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(12) # EUROPEAN PATENT APPLICATION

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(54) **Modular element heat exchanger, and method for making it.**

(57) The present invention relates to a composable heat exchanger (1), comprising a plurality of modular elements (2) which may be stacked onto one another in order to form a thermal exchange column, and each of which is provided with a base region (3), and a middle portion therefrom a cylindrical body (4) extends which is provided, at the bottom, with throughgoing openings (5).

At the mentioned bottom the cylindrical body (4) may be pressure inserted into the other end of a like cylindrical body (4) of an adjoining modular element (2), the thus assembled cylindrical bodies (4) forming the duct of the thermal exchange column, whilst the several base regions (3) provide the related fins.

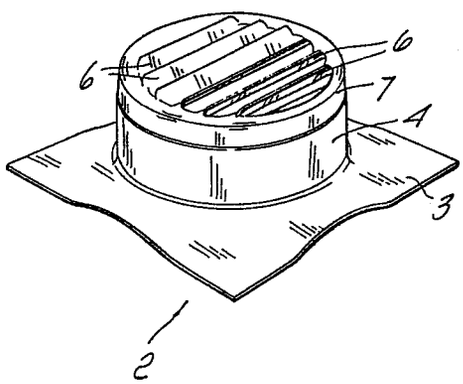

Fig. 1

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Description

MODULAR ELEMENT HEAT EXHANGER, AND METHOD FOR MAKING IT

BACKGROUND OF THE INVENTION

The present invention relates to a composable heat exchanger, made starting from modular elements, as well as the method for making said heat exchanger.

As is known, the heat exchangers are presently used in many industrial fields.

More specifically, these heat exchangers, in their most usual form, are provided with a central portion defining the passage duct of one of the thermal exchange elements, which central portion is provided with fins for greatly increasing the useful thermal exchange surface, the thermal exchange being carried out through a second fluid element inpinging on the ouside of the mentioned duct.

The known heat exchangers, as conventionally made, present however great drawbacks, since the thermal exchange elements thereof have a rather complex construction, mainly because of the provision of the fins,which are indispensable for increasing the thermal exchange surface.

Another drawback consists of the difficulty of making different size, and hence different thermal capacity,heat exchangers,depending on the speci fic application requirements: due to this reason it is presently necessary to suitably specifically design different size heat exchanging elements, depending on their uses.

SUMMARY OF THE INVENTION

Accordingly, the task of the present invention is to overcome the above mentioned drawbacks, by providing a modular element heat exchanger which can be easily made by quickly and simply assembling a plurality of modular elements so as to obtain the desired size.

Within the above mentioned task, it is a main object of the present invention to provide a composable heat exchanger which has very advantageous thermal exchange characteristics and in the meanwhile is of a comparatively simple structure.

Another object of the present invention is to provide a heat exchanger the single modular elements of which can be obtained by very simple and unexpensive mechanical operations and which may be assembled, in a very quick way, so as to provide the heat exchanger with the desired size.

Yet another object of the present invention is to provide a heat exchanger which may be easily constructed starting from easily commercially avail able elements and materials and which, moreover, is very reliable from the operation standpoint.

According to one aspect of the present invention, the above task and objects, as well as yet other objects, which will become more apparent thereinafter, are achieved by a composable heat exchanger characterized in that it comprises a plurality of modular elements, which may be stacked onto one another in order to form a thermal exchange column, each of said modular elements being provided with a base region and a middle portion therefrom a cylindrical body extends which is provided, on the bottom thereof, with throughgoing openings.

In particular, said cylindrical body may be coupled, at one end thereof, to the other end of the cylindrical body of a like adjacent modular element, whilst said stacked cylindrical bodies form the duct of the thermal exchange column and said base regions form the related fins.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the heat exchanger according to the present invention will become more apparent thereinafter from the following detailed disclosure of a preferred, though not exclusive, embodiment of said heat exchanger, which is illustrated, by way of an indicative example, in the accompanying drawings, where:

Fig. 1 is a perspective schematic view illustrating a modular element included in the heat exchanger according to the invention;

Fig. 2 is a top plan view illustrating that same modular element;

Fig. 3 is a cross-sectional view taken along the line III-III of Fig. 2 illustrating that same modular element;

Fig. 4 is a cross-sectional view illustrating a plurality of modular elements, coupled to one another in order to form a heat exchanger according to the invention;

Fig. 5 illustrates, on a greatly enlarged scale, the detail of the welded coupling of two modular elements;

Fig. 6 schematically illustrates a possible embodiment of a heat exchanger made by using the modular elements of the preceding Figures;

Fig. 7 illustrates a top plan view of a variation of a modular element for making heat exchangers acccording to the invention;

Fig. 8 is an elevation view of the modular element shown in Fig. 7;

and

Fig. 9 illustrates yet another variation of a modular element for making heat exchangers according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the Figures of the accompanying drawings, the composable heat exchanger according to the invention,which has been overally indicated at the reference number 1, comprises a plurality of modular elements 2 which may be stacked onto one another to form a thermal exchange column, having the desired size depending on the required thermal exchange capability.

