



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.06.2019 Bulletin 2019/26

(51) Int Cl.:
A47L 15/42 ^(2006.01)

(21) Application number: **17209821.2**

(22) Date of filing: **21.12.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD TN
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(54) **DISHWASHER**

(57) A dishwasher (1) comprising a washing compartment (10) and an air filter (2) for removing odours from air. The dishwasher (1) further comprises at least one piezoelectric fan (3) positioned to cause air from within the washing compartment (10) to pass through the air

filter (2) so as to remove odours from the dishwasher 1 and/or a control unit (14) adapted to monitor the usage of the air filter (2) and generate an alert when the remaining service life of the air filter (2) falls below a predetermined threshold.

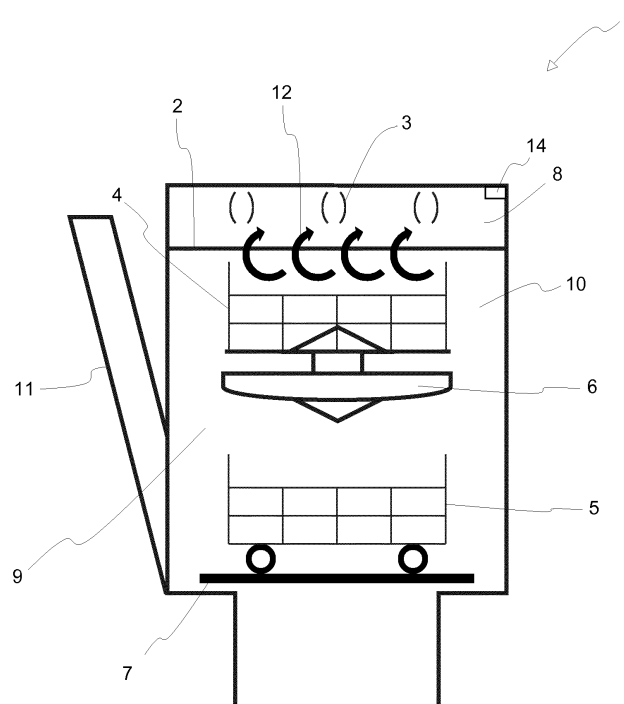


Figure 1

Description

[0001] This invention relates to a dishwasher, and in particular, a dishwasher comprising an air filter for removing odours from air.

[0002] During normal use of a dishwasher, food dregs often collect in a drain filter within the washing compartment. These can lead to unpleasant odours permeating throughout the dishwasher. As a result, various methods of removing odours from within the dish washing compartment have been proposed.

[0003] US 2003/0221709 A1, for example, describes including an odour eliminating material within the dish washing compartment of a dishwasher. The odour eliminating material is installed within a casing having a shutter and a shutter driving device. In use, the shutter and shutter driving device act to selectively open or close the casing in order to expose or conceal the odour eliminating material. When the shutter is open, air in the washing compartment is able to contact the odour eliminating material and the odour eliminating material acts to remove odours from the dish washing compartment.

[0004] EP 1 872 704 A1 also describes a dishwasher with an odour processing device. Here, the odour processing device includes a catalyst, such as titanium dioxide, and at least one source of ultraviolet rays. The odour processing device is installed in a ventilation duct of the drying circuit of the dishwasher, and the odours contained in the dish washing compartment are drawn into the ventilation duct by a rotating fan. Upon irradiation with ultraviolet light, the catalyst is able to destroy odorous organic materials that come into contact with its surface.

[0005] A problem with the dishwashers of US 2003/0221709 A1 and EP 1 872 704 A1 however, is that they require specialised mechanical and/or electrical components to be included in parts of the machine that are exposed to washing water or to residual moisture. In addition, in the case of US 2003/0221709 A1 especially, the effectiveness of the odour removal relies on the user replacing the odour eliminating material when it reaches the end of its service life.

[0006] Accordingly, there is a need to provide an improved dishwasher, which is able to remove odours from the dish washing compartment.

[0007] In a first aspect, the invention provides a dishwasher comprising a washing compartment; an air filter for removing odours from air; and at least one piezoelectric fan positioned to cause air from within the washing compartment to pass through the air filter so as to remove odours from the dishwasher.

