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

(11) EP 2 741 001 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.06.2014 Bulletin 2014/24

(51) Int Cl.:
F23M 5/04 *(2006.01)* ***F23R 3/00*** *(2006.01)*

(21) Application number: **13196562.6**

(22) Date of filing: **10.12.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **10.12.2012 IT MI20122104**

(71) Applicant: **Ansaldo Energia S.p.A.**
Genova (IT)

(72) Inventors:
- **Bertino, Gianluigi**
  16031 Bogliasco (IT)
- **Galella, Rocco**
  16151 Genova (IT)
- **Vella, Alessandro**
  16122 Genova (IT)

(74) Representative: **Bernotti, Andrea et al**
Studio Torta S.p.A.
Via Viotti, 9
10121 Torino (IT)

(54) Supporting structure for gas turbine combustion chamber heat-insulating tiles, heat-insulating module, and gas turbine combustion chamber

(57) A supporting structure for gas turbine combustion chamber heat-insulating tiles, includes: a first connection element and second connection element (5, 6) having respective first ends (5a, 6a), configured to fit onto sides of a heat-insulating tile (2) of a gas turbine combustion chamber (20), and respective second ends (5b, 6b); a clamping device (7); and a fixing device (8), provided with a threaded pin (15), extending from the clamping device (7) on the side opposite to the heat-insulating tile (2) in use, and with a nut (16). The connection elements (5, 6) clamped by the clamping device (7), and extend in opposite directions from the clamping device (7). The threaded pin (15) is rigidly connected to the clamping device (7), so as to prevent rotations of the threaded pin (15) with respect to the clamping device (7).

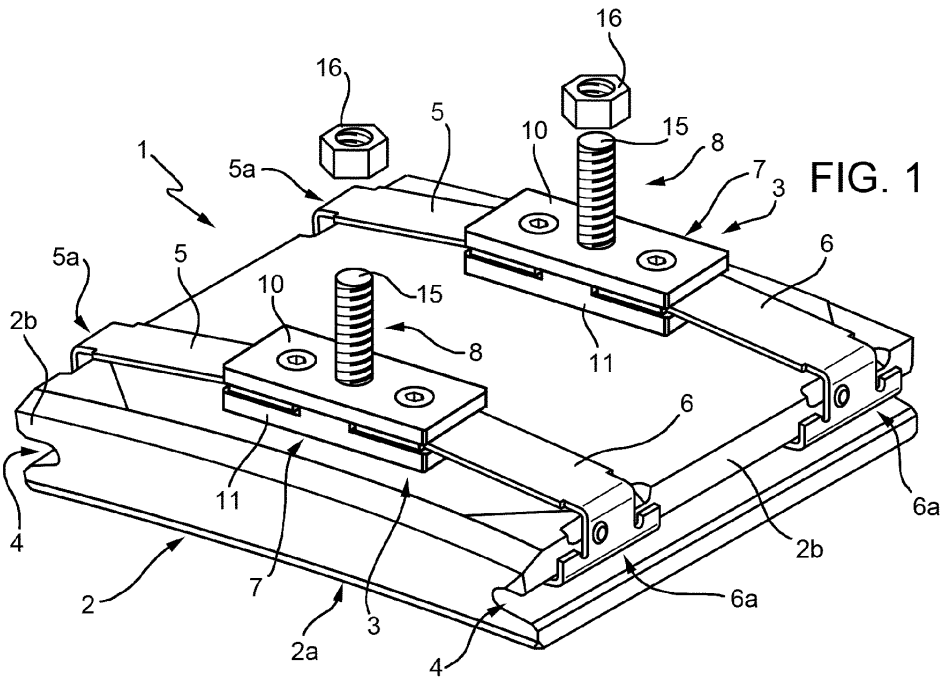


FIG. 1

EP 2 741 001 A1

Description

[0001] The present invention relates to a supporting structure for gas turbine combustion chamber heat-insulating tiles, an insulating module and a gas turbine combustion chamber.

[0002] As known, the combustion chamber of gas turbines must be provided on the inside with a heat-insulating lining made of refractory material, because of the high temperatures which are developed during machine operation. The heat-insulating lining is generally formed by a plurality of refractory tiles arranged in continuous rows on the inner walls of the combustion chamber casing, so as to define an essentially continuous surface. In the toroidal type combustion chambers, the refractory tiles are arranged on circumferences about the rotor axis.

[0003] Particularly in toroidal combustion chambers, the assembly of the refractory tiles includes inserting and sliding the connection elements along circumferential guides.

[0004] Normally, indeed, the refractory tiles have grooves on opposite sides and are fixed to the casing by connection elements which couple to ribs defined by the grooves. In general, the connection elements for one side of the refractory tiles are inserted in guides on the casing and made to slide to the respective fastening positions. The refractory tile is then arranged in seat, with a side engaging the fastening elements. Further connection elements are inserted along the guides and made to slide to couple with the side of the tile which is still free.

[0005] Particular measures are thus needed for the last tile of each row.

[0006] According to a known solution, a metallic tile is used in each row, which has a through hole and is fixed to the casing for last by micro-cast screw inserted from the outside and engaged on a pack of pre-assembled springs. In this manner, it is not necessary to make the fastening elements slide and assembly may be used in relatively easy manner. However, the metallic tile cannot guarantee an insulation comparable to that of the refractory tiles and moreover requires a specific cooling system.

[0007] Another known solution uses perforated refractory tiles, fixed to the casing with metallic through screws, using a system similar to that described above. Although heat dispersions are partially eliminated, the problem of cooling the metallic parts, in particular the screw, which is exposed to high temperature, remains. Furthermore, only a few specimens of specifically perforated refractory tiles must be used, with obvious additional costs.

[0008] It is thus an object of the present invention to provide a supporting structure for heat-insulating tiles of gas turbine combustion chambers, a heat-insulating module for gas turbine combustion chambers and a gas turbine combustion chamber which allow to overcome the limitations described.

[0009] According to the present invention, a supporting structure for heat-insulating tiles of gas turbine combustion chambers, a heat-insulating module for gas turbine combustion chambers and a gas turbine combustion chamber are provided, as defined in claims 1, 10 and 14, respectively.