A main feature of the present invention is that said modular elements 2 are made by very simple and unexpensive mechanical operations which, on the other hand, permit to construct a heat exchanger having very good efficiency characteristics.

More specificially, each modular element is made starting from a plate-like element of a thermally conducting material such as, for example, a metal as stainless steel or copper, which is drawn so as to provide a peripheral base region 3, of flat shape, from the middle portion of which there extends a cylindrical body 4.

The cylindrical body 4, at its bottom, is provided with a plurality of slots 5, which extend in parallel relationship with respect to one another, and may be made by cutting and bending the fins 6, having a given slant with respect to the axis of the body 4 and which diverge from the fluid path, inside the duct, which duct is obtained by stacking onto one another a plurality of modular elements.

In particular, the fins 6, which are arranged with a slanted orientation, will act to provide a turbolence in the fluid path, which fluid may be either in liquid form or gas form, so as to facilitate the thermal exchange.

On its periphery, the cylindrical body 4, at the end thereof therethrough the slots 5 are formed, is provided with a recessed region 7 which practically defines the insertion element, since this region may be inserted into the respective end of a like cylindrical body in order to stack a plurality of modular elements.

If the two thermal exchange fluids consist of gases, then it will be sufficient to make the heat exchanger by simply pressure coupling the several modular elements.

In the case in which one of the thermal exchange fluid consists of a liquid, it will be necessary to weld to one another the several modular elements and, to that end, a new welding process has been designed, which affords the possibility of remarkably simplifying all of the related welding operations.

This new process practically consists of applying, between the several modular elements, thin copper rods, indicated at 10 and then arranging the stacked modular elements in a vacuum oven.

In this oven said modular elements will be subjected to a high temperature adapted to melt the copper which, by capillarity, will deposit at the insertion region of the cylindrical bodies of the adjoining modular elements so as to provide a perfect welding connection which practically tightly closes the duct formed by stacking onto one another several modular elements.

Figs. 7 and 8 illustrate a variation in which a modular element 2′ has been provided having radially extending slots 6′, whilst Fig. 9 illustrates yet another variation in which the modular element 2″ is provided with radially extending slots 6″ as well as a central hole 6‴.

Also these variations of the subject modular elements have been found to provide very good results in making high efficiency thermal exchangers.

All of the disclosed modular elements may be coupled to one another, in different numbers, so as to obtain the desired heat exchanger, without the need of modifying the component elements thereof.

From the above disclosure it should be apparent that the invention fully achieves the intended task and objects.

In particular the fact is to be pointed out is that the composable modular element heat exchanger may be constructed in a very simple way and, moreover, the single modular elements may be made by very simple machining operation, by mechanically deforming a plate-like element, and hence with a series production of very low cost.

Another important aspect of the invention is that the single modular element may be assembled by means of a vacuum welding operation which is very safe and reliable.

The invention as disclosed is susceptible to several modifications and variations all of which come within the scope of the invention itself.

Moreover all of the details may be replaced by other technically equivalent elements.

In practicing the invention, the used materials,provided that they are compatible to the intended use, as well as the specific size and shapes may be any, according to requirements.

Claims

1. A composable heat exchanger, characterized in that it comprises a plurality of modular elements adapted for being stacked onto one another to form a thermal exchange column, each of said modular elements being provided with a base region from a middle portion of which a cylindrical body extends, said cylindrical body being provided, at the bottom, with throughgoing openings, said cylindrical body being adapted for coupling, at one end, to the other end of the cylindrical body of an adjoining like modular element, said stacked cylindrical bodies forming the duct of the thermal exchange column and said base regions forming the related fins.

2. A composable heat exchanger according to the preceding Claim, characterized in that said throughgoing openings consist of slots which are formed through the bottom of said cylindrical body and are spaced from one another by fins.

