(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 May 2006 (04.05.2006)

PCT

(10) International Publication Number
WO 2006/045306 A1

(51) International Patent Classification[7]: **H05K 9/00**, G01R 1/04, 31/28

(21) International Application Number: PCT/DK2004/000739

(22) International Filing Date: 27 October 2004 (27.10.2004)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

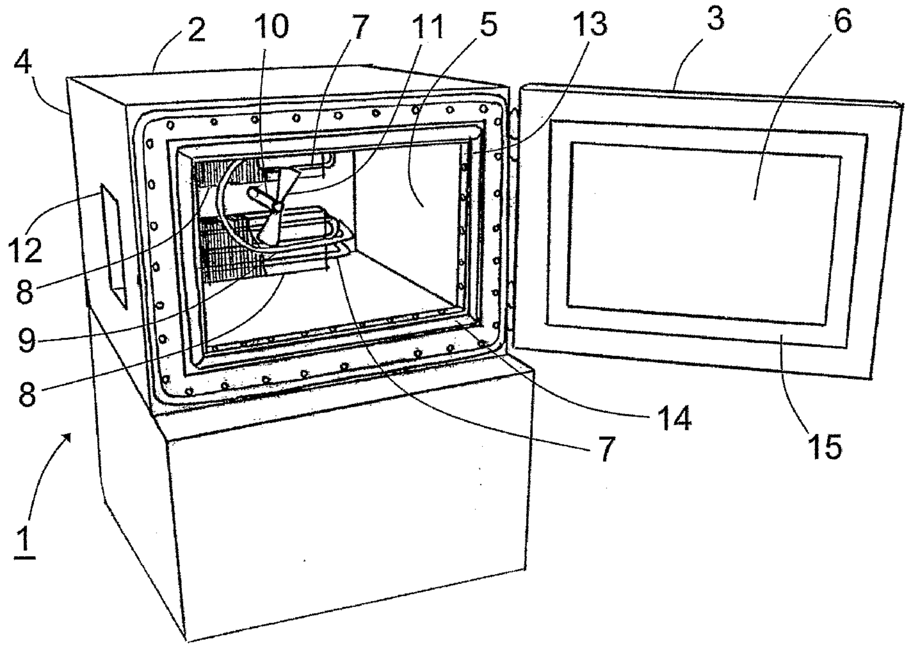
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: AN ENVIRONMENTAL TEST CHAMBER



(57) Abstract: An environmental test chamber (1) comprising a cabinet (2) and at least one door (3) for closing said cabinet (2) in a sealed manner. The test chamber (1) further including means (7, 8, 9, 11) for controlling the environment within said cabinet (2) when said at least one door (3) is closed. The cabinet (2) and door (3) are adapted to electromagnetically shield said test chamber (1) against undesired electromagnetic signals, when the at least one door (3) is closed. Shielded lead-ins (27-35) for electric measurement signals are provided in said cabinet (2).

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An environmental test chamber

The present invention relates to an environmental test chamber, a cabinet and at least one door for closing said cabinet in a sealed manner, said test chamber further including means for controlling the environment within said cabinet when said at least one door is closed.

Environmental test chambers for testing specimens such as apparatuses, devices, materials or the like are well known in the art. The test chambers generally comprise a cabinet with a door that may close the cabinet in a sealed manner. In the chamber there are provided various means for controlling the environment. Such means typically include an electric heater, a refrigerating means, a humidifier, a fan for circulating the air in order to minimise any temperature gradient within the chamber. With these means climate cycles, such as heating and cooling, humidifying and drying can be achieved, in order to test the specimens for their ruggedness against environmental influences to be expected in real use.

However, in addition to the environmental testing of apparatuses and devices in general, there is often a need for testing the functionality of electrical apparatuses and devices, in particular testing of the electromagnetic compatibility of the apparatuses or devices with other electrical apparatuses and devices as well as measuring the general electromagnetic emission of the devices.

Thus, in order to save time, it is advantageous if both the environmental and electrical testing could take place simultaneously.

