

(19)



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(11)

EP 0 834 715 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.04.1998 Bulletin 1998/15

(51) Int Cl.⁶: **F28D 15/02, F28D 1/03**

(21) Application number: **97307599.7**

(22) Date of filing: **26.09.1997**

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE**
Designated Extension States:
AL LT LV RO SI

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(30) Priority: **02.10.1996 GB 9620492**

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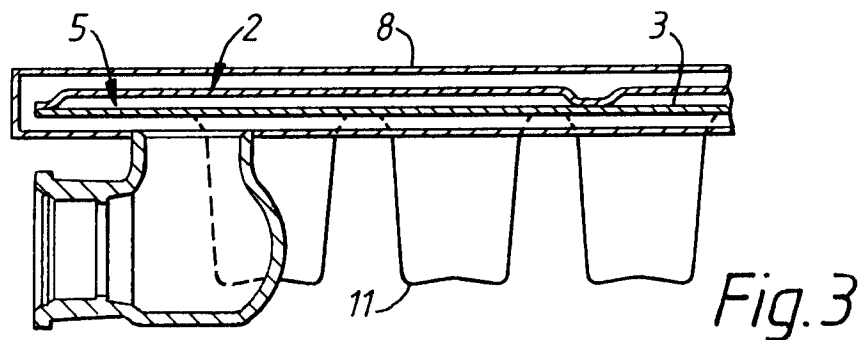
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(54) A thermosiphon radiator

(57) A radiator (1) of the thermosiphon type has a plurality of mutually isolated compartments (5) connected in a planar array. The vaporising fluid (7) in each compartment is heated by a fluid, another suitable heat

source, which flows or is dispersed externally of each compartment. The isolation of the compartments and external location of the heat source increase the overall efficiency of the radiator.



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Description

This invention relates to thermosiphon radiators and is particularly, but not exclusively, concerned with thermosiphon radiators suitable for use in a central heating system.

Known thermosiphon radiators, such as described in British Patent Application No 2 099 980A, comprise a casing enclosing a chamber evacuated of incondensable gases and partially filled with a vaporising liquid, and a heat source at the bottom of the chamber for heating the vaporising liquid. Actuation of the heat source, which can be a pipe through which hot water is passed, vaporises the liquid which rises upwardly and condenses on, and thereby heats, the walls of the chamber. The condensate flows down to the bottom of the chamber under the force of gravity and is thereafter repeatedly recycled in the same manner.

In comparison with a conventional panel radiator containing pressurised water, a thermosiphon radiator has several advantages. For instance, a conventional panel radiator requires welding to reinforce the structure and is typically formed from steel sheets approximately 1.25 mm thick. As a thermosiphon radiator is not pressurised it can be formed without reinforcement of the radiator structure and it can be manufactured from steel sheet approximately 0.8 mm thick. Further, thermosiphon radiators have a lower thermal inertia than conventional radiators.

The known thermosiphon radiators have limited efficiency, however, as the average maximum temperature is approximately equal to the outlet temperature of the heating water, e.g. if the inlet temperature and outlet temperature of the heating water are 90°C and 70°C respectively, the average temperature of the thermosiphon radiator would be slightly less than 70°C. In contrast, a conventional hot water radiator has an average maximum temperature approximately equal to the median of the inlet and outlet temperatures, i.e. 80°C when the inlet and outlet temperatures are 90°C and 70°C. Hence the thermal emission efficiency of known thermosiphon radiators is about 20% less than that of comparable hot water radiators. (Currently standardised tests of the emission efficiency of radiators are based on inlet and outlet temperatures of 90°C and 70°C respectively; these temperatures are used throughout the specification by way of example only.)

The present invention addresses the above drawback and accordingly provides a thermosiphon radiator comprising a plurality of mutually isolated compartments connected in juxtaposition in a predetermined array and each containing a vaporising fluid, and heating means for heating the vaporising fluid in each compartment.

As the compartments are isolated from each other, each compartment will have an average maximum temperature determined by the temperature of the heat source in that compartment. Thus where the heat

source is hot water, the average maximum temperature for each compartment is the local outlet temperature of the heating water leaving the compartment. Therefore, the average maximum temperature of the entire radiator, i.e. of all the compartments taken together, is higher than the outlet temperature of the heating water leaving the radiator, and the thermal emission efficiency of the radiator is thereby increased.