[0010] The present invention will now be described with reference to the accompanying drawings, which illustrate some non-limitative embodiments thereof, in which:

- figure 1 is a perspective three-quarters view from the top of a heat-insulating module incorporating supporting structures according to an embodiment of the present invention;
- figure 2 is a plan view from the top of the heat insulating module in figure 1;
- figure 3 is a front view of the heat-insulating module in figure 1, taken along the plotting plane III-III in figure 2;
- figure 4 is a three-quarters perspective view from the bottom of one of the supporting structures in figure 1;
- figure 5 is a side view taken along a vertical axial plan of a gas turbine combustion chamber incorporating specimens of the heat-insulating module in figure 1;
- figure 6 is a front view of the combustion chamber in figure 5, taken along plotting line VI-VI in figure 5 and with parts removed for clarity;
- figure 7 shows an enlarged detail of the combustion chamber in figure 5, partially exploded and with parts removed for clarity;
- figure 8 shows a magnified detail of figure 5; and
- figure 9 is a partially exploded perspective view of the part in figure 8.

[0011] With reference to figures 1-3, a gas turbine combustion chamber heat-insulating module, as a whole indicated by reference numeral 1, comprises a heat-insulating tile 2, made of refractory material, e.g. a ceramic material, and supporting structures 3 for fixing the heat-insulating tile 2 to the walls of a gas turbine combustion chamber (not shown here).

[0012] The heat-insulating tile 2 is rectangular and has an essentially continuous and uniform working face 2a facing the inside of the combustion chamber in use. In particular, the working face 2a of the heat-insulating tile 2 is free from holes, cavities and through recesses.

[0013] In one embodiment, opposite sides of the heat-insulating tile 2 has respective groves 4, which extend for their entire length. The grooves 4 form ribs 2b, which define fastening seats for coupling with the supporting structures 3. Alternatively, the sides of the heat-insulating tile 2 may have separate recesses defining fastening seats for the supporting structures 3.

[0014] In one embodiment, the heat-insulating module 1 comprises two supporting structures 3 arranged parallel to each other but it is understood that a different number thereof could be provided.

[0015] Each supporting structure 3, one of which is shown in figure 4, comprises a first connection element 5, a second connection element 6, a clamping device 7 and a fixing device 8.

[0016] The first connection element 5 and the second connection element 6 are defined by respective elastic metal laminae and extend opposite to each other from the clamping device 7.

[0017] The first connection element 5 and the second connection element 6 have respective first ends 5a, 6a and second ends 5b, 6b. The first ends 5a, 6a are coupled to respective fastening seats, defined by portions of the ribs 2b on opposite sides of the heat-insulating tile 2. In one embodiment, for example, the first ends 5a, 6a of the first connection element and of the second connection element 6 are folded as a C toward respective second ends 5b, 6b, on the side facing the heat-insulating tile 2, and form terminals 13, 14 adapted to receive portions of respective ribs 2b of the heat-insulating tile 2.

[0018] The second ends 5b, 6b of the first connection element 5 and of the second connection element 6 are clamped by the clamping device 7. Furthermore, the second ends 5b, 6b at rest are folded so that the first ends 5a, 6a extend slightly towards the heat-insulating tile 2, once the first connection element 5 and the second connection element 6 are coupled to the clamping device.

[0019] The clamping device 7 comprises a first plate 10 and a second plate 11, reciprocally facing each other, and clamping screws 12 for alternatively clamping the first plate 10 and the second plate 11 against each other and to move the first plate 10 and the second plate 11 away from each other. In one embodiment, the first plate 10 and the second plate 11 have an essentially rectangular shape and the first connection element 5 and the second connection element 6 extend from the smaller sides, parallel to the greater sides of the first plate 10 and of the second plate 11.

[0020] The second ends 5b, 6b of the first connection element 5 and of the second connection element 6 are clamped between the first plate 10 and the second plate 11 of the clamping device 7. Furthermore, the second ends 5b, 6b have holes and the screws 12 are arranged through them preventing the connection elements 5, 6 from exiting from the respective seats. In one embodiment, the screws 12 are of the countersunk head type and are profiled so as to allow the thermal expansion of the connection elements 5, 6.

[0021] The fastening device 8 is arranged on one side of the supporting structure 3 opposite to the heat-insulating tile 2 in use and in an embodiment comprises a threaded pin 15 and a nut 16. The threaded pin 15 extends from the first plate 10 of the clamping device 7 on the side opposite to the heat-insulating tile 2 in use and, in the example of figures 1-4, is screw/nutscrew coupled to a threaded hole 18 in the second plate 11 and in the first plate 10 with through hole. In an embodiment, the threshold pin 15 is welded in the seat 18, so as to prevent the rotation with respect to the plates 10, 11 of the clamping device 7. Alternatively, the threaded pin 15 may be made in one piece with the second plate 11.

[0022] Figures 5 and 6 illustrate a combustion chamber 20 of a gas turbine (not shown as a whole). The combustion chamber 20 comprises a toroidal casing 21 extending about an axis having a first radially outer shell 22 and a second radially inner shell 23. The combustion chamber 20 is provided with a heat-insulating lining 25 which covers the inside of the first shell 22 and the second shell 23 and comprises a plurality of heat-insulating tiles 26 and a plurality of heat-insulating modules 1. In one embodiment, the heat-insulating tiles 26 are of the same type as the heat-insulating tiles 2 used in the heat-insulating modules 1 and are arranged in adjacent groups along circumferences about axis A of the combustion chamber 20. Each group comprises a respective heat-insulating module 1 (except possibly groups in which an access opening to the combustion chamber 20 is provided).

[0023] The heat-insulating tiles 26 are fitted on circumferential guides 28 by connection elements 30 on the first radially outer shell 22 (figure 7). The guides 28 are obtained on an inner face 22a of the first shell 22 and extend about axis A. The connection elements 30 are essentially equal to the connection elements 5, 6 of the supporting structures 3 of the heat-insulating modules 1 and are fixed directly to the casing 21 of the combustion chamber 20.

[0024] The heat-insulating modules 1 are fixed to the first shell 22, as shown in figures 7 and 8. More specifically, the first shell 22 has through holes 31. The threaded pins 15 of the heat-insulating modules 1 are housed in respective through holes 31 and clamped to one another by respective nuts 16. Furthermore, the guides 28 have seats 32 for housing the clamping devices 7 (in particular, the first plates 10) of the respective heat-insulating modules 1. Also by virtue of this measure, the heat-insulating modules 1 are arranged so that the heat-insulating tiles 2 form an essentially continuous surface without misalignments with the heat-insulating tiles 26 of the respective groups.

[0025] The heat-insulating tiles 26 are fitted in conventional manner. Once the connection elements 30 for one side of a heat-insulating tile 26 are housed in the guides 28 and fixed to the casing 21, the heat-insulating tile 26 is arranged in its seat and the connection elements 30 for the other side of the heat-insulating tile 26 are introduced. The procedure is repeated to complete a group of heat-insulating tiles 26 along a circumference, except for one element. A heat-insulating module 1 is used as last element of the group. This is pre-assembled and then fixed to the first shell 22 of the casing 21.

