(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 655 546 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.05.2006 Bulletin 2006/19

(21) Application number: **04106370.2**

(22) Date of filing: **07.12.2004**

(51) Int Cl.:
F24D 19/10 *(2006.01)* ***H05K 7/20*** *(2006.01)*
H05B 3/42 *(2006.01)* ***H05B 1/02*** *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR LV MK YU

(30) Priority: **07.11.2004 IT VI20030248**

(71) Applicant: **BORELLI Luigi**
55049 VIAREGGIO (LU) (IT)

(72) Inventor: **BORELLI Luigi**
55049 VIAREGGIO (LU) (IT)

(74) Representative: **Bonini, Ercole et al**
Corso Fogazzaro, 8
36100 Vicenza (IT)

(54) Heating group for diathermic fluid radiant elements

(57) A heating group (1) for diathermic fluid radiant elements (A, B) comprising: a heater (2) put in contact with the diathermic fluid and consisting of a tubular body (4) containing an electric insulator (4a) in which at least an electric resistance (5) is immersed; a tubular sleeve (6) disposed at one end of the tubular body (4) and provided with fastening means (6a) to the radiant element (A, B); a feeding group (7) of the heater (2), comprising at least a solid-state switch (8) able to connect the electric resistance (5) to a distribution power grid (9); electronic control means (10) for switching off and switching on the switch (8). The solid-state switch (8) is disposed inside the sleeve (6), where it is incorporated in a thermo-conductive core (11; 19; 20) adherent to the inner wall (6a) of the sleeve (6).

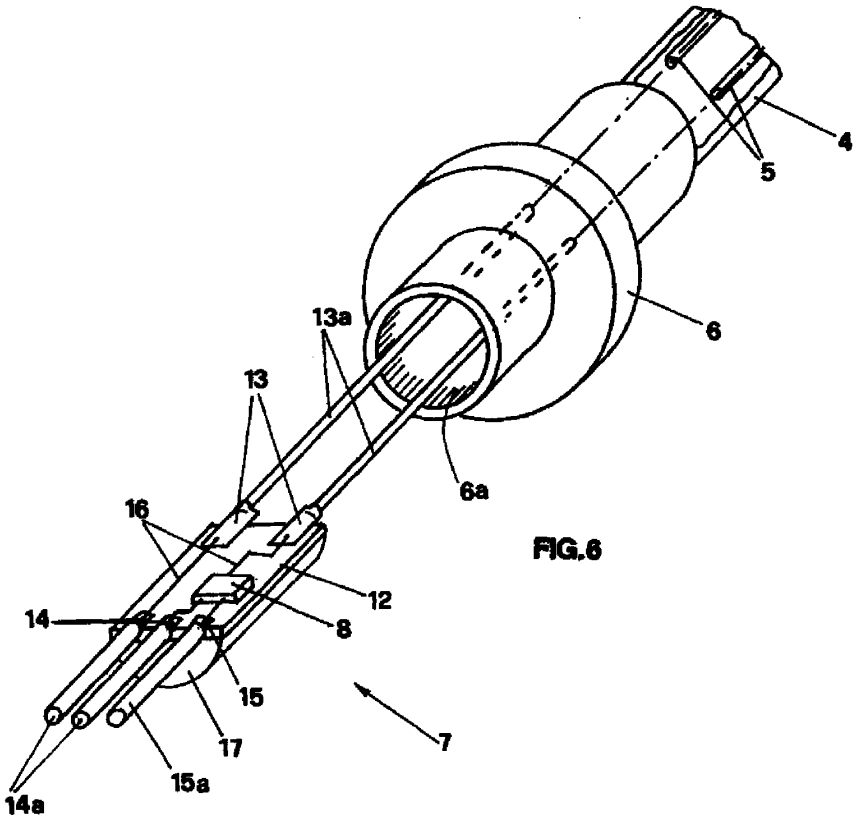

FIG.6

EP 1 655 546 A1

Description

[0001] The present invention is about a heating group for diathermic fluid radiant elements, in particular radiators and towel heaters especially for domestic use.

[0002] It is known that, in the electric radiators used to heat rooms or napkins and towels, the heat is supplied by proper heating groups which comprise a heater inserted in the radiant element and fed by electric current through a feeding group.

[0003] In particular, a radiator or a towel heater of known type comprises a heating group consisting of a tubular body inserted in the radiant element and put in contact with the diathermic fluid, which contains an insulating material in which one or more electric resistances are inserted.

[0004] The tubular body is provided at one end with a tubular sleeve for the fastening to the radiant element, and through it they pass conductive elements for the connection of the electric resistance to a feeding group, which is housed in a box fixed to the radiant element.

[0005] In particular, the feeding group, according to the prior art, comprises a solid-state switch, generally a bidirectional thyristor commonly called TRIAC or SCR, connected to electronic control means which set its switching on and switching off.

[0006] In all known embodiments, the thyristor cooling is particularly difficult, since the box in which it is contained is closed to avoid the entrance of humidity or water. The considerable heat produced by the thyristor makes the temperature inside the box to increase, and this can compromise the correct operation of the electronic components.

[0007] In particular, if the temperature exceeds 100°C, the operation of the thyristor itself is compromised.

[0008] The use of heat sinks applied to the box in which the thyristor is contained does not solve the problem in a satisfactory way and makes also more complex the manufacturing of the whole heating group.

[0009] Another inconvenience found in known embodiments is due to the fact that the electric resistance undergoes damages, sometimes irreparable, when a good contact between the diathermic fluid and the heater is not carried out, since the resistance operates partially in contact with air and this increases the specific load which causes its burnout.

[0010] The present invention intends to overcome the aforementioned inconveniences.

[0011] In particular, it is a first object of the invention to provide for a heating group for diathermic fluid radiant elements in which, during operation, the temperature of the solid-state switch, which fits out the resistance feeding group, is constantly below the highest allowed temperature.

[0012] It is another object that said temperature value is maintained without requiring heat sinks.

