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(54) **Method for manufacturing a thermal element, a thermal element, and the use thereof**

(57) The invention relates to a method for manufacturing a thermal element. The thermal element is made by casting a first layer of pourable mass into a mould, placing an uninsulated sheet-like resistance element cut from a metal sheet onto the fresh layer of pourable mass

and casting a second layer of pourable mass into the mould so that only the ends of the resistance element are left visible. Moreover, the invention relates to a thermal element manufactured by the method of the invention and to heat storing water tanks and electric sauna stoves utilising these thermal elements.

EP 0 989 779 A1

Description

[0001] The present invention relates to a method as defined in the preamble of claim 1 for manufacturing a thermal element, a thermal element as defined in the preamble of claim 5 and an electric sauna stove as defined in the preamble of claim 12 for the use of the thermal element.

[0002] Traditionally, various electrically operated thermal elements are manufactured using tubular resistors. In all practical tubular resistor applications, the worst problem are the manufacturing costs of the tubular resistor. Depending on where they are used, tubular resistors also have other drawbacks. If they are used without insulation and e.g. only covered with stones as in electric sauna stoves, the glowing resistors cause a deterioration of steam quality, as is well known. On the other hand, in heat storing water tanks, tubular resistors are placed in the water space, i.e. they are used in conditions subject to corrosion, and in this case, too, the installation of the resistors is a considerable cost factor. Tubular resistors are also used in various direct and storing heater units and thermal elements, such as radiators. A problem with all these applications is how to install the resistors safely and so that they will not cause a risk to health or a fire risk even when aglow.

[0003] The object of the invention is to eliminate the drawbacks referred to above. A specific object of the invention is to disclose a new type of thermal element and a method for the manufacture thereof as well as new applications for the use of said element, thus to render different uses and applications of thermal elements both safe and structurally simple and economic to implement.

[0004] As for the features characteristic of the invention, reference is made to the claims.

[0005] In the method of the invention for the manufacture of a thermal element, a first layer of pourable mass is cast into a desired mould, the shape of which is not defined in any way by the invention. While the layer of pourable mass is still fresh, an uninsulated sheet-like resistance element cut from a metal sheet is placed upon it, whereupon a second layer of pourable mass is poured onto the resistance element in the mould so that only the ends of the resistance element remain visible. Thus, as the resistance element is a sheet-like and flat piece lying in one plane, it is easy to mount on the layer of pourable mass and it sets tightly in the mass, unlike the various helical resistors and other clearly three-dimensional resistor structures used in prior art, which generally have had to be placed in bores and similar cavities provided in the mass.

[0006] In an embodiment of the invention, the first and/or the second layer of pourable mass are/is cast as two separate sub-layers, with a metallic grounding network placed between them, said grounding network being then grounded in the conventional manner.

[0007] In the method of the invention, the pourable mass used may be any of various kinds of concrete, oth-

er fire resistant mass or e.g. ceramic paste. In an embodiment of the invention, a core consisting of two layers of a medium capable of withstanding high temperatures is cast in the middle of the thermal element, in which case the resistance element is placed between the two layers of temperature resistant medium and the actual heat storing and heat releasing frame of the thermal element, including the outer surface of the frame, is cast around the core, on both sides of it, e.g. from a cheaper material or a material with a better heat storing capacity. Thus the core part will withstand the high temperatures of the resistor and release heat uniformly and at a lower temperature to the frame of the thermal element, the frame being less temperature resistant but having a good heat storing capacity.

[0008] The thermal element of the invention comprises heat storing pourable mass and a resistance element embedded in the pourable mass. According to the invention, the resistance element is a sheet-like and flat element lying in one plane, machined from an uninsulated metal sheet and placed in the mass in conjunction with the casting of the pourable mass.

[0009] In a preferred embodiment, the thermal element comprises a grounding network or grounding conductor placed inside the pourable mass and having no galvanic connection with the resistance element. In an embodiment of the invention, the thermal element comprises a layer of a medium capable of withstanding high temperatures, placed around the resistance element to prevent direct contact between the hot resistance element and the less temperature resistant components of the thermal element.

