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(54) Title: A HOUSEHOLD APPLIANCE WITH A CONTROL PANEL ASSEMBLY

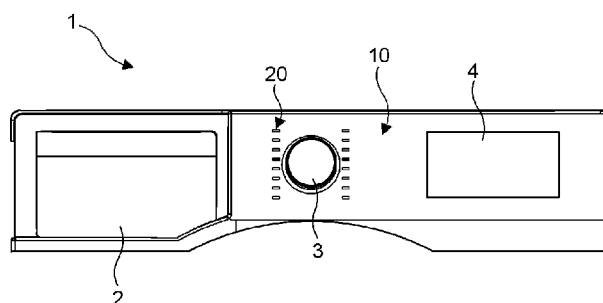


Figure1

(57) Abstract: Invention relates to a household appliance comprising a control panel assembly (10) with a front panel (11) wherein a plurality of holes (12) are arranged and a light guide (20) having rods (22) extending between each corresponding hole (12) and a light source (42) provided at a circuit board (40) attached to a base plate (25) at which the rods (22) are integrally formed.

Description**A HOUSEHOLD APPLIANCE WITH A CONTROL PANEL ASSEMBLY**

- [0001] The present invention relates to a household appliance having a control panel assembly for controlling its operation.
- [0002] Household appliances comprise control panel assemblies provided with buttons and/or knobs for allowing the user to operate the appliance and with illuminated displays aimed to inform the user on functioning aspects of the appliance. In illuminated displays, light sources are used, such as light emitting diodes (LED), that are placed on a printed circuit board behind the front panel. In order to transfer the light from a light source to the front panel a light guide, made of transparent material, is provided between the light source on the circuit board and a corresponding hole on the front panel. Opaque light barriers are used between the light sources so that there is no optical crosstalk between the light sources that are close to one another. Liquid may enter through the gaps around the holes during the cleaning of the household appliance or due to other causes. The printed circuit board can be damaged when the liquid entering from the gaps reaches the electronic components like the light source by moving along the light barrier.
- [0003] WO2016101971A1 discloses a control panel assembly for a household appliance comprising a panel body provided with a plurality of touch buttons designed to interact with an electronic control card when being pressed by a user for controlling the appliance. The control panel assembly further includes a beam collector having a plurality of light channels and connected to a separator to guide the light from each of the light sources on the electronic control card towards a limited surface area on the wall of the panel body illuminating the correspondent button being pressed.
- [0004] The beam collector is mounted on the separator such that the light channels fit into the apertures of the separator, extending outwardly towards the panel body and directing the light beam homogenously. Neighboring light channels are preferably separated from each other by light barriers provided on the separator to prevent light leakage.

- [0005] The object of the invention is providing a household appliance having a control panel assembly which allows transferring light from a light source to the front panel in a precise manner while avoiding any water contact with the circuit board.
- [0006] The above objective is achieved by the present invention which is a household appliance comprising a control panel assembly with a front panel wherein a plurality of holes are arranged, in particular along one or more vertical directions, and a light guide having rods made of transparent material and extending between a corresponding hole and a corresponding light source, such as a LED unit, provided at a circuit board arranged at the rear side of a base plate at which the rods are integrally formed. A flow path is defined on the light guide and it is adapted to guide water between the rods downwards along the base plate. The flow path guiding the water downward facilitates the water droplets eventually penetrating through the holes on the front plate to be guided along the light guide due to the gravity, away from the circuit board.
- [0007] In another aspect, the flow path is defined along a plurality of sloping elements which are arranged on the base plate, in particular vertically aligned, so that each sloping element is provided between two subsequent rods. Each sloping element, sloping toward the front panel, is aimed to collect the water that might penetrate through the above hole on the front panel being carried by the correspondent rod inserted in the hole, thus guiding the water away from the circuit board.
- [0008] According to an embodiment, an opening is provided at the base plate between two of the neighboring rods. Each sloping element is arranged along the flow path below a corresponding opening and extends towards the rear side of the opening. Water will follow the opening below the upper rod, dropping onto the sloping element, and gravity will allow more water to be collected inside the flow path. Any water droplets reaching to the rear wall of the base plate will be removed from the rear wall by means of an access provided through the opening.
- [0009] In another aspect, the flow path is comprising a receptacle defined by the sloping element having a concave shape. This ensures that the water is

properly collected on the sloping element and guided toward the front.

