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(54) **Condensate level detecting system for a laundry drier and a laundry drier**

(57) A laundry dryer appliance (1) comprises a housing (2), a laundry space (4) arranged in the housing (2), a drying circuit (5) with a heat exchanger (7), an extractable container (10) for collecting the condensation and a sensor (11) for detecting a threshold level of condensation inside the collecting container (10), the sensor (11) comprising a magnetically susceptible switch (14) and a float (12) arranged in fluid communication with the inside of the collecting container (10) and carrying a magnet (13) that actuates the switch (14) upon reaching the condensation threshold level.

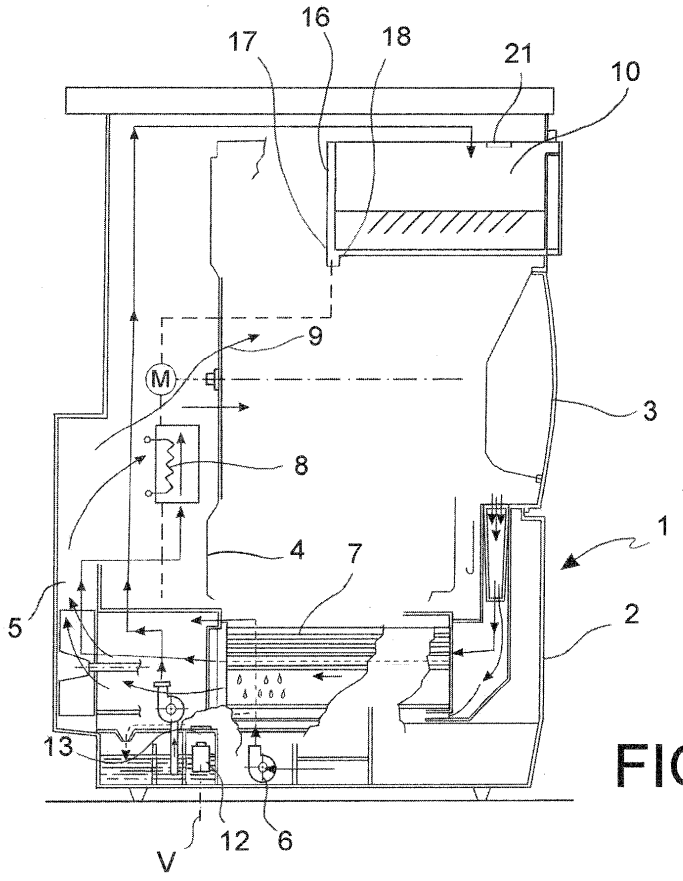

FIG. 1A

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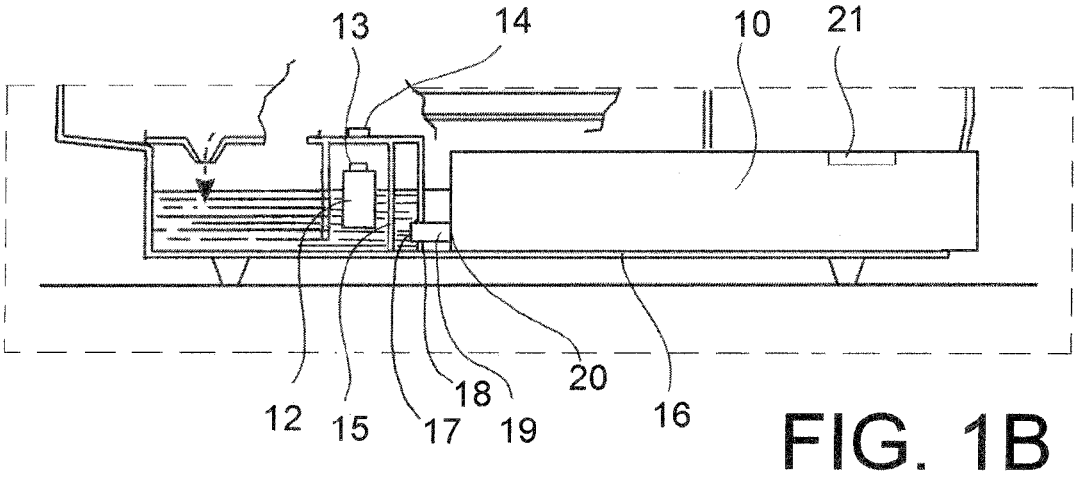

FIG. 1B

Description

[0001] The present invention relates to a system for detecting the level of condensation collected in a laundry dryer appliance, wherein the laundry dryer appliance may be of the type comprising a housing with a front loading port, a laundry rack received in the housing and suitable for receiving the laundry to be dried, as well as a "closed" drying circuit, with a suction unit, a heat exchanger and a heating unit with electrical resistors, configured for conveying a flow of heated and dry air through the laundry rack.

[0002] In such drying circuit known as closed circuit, the air flow caused by the suction unit is heated by the electrical resistors and conveyed into the rack, where crossing the wet laundry, it causes the evaporation of the water contained in the fabric. In the heat exchanger, the humid air is cooled, for example by a flow of cold water or by a flow of cool air. By the effect of cooling, the steam condensates and is collected in a condensation collecting container. The dehumidified air is then sucked in again by the suction unit and made to circulate.

