



- (51) **International Patent Classification:**
B29C 44/58 (2006.01) *B29C 33/00* (2006.01)
F16J 13/00 (2006.01)
- (21) **International Application Number:** PCT/EP2014/068391
- (22) **International Filing Date:** 29 August 2014 (29.08.2014)
- (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,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

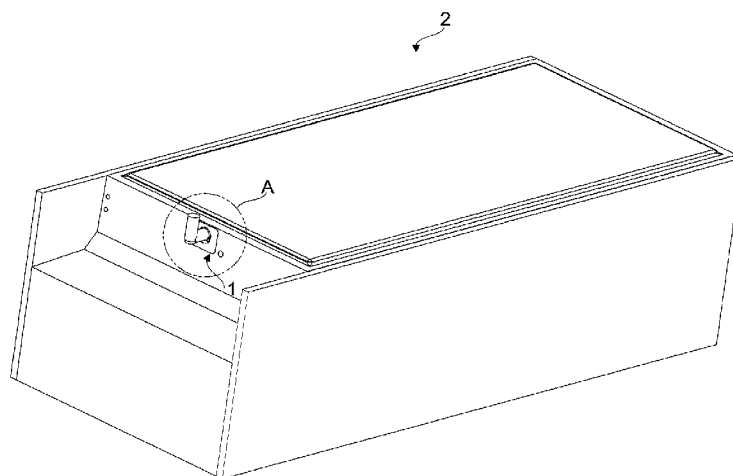
- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) **Title:** IMPROVED FOAM INJECTION PLUG ASSEMBLY FOR USE IN A REFRIGERATION APPLIANCE

Fig. 1



(57) **Abstract:** The present invention relates to a foam injection plug assembly (1) for use in a refrigeration appliance (2) comprising an inner case and an outer case (3). The outer case (3) has an aperture (4) for injecting liquid foam into the intermediate region (5) between the inner case and the outer case (3).

Description**IMPROVED FOAM INJECTION PLUG ASSEMBLY FOR USE IN A REFRIGERATION APPLIANCE**

- [0001] The present invention relates to a refrigeration appliance, in particular in a domestic refrigerator which includes a thermal insulation layer made of foam material such as polyurethane and a method of manufacturing such refrigeration appliance. The present invention more particularly relates to a foam injection plug assembly for injecting liquid foam material during the manufacturing process of the refrigeration appliance.
- [0002] In general, the energy efficiency of a refrigeration appliance is influenced by several factors. One important factor is the thermal insulation of the refrigeration appliance. Several techniques are known for thermally insulating a refrigeration appliance. In a commonly known technique, when manufacturing the refrigeration appliance, liquid foam material, in particular polyurethane is injected with an injection head into the intermediate region between the outer case and the inner case of the refrigeration appliance through an injection aperture formed on the outer case. After completion of the curing process, the foam material provides a thermal insulation layer.
- [0003] During the curing process of the foam material, the air inside the intermediate region is generally allowed to escape to the outside through an air escape opening that is typically formed into the outer case. The air escape opening is usually at the highest location of the outer case in a state when the refrigeration appliance is positioned for filling the liquid foam material into the intermediate region. To prevent the curing foam material from leaking to the outside through the air escape opening, an air permeable material such as a sponge is generally placed in front of the air escape opening. The sponge is usually fixed to the air escape opening by utilizing adhesives. The sponge allows the air to escape to the outside while keeping the curing foam material inside the intermediate region. To prevent the foam material from leaking through the injection aperture to the outside during the curing process, a flexible leaf is usually plugged onto the injection aperture.

- [0004] A drawback of the above-mentioned conventional technique is that during the curing process, the foam material may occasionally leaks through the injection aperture to the outside. Consequently, the amount of foam material filled into intermediate region will not be sufficient for a proper insulation. Such a refrigeration appliance has an inferior quality and becomes junk. Moreover, such production errors and production wastes increase the overall costs per refrigeration appliance.
- [0005] JPH07237230 (A) discloses a prior art refrigerator. This prior art refrigerator comprises an inner case and an outer case which includes an injection aperture for injecting foam material into the space between the inner case and the outer case. In this prior art refrigerator, the injection aperture is closed by a flexible leaf.
- [0006] An objective of the present invention is to provide a foam injection plug assembly and a refrigeration appliance having the same which overcomes the aforementioned drawbacks of the prior art in a cost effective way and which has an improved reliability. Another objective of the present invention is to provide a method of manufacturing a refrigeration appliance using the plug assembly of the present invention.
- [0007] These objectives have been achieved by the foam injection plug assembly as defined in claim 1, the refrigeration appliance as defined in claim 8 and the manufacturing method of as defined in claim 10. Further achievements have been attained by the subject-matters respectively defined in the dependent claims.
- [0008] The foam injection plug assembly of the present invention comprises a frame which is attachable to the outer case around the aperture, a pivotable lid which is hinged to the frame and configured to pivotably move within the intermediate region between a first position where the aperture is leak-tightly closed and a second position where the aperture is opened and a spring element which is attached to the frame and configured to abut against the rear surface of the lid, which is averted from the foam injection direction so as to bias the lid to the first position.
- [0009] In an embodiment, the frame is a two-piece component. The inner and outer pieces cover opposite sides of the outer case around the aperture.

Each piece has an opening which faces the aperture. These openings and the aperture define a foam injection passage for the injection head. In a version of this embodiment, the inner and outer pieces have parts which interlock through cut-outs formed in the outer case. Thereby, the frame can be easily and firmly connected with each other and assembled with the outer case. In another version of this embodiment, the interlocking parts have claws and snap slots which face each other.