According to another aspect the present invention provides a thermosiphon radiator comprising a compartment containing a vaporising fluid, and heating means for heating the vaporising fluid in the compartment, characterised in that the heating means is disposed externally of the compartment.

With the heating means located externally of the compartments, in addition to heating the vaporising fluid, the heating means can transfer heat directly to the surrounding air. The externally disposed heating means has an average temperature approximately equal to the median of the radiator inlet and outlet temperatures. The external heating means contributes to the total heat output of the radiator and thereby increases the overall thermal emission efficiency of the radiator.

Preferably, a radiator according to either aspect of the invention comprises five or more compartments.

A clear understanding of the invention will be gained from the following detailed description given with reference to the accompanying drawings in which:

Figure 1 is a front elevation of a thermosiphon radiator according to the present invention;

Figure 2 is a side view of the radiator shown in Figure 1;

Figure 3 is an enlarged cross-section taken along the line A-A' in Figure 1;

Figures 4 and 5 are enlarged side views of the top and bottom of the radiator in Figure 1 respectively shown partially cut away;

Figures 6 and 7 are front and plan views respectively of an alternative embodiment of a thermosiphon radiator according to the present invention;

Figures 8 and 9 are front views of modified constructions of the radiators shown in Figures 6 and 1 respectively; and

Figure 10 is a cross-sectional view similar to that shown in Figure 5 depicting an alternative construction of the radiator.

A thermosiphon radiator 1 has a casing including a front wall 2 and a rear wall 3, and formed from a good heat conductive material, e.g. steel or aluminium. The front wall 2 has ten transverse troughs or channels 4, the edges of which are fixed securely by welding, gluing or any other suitable method to the substantially uniplanar rear wall 3 to form ten sealed generally upright parallelepiped compartments 5. Each of the compartments 5 is partially filled by a vaporising liquid 7, e.g. water, ethanol, methanol, freon, or a mixture of any two or more

thereof, and the remainder of the compartment is substantially evacuated. Each compartment is provided with a port 6 at the top of the rear wall for evacuating incondensable gases and filling with the vaporising liquid, the port being closed either by a valve or by being permanently sealed after filling of the compartment. At the base of the radiator 1, an elongate generally rectangular conduit or tube 8 is attached to the casing and defines flow paths extending along the radiator either side of the basal ends of compartments 5. Pipe connectors 9 and 10 are provided at opposite ends of the conduit and define an inlet and outlet for heating fluid, such as in a hot water central heating system. Optionally, a multitude of fins 11, e.g. provided by a pressed sheet of aluminium or steel, are secured to the rear wall 3 to speed the dissipation of heat from the panel radiator 1 to the surrounding air in a manner known *per se*.

Figures 6 and 7 show an alternative embodiment of the invention having ten sealed generally ovoid tubes 20 forming respective upright compartments 5. The lower ends of the tubes are sealingly connected to and extend into a conduit 8 which supports the tubes 20 in a uniplanar array and defines flow paths for a heating liquid extending along the radiator and either side of each tube 20. Pipe connectors 9,10 are located at opposite ends of the conduit. In the modified construction of Figure 8, the pipe connectors 9,10 are located adjacent each other, the conduit 8 being partitioned to define a circular flow path for the heating fluid from the inlet to the outlet. The adjacent pipe connectors may be at any convenient position along the radiator e.g. centrally located as shown, or disposed at one end of the radiator. At their lower ends the compartments 5 can be shaped, e.g. arcuate or vee shaped, to promote the central collection of condensate (see Figures 6 and 9) and to enhance and equalise the flow of heating liquid around the lower ends of the compartments to improve the heat exchange efficiency between the heating liquid and the vaporising liquid within the tubes 20.

A mesh or wick 21 can be provided on the interior of the compartments 5 adjacent to conduit 8 to enhance the evaporation of the vaporising liquid by providing a greater surface area for evaporation and/or to enhance transfer heat to the liquid. The mesh abuts the interior of each compartment adjacent the heating means, and it retains the vaporising liquid by capillary action.