Attempts have been made to use separate Faraday cages, in which the apparatuses or devices are placed, the Faraday cages then being placed in the environmental test chambers.

However, the use of separate Faraday cages involves several disadvantages and problems. One problem is that, in order to test modern equipment such as cellular phones or blue-tooth devices operating well above 1 GHz, any opening in the Faraday cage must be very small. This severely hinders the air circulation within the Faraday cage. Thus a uniform temperature distribution within the test chamber and temperature conditioning of the device under test cannot be ensured. Moreover to further prevent that electromagnetic radiation passes though the openings of the Faraday cage, the holes should preferably also have a substantial depth, i.e. the walls should be quite thick. This again, not only hinders air circulation further, but also gives the Faraday cage a relatively large mass, and thus a substantial heat capacity. Thus, in order to subject the test specimen to specific heating and cooling cycles, a test chamber with a larger heating and cooling capacity is necessary. Furthermore, the test chamber itself should be more voluminous that otherwise needed in order to accommodate the Faraday cage in the first place.

It is the object of the present invention to overcome these problems in the simultaneous environmental and electromagnetic testing of apparatuses and devices, in particular of such devices as mobile phones and blue-tooth devices operating at high frequencies.

According to a first aspect of the present invention, this problem is solved with an environmental test chamber according to the opening paragraph, characterized in that said cabinet and door are adapted to electromagnetically shield said test chamber against undesired electromagnetic signals, when the at least one door is closed, and in that shielded lead-ins for electric measurement signals are provided in said cabinet.

By adapting the cabinet and door to shield the test chamber the use of a separate Faraday cage is avoided. The environmental cabinet used for the testing of electrical apparatuses and devices may thus be smaller, and have less heating and cooling power. Providing the lead-ins in the cabinet allows for measuring signals and the like to be provided to and from the device under test in a well controlled manner, i.e. without compromising the shielding of the chamber in general.

According to a preferred embodiment, the cabinet comprises a cut-out in a wall part, said cut-out being adapted for accommodating, in an electromagnetically shielded manner, an entry module comprising said shielded lead-ins.

Provision of a cut-out in the wall part of the environmental test chamber allows for the use of specially adapted entry modules to suit the specific measuring purpose. In particular, it allows for the use of an entry module with only those lead-ins necessary for a specific measurement, even a blank dummy module if no lead-ins are necessary. Surprisingly the use of modules with as few lead-ins as possible is important not for electrical reasons but for thermal reasons. The presence of the lead-ins through the thermally insulated cabinet wall may influence the maximum and minimum temperatures that may be achieved by the cabinet with more than 10 K, and thus necessitate the use of a cabinet with more cooling and heating power. Thus according to a further advantageous embodiment, the cabinet is adapted for interchangeably accommodating different entry modules in said cut-out.

Preferably lead-ins comprise coaxial lead-ins, allowing for supply of high frequency measurement signals.

Preferably, said lead-ins comprise DC or LF lines with pi circuit filters. Using pi circuit filters allows DC to be supplied to the device in the test chamber, and/or computer signals, communication signals or the like with relatively low frequencies to be transmitted to and from the test chamber.

According to a further preferred embodiment two separate sealing means are provided between said door and said cabinet for sealing said test chamber, the first sealing being an air tight sealing, the second sealing being an electromagnetic shielding sealing.

Having two separate sealing means is advantageous because the two sealing means have two very different properties. Typically, the electromagnetic shielding would comprise a mesh of finely woven metal threads. Such a sealing, however, is not airtight. The air tight sealing would normally be made of a nonconductive material such as silicone rubber, which does not seal electromagnetically.

According to yet another preferred embodiment said sealing means comprises a soft conductive metal foil.

The interior of the test camber or the door, depending on which part the foil is to be mounted on, is usually made of a hard, durable material such as stainless steel, which moreover has a relatively low electrical conductivity. Thus it is very hard to establish good electrical contact over the entire engagement surface between e.g. said the door or the cabinet and said part of the electromagnetic sealing comprising a mesh of finely woven metal threads. Using a softer conductive foil allows the mesh to literally dig into the surface thereof and ensure good electrical contact.