- [0010] In an alternative embodiment, the inner piece and the outer piece of the frame are assembled with the outer case by an adhesive. In another alternative embodiment, the two pieces of the frame are assembled with the outer case by screws or the like.
- [0011] In another embodiment, the spring element is mountable to a retainer formed on the inner piece of the frame. In this embodiment, the lid is integrally formed with the inner piece of the frame. A straight groove formed on the inner piece of the frame functions as a hinge for pivoting the lid. In a version of this embodiment, an elastically deformable metal clip is used as a spring element. The ends of the clip are retained by a pair of slots formed on the inner piece of the frame. In this embodiment, the clip has a raised portion which remains permanently in contact with the rear surface of the lid.
- [0012] In another embodiment, the contour of the foam injection passage matches the periphery of the injection head. In a version of this embodiment, the passage is substantially round shaped.
- [0013] With the present invention, in particular by virtue of the foam injection plug assembly, the curing foam material can be prevented from leaking to the outside and a proper thermal insulation capacity can be attained. Thereby, also the production wastes and the production errors due to leakage of the foam material have been eliminated or reduced as much as possible. With the present invention, a cost effective injection technique has been attained both in view of material and labor. With the foam injection plug assembly of the present invention, also the moisture is prevented from diffusing into the refrigeration appliance through the injection aperture. Thereby, the cured foam material can be permanently maintained in a

proper condition and the thermal insulation capacity thereof is prevented from degrading over time. With the present invention, the consumer satisfaction can be increased.

- [0014] Additional advantages of the foam injection plug assembly according to the present invention, the refrigeration appliance according to the present invention and the method of manufacturing the refrigeration appliance according to the present invention will become apparent with the detailed description of the embodiments with reference to the accompanying drawings in which:
- [0015] Figure 1 – is a schematic perspective view of the domestic refrigerator which has a foam injection plug assembly according to an embodiment of the present invention;
- [0016] Figure 2 – is a schematic perspective enlarged view of the detail A of Fig. 1;
- [0017] Figure 3 – is a schematic partial side view of the domestic refrigerator which has the foam injection plug assembly according to an embodiment of the present invention, wherein the liquid foam injection passage is leak-tightly closed by the pivotable lid prior to inserting the liquid foam injection head into the passage;
- [0018] Figure 4 – is a schematic partial side view of the domestic refrigerator which has the foam injection plug assembly according to an embodiment of the present invention, wherein the liquid foam injection passage is opened after having inserted the liquid foam injection head into the passage;
- [0019] Figure 5 – is a schematic partial perspective exploded view of the domestic refrigerator which has the foam injection plug assembly as shown in Fig. 1;
- [0020] Figure 6 – is a schematic perspective exploded view of the foam injection plug assembly as shown in Fig. 1, wherein the liquid foam injection head is omitted;
- [0021] Figure 7 – is another schematic perspective exploded view of the foam injection plug assembly as shown in Fig. 1, wherein the liquid foam injection head is omitted;

- [0022] Figure 8 – is schematic perspective view of the inner cover of the foam injection plug assembly according to an embodiment of the present invention;
- [0023] Figure 9 – is a schematic perspective enlarged view of the detail B of Fig. 8;
- [0024] Figure 10 – is a schematic front view of the spring element of the foam injection plug assembly according to an embodiment of the present invention;
- [0025] Figure 11 – is schematic perspective view of the outer cover of the foam injection plug assembly according to an embodiment of the present invention;
- [0026] Figure 12 – is a schematic perspective enlarged view of the detail C of Fig. 11;
- [0027] Figure 13 – is a schematic rear view of the foam injection plug assembly according to an embodiment of the present invention, wherein the outer case is omitted;
- [0028] Figure 14 – is a schematic sectional view of the foam injection plug assembly of Fig. 13, taken along the line D-D;
- [0029] Figure 15 – is a schematic enlarged view of the detail F of Fig. 14;
- [0030] Figure 16 – is a schematic sectional view of the foam injection plug assembly of Fig. 13, taken along the line E-E.
- [0031] The reference signs appearing on the drawings relate to the following technical features.
1. Plug assembly
 2. Refrigeration appliance
 3. Outer case
 4. Aperture
 5. Intermediate region
 6. Frame
- [0032] 6a. Inner cover
- 6b. Outer cover
- [0033] 7. Lid
- [0034] 8. Spring element

- [0035] 9. First opening
- [0036] 10. Second opening
- [0037] 11. Cut-out
- [0038] 12a. Connector
12b. Counterpart connector
13a. Snap slot
13b. Claw
- [0039] 14. Retainer
- [0040] 15. Clip
- [0041] 16a. End
- [0042] 16b. End
- [0043] 17a. Mounting slot
17b. Mounting slot
- [0044] 18. Raised portion
- [0045] 19. Injection head
- [0046] The foam injection plug assembly (1) is suitable for use in a refrigeration appliance (2), in particular a domestic refrigerator (2) (Fig. 1 to 10).
- [0047] The domestic refrigerator (2) comprises an inner case (not shown) and an outer case (3). The inner case forms the refrigeration compartment (not shown). The outer case (3) encloses at least partly the inner case. The outer case (3) has an aperture (4) which defines a passage for injecting liquid foam material into the intermediate region (5) between the inner case and the outer case (3).
- [0048] The foam injection plug assembly (1) of the present invention further comprises a frame (6) which is attachable to the outer case (3) around the aperture (4), a pivotable lid (7) which is hinged to the frame (6) and configured to move within the intermediate region (5) between a first position where the aperture (4) is leak-tightly closed and a second position where the aperture (4) is opened and a spring element (8) which is attached to the frame (6) and configured to abut against the rear surface of the lid (7), which is averted from the foam injection direction so as to bias the lid (7) to the first position.
- [0049] The domestic refrigerator (2) of the present invention comprises the foam

injection plug assembly (1) according to the present invention.