3. A composable heat exchanger, according to one or more of the preceding Claims, charachterized in that said fins diverge from the axis of said cylindrical body in order to generate a turbulence in the fluid path through the duct.

4. A composable heat exchanger, according to one or more of the preceding Claims, characterized in that said cylindrical body is provided, at the end thereon there are formed said slots, with a recessed region adpated to act as an insertion element for coupling to one another adjoining said modular elements.

5. A composable heat exchanger, according to one or more of the preceding Claims, characterized in that it comprises a welding region between adjoining said cylindrical bodies, said welding region being obtained by copper rods, molten at high temperature and deposited by capillarity along the insertion

region.

6. A composable heat exchanger, according to one or more of the preceding Claims, characterized in that said slots radially extend at said end.

7. A method for making a composable heat exchanger, starting from modular elements, characterized in that it comprises the steps of: providing modular elements having a base region from the middle portion of which a cylindrical body extends, stacking onto one another said cylindrical bodies by interposing therebetween a copper rod and then subjecting said stacked elements to a high temperature, in a vacuum oven, so as to melt said copper rods and introduce by capillarity the molten copper into the contacting regions of said cylindrical bodies in order to weld them.

8. A modular element for making composable heat exchangers, characterized in that it comprises a plate-like element, obtained by a drawing operation, and having, at a middle portion thereof, a cylindrical body encompassed by a flat region, through the bottom of said cylindrical body there being formed throughgoing openings.

9. A composable modular element heat exchanger, and a method for making it, according to the preceding Claims, and substantially as broadly disclosed and illustrated for the intended objects.