[0008] Advantageously, by including an air filter and at least one piezoelectric fan positioned to cause air from within the dish washing compartment to pass through the air filter, a dishwasher in accordance with the first aspect of the invention is able to remove odours from the washing compartment without requiring additional mechanical or electrical components to be included in parts of the

machine that are exposed to washing water or to residual moisture. This reduces risk of breakdown and also improves the electrical safety of the dishwasher.

[0009] Furthermore, the use of a piezoelectric fan provides a number of advantages over a conventional rotating fan. These include, for example, improved reliability, the provision of a more compact system (space saving), the provision of a lower energy system and reduced noise.

[0010] In a second aspect, the invention provides a dishwasher comprising an air filter for removing odours from air; and a control unit adapted to monitor the usage of the air filter and generate an alert when the remaining service life of the air filter falls below a predetermined threshold.

[0011] Advantageously, by including a control unit with the ability to monitor the usage of the air filter and generate an alert when the remaining service life of the air filter falls below a predetermined threshold, a dishwasher in accordance with the second aspect of the invention is able to track, in real-time, the condition of the air filter, and report on its effectiveness to the user.

[0012] The features of the first and the second aspect may be combined. In this embodiment, the dishwasher comprises an air filter for removing odours from air; a control unit adapted to monitor the usage of the air filter and generate an alert when the remaining service life of the air filter falls below a predetermined threshold; and at least one piezoelectric fan positioned to cause air from within the washing compartment to pass through the air filter so as to remove odours from the dishwasher.

[0013] The air filter is permeable to air. As such, the air filter allows air to flow through it unimpeded. In order to remove odours from the air, the air filter preferably comprises an odour adsorbing material, such as activated carbon (also called activated coal and activated coke).

[0014] Preferably, the air filter is impermeable to liquid, and in particular, impermeable to water. This prevents free flow of liquid through the air filter.

[0015] In this embodiment, the air filter may comprise a liquid-impermeable membrane formed from a hydrophobically modified odour adsorbing material, such as a hydrophobic activated carbon material. The term "hydrophobic" means that the static water contact angle at 25 °C is greater than or equal to 90°. However, the liquid-impermeable membrane may have a static water contact angle at 25 °C of greater than or equal to 100°, greater than or equal to 110° or greater than or equal to 120°. Alternatively, a liquid-impermeable air filter may be layered in structure. For example, the air filter may include at least one liquid-impermeable layer and at least one odour adsorbing layer. The liquid-impermeable layer may be formed of expanded polytetrafluoroethylene (ePTFE) and/or polyurethane (PU), while the odour adsorbing layer may be formed of activated carbon. The layers may be in contact or may be separated from each other. Preferably, when layered in structure, the air filter comprises at least two liquid-impermeable layers, dimen-

sioned so as to fully encapsulate the odour adsorbing layer. Encapsulation ensures that the odour adsorbing layer is protected from exposure to liquid.

[0016] The air filter may be located in the washing compartment of the dishwasher. When located in the washing compartment, the air filter is preferably dimensioned and arranged so as to divide the washing compartment into two separate chambers. In this embodiment, the first chamber may accommodate the dish washing space and the second chamber may accommodate at least one piezoelectric fan. When the air filter is impermeable to liquid, this arrangement prevents liquid from entering the piezoelectric fan-containing chamber. In contrast, air inside the washing compartment is circulated between the two chambers, via the air filter. To assist air flow, the dishwasher may be provided with air ducts, arranged to direct air out of piezoelectric fan-containing chamber and into the dish washing space of the first chamber.

[0017] Preferably, the air filter is located near the top of the washing compartment, such that, when the dishwasher includes a lower dishwasher basket and an upper dishwasher basket, the air filter is located above the upper dishwasher basket.

[0018] To enable replacement of the air filter at the end of its service life, the air filter is preferably held in position using reversible connectors.

[0019] As described above, the dishwasher may include at least one piezoelectric fan. Preferably, the dishwasher includes at least three piezoelectric fans, positioned to cause air from within the washing compartment to pass through different regions of the air filter.

