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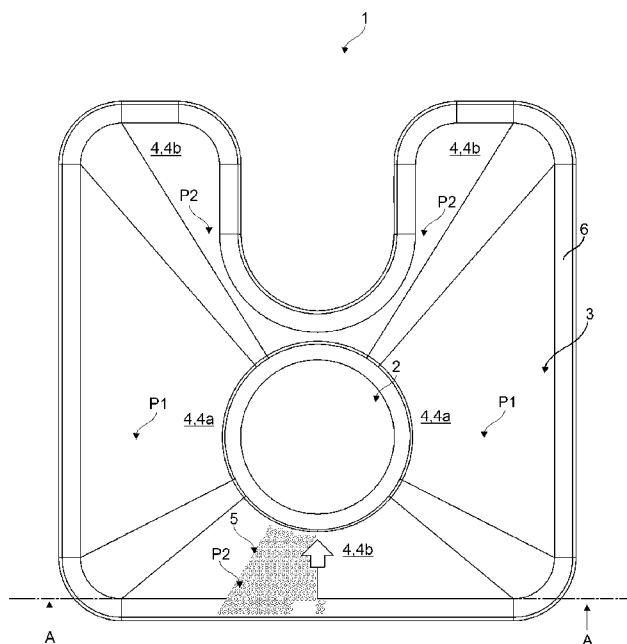
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(54) Title: FINE FILTER WITH IMPROVED FILTRATION PERFORMANCE FOR USE IN A DISHWASHER AND DISHWASHER HAVING THE SAME

Fig. 1



(57) Abstract: The present invention relates to a fine filter (1) for use in a dishwasher. The fine filter (1) comprises an aperture (2) for removably attaching a filter assembly which includes a coarse filter and a micro filter and a filter surface (3) for filtering a wash fluid. In the fine filter (1) of the present invention the filter surface (3) has plurality of regions (4, 4a, 4b) which are circumferentially arranged around the aperture (2).

Description**FINE FILTER WITH IMPROVED FILTRATION PERFORMANCE FOR USE IN A DISHWASHER AND DISHWASHER HAVING THE SAME**

- [0001] The present invention relates to a fine filter for filtering a wash fluid in a dishwasher. The present invention particularly relates to a fine filter which has an aperture for inserting a filter assembly which includes a coarse filter and a micro filter.
- [0002] A dishwasher generally includes a hydraulic circuit for circulating the wash fluid inside a washing tub. The hydraulic circuit includes a sump which is provided on a bottom of the washing tub and a pump which conveys the wash fluid collected in the sump to the spray arms by means of conduits. The spray arms direct the pressurized wash fluid towards the articles on the racks. The wash fluid resolves the dirt from the articles and drains down together with the resolved dirt along the side walls into the sump. To avoid recirculation of the dirt by the hydraulic circuit, a fine filter must be arranged on a bottom of the washing tub which completely covers the sump.
- [0003] The fine filter has a filter surface and a plurality of fine openings formed into the filter surface which allows the wash fluid to drain into the sump. The filter surface is usually inclined. The coarse dirt which cannot pass through the fine openings flows along the filter surface into the filter assembly where it is eventually trapped. The coarse dirt must be manually removed by a user after termination of the washing course.
- [0004] A proper functioning of the hydraulic circuit depends on the performance of the fine filter. If the filter is too fine, the openings start to get clogged and the flow of wash fluid into the sump is reduced. Thus, the circulation of the wash fluid via the pump and the spray arms is eventually impaired. Due to the unstable flow of the wash fluid, an auto-protective mechanism shuts the heater off and an efficiency of the heating process also degrades. If the filter is too coarse, the dirt is drained together with the wash fluid into the sump and recirculated via the pump and the spray arms. In either of the above-described cases, the articles cannot be effectively washed.
- [0005] US 2012/0024768 A1 discloses a flat funnel-type fine filter element which

covers a sump of a dishwasher. The flat funnel-type filter element has an insertion opening into which a hollow cylindrical pot-type coarse filter is inserted.

[0006] An objective of the present invention is to provide a filter for use in a dishwasher, which overcomes the aforementioned drawbacks of the prior art and which enables improved filtration of dirt from the wash fluid.

