(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 095 372 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.11.2016 Bulletin 2016/47

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

(21) Application number: **15168773.8**

(22) Date of filing: **21.05.2015**

(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

(71) Applicant: **Illinois Tool Works Inc.**
Glenview, IL 60025 (US)

(72) Inventors:
- **Orlandi, Riccardo**
  55011 Badia Pozzeveri- Altopascio (IT)
- **Fabbri, Riccardo**
  55011 Badia Pozzeveri- Altopascio (IT)
- **Cevoloni, Norberto**
  37000 Verona (IT)

(74) Representative: **Liefhold, Christian et al**
ITW Group France
3-5, rue de Saint Georges
75009 Paris (FR)

(54) **DISH WASHER WITH EFFICIENT HEATING SYSTEM**

(57) Dish washer (1), comprising
- a boiler (10) for storing and heating rinse water, wherein the boiler (10) comprises only one electric boiler heating unit (11), wherein the dish washer (1) is configured to power the boiler heating unit (11) at m different power levels above zero (11.1, 11.2, 11.3), wherein the m different power levels above zero (11.1, 11.2, 11.3) comprise a highest power level (11.1) and a second highest power level (11.2), and
- a tank (20) for heating wash water, wherein the tank (20) comprises only one electric tank heating unit (21), wherein the dish washer (1) is configured to power the tank heating unit (21) at only one power level above zero (21.1).

Method for operating a dish washer (1).

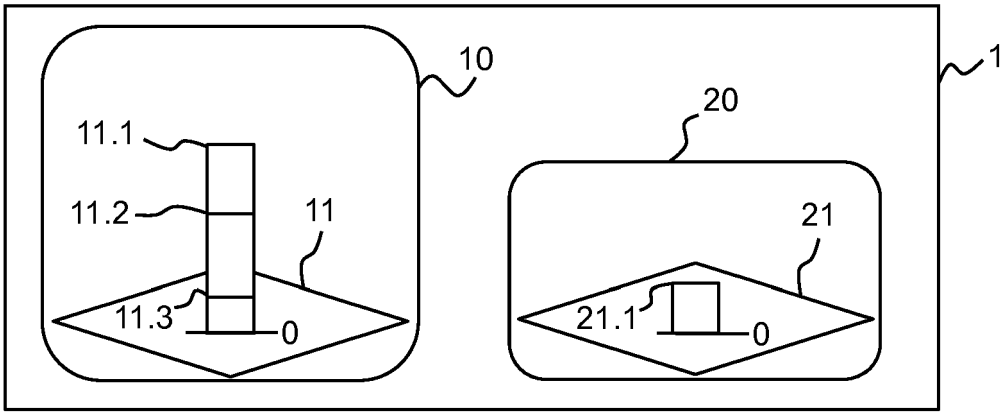

Fig. 1

EP 3 095 372 A1

Description

[0001] This invention relates to dish washers, preferably under-counter or hood type or conveyor dish washers. Usually, there is a limitation in power and current available from the power source. In most countries of Europe the typical connection available is 400 V, 3 x 16 amps.

[0002] According to the prior art EP 1 835 837, a dish washer has multiple load elements that are assigned multiple power output levels for not exceeding the maximum electric total output. As a simple configuration, EP 1 835 837 proposes to use exactly three power output levels for each load element. This simple configuration of circuitry was, according to EP 1 835 837, particularly easy to implement and already had all the advantages.

[0003] The inventors still found it very disadvantageous that the technical solution described in the prior art is complex. The object of the invention therefore was to find a non-complex solution. This object is achieved by the subject matter of the independent claims; preferred embodiments are specified by the dependent claims.

[0004] Particularly, this object is achieved by a dish washer, comprising

- a boiler for storing and heating rinse water, wherein the boiler comprises only one electric boiler heating unit, wherein the dish washer is configured to power the boiler heating unit at m different power levels above zero, wherein the m different power levels above zero comprise a highest power level and a second highest power level, and
- a tank for heating and preferably storing wash water, wherein the tank comprises only one electric tank heating unit, wherein the dish washer is configured to power the tank heating unit at only one power level above zero.

[0005] The object of the invention is also particularly achieved by a method for operating a dish washer comprising the steps:

- storing and heating rinse water in a boiler by only one electric boiler heating unit, wherein the boiler heating unit is powered at m different power levels above zero wherein the m different power levels above zero comprise a highest power level and a second highest power level;
- heating and preferably storing wash water in a tank by only one electric tank heating unit, wherein the tank heating unit is powered at only one power level above zero.

