



(11)

EP 3 447 389 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.02.2019 Bulletin 2019/09

(51) Int Cl.:
F24C 15/00 ^(2006.01) **H05B 6/12** ^(2006.01)
F24C 15/32 ^(2006.01)

(21) Application number: **17187974.5**

(22) Date of filing: **25.08.2017**

(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

(72) Inventor: **KUÇUKSAHİN, Oguzhan**
45030 Manisa (TR)

(74) Representative: **Flint, Adam**
Page White & Farrer
Bedford House
John Street
London WC1N 2BF (GB)

(71) Applicant: **Vestel Elektronik Sanayi ve Ticaret A.S.**
45030 Manisa (TR)

(54) **COOKING APPLIANCE**

(57) A cooking appliance and method of cooling are provided. The cooking appliance comprises a first cooking element (14) and a second cooking element (20), the first and second cooking elements having an associated cavity (16, 22) within the appliance. A cooling system (26, 28, 30, 32, 40) is provided for cooling one or both of the cavities (16, 22), the cooling system comprising a

pressure-changing tube arrangement (28, 30, 32) linking the cavities (16, 22) and a bi-directional fan (26) controllable, when operating in a first direction, to pump heated air between the cavities (16, 22) through the pressure-changing tube arrangement (28, 30, 32) thereby to cool one or both of the cavities (16, 22).

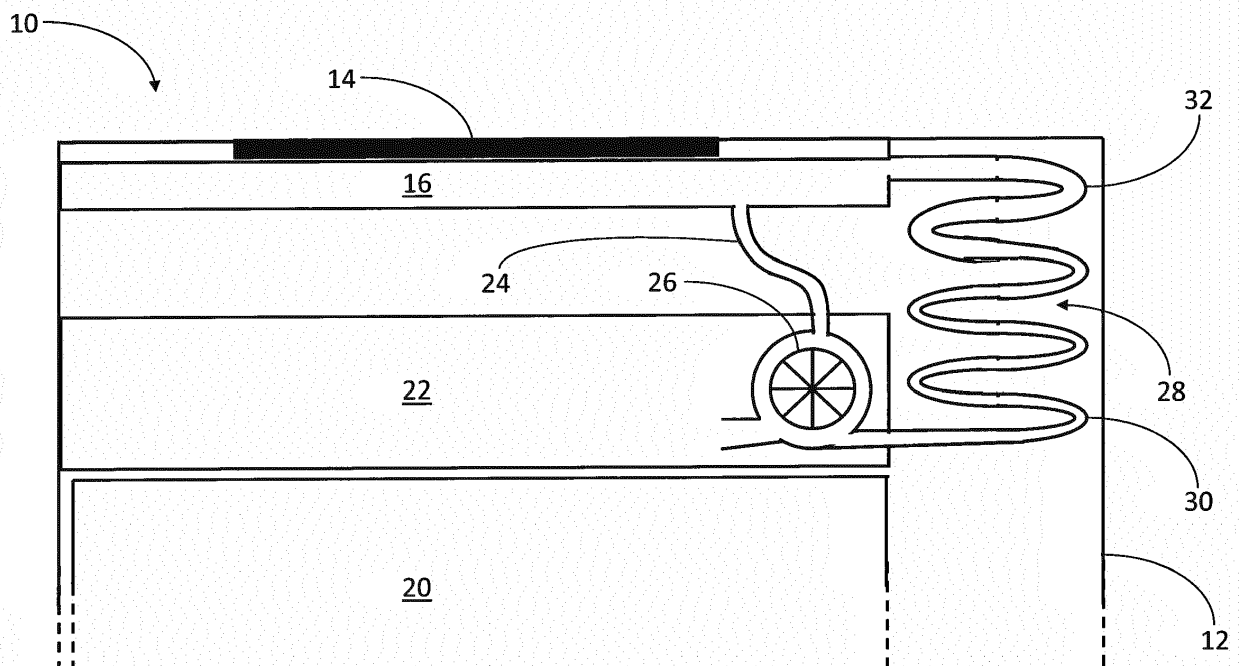


Figure 1

Description

Technical Field

[0001] The present disclosure relates to cooking appliances.