[0007] This objective has been achieved by the filter according to the present invention as defined in claim 1, and the dishwasher according to the present invention as defined in claim 15. Further achievements have been attained by the subject-matters respectively defined in the dependent claims.

[0008] In the fine filter of the present invention, the filter surface has a plurality of regions which are circumferentially arranged around the aperture. The plurality of regions includes a first region and a second region into which a plurality of openings are respectively formed. In the fine filter of the present invention, a material thickness of the first region is different from the material thickness of the second region and/or a percentage of an open area of the entire first region is different from a percentage of an open area of the entire second region.

[0009] In an embodiment, the material thicknesses of the regions are not greater than 1.2 mm respectively.

[0010] In another embodiment, the percentages of open areas of the regions are not less than 40 % respectively.

[0011] In another embodiment, the openings of two or more than two regions have different sizes, in particular different diameters respectively.

[0012] In another embodiment, the openings are circular shaped respectively.

[0013] In another embodiment, the diameters of the openings are not greater than 1.2 mm respectively.

[0014] In another embodiment, the cross sections of the openings are respectively constant along a thickness direction.

[0015] In another embodiment, the center-to-center distances between the openings of two or more than two regions are different from each other.

[0016] In another embodiment, the center-to-center distances between the

openings are not greater than 1.7 mm respectively.

- [0017] In another embodiment, the openings of one or more than one region form patterns of isosceles triangles respectively.
- [0018] In another embodiment, the openings of one or more than one region form patterns of equilateral triangles respectively.
- [0019] In another embodiment, the openings of one or more than region form random patterns respectively.
- [0020] The present invention provides a fine filter which has an improved filtration performance. By virtue of the different regions of the filtering surface, the fine filter has been prevented from entirely clogging. Consequently, a continual drainage of the wash fluid into the sump can be secured. Thus, the pump can be supplied with a sufficient amount of wash fluid so that the overall circulation process performed by the hydraulic circuit can be prevented from stopping. Owing to the stable flow of the wash fluid, a protective shut-off of the heater can be prevented and the heating process can be efficiently conducted. With the fine filter of the present invention, the washing results are positively influenced.
- [0021] Additional advantages of the filter of the present invention and the dishwasher of the present invention will become apparent with the detailed description of the embodiments with reference to the accompanying drawings in which:
- [0022] Figure 1 – is a schematic top view of a fine filter according to an embodiment of the present invention, wherein the openings have been shown only partly;
- [0023] Figure 2 – is a schematic cross sectional view of the fine filter shown in Fig. 1, taken along the line A-A;
- [0024] Figure 3 – is a schematic side view of the fine filter shown in Fig.1;
- [0025] Figure 4 – is another schematic side view of the fine filter shown in Fig.1.
- [0026] The reference signs appearing on the drawings relate to the following technical features.
1. Fine filter
 2. Aperture
 3. Filter surface

4. Region

[0027] 4a. First region

[0028] 4b. Second region

[0029] 5. Opening

[0030] 6. Frame

[0031] 7. Reinforcement rib

[0032] T1: First material thickness

T2: Second material thickness

P1: First percentage of open area

P2: Second percentage of open area

[0033] The fine filter (1) is suitable for use in a dishwasher (not shown). The fine filter (1) comprises an aperture (2) for removably attaching a filter assembly which includes a coarse filter and a micro filter and a filter surface (3) for filtering a wash fluid (Figs. 1 to 4).

[0034] In the fine filter (1) of the present invention, the filter surface (3) has plurality of regions (4, 4a, 4b) which are circumferentially arranged around the aperture (2). The plurality of regions (4, 4a, 4b) comprise a first region (4a) into which a plurality of openings (5) are formed and a second region (4b) into which a plurality of openings (5) are formed. The first region (4a) has a first material thickness T1 and a first percentage of open area P1 which is defined through a total surface area of the openings (5) in the first region (4a) divided by a total surface area of the first region (4a). The second region (4b) has a second material thickness T2 and a second percentage of open area P2 which is similarly defined through a total surface area of the openings (5) in the second region (4b) divided by a total surface area of the second region (4b). T1 and T2 are different from each other and/or P1 and P2 are different from each other.