Each compartment may be formed with a forwardly inclined step (see Figure 10) to align the front wall of the conduit and the front walls of the compartments protruding above the conduit to thereby improve the aesthetic appearance of the radiator.

In operation, hot water or other suitable fluid from a boiler is supplied to the inlet 9, e.g. at approximately 90°C, flows through the conduit 8 and leaves the radiator 1 through the outlet 10, e.g. at approximately 70°C, having given up its heat by raising the temperature of the conduit 8 and the parts of the walls of the compartments 5, defined by the casing 2,3 in the embodiment

of Figures 1-5 and by the tubes 20 in the embodiments of Figures 6-9, located within the conduit by conduction. The conduit 8 radiates heat to the surrounding air. The vaporising liquid 7 within the compartments 5, heated by the interior walls of the compartment 5 directly or via the mesh or wick 21, is evaporated and rises upwardly to heat the upper portions of the compartments, from which heat is transferred to the surrounding air, before condensing and flowing down again under the force of gravity. The vaporising fluid in its fully condensed state occupies more than 50% of the volume of each compartment contained within the conduit 8, and preferably it occupies between 70% and 100% of the internal volume. A smaller volume of liquid will be appropriate if a mesh or wick is included in the compartment. The temperature of each compartment 5 is approximately equal to the lowest temperature of fluid in the adjacent section of the conduit 8 responsible for heating the vaporising liquid in that compartment. Thus, assuming the inlet and outlet temperatures of the heating water are as mentioned above and the drop in temperature of the fluid in the conduit is linear, the compartments viewed from left to right in Figure 1, are heated to 88°C, 86°C, ..., 72°C and 70°C. Hence the average maximum temperature of all the compartments, and thereby the radiator, is approximately 79°C. This is comparable to the maximum average temperature of a conventional hot water radiator and compares very favourably with the maximum average temperature of known thermosiphon radiators.

The location of the conduit 8 externally of the compartments allows the transfer of heat directly to the surrounding air as well as to the fluid in the compartments. When compared with conventional thermosiphon radiators which have a conduit disposed internally of their compartment, the external location of the conduit can improve the contribution of the conduit to the thermal efficiency of the radiator by around 20%.

Various modifications to the above described radiator are possible without departing from the scope of the claims and, in particular, it is to be appreciated that any source of heat, e.g. an electrical element, could be used to heat the vaporising fluid. However, the invention is especially suited to thermosiphon radiators employing a fluid as a heat source, as described above wherein an appreciable cooling of the heating fluid occurs as it passes through the conduit 8. Further the heat source could be provided on one side of the compartments, rather than on both sides as specifically described. Also, although the described embodiment of the radiator has ten compartments, any number of compartments could be provided.