[0010] In an embodiment of the invention, the thermal element is implemented as a plate-like radiator which, having a good heat storing capacity, can preferably be arranged to use night-time electricity.

[0011] In another embodiment of the invention, the thermal element forms the heating element of a heat storing water tank. In this case, the heating element may be placed in the water space of the heat storing water tank, but preferably the thermal element is mounted on the outer surface of a metallic shell of the heat storing water tank. Thus, the shell and the thermal element are surrounded by a heat insulating layer and all of the heat generated by the thermal element can be passed through the shell of the heat storing water tank into the water space inside. This construction provides a very simple and cheap solution for manufacturing heat storing water tanks because it obviates the need for building electric connections inside the reservoir while the structure of the thermal element is also as simple as possible.

[0012] A preferred embodiment of the invention is an electric sauna stove. In the electric sauna stove of the invention, an electric resistor is placed inside a casting made of fire resistant pourable mass. The casting has preferably been cast around the electric resistor. Thus, the electric resistor is completely hidden inside the casting and cannot be affected by the steam water or come

into direct contact with it. Therefore, the whole electric sauna stove may consist of only one casting of suitable shape, the electric resistor inside it being connected to an electrical power network.

[0013] The invention does not define the shape of the casting as such, but if the electric sauna stove consists of only one coherent casting, then it is preferably provided with cup-like water spaces with their open sides upward so that steam water can gather in them and be gradually evaporated.

[0014] In an embodiment of the invention, the casting in the electric sauna stove is e.g. a plate-like structure or a structure with a planar surface at least on its upper side, allowing loose sauna stove stones to be placed on top of the casting to give the structure an appearance that is more like a traditional sauna stove. At the same time, the stones heated upon the casting prevent the steam water thrown onto the stove from getting into direct contact with the casting, thus increasing its durability and prolonging its service life. Such a casting with loose sauna stove stones placed upon it is preferably provided with vertically extending holes to permit hot air to rise up through them so that heat is effectively conveyed from the casting to the sauna stove stones.

[0015] In an embodiment of the invention, the electric sauna stove comprises a shell, i.e. a vertical cage-like envelope delimiting a space inside it, which traditionally has been used to house glowing tubular resistors. In the structure of the invention, this space contains one or more castings, i.e. thermal elements as provided by the invention, which are preferably covered with conventional loose sauna stove stones. The castings may be plates placed in an upright position and side by side in a suitable manner, at a distance from each other. Of course, it is possible to use thermal elements of other shapes as well. As the electric resistors are embedded in the pourable mass, a heated sauna stove will not have any surfaces aglow and steam water thrown on the stove cannot come into contact with the resistors. Thus, the formation of harmful ions and ozone is avoided, agreeable sauna steam is obtained and durable structures with highly economic manufacturing costs are achieved.

[0016] The electric resistors used in the casting for an electric sauna stove are made from mere uninsulated metal wire of suitable material or from some other suitable uninsulated resistive material. For instance, the resistor may be made by cutting a piece from an uninsulated metal sheet and machining it so as to form a sheet-like and flat resistance element, which is placed inside the casting in conjunction with the moulding thereof. In this way, a heating element for an electric sauna stove which is very simple and cheap to manufacture is achieved.

[0017] As described in detail above in conjunction with different embodiments, the method and structure of the invention have several significant advantages as compared with prior art. However, the greatest advantage

provided by the invention can be considered as consisting in the fact that it replaces well-known and relatively expensive structures with a simple, cheap and durable construction which will bring the profitability of the manufacture of e.g. traditional electric sauna stoves to a completely new level.

[0018] In the following, the invention will be described in detail with reference to the attached drawings, wherein

Fig. 1 presents a thermal element according to the invention, layer by layer.

Fig. 2 presents a first embodiment of the invention designed to be used as a sauna stove,

Fig. 3 presents a second embodiment of the invention designed to be used as a sauna stove,

Fig. 4 presents a third embodiment of the invention designed to be used as a sauna stove,

Fig. 5 presents a cross-section through a heat storing water tank according to the invention, and

Fig. 6 presents an embodiment of a thermal element according to the invention.

