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Noren

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[54] HEAT SHIELD ASSEMBLY

[75] Inventor: **Don W. Noren,** Redwood City, Calif.

[73] Assignee: **Noren Products, Inc.,** Redwood City, Calif.

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[52] **U.S. Cl.** **165/47,** 62/514, 110/182.5, 165/105, 250/89

[51] **Int. Cl.**.....**F28d 15/00**

[58] **Field of Search**.....165/47, 105; 62/467, 514 A; 122/6.6; 266/34 L; 110/182.5; 250/89

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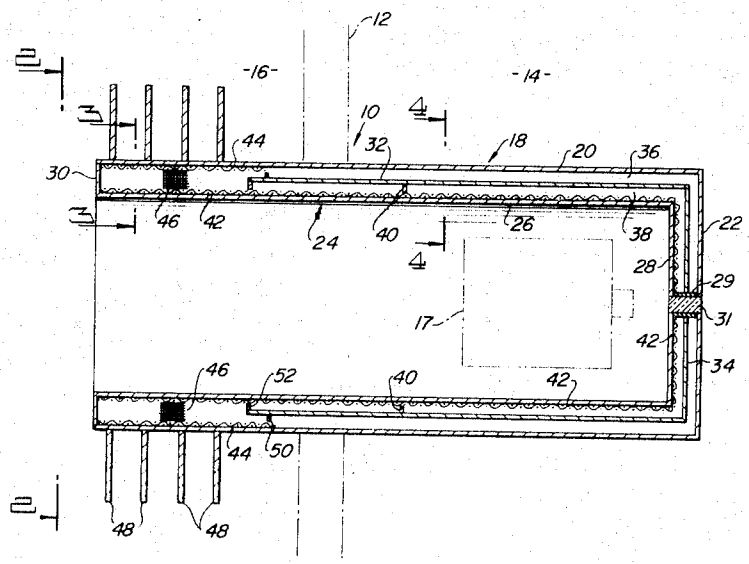
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Primary Examiner—Albert W. Davis, Jr.
Attorney—Fay, Sharpe & Mulholland

[57] **ABSTRACT**

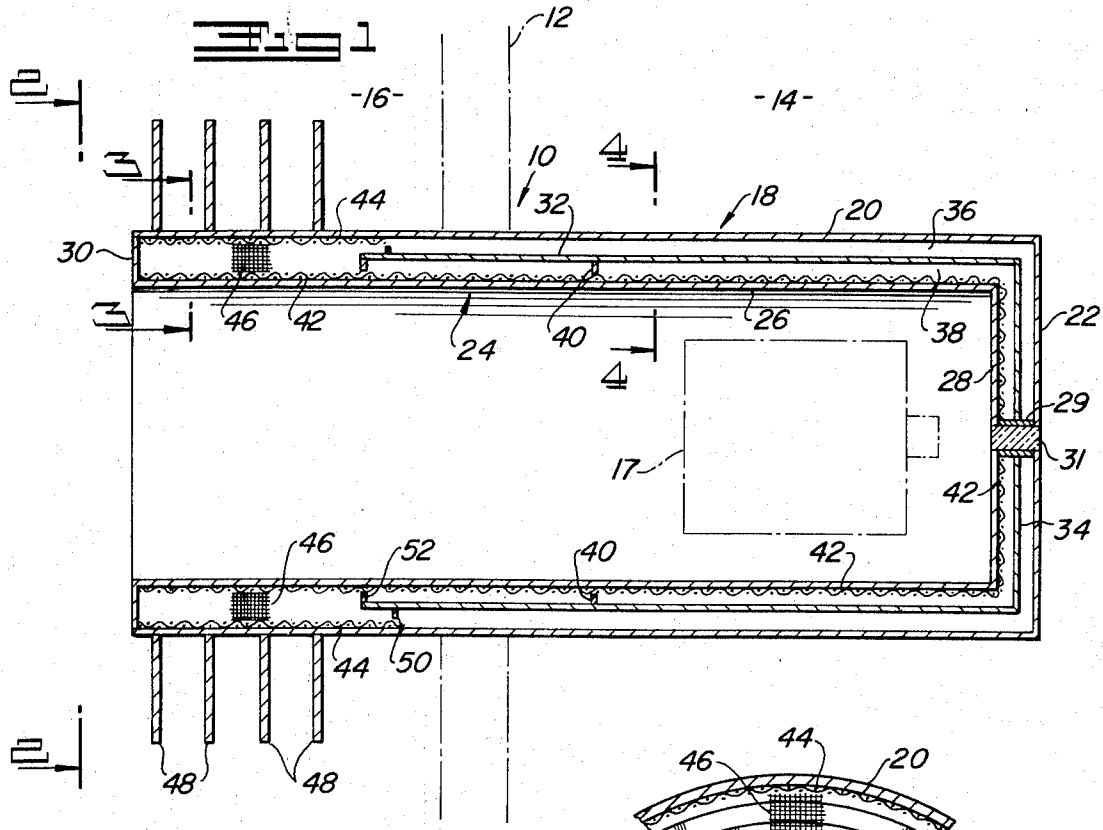
The specification and drawing disclose a heat pipe type of heat shield assembly comprising a double walled member positioned to extend between a high temperature area and a low temperature area and having a sealed inner-chamber. The outer face of one of the walls is adapted to face the high temperature area and wick material is positioned in engagement with the entire inner face of the other wall. A portion of the inner face of the wall exposed to the high temperature area is also covered with wick material and the remaining inner surface of the wall is bare. A partition member is positioned within the inner chamber. The partition member extends throughout the bare portion of the outer wall to reduce heat transfer by convection. Cooling fins are connected to the outer wall throughout at least the portion exposed to the lower temperature area.