[0006] By this extremely simple and minimalistic solution and distribution of heating units between boiler and tank, short cycle times can be achieved without exceeding the maximum electric total consumption using a minimum of constructional and control effort. In a commercial dishwasher the wash is performed in an extremely short time (60 s to 120 s in most cases) using water at 50 °C to 65 °C and the rinse is done using 1.5 l to 3.5 l of fresh water per rack, at a temperature of 80 °C to 90 °C; both wash and rinse water are independently heated by two different heating units located in a tank (wash) and in a boiler (heating).

[0007] The water in the tank heats the plates, increasing their temperature by some tenths °C. In this process the water gives heat to the plates and a significant part of this heat has to be reintegrated by the heating element in the tank, otherwise the temperature of the wash solution reaches a temperature not sufficient to achieve a good result, with the creation of foam, pump's cavitation, difficulties in drying, etc. This requires a high power heating unit in the tank.

[0008] The inventor, however, has realized that running short cycles one after the other, especially with cold feed water, requires a high power especially in the boiler to achieve a sufficiently short recovery time, which should be shorter than the cycle time plus load/unload time, and therefore, for optimizing the cycle time it is sufficient to power the boiler heating unit at different power levels above zero, while the tank heating unit is powered at only one power level above zero.

[0009] A heating unit may include one or more heating elements (e.g. heating coil or other heat emitting element, whereby heat is converted from electric power). The boiler/tank comprising the boiler/tank heating unit preferably means that the boiler/tank heating unit is dedicated to heat up the content of the boiler/tank. The boiler heating unit and tank heating unit are different; however, they may share one or more common heating elements, preferably as long as they differ in at least one heating element.

[0010] The dish washer being configured to power the boiler heating unit at m different power levels above zero preferably means that the dish washer comprises a control unit which is configured (and provisioned/programmed) to set the boiler heating unit to different power levels, e.g. by switching between or switching on/off different heating elements and/or by adjusting the voltage/current (e.g. pulse-width-modulation or conventional voltage control) delivered to one or more heating elements of the boiler heating unit. It should be noted that the term "powering" already implies that the according power level is above zero.

[0011] The dish washer being configured to power the tank heating unit at only one power level above zero preferably means that the dish washer does not contain any configuration/program for setting the tank heating units to other power levels than OFF and ON and does not contain any configuration/program to perform pulse-width modulation, whereas pulse-width modulation is preferably considered as having a pulse-frequency of less than 1 s.

[0012] In a further preferred embodiment or method according to the present invention the power level above zero of the tank heating unit is equal to the difference between the highest power level and the second highest power level of the boiler heating unit.

[0013] Hereby the dish washer uses the available energy optimally. As an example, the following configuration could be chosen:

The under-counter dishwasher is fed with 15 °C, the water consumption is 2.0 l per rack, rinse temperature is 85°C, and heating power is 7.6 kW. The tank heating unit's power level is 2.1 kW; the cycle time is 90 s, the load time 10 s, and the available time is 100 s. The boiler heating unit's highest power level is 7.6 kW; the boiler heating unit's second highest power level is 5.5 kW; the tank heating unit's power level is 2.1 kW.

[0014] Then, the energy required to heat the water is 2 x 70 x 4.186 = 586 kJ, the energy available from the boiler heating unit at the second highest level is 100 x 5.5 = 550 kJ. The energy still required to recover the water temperature during a boosting time (boiler heating unit operated at highest power level) is 586 - 550 = 36 kJ. The available boiler heating unit extra power is 2.1 kW (difference between highest and second highest power level). The time of work of the boiler heating unit at the highest power is 36 : 2.1 = 17 s. Therefore, the tank heating unit will work for 83 s, giving to the water in the tank an energy of 174 kJ.

[0015] A fast cycle is feasible even with cold water feed and the energy. This result is obtained by a very simple construction and without exceeding the given level of power.

[0016] In a further preferred embodiment or method according to the present invention m=2.

[0017] Hereby, an even less complex dish washer or method is provided with at the same short cycle times.