- [0010] In another aspect, the base plate and the circuit board are jointly attached to an inner wall of the front panel by means of a fastening element. Base plate will cover circuit board and discharge any water drop reaching to the base plate by means of the flow path.
- [0011] In another aspect, a light blocker is made of an opaque material is mounted at the rear side of the base plate so that extending between the rods to block the light emitted by any one of the corresponding light source. Compact design of the control panel assembly with a transparent light guide will be possible without any interference of the light emitted by neighboring light sources, so that each rod just collects and delivers on the front panel the light emitted by the correspondent light source.
- [0012] In another aspect, the light blocker is comprising a through-hole wherein the rear extension of a correspondent rod is accommodated. When the rods are accommodated inside the respective through holes, rear extension of the rods are separated from each other to prevent light interference between the rods.
- [0013] In another aspect, a cavity between two neighboring through-hole is provided at the light blocker such that the sloping element fits inside the cavity. Tip of the cavity integral to the base plate is covered inside the cavity so that any light transferred through the base plate will be blocked inside the cavity to prevent any interference on the light guide.
- [0014] In another aspect, a support frame at the inner wall of the front panel is surrounding the hole and the outer end of the rod. The support frame both increases the rigidity of the control panel assembly and transfers the water to the guiding path.
- [0015] In another aspect, the rods are arranged at the base plate so that the base plate divides each rod into two sections with the rear section longer than the front section of each rod. The longer rear section leaves more distance between the base plate and the circuit board therefore increasing safety of the circuit board.
- [0016] In another aspect, the base plate has an outer frame pressing towards the inner wall of the front panel. The control panel assembly provides a water

proof inner wall when the base plate is mounted.

[0017] Additional advantages of the household appliance with a control panel assembly of the present invention will become apparent with the detailed description of the embodiments with reference to the accompanying drawings in which:

[0018] Figure 1 is a front view of a control panel assembly of a drum type front loading washing machine with two vertical arrays of holes illuminated by respective light sources.

[0019] Figure 2 is exploded view of the control panel assembly according to an embodiment of the invention as shown in Fig. 1.

[0020] Figure 3 is a cross-sectional view of the control panel assembly.

[0021] Figure 4 is a rear perspective view of a particular of the control panel assembly related to a light guide.

[0022] Figure 5 is a front perspective view of the light guide as shown in Figure 4.

[0023] Figure 6 is a rear perspective view of a particular of the control panel assembly relative to a front panel of the washing machine.

[0024] **REFERENCE NUMBERS**

1. Housing
2. Detergent drawer
3. Rotary knob
4. Display unit

[0025] 10. Control panel assembly

[0026] 11. Front plate

[0027] 12. Hole

[0028] 13. Inner wall

[0029] 14. Support frame

[0030] 16. Chamber

[0031] 17. Knob hole

[0032] 18. Fastening element

[0033] 19. Mounting plate

[0034] 20. Light guide

[0035] 21. Tip

[0036] 22. Rod

[0037] 23. Sloping element

[0038] 231. Receptacle

[0039] 24. Guiding wall

[0040] 25. Base plate

[0041] 251. Central hole

[0042] 252. Side groove

[0043] 253. Inner frame

[0044] 254. Bottom groove

[0045] 26. Outer frame

[0046] 28. Side bracket

[0047] 29. Opening

[0048] 30. Light blocker

[0049] 31. Upper arm

[0050] 32. Cavity

[0051] 33. Lower arm

[0052] 34. Through hole

[0053] 35. Rod

[0054] 36. Lower hook

[0055] 40. Circuit board

[0056] 42. Light source

[0057] 44. Board plate

[0058] 45. Tactile switch

[0059] F. Flow path

[0060] In this detailed description, the present invention is explained with references to examples without forming any restrictive effect and only in order to make the subject more understandable.

[0061] With reference to the drawings, a drum-type front loading washing machine having a control panel assembly (10) is shown in Figure 1. Although in the following an example of realization of the present invention will be described with reference to a washing machine, it is obvious that the household appliance according to the invention could be a different appliance, such as a dryer, a washer-dryer, an oven etc., without departing from the scope of protection herein defined.