Preferably, said conductive metal foil is a removable adhesive foil. This allows the foil to be easily replaced when it is worn from use, as it will inevitably be, if used together with said mesh.

The invention will now be described in greater detail based on non-limiting exemplary embodiments, and with reference to the drawing, on which

fig. 1 shows a schematic perspective view of an environmental cabinet according to the invention, without an entry module mounted and

fig. 2 shows a schematic perspective view of the entry module,

Fig. 1 shows an electromagnetically shielded environmental test chamber 1 according to the invention. In particular, the environmental test chamber may be a temperature test chamber as described below. The test chamber 1 comprises a cabinet 2 and a door 3 for closing the test chamber in a sealed manner. The cabinet 2 is double walled and comprises an outer wall 4 and an inner wall 5. The space between the outer wall 4 and the inner wall 5 is filled with a thermally insulating material, such as foam or a fibrous material. The inner wall 5 is preferably made of a corrosion resistant material such as stainless steel or surface treated aluminium. The outer wall 4 is preferably also made of metal, such as steel.

The inner wall 5 constitutes the major part of the Faraday cage. The five sides of the inner wall are preferably formed from one single sheet of metal, which is cut and bent appropriately. Those corners between the sides of the inner wall 5, that cannot be formed by bending, are preferably joined by welding or the like, in order to ensure the integrity of the inner wall 5.

The door 3 constitutes the second largest part of the Faraday cage. The door 3 preferably also has a double wall with an inner wall 6, and an outer wall (not visible). The inner wall 6 of the door is preferably also made of a corrosion resistant material such as stainless steel or surface treated aluminium. The space between the inner wall 6 of the door 3 and the outer wall thereof is preferably also filled with a thermally insulating material, such as foam or fibrous material.

Regarding the electromagnetic shielding, these two parts, i.e. the inner wall 5 of the cabinet 2 and the inner wall 6 of the door 3, generally perform very well, even though stainless steel does not have a very high conductivity.

The problems to be overcome regarding the shielding generally arise between these parts, i.e.

the inner wall 5 of the cabinet 2 and the inner wall 6 of the door 3, but also in places where the integrity of the inner wall 5 has to be broken for practical reasons. Such practical reasons would be the lead-ins for the measuring signals to and from the device under test, and possibly for the power supply thereof. Others include the conduits 7 of the cooling circuit connecting the condenser 8 (partially broken away for illustration purposes) within the cabinet 2 to the radiator and pump outside the cabinet 2; the heating element 9 or the leads thereto; a temperature sensor within the cabinet; and the shaft connecting the fan 11 within the cabinet with the electric motor placed in a well behind the inner wall 5.

It should be noted, that evidently a perfect shielding against electromagnetic radiation is not possible. Shielding in this context is to be understood as damping of undesired electromagnetic signals to a level where their influence on the measurements can be neglected. This again, means only in the relevant frequency range of up to a few gigahertz, and not e.g. ionizing radiation. The damping in this range should be at least 30 dB and preferably more.

At the places mentioned above, where the integrity has to be broken, the test chamber 1 will be susceptible to radiation leaks, and countermeasures have to be taken to prevent, or at least reduce, these leaks.

Thus, around the shaft connecting the motor to the fan 11 there is a tubular sleeve 10 with an internal diameter matched as closely as possible to the outer diameter of the shaft. Both the shaft and the tubular sleeve are made of good conductors such as metal. The end of the tubular sleeve is welded or soldered to the inner wall 5 of the cabinet 2, so as to surround the aperture in the inner wall 5 through which the shaft passes. Depending on how the welding is performed, e.g. if spot welding is used, any gap between the sleeve 10 and the inner wall 5 may be filled with conductive glue. The use of a conductive shaft and a conductive sleeve 10 provides a gap, which is not only narrow, but also deep. The skilled person will know that mainly the width of the gap, but also the depth thereof, in relation to the wavelength of the electromagnetic radiation, is of importance for the prevention of leaks. For the frequency range used by the devices and apparatuses, which the present invention seeks to facilitate the testing of, the width of such gaps should preferably not exceed 10-100 μm.