4 Claims, 4 Drawing Figures



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Fig 1



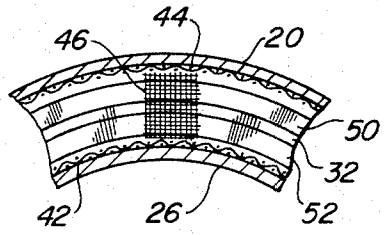


Fig 3

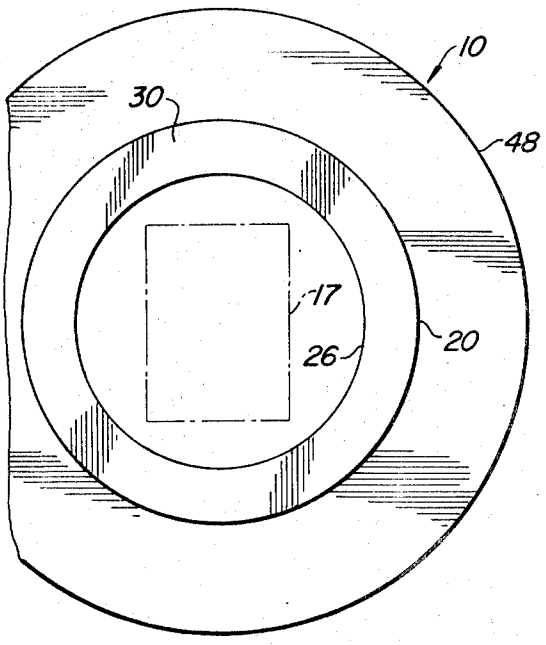


Fig 2

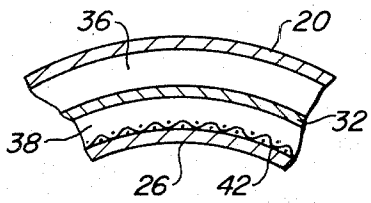


Fig 4

INVENTOR.
DON W. NOREN
BY
Fay, Sharpe & Mulholland
ATTORNEYS

HEAT SHIELD ASSEMBLY

The subject invention is directed toward the heat transfer art and, more particularly, to an improved heat shielding apparatus.

The invention will be described with reference to a structural embodiment especially suited for housing electronic equipment in a high temperature environment; however, it should be appreciated that the invention is capable of broader application and can be embodied in many different structural forms for a variety of uses.

Prior heat shielding assemblies have generally been two different types. The most commonly used has merely been a housing or wall having low coefficient of heat transfer and formed, for example, from multiple layers or thicknesses of heat insulating material such as glass wool, foam plastic, or the like. A second type sometimes used has been the evacuated chamber or vacuum bottle type.