- [0050] In an embodiment, the frame (6) comprises an inner cover (6a) and an outer cover (6b) which together sandwich the outer case (3). The inner cover (6a) has a first opening (9). The outer cover (6b) has a second opening (10). The first opening (9), the aperture (4) and the second opening (10) define the passage for injecting the liquid foam material into the intermediate region (5). The inner cover (6a) is configured to leak-tightly abut against the inner surface of the outer case (3) such that the first opening (9) fluidly communicates with the aperture (4). The outer cover (6b) is configured to leak-tightly abut against the outer surface of the outer case (3) such that the second opening (10) fluidly communicates with the aperture (4).
- [0051] In a version of this embodiment, the inner cover (6a) has one or more than one connector (12a) and the outer cover (6b) has one or more than one counterpart connector (12b) for releasably engaging with the corresponding connector (12a). The connector (12a) and the counterpart connector (12) releasably engage through a corresponding cut-out (11) formed into the outer case (3).
- [0052] In another version of this embodiment, the connector (12a) has a snap slot (13a) and the counterpart connector (12b) has a corresponding claw (13b). The claw (13b) snap-fittingly engages with the snap slot (13a).
- [0053] In another version of this embodiment, the inner cover (6a) has a retainer (14) for detachably mounting the spring element (8). The pivotable lid (7) is integrally formed with the inner cover (6a).
- [0054] In another version of this embodiment, the spring element (8) comprises an elastically deformable u-shaped clip (15). The clip (15) has an arc-shaped raised portion (18) which abuts against the rear surface of the lid (7). The opposing ends (16a, 16b) of the clip (15) are insertable into opposing mounting slots (17a, 17b) of the retainer (14).
- [0055] In another embodiment, the foam injection plug assembly (1) further comprises a liquid foam injection head (19) for inserting into the passage so as to inject liquid foam material into the intermediate region (5). The periphery of the injection head (19) form-fittingly matches the contour of

the passage.

[0056] In another embodiment, the outer case (3) is at least partly made of paper or the like.

[0057] The present invention also provides a method of manufacturing the refrigeration appliance (2), in particular the domestic refrigerator (2) by utilizing the foam injection plug assembly (1) of the present invention. In the method of the present invention, the foam injection plug assembly (1) is assembled with the refrigeration appliance (2), in particular with the outer case (3). Then, the liquid foam injecting head (19) is inserted into the passage and a predetermined amount of liquid foam material is injected into the intermediate region (5). Thereafter, the liquid foam injecting head (19) is removed.

[0058] With the present invention, in particular by virtue of the foam injection plug assembly (1), the curing foam material can be prevented from leaking to the outside and a proper thermal insulation capacity can be attained. Thereby, also the production wastes and the production errors due to leakage of the foam material have been eliminated or reduced as much as possible. With the present invention, a cost effective injection technique has been attained both in view of material and labor. With the present invention, in particular by virtue of the foam injection plug assembly (1) the moisture can be prevented from diffusing into the refrigeration appliance (2) through the injection aperture (4). Thereby, the cured foam material can be permanently maintained in a proper condition and the thermal insulation capacity thereof is prevented from degrading over time. With the present invention, the consumer satisfaction can be increased.

Claims

1. A foam injection plug assembly (1) for use in a refrigeration appliance (2), in particular a domestic refrigerator (2) comprising an inner case which forms a refrigeration compartment and an outer case (3) which encloses at least partly the inner case, wherein the outer case (3) has an aperture (4) which defines a passage for injecting liquid foam material into the intermediate region (5) between the inner case and the outer case (3),
characterized in that
 - a frame (6) which is attachable to the outer case (3) around the aperture (4),
 - a pivotable lid (7) which is hinged to the frame (6) and configured to pivotably move within the intermediate region (5) between a first position where the aperture (4) is leak-tightly closed and a second position where the aperture (4) is opened and
 - a spring element (8) which is attached to the frame (6) and configured to abut against the rear surface of the lid (7), which is averted from the foam injection direction so as to bias the lid (7) to the first position.
2. The foam injection plug assembly (1) according to claim 1, **characterized in that**
the frame (6) comprising
 - an inner cover (6a) which has a first opening (9), wherein the inner cover (6a) is configured to leak-tightly abut against the inner surface of the outer case (3) such that the first opening (9) fluidly communicates with the aperture (4) and
 - an outer cover (6b) which has a second opening (10), wherein the outer cover (6b) is configured to leak-tightly abut against the outer surface of the outer case (3) such that the second opening (10) fluidly communicates with the aperture (4), wherein the first opening (9), the aperture (4) and the second opening (10) define the passage for injecting the liquid foam material into the intermediate region (5).
3. The foam injection plug assembly (1) according to claim 2, **characterized in that** the outer case (3) has one or more than one cut-out (11), the inner cover (6a) has one or more than one connector (12a) and the outer cover (6b) has one or more than one counterpart connector (12b) for releasably engaging with the corresponding connector (12a) through the corresponding cut-out (11).

4. The foam injection plug assembly (1) according to claim 3, **characterized in that** the connector (12a) has a snap slot (13a) and the counterpart connector (12b) has a corresponding claw (13b), wherein the claw (13b) snap-fittingly engages with the snap slot (13a).
5. The foam injection plug assembly (1) according to any one of claims 2 to 4, **characterized in that** the inner cover (6a) has a retainer (14) for detachably attached the spring element (8) and the pivotable lid (7) is integrally formed with the inner cover (6a).
6. The foam injection plug assembly (1) according to claim 5, **characterized in that** the spring element (8) comprises an elastically deformable u-shaped clip (15), wherein the opposing ends (16a,16b) of the clip (15) are insertable into opposing mounting slots (17a,17b) of the retainer (14) and wherein the clip (15) has an arc-shaped raised portion (18) which abuts against the rear surface of the lid (7).
7. The foam injection plug assembly (1) according to any one of claims 1 to 6, **characterized in that** a liquid foam injection head (19) for inserting into the passage so as to inject liquid foam material into the intermediate region (5), wherein the periphery of the injection head (19) form-fittingly matches the contour of the passage.
8. A domestic refrigerator (2) comprising
 - an inner case which forms a refrigeration compartment and
 - an outer case (3) which encloses at least partly the inner case, wherein the outer case (3) has an aperture (4) which defines a passage for injecting liquid foam material into the intermediate region (5) between the inner case and the outer case (3),**characterized in that**
a foam injection plug assembly (1) as defined in any one of claims 1 to 7.
9. The domestic refrigerator (2) according to claim 8, **characterized in that** an outer case (3) is at least partly made of paper or the like.
10. A method of manufacturing a refrigeration appliance (2), in particular a domestic refrigerator (2) as defined in claim 8 or 9, the method being characterized by comprising:
 - a step of assembling the foam injection plug assembly (1) as defined in any

one of claims 1 to 7 with the refrigeration appliance (2),
- a step of inserting the liquid foam injecting head (19) into the passage and filling a predetermined amount of liquid foam material into the intermediate region (5) and
a step of removing the liquid foam injecting head (19).