[0019] Fig. 1 illustrates a thermal element according to the invention and a method for the manufacture thereof. In this embodiment, a first layer of pourable mass 1 is first cast as two sub-layers 1a and 1b, placing a grounding network 4 between them so that only a suitable projection 15 for the connection of a grounding wire is left outside the first layer of pourable mass 1. A relatively thin medium layer 5a of a mass capable of withstanding high temperatures is cast upon the first layer of pourable mass 1, and a sheet-like and relatively flat resistance element 2 is placed upon the medium layer 5a. A second medium layer 5b of corresponding mass capable of withstanding high temperatures is cast upon the resistance element, which is thus completely embedded inside the heat-resistant mass while only the ends 16 of the resistance element are left outside to permit the connection of conductors. After this, a first sub-layer 3a of a second layer of pourable mass 3 is cast upon the second medium layer 5b. Upon the first sub-layer 3a is placed a grounding network 4, which is covered with a second sub-layer 3b. In this way, a thermal element has been formed which has an inner part capable of withstanding high temperatures and outer layers with a good heat storing efficiency and a slow heat releasing property and which, or whose different embodiments, can be used in a plurality of possible applications.

[0020] Fig. 2 illustrates an embodiment of the thermal element of the invention used as a sauna stove. In this embodiment, the thermal element is a casting 10 of a substantially square shape, attached in a horizontal position to a wall by means of a bracket 17. The casting is provided with vertical holes 18 disposed at a distance from each other substantially in the entire area of the casting. Heaped on the casting are a number of conven-

tional loose sauna stove stones 12. In addition, a switching and control device 19 as is generally known and used in conjunction with sauna stoves is connected to the casting for the operation of the sauna stove. Thus, a very simple and compact new sauna stove structure is formed in which the thermal element 10 is first heated by means of the electric resistor inside it and from which the heat rises both by direct transmission and by air flow via the holes 18, heating the stones 12 and the air space in the sauna.

[0021] Fig. 3 illustrates another embodiment of the invention for application in an electric sauna stove. In this case, instead of expensive tubular resistors as are exclusively used so far, castings 10, i.e. plate-like thermal elements are mounted in the interior space 14 delimited by a cage-like envelope 13 made of sheet metal. This embodiment comprises three plate-like thermal elements placed side by side in an upright position and at a distance from each other, leaving clear vertical air spaces both between themselves and between the thermal elements and the envelope of the sauna stove.

[0022] On top of the thermal elements, it is possible to set conventional sauna stove stones or equivalent in the traditional manner, which will be heated by the heavy upward heat flow from the thermal elements. The essential point about this sauna stove application, too, is that no red-hot metal parts with which the steam water or the oxygen in the air would get into contact are formed in the sauna stove.

[0023] The thermal elements used in the sauna stove applications are preferably entirely cast from previously known pourable masses capable of withstanding high temperatures. The resulting elements will endure the throwing of steam water onto them, although in the embodiments in Fig. 2 and 3 the sauna stove stones placed on the thermal elements minimise the chance of steam water getting into contact with the surface of the thermal elements.

[0024] Fig. 4 again presents an embodiment for application in a sauna stove corresponding to Fig. 2 but without the use of separate sauna stove stones. In this case, an electric sauna stove formed by a mere plate-like thermal element designed to be mounted in a horizontal position, which can be attached to a wall, floor even a ceiling with fixtures placed at suitable distances. The plate-like element comprises a number of holes 18 to create an intensive upward air flow through the element so as to produce an effective heat transfer from the thermal element to the sauna space. Moreover, the thermal element has a number of cup-like, i.e. upward-opening water spaces 11. When steam water is thrown onto the plate, some of the water will evaporate immediately and some of it will boil slowly in the water spaces 11. Thus, thanks to the water spaces, agreeable and soft steam is produced and splashing and flow of steam water outside the sauna stove is prevented.