Such conductive glue could also be used to seal around the apertures in the inner wall 5, through which the conduits 7 of the cooling circuit pass, so as to connect them electrically to the inner wall 5. The conduits themselves are typically made of copper and do not allow any electromagnetic radiation to pass in the relevant frequency range. But they are held in rubber bushings. These rubber bushings should then be covered with the conductive glue, and preferably also made of an electrically conductive rubber.

In a similar manner conductive glue could be used to seal around the aperture in the inner wall through which the heating element 9 is passed. The heating element 9 itself is located within a metallic mantle, which can thereby be connected electrically to the inner wall 5.

For safety reasons environmental test chambers comprise a protection against overheating, e.g. of the heating element in the event that the fan 11 fails. Such a protection typically uses a switch controlled by the melting of a solid such as wax, with an appropriate melting point, e.g. 130 °C. To prevent any high frequency signals to leak into the test chamber via these leads, these leads comprise pi circuit filters. The leads to the switch carry DC, which is not influenced by the pi circuit filter. A pi circuit filter is a filter comprising an inductance in the line to block high frequency signals, and a grounded capacitance at both ends of the inductor to short circuit the high frequency signals to ground.

Apart from the electrical connections above, which are needed for the general functionality of the environmental test chamber, connections are needed for the purpose of testing the device.

For testing a device, various electrical signals need to be transferred to and from the device under test and other equipment within the environmental test chamber. Such signals may *inter alia* include DC power supply signals, LF control signals and HF or RF measurement signals.

According to the preferred embodiment of the invention, these signals are lead into the test chamber via an interchangeable entry module 20. The entry module is adapted to be placed in an appropriate cutout 12 in the outer wall 4 and inner wall 5 of the cabinet. The entry module may be a closed metal box or, as illustrated in fig. 2, an open construction with a front plate 21 and a back plate 22 of metal.

In either case, the entry module 20 will include heat insulating material, not shown, to reduce the heat transport through the wall of the cabinet 2. The heat insulating material may be the same fibrous material or foam as the one used between the outer wall 4 and the inner wall 5 of the cabinet 2 in general.

The front plate 21 is in size adapted to fit in the cut-out 12 in the cabinet 2. The cut-out has the same size in both the outer wall 4 and the inner wall 5. The back plate 22, has a slightly larger dimension so as to present a mounting flange, which overlaps the inner wall 5 around the cut-out 12. The mounting flange has a number of holes 24 allowing it to be screwed into tight engagement with the inner wall 5 of the cabinet 2. The inner wall 5 of the cabinet has corresponding bores, which are preferably threaded, so as to allow the use of bolts. This, as opposed to e.g. self-cutting screws, allows the bolts to be unscrewed for exchange or replacement of the entry module 20.

The front plate 21 and the back plate 22 are held apart by four spacers 23 made of a material with low heat conductance. The height of the spacers 23 is selected so that the front plate is flush with the outer wall 4 of the cabinet 2, when the flange is screwed into engagement with the inner wall 5.

To avoid any gaps between the inner wall 5 and the flange of the entry module, quite a large number of screws is necessary, e.g. one every two centimetres along the length of the flange. Moreover, shielding strips 25 with flexible fingers 26 are mounted on the flange so as to engage the inner wall 5, when the bolts are tightened. For illustration purpose only, one shielding strip 25 is shown along one edge of the back plate 22, but evidently the shielding strip will be present around all four edges of the back plate 22.

In the front plate 21 and in the back plate 22, appropriate connectors 27, 28, 29, 30, 31, 32 are mounted. Such connectors may include, but is not restricted to, sockets 27 for banana plugs, twenty-five pin D-sub connectors 31, 32, coaxial connectors 29, 30 such as SMA or BNC connectors, or even soldering pins 28.

The connectors 27, 29, 31 in the front plate 21 are connected to respective connectors 28, 30, 32 in the back plate 22. These connections may comprise flexible or rigid leads or cables 33, 34 and 35.

