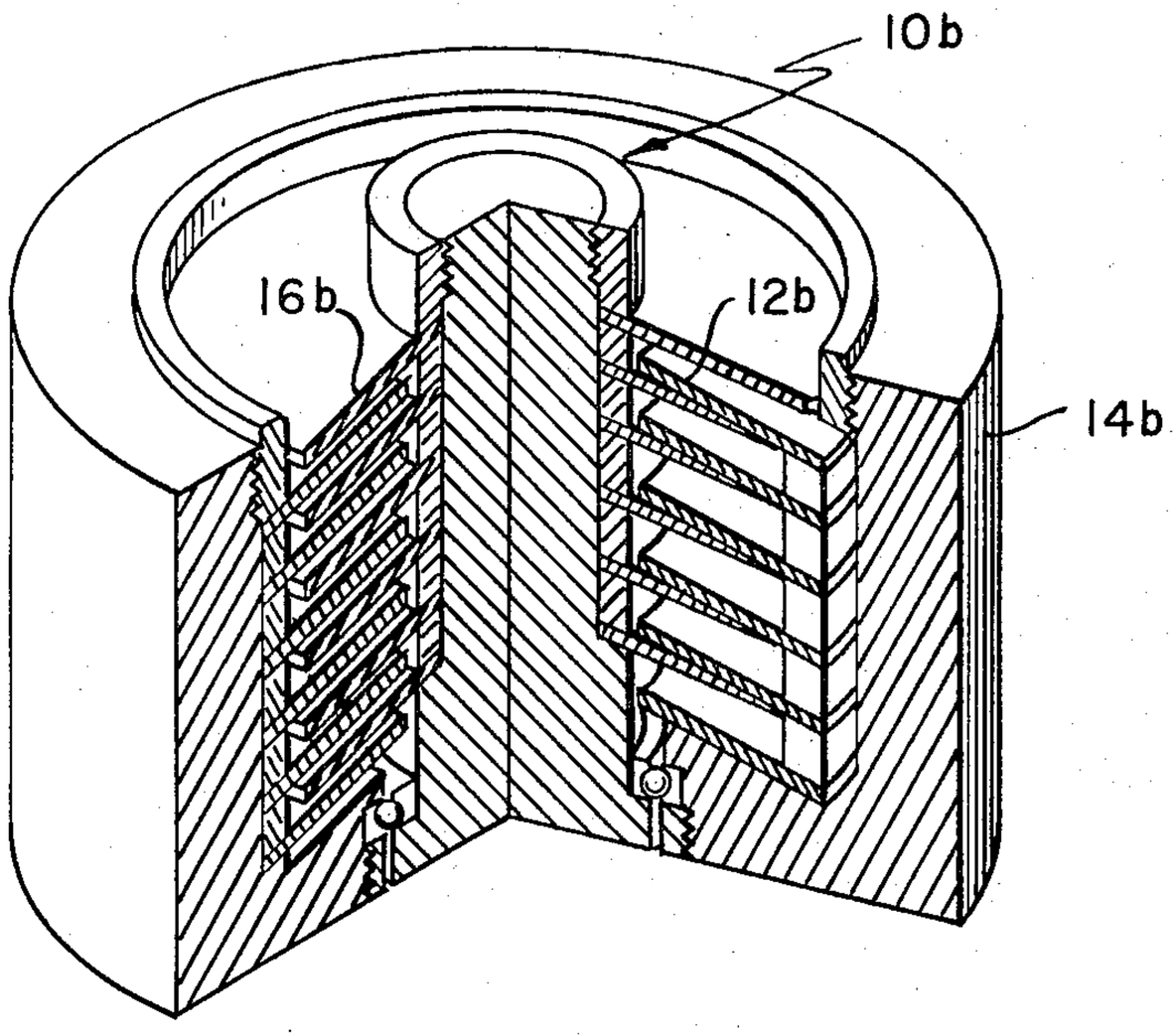


FIG. 3.