[0003] In laundry dryer appliances with condensation collection without automatic discharge it is important to know the filling level of the condensation collecting container in order to influence the control of the laundry dryer appliance so as to prevent an overflow of the collecting container and consequent damages to the household appliance and prevent water damages to the apartment or house where it is installed.

[0004] Laundry dryer appliances of the type mentioned above are known, provided with a drawer-like extractable condensation collecting container and a pressure switch level sensor in fluid communication with the inside of the collecting container, wherein the pressure switch sensor is configured for activating (for example for switching an electrical control circuit) upon reaching a threshold pressure value that corresponds to a threshold filling value of the condensation collecting container.

[0005] Such known solution is expensive, complex and difficult to install since the pressure switch sensor must be exposed to the condensation pressure on the bottom of the collecting container but the electrical control circuit must be isolated from the condensation itself.

[0006] Moreover, the use of a contactless sensor is known, for example a Reed switch that is activated by a magnet supported by a float arranged in the condensation collecting container.

[0007] While the magnetic switch is less expensive than a pressure switch detector, due to the uneven magnetic field, the condensation level detection results in the collecting container are not always sufficiently accurate and therefore, the magnetic switch must be calibrated to a "safe" threshold level which is lower than the maximum filling level. As a consequence, the collecting container must be filled more often than what strictly required. Moreover, the arrangement of the float with the permanent magnet inside the collecting container reduces the volumetric capacity thereof, the overall dimensions being the same, further increasing the emptying frequency thereof.

[0008] The aim of the present invention therefore is to provide a system for detecting the condensation level in laundry dryer appliances, having such features as to obviate at least some of the disadvantages mentioned with reference to the prior art.

[0009] A particular aim of the present invention is to propose a laundry dryer appliance with a more accurate and repeatable system for detecting the condensation level.

[0010] This and other aims are achieved by a laundry dryer appliance comprising a housing with a loading port, a laundry rack received in the housing and suitable for receiving the laundry to be dried, a drying circuit with a heat exchanger, an extractable container for collecting the condensation and a sensor for detecting a threshold level of the condensation inside the collecting container, wherein the sensor comprises:

- a float carrying a permanent magnet, the float being arranged in a guided manner in fluid communication with the inside of the collecting container;
- a magnetically susceptible switch, in particular a Reed switch positioned and configured for being actuated by the permanent magnet upon reaching the condensation threshold level,

  wherein the float is slidingly supported along a sliding axis and the magnet defines a magnetic axis and two magnetic poles of opposite sign respectively arranged at two opposite ends of the magnet along the magnetic axis and wherein the magnet is oriented with the magnetic axis thereof substantially perpendicular to the sliding axis of the float and both magnetic poles exhibit the same axial distance from the switch (with reference to the sliding axis).

[0011] This allows a precise positioning and orientation of the permanent magnetic field relative to the focal point of magnetic sensitivity of the Reed switch 14 and thus, a more accurate and repeatable detection of the moment in which the threshold level of the condensation collected in container 10 is reached.

[0012] To better understand the invention and appreciate the advantages thereof, some exemplary non-limiting embodiments thereof are described below with reference to the annexed drawings, wherein:

[0013] figure 1A shows a schematic view of a laundry dryer appliance according to an embodiment of the invention;

[0014] figure 1B shows a schematic view of a detail of a laundry dryer appliance according to a further embodiment of the invention;

[0015] figure 2 shows an exploded view of a level detection unit of the laundry dryer appliance according to an embodiment;

[0016] figure 3 shows a perspective view of the level

detection unit of figure 2 in an assembled configuration;

[0017] figure 4 shows a top view of the level detection unit of figure 2 in an assembled configuration;

[0018] figure 5 shows a bottom view of the level detection unit of figure 2 in an assembled configuration;

[0019] figures 6 and 7 show cutaway views of the level detection unit of figure 3;

[0020] figure 8 shows a cutaway view of the level detection unit according to a further embodiment;

[0021] figure 9 shows the configuration of a level sensor according to an embodiment.

[0022] With reference to the figures, a laundry dryer appliance, in particular a laundry dryer appliance with front loading, is globally indicated with reference number 1. Appliance 1 comprises a housing 2 with a loading port 3, a laundry rack or space 4 received in housing 2 and suitable for receiving the laundry to be dried, a drying circuit 5 with a suction unit 6, a heat exchanger 7 and a heating unit 8, for example one or more electrical resistors, configured for conveying a heated and dry air flow 9 through the laundry rack or space 4.

[0023] Appliance 1 further comprises a container 10 for collecting the condensation and a sensor 11 for detecting a condensation threshold level inside the collecting container 10. The collecting container 10 is received in an extractable manner in a special space 16 of housing 2 so as to allow the extraction and emptying of the collecting container 10 when the latter is totally filled with condensation.

[0024] Sensor 11 comprises a float 12 guided in vertical direction and arranged in fluid communication with the inside of the collecting container. Float 12 carries a permanent magnet 13 which collaborates with a magnetically susceptible switch 14, in particular a Reed switch positioned and configured for being actuated by the permanent magnet 13 upon reaching the condensation threshold level.