[0020] Piezoelectric fans are solid state devices without rotating or moving parts. A typical piezoelectric fan includes an amplifying blade, such as a sheet of Mylar, attached to a piezo bending element. When the piezo bending element is connected to an AC power supply, it is caused to flex back and forth at the electrical input frequency. This drives oscillation of the amplifying blade at the same vibrational frequency. In free air, high amplitude vibration of the amplifying blade causes the formation of a high velocity flow stream. Maximum airflow occurs along the axis of the fan's centreline. Air intake is above and below the swept-out volume of the blade.

[0021] The at least one piezoelectric fan may be a commercially available piezoelectric fan that provides high air velocity with minimal power consumption. For example, the "Piezoelectric Fan Blade 60 Hz", which is based on the piezo material SM111 and is available from STEINER & MARTINS, INC.

[0022] The control unit, when present, is adapted to monitor the usage of the air filter and generate an alert when the remaining service life of the air filter falls below a predetermined threshold. This may be determined, for example, based upon the predicted number of vacant adsorption sites.

[0023] The alert may be vibrational, visible and/or audible, and may be selected by the user. For example, the alert may be the illumination of a warning light or the

activation of an audio alarm included in the dishwasher.

[0024] In order to alert the user remotely, the control unit may be configured to transmit to a receiver a signal indicative of the remaining service life of the air filter. In this embodiment, preferably both the signal and receiver are wireless. When the signal is transmitted wirelessly, the receiver may be a personal electronic device, such as, a laptop computer, a mobile phone or a tablet computer, and the alert may be the activation of an alarm or the sending of a text message or an email.

[0025] The control unit may comprise a microprocessor and a wireless transmitter. The microprocessor is preferably a Peripheral Interface Controller (PIC), arranged to measure and record the accumulative usage time of the air filter and, from this, calculate its expected remaining service life.

[0026] The wireless transmitter may comprise a Bluetooth transmitter, a radio transmitter or a Wi-Fi transmitter. The Bluetooth transmitter may comprise a standard Bluetooth module and/or a Bluetooth low energy (BLE) module. The term "standard Bluetooth module" is used herein to refer to a Bluetooth module such as, but not limited to, a Bluetooth version 2.0 + EDR (Enhanced Data Rates) module, while the term "Bluetooth low energy module" is used to refer to a Bluetooth module such as, but not limited to, a Bluetooth version 4.0 (Bluetooth smart), a Bluetooth version 4.1, a Bluetooth version 4.2 or a Bluetooth version 5. Alternatively, the Bluetooth sensor module may comprise a Bluetooth module using IPv6 Internet Protocol Support Profile (IPSP).

[0027] The control unit may be mounted on or close to the air filter. Alternatively, the control unit can be included in the control panel of the dishwasher.

[0028] In a third aspect, the invention provides a system for removing odours from a dishwasher. The system comprises a dishwasher having an air filter for removing odours from air and a control unit adapted to monitor the usage of the air filter and generate an alert when the remaining service life of the air filter falls below a predetermined threshold; and a wireless receiver adapted to receive the wireless signal and communicate the remaining service life of the air filter to a user.

[0029] By using a wireless signal and a wireless receiver, a system in accordance with the third aspect of the present invention is able to communicate the remaining service life of the air filter to a user remotely, and alert the user when the air filter needs replacing.

[0030] As described above, the wireless receiver may be a personal electronic device, such as, a laptop computer, a mobile phone or a tablet computer.

[0031] Preferably, the wireless receiver is adapted to pair automatically to the wireless transmitter and includes means for advising the user of the subsistence of a wireless link between the wireless receiver and the wireless transmitter.

[0032] The wireless receiver may include a visual display for presenting to the user a visual representation of the remaining service life of the air filter. This may, for

example, be in the form of a percentage value or the filling of a scale bar.

[0033] In order to alert the user when the remaining service life of the air filter falls below a predetermined threshold, the wireless receiver preferably includes an alarm. The alarm may be a vibrational, visible and/or audible alarm, or the sending of a text message or an email.

[0034] All features described in connection with any aspect of the invention can be used with any other aspect of the invention.

[0035] An exemplary embodiment of the invention will be further described with reference to the accompanying drawing in which:

Figure 1 is a vertical sectional representation of a dishwasher in accordance with an embodiment of the first and second aspect of the invention.