Claims

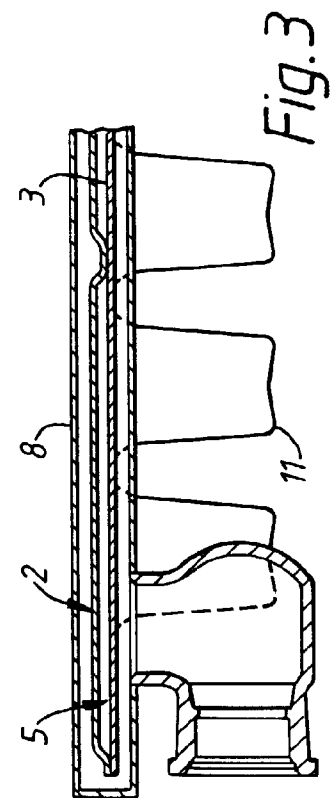
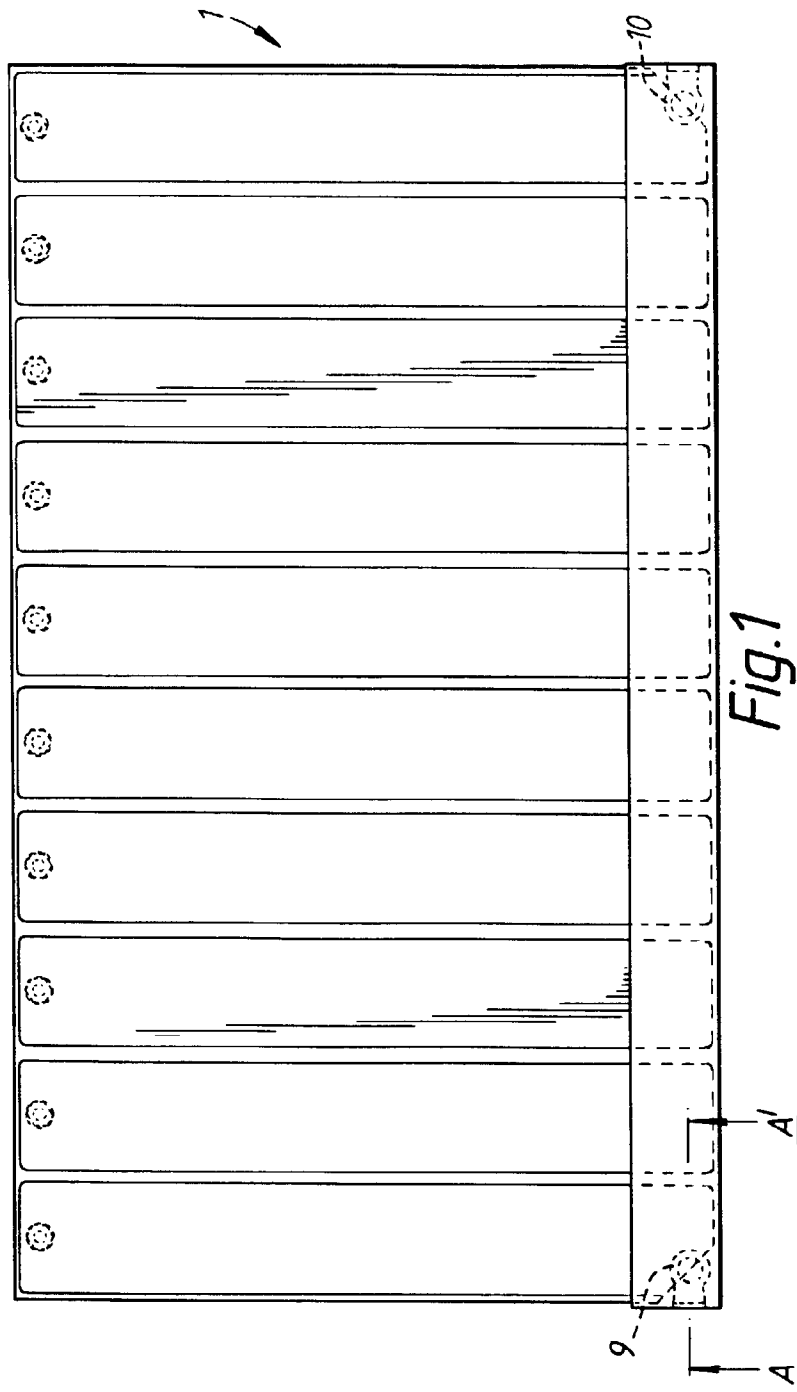
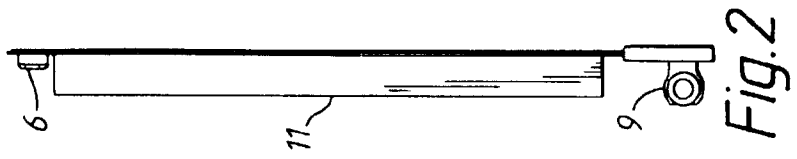
1. A thermosiphon radiator (1) comprising a plurality of mutually isolated compartments (5) connected in juxtaposition in a predetermined array and each

containing a vaporising fluid (7), and heating means (8) for heating the vaporising fluid in each compartment.