[0035] In an embodiment, the first material thickness T1 and the second material thickness T2 are not greater than 1.2 mm respectively. Reducing the material thickness increases the filtration performance. The filtration performance is effectively enhanced when the material thicknesses are equal to or lower than 1.2 mm.

[0036] In another embodiment, a first percentage of open area P1 and a second

percentage of open area P2 are not less than 40 % respectively. The filtration performance increases when the percentage of an open area is high. The filtration performance is effectively enhanced when the percentage of an open area is equal to or larger than % 35. In a version of this embodiment, all regions of the filter surface (3), including the first region (4a) and the second region (4b) have a percentage of open area which equals to 41% respectively.

- [0037] In another embodiment, the openings (5) of the first region (4a) and the openings (5) of the second region (4b) have a same shape and a same size respectively.
- [0038] In an alternative embodiment, the openings (5) of the first region (4a) and the openings (5) of the second region (4b) have a same shape but different size respectively.
- [0039] In another embodiment, the openings (5) of the first region (4a) and the openings (5) of the second region (4b) are circular shaped respectively (Fig. 1).
- [0040] In another embodiment, a diameter of the openings (5) of the first region (4a) and a diameter of the openings (5) of the second region (4b) are not greater than 1.2 mm respectively. The filtration performance is effectively enhanced when the diameter of the openings (5) is equal to or smaller than 1.2 mm.
- [0041] In another embodiment, a cross section of the openings (5) of the first region (4a) and a cross section of the openings (5) of the second region (4b) are respectively constant along a thickness direction (Fig. 2)
- [0042] In another embodiment, a center-to-center distance between the openings (5) of the first region (4a) and a center-to-center distance between the openings (5) of the second region (4b) are different from each other.
- [0043] In another embodiment, a center-to-center distance between the openings (5) of the first region (4a) and a center-to-center distance between the openings (5) of the second region (4b) are not greater than 1.7 mm respectively. There is an inverse proportional relationship between the number of openings (5) and the interspacing between the same. The number of openings (5) can be increased by reducing the distance

between the openings (5). The filtration performance is effectively enhanced when the center-to-center distance between the openings (5) is equal to or smaller than 1.7 mm.

- [0044] In another embodiment, the openings (5) of the first region (4a) and the openings (5) of the second region (4b) are arranged at the vertices of imaginary isosceles triangles respectively (Fig. 1).
- [0045] In another embodiment, the openings (5) of the first region (4a) and the openings (5) of the second region (4b) are arranged at the vertices of imaginary equilateral triangles respectively.
- [0046] In another embodiment, the openings (5) of the first region (4a) and the openings (5) of the second region (b) are randomly arranged respectively.
- [0047] In another embodiment, the fine filter (1) comprises a frame (6) and a plurality of reinforcement ribs (7) which support the filter surface (3). In this embodiment, the filter surface (3) is made from plastic.
- [0048] In another embodiment, the filter surface (3) is made from metal.
- [0049] The present invention also provides a dishwasher (not shown) comprising a washing tub, spray arms which are rotatably arranged into the washing tub, a sump for collecting wash fluid and a pump for conveying the wash fluid to the spray arms via conduits.
- [0050] The dishwasher of the present invention has a fine filter (1) which is configured to completely cover the sump.
- [0051] The present invention provides a fine filter (1) which has an improved filtration performance. By virtue of the different regions (4, 4a, 4b) of the filtering surface (3), the fine filter (1) has been prevented from entirely clogging. Consequently, a continual drainage of the wash fluid into the sump can be secured. Thus, the pump can be supplied with a sufficient amount of wash fluid so that the overall recirculation process performed by the hydraulic circuit can be prevented from degrading. Owing to the stable flow of the wash fluid a protective shut-off of the heater can be prevented and the heating process can be efficiently conducted. With the fine filter (1) of the present invention, the washing results are positively influenced.