[0025] Fig. 5 presents a sectional view of a heat storing water tank application of the invention. The heat stor-

ing water tank 7 comprises a metallic shell 8, i.e. a cylindrical mantle, which is generally mounted in a horizontal position for use. The electric resistor of the heat storing water tank consists of a thermal element 6 according to the invention, whose surface has a shape corresponding to the curvature of the shell 8 and is disposed below the shell 8 against its outer surface, i.e. at the bottom of the heat storing water tank. In addition, the entire shell as well as the thermal element 6 are surrounded by a layer 9 of insulating material of sufficient thickness. In this way, a very simple heat storing water tank is formed, in which heat is conducted from the thermal element through the shell 8 to the water inside. Thus, the heat storing water tank need not be provided with any mounting bosses for resistors or with expensive resistors designed to endure the conditions in a water tank.

[0026] Fig. 6 presents a preferred embodiment of the thermal element of the invention. The thermal element consists of a hollow tube manufactured by casting a first layer of pourable mass 1 around a suitable cylindrical mould. After this, an uninsulated band-like resistance element 2 has been wound in a spiralling fashion around the first layer of pourable mass 1. Finally, a second layer of pourable mass 3 has been cast upon the first one, covering the resistance element so that only its ends are left visible to allow the required connections to be made. To give a clearer illustration of the structure, the figure shows only a part of the second layer of pourable mass.

[0027] The element presented in Fig. 6 is especially applicable for use in electric sauna stoves in place of the traditional resistor. For example, when mounted in an upright position, the structure allows an effective air circulation both inside and outside the tube, thus accelerating the heating of the sauna, yet the resistors are completely hidden in pourable mass, so they cannot come into contact with the steam water. In addition, the element can be manufactured by a simple and fast process.

[0028] In the foregoing, the invention has been described by way of example with reference to the attached drawings while many variations of the invention are possible within the scope of the inventive idea defined in the claims.

Claims

1. Method for manufacturing a thermal element, **characterised** in that a first layer of pourable mass (1) is cast into a mould, an uninsulated sheet-like resistance element (2) cut from a metal sheet is placed upon the fresh layer of pourable mass and a second layer of pourable mass (3) is cast into the mould so that only the ends of the resistance element remain visible.
2. Method as defined in claim 1, **characterised** in that

the first and/or the second layer of pourable mass (1, 3) are/is cast as two sub-layers (1a, b, 3a, 3b) and a metallic grounding network (4) is placed between the sub-layers.

3. Method as defined in claim 1 or 2, **characterised** in that the pourable mass used consists of concrete, fire resistant mass and/or ceramic mass.

4. Method as defined in claim 1, **characterised** in that a layer (5a, 5b) of a medium capable of resisting high temperatures is cast in two parts between the first and the second layers of pourable mass and the resistance element (2) is placed inside said layer (5a, 5b) .

5. Thermal element comprising heat storing pourable mass (1, 3) and a resistance element (2) embedded in it, **characterised** in that the resistance element is a substantially sheet-like element machined from an uninsulated metal sheet.

6. Thermal element as defined in claim 5, **characterised** in that it comprises a grounding network (4) placed inside the pourable mass (1, 3) so that it is not in contact with the resistance element (2).

7. Thermal element as defined in claim 5, **characterised** in that the resistance element (2) is surrounded by a layer (5a, 5b) of a medium capable of resisting high temperatures, outside which the layers of pourable mass (1, 3) are disposed.

8. Thermal element as defined in claim 7, **characterised** in that the thermal element is a plate-like radiator, which is preferably arranged to use night-time electricity.

9. Thermal element as defined in any one of claims 5 - 7, **characterised** in that the thermal element (6) is the heating element of a heat storing water tank (7).

10. Thermal element as defined in claim 9, **characterised** in that the thermal element (6), having a shape corresponding to the shape of the surface of the shell (8) of the heat storing water tank, is placed on the outer surface of the shell, inside an insulating layer (9).

11. Thermal element as defined in claim 9, **characterised** in that the heating element is placed in the water space of the heat storing water tank.

12. Electric sauna stove comprising an electric resistor, **characterised** in that an electric resistor is placed inside a casting (10) manufactured from fire-resistant pourable mass.

13. Electric sauna stove as defined in claim 12, **characterised** in that the casting has been cast around the electric resistor.

5 14. Electric sauna stove as defined in claim 12, **characterised** in that the casting (10) comprises one or more cup-like water spaces (11) open at their upper side.