Fig. 1

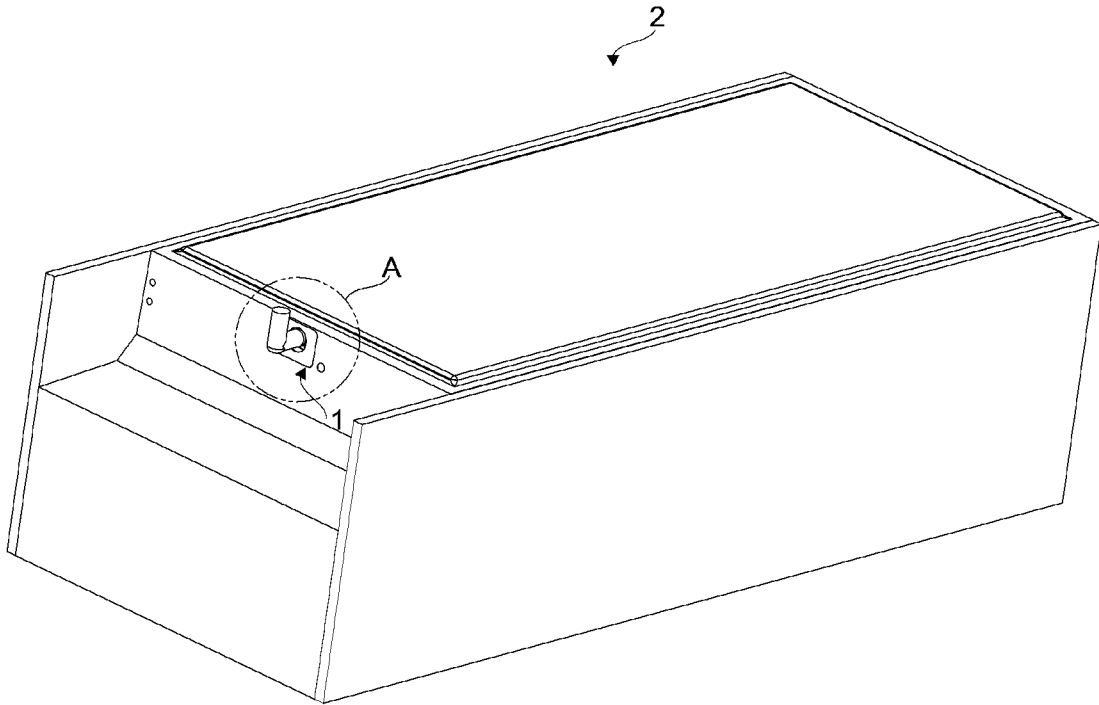


Fig. 2

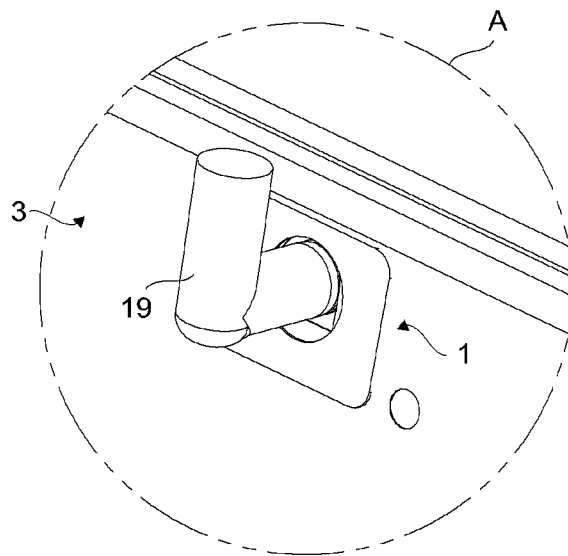


Fig. 3

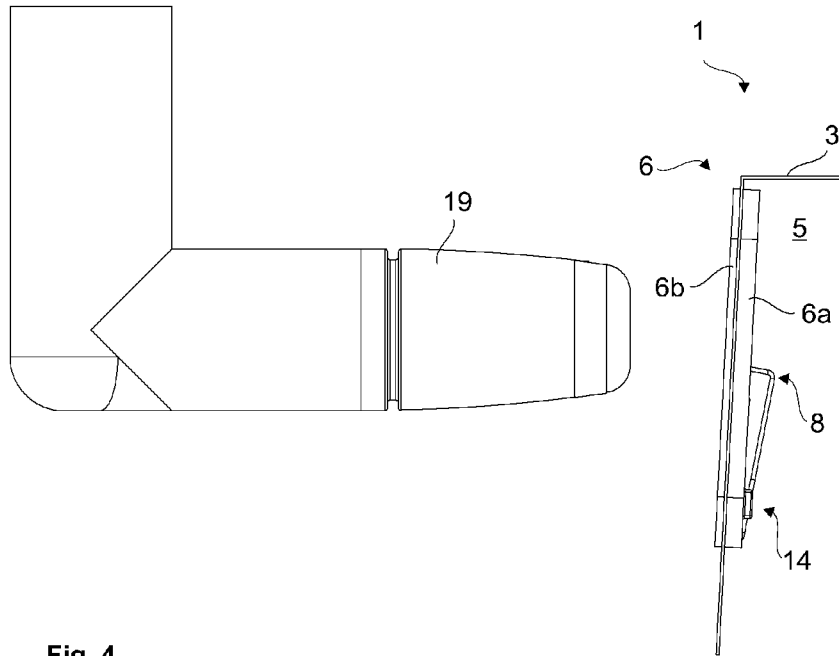


Fig. 4

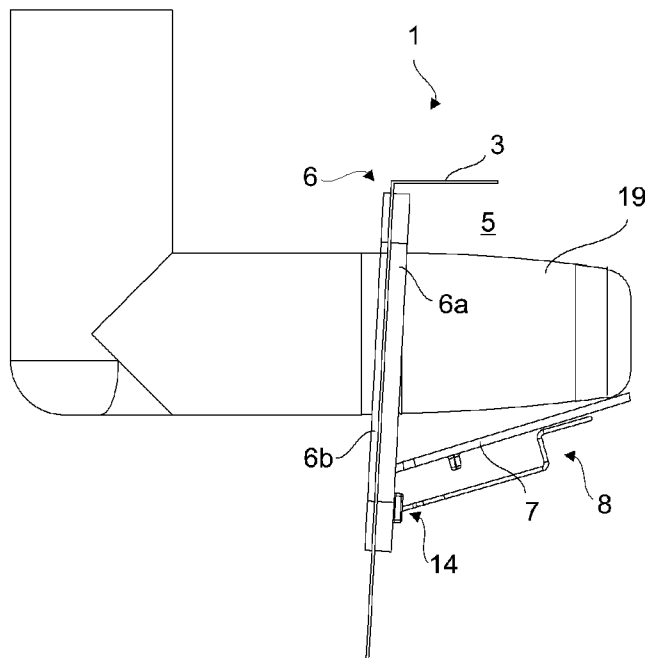


Fig. 5

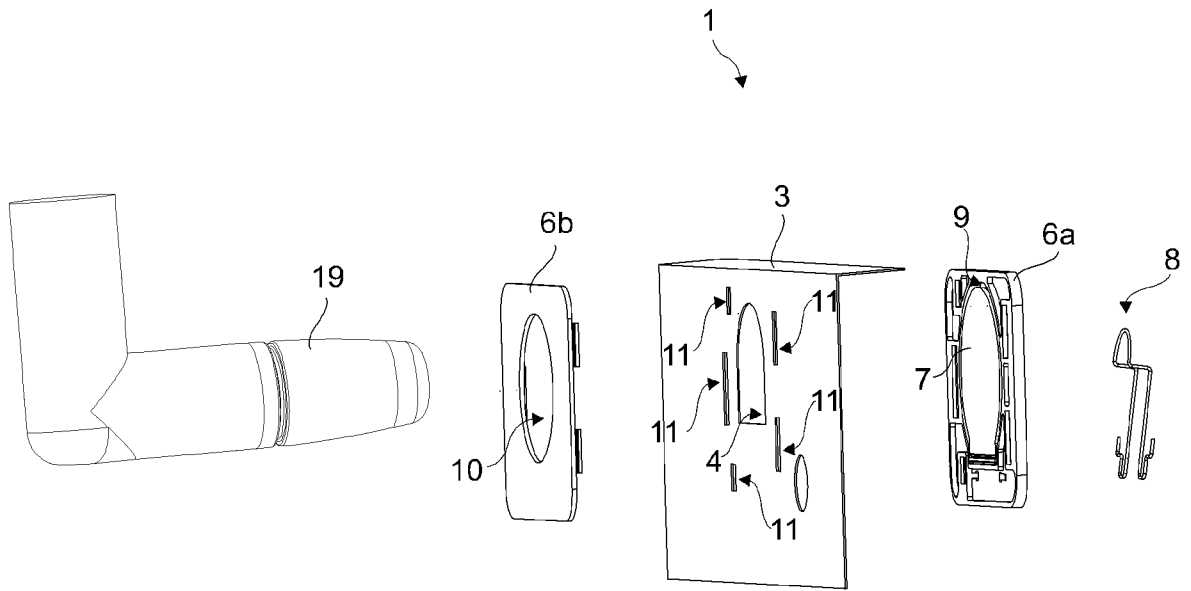


Fig. 6

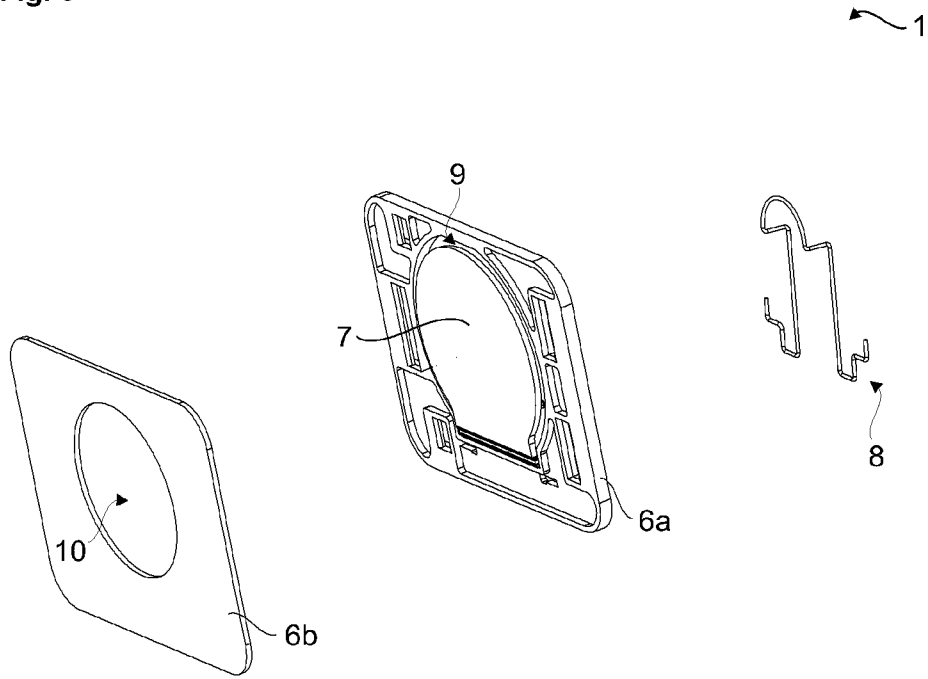


Fig. 7

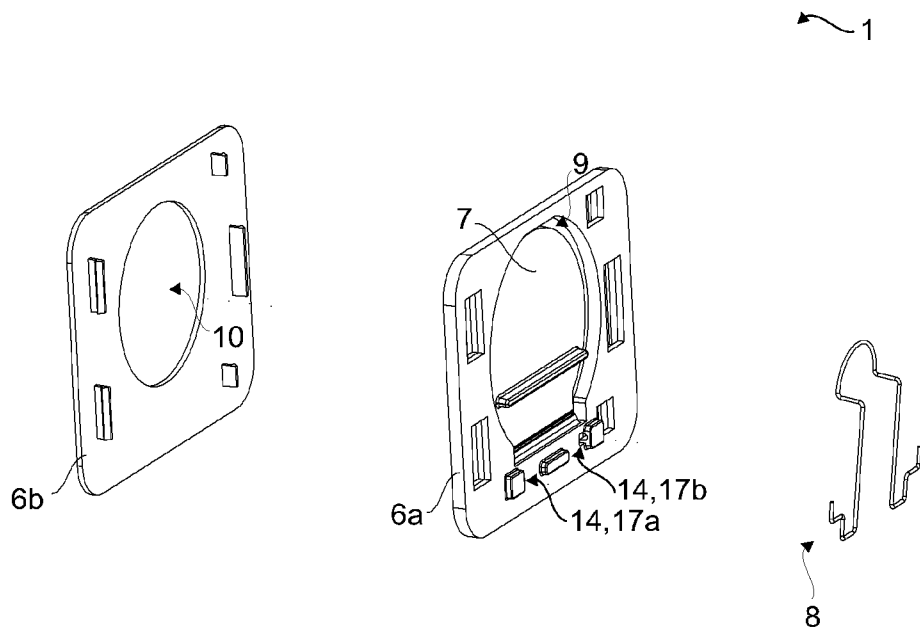


Fig. 8

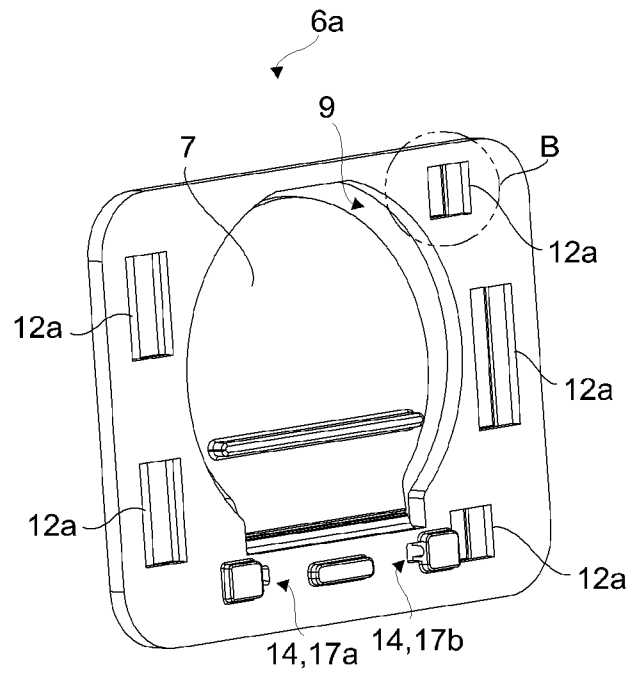


Fig. 9

