**Title:** RESISTANCE FOR WATER HEATING WITH ENHANCED ANTIBACTERIAL EFFECT

**Abstract:** An armoured resistance (2) for heating the water of an electric storage water heater or the sump of a laundry machine or a dishwasher is provided. The metal surface in contact with the water to be heated thereof is covered with a glass enamel, on the surface whereof metals (Ag, Cu, Zn) having antibacterial properties are deposited according to known techniques. The deposited metal is preferably silver and, even more preferably, it is in the form of nanoparticles.
Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR). Published: with international search report (Art. 21(3))
RESISTANCE FOR WATER HEATING WITH ENHANCED ANTIBACTERIAL EFFECT

Description

Technical Field

The present invention relates to means apt to limit bacterial proliferation in water containers for hygienic or alimentary purposes.

Background Art

The effectiveness of some metal elements such as zinc, copper or silver to control or reduce the bacterial flora in water containers wherein the metal elements thereof are immersed is known since a long time.

Said metal elements and/or ions thereof and/or chemical combinations between them or with supporting substances and/or more appropriate mixes, free or chemically combined, thereof will hence be referred as "AntiBacterial Metal Compounds" or ABM compounds. In other words, it is intended herein as "AntiBacterial Metal Compounds" or ABM compounds any compound wherein chemical elements having recognized antibacterial effectiveness such as zinc and/or copper and/or silver are present in such a form that said effectiveness can be expressed.

The reduction or, at least, not proliferation effect on the bacterial flora is also known as, using a neologism, "sanitation".

A thorough literature concerning the ABM preparation processes, as well as their ways of use, is available.

For example, document CN 101 305 735 discloses how to obtain
nanoparticles of Ag to be employed in sanitation.

US 6 303 183 proposes, inter alia, to apply on a metal surface a conventional non antibacterial glass enamel an ABM compound powder prior to the baking of the enamel thereof obtaining thus an antibacterial enamel.

The enamel with an ABM compound surface deposit can then be processed in oven for vitrification according to the traditional processes.

From now on, it will be referred as glass enamel with antibacterial surface a glass enamel obtained through application of conventional enamel on the surface to be enamelled, followed by an application on said enamel layer of an ABM compound, according to any known process, and a subsequent baking for vitrification.

The so-called "armoured" electric resistances are well known, the resistance filament thereof is arranged within a metal tube (the armour) and immersed in pressed Magnesium Oxide powder (MgO) which keeps the filament away and electrically insulated from the armour.

Resistances of this kind are widespread for the water heating in electric storage water heaters, laundry machines and dishwashers wherein they are employed immersed in the water to be heated.

From now on, those armoured electric resistances having an armour and intended to be immersed in the water to be heated will be referred as immersion resistances.

In the past, usually, immersion resistances had copper alloy armours due to the simplicity of the production process; copper, however, caused galvanic effect corrosion of the steel tanks or sumps containing the heated water; there has been, therefore, an increasing switch-over to armours in stainless steel alloy.

Simultaneously, in order to protect from corrosion the steel tanks of the
storage water heaters, there has been an increasing switch over from zinc coating to the protection of surfaces through their coating using glass enamel or PTFE based or epoxy resin based coatings. The cathodic protection from corrosion offered by zinc is now provided by sacrificial anodes in Mg or long lasting impressed current anodes.

Coming back to the bacterial proliferation, a few decades ago this was not seen as a particularly significant issue with regards to the water of storage water heaters, when, before the energetic crisis, it was usual to set water heaters at rather high temperatures (up to 80 °C), able to return a sanitizing effect. Today, on the other hand, the maintenance temperature of the water is significantly lower (55 - 60 °C) and the values thereof could favour bacterial proliferation.

Moreover, in order to achieve a better protection against corrosion, the use of copper and zinc, respectively for immersion resistances and storage tanks, was abandoned.

