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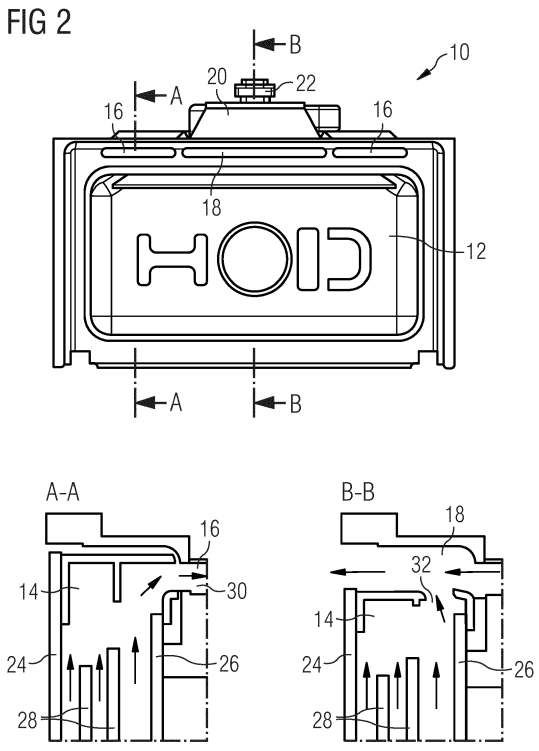
(54) COOLING SYSTEM FOR AN OVEN DOOR OF A COOKING OVEN

(57) The present invention relates to a cooling system for an oven door (14) of a cooking oven (10). The cooling system includes at least one cooling fan (20). The cooling system includes at least one suction channel (16), wherein an outlet of said suction channel (16) is connected to an inlet of the cooling fan (20). An inlet of the suction channel (16) is aligned with a suction hole (30) of the oven door (14) in a closed state of said oven door (14). The cooling system includes at least one exhaust channel (18), wherein an inlet of said exhaust channel (18) is connected to an outlet of the cooling fan (20). An outlet of the exhaust channel (18) is aligned with a Venturi opening (32) of the oven door (14) in the closed state of said oven door (14).

FIG 2



EP 3 333 490 A1

Description

[0001] The present invention relates to a cooling system for an oven door of a cooking oven. Further, the present invention relates to a cooking oven.

[0002] During operation of the cooking oven, in particular during a pyrolytic cleaning operation of the oven cavity, the outer panel or outer glass panel of the oven door is heated up. There are regulations limiting the temperature of the outer glass panel in the area of the door handle. Moreover, it is reasonable in view of the user's safety and health that the temperature of the outer glass panel in the environment of the door handle is limited.

[0003] Usually, the limitation of the temperature at the outer glass panel is achieved by venting the oven door. For example, air is sucked through the door and a lower cooling channel by a radial fan and is blown out through an upper cooling channel. The upper cooling channel and the lower cooling channel are arranged one upon the other. However, such a cooling system requires a large height, while the oven cavities of modern cooking ovens have often large volumes.

[0004] It is an object of the present invention to provide a cooling system for an oven door of a cooking oven, which cooling system has a compact structure and allows a high efficiency.

[0005] The object is achieved by the cooling system for the oven door of the cooking oven according to claim 1.

[0006] According to the present invention a cooling system for an oven door of a cooking oven is provided, wherein:

- the cooling system includes at least one cooling fan,
- the cooling system includes at least one suction channel,
- an outlet of the suction channel is connected to an inlet of the cooling fan,
- an inlet of the suction channel is aligned with a suction hole of the oven door in a closed state of said oven door,
- the cooling system includes at least one exhaust channel,
- an inlet of the exhaust channel is connected to an outlet of the cooling fan, and
- an outlet of the exhaust channel is aligned with a Venturi opening of the oven door in the closed state of said oven door.

[0007] One idea of the present invention relates to the different kinds of cooling air streams generated in the oven door by the cooling system. The suction channel and the suction hole provide a main cooling air stream, while the exhaust channel and the Venturi opening generate an assisting cooling air stream.

[0008] In particular, at least one inlet of the cooling fan is arranged axially to an impeller of said cooling fan, while the outlet of the cooling fan is arranged radially to the impeller, wherein preferably the cooling fan is a centrifugal fan. In this constellation, the centrifugal fan is more effective than other fan types, since it generates higher pressures and therefore pushes air through the narrow cooling channel.

[0009] In particular, the at least one suction channel, the at least one exhaust channel and the at least one cooling fan are arranged above a top wall of an oven cavity of the cooking oven.

[0010] In this case, the cooling fan may include a lower inlet connected to at least one suction channel.

[0011] Moreover, the cooling fan may include an upper inlet for sucking air from a space above the top wall of the oven cavity in order to cool down components of the cooking oven inside said space.

[0012] Further, the inlet of the suction channel and the outlet of the exhaust channel may be arranged at the same level. Preferably, the inlet of the at least one suction channel and the outlet of the at least one exhaust channel are arranged along one line. For example, the inlet of the at least one suction channel and the outlet of the at least one exhaust channel are arranged side by side. The one-line arrangement of the inlet and outlet in the front frame combined with the Venturi-assisted door ventilation is space-saving. These constellations allow a compact structure of the cooling system.

[0013] Moreover, the outlet of the suction channel and the inlet of the exhaust channel may be arranged at different levels.

[0014] Substantially, the at least one suction channel and/or the at least one exhaust channel extend horizontally. This contributes to the compact structure of the cooling system.

[0015] In particular, the cooling system comprises the oven door including at least one suction hole and at least one Venturi opening.

[0016] Moreover, the suction hole and the Venturi opening may be arranged in an upper portion of the oven door.

[0017] According to a preferred embodiment of the present invention, the cooling system includes a central exhaust channel and two lateral suction channels, wherein the oven door includes a central Venturi opening and two lateral suction holes.

[0018] In this case, the outlet of the central exhaust channel may be connected to or correspond with the central Venturi opening of the oven door, while the inlets of the lateral suction channels may be connected to or correspond with the lateral suction holes. The cooling air stream through the central portion of the oven door is the assisting cooling air stream, i.e. generated by the Venturi effect, while the cooling air stream through the lateral portions of the oven door is the main cooling air stream, i.e. generated by the cooling fan.

[0019] According to an alternative embodiment of the present invention, the cooling system includes a central suction channel and two lateral exhaust channels, wherein the oven door includes a central suction hole and two lateral Venturi openings.