The connectors for DC or LF, in the present embodiment that would be the D-sub connectors and the banana sockets, include pi circuit filters, preferably built-in pi circuit filters. Such connectors, which have built-in pi circuit filters and are sufficiently leak proof against electromagnetic radiation, are commercially available, but also separate units containing pi circuit filters are commercially available.

The pi circuit filters are preferably mounted in connection with the back plate 22, in particular directly in bores in the back plate 22. The reason for this lies in the focus on the integrity of the inner wall 4, as will be explained below.

The coaxial connectors are inherently shielded, with their screens connected electrically to the plate they are mounted in, be it the front plate 21 or the back plate 22, but if they are not in use they must be appropriately terminated. Preferably however, the module used should not comprise any unused connections.

The reason for this is not so much the electromagnetic shielding, but rather the heat transmission through the wall of the cabinet 2. Compared to the heat insulating material that fills the space between the outer wall 4 and the inner wall 5, the copper conductors between the connectors act as efficient heat bridges, conducting heat in and out of the test chamber 1, depending on the inside and outside temperature. This heat conduction is so substantial that for a typical test chamber 1, the minimum and maximum temperatures that may be reached within the chamber 1 could be more than 10 K higher and lower, respectively, as compared to a test chamber with the same dimensions and heating and cooling power, but without these conductors.

Thus, according to a preferred embodiment of the invention, an interchangeable entry module 20 is used, in order to provide the best efficiency possible, by using an entry module with the least possible heat bridges. If no electrical testing is needed, the entry module 20 could be a dummy module or a blank module without any connections at all.

Thus with the entry module 20 it is possible to couple those, and preferably only those, connections needed for the test of the device to the equipment within the test chamber 1 using ordinary cables and plugs outside and inside the test chamber, thereby reducing the heat transmission through the wall of the cabinet 2.

Regarding the electromagnetic shielding, it is evident that both the outer wall 5 and the inner wall 4 may fulfil the purpose of a Faraday cage. However, focus in this respect is on the inner wall 5, because some auxiliary equipment, such as the electric motor for the fan 11 and the pump for the cooling circuit 7, 8 may be housed at least partially between the inner wall 5 and the outer wall 4. Since such equipment is likely to produce at least some electromagnetic noise, the focus has to lie on the integrity of the inner wall 4. Consequently, when sealing between the door 3 and the cabinet 2, the aim is to achieve the best possible electromagnetic shielding between the inner wall 5 of the cabinet and the inner wall 6 of the door 3.

This is in the currently preferred embodiment achieved by using a rigid frame 13. The rigid frame 13 is generally rectangular and has an L-shaped profile. The rigid frame is mounted along the four sides of the inner wall 5 at the door opening. This may be done with screws or rivets. Also, shielding strips like the ones described in connection with the entry module 20 may be interposed between the inner wall 5 and the frame 13. The rigid frame 13 is made of a thicker material than the inner wall 5 so as to give good support for an electromagnetic sealing strip 14 placed on the front face thereof. The electromagnetic sealing strip is a tightly woven or braided metal material or a mesh of metal. Such electromagnetic sealing strips 14 are commercially available and the specific construction thereof is not considered important for this invention.

Using the rigid frame 13 gives good support for the electromagnetic sealing strip 14, thus allowing a substantial sealing pressure to be exerted thereon by the inner wall 6 of the door 3 when the door is closed. However, like the inner wall 5 of the cabinet 2 the inner wall 6 of the door 3 is typically made of stainless steel, which is quite hard and has quite a poor conductivity. In this case it may be difficult, even with a high sealing pressure, to ensure sufficient electromagnetic shielding between the sealing strip 14 and the inner wall 6 of the door 3.

In order to provide better electromagnetic shielding, a strip of 15 of a soft conducting material is placed on the inner wall 6 of the door 3, covering the area, which will engage the sealing strip 14. This may be in the form of a self-adhesive strip with conducting adhesive. The soft conducting material of the self-adhesive strip will deform plastically under the pressure of the sealing strip 14, allowing the latter to dig into it so as to prevent any leaks between the inner wall 6 of the door 3 and the sealing strip 14.