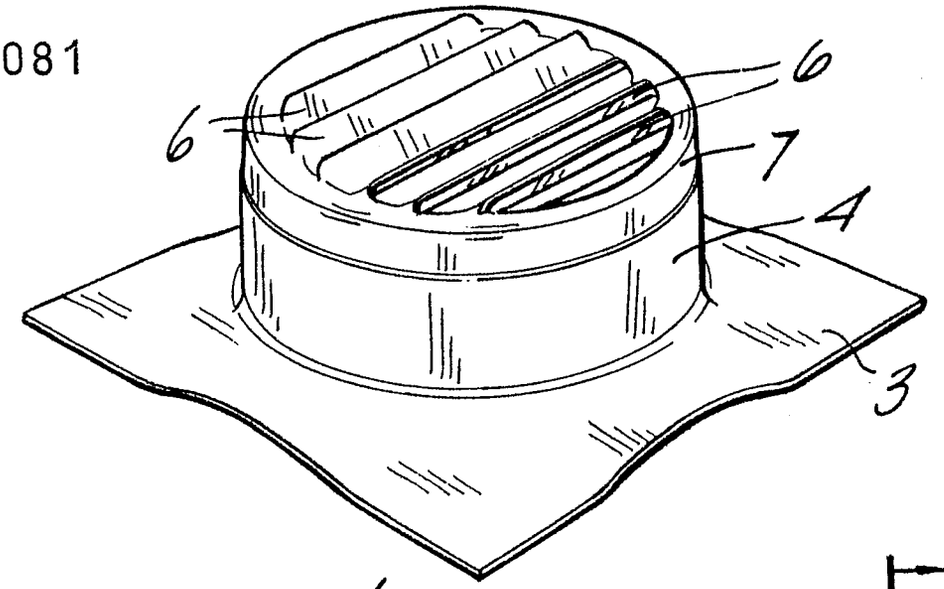


FIG. 1

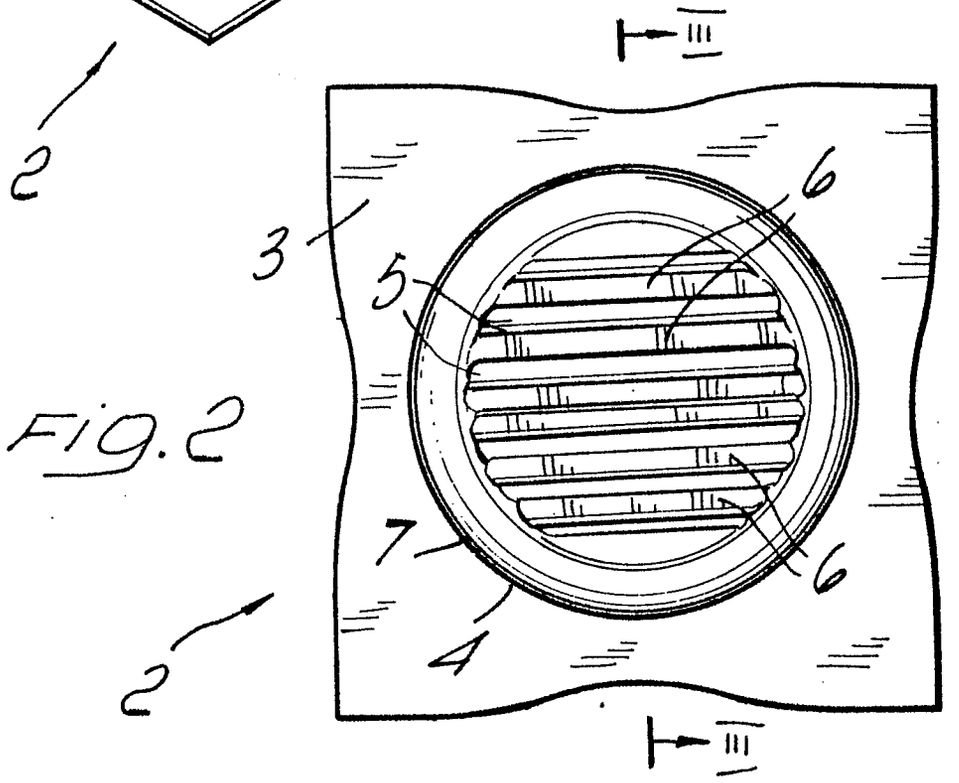