[0013] It is a further object to reduce the possibility that the resistance is burned out in case of failed contact between the heating element and the diathermic fluid.

[0014] Not the least object is that the heating group of the invention maintains at least the same electric safety standards found in the prior art heating groups.

[0015] Said objects are obtained by a heating group for diathermic fluid radiant elements which, according to the main claim, comprises:

- a heater inserted in a housing present in said radiant element and put in contact with said diathermic fluid, said heater consisting of a tubular body containing an electric insulator in which at least an electric resistance is inserted;
- a tubular sleeve disposed at one end of said tubular body and provided with fastening means to said radiant element;
- a feeding group of said heater, comprising at least a solid-state switch able to connect said electric resistance to a distribution power grid;
- electronic control means for switching off and switching on said switch, and it is characterized in that said solid-state switch is disposed in said sleeve where it is incorporated in a thermo-conductive core adherent to the inner wall of said sleeve.

[0016] According to a preferred executive embodiment, the solid-state switch is a bidirectional thyristor coupled with a support base incorporated in the thermo-conductive core.

[0017] First terminals for the connection to the electric resistance, second terminals for the connection to the distribution power grid and third terminals for the connection to the electronic control means of the thyristor are present in the support base.

[0018] The support base comprises a printed circuit consisting of conductive stripes to connect the solid-state switch to the connection terminals.

[0019] According to an executive embodiment, the solid-state switch is incorporated in the thermo-conductive core, being connected in the air to the electric resistance, to the distribution power grid and to the electronic control means.

[0020] Preferably, the heating group also comprises a resistive protection element with positive temperature coefficient, commonly called PTC (Positive Temperature Control), which is connected in series between the solid-state switch and the electronic control means which control its switching on and switching off.

[0021] Advantageously, the heating group of the invention is more reliable with respect to the known heating groups, since the thermal dispersion that the thyristor carries out inside the sleeve that houses it is greater than that achievable in known embodiments, in which the thermal exchange takes place directly in the air or by means of heat sinks.

[0022] Consequently, and in a still advantageous way, the heating group of the invention is also more reliable in its operation with respect to the equivalent heating

groups of known type.

[0023] Furthermore advantageously, the presence of the resistive element with positive temperature coefficient warrants an effective protection against the electric resistance burnout, especially in case of the specific load on the resistance is raised beyond unacceptable values for a lack of contact with the diathermic fluid.

[0024] The aforesaid objects and advantages will be better highlighted in the description of preferred executive embodiments of the invention, given in an explanatory but not limiting way hereinafter, with reference to the figures of the annexed drawings, wherein:

- Figures 1 and 2 show two different views of a radiator to which the heating group of the invention is applied;
- Figures 3 and 4 show two different views of a towel heater to which the heating group of the invention is applied;
- Figure 5 shows a detail of the heating group of the invention shown in Figures 1 to 4;
- Figure 6 is an axonometric exploded view of a detail of Figure 5;
- Figure 6a is a front view of the detail of figure 6 in assembled configuration;
- Figure 7 is a different executive embodiment of the detail of Figure 6;
- Figure 7a is a front view of the detail of figure 7 in assembled configuration;
- Figure 8 is another executive embodiment of the detail of Figure 6;
- Figure 8a is a front view of the detail of figure 8 in assembled configuration;
- Figure 9 is a further executive embodiment of the detail of Figure 6;
- Figure 10 shows the electric diagram of the heating group of the invention for any of the executive embodiments of Figures 6 to 8; and
- Figure 11 shows an executive embodiment of the electric diagram of Figure 10.

[0025] The heating group of the invention is shown in Figures 1 to 4, where it is generally indicated with numeral **1.**

[0026] In particular, in Figures 1 and 2 said group is applied to a diathermic fluid radiator, generally indicated with **A,** while in Figures 3 and 4 it is applied to a towel heater, with diathermic fluid too, generally indicated with **B.**

[0027] It is evident that the heating group of the invention could be also applied to fixed or mobile radiant element of other kind.

[0028] One can see that the heating group **1** comprises a heater **2** of known type, which is inserted in a housing **3** present in the radiant element **A, B** and which, as one can see in greater detail in Figure 5, is composed by a tubular body **4** put in contact with the diathermic fluid, said body containing an electric insulator **4a** in which an electric resistance, schematically shown in Figure 5 and indicated with numeral **5**, is inserted.

[0029] It is pointed out that also several electric resistances could be housed inside the tubular body **4.**

[0030] According to the prior art, a thermo-fuse **5a** and a protective electro mechanic thermostat **5b,** disposed inside the tubular body **4,** are coupled with the resistance **5.**

[0031] A tubular sleeve, generally indicated with numeral **6,** is disposed at the end of the tubular body **4** and it is provided with fastening means consisting, for example, of a threaded collar **6a** which is screwed to the radiant element.

[0032] In other executive embodiments, the fastening means could also be of other kind, like for instance screws.

[0033] The heating group **1** also comprises a feeding group, generally indicated with numeral **7** and shown in axonometric view in Figure 6, provided with a solid-state switch **8** for the connection of the electric resistance **5** to a distribution power grid **9** according to the electric diagram of Figure 10.

[0034] Electronic control means, generally indicated with numeral **10** and shown in the electric diagram of Figure 10, are present too for switching off and switching on the switch **8.**

[0035] According to the invention, the solid-state switch **8** is disposed inside the sleeve **6,** where it is contained in a thermo-conductive core **11** adherent to the inner wall **6a** of the sleeve **6.**

[0036] According to the executive embodiment shown in Figures 6 and 6a, and with reference to the electric diagram of Figure 10, the solid-state switch **8** is coupled with a support base **12,** which is incorporated in the thermo-conductive core **11** and on which are present:

- first terminals **13** and respective conductors **13a** for the connection to the electric resistance **5;**
- second terminals **14** and respective conductors **14a** for the connection to the distribution power grid **9;**
- third terminals **15** and respective conductors **15a** for the connection to the electronic control means **10** for switching on and switching off the switch 8.