[0026] During pre-assembly, the first ends 5a, 6a of the connection elements 5, 6 of the supporting structures 3 are coupled to the ribs 2b on the sides of the heat-insulating tile 2 and the second ends 5b, 6b are rested on the second plate 11. The first plate 10 is thus joined to the second plate 11 and clamped by screws 12. As a

result of this operation, the first connection element 5 and the second connection element 6, which are elastic, are preloaded.

[0027] The pre-assembled heat-insulating module 1 is inserted in the single space which is still empty of the respective group and fixed to the first shell 22 of the casing 21. The threaded pins 15 of the supporting structures 3 are introduced into respective through holes 31 and fixed by the nuts 16.

[0028] The described supporting structure thus allows to complete the heat-insulating lining of a toroidal gas turbine combustion chamber using heat-insulating tiles of a same type. Multiple advantages derive from this.

[0029] Firstly, the lining is uniformly made of heat-insulating material, without tiles or metallic inserts. The thermal conductivity of the refractory material of the heat-insulating tiles is considerably lower than that of metals, and consequently insulation is more effective and thermal energy losses are reduced.

[0030] Furthermore, also the fixing of the casing does not require metallic component exposed to the high temperature of the combustion chamber. Consequently, the working conditions being the same, the cooling system of the metallic parts (connection elements), already present for the other heat-insulating tiles, is suitable also for the heat-insulating modules.

[0031] The fact that no special heat-insulating tiles are needed for completing the lining is advantageous also from the economic point of view because the need to make only a few special specimens with high costs is avoided. Furthermore, the assembly of the heat-insulating modules is simple and rapid.

[0032] It is finally apparent that changes and variations can be made to the described heat-insulating module and the combustion chamber described and illustrated without departing from the scope of protection of the accompanying claims.

Claims

1. A supporting structure for gas turbine combustion chamber heat-insulating tiles, comprising:

   a first connection element (5) and second connection element (6) having respective first ends (5a, 6a), configured to fit onto sides of a heat-insulating tile (2) of a gas turbine combustion chamber (20), and respective second ends (5b, 6b);
   a clamping device (7); and
   a fixing device (8), provided with a threaded pin (15), extending from the clamping device (7) on the side in use opposite to the heat-insulating tile (2), and with a nut (16);
   wherein the first connection element (5) and second connection element (6) have the respective second ends (5b, 6b) clamped by the clamping device (7), and extend in opposite directions from the clamping device (7);
   characterized in that the threaded pin (15) is rigidly connected to the clamping device (7), so as to prevent rotations of the threaded pin (15) with respect to the clamping device (7).

2. A supporting structure as claimed in claim 1, wherein the clamping device (7) comprises a first plate (10) and a second plate (11) facing each other, and screw clamping means (12) for alternatively tightening the first plate (10) and second plate (11) against each other, and separating the first plate (10) and second plate (11) from each other; and wherein the second ends (5b, 6b) of the first connection element (5) and of the second connection element (6) are clamped between the first plate (10) and second plate (11).

3. A supporting structure as claimed in claim 2, wherein the first plate (10) and second plate (11) are substantially rectangular.

4. A supporting structure as claimed in claim 2 or 3, wherein the second ends (5b, 6b) of the first connection element (5) and of the second connection element (6) have holes, and the screw clamping means (12) comprise a first and second screw, which fit through the second ends (5b, 6b) of the first connection element (5) and of the second connection element (6), respectively.

5. A supporting structure as claimed in any one of the claims 2 to 4, wherein the threaded pin (15) is screw/nut-screw coupled to a threaded hole (18) in either the first plate (10) or the second plate (11) and welded in the threaded seat (18).

6. A supporting structure as claimed in any one of the claims 2 to 4, wherein the threaded pin (15) is made in one piece between either the first plate (10) and the second plate (11).

7. A supporting structure as claimed in any one of the foregoing claims, wherein the first connection element (5) and second connection element (6) comprise respective elastic metal laminae.

8. A supporting structure as claimed in any one of the foregoing claims, wherein the first ends (5a, 6a) of the first connection element (5) and second connection element (6) form seats (13, 14) for housing portions of respective sides of the heat-insulating tile (2).

9. A supporting structure as claimed in any one of the foregoing claims, wherein the first ends (5a, 6a) of the first connection element (5) and of the second connection element (6) are bent towards the respective second ends (5b, 6b), on the side facing the heat-

insulating tile (2) in use.

10. A gas turbine combustion chamber heat-insulating module comprising a heat-insulating tile (2) and at least one supporting structure (3) as claimed in any one of the foregoing claims, fitted to the heat-insulating tile (2).

11. A heat-insulating module as claimed in claim 10, wherein the heat-insulating tile (2) has fastening seats (2b) on opposite sides; and the first ends (5a, 5b) of the first connection element (5) and of the second connection element (6) are fitted to respective fastening seats (2b) on the heat-insulating tile (2).

12. A heat-insulating module as claimed in claim 10 or 11, comprising a plurality of supporting structures (3) as claimed in any one of Claims 1 to 9 and fitted to the heat-insulating tile (2) and arranged parallel to each other.

13. A heat-insulating module as claimed in any one of claims 10 to 12, wherein the heat-insulating tile (2) has a substantially continuous and uniform work face.

14. A gas turbine combustion chamber comprising a toroidal casing (21) extending about an axis (A) and a heat-insulating lining (25) fixed to the casing (21) having at least one heat-insulating module (1) as claimed in any one of claims 10 to 13, and wherein the heat-insulating module (1) is fixed to the casing (21) with the threaded pin (15) fitted through a hole (31) in the casing (21), and the nut (16) is fitted to the threaded pin (15) from outside the casing (21).

15. A combustion chamber as claimed in claim 14, wherein the heat-insulating lining (25) comprises a plurality of further heat-insulating tiles (26) fitted to the first shell (22), along a circle about the axis (A); and wherein the heat-insulating module (1) forms a substantially continuous surface with the further heat-insulating tiles (26).

16. A combustion chamber as claimed in claim 15, wherein an inner surface (22a) of the first shell has circumferential guides (28) for housing connection elements (30) for fastening the further heat-insulating tiles (26), and a seat (32) in which the clamping device (7) of the heat-insulating module (1) is housed.