FIG. 2

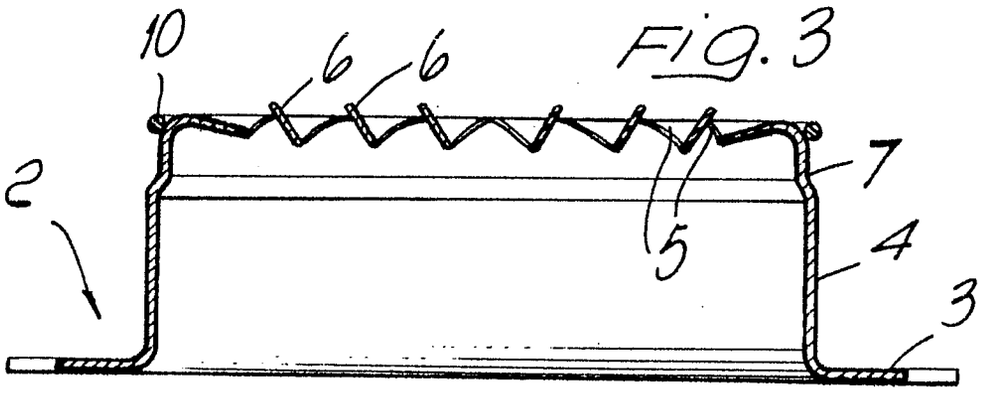
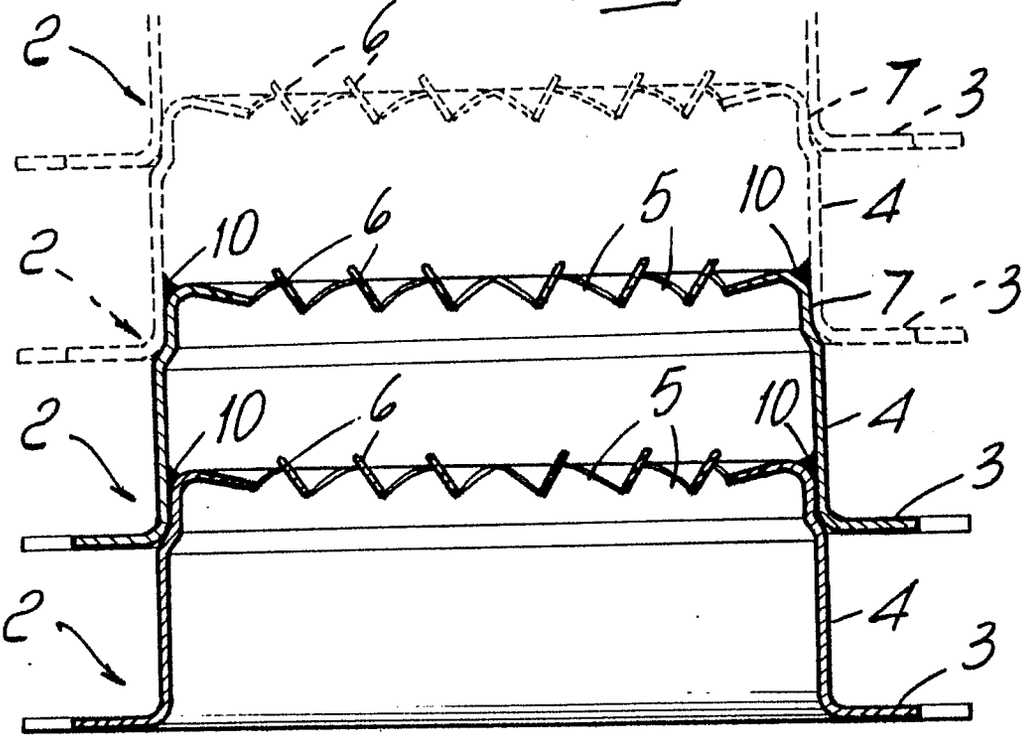