- [0062] The control panel assembly (10) is mounted to the front side of a housing (1) wherein a rotatable drum (not shown) for receiving laundry items to be treated is accommodated. A retractable detergent drawer (2) is slidably mounted at the front side of the housing (1). A display unit (4) is also provided at the front side of the housing (1) on the control panel assembly (10). According to the embodiment illustrated in Figure 1, a rotary knob (3) for allowing the user to select the functioning parameters of the household appliance is provided on the control panel assembly (10), mounted on a tactile switch (45).
- [0063] As shown in Figure 2, the control panel assembly (10) comprises a front panel (11) provided with a plurality of through holes (12) which are in particular aligned along a vertical direction. According to the embodiment illustrated in Figure 1, the front panel (11) comprises two parallel rows of vertically aligned holes (12), in particular arranged at the sides of the knob (3).
- [0064] The control panel assembly (10) further comprises a circuit board (40) placed at the rear of the front panel (11) and provided with a plurality of light sources (42), such as light emitting diodes (LED) units, each aligned to a correspondent through hole (12) of the front panel (11).
- [0065] A light guide (20) is arranged between the front panel (11) and the circuit board (40) and comprises a base plate (25) and a plurality of rods (22) made of transparent material transversal to the base plate (25) and extending between one of the light sources (42) and the corresponding hole (12) of the front panel (11). Advantageously the whole light guide (20) is made of a transparent plastic material, for instance by injection molding. Each one of the rods (22) corresponds to a hole (12) at the front plate (11). Size of a tip (21) of the rod (22) is adapted to fit inside the hole (12). The base plate (25) holds the transversal rods (22) together and divide each rod (22) into two section namely a front section and a rear section.
- [0066] When a user select a predefined washing program or provide an input for the washing operation, the control panel assembly (10) indicate the status or the result of the selected action by means of a light signal provided by a correspondent light source (42) and brought on the front panel (11)

through the light guide (20).

- [0067] According to the present invention, a flow path (F), illustrated in Figure 3 with dotted line, is defined on the light guide (20) adapted to guide water penetrating through the holes (12) between the rods (22), downwards along the base plate (25). The flow path (F) allows water reaching the light guide (20) to be discharged in the vertical direction by means of the weight of the water droplets.
- [0068] In the embodiment illustrated in the attached figures, the flow path (F) is defined by a plurality of sloping element (23) provided on the base plate (25), in particular substantially aligned along one or more vertical directions as shown in Figure 5, each arranged between two neighboring rods (22), as visible in Figure 3, for collecting water trickling from the above rod (22) and for guiding such water away from the circuit board (40), toward the front of the control panel assembly (10).
- [0069] In a further embodiment, the base plate (25) comprises a plurality of opening (29) along the flow path (F) and each sloping element (23) is arranged below a corresponding opening (29) and extends towards the rear side of the opening (29) such that it guides water moving down from rear side to the front side of the base plate (25).
- [0070] In another embodiment, each sloping element (23) has a concave shape, defining a receptacle (231) which ensures a better collection of water.
- [0071] In particular, according to the constructional details of the light guide (20) as illustrated in the attached figures, the base plate (25) comprises between each couple of subsequent rods (22) a sloping element (23), in particular extending at the upper side of the lower rod (22), and a guiding wall (24) extending at the lower side of the upper rod (22) toward the sloping element (23) of the neighboring rod (22) below, inside the correspondent receptacle (231). The sloping element (23) defines, together with the corresponding guiding wall (24) above, an opening (29) facing towards the rear side of the base plate (25). Therefore, any water droplets at the rear side of the base plate (25) will follow the guiding wall (24) and then drop onto the sloping element (23), in particular inside the corresponding receptacle (231), for being transferred to the front side

through opening (29) while the water droplet move in vertical direction due to the gravity.

- [0072] According to an embodiment, a fastening element (18), in particular in the form of an elastic hook, extends horizontally at an inner wall (13) of the front plate (11). The base plate (25) and the circuit board (40) are jointly attached to the inner wall (13) of the front panel (11) by means of the fastening element (18).
- [0073] As shown at Figure 3, in an embodiment a light blocker (30), made of an opaque material, is coupled to the light guide (20), mounted at the rear side of the base panel (25), so that the light guide (20) is secured between the front plate (11) and the light blocker (30). The light blocker (30) extends between the rods (22) to block the light provided by the neighboring light source (42) from reaching the rod (22) not coupled to it.
- [0074] In an embodiment, the light blocker (30) comprises a plurality of through-holes (34) in each of which the rear extension of a correspondent rod (22) is accommodated and, in a further embodiment, the light blocker (30) comprises a plurality of cavities (32) each arranged between two neighboring through-holes (34) such that a corresponding sloping element (23) of the base plate (25) fits inside the cavity (32).
- [0075] As illustrated in the attached figures, the light blocker (30) comprises vertically aligned side by side cavities (32). Each cavity (32) is adapted to receive a sloping element (23) when the light blocker (30) is assembled to the light guide (20). A through hole (34) is formed between side walls of two opposite cavity (32) and configured so that when the rear portion of the rod (22) rest inside the through hole (34) the rear tip of the rod (22) is sufficiently close to a light source (42) to reflect the light to the front tip (21).
- [0076] Figure 4 shows the light guide (20) from the front side. The light guide (20) is advantageously a panel made of one piece plastic injection molded transparent plastics. A central hole (251) is provided at the center of the base plate (25) allowing outer extension of the tactile switch (45) to pass through the base plate (25). At the lower periphery of the base plate (25) a bottom groove (254), for instance in the form of a rectangle, is provided to