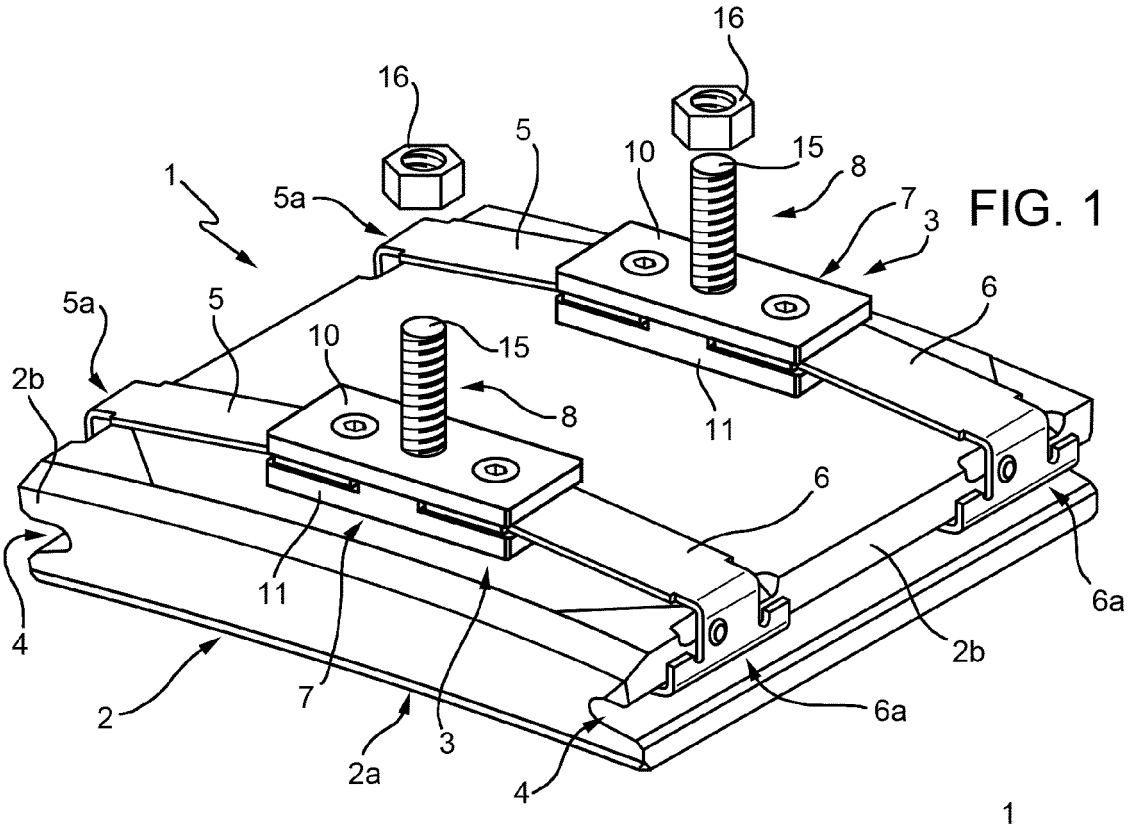

16
16
5
10
15
8
1
5a
7
3
6
5a
5
10
15
2b
8
11
6
4
11
7
3
6a
2b
2
6a
2a
4

FIG. 1

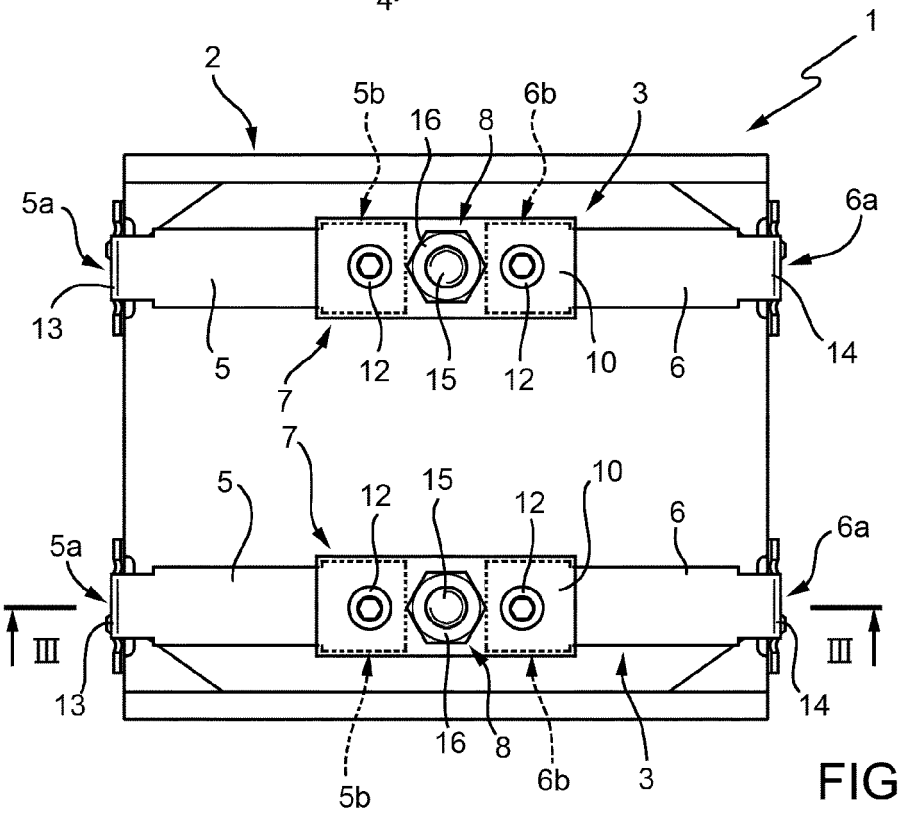

1
2
5b
16
8
6b
3
5a
6a
13
5
7
12
15
12
10
6
14
7
5
12
15
12
10
6
5a
6a
III
III
13
14
16
8
6b
3
5b