Also in the sumps of laundry machines and dishwashers, notwithstanding that the detergents and the sometimes rather high temperatures have a cleaning and sterilizing function, the dirt, which inevitably collects in them, acts as a culture ground for health harmful germs.

There has been a change, with regards to the containing sumps for heated water in laundry machines and dishwashers, from the employment of ferrous steels painted with polyamide resins to the use of stainless steels or, where possible, of a much more cost effective plastic material.

The already cited US 6 303 183 proposes, among the other, to make the tank of a storage water heater a sanitizer by enamelling its inner surface with antibacterial glass enamel.
The prior art shows that, among ABMs, silver (Ag) has a very effective "sanitizing" action, wherefore and notwithstanding its price, very little quantities are required to achieve good results at a reasonable price.

But it is obvious that enamelling the inner surface of storage water heaters using Ag based antibacterial glass enamel would entail too high costs.

Moreover, such a process, would be scarcely employable in the sumps of laundry machines and dishwashers because it would require significant modifications in the production process and design of the machine.

Lastly, this process is not in any way employable if the container for heating water is not metal or made in another non enamelable material.

Summary of the Invention

An object of the present invention is to show simple means to provide to the sanitization of containers for water to be heated through immersion resistances such as, in particular, tanks of electric storage water heaters but also sumps of laundry machines and dish washers.

A further object of the present invention is to provide the sanitization function also for containers of water to be heated through immersion resistances already in service.

A further object of the present invention is to enhance the sanitization function by making the sanitization process occur at the highest temperatures compatible with operating conditions.

Brief Description of Drawings

These and other objects, which will be clear hereinafter, can be achieved with an immersion resistance according to the claims herein appended. Further
features of the present invention will appear more clearly from the description of some preferred but not exclusive embodiments, according to the claims and disclosed by way of non limiting example in the drawing of Figure 1. Figure 1 shows, in vertical section, the lower part of an electric storage water heater.

**Detailed Description of the Preferred Embodiments**

1 indicates the storage tank, 2 one or more armoured electric resistances, 3 a possible housing sheath for temperature sensors, 4 a possible flange for closing of the tank and eventually for supporting the electric resistance 2 other than supporting the possible sheath 3.

According to the invention, the immersion resistances 2 for heating the water of a electric storage water heater or of the sump of a laundry machine or a dishwasher have, at least in part, the surface of their armour in contact with the water to be heated covered with glass enamel with antibacterial surface obtained according to processes and materials of the prior art.

It must be noted that, as known, the highest is the temperature at which the ABMs compounds come in touch with the water to be sanitised, the highest is the sanitising effect.

The armour of said immersion resistances 2 for water heating are the items at the highest temperatures compatible with operating conditions with which the water to be sanitised in the electric water heater or in the sump of a laundry machine or dishwasher come in touch.

This brings, therefore, an enhanced sanitising effect due to the temperature which could not be possible, given an equal enamelled surface and antibacterial metal concentration, in whichever other zone of the storage of the
water heater or of the sump of the laundry machine or dishwasher.

Preferably, the antibacterial glass enamel which covers, at least in part, the armour of said immersion resistances 2 according to the invention, provides a ABM compound comprising silver.

Even more preferably, silver is substantially the only metal element with sanitizing effect which, in any of its form or chemical or physical combination with other non sanitizing chemical elements, is included in said ABM compound.

-Even more preferably, the silver included in said ABM compound is in the form of silver nanoparticles.

Whichever is the fastening mean of the armoured electric resistance 2, also different from the flange 4 sketched in the figure, certainly said armoured electric resistance 2 is removable for replacement with an identical unit or, at least, has compatible dimensional and thermoelectric features with the previous.

Typically the immersion resistances 2 for storage water heaters have a surface thermal load of around 5 - 13 W/sq. cm. while the delivered electric power ranges from 800 to 3000 W for storage tanks from 40 to 100 litres.