[0037] The support base **12** comprises conductive stripes **16** to connect the solid-state switch **8** to the connection terminals **13, 14** and **15** which are completely immersed in the thermo-conductive core 11 after the support base 12 has been inserted in the tubular sleeve **6.**

[0038] In particular, one can see in Figures 6 and 6a that the thermo-conductive core **11** comprises a first thermo-conductive body **17** with a circular sector cross section, made of metallic material, and a second thermo-conductive body **18,** made of thermo-conductive resin, between which the support base 12 is present, as one can see in detail in Figure 6.

[0039] Operatively, the manufacturing process provides for the assembly of the solid state switch **8** on the support base **12** and the connection of the terminals to

the respective wires, and thus the fastening of the base **12** to the first thermo-conductive body 17 through fastening means.

[0040] Once the fastening is performed, the support base **12,** together with the thermo-conductor **17,** is inserted in the tubular sleeve **6.**

[0041] Then, the space inside the sleeve **6** comprised between the support base **12** and the inner surface **6a** of the sleeve **6** is filled with thermo-conductive resin, obtaining the second thermo-conductive body **18** shown in Figure 6a.

[0042] In this way, the so obtained thermo-conductive core **11** perfectly adheres with interference to the inner surface **6a** of the sleeve **6**, providing for the connection stability of the support base **12** and all the components associated therewith inside the tubular sleeve **6.**

[0043] The perfect adhesion of the thermo-conductive core **11** to the inner surface 6a of the sleeve **6** enhances the thermal exchange and assures the operation of the solid-state switch **8** at an optimal constant temperature, comprised between 70°C and 80°C, thus considerably below the dangerous threshold of 100°C.

[0044] A different executive embodiment of the invention is shown in Figures 7 and 7a, which is different from that previously described in that the support base **12** of the solid-state switch **8** and the terminals **13, 14** and **15** is incorporated in a single thermo-conductive body, generally indicated with numeral **19,** which is obtained injecting thermo-conductive resin inside the sleeve **6** after the insertion of the support base **12,** centred on the sleeve **6.**

[0045] Another executive embodiment is shown in Figures 8 and 8a, and it differs from those previously described in that the solid-state switch **8** is assembled in the air directly to the conductors **13a** for the connection to the electric resistance **5,** to the conductors **14a** for the connection to the distribution power grid **9** and to the conductor **15a** for the connection to the electronic control means **10.**

[0046] Said switch is incorporated in a thermo-conductive core, generally indicated with numeral **20,** which is obtained injecting thermo-conductive resin inside the sleeve **6** after the interposition of an insulating ring **21** circumferentially close to the inner surface **6a** of said sleeve **6.**

[0047] All the described embodiments could be made according to a different circuit diagram shown in Figures 9 and 11, which provides for the insertion of a resistive protection element with positive temperature coefficient (PTC), indicated with numeral **22,** instead of the electro mechanic thermostat **5b.**

[0048] As one can see in the electric diagram of Figure 11, the resistive element **22** is connected in series between the solid-state switch **8** and the electronic control means **10** which control its switching on and switching off.

[0049] On the basis of the aforesaid description, it should be understood that the heating group of the invention achieves all the intended objects.

[0050] In particular, incorporating the solid-state switch inside the sleeve for fastening the heater to the radiant element, a greater heat dispersion is obtained, since in the area in which the sleeve is connected to the radiant element the operative temperature is constantly around values comprised between 70°C and 80°C, and thus far from the temperature threshold of 100°C which is dangerous for the switch **8.**

[0051] As previously mentioned, the heating group of the invention could be applied to radiant elements of any kind, both of fixed installation and of mobile installation.

[0052] The thermo-conductive materials used could be of any kind, as long as thermo-conductive and thus able to provide for an optimal dispersion of the heat produced by the solid-state switch during operation.

[0053] It is important to point out that said switch could be a thyristor of TRIAC or SCR type.

[0054] It is intended that further executive embodiments of the invention, neither described nor shown in the drawings, if they fall within the scope of protection of the following claims, should be intended as protected by the present patent.

Claims

1. A heating group (1) for diathermic fluid radiant elements (A, B) comprising:

- a heater (2) inserted in a housing (3) present in said radiant element (A, B) and put in contact with said diathermic fluid, said heater (2) consisting of a tubular body (4) containing an electric insulator (4a) in which at least an electric resistance (5) is inserted;
- a tubular sleeve (6) disposed at one end of said tubular body (4) and provided with fastening means (6a) to said radiant element (A, B);
- a feeding group (7) of said heater (2), comprising at least a solid-state switch (8) able to connect said electric resistance (5) to a distribution power grid (9);
- electronic control means (10) for switching off and switching on said switch (8),

characterized in that said solid-state switch (8) is disposed in said sleeve (6) where it is incorporated in a thermo-conductive core (11; 19; 20) adherent to the inner wall (6a) of said sleeve (6).

2. The heating group (1) according to claim 1), **characterized in that** said solid-state switch (8) is coupled with a support base (12) incorporated in said thermo-conductive core (11), in which base (12) first terminals (13) for the connection to said electric resistance (5), second terminals (14) for the connection to said distribution power grid (9) and third terminals (15) for the connection to said electronic control means (10) are present.

3. The heating group (1) according to claim 2), **characterized in that** said support base (12) comprises conductive stripes (16) to connect said solid-state switch (8) to said connection terminals (13; 14; 15).

4. The heating group (1) according to claim 1), **characterized in that** said solid-state switch (8) is disposed in the air and it is connected to said electric resistance (5), to said distribution power grid (9) and to said electronic control means (10), being incorporated in said thermo-conductive core (20).

5. The heating group (1) according to claim 2), **characterized in that** said thermo-conductive core (11) comprises a first thermo-conductive body (17), made of metallic material, and a second thermo-conductive body (18), with semicircular cross section and made of thermo-conductive resin, said first body (17) and said second body (18) being of circular sector cross section and having mutually facing contact surfaces between which said support base (12) of said solid-state switch (8) is comprised.

