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(71) Applicant: **Prometeoegineering.IT S.r.l.**
00191 Roma (IT)

(72) Inventor: **Focaracci, Alessandro**
I-00191, Roma (IT)

(74) Representative: **Cicogna, Franco**
Ufficio Internazionale Brevetti
Dott.Prof. Franco Cicogna
Via Visconti di Modrone, 14/A
20122 Milano (IT)

(54) **Tunnel including safety structures for evacuating persons**

(57) The present invention relates to a tunnel (1) including safety structures for evacuating persons, said tunnel comprises a hanging passage or drift (2), comprising a plurality of adjoining modular elements (3), connected to and suspended from the tunnel vault by connecting and suspending tie-rods (8), the modular elements including elements having a central walking-on portion (4) and side walls (5), the end portions of which are tightly engaged with the tunnel vault (6), the tunnel further comprising, at preset spacings, a plurality of controlled access arrangements (30), for communicating the tunnel floor and the hanging or suspended drift.

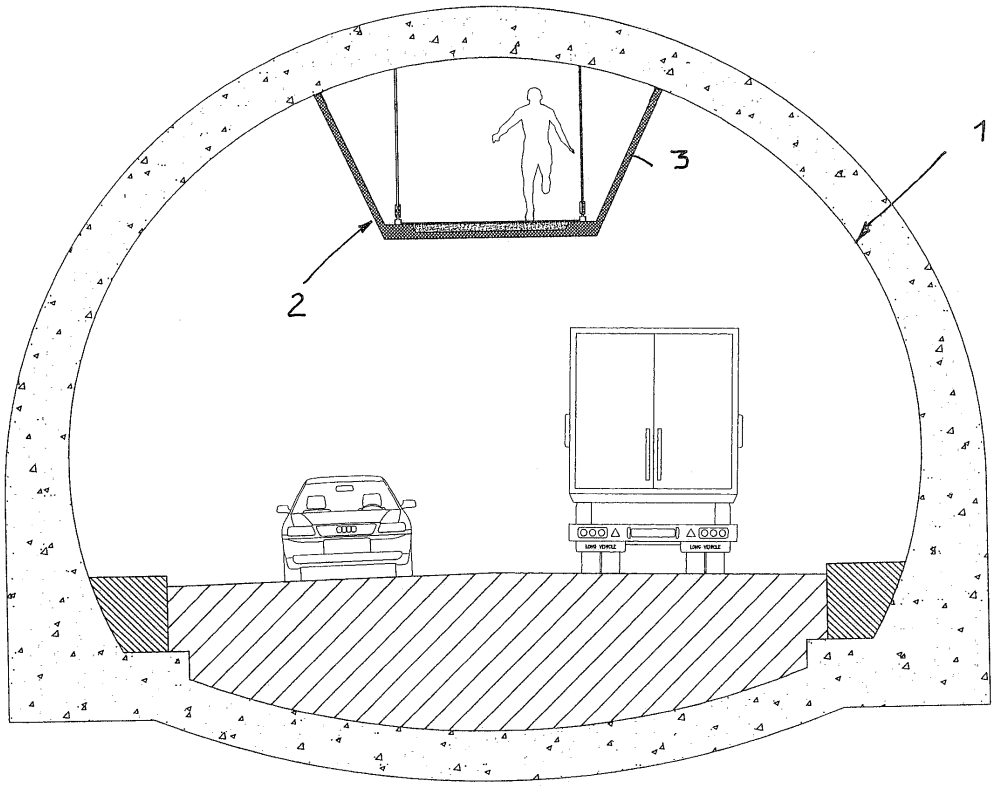


FIG. 3

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a tunnel including safety structures for evacuating persons.

[0002] As is known, a very important problem in making tunnels is that of providing said tunnels with emergency exits allowing persons to be evacuated from the tunnel, in a case of fire or other dangerous events.

[0003] Prior solutions, usually based on fire barriers, are not suitable to provide a safe evacuating and, moreover, represent dangerous constructions for the persons being evacuated.

SUMMARY OF THE INVENTION

[0004] Accordingly, the aim of the present invention is to overcome the above mentioned drawbacks, by providing a tunnel including safety or emergency means for evacuating persons, allowing to form a safety or emergency region providing an easy access thereto for persons being evacuated, for example, in a tunnel fire event.

[0005] Within the scope of the above mentioned aim, a main object of the invention is to provide such a preferential escaping way easily accessible for persons being evacuated, and which is separated from the tunnel environment, thereby preventing fumes from entering said escaping way.

[0006] Another object of the present invention is to provide such a tunnel which, owing to its specifically designed characteristics and features, is very reliable and safe in operation.

[0007] Yet another object of the present invention is to provide such a tunnel including safety or emergency means for evacuating persons, which can be easily made and which, moreover, is very competitive from a mere economic standpoint.