[0020] In the latter case, the inlet of the central suction channel may be connected to or correspond with the central suction hole of the oven door, while the outlets of the lateral exhaust channels may be connected to or correspond with the lateral Venturi openings. The cooling air stream through the central portion of the oven door is the main cooling air stream, while the cooling air stream through the lateral portions of the oven door is the assisting cooling air stream.

[0021] At last, the present invention relates to a cooking oven with at least on oven door, wherein said cooking oven comprises the cooling system mentioned above.

[0022] Novel and inventive features of the present invention are set forth in the appended claims.

[0023] The present invention will be described in further detail with reference to the drawings, in which

FIG 1 illustrates a schematic perspective view of a cooking oven with a cooling system according to a first embodiment of the present invention,

FIG 2 illustrates a schematic front view of the cooking oven with the cooling system according to the first embodiment of the present invention,

FIG 3 illustrates a schematic top view of the cooking oven with the cooling system according to the first embodiment of the present invention,

FIG 4 illustrates a schematic perspective view of an oven door of the cooking oven with the cooling system according to the first embodiment of the present invention,

FIG 5 illustrates a schematic perspective view of the cooking oven with the cooling system according to a second embodiment of the present invention,

FIG 6 illustrates a schematic perspective view of the oven door of the cooking oven with the cooling system according to the second embodiment of the present invention,

FIG 7 illustrates a schematic sectional side view through a central portion of the cooking oven with the cooling system according to the first embodiment of the present invention, and

FIG 8 illustrates a schematic sectional side view through a lateral portion of the cooking oven with the cooling system according to the first embodiment of the present invention.

[0024] FIG 1 illustrates a schematic perspective view of a cooking oven 10 with a cooling system according to a first embodiment of the present invention.

[0025] The cooking oven 10 comprises an oven cavity 12 enclosed by a top wall, a bottom wall, a rear wall and two side walls. The open front side of the oven cavity 12 is closed or closable by an oven door 14. The cooling system is arranged above the top wall of the cooking oven 10.

[0026] In this embodiment, the cooling system includes two suction channels 16, an exhaust channel 18, a cooling fan 20 and a fan motor 22. In this example, the cooling fan 20 is arranged upon the centre of the top wall of the cooking oven 10. Alternatively, the cooling fan 20 may be arranged on the left hand side or right hand side and/or on the front portion or rear portion upon the top wall of the cooking oven 10. It is not necessary that the cooling fan 20 is arranged upon the centre of the top wall of the cooking oven 10. The exhaust channel 18 extends from the cooling fan 20 to an upper central portion of the oven door 14, when said oven door 14 is in a closed state. The suction channels 16 extend from upper lateral portions of the oven door 14 to the cooling fan 20, when said oven door 14 is in the closed state. The cooling fan 20 is driven by the fan motor 22 arranged above said cooling fan 20.

[0027] The inlets of the suction channels 16 and the outlet of the exhaust channel 18 are arranged at the same level. Fresh air is sucked into the oven door 14, wherein said fresh air enters the bottom side of the closed oven door 14. Inside the oven door 14 a cooling air stream flows vertically upwards. In the lateral portions of the oven door 14 the vertical cooling air stream is sucked by the cooling fan 20 via the suction channels 16. In the central portion of the oven door 14 the vertical cooling air stream is sucked due to the Venturi effect generated by the air stream from the exhaust channel 18 above the Venturi openings.

[0028] The cooling fan 20 is a centrifugal fan, wherein the axis of the fan impeller is vertical. The outlets of the suction channels 16 are connected to a bottom side of the cooling fan 20. The cooling air stream from the suction channels 16 enters the cooling fan 20 axially to the fan impeller, leaves said cooling fan 20 radially to the fan impeller and enters the exhaust channel 18. In this example, the cooling fan 20 includes an upper inlet and a lower inlet arranged axially to the fan impeller. The lower inlet of the cooling fan 20 is connected to the suction channels 16. The upper inlet of the cooling fan 20 sucks air from a space above the top wall of the oven cavity 12, so that components, in particular electric and/or electronic components, inside said space are cooled down. The inlet of the exhaust channel 18 is connected to the circumferential side of the cooling fan 20.

[0029] FIG 2 illustrates a schematic front view of the cooking oven 10 with the cooling system according to the first embodiment of the present invention.

[0030] The cooling system is arranged above the top wall of the cooking oven 10. The cooling fan 20 is driven by the fan motor 22 arranged above said cooling fan 20. The inlets of the suction channels 16 and the outlet of the exhaust channel 18 are arranged at the same level. In this example, the inlets of the suction channels 16 and

the outlet of the exhaust channel 18 are formed a horizontal slots.

[0031] Additionally, FIG 2 shows two sectional side views A-A and B-B of an upper portion of the oven door 14. The oven door 14 includes an outer glass panel 24 and an inner glass panel 26. In this example, the oven door 14 includes further two intermediate glass panels 28. The sectional side view A-A relates to those parts of the oven door 14 arranged in front of the inlets of the suction channels 16, while the sectional side view B-B relates to that part of the oven door 14 arranged in front of the outlet of the exhaust channel 18.

[0032] The oven door 14 includes two suction holes 30 arranged in front of the corresponding inlets of the suction channels 16 in the closed state of the oven door 14. The suction holes 30 are arranged at the upper portion of the inner side of the oven door 14. The cooling air stream flows upwards through the oven door 14 and enters the suction channels 16 via the suction holes 30, wherein said cooling air stream is directly driven by the cooling fan 20.

[0033] Further, the oven door 14 includes a Venturi opening 32 arranged in front of the corresponding outlet of the exhaust channel 18 in the closed state of the oven door 14. The Venturi opening 32 is arranged at the top side of the oven door 14. The cooling air stream flows upwards through the oven door 14 and enters the ambient via the Venturi opening 32, wherein said cooling air stream is driven by the Venturi effect generated by the air cooling air stream leaving the exhaust channel 18.

[0034] The cooling air stream through the oven door 14 is composed by two lateral cooling air streams directly sucked by the cooling fan 20 via the suction channels 16 on the one hand and by one central cooling air stream driven by the Venturi effect generated by cooling air stream from the exhaust channel 18 on the other hand.

[0035] FIG 3 illustrates a schematic top view of the cooking oven 10 with the cooling system according to the first embodiment of the present invention.