Background

[0002] Cooking appliances usually require some form of cooling system to remove heat from internal cavities, for example cavities housing electronic control circuits. This is a particular requirement where one or more ovens are provided beneath a cooking surface having an electric induction cooker or other direct heating element, both types of cooking element being provided in the same cooking appliance.

[0003] It is conventional to provide a cavity above or surrounding an oven between the oven housing and a housing of the cooking appliance. This enables heat emitted by the oven due to imperfect thermal insulation of the oven to be removed before it has a chance to heat an outer surface of the appliance housing, for safety reasons. Such a cavity also typically houses control electronics for the oven and requires some level of cooling. A fan may be located in the cavity above an oven to expel heated air from the cavity to the outside world via a conveniently positioned vent. Air contained in such a cavity would otherwise be heated to a high temperature when the oven below it is operating.

[0004] It is also conventional to provide a cavity below an induction cooker coil or other form of direct heating element to house control electronics and to enable air to circulate and provide some level of cooling. A fan may also be provided in such a cavity to assist with the circulation of air. However, a lower level of heating within such a cavity would be expected as compared with a cavity above an oven and heat would be expected to originate primarily from the control electronics, in particular when controlling an induction cooker.

Summary

[0005] According to a first aspect disclosed herein, there is provided a cooking appliance, comprising a first cooking element and a second cooking element, the first and second cooking elements having an associated cavity within the appliance, and a cooling system for cooling one or both of the cavities, the cooling system comprising a pressure-changing tube arrangement linking the cavities and a bi-directional fan controllable, when operating in a first direction, to pump heated air between the cavities through the pressure-changing tube arrangement thereby to cool one or both of the cavities.

[0006] In an example, the pressure-changing tube arrangement comprises a high-pressure section of tubing linked to a low-pressure section of tubing such that heated air is pumped by the fan, when operating in a first

direction, into the high-pressure section of tubing. Such an arrangement implements a heat pump effect with the benefit that a more rapid cooling of heated air may be achieved. By causing the pressure of the heated air to fall, the temperature of the heated air reduces rapidly, thereby cooling the heated air.

[0007] In an example, the low pressure section of tubing comprises crimped tubing. The additional surface area of crimped tubing provides an additional cooling effect.

[0008] In an example, the high and low pressure sections of tubing comprise, respectively a section of relatively narrow and a section of relatively wide tubing.

[0009] In an example, heated air is pumped by the fan, when operating in a second direction, out of the cooking appliance by means of a vent linking the fan to an outside of the appliance.

[0010] In an example, comprising at least one temperature sensor for sensing a temperature in at least one of the first and second cavities and a control unit arranged to receive the at least one sensed temperature and to control the fan to operate at a fan speed and in a direction selected according to the at least one sensed temperature.

[0011] In an example, the control unit is arranged, when the at least one sensed temperature reaches a predetermined threshold temperature, to activate the fan to operate in the first direction to pump air between the cavities via the pressure-changing tube arrangement. In this way, the fan may be controlled to cool the air in the cavities according to a sensed temperature.

[0012] In an example, the control unit is arranged to activate the fan to operate in the first direction at a reduced fan speed when only the first cooking element is operating.

[0013] In an example implementation, the first cooking element is an induction cooker or other cooking element provided at a cooking surface of the appliance, and the second cooking element is an oven.

[0014] According to a second aspect disclosed herein, there is provided a method for cooling a cooking appliance, the cooking appliance having first and second cavities associated with first and second cooking elements of the appliance, the method comprising pumping heated air between the first cavity and the second cavity via a pressure-changing tube arrangement linking the cavities (16, 22) such that heated air passes from a higher pressure section of the pressure-changing tube arrangement to a lower pressure section of the pressure-changing tube arrangement thereby to cool the heated air.

[0015] In an example, the method comprises measuring a temperature in at least one of the first and second cavities and controlling a fan to pump heated air between the cavities via the pressure-changing tube arrangement according to the measured temperature.

[0016] In an example, the method comprises controlling the speed and direction of the fan according to the measured temperature.

Brief Description of the Drawings

[0017] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically a section through a cooking appliance having a cooling system according to the present disclosure; and

Figure 2 shows schematically a control unit for controlling the cooling system according to the present disclosure.