A self-adhesive strip, which may be easily replaced, is preferable in this respect because it will eventually be worn by the sealing strip 14 digging into it.

It should be noted that the opposite arrangement could just as well be used, i.e. having the sealing strip 14 on the door 3, and the soft, self-adhesive conductive foil on the rigid frame 13.

Preferably, in order to secure the rigid frame 13 to the outer wall 4 of the cabinet 2 it is also clamped by a front frame 16. The front frame 16 is screwed or riveted onto the outer wall 4. Moreover, the front frame 16 holds an environmental sealing 17, such as a rubber or silicone sealing, in order to prevent heat transmission and leak of humidity in and out of the test chamber 1.

The closing mechanism for the door 3 could be any conventional locking mechanism capable of producing sufficient force, such as a hook cooperating with a top dead centre loop mechanism.

Though not shown, a perforated screen would typically be arranged in front of the condenser, heater and fan, in order to protect these physically against harm.

Thus with the present invention an environmental test chamber, which is electromagnetically protected, is achieved. Though described in context of a test chamber capable of heating and cooling, the skilled person will understand that same principles will apply to chambers with controlled humidity and other climate parameters, without deviating from the scope of the present invention as presented in the claims.

P A T E N T C L A I M S

1. An environmental test chamber comprising a cabinet and at least one door for closing said cabinet in a sealed manner, said test chamber further including means for controlling the environment within said cabinet when said at least one door is closed, c h a r a c t e r i z e d in that said cabinet and door are adapted to electromagnetically shield said test chamber against undesired electromagnetic signals, when the at least one door is closed, and that shielded lead-ins for electric measurement signals are provided in said cabinet.

2. An environmental test chamber according to claim 1, c h a r a c t e r i z e d in that said cabinet comprises a cut-out in a wall part, said cut-out being adapted for accommodating, in an electromagnetically shielded manner, an entry module comprising said shielded lead-ins.

3. An environmental test chamber according to any one of the preceding claims, c h a r a c t e r i z e d in that said cabinet is adapted for interchangeably accommodating different entry modules in said cut-out.

4. An environmental test chamber according to any one of the preceding claims, c h a r a c t e r i z e d in that said lead-ins comprise coaxial lead-ins.

5. An environmental test chamber according to anyone of the preceding claims, c h a r a c t e r i z e d in that said lead-ins comprise DC or LF lines with pi circuit filters.

6. An environmental test chamber according to any one of the preceding claims, c h a r a c t e r -

i z e d in that for sealing said test chamber two separate sealing means are provided between said door and said cabinet, the first sealing being an air tight sealing, the second sealing being an electromagnetic shielding sealing.

7. An environmental test chamber according to any one of preceding claims, c h a r a c t e r i z e d in that said sealing means comprises a soft conductive metal foil.

8. An environmental test chamber according to claim 7, c h a r a c t e r i z e d in that said conductive metal foil is a removable adhesive foil.