[0036] The inlets of the suction channels 16 and the outlet of the exhaust channel 18 are arranged behind the oven door 14 at the same level. However, the outlets of the suction channels 16 are arranged at a lower level than the inlet of the exhaust channel 18. The outlets of the suction channels 16 are connected to the bottom side of the cooling fan 20, so that the cooling air stream from the suction channels 16 enters the cooling fan 20 axially to the fan impeller. The inlet of the exhaust channel 18 is connected to the circumferential side of the cooling fan 20, so that the cooling air stream leaves said cooling fan 20 radially to the fan impeller and enters the exhaust channel 18.

[0037] FIG 4 illustrates a schematic perspective view of an oven door 14 of the cooking oven 10 with the cooling system according to the first embodiment of the present invention.

[0038] The oven door 14 includes the suction holes 30 and the Venturi opening 32. In the closed state of the oven door 14, the suction holes 30 are connected to the inlets of the suction channels 16, while the Venturi opening 32 is connected to the outlet of the exhausts channel 18. The cooling air stream through the suction holes 30 is directly sucked by the cooling fan 20 via the suction channels 16. The cooling air stream through the Venturi opening 32 is driven by the Venturi effect generated by the cooling air stream from the exhaust channel 18.

[0039] FIG 5 illustrates a schematic perspective view of the cooking oven 10 with the cooling system according to a second embodiment of the present invention.

[0040] The cooking oven 10 comprises the oven cavity 12 enclosed by the top wall, the bottom wall, the rear wall and the two side walls. The open front side of the oven cavity 12 is closed or closable by an oven door 14. The cooling system is arranged above the top wall of the cooking oven 10.

[0041] In this embodiment, the cooling system includes one suction channel 16, two exhaust channels 18, the cooling fan 20 and the fan motor 22. The suction channel 16 extends from the upper central portion of the oven door 14 to the cooling channel 20, when said oven door 14 is in the closed state. The cooling fan 20 is arranged on the left side of the top wall of the cooking oven 10. The exhaust channels 18 extend from the cooling fan 20 to the upper lateral portion of the oven door 14, when said oven door 14 is in the closed state. The cooling fan 20 is driven by the fan motor 22 arranged above said cooling fan 20.

[0042] The inlet of the suction channels 16 and the outlets of the exhaust channel 18 are arranged at the same level. Fresh air is sucked through the oven door 14, wherein said fresh air enters the bottom side of the closed oven door 14. Inside the oven door 14 the cooling air stream flows vertically upwards. In the central portion of the oven door 14 the vertical cooling air stream is sucked by the cooling fan 20 via the suction channels 16. In the lateral portions of the oven door 14 the vertical cooling air stream is sucked by the Venturi effect generated by the air stream from the exhaust channels 18.

[0043] The cooling fan 20 is a centrifugal fan, wherein the axis of the fan impeller is arranged vertically. The outlet of the suction channel 16 is connected to the bottom side of the cooling fan 20. The cooling air stream from the suction channel 16 enters the cooling fan 20 axially to the fan impeller, leaves said cooling fan 20 radially to the fan impeller and enters the both exhaust channels 18. The inlets of the exhaust channels 18 are connected to the circumferential side of the cooling fan 20.

[0044] FIG 6 illustrates a schematic perspective view of the oven door 14 of the cooking oven 10 with the cooling system according to the second embodiment of the present invention.

[0045] The oven door 14 includes one suction hole 30 and two Venturi openings 32. In the closed state of the oven door 14, the suction hole 30 is connected to the inlet of the suction channel 16, while the Venturi openings

32 are connected to the outlets of the exhausts channels 18. The cooling air stream through the suction hole 30 is directly sucked by the cooling fan 20 via the suction channel 16. The cooling air stream through the Venturi openings 32 is driven by the Venturi effect generated by the cooling air stream from the exhaust channels 18.

[0046] The cooling system according to the second embodiment comprises one suction channel 16 and two exhaust channels 18, while the cooling system according to the first embodiment comprises two suction channels 16 and one exhaust channel 18.

[0047] FIG 7 illustrates a schematic sectional side view through a central portion of the cooking oven 10 with the cooling system according to the first embodiment of the present invention.

[0048] The sectional side view relates to the central portion of the cooking oven 10, in which the outlet of the exhaust channel 18 is aligned with the Venturi opening 32 of the oven door 14. The Venturi opening 32 is arranged in the top side of the oven door 14. The cooling air stream flows upwards through the oven door 14 and enters the ambient via the Venturi opening 32, wherein said cooling air stream is driven by the Venturi effect generated by the air cooling air stream leaving the exhaust channel 18.

[0049] FIG 8 illustrates a schematic sectional side view through a lateral portion of the cooking oven 10 with the cooling system according to the first embodiment of the present invention.

[0050] The sectional side view relates to the lateral portion of the cooking oven 10, in which the inlets of the suction channels 16 are aligned with the suction holes 30 of the oven door 14. The suction holes 30 are arranged in the upper portion of the inner side of the oven door 14. The cooling air stream flows upwards through the oven door 14 and enters the suction channels 16 via the suction holes 30, wherein said cooling air stream is directly driven by the cooling fan 20.

[0051] The cooling air stream through the oven door 14 is composed by one central cooling air stream driven by the Venturi effect generated by cooling air stream from the exhaust channel 18 as shown in FIG 7 and two lateral cooling air streams directly sucked by the cooling fan 20 via the suction channels 16 as shown in FIG 8.

[0052] Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to those precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

List of reference numerals

[0053]

10	cooking oven
12	oven cavity
14	oven door
16	suction channel
18	exhaust channel
20	cooling fan
22	fan motor
24	outer glass panel
26	inner glass panel
28	intermediate glass panel
30	suction hole
32	Venturi opening

Claims

1. A cooling system for an oven door (14) of a cooking oven (10), wherein:

   - the cooling system includes at least one cooling fan (20),
   - the cooling system includes at least one suction channel (16),
   - an outlet of the suction channel (16) is connected to an inlet of the cooling fan (20),
   - an inlet of the suction channel (16) is aligned with a suction hole (30) of the oven door (14) in a closed state of said oven door (14),
   - the cooling system includes at least one exhaust channel (18),
   - an inlet of the exhaust channel (18) is connected to an outlet of the cooling fan (20), and
   - an outlet of the exhaust channel (18) is aligned with a Venturi opening (32) of the oven door (14) in the closed state of said oven door (14).