Detailed Description

[0018] According to embodiments to be described below, a different type of cooling system may be provided in cooking appliances having both an oven and an induction cooker, for example, provided in the same cooking appliance. The cooling system may be operated differently according to whether only one of the oven and the induction cooker is operating or both of the oven and the induction cooker are operating.

[0019] The cooling system and its operation will now be described with reference to Figure 1. The description provided will assume by way of example that the cooking appliance incorporates an oven and an induction cooker. However, it will be clear that other types of direct or indirect heat source may be used to heat cooking vessels and the cooling system to be described below may be applied also to cooking appliances incorporating such other types of heat source as a cooking element of the appliance.

[0020] Referring to Figure 1, there is shown schematically a cooking appliance 10 having a housing 12 in which is mounted an induction cooker coil 14 and an associated cavity 16 for containing control electronics (not shown in Figure 1) for the induction cooker coil 14.

[0021] Also shown in Figure 1, the housing 12 contains an oven 20 having a cavity 22 located above the oven 20 for containing control electronics for example (not shown in Figure 1) and to provide a cooling region between the oven 20 and the housing 12. A bi-directional fan 26 is provided in or linked to the cavity 22 which may be operated to rotate in a first direction to pump air between the cavity 22 above the oven 20 and the induction cooker cavity 16 through an arrangement of tubing 28 linking the cavity 22 above the oven to the induction cooker cavity 16. The fan 26 is also linked to the induction cooker cavity 16 by means of a tube 24. The tube 24 provides a return path for air that has been pumped by the fan 26 from the cavity 22 above the oven 20 to the induction cooker cavity 16 via the arrangement of tubing 28, after the air has circulated through the induction cooker cavity 16.

[0022] The fan 26 may be operated to rotate in a second direction to pump air from the cavity 22 above the

oven 20 out of the appliance housing 12 without passing through the tubing 28. A vent is provided (not shown in Figure 1) linking the fan 26 to the outside of the appliance housing 12 to enable air to be pumped out of the appliance in this way. When the fan 26 is operating in the first direction, the vent linking the fan 26 to the outside of the housing 12 is closed by a moveable flap, moved for example by means of an active closure arrangement involving a small solenoid actuator, or a passive closure arrangement triggered by a change of direction of air flow by the fan 26.

[0023] The arrangement of tubing 28 comprises two sections: a relatively narrow section of tubing 30 linked to the cavity 22 above the oven 20, and a relatively wide section of tubing 32 linked to the induction cooker cavity 16. When the fan 26 is operated in the first direction, it pumps heated air into the narrow section 30 of the tubing 28, increasing the pressure of the heated air as it passes through that narrow section 30. When the higher-pressure heated air reaches the wider section 32 of the tubing 28 the air pressure drops leading to a rapid fall in temperature of the air as it passes through that wider section 32. A further cooling effect may be achieved if the wider section 32 of the tubing 28 comprises a crimped tube, having an increased surface area.

[0024] As mentioned above, the fan 26 is a bi-directional fan which may be operated differently for three different modes of operation of the cooling system.

[0025] In a first mode, for example when only the oven 20 is being operated, air contained in the cavity 22 above the oven 20 is heated by the oven. The fan 26 is operated to rotate in the second direction to expel the heated air from the cavity 22 to the outside world by means of the vent mentioned above, linking the fan 26 to the outside world.

[0026] In a second mode, for example when only the induction cooker 14 is operating, the fan 26 may be operated to rotate in the first direction at a reduced speed, taking account of the lower temperature of heated air expected within the induction cooker cavity 16. The reduced-speed fan 26 draws the heated air from the induction cooker cavity 16 via the tube 24 and pumps the heated air through the arrangement of tubing 28, returning cooled air to the induction cooker cavity 16.

[0027] In a third mode, for example when both the oven 20 and the induction cooker 14 are operating, the fan 26 is operated to rotate in the first direction at full speed. The fan 26 pumps heated air from the cavity 22 above the oven 20, and any partially heated air drawn into the cavity 22 from the induction cooker cavity 16 via the tube 24, into the narrow section 30 of the tubing 28. The pressure is raised by the full-speed fan 26 to a higher level in the narrow section 30 than for the second mode, above. After the pressure drop and resultant cooling of the heated air, cooled air is returned to the induction cooker cavity 16 and is drawn through that cavity 16 to cool electrical components housed therein, the cooled air also returning to the cavity 22 above the oven 20 via the tube 24.