Claims

1. A fine filter (1) for use in a dishwasher, the fine filter (1) comprising an aperture (2) for removably attaching a filter assembly which includes a coarse filter and a micro filter and a filter surface (3) for filtering a wash fluid,
characterized in that
the filter surface (3) has plurality of regions (4, 4a, 4b) which are circumferentially arranged around the aperture (2), the plurality of regions (4, 4a, 4b) including
a first region (4a) into which a plurality of openings (5) are formed and
a second region (4b) into which a plurality of openings (5) are formed,
wherein the first region (4a) has a first material thickness T1 and a first percentage of open area P1 which is defined through a total surface area of the openings (5) in the first region (4a) divided by a total surface area of the first region (4a),
wherein the second region (4b) has a second material thickness T2 and a second percentage of open area P2 which is defined through a total surface area of the openings (5) in the second region (4b) divided by a total surface area of the second region (4b), and
wherein T1 and T2 are different from each other and/or P1 and P2 are different from each other.
2. The fine filter (1) according to claim 1, **characterized in that** the first material thickness T1 and the second material thickness T2 are not greater than 1.2 mm respectively.
3. The fine filter (1) according to claim 1 or 2, **characterized in that** a first percentage of open area P1 and a second percentage of open area P2 are not less than 40 % respectively.
4. The fine filter (1) according to any one of claims 1 to 3, **characterized in that** the openings (5) of the first region (4a) and the openings (5) of the second region (4b) have a same shape and a same size respectively.
5. The fine filter (1) according to any one of claims 1 to 3, **characterized in that** the openings (5) of the first region (4a) and the openings (5) of the second region (4b) have a same shape but different size respectively.

6. The fine filter (1) according to any one of claims 1 to 5, **characterized in that** the openings (5) of the first region (4a) and the openings (5) of the second region (4b) are circular shaped respectively.
7. The fine filter (1) according to any one of claims 1 to 6, **characterized in that** a diameter of the openings (5) of the first region (4a) and a diameter of the openings (5) of the second region (4b) are not greater than 1.2 mm respectively.
8. The fine filter (1) according to any one claims 1 to 7, **characterized in that** a cross section of the openings (5) of the first region (4a) and a cross section of the openings (5) of the second region (4b) are respectively constant along a thickness direction.
9. The fine filter (1) according to any one of claims 1 to 8, **characterized in that** a center-to-center distance between the openings (5) of the first region (4a) and a center-to-center distance between the openings (5) of the second region (4b) are different from each other.
10. The fine filter (1) according to any one claims 1 to 9, **characterized in that** a center-to-center distance between the openings (5) of the first region (4a) and a center-to-center distance between of the openings (5) of the second region (4b) are not greater than 1.7 mm respectively.
11. The fine filter (1) according to any one claims 1 to 10, **characterized in that** the openings (5) of the first region (4a) and the openings (5) of the second region (4b) are arranged at the vertices of imaginary isosceles triangles respectively.
12. The fine filter (1) according to any one claims 1 to 10, **characterized in that** the openings (5) of the first region (4a) and the openings (5) of the second region (4b) are arranged at the vertices of imaginary equilateral triangles respectively.
13. The fine filter (1) according to any one claims 1 to 10, **characterized in that** the openings (5) of the first region (4a) and the openings (5) of the second region (4b) are randomly arranged respectively.
14. The fine filter (1) according to any one of claims 1 to 13, **characterized in that** a frame (6) and plurality of reinforcement ribs (7) which support the filter surface (3), wherein the filter surface (3) is made from plastic or metal.
15. A dishwasher comprising a washing tub, spray arms rotatably arranged into the washing tub, a sump for collecting a wash fluid, a pump for conveying the

wash fluid to the spray arms via conduits, **characterized in that** a fine filter (1) as defined in any one of claims 1 to 14, wherein the fine filter (1) is configured to completely cover the sump.

