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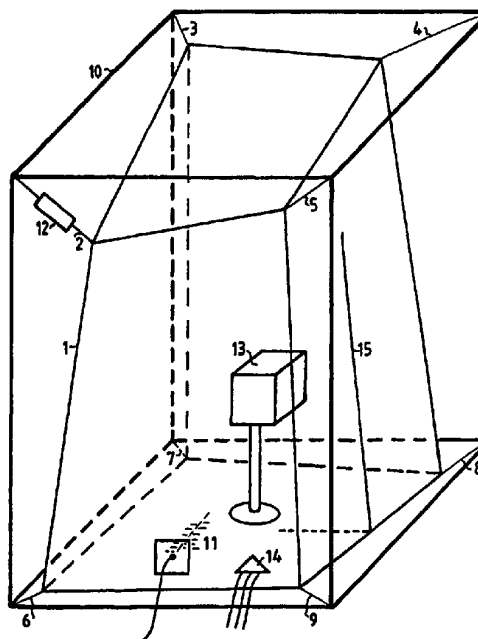
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(21) International Application Number: PCT/EP99/09216 (22) International Filing Date: 26 November 1999 (26.11.99) (30) Priority Data: 1010745 7 December 1998 (07.12.98) NL (71) Applicant <i>Thales Nederland B.V.</i> (for all designated States except US): HOLLANDESE SIGNAALAPPARATEN B.V. [NL/NL]; Zuidelijke Havenweg 40, P.O. Box 42, NL-7550 GD Hengelo (NL). (72) Inventor; and (75) Inventor/Applicant (for US only): LEFERINK, Franciscus, Bernardus, Johannes [NL/NL]; Stroom Eschlaan 57, NL-7623 CW Borne (NL).		(81) Designated States: AU, BR, CA, CN, CZ, HU, ID, IL, IN, JP, KR, MX, NO, NZ, PL, RU, SG, TR, UA, US, ZA, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report. 

(54) Title: TEST CHAMBER

(57) Abstract

Test chamber for measuring electromagnetic radiation emitted by an apparatus to be tested or for exposing an apparatus to be tested to an electromagnetic radiation field, realized as a reverberation chamber made of a conductive tent fabric. To create a statistically uniform field in the test chamber, the test chamber is partially set into a mechanical vibration, induced by a vibrator.



Test chamber

The invention relates to a test chamber in which objects to be tested can be exposed to an electromagnetic radiation field, or in which electromagnetic radiation emitted by objects
5 to be tested can be measured, provided with means for coupling in/coupling out electromagnetic radiation and provided with means to distribute the electromagnetic radiation uniformly throughout the test chamber.

Test chambers of this type are known. They serve to verify the proper functioning of
10 equipment exposed to a radiation field of predefined strength. Therefore, it is of importance to introduce a substantially uniform radiation field into the test chamber. A known and approved embodiment realizes a uniform radiation field by radiating a defined radiation field into one side of the test chamber and by absorbing the radiation at an opposite side. This embodiment has the drawback that high power levels are required
15 which, particularly in case of high frequencies, is extremely costly. A further known and theoretically acceptable embodiment approximates a uniform radiation field by introducing a radiation field into a test chamber metallized on the inside and by subsequently creating an at least statistically uniform field by means of a stirrer. This method entails the drawback of being very time-consuming, because each measurement
20 has to be averaged out during at least one stirrer revolution.

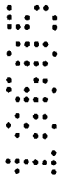
The inventive test chamber obviates this drawback to a significant extent and is characterized in that the test chamber has no two parallel walls and at most one wall perpendicular to another, the walls being made of an electrically-conductive material.
25 The test chamber is provided with means for the uniform distribution of the electromagnetic radiation which is designed to cause at least one part of one of the walls to vibrate.

An advantageous embodiment according to a further aspect of the invention is characterized in that the wall is made of a conductive fabric. This enables an apparatus to be field-tested with the test chamber built around the apparatus to be tested. This obviates the need to test the apparatus in a laboratory environment which causes a substantial reduction of expenses, since there are no cost arising from transportation or laboratory testing, the latter often requiring an environment comprising additional equipment,
35 special-purpose cables, power supplies and the like.

An advantageous embodiment according to a further aspect of the invention is characterized in that the reverberation chamber is realized as a tent. In this embodiment, the conductive fabric can advantageously be provided with conductive slide fasteners, so
5 that the tent can simply be set up around the apparatus to be tested. If required, it is possible to remove a part of the tent's lower edge, causing it to abut against a metal plate or foil, preferably placed underneath the apparatus to be tested.