[0036] The embodiment shown in **Figure 1** includes a dishwasher **1** comprising a washing compartment **10** and a door **11** hinged at its base to selectively open and close a front opening of the dishwasher **1**.

[0037] Upper and lower dishwasher baskets **4** and **5**, designed to accommodate dishes, glasses, mugs, etc., to be washed, are removably arranged in upper and lower portions of the washing compartment **10**, respectively. Upper and lower injection nozzles **6** and **7** are supplied with wash water, and inject the wash water into the upper and lower dishwasher baskets **4** and **5**, respectively. The upper and lower injection nozzles **6** and **7** are positioned under the corresponding upper and lower dishwasher baskets **4** and **5**.

[0038] The dishwasher **1** includes an air filter **2** which extends horizontally between the three walls of the washing compartment **10** and abuts the door **11**, when closed. As a result, the air filter **2** divides the washing compartment **10** into an upper chamber **8** and a lower chamber **9**. The air filter **2** is a liquid-impermeable membrane formed of a hydrophobic activated carbon material. The air filter **2** is reversibly secured within the washing compartment **10** via connectors (not shown).

[0039] The upper chamber **8** includes three piezoelectric fans **3** comprising a piezo bending element and a Mylar blade. The piezoelectric fans **3** are positioned relative to the air filter **2** for drawing air from the lower chamber **9** into the upper chamber **8**. Each piezoelectric fan **3** is connected to an AC power supply by two conductor wires (not shown). The connections are encapsulated in a resin material, which isolates them from the external environment.

[0040] When the AC power supply is switched on, the piezoelectric fans **3** are caused to oscillate. This oscillation draws air from the lower chamber **9** into the swept-out volume of the Mylar blade in the upper chamber **8**, via the air filter **2**. At the same time, the oscillation of the piezoelectric fans **3** drives air from the upper chamber **8** into the lower chamber **9**, via the air filter **2**. As the air travels through the air filter **2**, in either direction, it is

stripped of odorous organic materials by the activated carbon. The continued air circulation (shown by arrows **12**) ensures that substantially all odorous organics are removed from the washing compartment **10**. The hydrophobic nature of the air filter **2** prevents any wash water or residual moisture present in the washing compartment **10** from flowing into the upper chamber **8**.

[0041] A control unit **14** is also included in the control panel of dishwasher **1**. The control unit **14** comprises a microprocessor and a wireless transmitter. In this embodiment, the wireless transmitter is a Bluetooth™ module. In use, the Bluetooth™ module is paired to a receiver, such as a mobile phone or other remote electronic device. The microprocessor measures and records the accumulative usage time of the air filter **2**. The microprocessor subsequently generates a digital signal corresponding to the remaining service life expectancy of the air filter **2** and communicates this to the remote electronic device via the Bluetooth™ module.

[0042] When the remaining service life of the air filter **2** falls below a pre-set value, the signal transmitted to the receiver triggers an alarm. This alarm alerts the user to the fact that the air filter **2** needs replacing.

[0043] Whilst the invention has been described with reference to an exemplary embodiment, it will be appreciated that various modifications are possible within the scope of the invention.

[0044] In this specification, unless expressly otherwise indicated, the word 'or' is used in the sense of an operator that returns a true value when either or both of the stated conditions is met, as opposed to the operator 'exclusive or' which requires that only one of the conditions is met. The word 'comprising' is used in the sense of 'including' rather than to mean 'consisting of'. All prior teachings acknowledged above are hereby incorporated by reference. No acknowledgement of any prior published document herein should be taken to be an admission or representation that the teaching thereof was common general knowledge in Europe or elsewhere at the date hereof.

Claims

1. A dishwasher, comprising:

a washing compartment;
an air filter for removing odours from air; and
at least one piezoelectric fan positioned to cause air from within the washing compartment to pass through the air filter so as to remove odours from the dishwasher.

2. A dishwasher as claimed in Claim 1, comprising a control unit adapted to monitor the usage of the air filter and generate an alert when the remaining service life of the air filter falls below a predetermined threshold.