10 15. Electric sauna stove as defined in any one of claims 12 - 14, **characterised** in that it comprises loose sauna stove stones (12) placed upon the casting (10) to prevent steam water from getting to the surface of the casting.

15 16. Electric sauna stove as defined in any one of claims 12 - 15, **characterised** in that the casting comprises holes (18) extending vertically through it.

20 17. Electric sauna stove as defined in claim 12, **characterised** in that the electric sauna stove comprises a substantially upright cage-like envelope (13) with one or more castings (10) mounted in the space (14) delimited by it.

25 18. Electric sauna stove as defined in claim 17, **characterised** in that it comprises loose sauna stove stones placed upon the castings, above the space delimited by the envelope.

30 19. Electric sauna stove as defined in claim 17 or 18, **characterised** in that the castings (10) are plates placed in an upright position and side by side at a distance from each other.

35 20. Electric sauna stove as defined in claim 17 or 18, **characterised** in that the casting is a tube, the electric resistor being placed inside the tube wall.

40 21. Electric sauna stove as defined in any one of claims 12 - 20, **characterised** in that the electric resistor consists of an uninsulated metal wire placed inside the pourable mass.

45 22. Electric sauna stove as defined in any one of claims 12 - 20, **characterised** in that the electric resistor consists of a substantially sheet-like resistance element machined from an uninsulated metal sheet and mounted inside the pourable mass.

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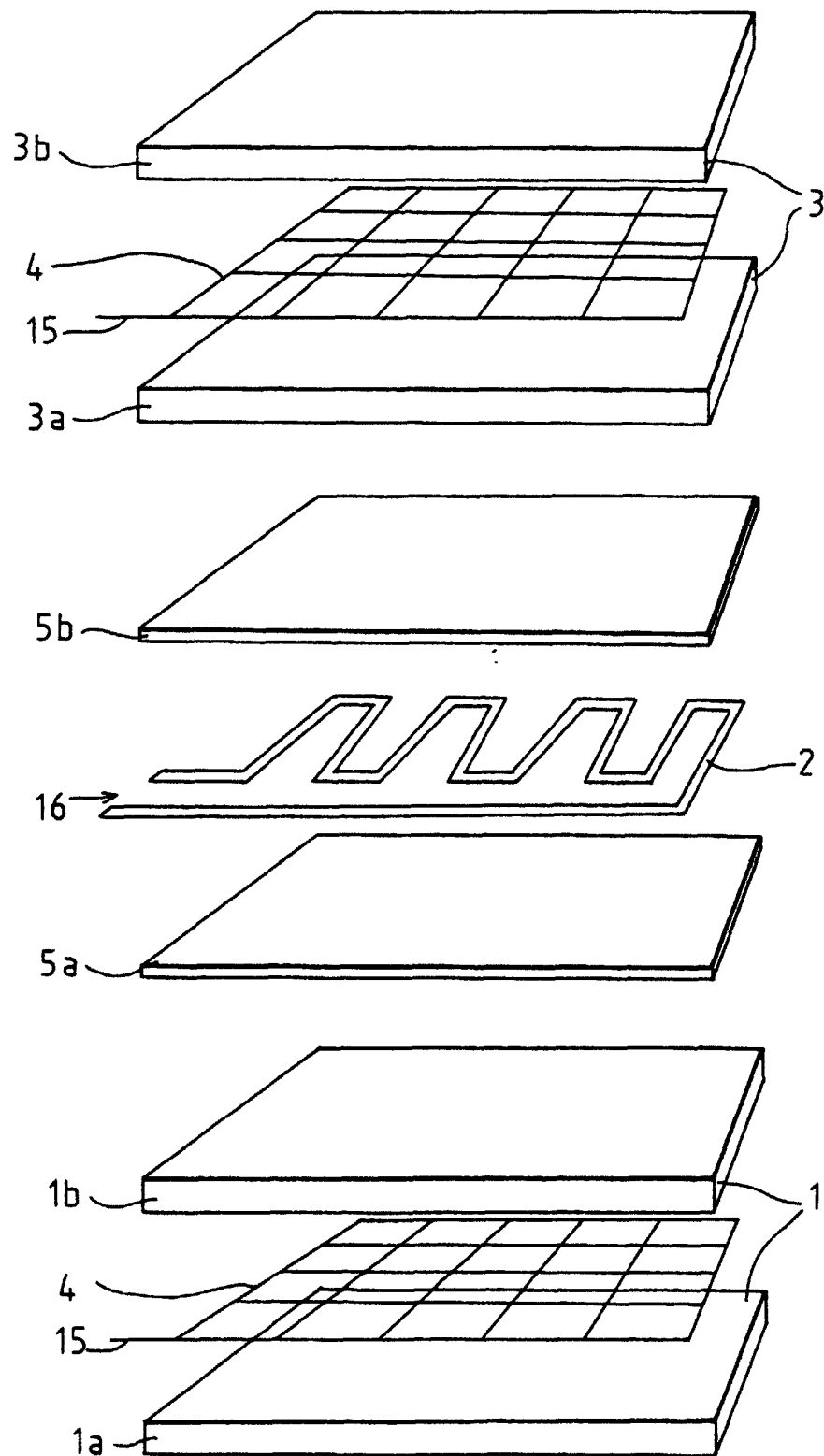