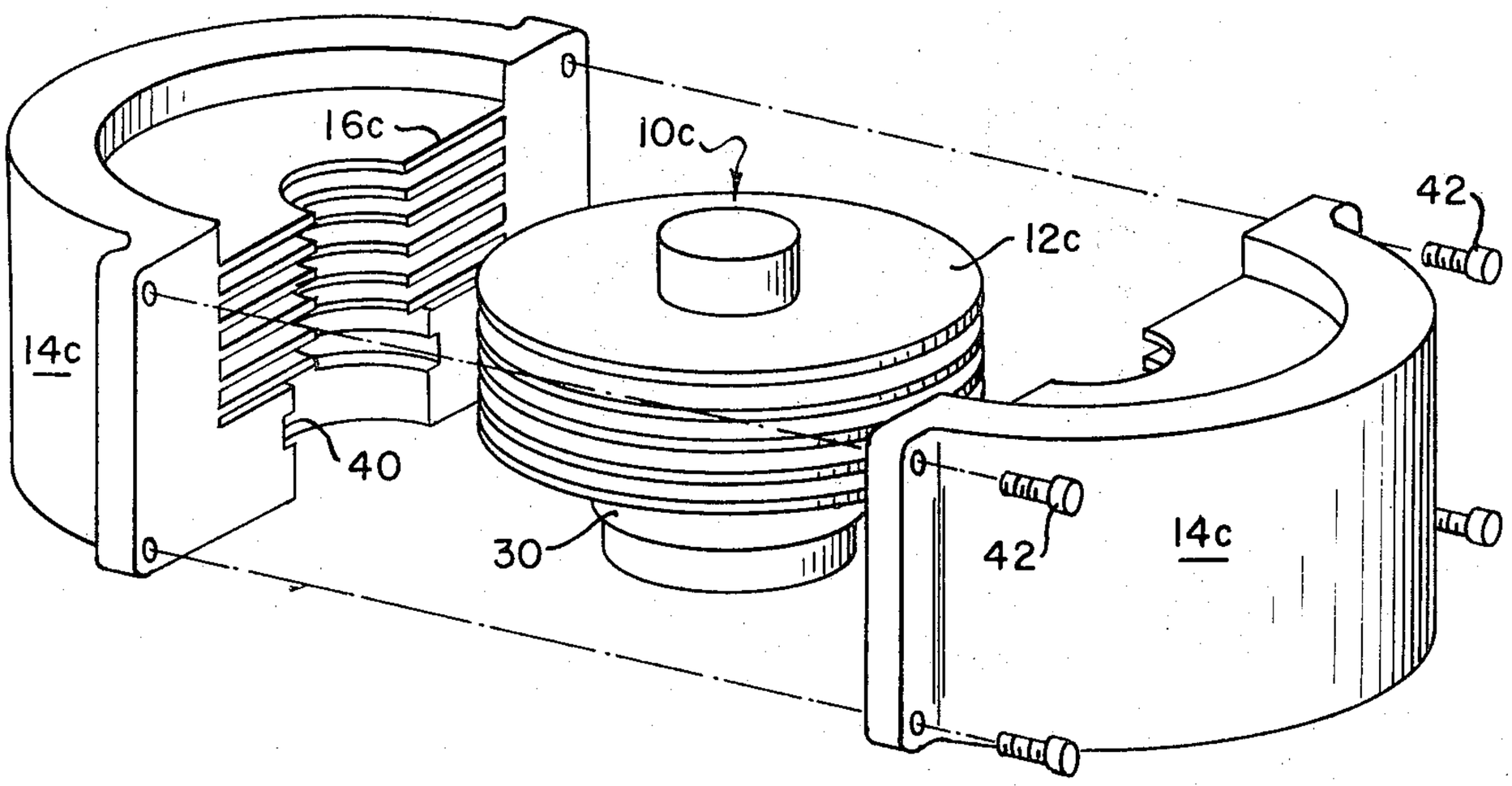


FIG. 4.

ROTATABLE FINNED HEAT TRANSFER DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to heat exchange devices and in particular to those having a movable heating or cooling surface.

2. Description of the Prior Art

Conventionally, when it was desired to transfer heat from a heat source to a relatively rotating heat sink, the only practical means of transferring such heat was through compact high-speed blowers. Although such prior art devices are capable of transferring heat, several disadvantages are connected with their use. For example, blowers consume power and may require special power supplies. Also fan or blower devices can be noisy, induce vibration and generally have a relatively limited life. Furthermore, since thermal impedance will vary with changes in gas pressure, a blower speed controller must be used to limit the shifting of thermal gradients.

In applications such as the intergimbal assembly of inertial guidance structures, there is a need for a novel heat transfer device to provide a heat transfer path between the relatively rotating gimbals without the undesirable effects of blower devices.

SUMMARY OF THE INVENTION

Accordingly, the present invention provides a device to transfer heat from a heat source to a relatively rotating heat sink. This is accomplished substantially without the disadvantages of the fan and blower devices by providing a first member adapted for connection to a heat source and a second member thermally coupled with the first member and adapted for connection to a heat sink. Each of the members have a plurality of equally spaced fins which are alternately disposed in overlapping relationship to form substantially equally sized gaps therebetween. The first and second members are mounted for continuous relative rotation in either a clockwise or a counterclockwise direction while maintaining the substantially equally sized gaps between the fins.

OBJECTS OF THE INVENTION

It is therefore an object of this invention to provide a heat transfer path between a heat source and a relatively rotating heat sink.