2. The cooling system according to claim 1, **characterised in that** at least one inlet of the cooling fan (20) is arranged axially to an impeller of said cooling fan (20), while the outlet of the cooling fan (20) is arranged radially to the impeller of said cooling fan (20), wherein preferably the cooling fan (20) is a centrifugal fan (20).

3. The cooling system according to claim 1 or 2, **characterised in that** the at least one suction channel (16), the at least one exhaust channel (18) and the at least one cooling fan (20) are arranged above a top wall of an oven cavity (12) of the cooking oven (14).

4. The cooling system according to claim 3, **characterised in that** the cooling fan (20) includes a lower inlet connected to at least one suction channel (16).

5. The cooling system according to claim 4, **characterised in that**

the cooling fan (20) includes an upper inlet for sucking air from a space above the top wall of the oven cavity (12) in order to cool down components of the cooking oven (10) inside said space.

6. The cooling system according to any one of the preceding claims,
characterised in that
the inlet of the suction channel (16) and the outlet of the exhaust channel (18) are arranged at the same level, wherein preferably the inlet of the suction channel and the outlet of the exhaust channel are arranged along one line.

7. The cooling system according to any one of the preceding claims,
characterised in that
the outlet of the suction channel (16) and the inlet of the exhaust channel (18) are arranged at different levels.

8. The cooling system according to any one of the preceding claims,
characterised in that
the at least one suction channel (16) and/or the at least one exhaust channel (18) extend horizontally.

9. The cooling system according to any one of the preceding claims,
characterised in that
the cooling system comprises the oven door (14) including at least one suction hole (30) and at least one Venturi opening (32).

10. The cooling system according to any one of the preceding claims,
characterised in that
the suction hole (30) and the Venturi opening (32) are arranged in an upper portion of the oven door (14).

11. The cooling system according to any one of the preceding claims,
characterised in that
the cooling system includes a central exhaust channel (18) and two lateral suction channels (16), wherein the oven door (14) includes a central Venturi opening (32) and two lateral suction holes (30).

12. The cooling system according to claim 11,
characterised in that
the outlet of the central exhaust channel (18) is connected to or corresponds with the central Venturi opening (32) of the oven door (14), while the inlets of the lateral suction channels (16) are connected to or corresponds with the lateral suction holes (30).

13. The cooling system according to any one of the claims 1 to 10,
characterised in that
the cooling system includes a central suction channel (16) and two lateral exhaust channels (18), wherein the oven door (14) includes a central suction hole (30) and two lateral Venturi openings (32).

14. The cooling system according to claim 13,
characterised in that
the inlet of the central suction channel (16) is connected to or corresponds with the central suction hole (30) of the oven door (14), while the outlets of the lateral exhaust channels (18) are connected to or corresponds with the lateral Venturi openings (32).

15. A cooking oven (10) with at least on oven door (14),
characterised in that
the cooking oven (10) comprises a cooling system according to any one of the preceding claims.