[0025] According to an aspect of the invention, float 12 with the permanent magnet 13 is arranged in a measurement space 15 outside the collecting container 10 and, when the collecting container 10 is inserted into space 16 of housing 2, the collecting container 10 is coupled in fluid communication with the measurement space 15.

[0026] This allows detecting the level of condensation outside the collecting container 10 and maximising the volumetric capacity of the collecting container, the overall dimensions being the same. The measurement space 15 may advantageously be formed in a zone of the housing not used or usable for other purposes.

[0027] According to an embodiment, the measurement space 15 is in fluid communication with a first connector 18 arranged at the container space 16 and provided with a first locking valve 17. The collecting container 10 forms a corresponding second connector 19 provided with a second locking valve 20. The first and second connectors 18, 19 are positioned and configured in such a way as to connect to one another and place the measurement space 15 and the collecting container 10 in fluid communication when the collecting container 10 is inserted in the container space 16, as well as separate from one another when the collecting container 10 is extracted from the container space 16. The first and second locking valves 17, 20 are configured so as to open the passage through connectors 18, 19 when the latter are coupled and locking the liquid passage through each one of connectors 18, 19 when they are uncoupled.

[0028] In this way, when the collecting container 10 is extracted from the container space 16 or inserted in an incomplete manner, the measurement space 15 remains isolated from the outside and retains any accumulated condensation. On the other hand, during and after the extraction of the collecting container 10 from the laundry dryer appliance 1, the second connector 19 is closed and allows an easy handling without any risk of liquid spilling, which can be easily poured through an emptying opening 21 (separate from the second connector 19) closable by a threaded cap and having a relatively large opening section.

[0029] According to an embodiment, sensor 11 comprises a support structure 22 with a fixing plate 23 suitable for fixing sensor 11 in the measurement space 15, a switch seat 24 suitable for receiving, through snap-engagement, the magnetically susceptible switch 14, for example a Reed switch, and a guide 25 suitable for receiving float 12 in a sliding manner along a direction V which, in operating conditions of appliance 1 substantially corresponds to the vertical direction.

[0030] Advantageously, the switch seat 24 is formed integral with the fixing plate 23 and receives the Reed switch 14 directly, that is, without the interposition of a further adapter or housing. This ensures a perfect alignment of the Reed switch 14 with the support structure 22 and thus, with guide 25 and with float 12 with magnet 13.

[0031] According to an embodiment, the switch seat 24 comprises two side guides 26 having an L shaped section and protruding from a top surface 27 of the fixing plate 23 opposite guide 25, an abutment tooth 28 protruding from the top surface 27 and defining a position reference for switch 14 which is received and guided by the side guides 26, as well as an elastic tab 29 also protruding from the top surface 27 and positioned opposite the abutment tooth 28 with reference to the target position of switch 14, so as to allow the insertion of switch 14 into the switch seat 24 and prevent an extraction or accidental or undesired loss thereof (Figures 2 and 3).

[0032] According to an embodiment, at least one of the side guides 26 may comprise a yielding appendix 30 that, when switch 14 is inserted in the switch seat 24, engages a corresponding shoulder 31 of switch 14 so as to bias switch 14 elastically in abutment against the abutment tooth 28 and thus ensure the correct positioning thereof.

[0033] In accordance with an embodiment, the permanent magnet 13 is at least partly or entirely encapsulated in the plastic material of float 12.

[0034] As an alternative, the permanent magnet 13 is received by snap-wise coupling in a magnet seat 32 of float 12.

[0035] Advantageously, the same magnet 13 may exhibit a cylindrical or discoid or cylindrical pad shape and defines a magnetic axis M and two magnetic poles N, S of opposite sign respectively arranged at two opposite ends of magnet 13 along the magnetic axis M and wherein magnet 13 is oriented with the magnetic axis M thereof substantially perpendicular to the sliding axis V of float 12 and both magnetic poles N, S exhibit the same axial distance DV (with reference to the sliding axis) from switch 14 (Figure 9). This allows a precise positioning and orientation of the permanent magnetic field relative to the focal point of magnetic sensitivity of the Reed switch 14 and thus, a more accurate and repeatable detection of the reaching of the threshold level of the condensation collected in container 10.

[0036] According to an embodiment (Figures 6, 7), float 12 comprises a closed hollow body 32 made starting from two or more pieces, for example a cover portion 33 and a base portion 34 shaped as a cup with closed bottom, both made of plastic and connected to one another by welding or gluing.

[0037] According to an alternative embodiment (Figure 8), float 12 comprises a hollow body 35 open at the bottom, made in a single piece in the shape of a bell with a top dome that carries magnet 13, and a side wall preferably cylindrical formed integral with the top dome and delimiting a bottom opening 36 opposite the top dome.

[0038] Such open hollow body can be easily made by injection moulding and during the operation of the laundry dryer appliance, it is in any case closed at the bottom by the condensed water.