3. A dishwasher as claimed in Claim 2, wherein the control unit is configured to transmit to a receiver a signal indicative of the remaining service life of the air filter. 5
4. A dishwasher as claimed in Claim 3, wherein the control unit comprises a wireless transmitter operable to transmit the signal wirelessly to the receiver. 10
5. A dishwasher as claimed in Claim 3 or Claim 4, wherein the receiver is an electronic user device. 15
6. A dishwasher, comprising:
 - a washing compartment; 20
 - an air filter for removing odours from air; and
 - a control unit adapted to monitor the usage of the air filter and generate an alert when the remaining service life of the air filter falls below a predetermined threshold. 25
7. A dishwasher as claimed in Claim 6, wherein the control unit is configured to transmit to a receiver a signal indicative of the remaining service life of the air filter. 30
8. A dishwasher as claimed in Claim 7, wherein the control unit comprises a wireless transmitter operable to transmit the signal wirelessly to the receiver. 35
9. A dishwasher as claimed in Claim 7 or Claim 8, wherein the receiver is an electronic user device. 40
10. A dishwasher as claimed in any of claims 6 to 9, comprising at least one piezoelectric fan positioned to cause air from within the washing compartment to pass through the air filter so as to remove odours from the dishwasher. 45
11. A dishwasher as claimed in any preceding claim, wherein the air filter is impermeable to liquid. 50
12. A dishwasher as claimed in any preceding claim, wherein the air filter comprises a hydrophobic activated carbon material. 55
13. A dishwasher as claimed in any preceding claim, comprising a lower dishwasher basket arranged in the lower region of the washing compartment and an upper dishwasher basket arranged in the upper region of the washing compartment, wherein the air filter extends at least partially across the washing compartment and is located above the upper dishwasher basket. 60
14. A system for removing odours from a dishwasher, the system comprising the dishwasher according to Claim 4 or Claim 8 and a wireless receiver adapted to receive the wireless signal and communicate the remaining service life of the air filter to a user. 65
15. A system as claimed in Claim 14, wherein the wireless receiver includes an alarm for alerting the user when the remaining service life of the air filter falls below a predetermined threshold. 70