[0028] These three modes of operation may in practice be selected according to a measured temperature within one or both of the cavities 16, 22 or according to a temperature difference between the induction cooker cavity 16 and the cavity 22 above the oven 20. For example, if both the oven 20 and the induction cooker 14 are operating, but the oven 20 is not yet up to its operating temperature, the fan 26 may be operated as for the second mode at a reduced speed until the temperature in the cavity 22 increases to a predetermined threshold level. Use of the second mode wherever possible reduces electricity consumption.

[0029] Furthermore, if only the oven 20 is operating but the cavity 22 above the oven 20 is reaching a high temperature, the cooling system may be operated according to the third mode instead of the first mode to exploit the cooling effects provided by the arrangement of tubing 28.

[0030] A temperature sensor may be provided in each of the induction cooker cavity 16 and the cavity 22 above the oven 20 to provide respective temperature indications to a control unit for the cooker 10. The control unit is arranged to control the fan 26 according to the most appropriate one of the three modes of operation summarised above. Operation of the control unit will now be described in more detail with additional reference to Figure 2.

[0031] Referring additionally to Figure 2, a cooker control unit 40 is shown connected to receive temperature indications from a temperature sensor 42 located within the induction cooker cavity 16 and a temperature sensor 44 located within the cavity 22 above the oven 20. The temperature sensors 42, 44 may be thermistors, for example. The control unit 40 is connected to control the fan 26 according to the selected one of the three modes described above.

[0032] The control unit 40 may be arranged to store one or more threshold temperature values and to switch between the modes when sensed temperatures reach those threshold values, including for example:

- a threshold temperature for the sensor 44: at or below the threshold, the fan 26 will be operated according to the second mode; above the threshold the fan 26 will be operated according to the third mode, and
- a threshold difference between the temperature of the sensor 42 and that of the sensor 44: at or below the threshold difference the fan 26 will be operated according to the second mode or the third mode, according to the temperature sensed by the sensor 44; above the threshold difference, the fan 26 will be operated according to the first mode.

[0033] Further threshold levels may be stored and acted upon by the control unit 40, for example if the fan 26 is to be operated at one of a number of different speeds. For example the fan speed when operating according to any of the modes may be increased by the control unit

40 in a number of steps according to increasing temperature of the sensor 44 in the cavity 22. For each of a number of different fan speeds, a respective temperature range may be stored by the control unit 40 such that it may select the fan speed according to which temperature range a sensed temperature falls within.

[0034] It will be understood that the cooker control unit 40 may be implemented using a processor or processing system and by circuitry referred to herein comprising a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC) or field-programmable gate array (FPGA), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors and a digital signal processor or processors, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0035] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A cooking appliance, comprising a first cooking element (14) and a second cooking element (20), the first and second cooking elements having an associated cavity (16, 22) within the appliance, and a cooling system (26, 28, 30, 32, 40) for cooling one or both of the cavities (16, 22), the cooling system comprising a pressure-changing tube arrangement (28, 30, 32) linking the cavities (16, 22) and a bi-directional fan (26) controllable, when operating in a first direction, to pump heated air between the cavities (16, 22) through the pressure-changing tube arrangement (28, 30, 32) thereby to cool one or both of the cavities (16, 22).
2. The cooking appliance according to claim 1, wherein the pressure-changing tube arrangement comprises a high-pressure section of tubing (30) linked to a low-pressure section of tubing (32) such that heated air

is pumped by the fan (26), when operating in a first direction, into the high-pressure section of tubing (30).