[0039] Also guide 25 may be formed integral with the fixing plate 23 and may comprise a substantially tubular longitudinally grooved wall for forming two flaps 37 that may be elastically spread apart to a certain extent that allows the snap-wise insertion of the float into the tubular wall. Also flaps 37 may comprise one or more longitudinal grooves closed at the bottom and suitable for receiving corresponding side tabs 38 of float 12 with clearance so as to cause the vertical and guided sliding of the float relative to switch 14 and prevent an undesired exit thereof from guide 25.

[0040] It is clear that a man skilled in the art may make several changes and adjustments to the laundry dryer appliance and to the system for detecting the threshold level of condensation according to the present invention in order to meet specific and incidental needs, all falling within the scope of protection of the invention as defined in the following claims.

Claims

1. A laundry dryer appliance (1) comprising a housing (2), a laundry space (4) arranged in the housing (2), a drying circuit (5) with a heat exchanger (7), an extractable container (10) for collecting the condensation and a sensor (11) for detecting a threshold level of condensation inside the collecting container (10), the sensor (11) comprising a magnetically susceptible switch (14) and a float (12) arranged in fluid communication with the inside of the colleting container (10) and carrying a magnet (13) that actuates the switch (14) upon reaching the condensation threshold level,
characterised in that the float (12) is slidingly supported along a sliding axis (V) and the magnet (13) defines a magnetic axis (M) and two magnetic poles (N, S) of opposite sign respectively arranged at two opposite ends of the magnet along the magnetic axis and wherein the magnet is oriented with the magnetic axis thereof (M) substantially perpendicular to the sliding axis (V) of the float (14).

2. A laundry dryer appliance (1) according to claim 1, wherein both magnetic poles (S, N) exhibit the same distance (DV) from the switch (14) in the direction of the sliding axis (V).

3. A laundry dryer appliance (1) according to claim 1 or 2, wherein the float (12) with the permanent magnet (13) is arranged in a measurement space (15) outside the collecting container (10) and, when the collecting container (10) is inserted in a container space (16) of the housing (2), the collecting container (10) is coupled in fluid communication with the measurement space (15).

4. A laundry dryer appliance (1) according to claim 3, wherein the measurement space (15) forms a first connector (18) provided with a first locking valve (17) and the collecting container (10) forms a corresponding second connector (19) provided with a second locking valve (20) and configured for coupling with the first connector (18) when the collecting container (10) is inserted in the container space (16) and for separating from the first connector (18) when the collecting container (10) is extracted from the container space (16),
the first and the second locking valves (17, 20) being configured so as to open a fluid passage through the connectors (18, 19) when they are coupled and locking the liquid passage through each one of the connectors (18, 19) when they are uncoupled.

5. A laundry dryer appliance (1) according to any one of the previous claims, wherein the sensor (11) comprises:

- a fixing plate (23) suitable for fixing the sensor (11) in the measurement space (15),
- a switch seat (24) suitable for receiving, through snap-wise engagement, the switch (14),

- a guide (25) suitable for slidingly receiving the float (12) along a direction (V) which, in operating conditions of the appliance (1) substantially corresponds to the vertical direction,
Wherein the switch seat (24) is formed integral with the fixing plate (23) and with the guide (25) and receives the switch (14) directly without the interposition of further adapters.

6. A laundry dryer appliance (1) according to claim 5, wherein the switch seat (24) is configured for receiving the switch (14) through shape coupling and for positioning the switch (14) in a target position by an elastic preload.

7. A laundry dryer appliance (1) according to claim 5 or 6, wherein the switch seat (24) comprises two side guides (26) having an L-shaped section and protruding from a top surface (27) of the fixing plate (23) opposite the guide (25), an abutment tooth (28) protruding from the top surface (27) and defining a position reference for the switch (14), an elastic tab (29) protruding from the top surface (27) in a position opposite the abutment tooth (28) with reference to a target position of the switch (14), so as to allow the insertion of the switch (14) in the switch seat (24) on the side of the elastic tab (29) in the direction of the abutment tooth (28) and prevent an accidental extraction thereof in the opposite direction.

8. A laundry dryer appliance (1) according to claim 7, wherein at least one of the side guides (26) forms a yielding appendix (30) that, when the switch (14) is inserted in the switch seat (24), elastically engages a shoulder (31) of the switch (14) protruding crosswise the direction of insertion thereof into the switch seat (24) so as to bias the switch (14) elastically in abutment against the abutment tooth (28).

9. A laundry dryer appliance (1) according to any one of the previous claims, wherein the float is made of plastic and the permanent magnet (13) is at least partly encapsulated in the plastic of the float (12).

10. A laundry dryer appliance (1) according to any one of the previous claims, wherein the permanent magnet (13) is received by snap-wise coupling in a magnet seat (32) of the float (12).

11. A laundry dryer appliance (1) according to any one of the previous claims, wherein the float (12) comprises a hollow body (35) open at the bottom, shaped as a bell with a top dome that carries the magnet (13) and a side wall formed integral with the top dome and delimiting a bottom opening (36) opposite the top dome.