FIG. 2

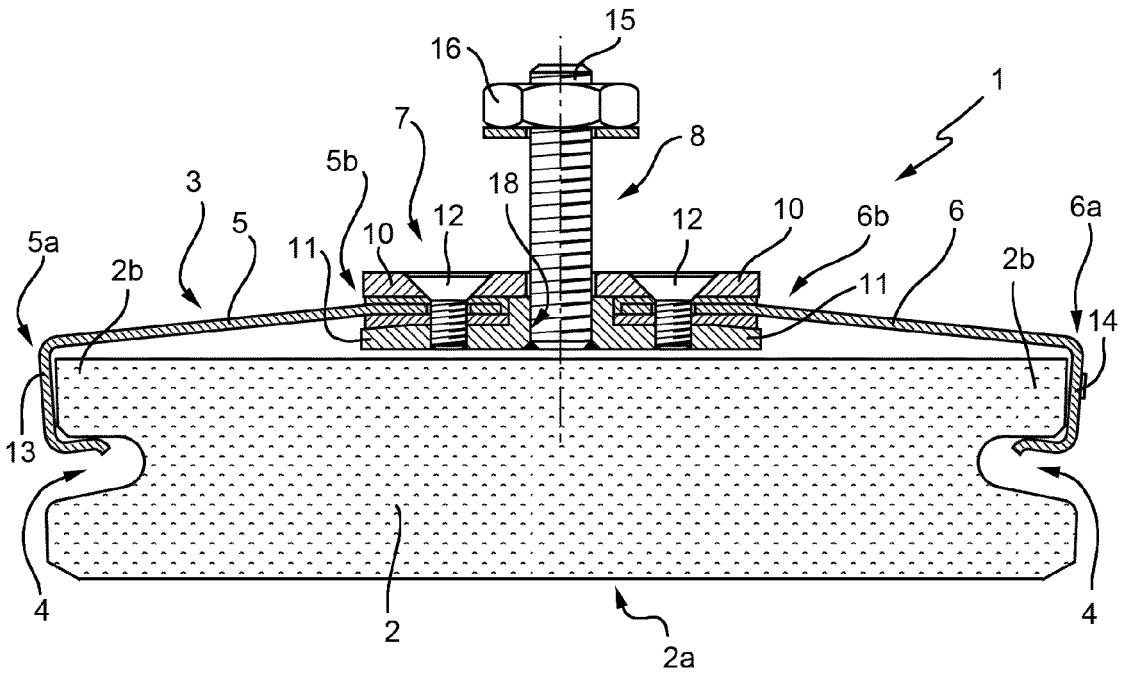

15
16
1
7
8
5b
3
18
5
12
12
10
6b
6
6a
5a
2b
11
10
11
2b
14
13
4
2
2a
4

FIG. 3

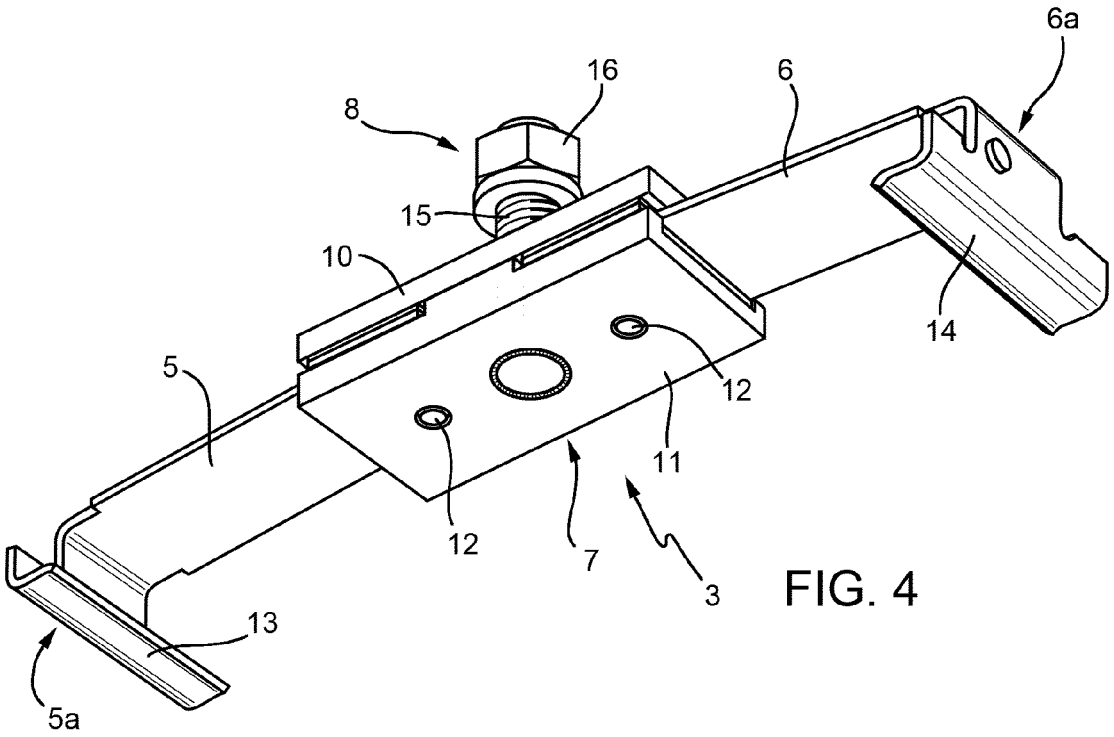

6a
16
6
8
15
10
14
5
12
11
12
7
3
13
5a

FIG. 4

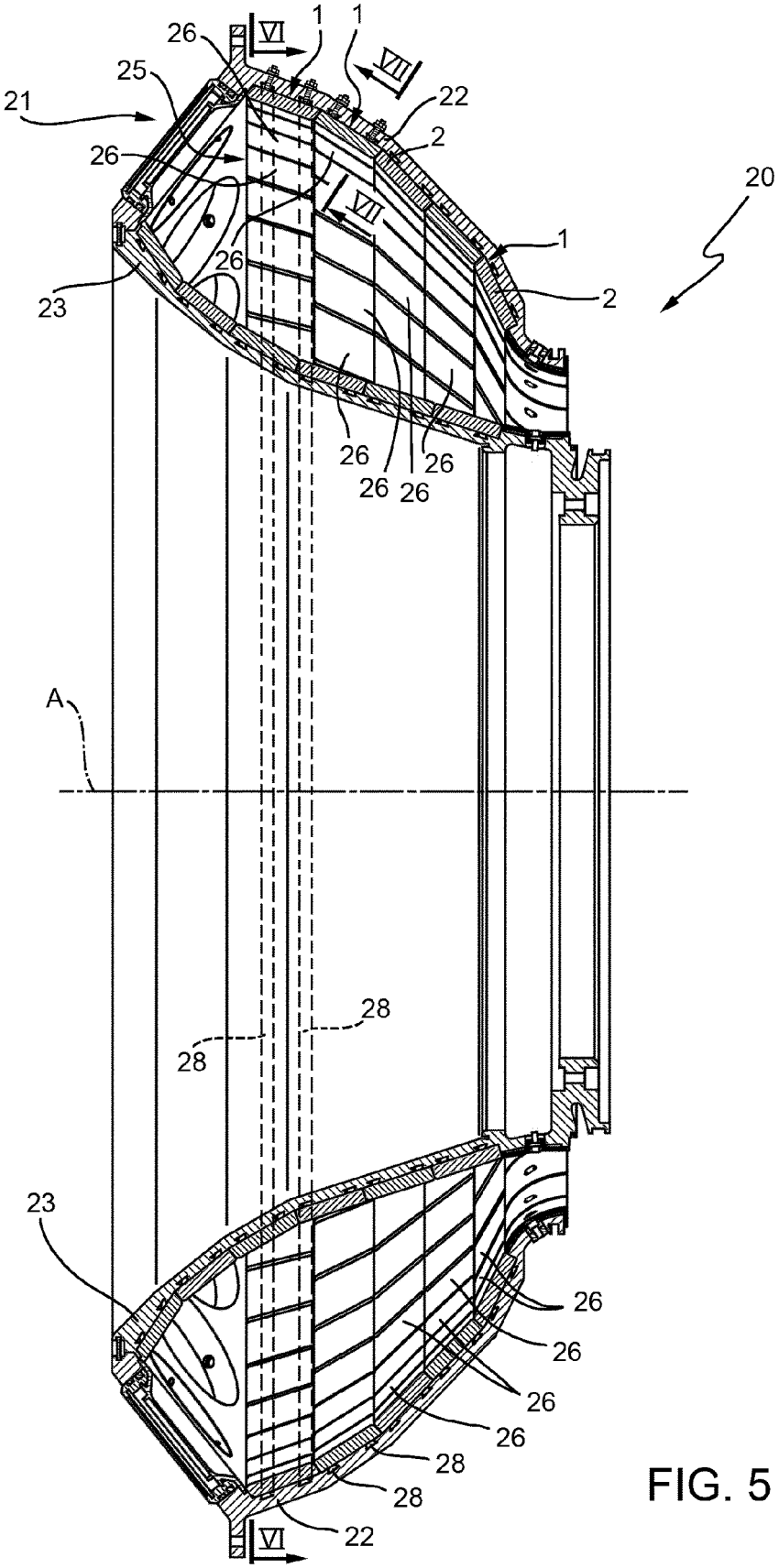

26
VI
1
1
25
VII
21
22
2
26
20
VII
1
26
23
2
26
26
26
26
A
28
28
23
26
26
26
26
28
28
22
VI

FIG. 5

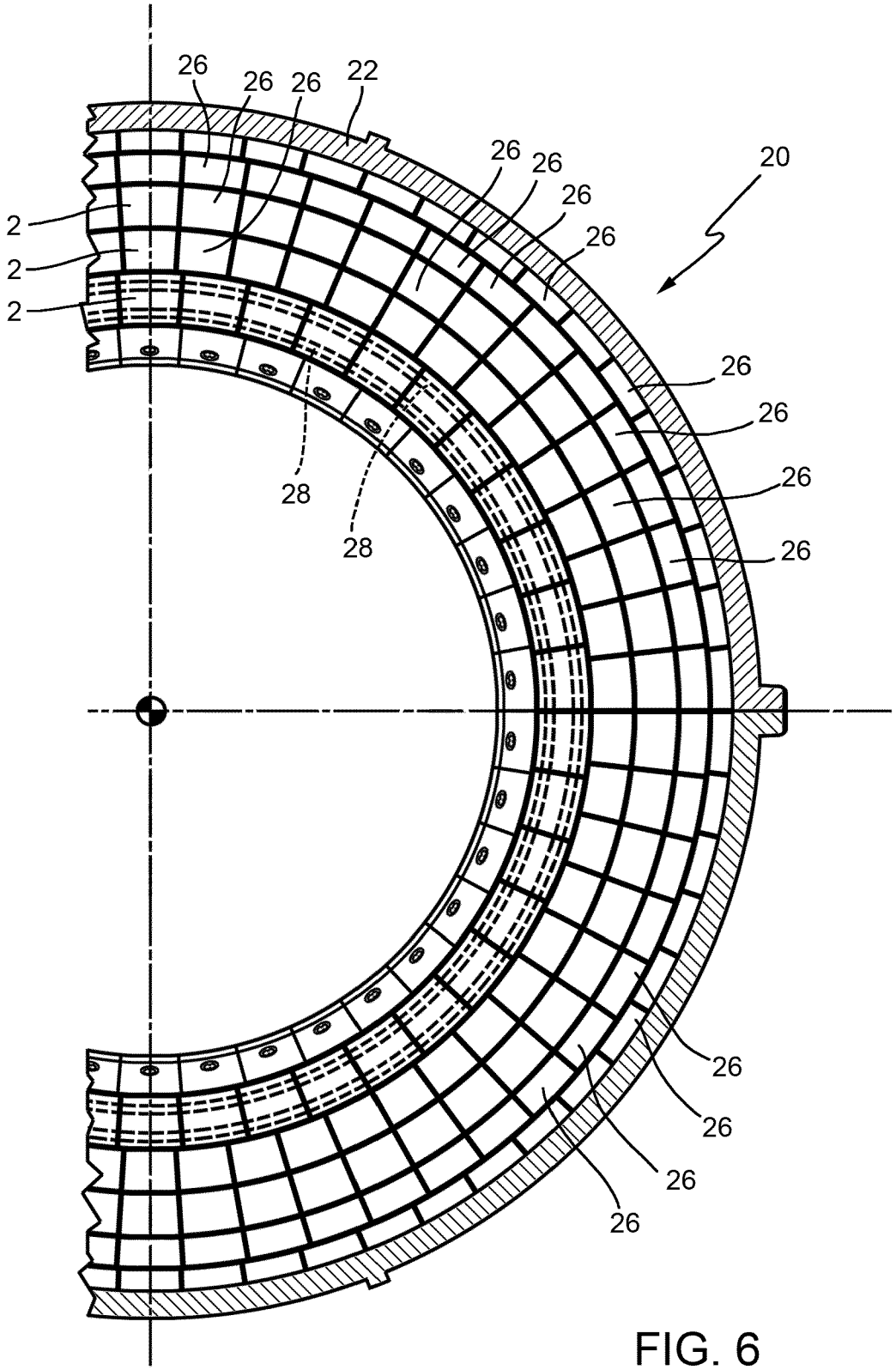


FIG. 6

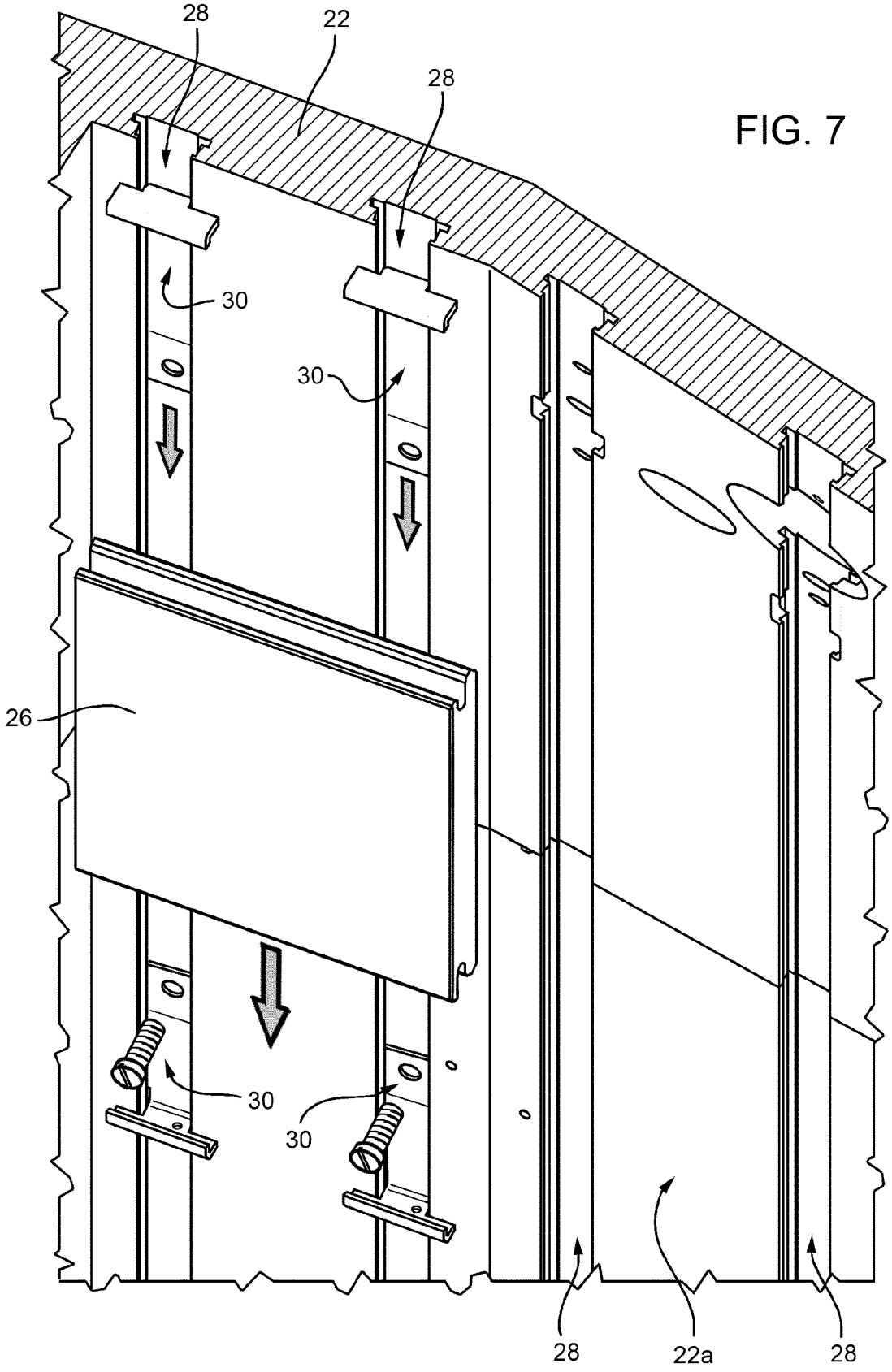


FIG. 7