Fig. 1

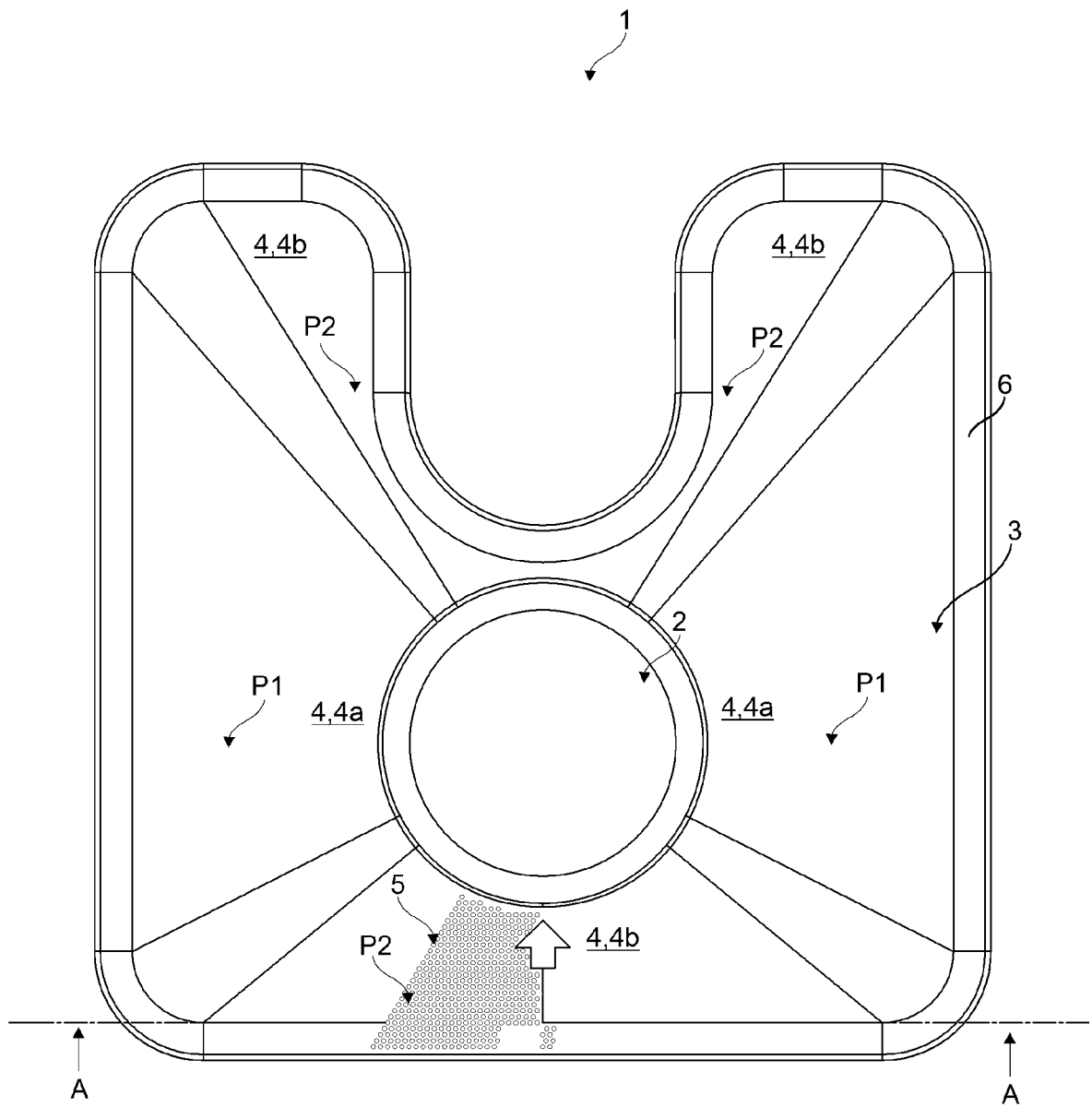


Fig. 2

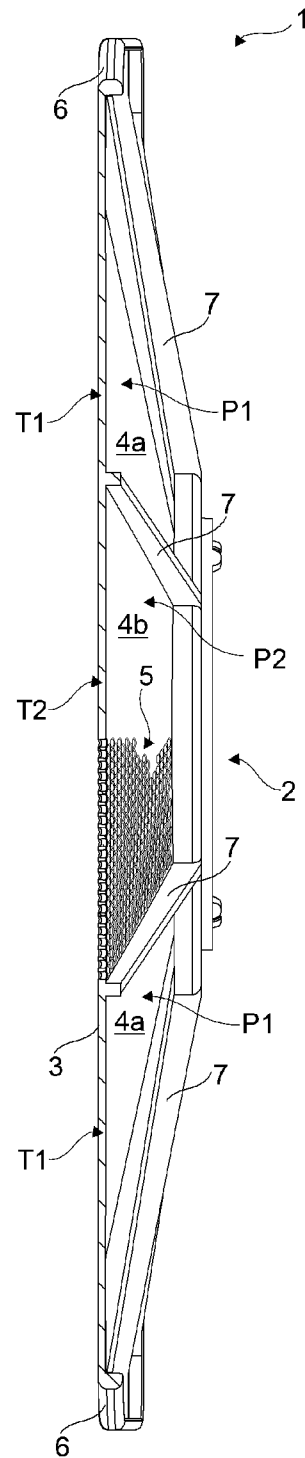


Fig. 3

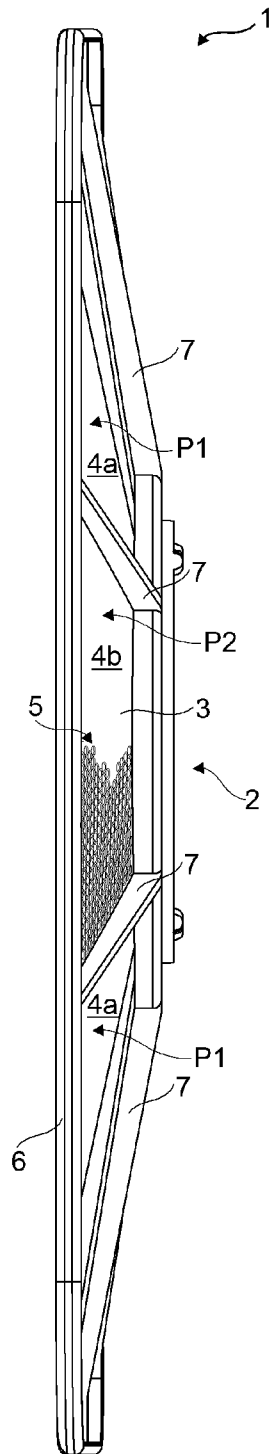
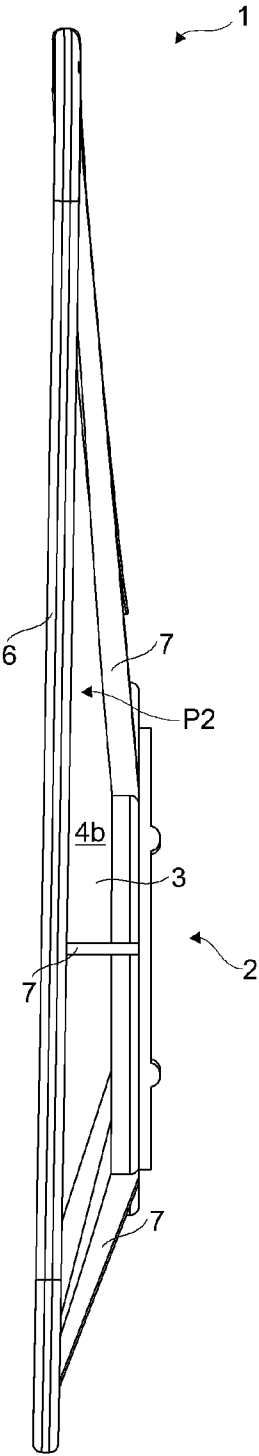


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/053931

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L15/42
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)
A47L

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

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Y	column 2, paragraph 9 - column 3, paragraph 12; figures 1-6	1,2,11, 12
X	US 2008/190464 A1 (STAHLMANN ROLF [DE] ET AL) 14 August 2008 (2008-08-14) page 1, paragraph 16 - page 2, paragraph 18; claims 1-15; figure 1	1-15
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Further documents are listed in the continuation of Box C.



See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

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13/11/2014

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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