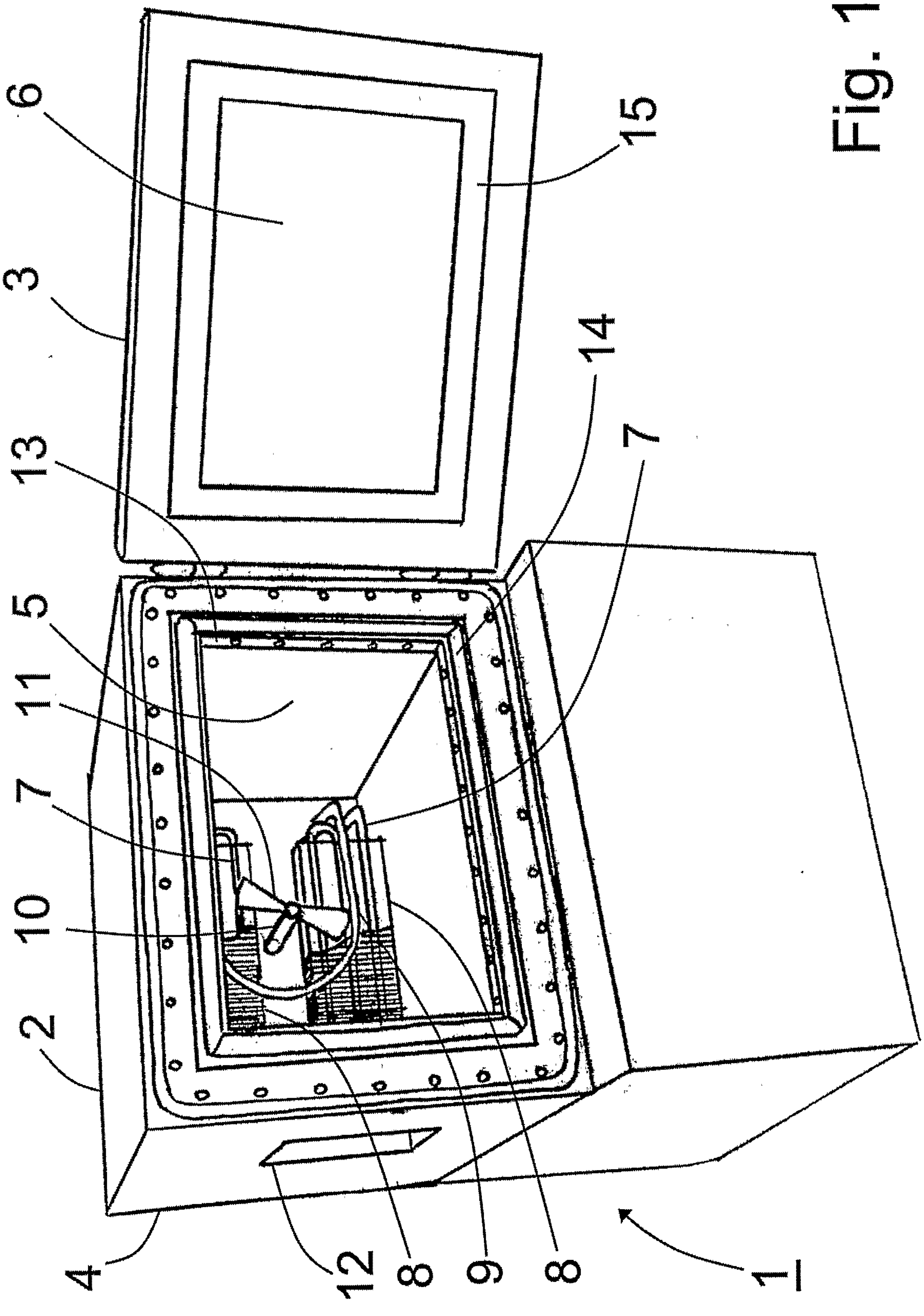

Fig. 1

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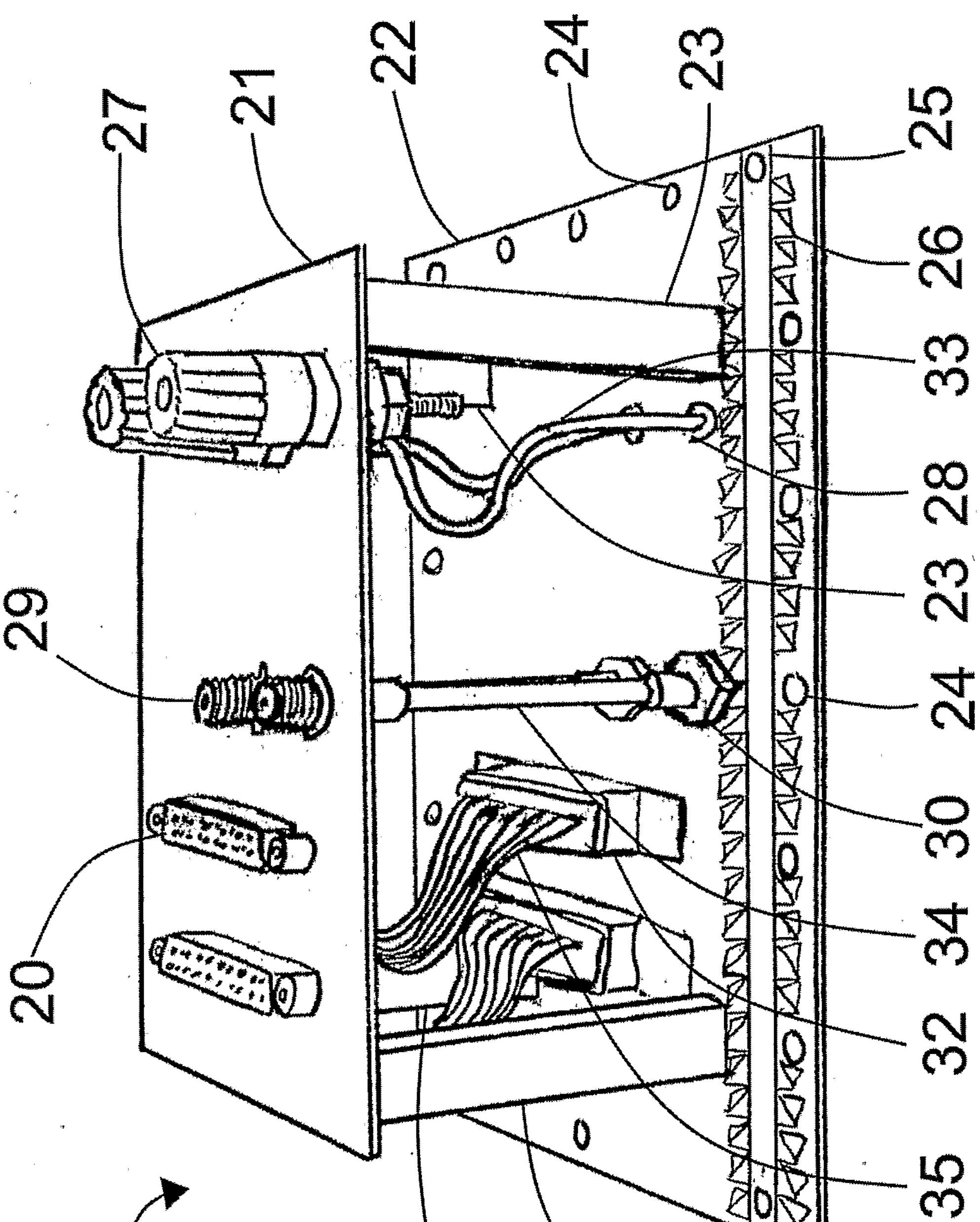

Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/DK2004/000739

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05K9/00 G01R1/04 G01R31/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H05K G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 072 177 A (LIKEN ET AL) 10 December 1991 (1991-12-10) column 2, line 44 - column 4, line 39; figures 1-4	1-8
Y	PATENT ABSTRACTS OF JAPAN vol. 013, no. 173 (E-748), 24 April 1989 (1989-04-24) & JP 64 002398 A (TAISEI CORP), 6 January 1989 (1989-01-06) abstract; figures 1-4	1-3,6
Y	DE 37 11 937 C1 (SVT BRANDSCHUTZ VERTRIEBSGESELLSCHAFT MBH INTERNATIONAL, 2105 SEEVETAL) 28 July 1988 (1988-07-28) column 3, line 39 - column 4, line 24; figure 1	4,7,8

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
30 August 2005	09/09/2005

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 443 550 A (YONEDA ET AL) 22 August 1995 (1995-08-22) column 3, line 56 - column 4, line 47; figures 1,6,7,10 -----	5

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/DK2004/000739

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5072177	A	10-12-1991	JP	4230877 A	19-08-1992
			CA	1315012 C	23-03-1993
JP 64002398	A	06-01-1989	JP	2114102 C	06-12-1996
			JP	8021789 B	04-03-1996
DE 3711937	C1	28-07-1988	NONE		
US 5443550	A	22-08-1995	JP	3140081 B2	05-03-2001
			JP	5322595 A	07-12-1993