[0008] According to one aspect of the present invention, the above mentioned aim and objects, as well as yet other objects, which will become more apparent hereinafter, are achieved by a tunnel including safety means for evacuating persons, **characterized in that** said tunnel comprises a hanging or suspended drift or passage formed by a plurality of adjoining modular elements coupled to the tunnel vault by coupling tie-rod or other anchoring devices. Said modular elements have a walking-on central portion and side walls, the end portions of which are tightly engaged with the vault, said tunnel further comprising, at preset spacings, a plurality of controlled access arrangements, for communicating the tunnel floor and said hanging drift or passage.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Further characteristics and advantages of the present invention will become more apparent hereinafter from the following detailed disclosure of a preferred, though not exclusive, embodiment of a tunnel including safety means for evacuating persons, which is illustrated, by way of a non limitative example, in the accompanying drawings, where:

Figure 1 is a cross-sectional view showing the tunnel according to the present invention, including a possible arrangement of access ways or passages to the hanging drift;

Figure 2 is a top plan view showing a detail of an access way type;

Figure 3 shows a further cross-sectional view of a tunnel having a hanging or suspended evacuating way;

Figure 4 shows, on an enlarged scale, a detail of the hanging drift;

Figure 5 is a further top plan view showing a possible embodiment of adjoining modular elements forming the tunnel hanging drift;

Figure 6 is a perspective view showing the vault hanging drift;

Figure 7 is a further perspective view showing a possible embodiment of a modular element according to the present invention;

Figure 8 is a top plan of the modular element;

Figure 9 is a cross-sectional view taken along the line IX-IX of figure 8;

and

Figure 10 is a further cross-sectional view taken along the line X-X of figure 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] With reference to the number references of the above mentioned figures, the tunnel including safety or emergency means for evacuating people or persons according to the present invention is herein generally indicated by the reference number 1.

[0011] The main feature of the subject tunnel is that it includes a hanging or suspended drift or passage, generally indicated by the reference number 2, and formed by a plurality of adjoining modular elements 3.

[0012] Each said modular element 3 comprises a central walking-on or trampling portion 4, which is advantageously made of a lightened reinforce concrete or steel material slab, thereon it is possible to optionally apply a floating floor, or any other desired types of floor.

[0013] To the central walking-on portion 4 are coupled side walls 5 extending at the opposite end portions of the central trampling portion, and which are either outward tapered, or have a vertical arrangement.

[0014] The side walls 5, at their end portions, are tightly engaged with the tunnel vault 6.

[0015] Said modular elements, in particular, are coupled to said tunnel vault by coupling tie-rods 8 connected to connection joints or fittings 9, associated with concrete embedded plates, or clamped to the elements 3 by other

clamping technology of like efficiency.

[0016] At their adjoining end portions, said modular elements comprise plug-in systems 10-11 allowing a mutual male-female connection with a possibility of easily performing an azimuthal and zenithal adjustment, or being merely connected to one another by metal connecting plates.

[0017] To connect the adjoining elements, are herein used connecting or coupling plates 15 and 16, arranged at said walking-on plane near the side wall connecting region.

[0018] At the top end portion of said sidewalls, are provided a plurality of coupling elements 20, made of a steel or other material, coupling to one another consecutive modular elements and which are in turn clamped to the tunnel vault, by mechanical, chemical or other like clamping means.

[0019] The tie-rods 8 may moreover operate as supporting elements for a handrail arrangement (either of an illuminated type or not), which longitudinally extends within the tunnel, thereby defining the escaping way.

[0020] For accessing the hanging drift or passage, a plurality of controlled access arrangement 30 are arranged sideways of the tunnel and being separated from said tunnel by fire barrier door 31.

[0021] The controlled access arrangements 30 comprise corresponding staircases 32 leading to the hanging drift or passage, and an optional elevator 33 for handicapped persons.

[0022] The tunnel system comprises moreover a mortar layer, for example of a fireshield type, arranged along the outline of the prefabricated tunnel system and designed for protecting against fire, so as to provide a REI 120 type of construction; furthermore, at the male and female connection fittings, a fume sealing gasket is arranged.

[0023] Thus, the above disclosed safety or emergency structure provides an easily accessible escaping way, directly arranged within the tunnel, said structure being adapted to be easily used owing to the provision of the controlled access arrangement, which are suitably located along the extension of the tunnel.

[0024] In this connection, it should be apparent that the inventive person evacuating safety or emergency structure may have either a trapezoidal or rectangular shape, or any other shape designed for providing a quick and easy evacuation.

[0025] Said safety structure may be made of either a regular or pre-pressed reinforced concrete material, either of a pre-fabricated type or not, or it may also be made of a metal structural work.