[0018] In a further preferred embodiment according to the present invention the dish washer is configured to operate the tank heating unit and the boiler heating unit, such that the boiler heating unit is, preferably always, being switched to a power level lower than or equal to the second highest power level, when the tank heating unit is set to the power level above zero. In a further preferred method according to the present invention, the tank heating unit and the boiler heating unit are operated accordingly.

[0019] Hereby, it is ensured that the maximum electric total consumption due to heating is not exceeded. As especially the heating elements are responsible for the electric total consumption, the dish washer is very efficiently using the available power.

[0020] In a further preferred embodiment according to the present invention the boiler heating unit comprises two or more, preferably exactly two, heating elements and a switching unit, wherein the switching unit is configured to alternately switch between one of the heating elements and the tank heating unit, such that the one of the heating elements is interlocked with the tank heating unit. In a further preferred method, a switching unit alternately switches between one heating element in a boiler and the tank heating unit.

[0021] Hereby, a very simple control mechanism is achieved. For example, in its simplest application a dual level boiler heating unit (e.g., 5.5 kW + 2.1 kW) consisting of two respective heating elements and a single level (e.g., 2.1 kW) tank heating unit are installed. By means of the switching unit (e.g., relay(s)) the tank heating unit is interlocked with its equivalent power level or heating element in the boiler allowing for a continuous heating power in the boiler and a working time at maximum power strictly limited to the value needed to recover in the available time.

[0022] Embodiments of the present invention will now be described - by way of example only - with reference to the accompanying drawings, whereby

Fig. 1 is a conceptual overview of a dish washer according to the invention,
Fig. 2 an overview based on Fig. 1, whereby the power level of the tank heating unit is adapted to the power levels of the boiler heating unit,
Fig. 3 an overview based on Fig. 2, whereas an even simpler solution is shown,
Fig. 4 an overview based on Fig. 3, whereas a technical simple realization is chosen.

[0023] **Fig. 1** shows a conceptual overview of a dish washer 1 according to the invention. It comprises a boiler 10 for storing and heating rinse water, wherein the boiler 10 comprises only one electric boiler heating unit 11. The dish washer 1 is configured to power the boiler heating unit 11 at m different power levels above zero 11.1, 11.2, 11.3, wherein here, m=3, wherein the m different power levels above zero 11.1, 11.2, 11.3 comprise a highest power level 11.1 and a second highest power level 11.2. The dish washer 1 further comprises a tank 20 for heating wash water, wherein the tank 20 comprises only one electric tank heating unit 21, wherein the dish washer 1 is configured to power the tank heating unit 21 at only one power level above zero 21.1.

[0024] The operation of the dish washer 1 comprises the steps:

- storing and heating rinse water in a boiler 10 by only one electric boiler heating unit 11, wherein the boiler heating

unit 11 is powered at m different power levels above zero 11.1, 11.2, 11.3, wherein the m different power levels above zero 11.1, 11.2, 11.3 comprise a highest power level 11.1 and a second highest power level 11.2;

- heating wash water in a tank 20 by only one electric tank heating unit 21, wherein the tank heating unit 21 is powered at only one power level above zero 21.1.

[0025] Preferably, the dish washer 1 is configured to operate the tank heating unit 21 and the boiler heating unit 11, such that the boiler heating unit 11 is being switched to a power level 11.2, 11.3 lower than or equal to the second highest power level 11.2, when the tank heating unit 21 is set to the power level 21.1 above zero.

[0026] **Fig. 2** shows an overview based on Fig. 1, whereby the power level 21.1 of the tank heating unit 21 is adapted to the power levels 11.1, 11.2, 11.3 of the boiler heating unit 11. The power level above zero 21.1 of the tank heating unit 21 is equal to the difference between the highest power level 11.1 and the second highest power level 11.2 of the boiler heating unit 11. For example, the power level 11.1 is 7.6 kW, the power level 11.2 is 5.5 kW and the power level 21.1 is 2.1 kW.

[0027] **Fig. 3** shows an overview based on Fig. 2, whereas an even simpler solution is shown. Here, m=2, which reduces production costs without losing the efficient usage of available power.

[0028] **Fig. 4** shows an overview based on Fig. 3, whereas a technical simple realization is chosen. The boiler heating unit 11 comprises two heating elements 12.1, 12.2 and a switching unit 30, wherein the switching unit 30 is configured to alternately switch between the heating element 12.2 and the tank heating unit 21, which has a tank heating element 22.1, such that the heating element 12.2 is interlocked with the tank heating unit 21.