A further advantageous embodiment of the invention is characterised in that a frame is
10 provided within which the reverberation chamber can be suspended from the frame's corner joints. This embodiment, well-known in the field of tent constructions, entails the advantage that the test chamber does not require any supporting means.

A further advantageous embodiment of the invention is characterised in that the tent is
15 provided with a



connection for a pressure gas, for creating an overpressure in the tent. Also this embodiment, well-known in the field of tent constructions entails the advantage that the test chamber does not require any supporting means. Additional
5 advantages in this respect are that the test chamber can be set up in a relatively short time and that the gas flow, usually air, ensures a good ventilation in the tent.

A further advantageous embodiment according to an aspect of
10 the invention is characterized in that the means for moving at least one part of a wall are realized as a vibrator, in the operating mode attached to one of the tent's corner joints. In an advantageous embodiment, drive means are provided for actuating, in the operating mode, the vibrator
15 at a frequency of 5-20 Hz.

The invention will now be explained in greater detail with reference to the following figures, of which:

- Fig. 1 represents a first possible embodiment of a test
20 chamber according to the invention;
Fig. 2 represents a second possible embodiment of a test chamber according to the invention.

Fig. 1 shows a first possible embodiment of a test chamber
25 1 according to the invention, which test chamber 1 is realized as a tent made of woven aluminium fabric, which material is known to be an excellent reflector of electromagnetic radiation. Test chamber 1 is attached to a metal frame 10 by means of straps 2,3,4,5,6,7,8,9. Test
30 chamber 1 possesses a reverberation chamber-geometry, which means that i.e. no two walls are parallel, that at most one wall is placed perpendicular to another wall, that the average distances between two opposite tent walls vary and mutual multiples do not apply. In this situation, no
35 eigenmodes exist in test chamber 1, causing a substantially uniform distribution of the electromagnetic energy injected

into test chamber 1 by means of a wideband antenna 11. Measurements, however, reveal that the electric field strength measured at a random point within test chamber 1 may vary significantly with the frequency as provided by antenna 11. Strap 2 is therefore provided with a vibrator 12, known in the art, which causes one of the corners of test chamber 1 to vibrate at a frequency of 10 Hz. These vibrations particularly serve to smooth out the sharp nulls present in the field which, from a statistical point of view, significantly improves the uniformity of the electric field strength.

To enable a measurement on an apparatus 13 placed in test chamber 1, antenna 11 is connected to a tunable transmitter or receiver, which is swept very slowly while transmitting or receiving within a certain bandwidth. In this respect it should be noted that tuning shall proceed so slowly that a sufficient statistical average value of the field is obtained. To this end, conventional test chambers are provided with a field stirrer which makes at most one revolution per second and for which an integration time of at least one second should be taken. In the novel test chamber which vibrates at a frequency of approximately 10 Hz, the integration time can be reduced to approximately one tenth of a second which yields a considerable gain in time.

Test chamber 1 furthermore comprises a cable feed-through 14 and a slide fastener 15 made of a conductive material, which facilitates the installation of the apparatus 13 to be tested. Additionally, it may be advantageous to implement test chamber 1 with an opening (not shown) in the centre of the ground sheet. Apparatus 13 can first be positioned on a metal plate (not shown), after which test chamber 1 can be set up around apparatus 13. To ensure a good contact between metal plate and aluminium ground

sheet, several weights can be placed on the ground sheet near the opening.

- Fig. 2 shows a second possible embodiment of a test chamber according to the invention in which test chamber 1 is also realized as a tent made of woven aluminium fabric. Test chamber 1 is provided with a hose 16 to be connected to an air pump 17 for causing the tent to stay in shape once it has been put up. Test chamber 1 is provided with a vibrator 12, on one side attached to one of the corner joints of test chamber 1 and on another side attached, via a connecting cable, to a reference point, e.g. a building or a pole.
- Also in this embodiment, test chamber 1 may be implemented with an opening in the centre of the ground sheet. Apparatus 13 can first be positioned on a metal plate (not shown), after which test chamber 1 can be set up around apparatus 13. Because in this embodiment, the connection between the tent fabric and the tent must be gastight to a certain extent, use can be made of conductive slide fasteners with one fastener element attached to the aluminium plate to interlock with the second fastener element around the opening in the ground sheet.