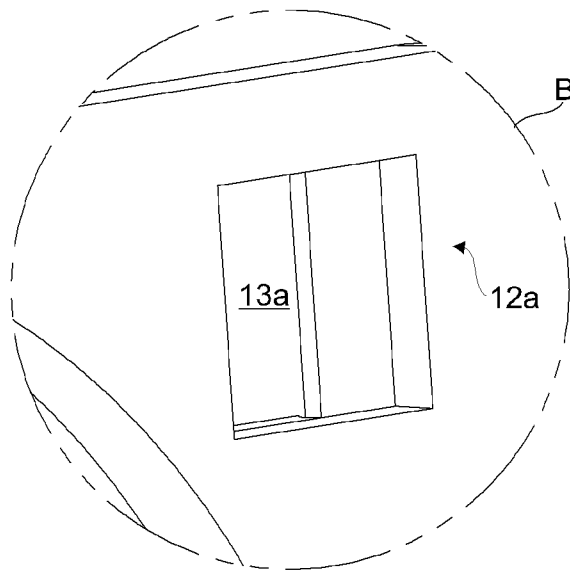


Fig. 10

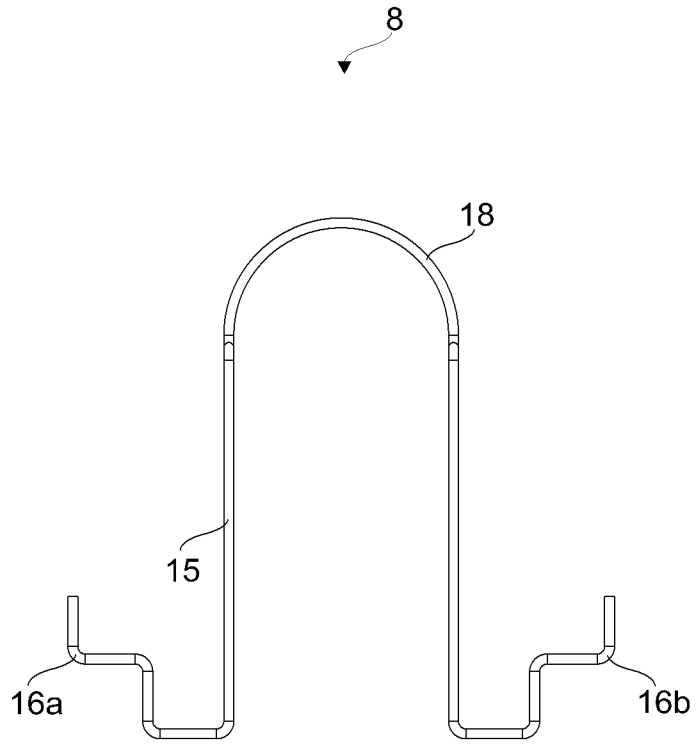


Fig. 11

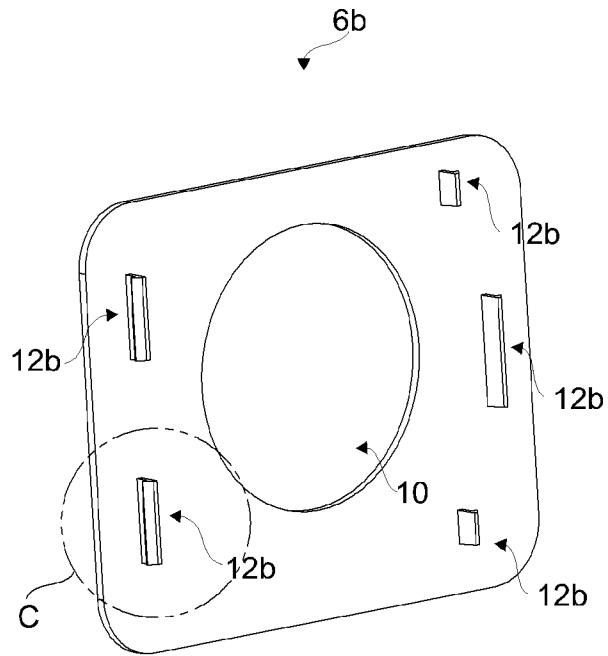


Fig. 12

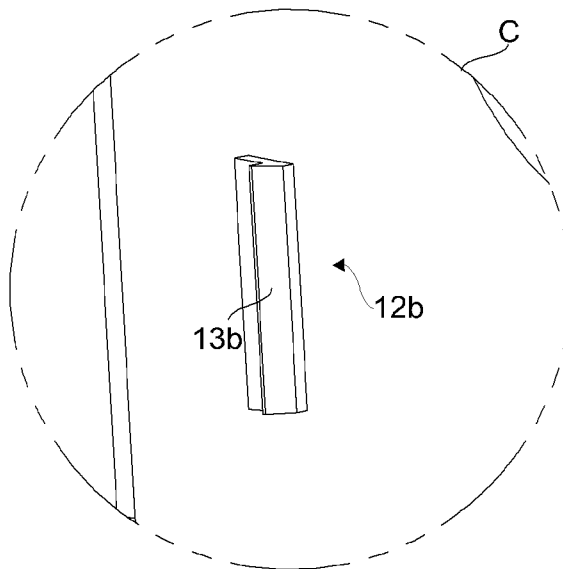


Fig. 13

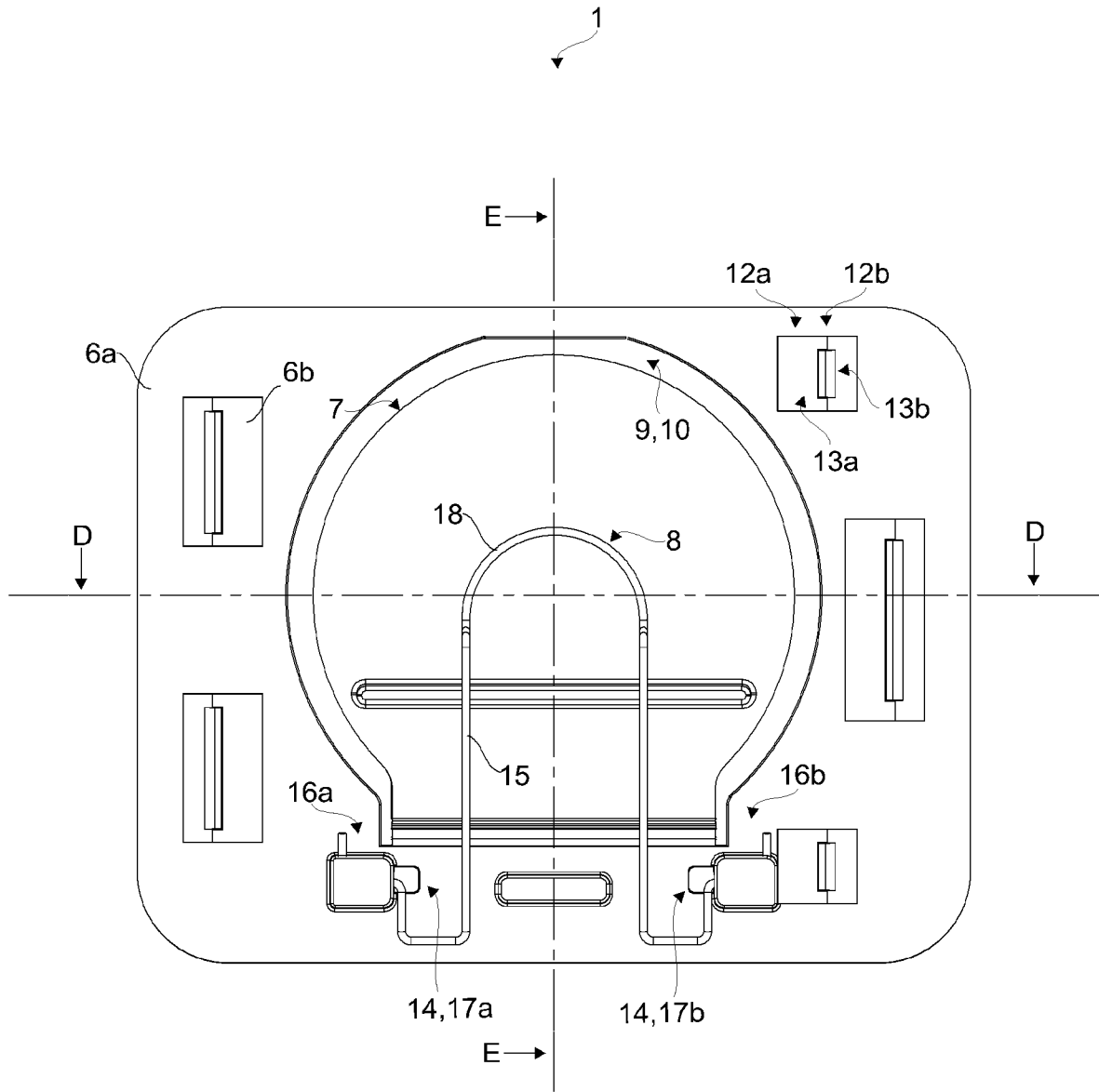


Fig. 14

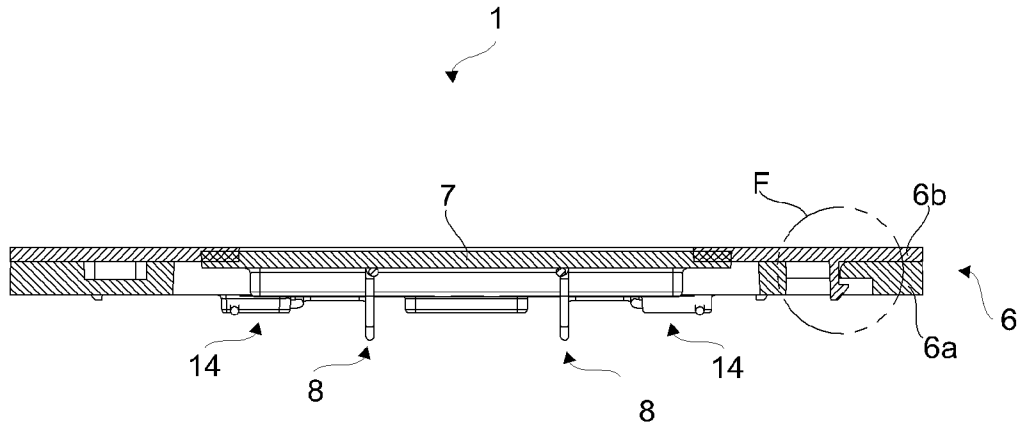


Fig. 15

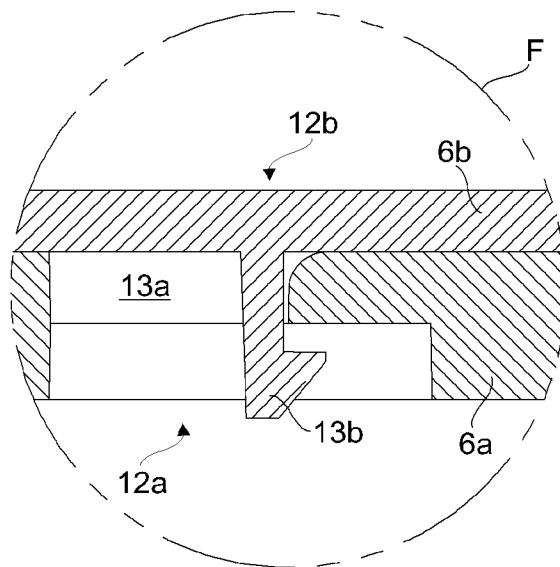
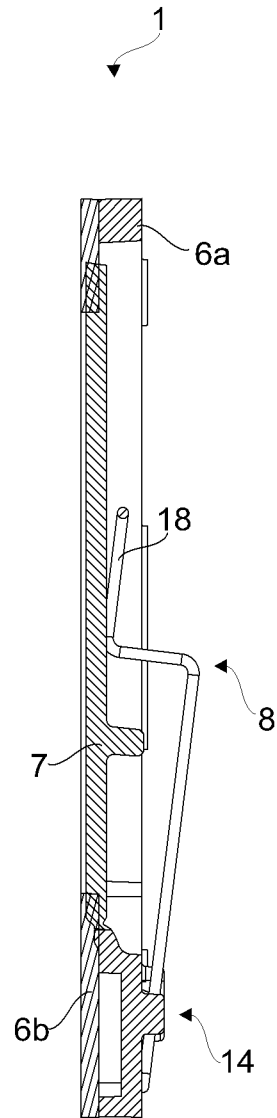


Fig. 16



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/068391

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29C44/58 F16J13/00 B29C33/00
ADD.
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)
B29C F16J F25D

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 practicable, search terms used)
EPO-Internal, 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 A	DE 78 26 431 U1 (BOSCH SIEMENS HAUSGERAETE [DE]) 21 December 1978 (1978-12-21) page 2, paragraph 1 page 5, paragraph 4 - page 7, paragraph 3 -----	1,2,8-10 3-7
Y A	DE 198 25 980 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 16 December 1999 (1999-12-16) column 2, line 9 - column 3, line 43; figures 1-5 -----	1,8-10 2-7
Y A	JP H09 220724 A (INOUE MTP KK) 26 August 1997 (1997-08-26) abstract; figures 1-6 -----	1,2,8-10 3-7
Y A	US 3 478 922 A (MOLE PHILIP J) 18 November 1969 (1969-11-18) column 2, lines 62-70; figure 4 -----	1,2,8-10 3-7
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search 28 May 2015	Date of mailing of the international search report 08/06/2015
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Molenaar, David
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/068391

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/068391

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