6. The heating group (1) according to claim 5), **characterized in that** said first body (17) and said second body (18) are coupled with interference with the inner surface (6a) in said tubular sleeve (6).

7. The heating group (1) according to claims 2) or 4), **characterized in that** said thermo-conductive core comprises a single thermo-conductive body (19) made of thermo-conductive resin, having circular cross section and being coupled with interference with said tubular sleeve (6).

8. The heating group (1) according to claim 7), **characterized in that** an annular jacket (21), made of thermo-conductive and electrically insulated material, is interposed between said single thermo-conductive body (20) and the inner surface (6a) of said tubular sleeve (6).

9. The heating group (1) according to any of the preceding claims, **characterized by** comprising a protective thermo-fuse (5a) disposed in said tubular body (4) and electrically connected to said electric resistance (5).

10. The heating group (1) according to any of the claims 1) to 8), **characterized by** comprising a resistive protection element (22) with positive temperature coefficient connected in series between said solid-state switch (8) and said switching on and switching off electric control means.

11. The heating group (1) according to any of the preceding claims, **characterized in that** said solid-state switch (8) is a thyristor.

12. The heating group (1) according to any of the preceding claims, **characterized in that** said solid-state switch (8) is a SCR.

13. The heating group (1) according to what claimed and described.

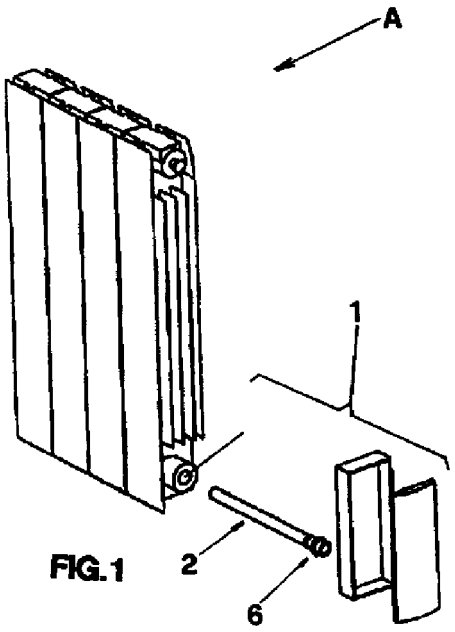

FIG.1

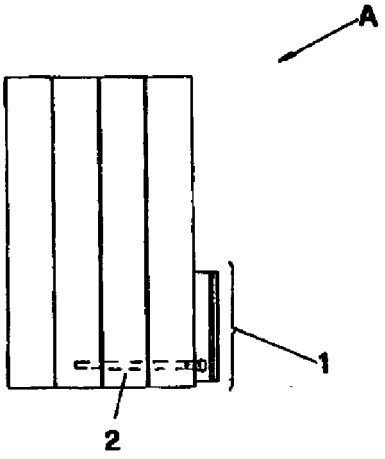

FIG.2

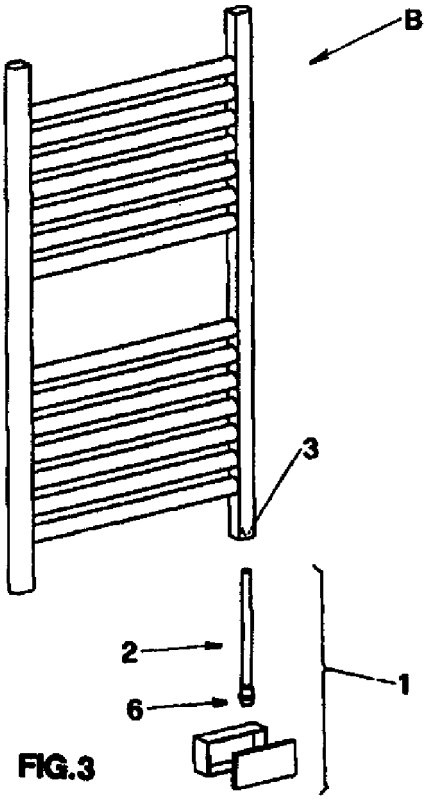

FIG.3

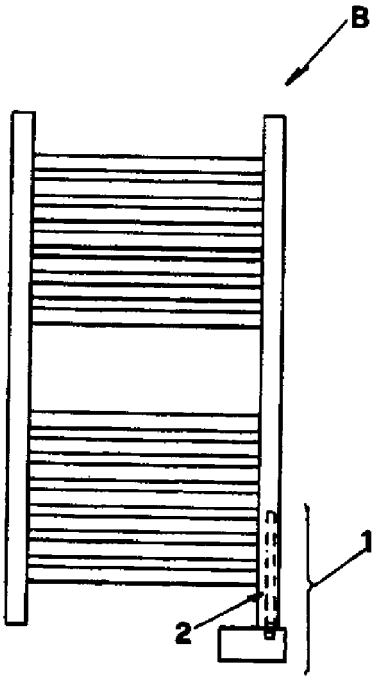

FIG. 4

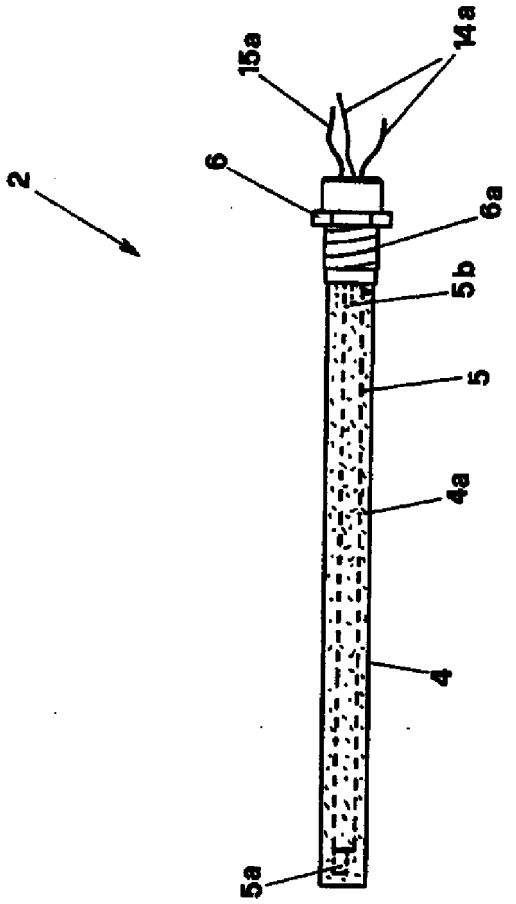

FIG. 5

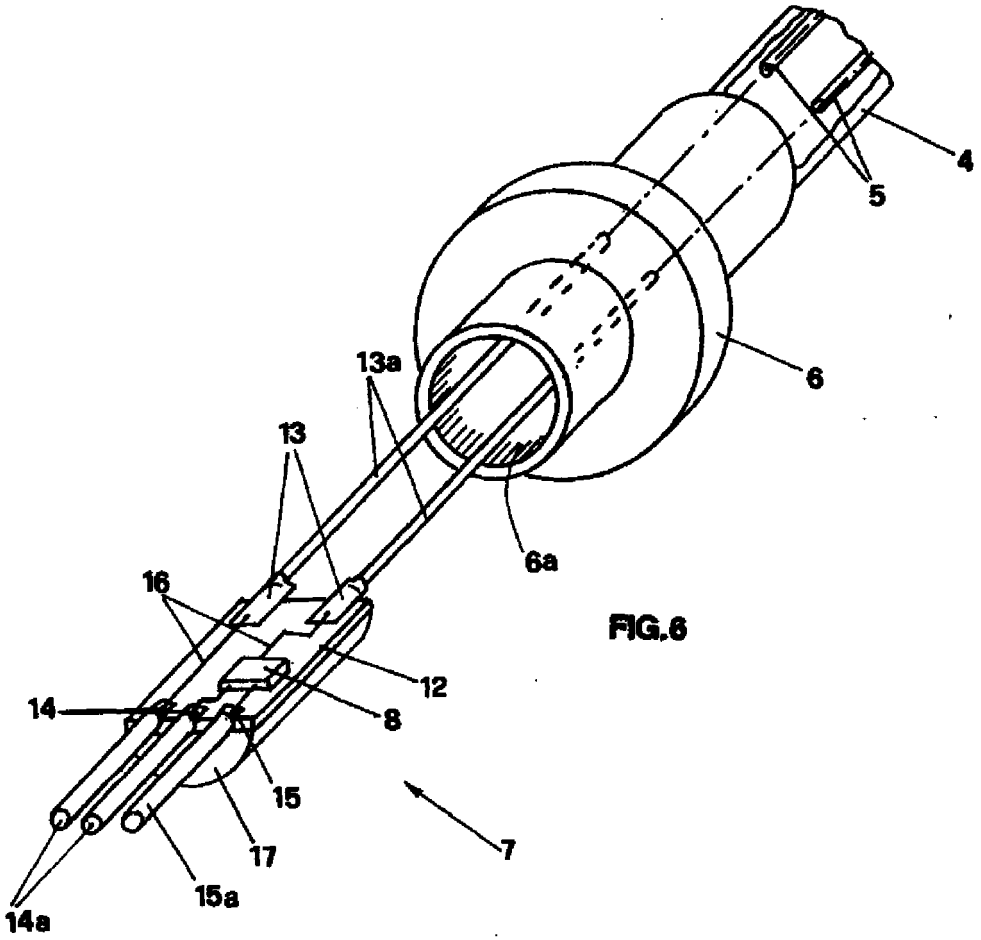

FIG.6

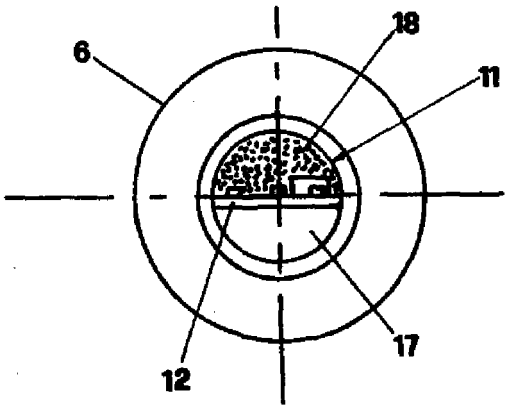

FIG.6a

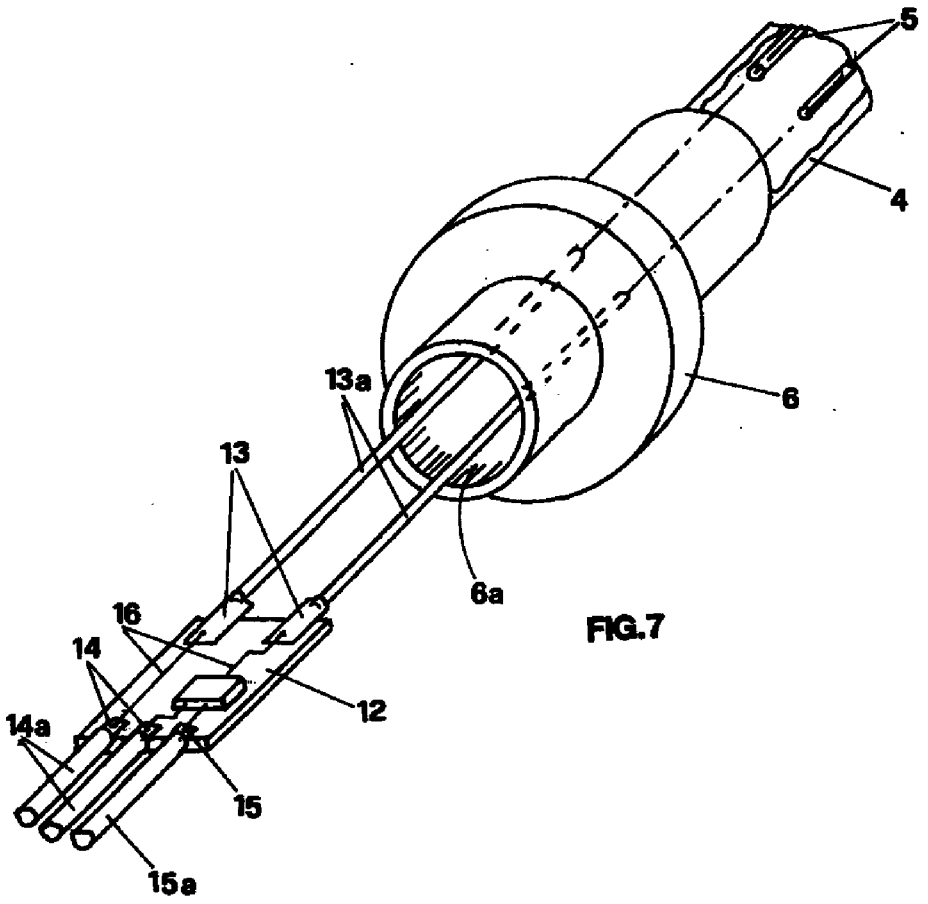

FIG.7

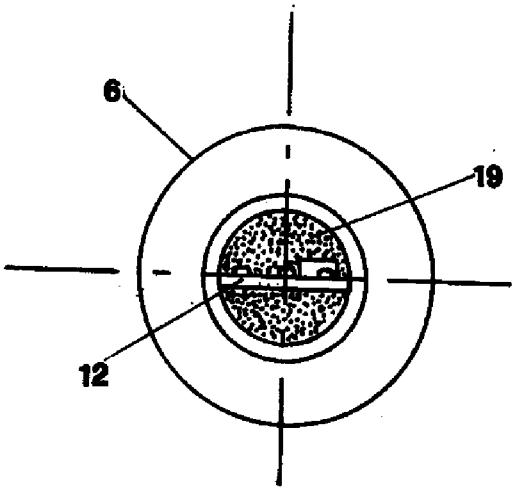

FIG.7a

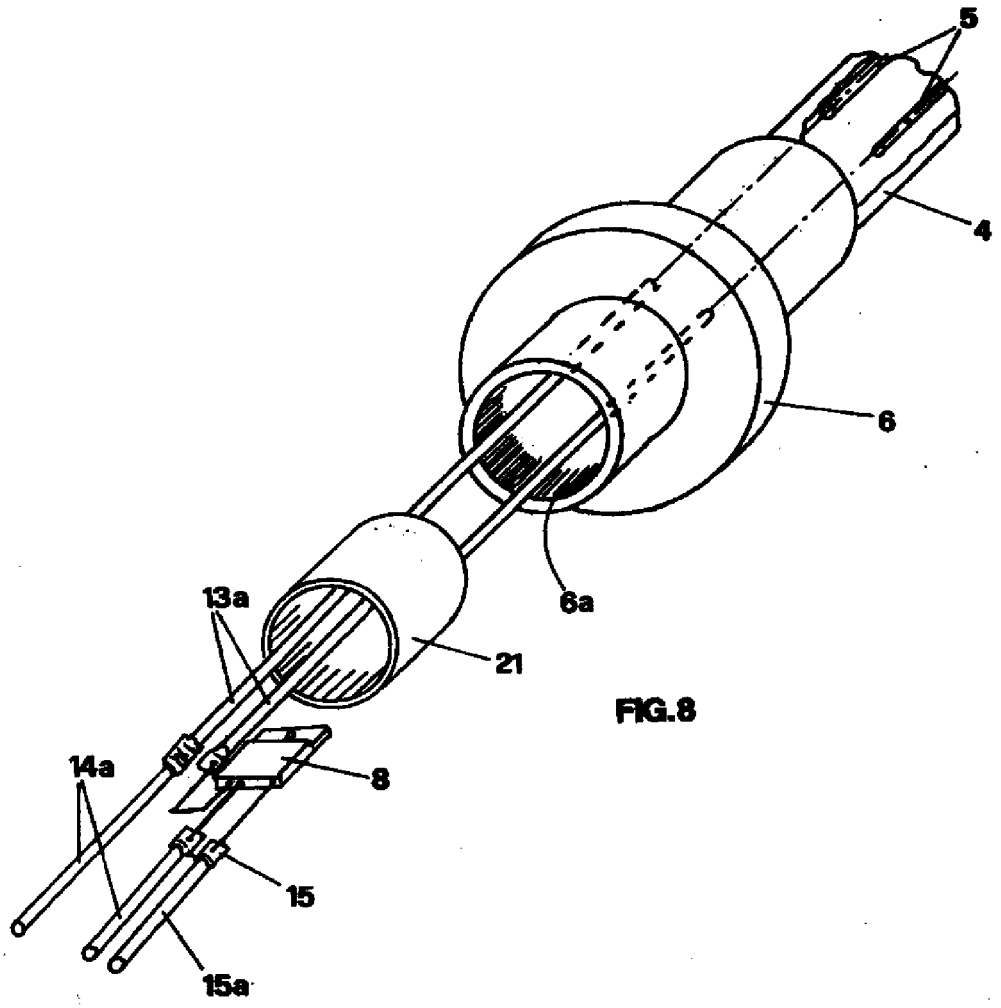

FIG.8

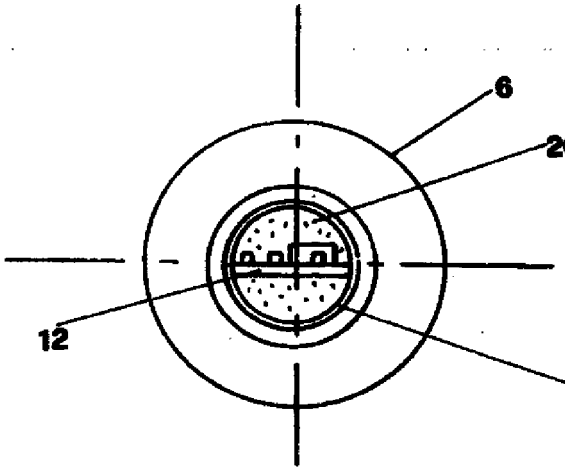

FIG.8a

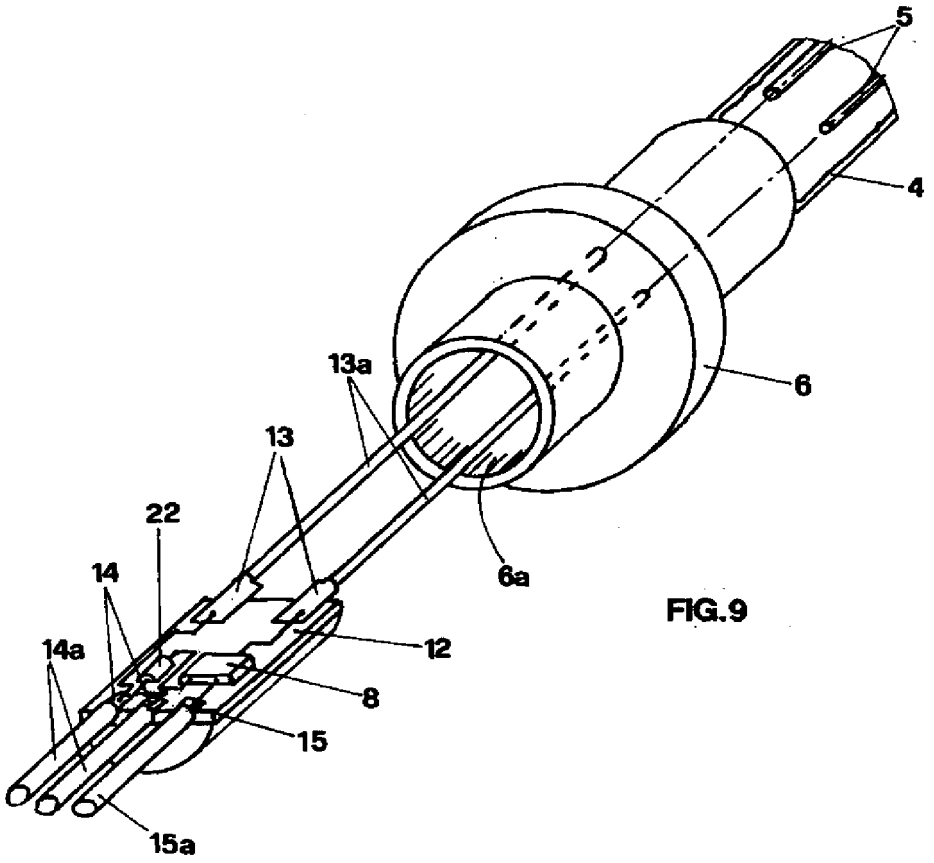

FIG.9

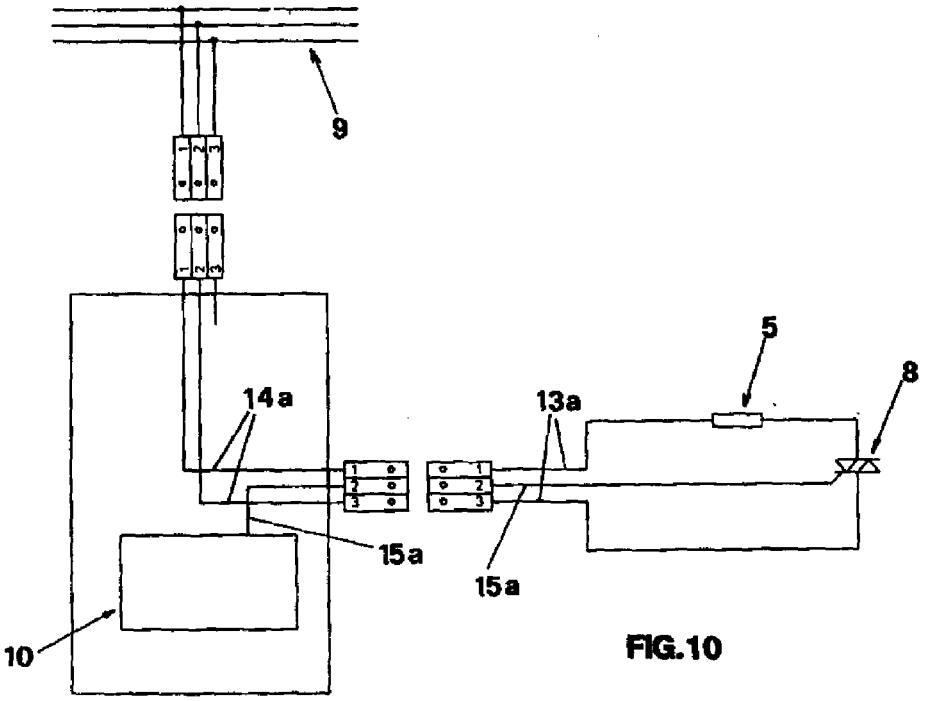

FIG.10

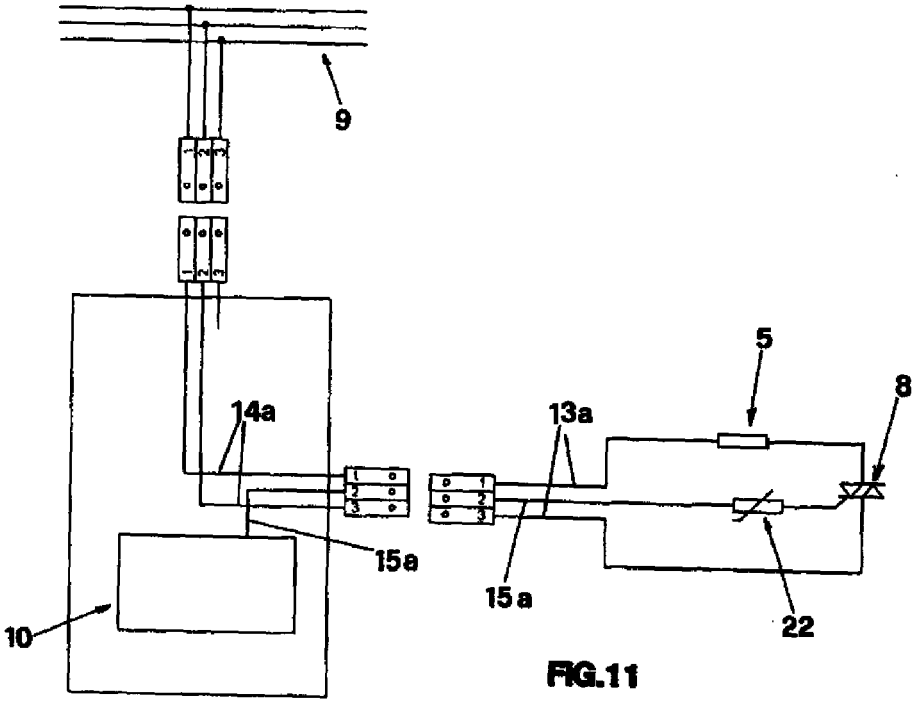

FIG.11