axially align the base plate (25) at the inner wall (13) by means of a corresponding protrusion engaging to the bottom groove (254) in a shape fitting manner. At the side portions of the base plate (25) two opposite side groove (252) are provided. A bracket (28) is extending inside the side groove (252) and snap fit the base plate (25) by means of fastening elements (18) extending from the inner wall (13). Rods (22) are aligned along two vertical parallel directions at the two opposite side of the base plate (25) parallel to the side edges. Each of the rods (22) is surrounded by a flat portion of the base plate (25) forming the guiding wall (24) to a next opening (29) below each rod (22). The number of the rods (22) are equal to the number of the holes (12) at the front plate (11). Two parallel spaced extensions are forming an inner frame (253) so that any water droplet flow through the rod (22) is confined in a vertically limited region at the front side of the base plate (25).

[0077] Figure 5 shows the light guide (20) from the rear side. Rear section of the rods (22) are longer than the front section so that the light guide (20) is kept at a safe distance from the circuit board (40) to prevent any water droplet to reach the latter. A sloping element (23) having access to the opening (29) is facing the above corresponding rod (22) from its rear section.

[0078] Figure 6 is a perspective view of the front plate (11) from the rear side. The inner wall (13) of the front panel (11) comprises a support frame (14) surrounding each row of holes (12).

[0079] A knob hole (17) is provided as a circular hole surrounded by a depression and arranged between two vertical support frames (14). The support frame (14) has a stair like form having two parallel side extensions divided by horizontal extensions forming a chamber (16) around each one of the holes (12) and the outer end of the corresponding rod (22) provided on the front plate (11).

[0080] In an embodiment the base plate (25) has an outer frame (26) pressing towards an inner wall (13) of the front panel (11). The outer frame (26) shorter than the front section of the rods (22) extends towards the inner wall (13) from outer periphery of the base plate (25) and defines a sealing

boundary at a secure perimeter from the holes (12) at the inner wall (13).

[0081] In order to assembly the control panel (10) the light guide (20) is coupled to the inner wall (13) from its front side so that each tip (21) of the rods (22) can be seen from the corresponding hole (12). A lower hook (36) extending from inner wall (13) extend behind the bottom groove (254) and hold the light blocker (30) and circuit board (40) together in a compact manner.

[0082] When a washing machine is stored at the house, if a condensation occur or a water droplet, for instance while cleaning, penetrates from one of the holes (12) at the front plate (12), the water droplet is stored at the chamber (16) at the inner wall (13). If the water amount inside the chamber (16) increases, water droplets, thanks to the flow path (F), reach the sloping element (23) and are transferred to the front side of the base plate (25). Due to the vertical position of the base plate (25) water droplets are guided toward the next lower sloping element (23) from the guiding wall (24). Therefore, the water on the base plate (25) follows a vertical path which is defined mainly by the sloping elements (23) spaced apart and aligned along a same substantially vertical direction.

Claims

1. A household appliance comprising a control panel assembly (10) having:
 - a front panel (11) wherein a plurality of holes (12) are arranged;
 - a circuit board (40) placed at the rear of the front panel (11) and provided with a plurality of light sources (42);
 - a light guide (20) arranged between the front panel (11) and the circuit board (40) and comprising a base plate (25) and a plurality of rods (22) transversal to the base plate (25) and extending between a light source (42) and a corresponding hole (12) of the front panel (11) characterized in that a flow path (F) is defined on the light guide (20) adapted to guide water penetrating through the holes (12) between the rods (22) downwards along the base plate (25).
2. A household appliance according to claim 1, wherein the base plate (25) comprises a plurality of sloping elements (23) defining the flow path (F) each sloping element (23) being arranged between two of the neighboring rods (22) for collecting water trickling from the above rod (22) and for guiding such water away from the circuit board (40).
3. A household appliance according to claim 2, wherein the base plate (25) comprises a plurality of opening (29) along the flow path (F), each sloping element (23) being arranged below a corresponding opening (29) and extending towards the rear side of the opening (29) such that it guides water moving down from rear side to the front side of the base plate (25).
4. A household appliance according to claim 2 or 3, wherein each sloping element (23) has a concave shape, defining a receptacle (231).
5. A household appliance according to any one of the preceding claims, wherein the base plate (25) and the circuit board (40) are jointly attached to an inner wall (13) of the front panel (11) by means of a fastening element (18).
6. A household appliance according to one of the preceding claims, wherein a light blocker (30) made of an opaque material is mounted at the rear side of the base plate (25) and it extends between the rods (22) to block the light provided by each of the corresponding light source (42).
7. A household appliance according to claim 6, wherein the light blocker (30) comprises a plurality of through-holes (34) in each of which the rear extension

of a correspondent rod (22) is accommodated.