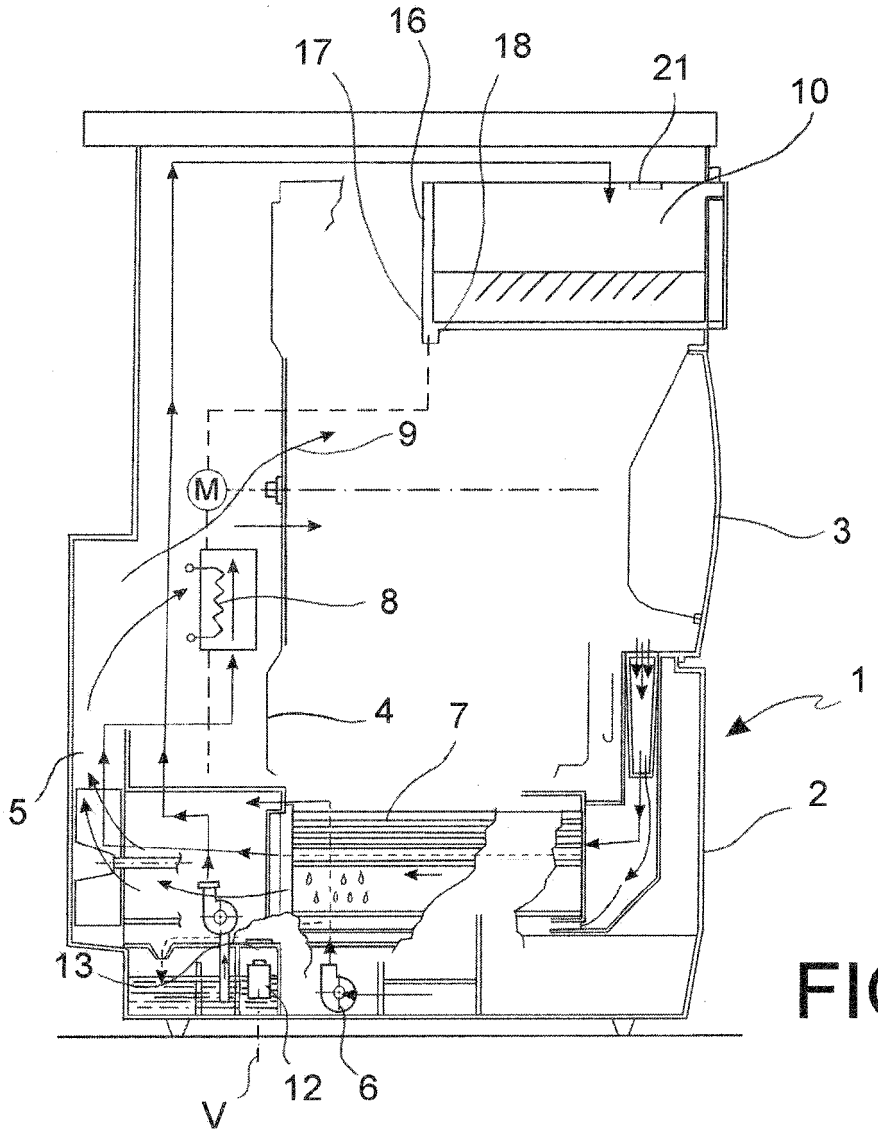

FIG. 1A

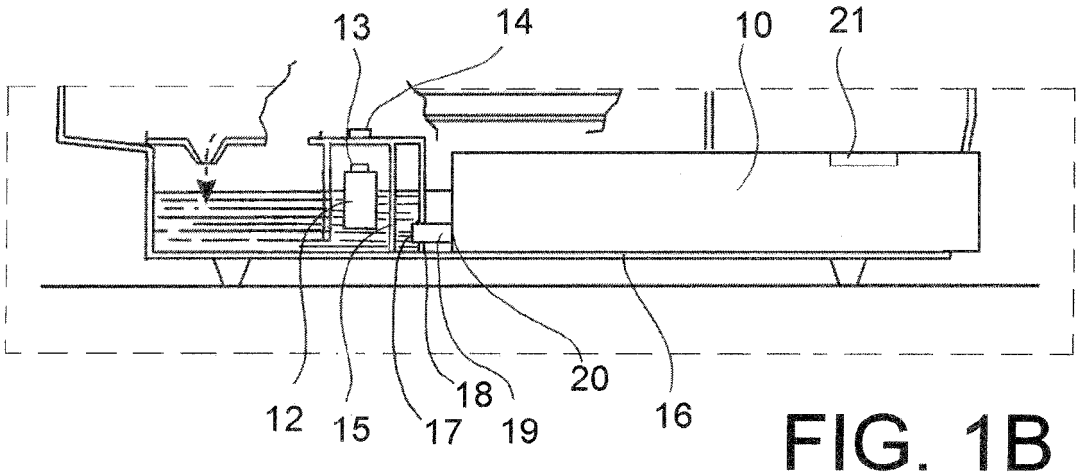

FIG. 1B

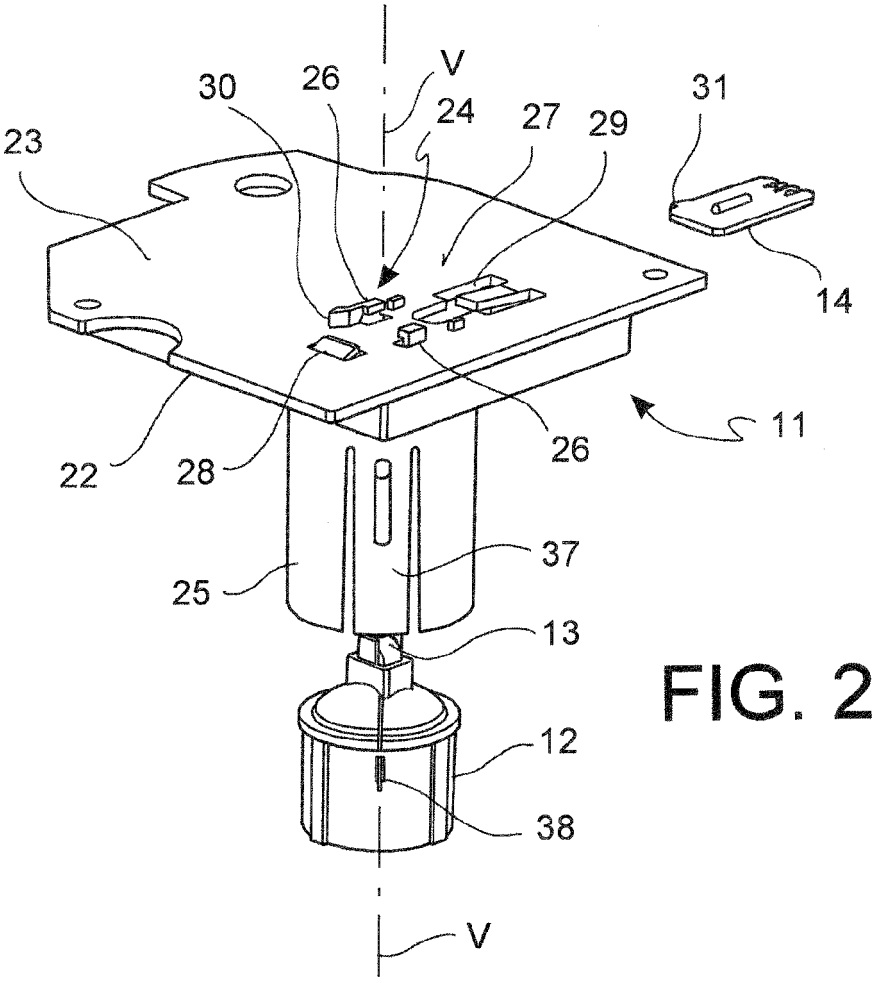
V