The disadvantages of the common, low conductivity wall structure are its thickness and weight. Normally, to achieve a desired shielding effect, it is necessary to provide a relatively thick wall of insulating material. Additionally, some of the materials required for extremely high temperature use are quite expensive and the resulting wall is not only thick and heavy but costly. The vacuum bottle type is capable of better shielding but is similarly expensive and often heavy.

The subject invention provides a heat shield device which utilizes heat pipe principles to achieve extremely good heat shielding characteristics combined with thinness and light weight. In accordance with the invention, the heat shield comprises a double walled housing adapted to extend from a low temperature area to a high temperature area and provides an enclosure in which the shielded components can be placed. The sealed inner chamber of the double walled structure is provided with wick material throughout the inner surface of the wall which faces the low temperature area. The inner surface of the wall which faces the high temperature area is bare except throughout those portions which are facing the low temperature area. A vaporizable fluid is positioned in the structure in an amount sufficient to substantially completely wet the wick material and means are provided for producing flow of the vaporizable material between the wick adjacent the outer wall and the wick adjacent the inner wall. Additionally, it is preferable to provide an interior baffle to divide the inner space into two separate chambers at least throughout the area exposed to the high temperature area. Additionally, but not necessarily, it is preferable to have heat exchange fins on the portion of the apparatus exposed to the low temperature area.

Accordingly, a primary object of the invention is the provision of a heat shield structure which uses heat pipe principles to provide an extremely effective and light weight heat shield assembly.

A further object of the invention is the provision of a hollow, light weight heat shield assembly which can be formed from relatively thin sheet metal and provides an extremely low conductivity heat shield.

The above and other objects and advantages will become apparent from the following description when read in conjunction with the accompanying drawings wherein:

FIG. **1** is a longitudinal cross-sectional view of a heat shield assembly formed in accordance with the preferred embodiment of the invention;

FIG. **2** is an end view of the FIG. **1** assembly taken on line **2—2** of FIG. **1**; and,

FIGS. **3** and **4** are partial cross-sectional views taken on lines **3—3** and **4—4**, respectively, of FIG. **1**.

Referring more particularly to the drawing wherein the showings are for the purpose of illustrating a preferred embodiment of the invention only, and not for the purpose of limiting same, FIG. **1** shows the overall arrangement of a heat shield assembly **10** extending through a partition wall **12** which separates a high temperature area **14** from a low temperature area **16**. The particular environment and use of the heat shield forms no part of the invention; however, in the illustrated arrangement, the heat shield is utilized for protecting a piece of electronic scanning equipment **17** which is used for viewing the interior of the high temperature area **14**. Obviously, the heat shield assembly could be used for housing or protecting many different types of equipment in substantially any environment.

Referring again more particularly to the heat shield assembly **10**, it is shown as including an outer, generally cylindrical, housing **18** comprised of a cylindrical side wall **20** having its right-hand end (as viewed in FIG. **1**) closed by an end wall **22**. Preferably, the walls **20** and **22** are formed from a relatively thin, temperature resistant material having a low thermal conductivity. The particular material best suited for forming the outer shell would vary depending upon the environment and temperature conditions to which the shield is to be exposed. However, for example, in many installations, a thin, stainless steel housing is especially suitable.

The shield assembly **10** further includes an inner, preferably cylindrical, wall **24** which is preferably concentric with the outer wall or housing assembly and spaced a short distance therefrom. In the embodiment under consideration, the inner housing **24** comprises a cylindrical side wall **26** and a closed end wall **28**. Together, the walls **26** and **20** define a closed, annular chamber. An annular end wall **30**, together with a tubular spacer **29**, support the inner wall or housing assembly **24** within the outer assembly **18**. Additionally, a translucent, temperature resistant plug member **31** is positioned within the tubular member **29** and provides a viewing opening for the electronic scanning device **17**. The presence of the opening is not of importance to the invention and, in many installations, could be eliminated.