2. A radiator according to claim 1, wherein the heating means are disposed externally of the compartments. 5
3. A radiator according to claim 1 or 2, wherein the compartments comprise upwardly extending cavities enclosed by a casing. 10
4. A radiator according to any one of claims 1 or 2, wherein the compartments are formed by elongate tubes (20). 15
5. A radiator according to any one of the preceding claims, wherein five or more compartments are provided. 20
6. A radiator according to any one of claims 1 to 5, wherein the number of compartments is from 7 to 13.
7. A thermosiphon radiator (1) comprising a sealed compartment (5) containing vaporising fluid (7), and heating means (8) for heating the vaporising liquid in the compartment, characterised in that the heating means is disposed externally of the compartment. 25 30
8. A radiator according to claim any one of the preceding claims, wherein a mesh (21) abuts the interior of the or each compartment adjacent the heating means. 35
9. A radiator according to any one of claims 1 to 8, wherein the heating means comprises a passage for a heating fluid. 40
10. A radiator according to claim 9, wherein the passage for heating fluid includes flow paths extending along opposite sides of the or each compartment.
11. A radiator according to claim 9 or 10, wherein the passage is defined by an elongate conduit surrounding a lower end portion of the or each compartment. 45
12. A radiator according to any one of the preceding claims, wherein in the or each compartment the vaporising fluid in its liquid state occupies between 70% and 100% of the internal volume of the compartment located in direct juxtaposition to the heating means. 50 55
13. A radiator according to any one of claims 1 to 12, wherein the vaporising fluid is water, ethanol, meth-

anol, freon or a mixture thereof.

14. A radiator according to any one of the preceding claims, wherein the heating means comprises an electrical heating element.
15. A central heating system including one or more radiators as claimed in any one of claims 1 to 14.