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FIG. 2

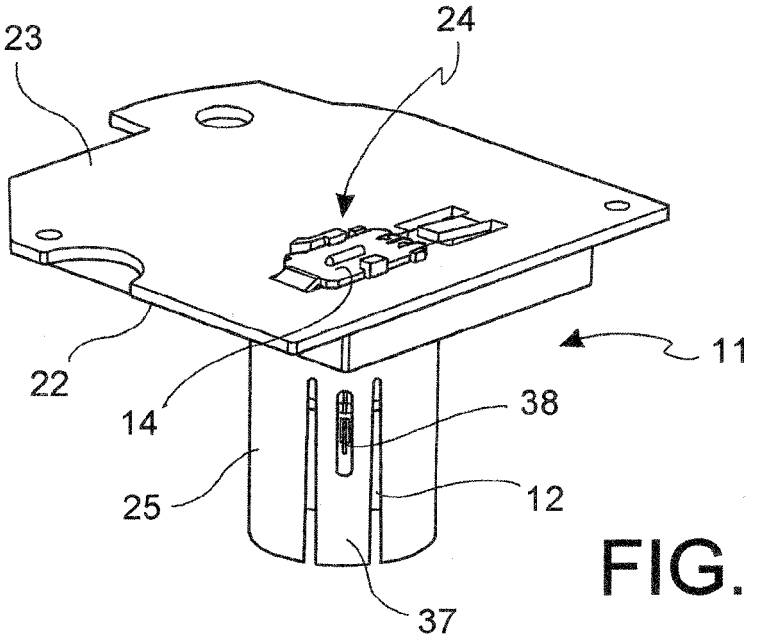
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FIG. 3