3. The cooking appliance according to claim 2, wherein the low-pressure section of tubing (32) comprises crimped tubing. 5
4. The cooking appliance according to claim 2 or claim 3, wherein the high and low-pressure sections of tubing (30, 32) comprise, respectively a section of relatively narrow and a section of relatively wide tubing. 10
5. The cooking appliance according to any one of claims 1 to 4, wherein heated air is pumped by the fan (26), when operating in a second direction, out of the cooking appliance by means of a vent linking the fan (26) to an outside of the appliance. 15
6. The cooking appliance according to any one of claims 1 to 5, comprising at least one temperature sensor (42, 44) for sensing a temperature in at least one of the first and second cavities (16, 22) and a control unit (40) arranged to receive the at least one sensed temperature and to control the fan (26) to operate at a fan speed and in a direction selected according to the at least one sensed temperature. 20 25
7. The cooking appliance according to claim 6, wherein the control unit (40) is arranged, when the at least one sensed temperature (42,44) reaches a predetermined threshold temperature, to activate the fan (26) to operate in the first direction to pump air between the cavities (16, 22) via the pressure-changing tube arrangement (28, 30, 32). 30 35
8. The cooking appliance according to claim 6 or claim 7, wherein the control unit (40) is arranged to activate the fan (26) to operate in the first direction at a reduced fan speed when only the first cooking element (14) is operating. 40
9. The cooking appliance according to any one of claims 1 to 8, wherein the first cooking element (14) is an induction cooker or other cooking element provided at a cooking surface of the appliance, and the second cooking element (20) is an oven. 45
10. A method for cooling a cooking appliance, the cooking appliance having first and second cavities (16, 22) associated with first and second cooking elements (14, 20) of the appliance, the method comprising pumping heated air between the first cavity and the second cavity via a pressure-changing tube arrangement (28, 30, 32) linking the cavities (16, 22) such that heated air passes from a higher pressure section (30) of the pressure-changing tube arrangement to a lower pressure section (32) of the pressure- 50 55

changing tube arrangement thereby to cool the heated air.

11. The method according to claim 10, comprising measuring (42, 44) a temperature in at least one of the first and second cavities (16, 22) and controlling (40) a fan (26) to pump heated air between the cavities (16, 22) via the pressure-changing tube arrangement (28, 30, 32) according to the measured temperature.
12. The method according to claim 11, comprising controlling the speed and direction of operation of the fan (26) according to the measured temperature.