8. A household appliance according to claims 2 and 7, wherein the light blocker (30) comprises a plurality of cavities (32) each arranged between two neighboring through-holes (34) such that a corresponding sloping element (23) of the base plate (25) fits inside the cavity (32).
9. A household appliance according to any of the preceding claims, wherein an inner wall (13) of the front panel (11) comprises a support frame (14) surrounding each hole (12) and the outer end of the corresponding rod (22).
10. A household appliance according to any of the preceding claims, wherein the rods (22) are arranged at the base plate (25) so that the base plate (25) divides each rod (22) into two sections with the rear section longer than the front section of each rod (22).
11. A household appliance according to any of the preceding claims, wherein the base plate (25) has an outer frame (26) pressing towards an inner wall (13) of the front panel (11).

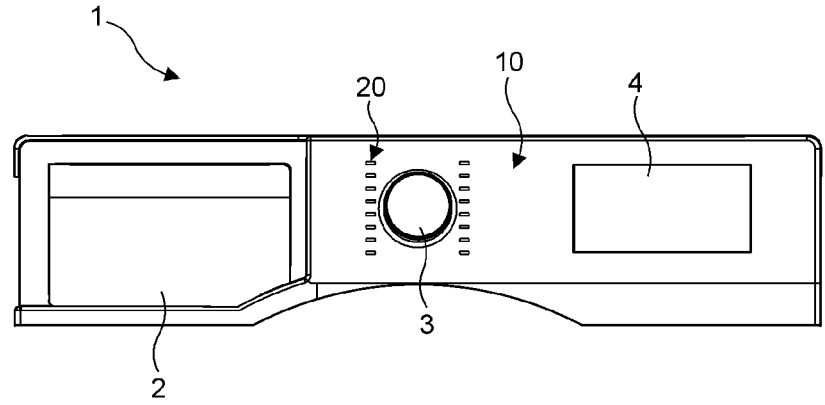


Figure 1

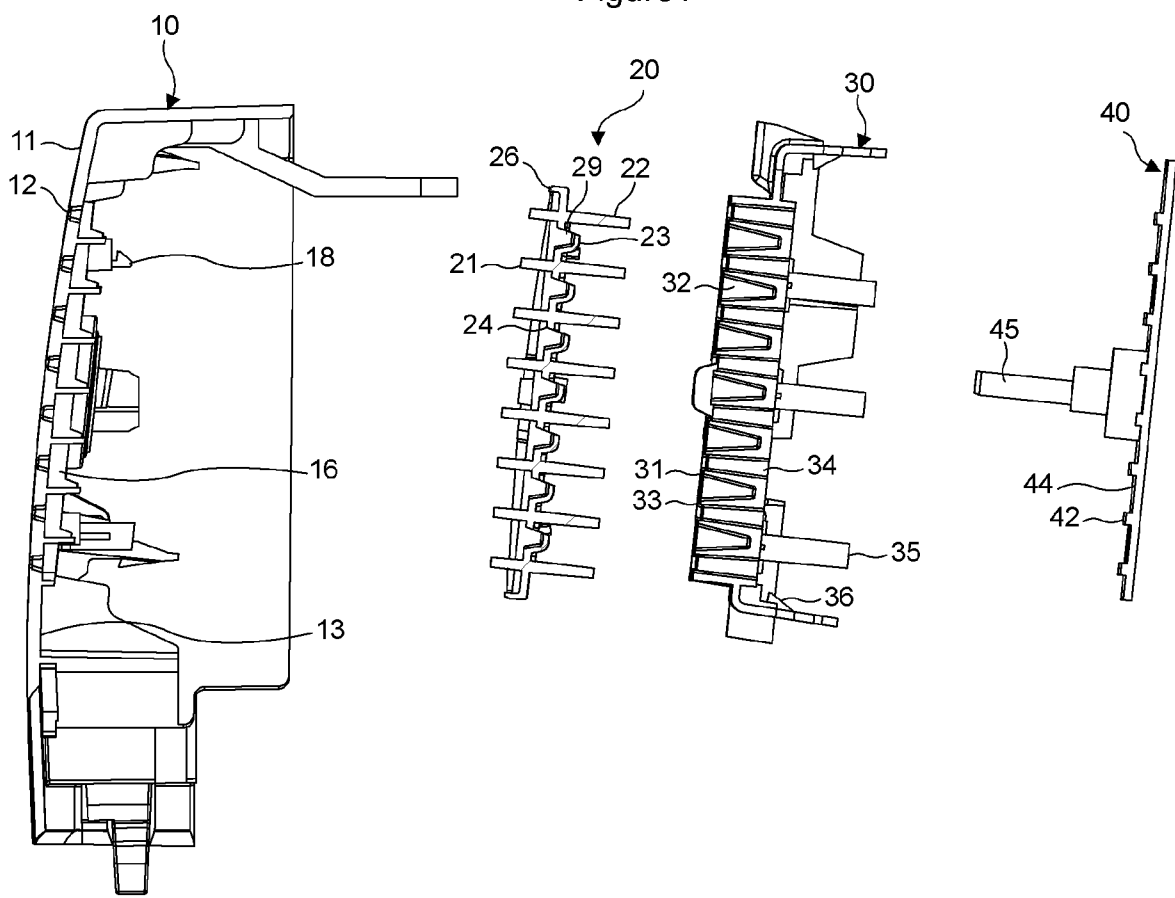


Figure 2

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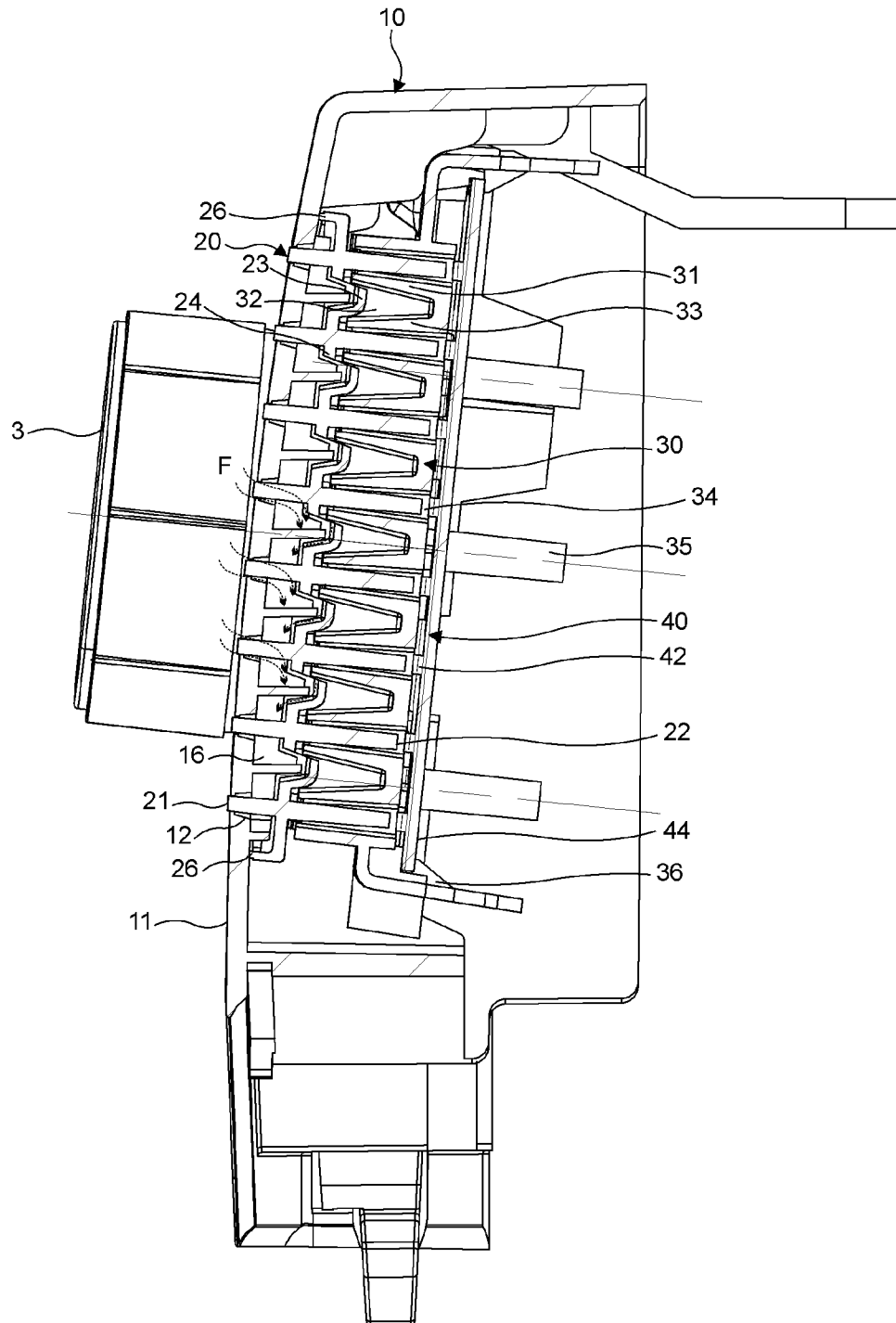