It is also an object of this invention to provide such a heat transfer path having substantially reduced variations in thermal impedance.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a partial cut-away isometric view of the preferred embodiment of the invention;

FIG. 2 illustrates a partial cut-away isometric view of another embodiment;

FIG. 3 illustrates a partial cut-away isometric view of still another embodiment; and

FIG. 4 illustrates an isometric view of an alternate construction of the embodiment of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring generally to FIGS. 1–3 and in particular to FIG. 1, it is shown that the rotatable finned heat transfer device of a preferred embodiment of the present invention generally includes a first member 10 adapted for connection to a heat source (not shown). Member 10 includes a plurality of equally spaced concentric fins 12.

A second member 14 is adapted for connection to a heat sink (not shown) and includes a plurality of equally spaced concentric fins 16. The fins 12 and 16 are alternately disposed in overlapping relationship to form substantially equally sized concentric gaps 18 therebetween.

The first and second members 10 and 14, including their respective fins 12 and 16, may be made preferably of aluminum although it is to be understood that any suitable material may be substituted. Grooves 20 of first member 10 and grooves 22 of second member 14 may be preferably machined by the electrical discharge method. The fin diameters are preferably machined to a tolerance of ± 0.001 inches each with a resulting radial gap 18 preferred to be of 0.005 to 0.007 inches between overlapping fins 12 and 16.

Members 10 and 14 may be coaxially bearing mounted within their overlapping hubs or cores 24 and 26 respectively and the members may be retained in position by several retention means such as for example snap rings, threaded ring nuts, clamps or the like. In this manner, first and second members 10 and 14 respectively, are mounted for continuous relative rotation in either a clockwise or a counterclockwise direction while maintaining the substantially equally sized gaps 18.

Specifically, the fins of first member 10 and second member 14 as illustrated in FIG. 1, form a plurality of equally spaced concentric cylinders.

In FIG. 2, fins or discs 12*a* and 16*a* of first and second members 10*a* and 14*a*, respectively, form a plurality of equally spaced parallel discs. Similarly, in FIG. 3 fins or discs 12*b* of first member 10*b* and fins or discs 16*b* of second member 14*b* form a plurality of equally spaced parallel discs. Also, the device illustrated in FIGS. 2 and 3 have discs angularly disposed with the axis of rotation of the mounted members. However, the discs 12*a* and 16*a* of FIG. 2 are right angularly disposed whereas the discs 12*b* and 16*b* of FIG. 3 may be disposed at any suitable angle.

Again in FIG. 2, core 24*a* of first member 10*a* may be inserted in second member 14*a* and retained therein by a threaded ring nut 30. Bearing 32 may be provided to permit relative rotation of core 24*a* and second member 14*a*. The first and second members 10*a* and 14*a* may then be completed about core 24*a* by the sequential addition of discs 16*a*, spacers 28, discs 12*a* and spacers 34. This sequence may be repeated until the maximum permissible number of spacers and discs are alternately disposed to overlap and form equal gaps 18*a* therebetween. Similarly, members 14*a* and 10*a* may be retained mounted in rotating relationship by means of threaded ring nuts 36 and 38 or the like. Such a stacked type construction would be substantially more economical to produce and would allow for greater radial misalignments. Any lack of stiffness of the discs such as those shown in FIG. 2 could be in-

creased by resulting conical shaped fins as illustrated in FIG. 3. The device of FIG. 3 may be constructed in a manner similar to that described for the device of FIG. 2 however, appropriate parts would necessarily need to be tapered and formed to produce the desired resulting configuration as shown in FIG. 3.

FIG. 4 illustrates, parts of the device in a detached relationship to show another possible means of construction which could be used to form an embodiment similar to that of FIG. 2. First member **10***c* could be machined to form a unit type construction having discs **12***c*. Similarly, second member **14***c* could be machined in two halves to include fins **16***c*. Also grove **40** may be provided to accomodate bearing **30.** The two halves may then be joined and retained as a unit by screws **42** or the like.

It is further anticipated that, if desired, first and second members **10** and **14** having concentric cylindrical fins **12** and **16** respectively, may be mounted for axial movement to vary the overlapping area of the fins thus providing a variable impedance heat transfer device. Also, to further reduce thermal impedance, a substantially thermally efficient gas such as helium or a liquid could be provided under pressure within the gaps.

The foregoing has described a novel heat transfer device to provide a heat transfer path between a relatively moving heat source and heat sink without the undesirable effects of blower devices.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A heat transfer device comprising:

a first member adapted for connection to a heat source and having a plurality of equally spaced parallel faced fins;

a second member adapted for connection to a heat sink and having a plurality of equally spaced parallel faced fins alternately disposed in overlapping relationship with the first member fins to form substantially equally sized gaps therebetween;

the fins of the first and second members forming concentric hollow cylinders and being mounted for continuous relative rotation while maintaining the substantially equally sized gaps; and

means providing helium gas under pressure filling said gaps between said fins.

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