[0026] Said safety structure may be firmly connected to the tunnel cap or vault either by connecting tie-rod or coupling plates and/or bolts.

[0027] For providing an efficient protection against fire, it is moreover possible to use special mortar compounds or fire retardant panels.

[0028] The access arrangements of the safety or emergency structure according to the invention may be laterally located and comprise stair case and/or elevator systems arranged in dedicated chambers or enlargements of the current tunnel cross-section or located therein.

[0029] Furthermore, the tunnel system could also comprise all necessary systems for fitting the emergency escaping and exiting requirements.

[0030] The invention, as disclosed, is susceptible to several modifications and variations, all of which will come within the scope of the invention.

[0031] Moreover, all of the constructional details can be replaced by other technically equivalent elements.

[0032] In practicing the invention, the used materials, provided that they are compatible to the intended use, as well as the contingent size and shapes, can be any, depending to requirements.

Claims

1. A tunnel with safety or emergency structures for evacuating persons, **characterized in that** said tunnel comprises a hanging drift or passage, formed by adjoining modular elements coupled to the tunnel vault by coupling tie-rods, said modular elements having a central walking-on portion and side walls, with respective end portions tightly engaged with said tunnel vault, said tunnel further comprising, at preset spacings, a plurality of controlled access arrangements, for communicating the tunnel floor and said suspended drift or passage.

2. A tunnel, according to claim 1, **characterized in that** said modular elements have a rectangular or trapezoidal configuration to allow a quick evacuation, and further including joints for mutually coupling said modular elements to one another.

3. A tunnel, according to claim 1, **characterized in that** said tunnel sidewalls have an under-vertical arrangement, or being inclined at an angle from 0 to 45°, with respect to said central walking-on portion.

4. A tunnel, according to claim 1, **characterized in that** said tunnel comprises a floating plane on said central walking-on portion.

5. A tunnel, according to claim 1, **characterized in that** said tunnel comprises a plurality of coupling structural elements arranged on said central walking-on portion, at a converging region of said tunnel sidewalls.

6. A tunnel, according to claim 1, **characterized in that** said tunnel comprises a plurality of connecting joints elements anchored to said

walking-on plane for providing a connection to said tie-rods.

7. A tunnel, according to claim 1, **characterized in that** said tunnel comprises moreover, at free end portions of said sidewalls, a plurality of coupling joints coupling to one another two modular elements adapted to be coupled to said tunnel vault by anchoring coupling elements.

8. A tunnel, according to claim 1, **characterized in that** said tunnel comprises moreover a fume sealing double gasket arrangement located between the connection joints of said modular elements.

9. A tunnel, according to claim 1, **characterized in that** said tunnel comprises moreover a tunnel handrail.

10. A tunnel, according to claim 1, **characterized in that** said controlled access arrangements are provided with fire barrier doors.

11. A tunnel, according to claim 1, **characterized in that** said controlled access arrangements comprise a plurality of staircases and an elevator for handicapped persons, said access arrangements being lateral access arrangements and/or comprising elevator systems housed in elevator system housing chambers or in enlarged portions of a current cross-section of said tunnel, or housed in said cross-section.

12. A tunnel, according to claim 1, **characterized in that** said tunnel comprises moreover a coating arrangement made of fire resistant retardant mortar materials, extending along an outside outline of said tunnel sidewalls.

13. A tunnel, according to claim 1, **characterized in that** said tunnel comprises a safety structure made of a regular reinforced concrete or a pre-pressed reinforced concrete, either prefabricated or not, or being made of a metal work connected to said tunnel vault or cap by a plurality of connecting tie-rod or plates and/or bolts.

14. A tunnel with safety or emergency structures for evacuating persons, according to claim 1, **characterized in that** said tunnel comprises special mortar materials and/or fire retardant panels for protecting said tunnel against fire.

15. A tunnel, according to claim 1, **characterized in that** said tunnel comprises a safety structure for evacuating persons including all necessary systems as required for providing an emergency escaping and exiting way.