[0029] With this invention a very simple solution for the above mentioned problem of power limitation has been provided. The boiler has two or more levels of power, individually selectable, and the tank has one level of power. By combining the different levels of power it is possible to optimize the heat transfer to tank and boiler depending on the duration of the cycle and the temperature of feed water, allowing significant improvements.

Reference signs

[0030]

1	dish washer	20	tank
10	boiler	21	tank heating unit
11	boiler heating unit	21.1	power level above zero of the tank heating unit
11.1, 11.2, 11.3	power levels above zero of the boiler heating unit	22.1	heating element of the tank heating unit
12.1, 12.2	heating elements of boiler heating unit	30	switching unit

Claims

1. Dish washer (1), comprising

- a boiler (10) for storing and heating rinse water, wherein the boiler (10) comprises only one electric boiler heating unit (11), wherein the dish washer (1) is configured to power the boiler heating unit (11) at m different power levels above zero (11.1, 11.2, 11.3), wherein the m different power levels above zero (11.1, 11.2, 11.3) comprise a highest power level (11.1) and a second highest power level (11.2), and
- a tank (20) for heating wash water, wherein the tank (20) comprises only one electric tank heating unit (21), **characterized in that** the dish washer (1) is configured to power the tank heating unit (21) at only one power level above zero (21.1).

2. Dish washer (1) according to claim 1, wherein the power level above zero (21.1) of the tank heating unit (21) is equal to the difference between the highest power level (11.1) and the second highest power level (11.2) of the boiler heating unit (11).

3. Dish washer (1) according to one of the preceding claims, wherein m=2.

4. Dish washer (1) according to one of the preceding claims, wherein the dish washer (1) is configured to operate the

tank heating unit (21) and the boiler heating unit (11), such that the boiler heating unit (11) is being switched to a power level (11.2, 11.3) lower than or equal to the second highest power level (11.2), when the tank heating unit (21) is set to the power level (21.1) above zero.

5. Dish washer (1) according to claim 4, wherein the boiler heating unit (11) comprises two or more heating elements (12.1, 12.2) and a switching unit (30), wherein the switching unit (30) is configured to alternately switch between one of the heating elements (12.1, 12.2) and the tank heating unit (21), such that the one of the heating elements (12.1, 12.2) is interlocked with the tank heating unit (21).

6. Method for operating a dish washer (1) comprising the steps:

- storing and heating rinse water in a boiler (10) by only one electric boiler heating unit (11), wherein the boiler heating unit (11) is powered at m different power levels above zero (11.1, 11.2, 11.3), wherein the m different power levels above zero (11.1, 11.2, 11.3) comprise a highest power level (11.1) and a second highest power level (11.2);
- heating wash water in a tank (20) by only one electric tank heating unit (21), **characterized in that** the tank heating unit (21) is powered at only one power level above zero (21.1).