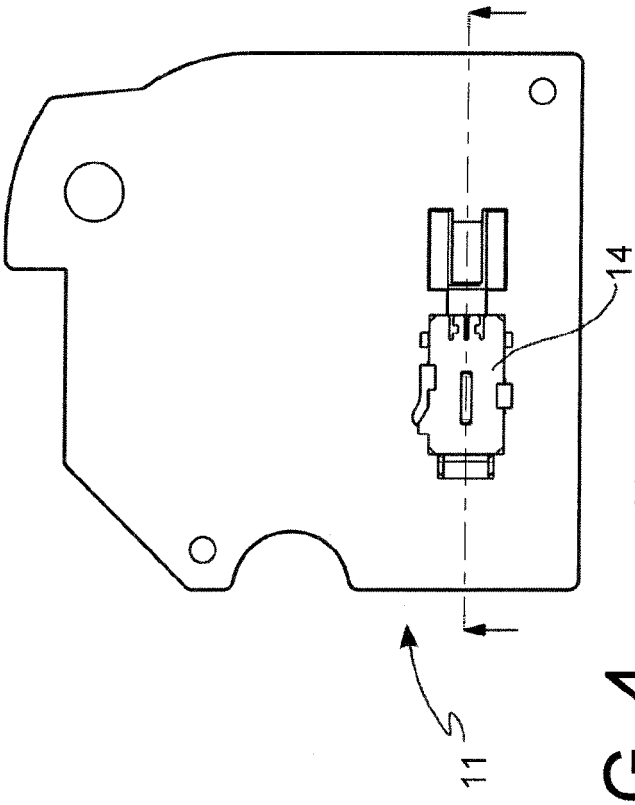

FIG. 4

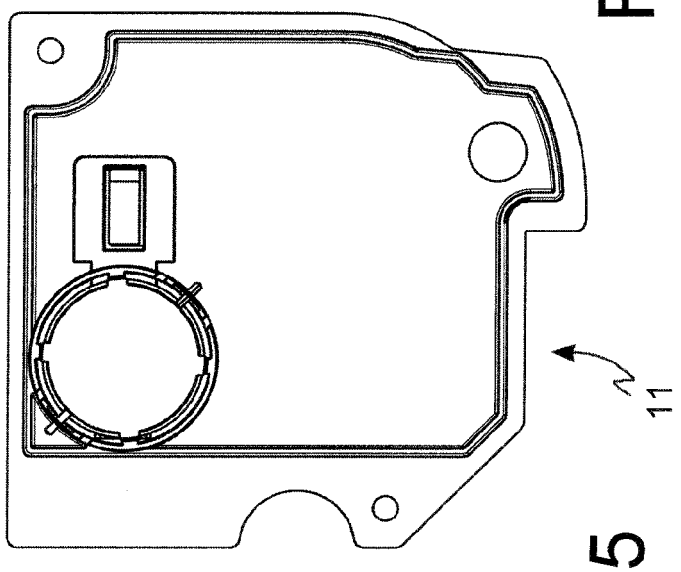

FIG. 5

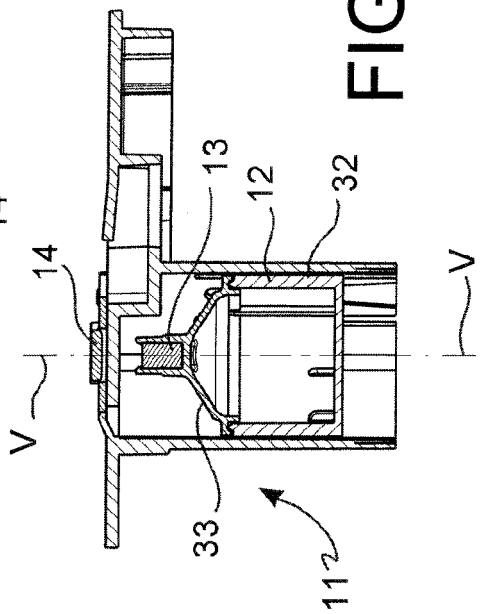

FIG. 6

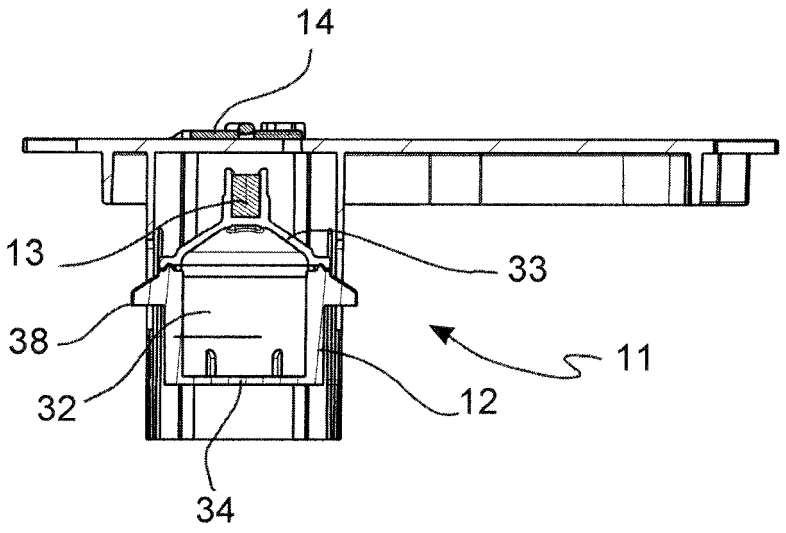

FIG. 7

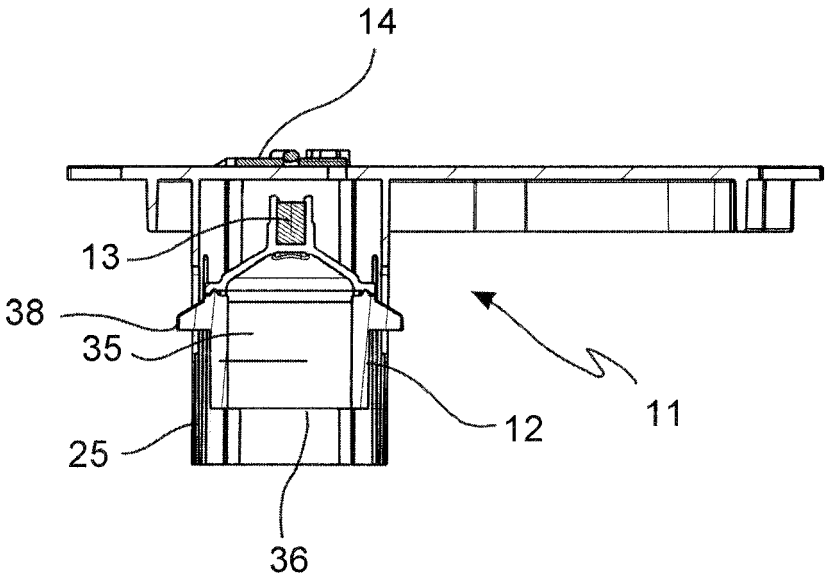

FIG. 8

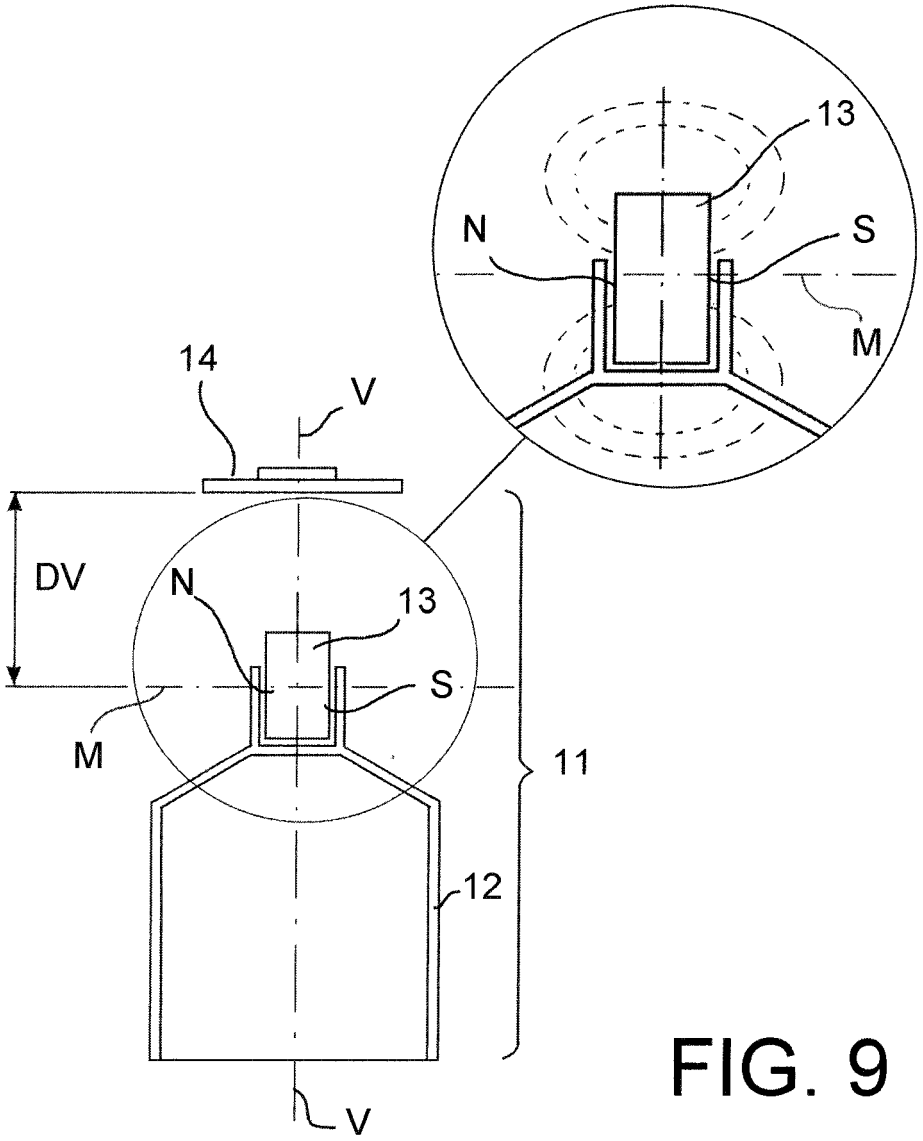

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 1731

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 1 816 252 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 8 August 2007 (2007-08-08)	1,2	INV. D06F58/24
A	* paragraphs [0001], [0002], [0005], [0006], [0009] - [0015]; claim 1; figures *	3-11	
A	DE 88 11 974 U1 (LICENTIA PATENT-VERWALTUNGS GMBH) 11 May 1989 (1989-05-11) * page 1, lines 1-7; page 5, line 1 - page 6, line 10;figure 2 *	1-11	
A	DE 10 2008 006349 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 30 July 2009 (2009-07-30) * paragraphs [0001], [0002], [0011] - [0016], [0043] *	1-11	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 September 2011	Clivio, Eugenio

CATEGORY OF CITED DOCUMENTS

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16-09-2011

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