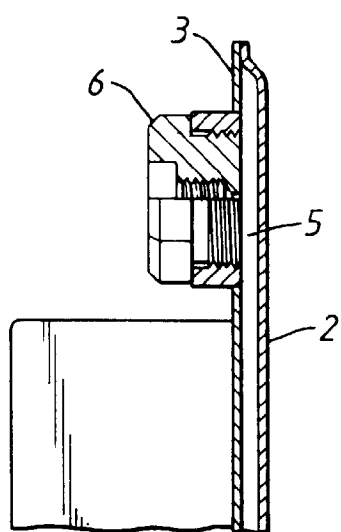


Fig. 4

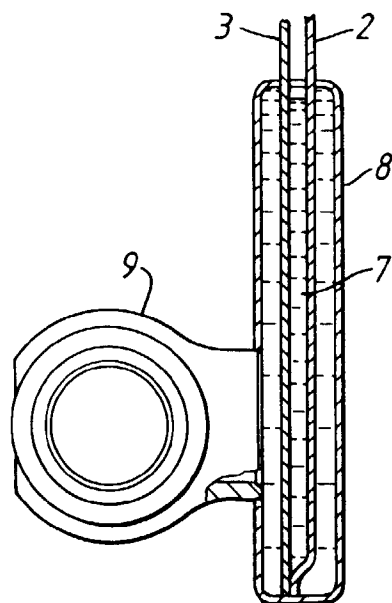


Fig. 5

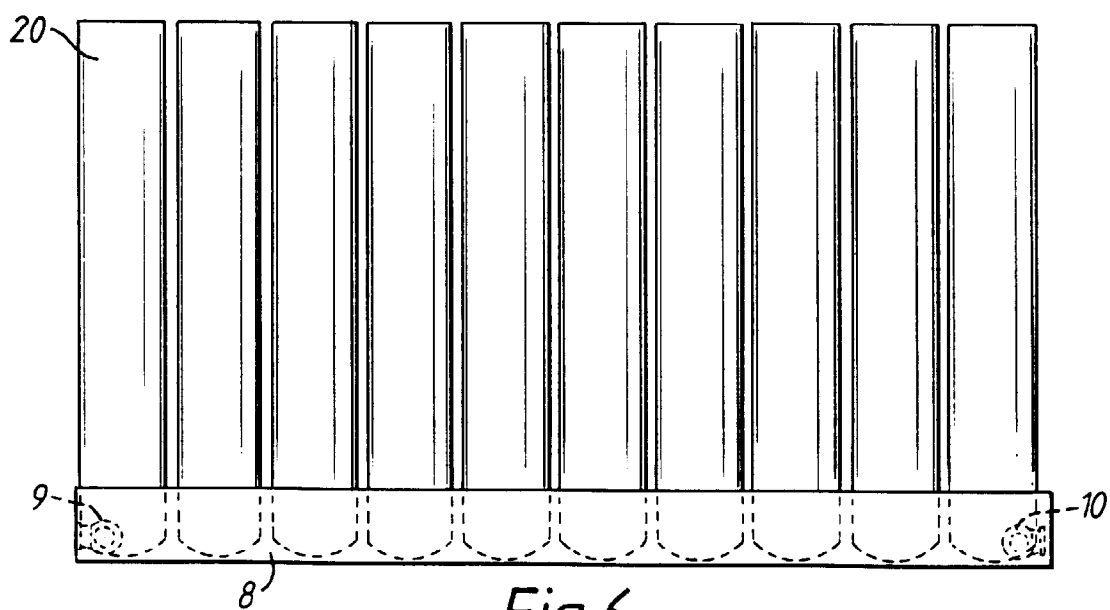


Fig. 6

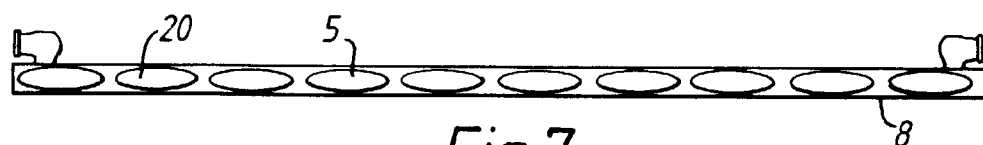