FIG. 3

FIG. 4



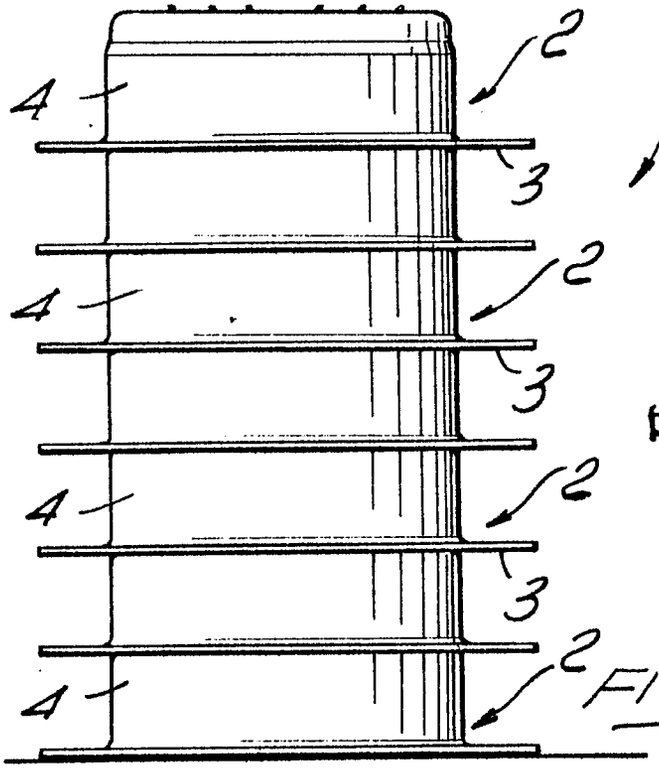


FIG. 6

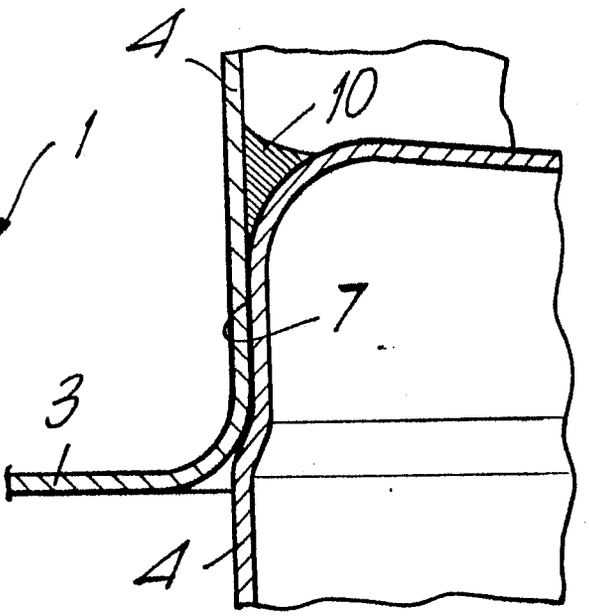


FIG. 5

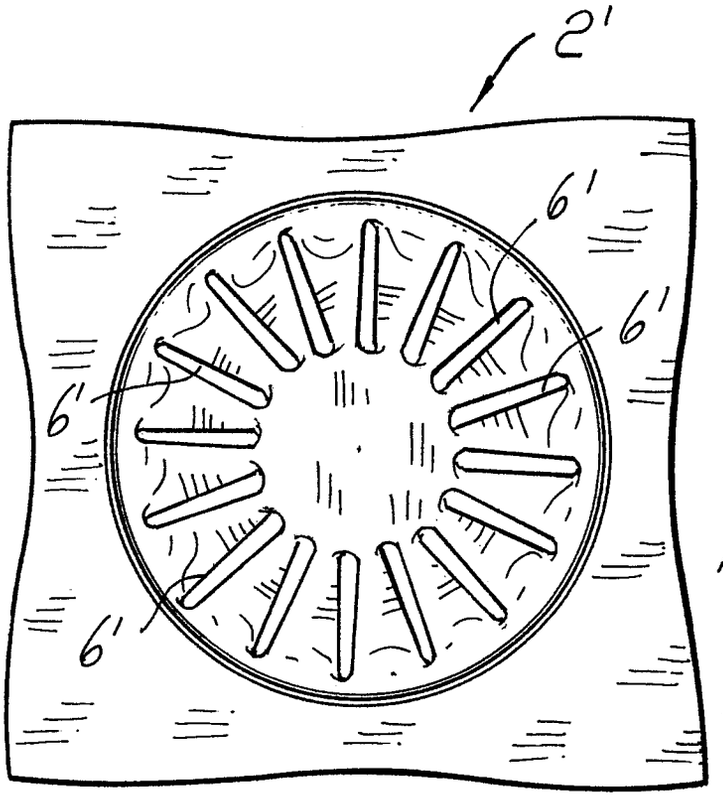
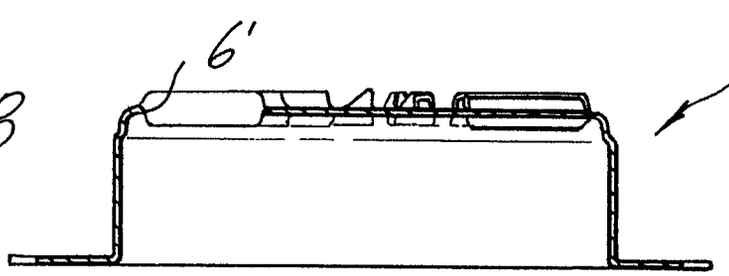


Fig. 7

Fig. 8



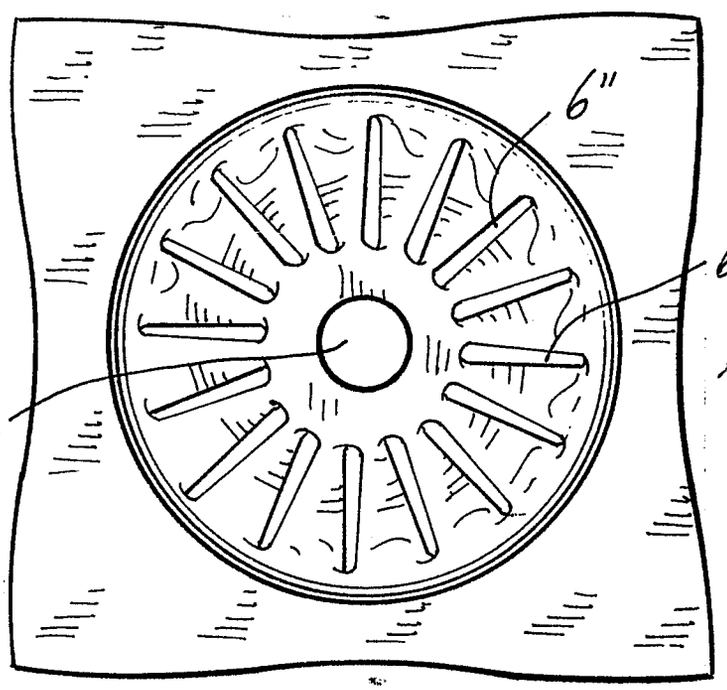


Fig. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number.

EP 87 83 0338

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A-3 242 260 (THERMAL-WERKE) * Abstract; figures 1-3 *	1,8,9	F 28 F 3/08
Y		2-7	
Y	US-A-1 591 323 (KARMAZIN) * Figures 1-16 *	2-4,6	
Y	DE-A-2 834 767 (GOULD CONTARDO) * Page 11, lines 15-27; figures 5,8 *	5,7	
A	FR-A-2 191 087 (DELANAIR) * Figures 1,2 *	1-9	
A	DE-C- 193 578 (TROOST) * Figures 6-8 *	2-4,6	
A	GB-A- 270 609 (KARMAZIN)		
A	FR-A-1 307 477 (GASSOT)		
A	US-A-1 870 012 (KARMAZIN)		TECHNICAL FIELDS SEARCHED (Int. Cl.4) F 28 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-12-1987	HOERNELL, L.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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