Figure 3

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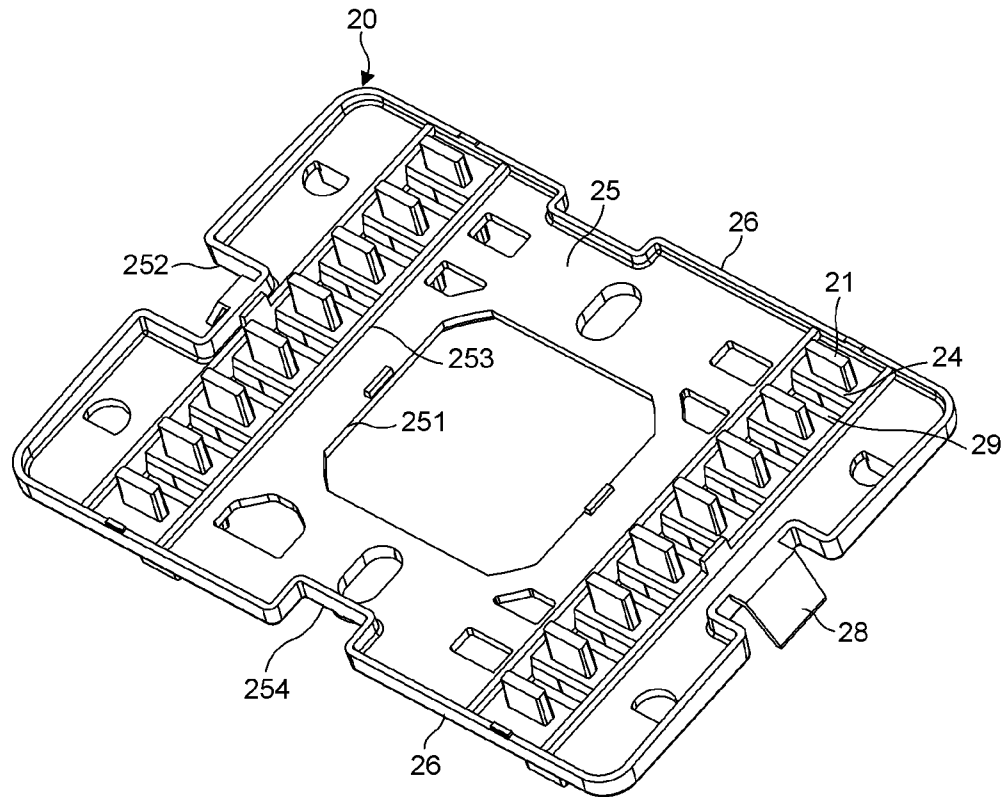