European Patent Office

PARTIAL EUROPEAN SEARCH REPORT

which under Rule 45 of the European Patent Convention shall be considered, for the purposes of subsequent proceedings, as the European search report

Application Number EP 04 10 6370

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 1 278 400 A (JEDAC) 22 January 2003 (2003-01-22) * columns 1-5; figures 1-4 * -----	1,2,4-7, 11,12 3,9,10	F24D19/10 H05K7/20 H05B3/42 H05B1/02
Y	WO 2004/034742 A (IRCA S.P.A; TAURIAN, ANDREA; POSER, IVAN; MARCHETTI, CORRADO) 22 April 2004 (2004-04-22) * page 2, line 10 - line 31 * * page 5, line 10 - line 20 * * page 6, line 4 - line 8 * * page 7, line 28 - line 32 * * figures 2-5 * -----	3,9,10	
X	DE 102 09 905 A1 (STIEBEL ELTRON GMBH & CO. KG) 18 September 2003 (2003-09-18) * column 1 - column 4; figures 1-3 * -----	1,4,11, 12	
X	US 6 147 335 A (VON ARX ET AL) 14 November 2000 (2000-11-14) * column 10; figures 10-14 * -----	1-3,7, 11,12	
A	EP 1 156 704 A (ACOVA; ZEHNDER GROUP SERVICES) 21 November 2001 (2001-11-21) * abstract; figures 1-3 * -----	9	
	-/--		

TECHNICAL FIELDS SEARCHED (IPC)

F24D
H05K
H05B
H01L
F24H

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:

see sheet C

Place of search	Date of completion of the search	Examiner
Munich	17 January 2006	García Moncayo, O

CATEGORY OF CITED DOCUMENTS

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

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

& : member of the same patent family, corresponding document

1

EPO FORM 1503 03.82 (P04C07)

European Patent Office

PARTIAL EUROPEAN SEARCH REPORT

Application Number
EP 04 10 6370

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A	EP 1 081 986 A (BLECKMANN GMBH & CO. KG; BLECKMANN GMBH) 7 March 2001 (2001-03-07) * paragraph [0013] * * paragraph [0017] *	10
A	EP 0 317 435 A (ANDRE, DAVID) 24 May 1989 (1989-05-24) * column 3, line 60 - column 4, line 4 * * column 8, line 10 - line 42 * * figures 1,2 *	1
A	WO 03/100326 A (IRCA S.P.A; TAURIAN, ANDREA; MARCHETTI, CORRADO; POSER, IVAN) 4 December 2003 (2003-12-04) * abstract; figures 1-3 *	1

CLASSIFICATION OF THE APPLICATION (IPC)

TECHNICAL FIELDS SEARCHED (IPC)

1

EPO FORM 1503 03.82 (P04C10)

European Patent Office

INCOMPLETE SEARCH SHEET C

Application Number
EP 04 10 6370

Claim(s) searched completely:
1-12

Claim(s) not searched:
13