Fig. 7

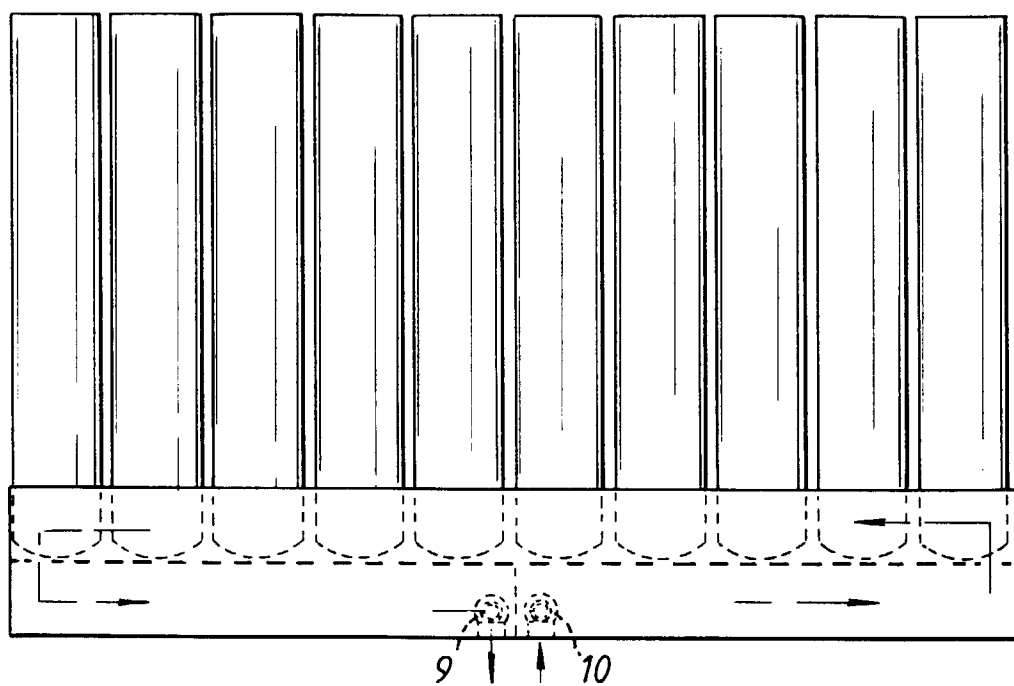


Fig. 8

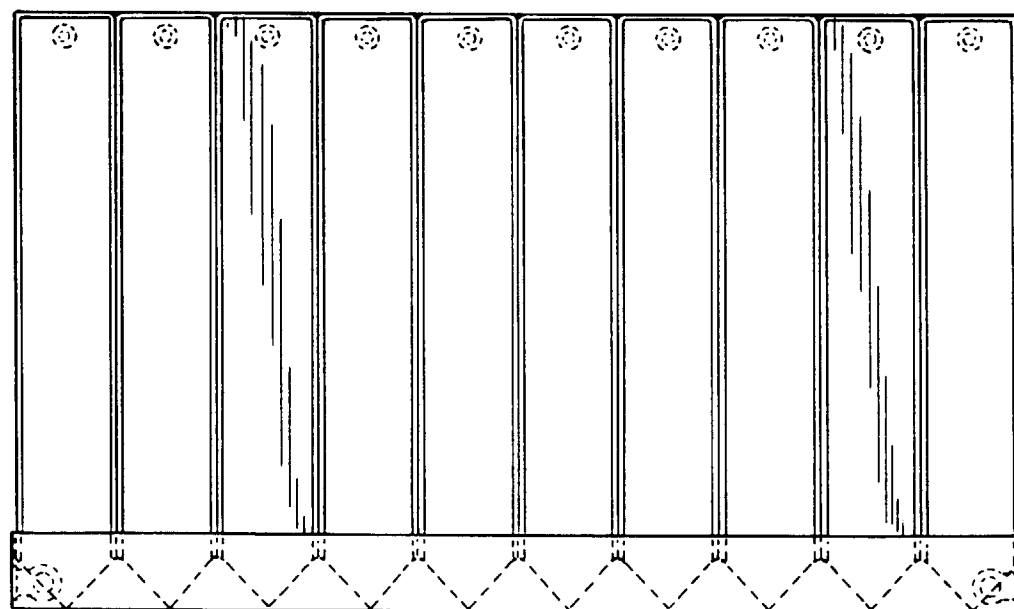


Fig. 9

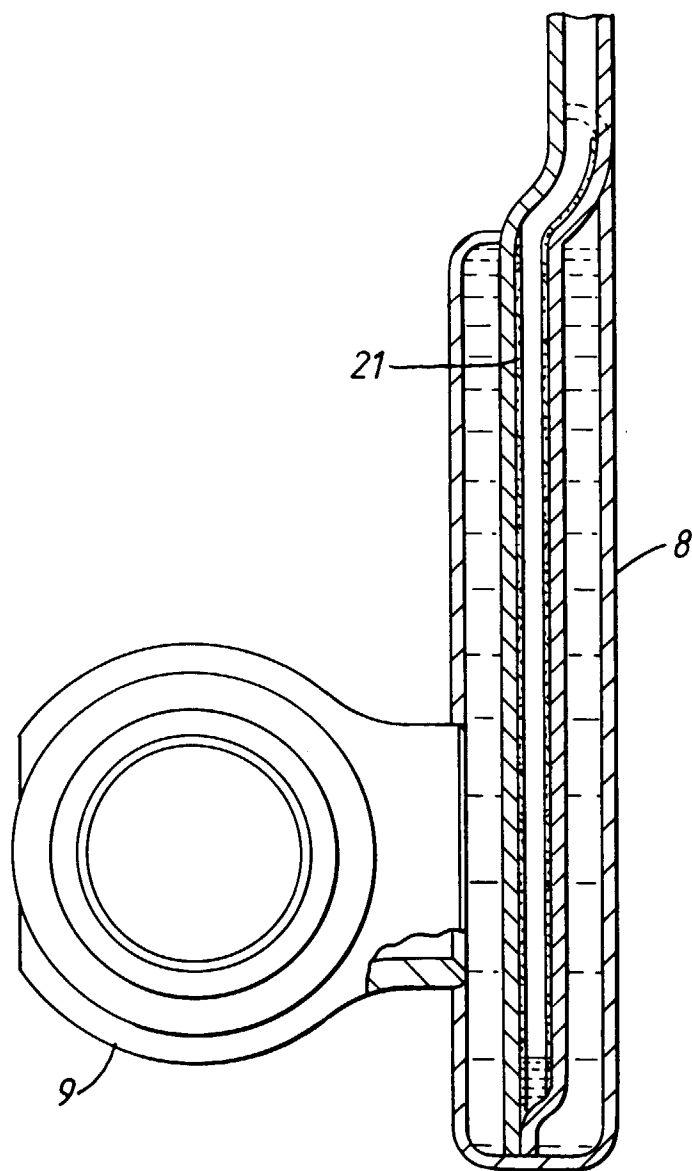


Fig.10