FIG 1

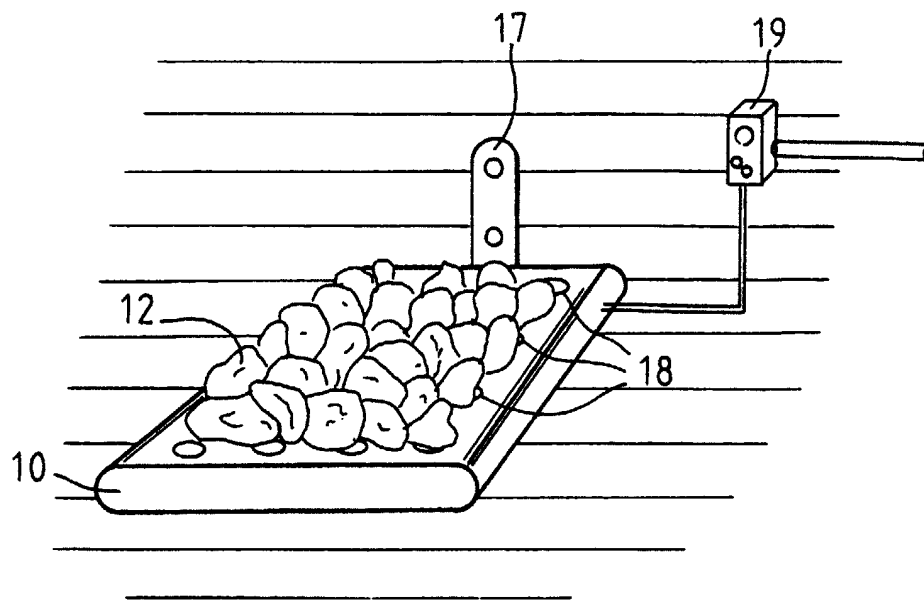


FIG 2

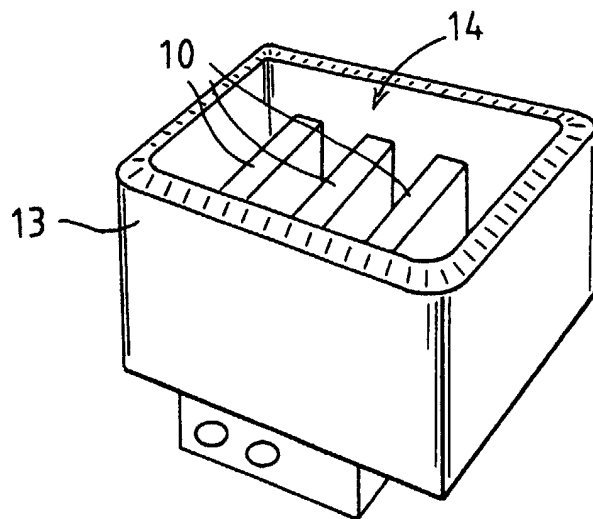


FIG 3

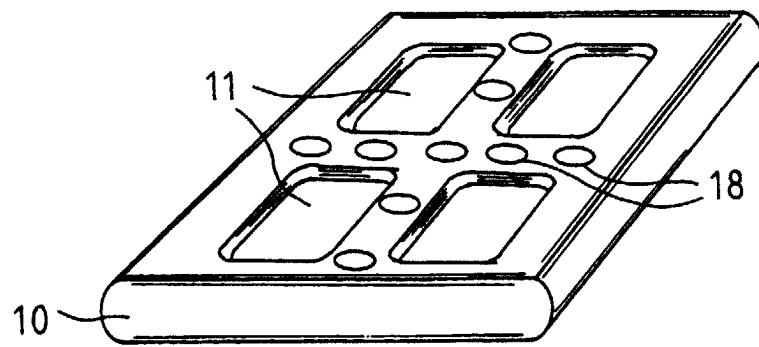


FIG 4

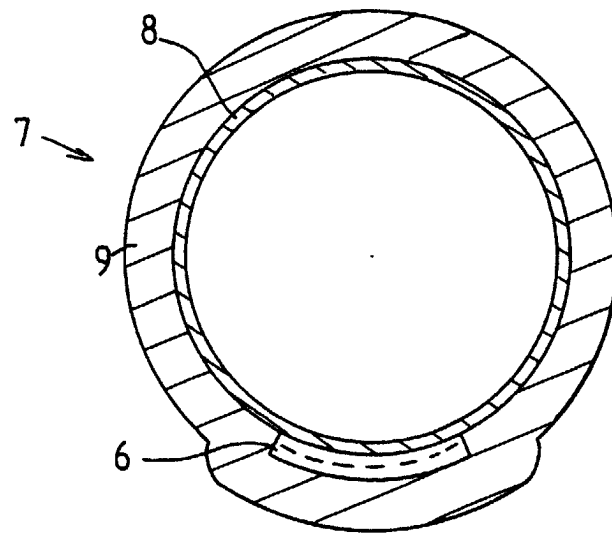


FIG 5

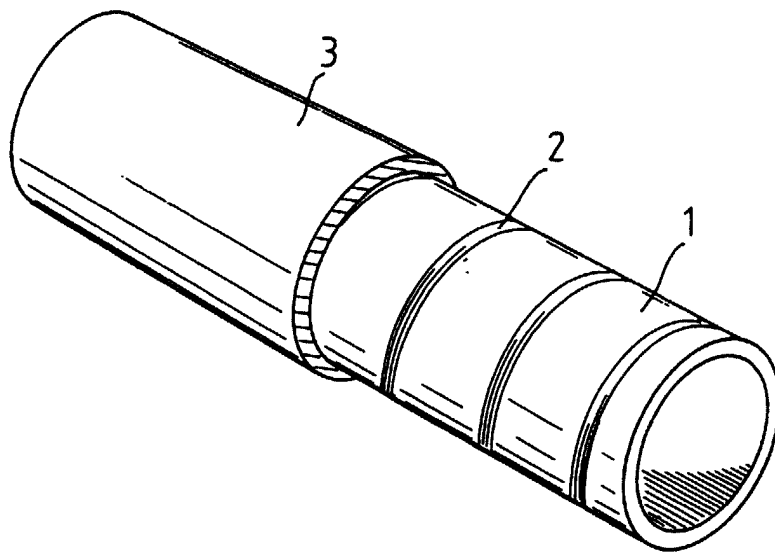


FIG 6



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EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 99660149.8
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 6)
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A	BE 905985 A (COGEBI S.A.) 16 April 1987, claims 1-4, fig. 2. --	1,5, 12,13	
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			TECHNICAL FIELDS SEARCHED (Int. Cl. 6)
			H05B3/00
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 30-11-1999	Examiner TSILIDIS
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons Z : member of the same patent family, corresponding document X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document	

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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO. EP 99660149.8

This annex lists the patent family members relating to the patent documents cited in the above-mentioned search report.
The members are as contained in the EPIDOS INPADOC file on 16.12.1999.
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For more details about this annex see Official Journal of the European Patent Office, No. 12/82.