Reason for the limitation of the search:

Claim 13 is formulated in such a vague and unclear manner that no meaningful search could be carried out.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 10 6370

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-01-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1278400 A	22-01-2003	AT 266938 T	15-05-2004
		DE 60200470 D1	17-06-2004
		DE 60200470 T2	25-05-2005
		ES 2219625 T3	01-12-2004
		FR 2827735 A1	24-01-2003
WO 2004034742 A	22-04-2004	CA 2500760 A1	22-04-2004
		EP 1550352 A1	06-07-2005
DE 10209905 A1	18-09-2003	NONE	
US 6147335 A	14-11-2000	NONE	
EP 1156704 A	21-11-2001	AT 233038 T	15-03-2003
		DE 60100107 D1	27-03-2003
		ES 2193126 T3	01-11-2003
		FR 2809276 A1	23-11-2001
EP 1081986 A	07-03-2001	AT 275319 T	15-09-2004
		DE 19941901 A1	29-03-2001
		ES 2226677 T3	01-04-2005
EP 0317435 A	24-05-1989	CA 1299623 C	28-04-1992
		DE 3872179 D1	23-07-1992
		DE 3872179 T2	04-03-1993
		ES 2032991 T3	01-03-1993
		FR 2623685 A1	26-05-1989
WO 03100326 A	04-12-2003	CA 2486209 A1	04-12-2003
		EP 1508003 A1	23-02-2005
		IT PN20020029 U1	24-11-2003

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82