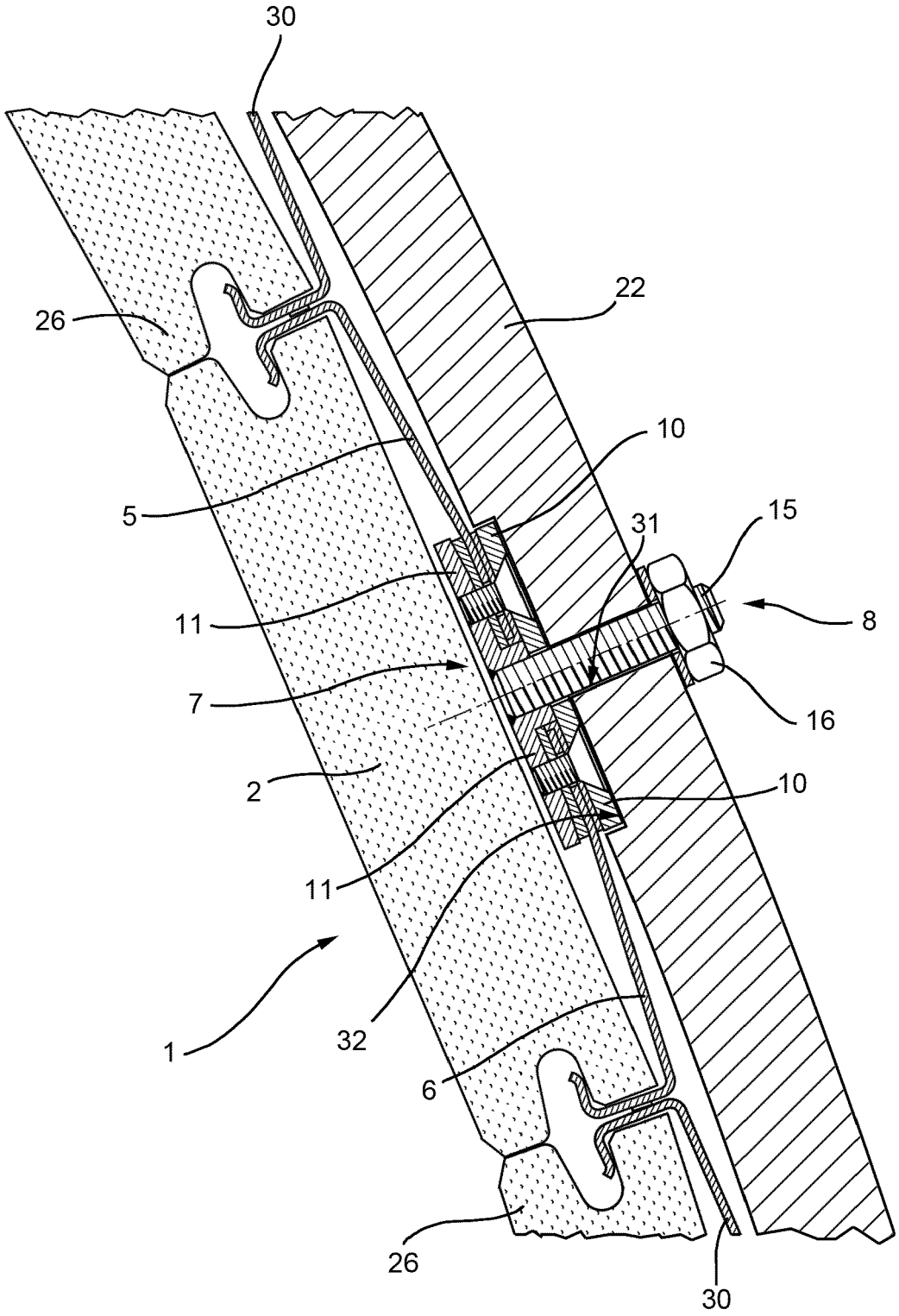


FIG. 8

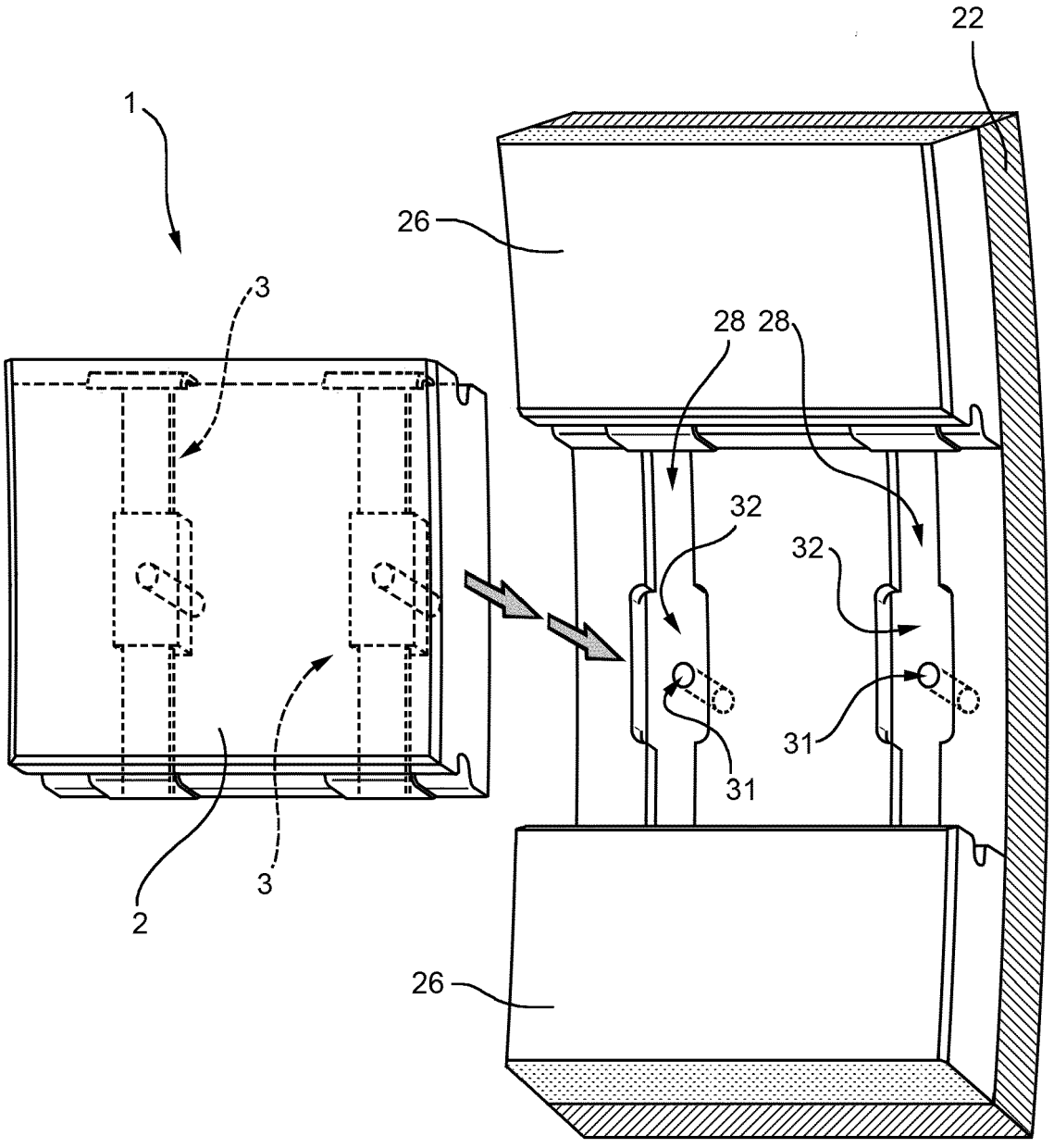


FIG. 9

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 19 6562

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 2 236 928 A1 (SIEMENS AG [DE]) 6 October 2010 (2010-10-06) * column 5, paragraph 29 - column 8, paragraph 54 * * figures 1-6 * -----	1-16	INV. F23M5/04 F23R3/00
Y	EP 2 270 395 A1 (SIEMENS AG [DE]) 5 January 2011 (2011-01-05) * column 6, paragraph 32 - column 8, paragraph 47 * * figures 3-6 * -----	1-16	
A	EP 2 341 287 A1 (ANSALDO ENERGIA SPA [IT]) 6 July 2011 (2011-07-06) * column 2, paragraph 14 - column 3, paragraph 27 * * figures 1,2 * -----	1,14-16	
			TECHNICAL FIELDS SEARCHED (IPC) F23M F23R

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 March 2014	Gavriliu, Costin

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 19 6562

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.

17-03-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2236928 A1	06-10-2010	CN 102356277 A	15-02-2012
		EP 2236928 A1	06-10-2010
		EP 2409083 A2	25-01-2012
		RU 2011141839 A	27-04-2013
		US 2011318531 A1	29-12-2011
		WO 2010105709 A2	23-09-2010
EP 2270395 A1	05-01-2011	CN 101922728 A	22-12-2010
		EP 2270395 A1	05-01-2011
		RU 2010123393 A	20-12-2011
		US 2010307162 A1	09-12-2010
EP 2341287 A1	06-07-2011	NONE	

EPO FORM P0459

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