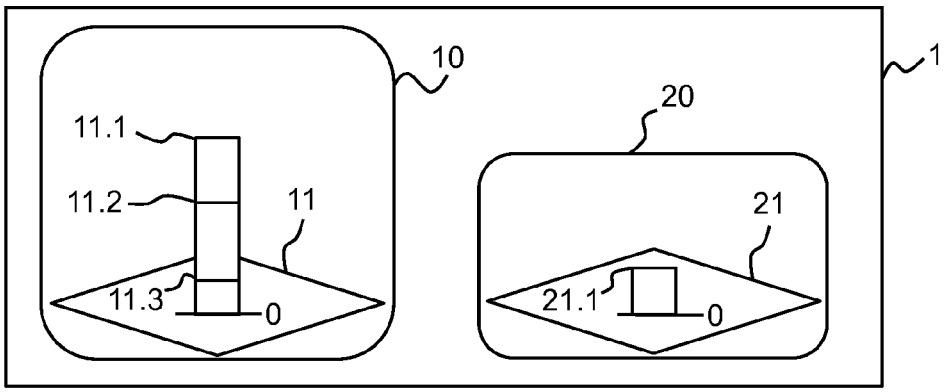

Fig. 1

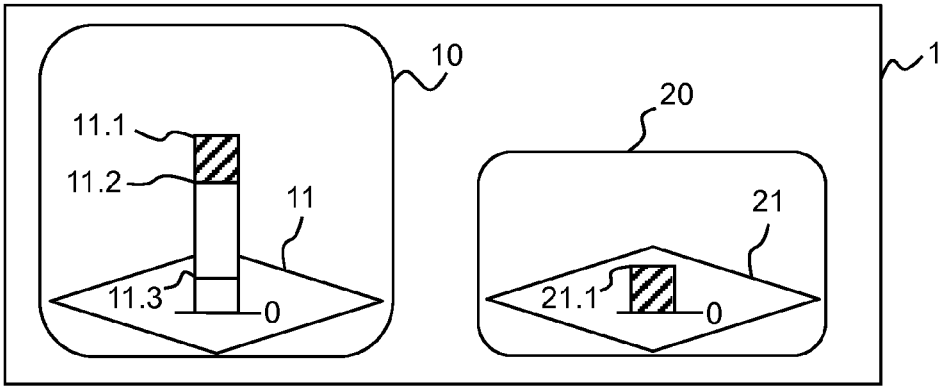

Fig. 2

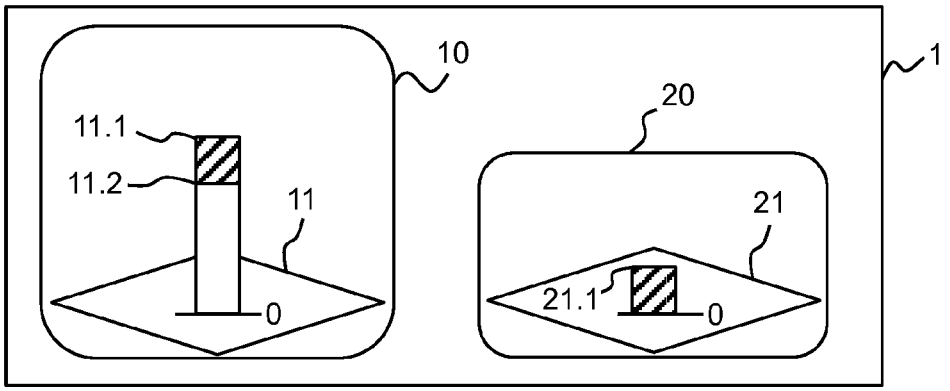

Fig. 3

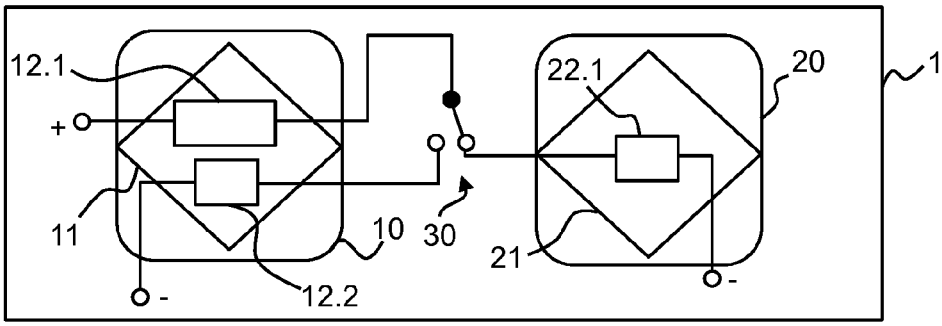

Fig. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 16 8773

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,D	EP 1 835 837 B1 (MEIKO MASCHINENBAU GMBH & CO [DE]) 28 October 2009 (2009-10-28) * the whole document *	1-6	INV. A47L15/42
A	US 2005/183746 A1 (MCKEE PHILIP R [US] ET AL) 25 August 2005 (2005-08-25) * the whole document *	1-6	
A	EP 1 666 654 A2 (INDESIT CO SPA [IT]) 7 June 2006 (2006-06-07) * the whole document *	1-6	

TECHNICAL FIELDS SEARCHED (IPC)

A47L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 November 2015	Jezierski, Krzysztof

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 15 16 8773

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.

12-11-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1835837 B1	28-10-2009	AT 446709 T	15-11-2009
		DE 102004046758 A1	06-04-2006
		EP 1835837 A1	26-09-2007
		US 2009151750 A1	18-06-2009
		WO 2006034760 A1	06-04-2006
US 2005183746 A1	25-08-2005	NONE	
EP 1666654 A2	07-06-2006	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1835837 A **[0002]**