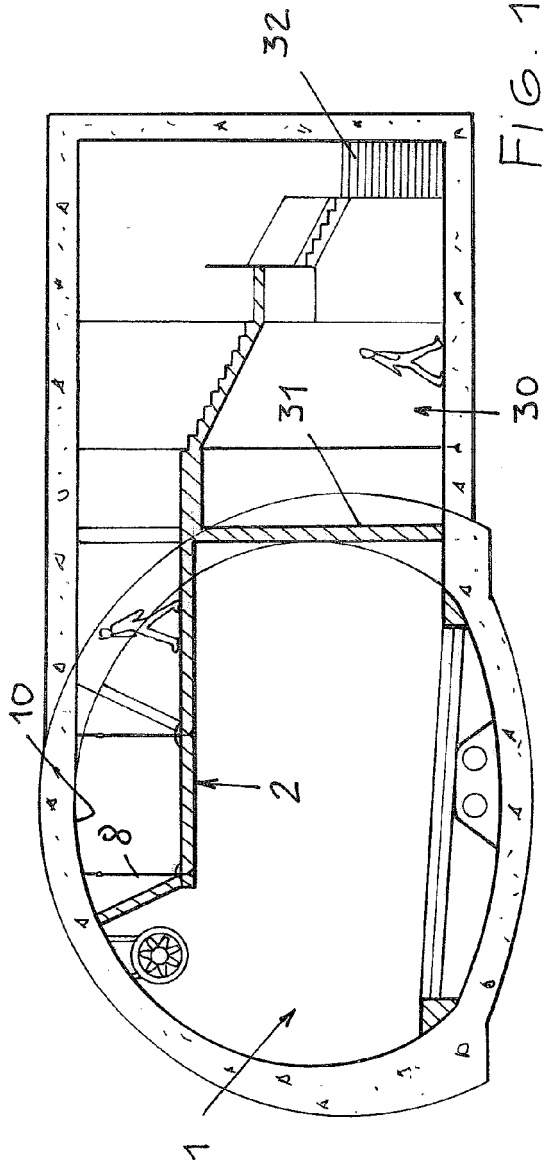


FIG. 1

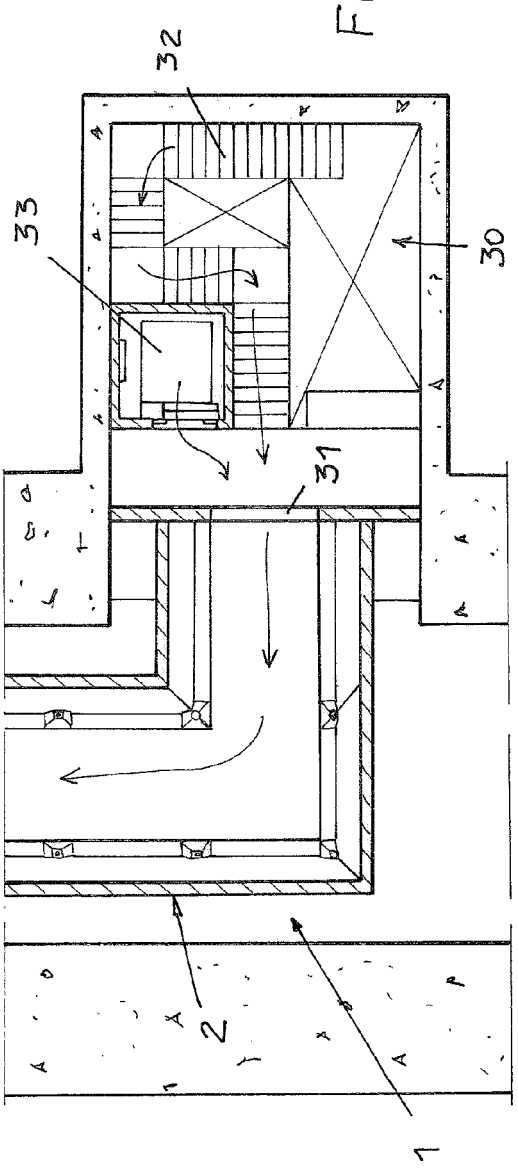


FIG. 2

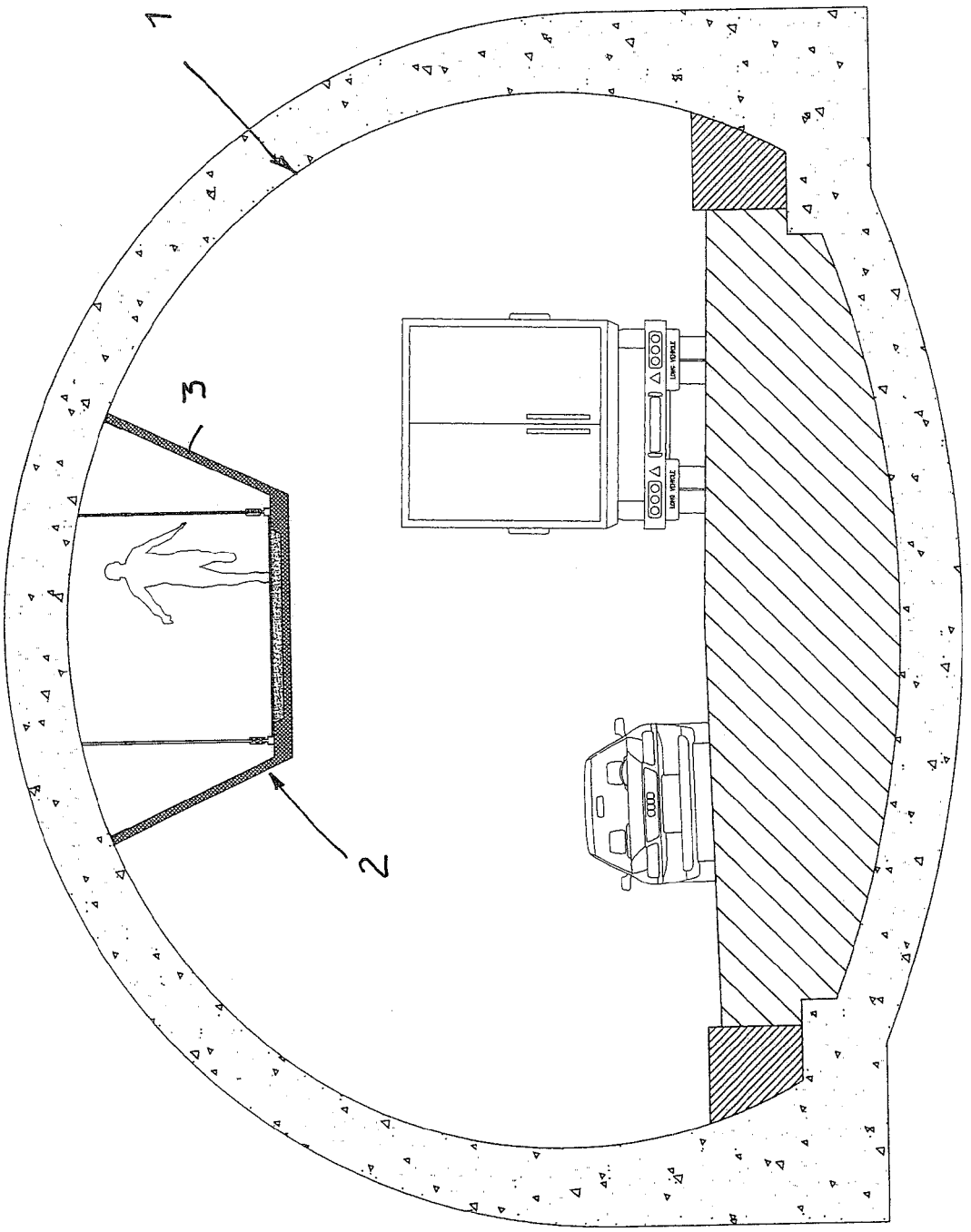


FIG. 3

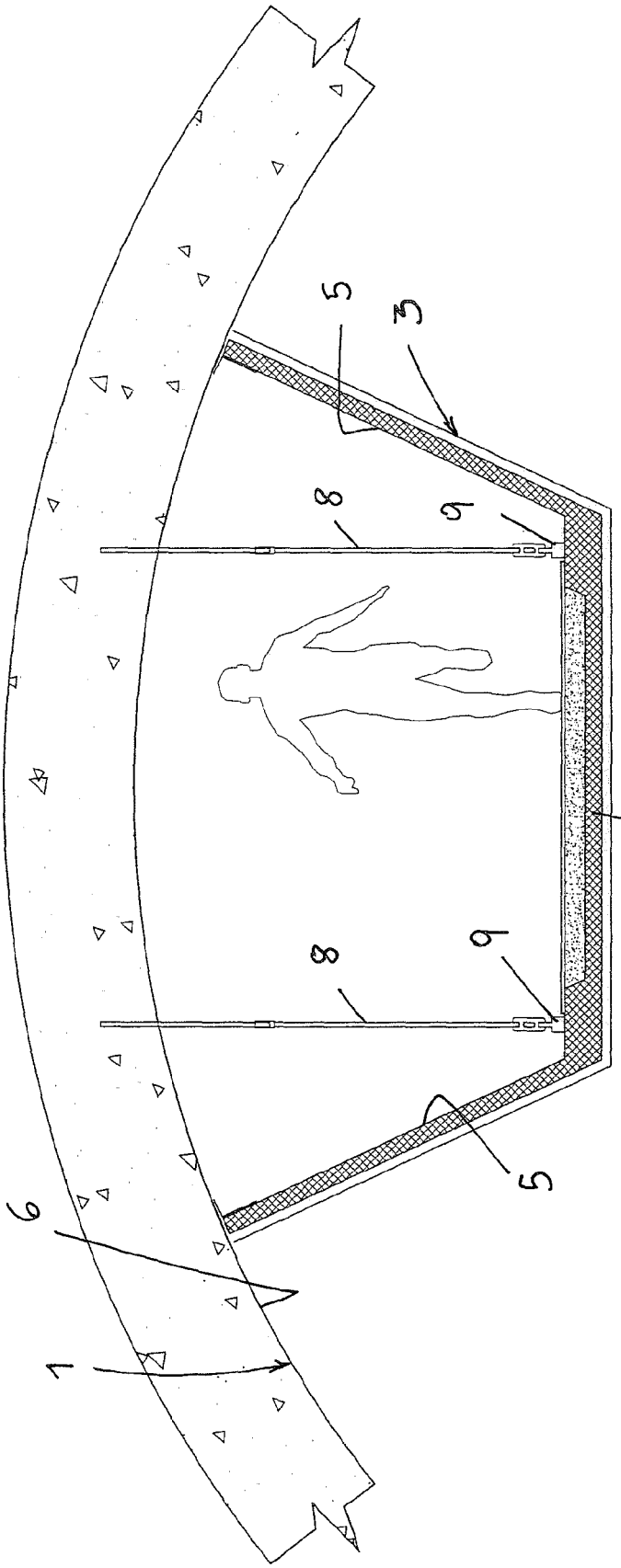


FIG. 4

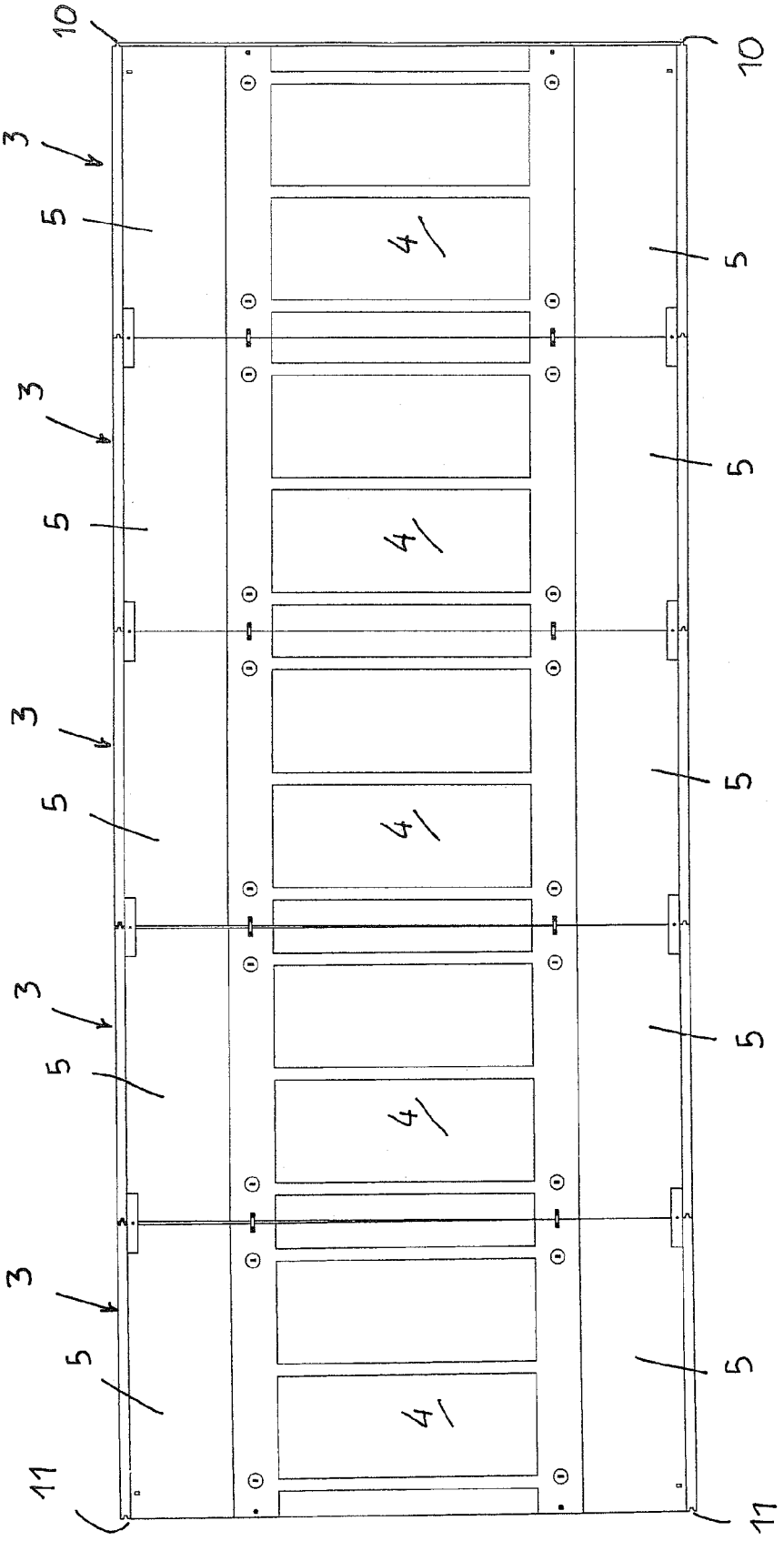


FIG. 5