The claims defining the invention are as follows:

1. Test chamber in which objects to be tested can be exposed to an electromagnetic radiation field, or in which electromagnetic radiation emitted by objects to be tested can
5 be measured, said test chamber having no two parallel walls and at most one wall perpendicular to another, said walls being made of an electrically conductive material, said test chamber being provided with:
means for the coupling in/coupling out of electromagnetic radiation; and
means for distributing the electromagnetic radiation uniformly throughout the
10 test chamber, adapted to cause at least one part of a wall to vibrate.
2. Test chamber as claimed in claim 1, wherein said wall is made of a conductive fabric.
- 15 3. Test chamber as claimed in claim 2, wherein said test chamber is realized as a tent.
4. Test chamber as claimed in claim 3, wherein a frame is provided within which
20 said test chamber is suspended from corner joints of said frame.
5. Test chamber as claimed in claim 3, wherein said tent is provided with a connection for a pressure gas, for creating an overpressure in said tent.
6. Test chamber as claimed in claim 4 or 5, wherein said means for distributing the
25 electromagnetic radiation uniformly are realized as a vibrator attached to one of said corner joints of said frame.
7. Test chamber as claimed in claim 6, wherein drive means are provided for
30 actuating said vibrator at a frequency of 5-20 Hz.

8. Test chamber substantially as herein described with reference to any one of the embodiments shown in the drawings.

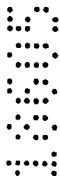
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DATED this Eleventh Day of March, 2003

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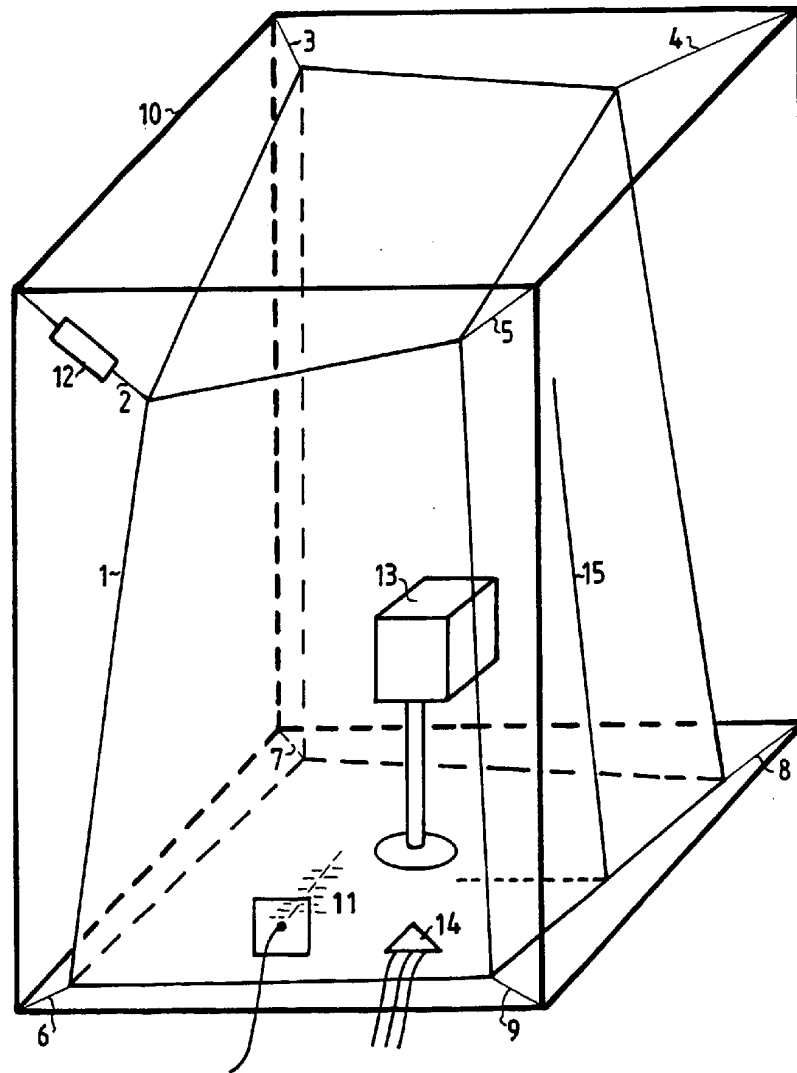


FIG. 1