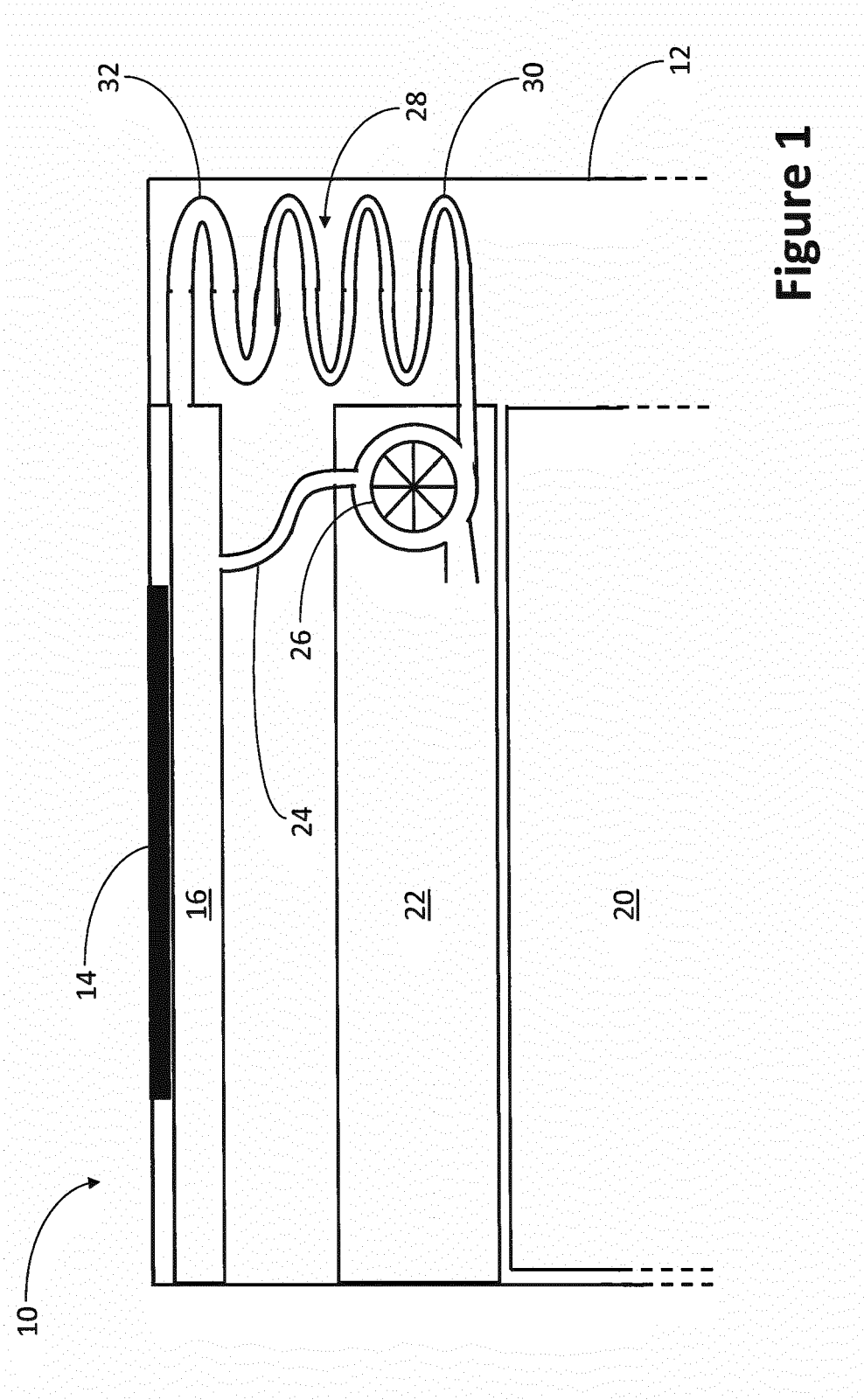


Figure 1

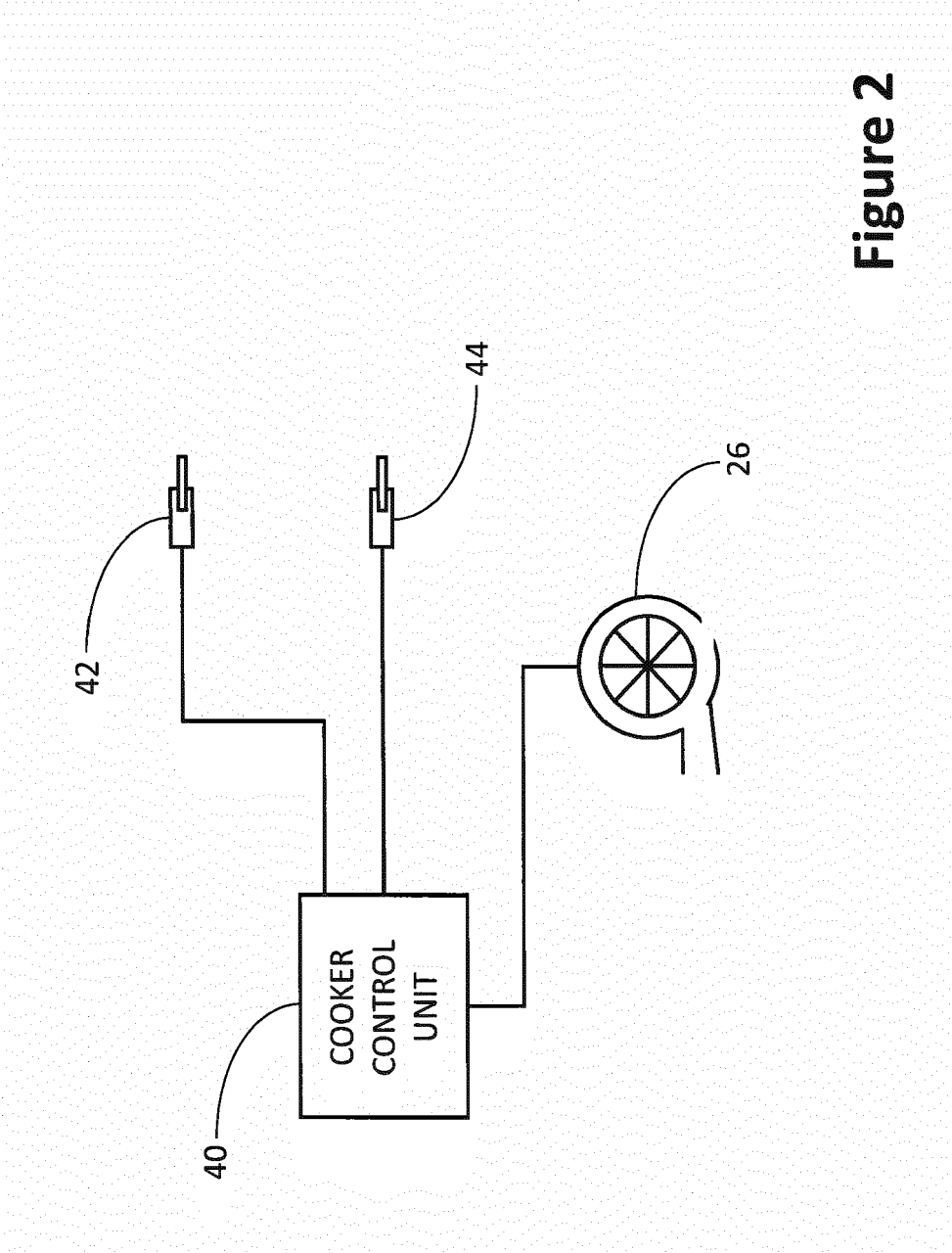


Figure 2



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 18 7974

5

10

15

20

25

30

35

40

45

50

55

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	DE 10 2006 007379 A1 (RATIONAL AG [DE]) 30 August 2007 (2007-08-30) * paragraphs [0027], [0033], [0037], [0040]; figures 1, 2 *	1,2,5,6	INV. F24C15/00 H05B6/12
X	EP 1 601 236 A2 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 30 November 2005 (2005-11-30) * paragraphs [0006], [0007], [0008], [0018], [0019], [0021], [0022] * * figure 1 *	1,2,9,10	ADD. F24C15/32
X	US 3 889 099 A (NUSS JAMES J) 10 June 1975 (1975-06-10) * column 2, line 22 - column 2, line 23 * * column 2, line 27 - column 2, line 35 * * column 2, line 44 - column 2, line 53 * * column 2, line 58 - column 2, line 68 * * column 3, line 5 - column 3, line 9 * * column 4, line 57 - column 4, line 59 * * figure 1 *	1,2,4,5,10	
X	DE 30 42 906 A1 (LICENTIA GMBH [DE]) 8 July 1982 (1982-07-08) * page 2, line 18 - page 2, line 22 * * page 3, line 1 - page 3, line 16 * * figure 1 *	1,10	TECHNICAL FIELDS SEARCHED (IPC) F24C H05B
A	DE 10 2008 058718 A1 (RATIONAL AG [DE]) 27 May 2010 (2010-05-27) * paragraphs [0001], [0034], [0035], [0038] * * figure 1 *	3,4	
A	DE 20 2015 106851 U1 (MIELE & CIE [DE]) 15 January 2016 (2016-01-15) * figure 1 *	1-12	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 19 February 2018	Examiner Jalal, Rashwan