FIG 1

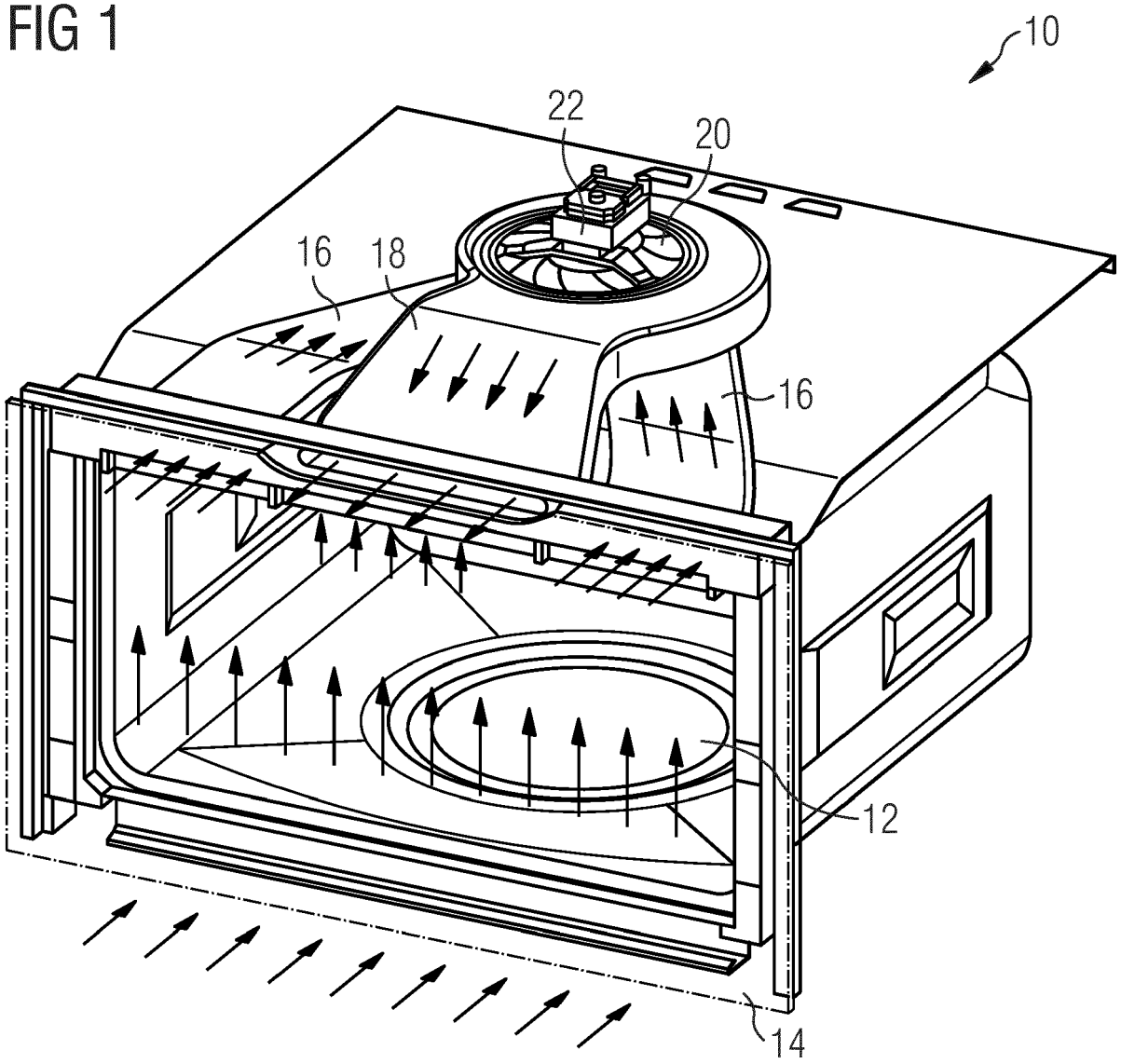
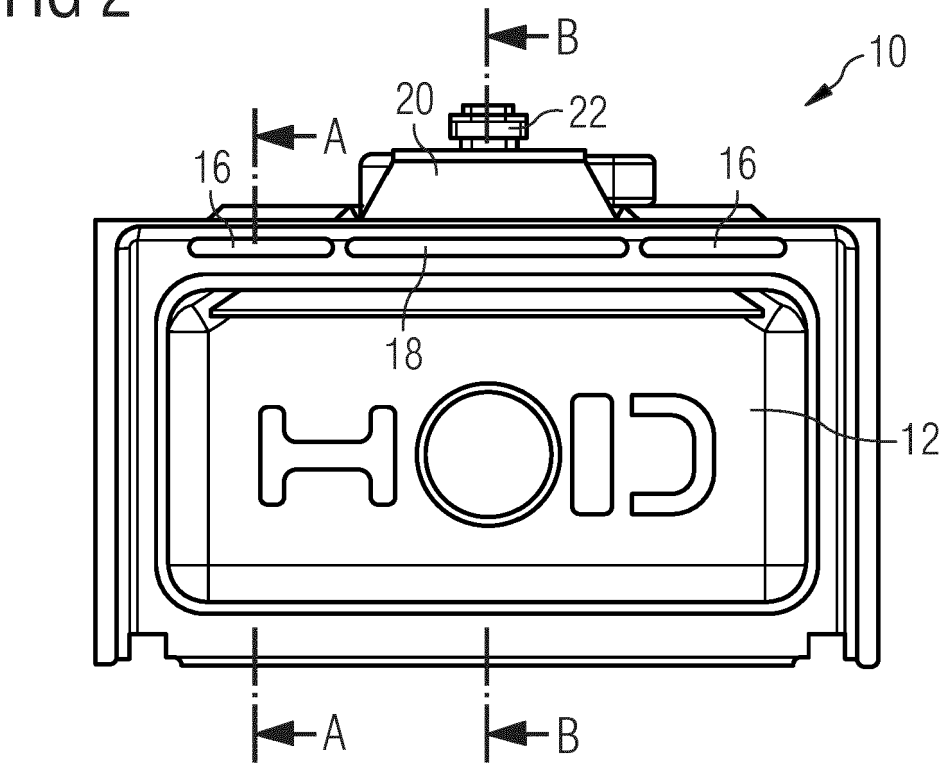
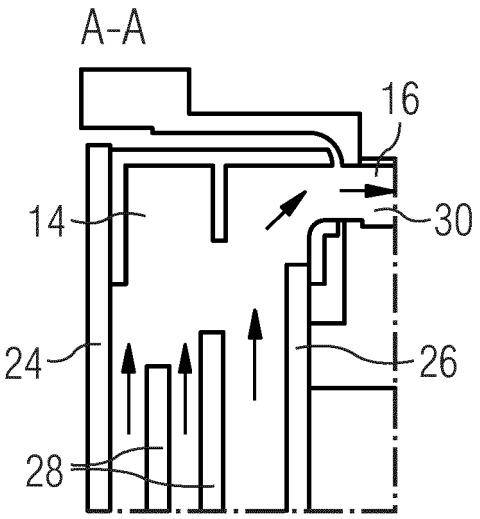