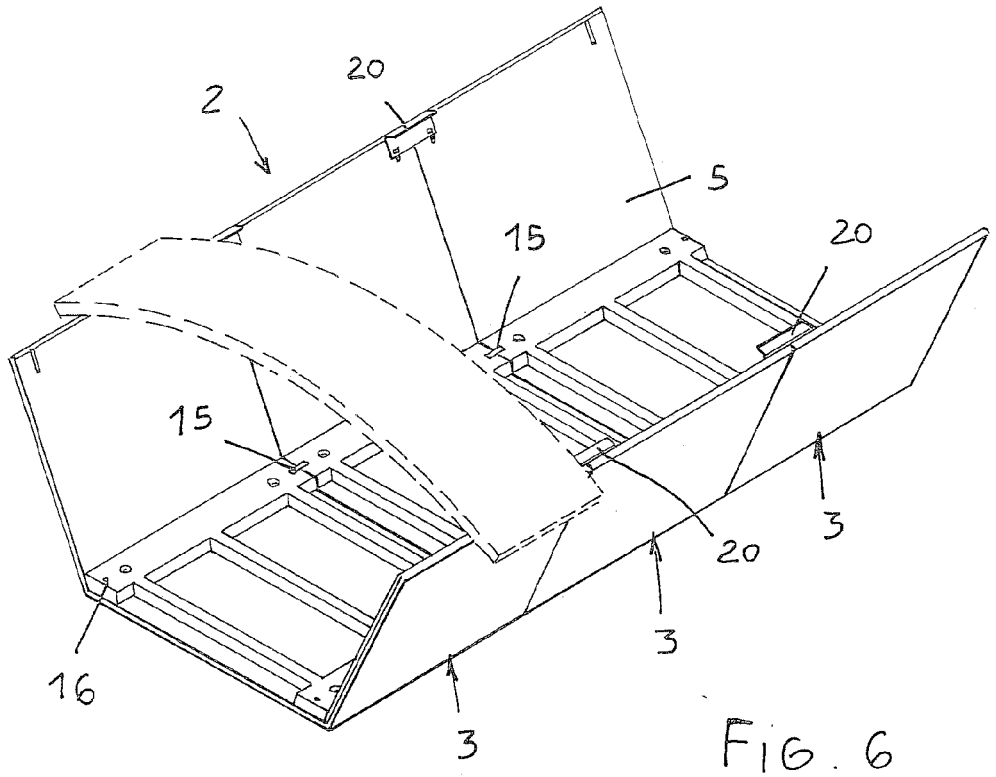


FIG. 6

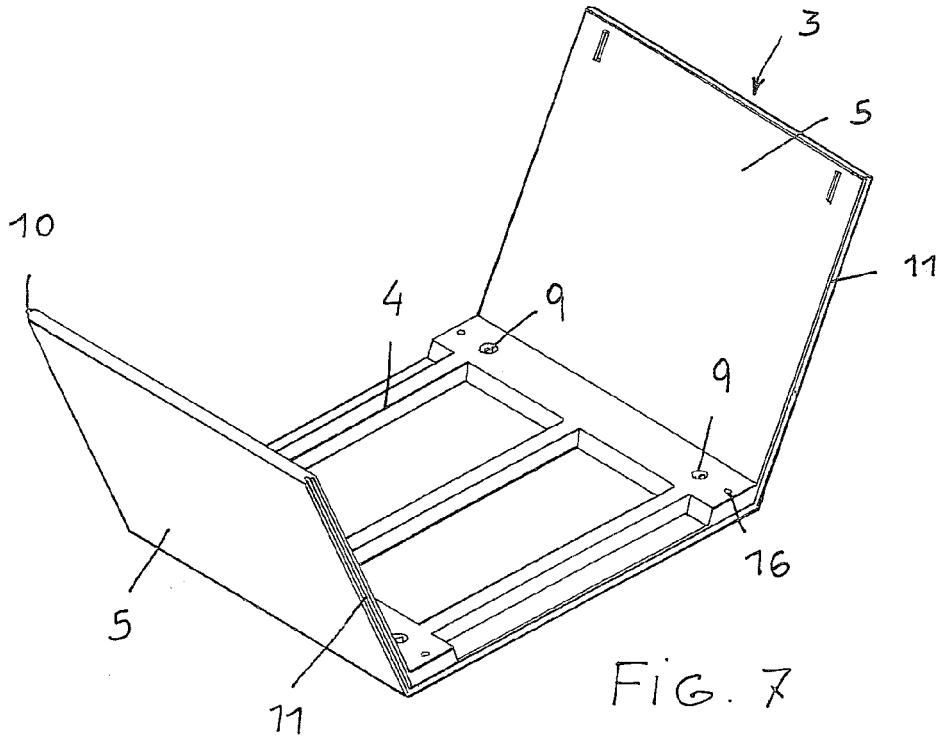


FIG. 7

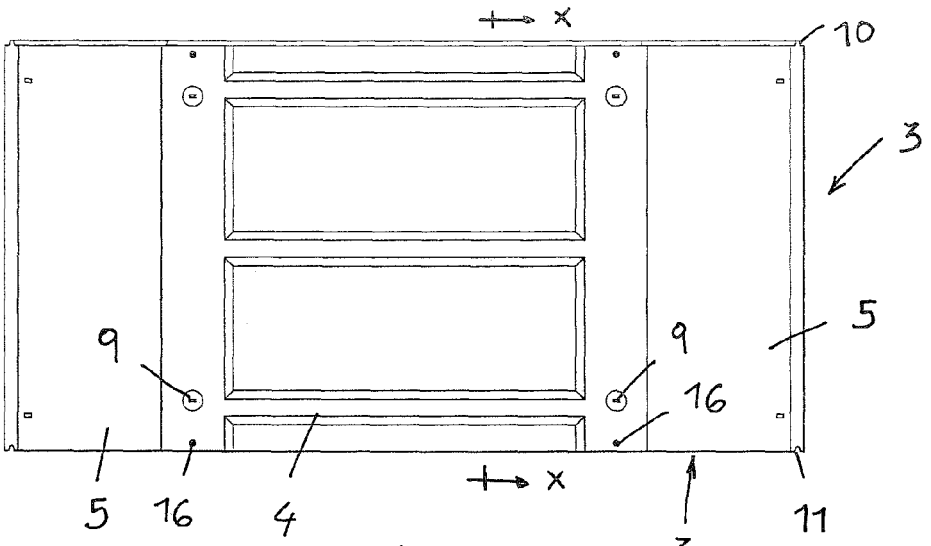


FIG. 8

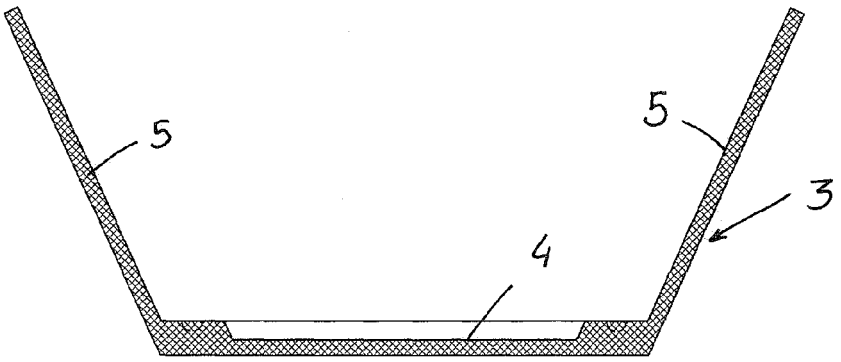


FIG. 9

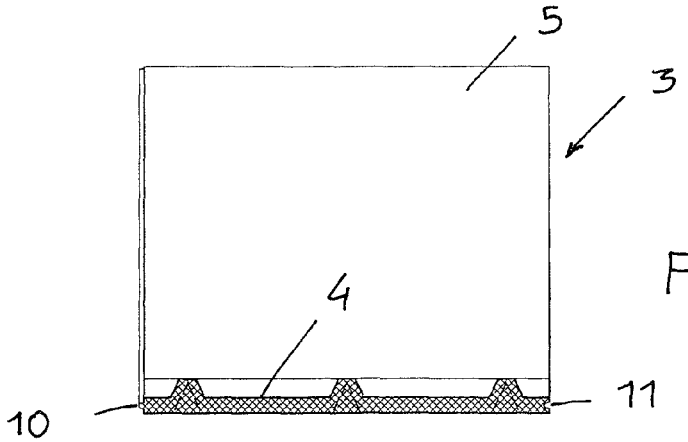


FIG. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 6893

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	DE 103 33 142 A1 (RICHTER HERBERT [DE]) 3 February 2005 (2005-02-03) * paragraphs [0020], [0021], [0025] *	1-15	INV. E21F11/00
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A	JP 11 200762 A (TEKKEN CONSTR CO) 27 July 1999 (1999-07-27) * abstract *	1-15	
A	WO 2007/094688 A1 (ACONA GROUP AS [NO]; VASSMYR KJELL ARE [NO]; AASEROED MARTIN IVAR [NO]) 23 August 2007 (2007-08-23) * abstract *	1-15	TECHNICAL FIELDS SEARCHED (IPC) E21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 May 2010	Garrido Garcia, M

CATEGORY OF CITED DOCUMENTS

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1 EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 17 6893

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