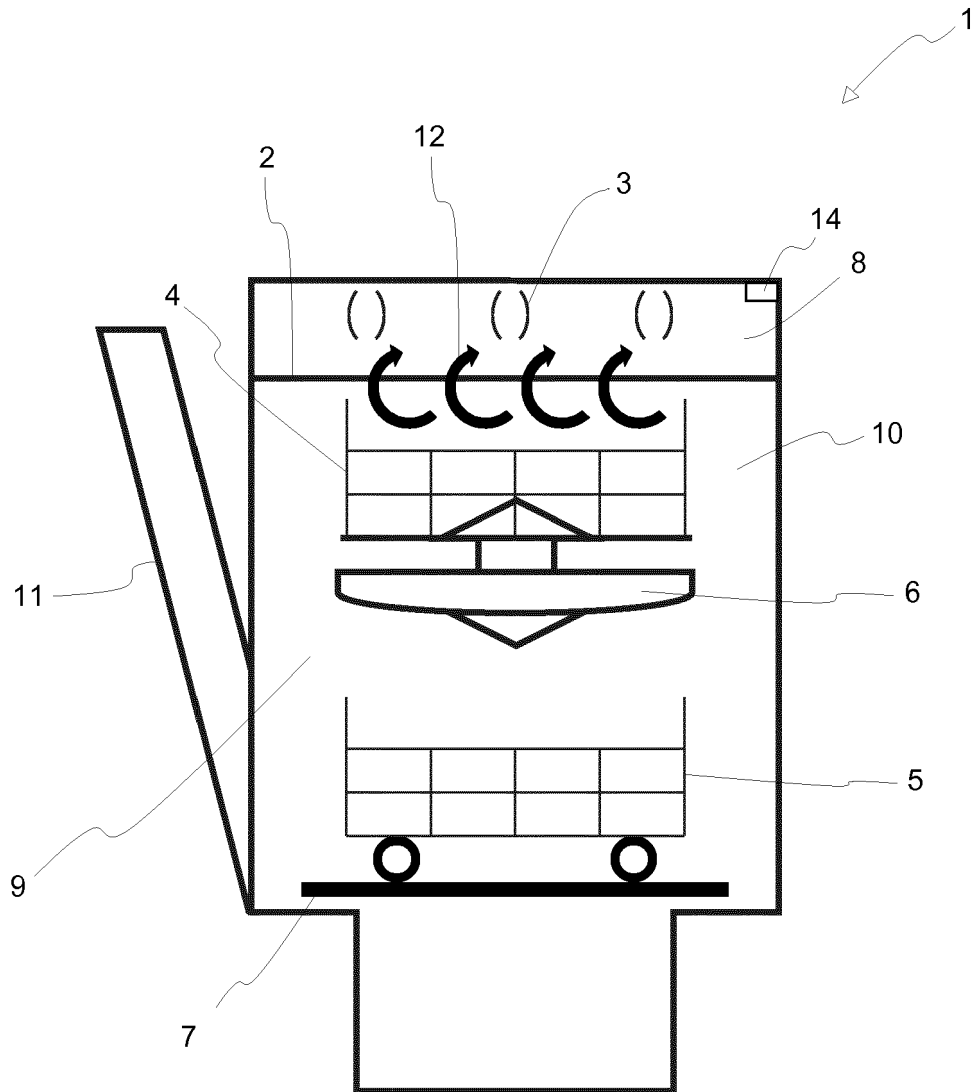


Figure 1



EUROPEAN SEARCH REPORT

Application Number
EP 17 20 9821

5

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	EP 1 872 704 A1 (BRANDT IND [FR]) 2 January 2008 (2008-01-02) * paragraphs [0170] - [0176]; figures 1,7 *	1-5, 11-15	INV. A47L15/42
Y	JP H06 159903 A (HITACHI LTD) 7 June 1994 (1994-06-07) * columns 26,27; figures 6,7 *	1-5, 11-15	
Y	CN 201 710 282 U (MATSUSHITA ELECTRIC IND CO LTD) 19 January 2011 (2011-01-19) * page 2 - page 2 *	2,3	
A	JP 2004 285920 A (NIPPON KEIKI WORKS) 14 October 2004 (2004-10-14) * abstract; figure 1 *	1	
A	US 2017/152845 A1 (SASAKI MASAHIRO [JP] ET AL) 1 June 2017 (2017-06-01) * abstract; figures 1,3,4a,4B *	1	
A	EP 1 602 774 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 7 December 2005 (2005-12-07) * paragraph [0025]; figures 3,4 *	1,3	TECHNICAL FIELDS SEARCHED (IPC) A47L D06F F04B
A	DE 10 2011 087583 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 6 June 2013 (2013-06-06) * paragraphs [0002], [0003], [0011]; figure 1 *	1	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 March 2018	Examiner Kising, Axel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	



Application Number

EP 17 20 9821

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-5, 11-15

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 17 20 9821

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-5, 11-15

A dishwasher with at least one piezoelectric fan and an air filter to remove odours

2. claims: 6-15

A dishwasher with a control unit to monitor the usage of an air filter and generate an alert when the remaining service life of the air filter falls below a determined threshold value

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 20 9821

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1872704 A1	02-01-2008	AT 457676 T EP 1872704 A1 ES 2340810 T3 FR 2902990 A1	15-03-2010 02-01-2008 09-06-2010 04-01-2008
JP H06159903 A	07-06-1994	NONE	
CN 201710282 U	19-01-2011	NONE	
JP 2004285920 A	14-10-2004	NONE	
US 2017152845 A1	01-06-2017	CN 206903844 U JP 6332461 B2 JP W02016027817 A1 US 2017152845 A1 WO 2016027817 A1	19-01-2018 30-05-2018 27-04-2017 01-06-2017 25-02-2016
EP 1602774 A1	07-12-2005	CN 1704519 A EP 1602774 A1 JP 2005342499 A KR 20050114107 A US 2005265890 A1	07-12-2005 07-12-2005 15-12-2005 05-12-2005 01-12-2005
DE 102011087583 A1	06-06-2013	CN 103957946 A DE 102011087583 A1 EP 2785385 A1 WO 2013079462 A1	30-07-2014 06-06-2013 08-10-2014 06-06-2013

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20030221709 A1 [0003] [0005]
- EP 1872704 A1 [0004] [0005]