Figure 4

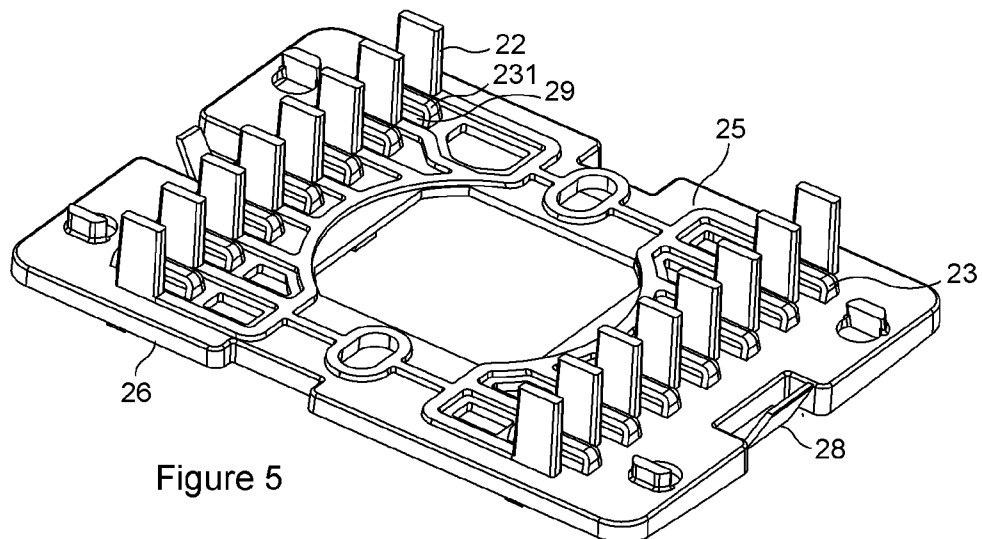


Figure 5

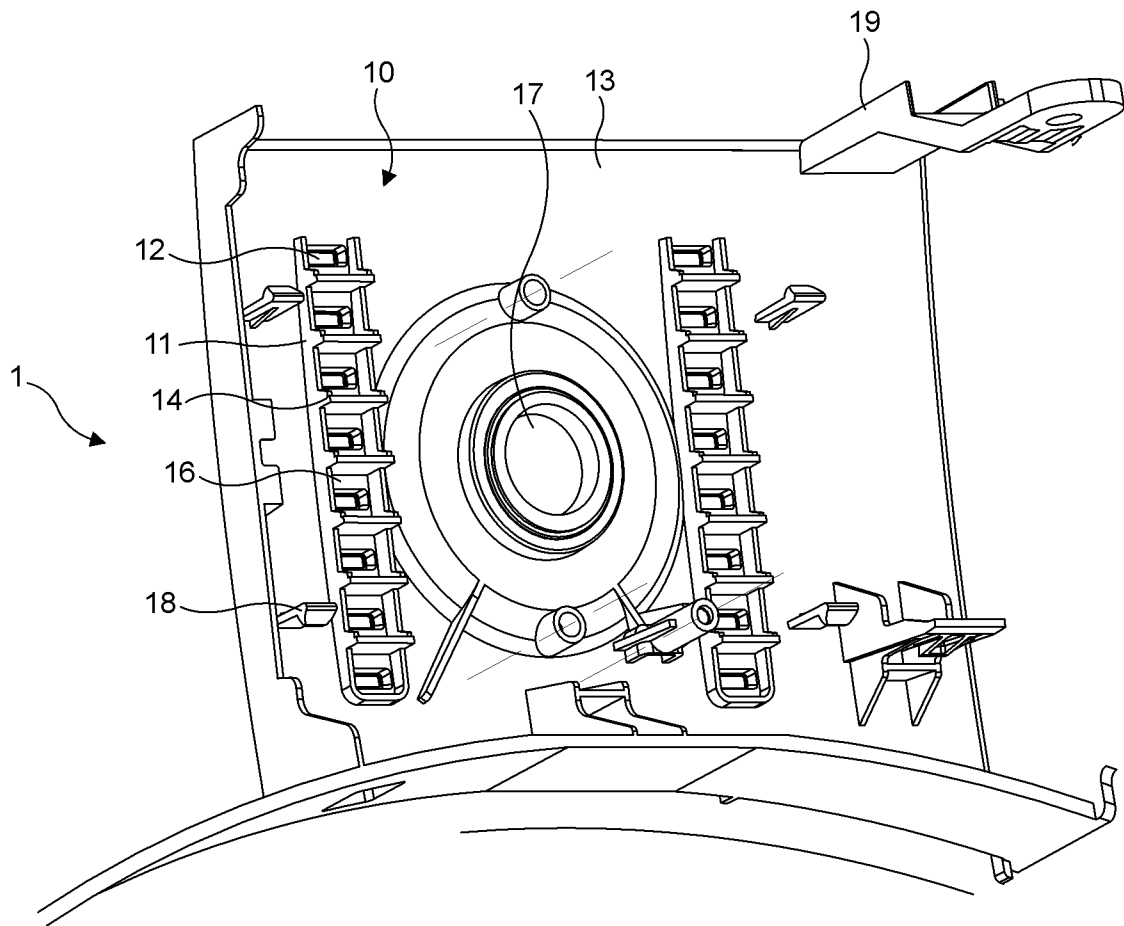


Figure 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/073486

A. CLASSIFICATION OF SUBJECT MATTER
INV. D06F39/00 A47L15/42 H01H9/00
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)
D06F A47L H01H

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.
X	WO 2016/101975 A1 (ARCELIK AS [TR]) 30 June 2016 (2016-06-30) paragraphs [0023], [0025], [0026], [0028], [0029], [0031]; figures 1,3,5 -----	1,2,4-7, 11
X	WO 2016/101971 A1 (ARCELIK AS [TR]) 30 June 2016 (2016-06-30) cited in the application	1,5,6, 10,11
Y	paragraphs [0027], [0037], [0038]; figures 1,3,5,6b -----	7,9
Y	WO 2015/180852 A1 (ARCELIK AS [TR]) 3 December 2015 (2015-12-03) paragraphs [0033] - [0035]; figures 1-4 -----	7,9
X	EP 2 837 725 A1 (ELECTROLUX APPLIANCES AB [SE]) 18 February 2015 (2015-02-18) paragraphs [0092] - [0134]; figures 2,5 ----- -/-	1,5-7, 9-11



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

2 November 2017

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13/11/2017

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/073486

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

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