FIG 2





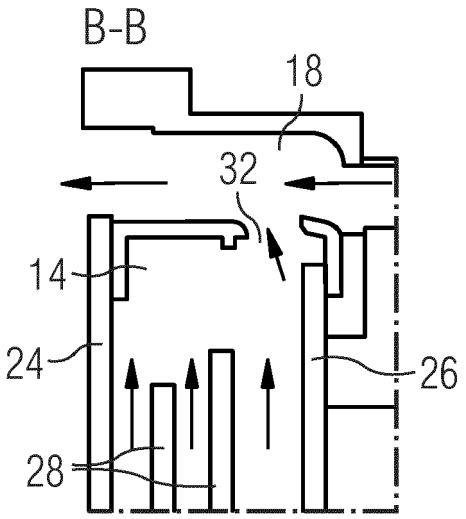


FIG 3

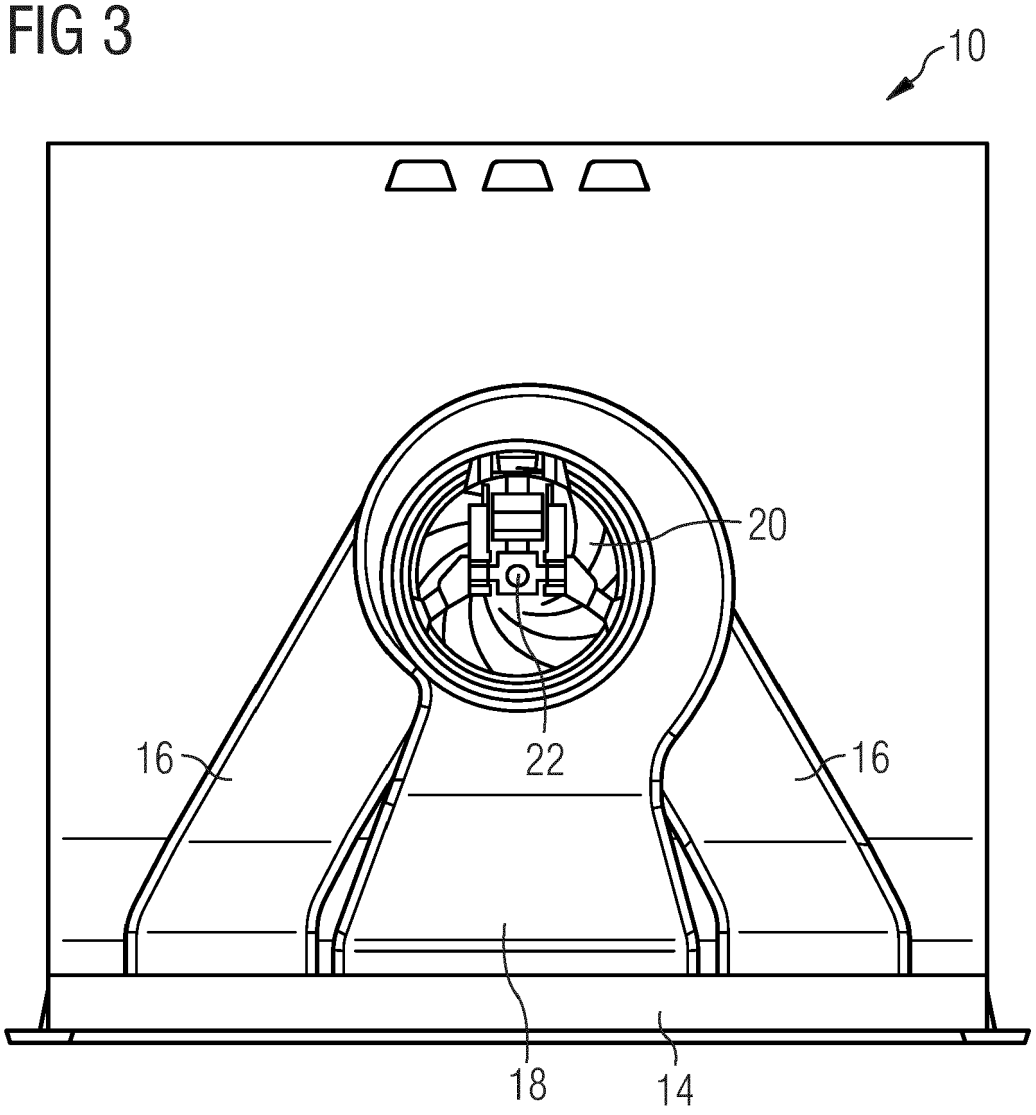


FIG 4

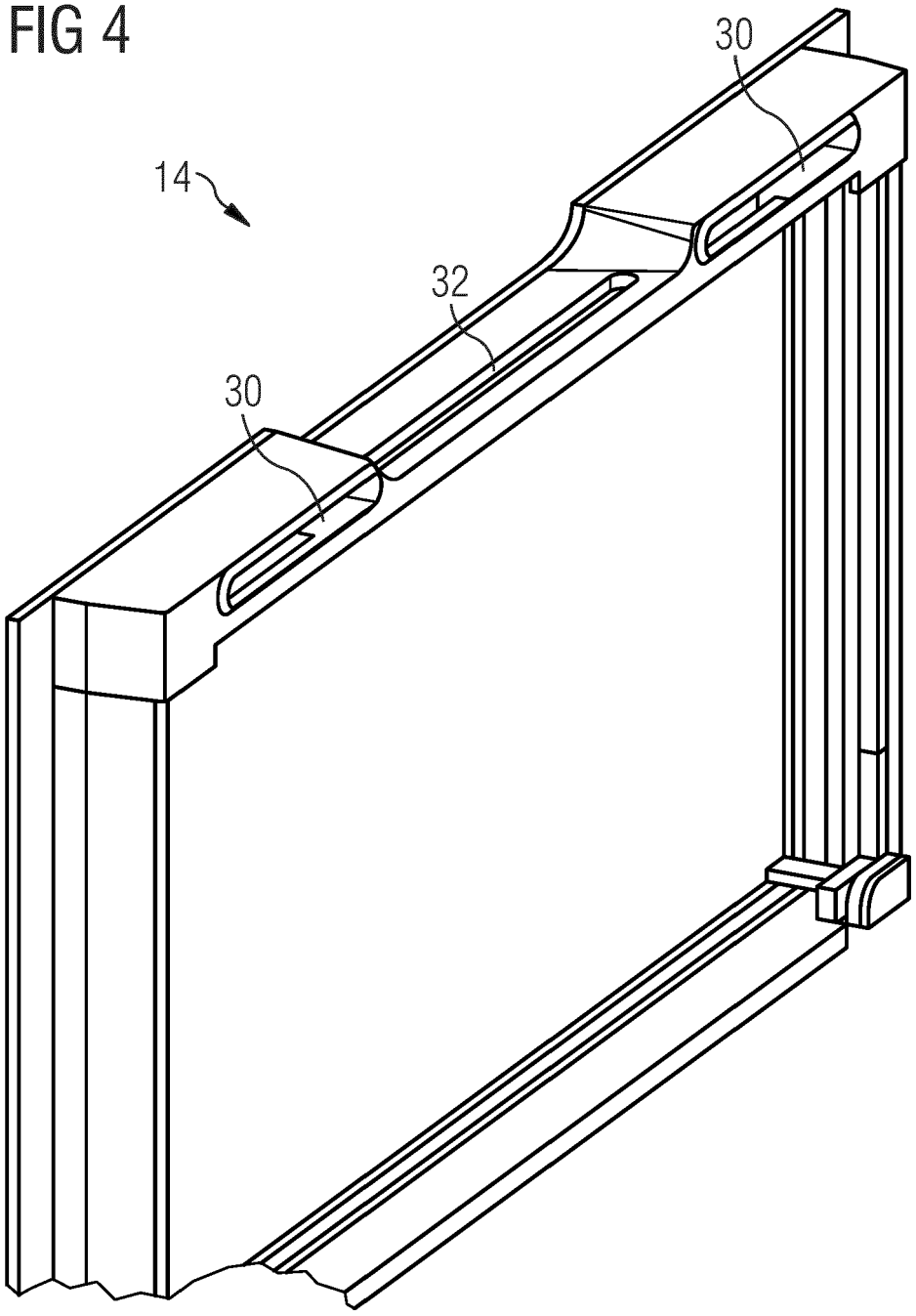


FIG 5

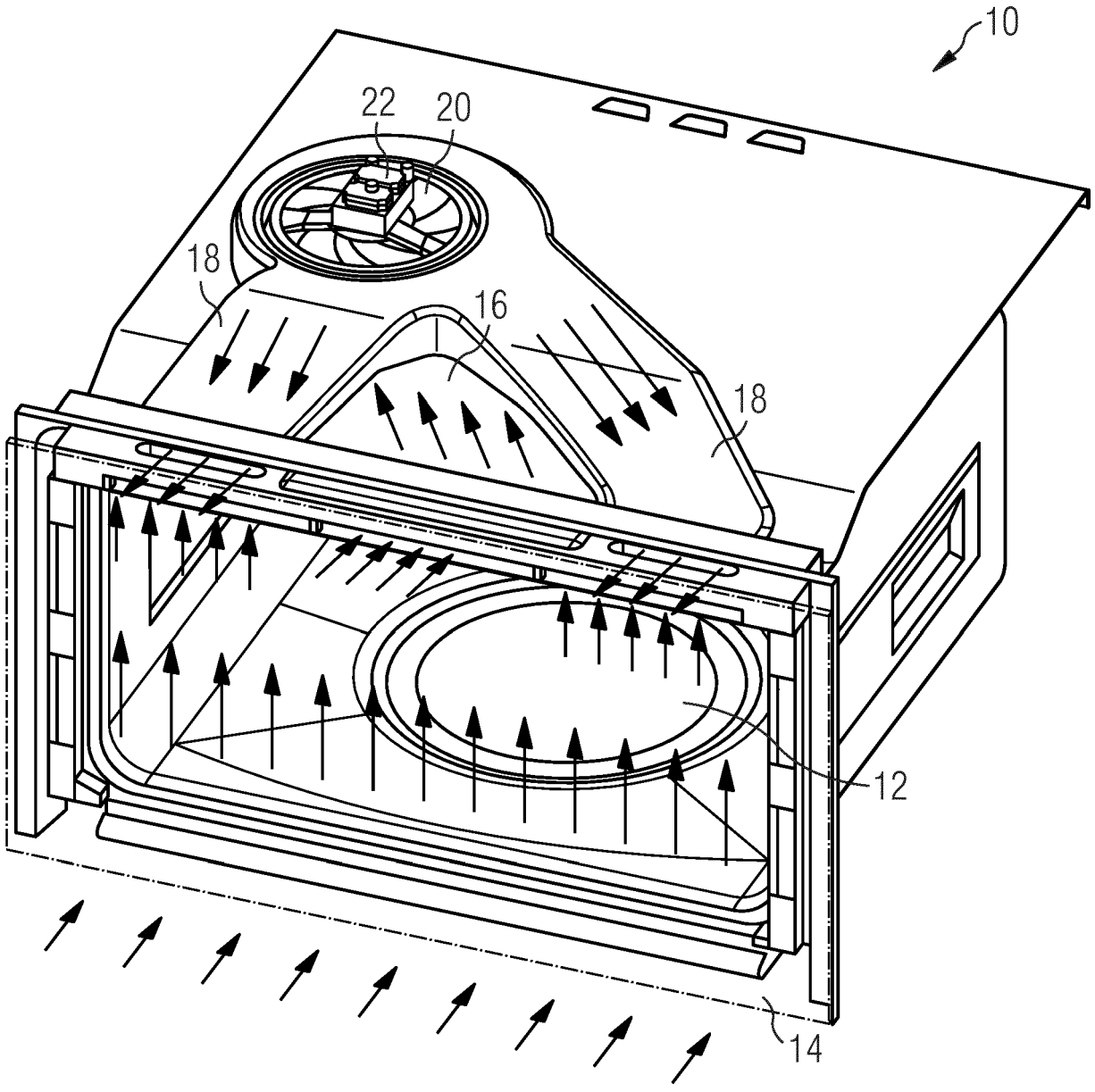


FIG 6

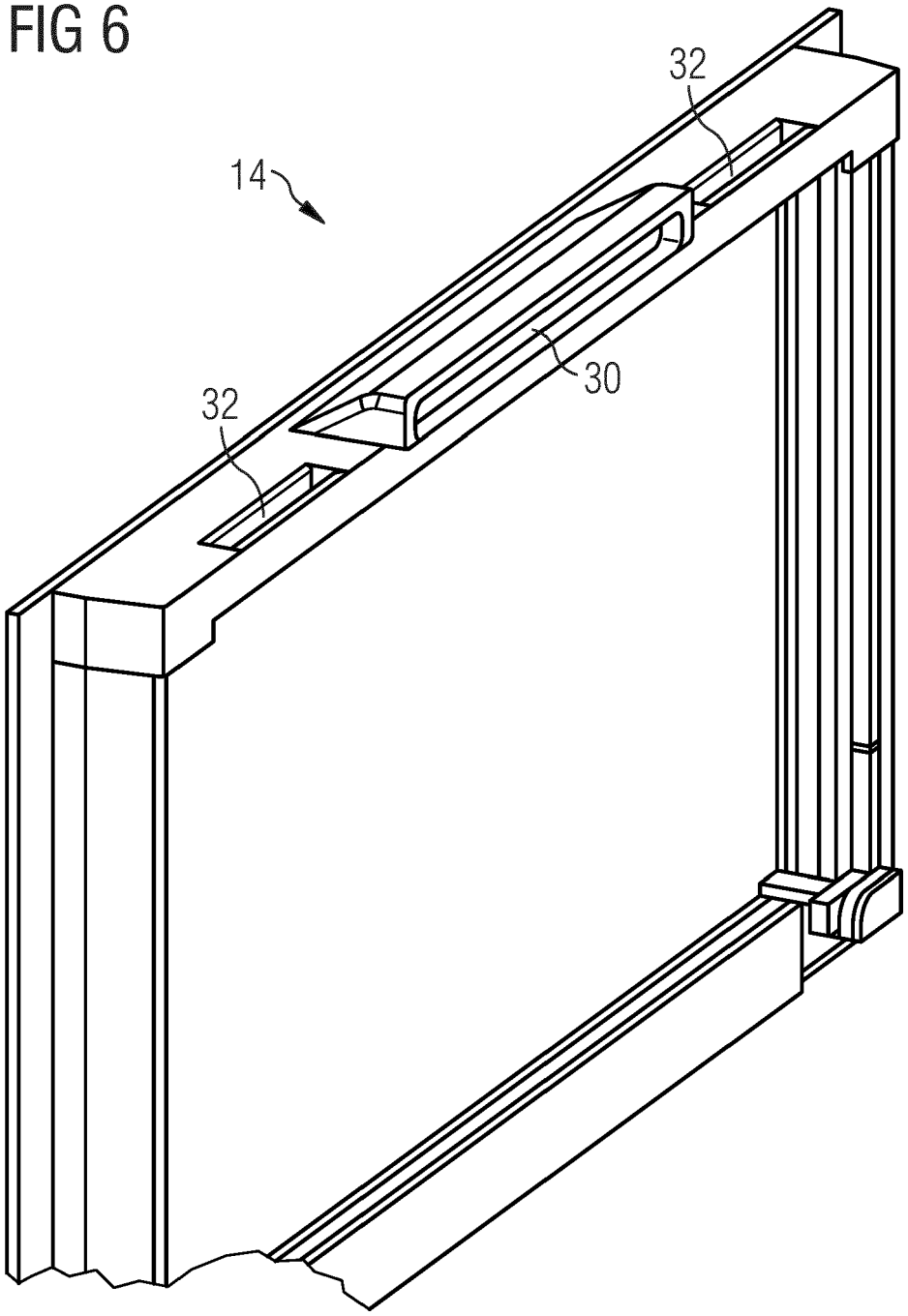


FIG 7

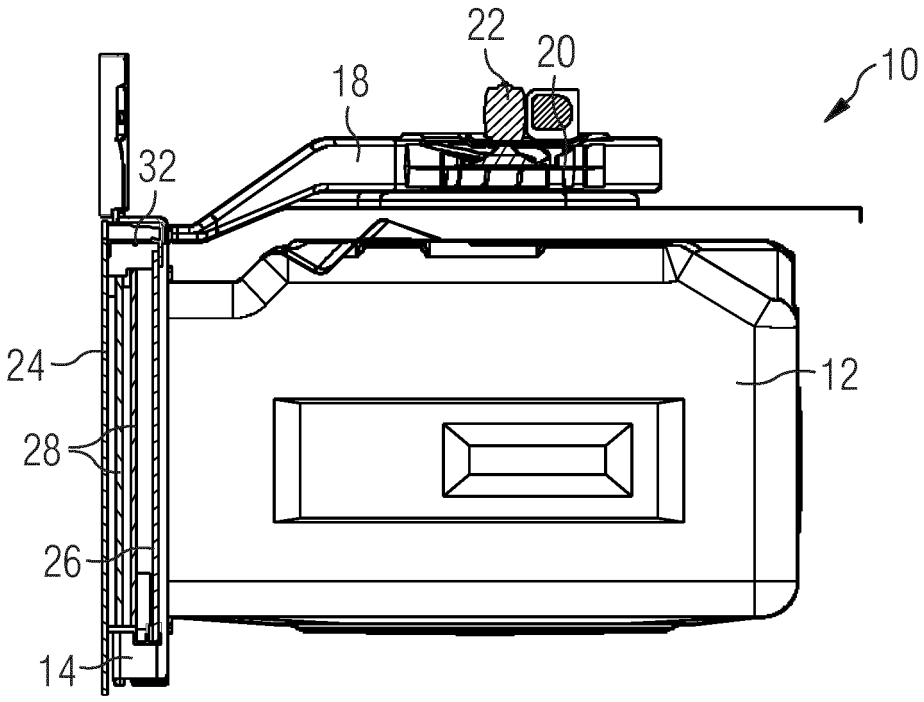
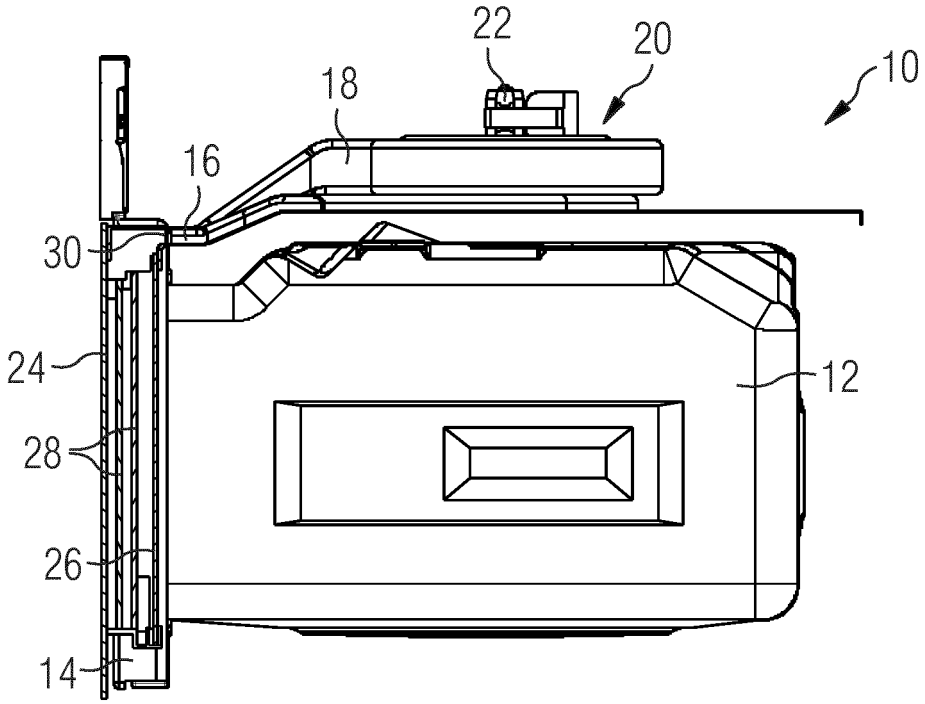


FIG 8



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EUROPEAN SEARCH REPORT

Application Number
EP 16 20 2607

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	EP 0 964 208 A1 (EUROP EQUIP MENAGER [FR]) 15 December 1999 (1999-12-15) * figures 1-6 * * paragraphs [0008] - [0018] *	1,3-15	INV. F24C15/04 F24C15/32
X	US 2011/214661 A1 (HYUN JONG HAK [KR] ET AL) 8 September 2011 (2011-09-08) * figures 1-6 * * paragraphs [0037] - [0041], [0049] *	1-5,8-15	
X	EP 2 333 424 A1 (ELECTROLUX HOME PROD CORP [BE]) 15 June 2011 (2011-06-15) * figures 1,2 * * paragraphs [0025] - [0029] *	1,3,6, 8-10,15	
X	GB 2 401 932 A (BRANDT IND [FR]) 24 November 2004 (2004-11-24) * figure 1 * * page 5, line 8 - page 8, line 4 *	1,2,15	
X	EP 2 567 632 A1 (PANASONIC CORP [JP]) 13 March 2013 (2013-03-13) * figure 1 * * paragraphs [0023], [0024] *	1	TECHNICAL FIELDS SEARCHED (IPC) F24C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	11 May 2017	Moreno Rey, Marcos

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 20 2607

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
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