In the discussion which follows, the right-hand end of the heat shield **10** which is in the high temperature area **14**, will be referred to as the "hot end" whereas the left-hand end which is within the cool area **16** will be referred to as the "cool end." As shown, the inner wall surface of the cylindrical member **20** is completely covered with a relatively thin layer of wicked material which can be any of the conventional wicking materials used in heat pipe-type assemblies and capable of transferring fluid by capillary action. For example, it can be a metal felt, screen, fiberglass or the like. The most suitable wicking material will depend upon the unit's operating conditions and environment. In the embodiment under consideration, the wick material comprises a cylinder of fine, phosphor bronze screen **44** which is

tightly in engagement with the inner surface of wall **20** and extends completely about the low temperature end of the heat shield. The entire outer surface of the inner housing **24** is similarly covered with the wick in the form of fine screen **42** which is likewise closely in engagement with the outer surface of the inner housing. Connected between the outer wick member **44** and the inner wick member **42** are a plurality of wick pads or tubes **46** which serve to transfer fluid by capillary action between the two wick assemblies.

Positioned within the annular chambers **36** and **38** defined by the inner and outer housing assemblies **18** and **24**, respectively, is a vaporizable fluid in an amount sufficient to substantially completely wet all wick surfaces within the assembly. The particular vaporizing material or fluid used can be any of the conventionally used fluids for heat pipes and the most desirable particular fluid would, of course, depend upon the operating temperatures expected for the heat shield.

To understand the operation of the device thus far described, assume that the right-hand end is subjected to extremely high temperatures about its outer surface. As can readily be seen, heat transfer from the outer surface to the inner surface is prevented by the space between the inner wall and the outer wall. Accordingly, any heat transfer which takes place is primarily by conduction along wall **20** to the cooler end **16**. If sufficient heat should be transferred through the space, the fluid within the wick is vaporized and the vapor flows to the cool end **16** where it is condensed in the wicks **44** and **42**. Thereafter, the condensed fluid flows back to the hot wick portion within the hot end of the heat shield. This function takes place in the same manner as a conventional heat pipe with extremely rapid transfer of the heat through the movement of the vapor.

To improve the heat shielding characteristics of the assembly, an inner, cylindrical partition **32** divides the hot, annular space and eliminates or substantially reduces heat transfer by internal convection currents. Additionally, an end divider plate **34** is positioned between the end walls **22** and **28** and connected to the end of the wall **32**. In order to further reduce the likelihood of convection currents, a pair of baffles **50** and **52** are connected to the end of the wall **32**. Note that baffle **50** extends radially outward to within a short distance from the inner surface of member **20**. Likewise, baffle **52** extends radially inward to within a short distance above the wick member **42**. The entire inner baffle assembly is supported in position in any convenient manner such as through the use of short, insulating rods or pins **40**.

In order to further increase the cooling effect produced by the cool end of the heat pipe, fins or the like can be added to the inner and/or outer surfaces of the heat shield. In the embodiment shown, a plurality of heat transfer fins **48** in the form of annular discs are brazed or otherwise joined to the outer surface of the outer, cylindrical housing member **20**.

Because of the arrangement of the described heat shield, it can be made extremely thin and light weight and will produce an insulating effect equivalent to an extremely thick and relatively heavy, conventional insulating wall. The obvious advantages and uses of the described type of heat shielding arrangement are many and the particular use or environment plays no part in the subject invention.

Obviously, modifications and alterations of the preferred embodiment will occur to others upon a reading and understanding of the specification. It is my intention to include all such modifications and alterations as part of my invention insofar as they come within the scope of the appended claims.

Having thus described my invention, I claim:

1. A heat shield device comprising:

a housing including spaced walls defining a sealed inner chamber adapted to extend between a low temperature area to a high temperature area, said sealed inner chamber being provided with wick material throughout the inner face of the wall facing the low temperature area, the inner face of the wall which faces the high temperature area being bare except throughout those wall portions which face the low temperature area;

a vaporizable fluid within said chamber in an amount to substantially completely wet the wick material; said wall portions which face the low temperature area having sufficient heat exchange capability to condense said fluid; and,

means for permitting capillary flow of the vaporizable material between the wicks.

2. The device of claim **1** wherein the interior of said sealed inner chamber includes a baffle adapted to divide said space into two separate chambers at least throughout the area exposed to high temperature.

3. The device of claim **1** wherein the wall exposed to the high temperature area extends into the low temperature area and is provided with extended heat exchange surface means on the portion in the low temperature area.

4. The device of claim **1** includes baffle means in said chamber to impede heat transfer by convection.

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