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	

EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
EP 17 18 7974

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 10 2013 213464 A1 (E G O ELEKTRO GERÄTEBAU GMBH [DE]) 7 August 2014 (2014-08-07) * figure 3 * * paragraphs [0001], [0002], [0022] * -----	1-12	
A	DE 10 2012 109153 A1 (MIELE & CIE [DE]) 17 April 2014 (2014-04-17) * paragraphs [0003], [0006], [0007], [0008], [0010] * * figures 1, 2 * -----	1-12	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
Place of search The Hague		Date of completion of the search 19 February 2018	Examiner Jalal, Rashwan
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			

EPO FORM 1503 03.82 (P04C01)

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

EP 17 18 7974

5

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-02-2018

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102006007379 A1	30-08-2007	NONE	
EP 1601236 A2	30-11-2005	DE 102004025915 A1 EP 1601236 A2	22-12-2005 30-11-2005
US 3889099 A	10-06-1975	AU 8243075 A CA 1033242 A DE 2533539 A1 FR 2280865 A1 US 3889099 A	06-01-1977 20-06-1978 19-02-1976 27-02-1976 10-06-1975
DE 3042906 A1	08-07-1982	NONE	
DE 102008058718 A1	27-05-2010	NONE	
DE 202015106851 U1	15-01-2016	DE 102015100508 A1 DE 202015106851 U1	14-07-2016 15-01-2016
DE 102013213464 A1	07-08-2014	NONE	
DE 102012109153 A1	17-04-2014	NONE	