Simple calculations on the data thereof show that, in an electric storage water heater, the surface of the immersion resistances in contact with the water ranges from 1 sq cm to 9 sq cm for each litre of water contained. Considering that the water of a storage water heater, during heating, is subject to convective movements which cyclically bring it to lap the surface of the armour of the immersion resistances 2, if these have the surface enamelled with antibacterial glass enamel, each litre of water has at its disposal 1 to 9 sq cm of sanitizing surface, a more than sufficient quantity to guarantee, indeed, the sanitizing function thereof.
With regards to the immersion resistances for laundry machines and dishwashers, they have a surface load of 10 - 12 W/sq cm and an electric power ranging usually between 1700 W to 2000 W, and, therefore, a surface in contact with the water ranging from 7 to 10 sq cm for each litre of water contained.

Even if, in said machines intended for washing, the sanitizing function is not considered particularly important in the same way that is considered in storage water heaters, it is clear that it can be however guaranteed in an extremely easy way using immersion resistances 2 according to the invention.

A particular advantage of the invention is that the employment of the immersion resistances 2 according to the invention allows to grant the sanitization function also to electric storage water heaters and washing machines and dishwashers already in service through the simple replacement of the immersion resistance which, as seen, proved to be the most effective component for sanitizing the water to be heated contained in the water heater or in the laundry machine or in the dishwasher.
CLAIMS

1. Immersion resistance (2) for heating the water of an electric storage water heater or the sump of a laundry machine or dishwasher,
   characterised in that
   - at least a part of the metal surface of its armour in contact with the water to be heated is covered with glass enamel with antibacterial surface,
   - said glass enamel with antibacterial surface consisting in a per se known glass enamel on the surface thereof, prior to baking, an ABM compound according to any per se known concentration and process is applied
   - said ABM compound consisting in a compound wherein elements having recognized antibacterial effectiveness such as zinc and/or copper and/or silver are present in any known form apt to actually express their antibacterial effectiveness.

2. Immersion resistance (2) according to Claim 1
   characterised in that,
   said ABM compound comprises silver in one or more of its possible forms or chemical or physical combinations with other non sanitizing chemical elements.

3. Immersion resistance (2) according to Claim 2
   characterised in that,
   silver in said one or more of its possible forms or chemical or physical combinations with other non sanitizing chemical elements is substantially the
only metal element with sanitizing effect included in said ABM compound.

4. Immersion resistance (2) according to Claims 2 or 3

characterised in that,

30 the silver included in said ABM compound is in form of silver nanoparticles.
# INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H05B 3, H05B 1, F24H 1, F24H 9, A01N 59, A01P 1, C03C 8, C04B 4 1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT,CNKI,WPI,EPODOC: resistance, immersion, armour, armor, sheath, water, heat, thermal, ABM, antibacterial, antimicrobial, antiseptic, enamel, glaze, porcelain, vitreous, glass, ceramic, silver, Ag, nano

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>CN1645972A, (I O SMITH CHINA WATER HEATER CO LTD), 27 July 2005 (27.07.2005), page 4 lines 4-22 of the description; figure 1</td>
<td>1-4</td>
</tr>
<tr>
<td>Y</td>
<td>CN1295041A, (AOS HOLDING CO), 16 May 2001(16.05.2001), page 2 lines 9-22, page 4 line 4 to page 5 line 7, page 6 lines 17-21 of the description</td>
<td>1-4</td>
</tr>
<tr>
<td>Y</td>
<td>CN1685830A, (NTNGBO HUASHI NANO MATERIAL CO LTD), 26 October 2005(26.10.2005), claim 1</td>
<td>4</td>
</tr>
<tr>
<td>A</td>
<td>CN1179702A, (TOTO LTD), 22 April 1998(22.04.1998), the whole document</td>
<td>1-4</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

- Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier application or patent but published on or after the international filing date
  - "L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - "O" document referring to an oral disclosure, use, exhibition or other means
  - "P" document published prior to the international filing date but later than the priority date claimed
  - "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  - "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  - "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  - "&" document member of the same patent family

Date of the actual completion of the international search: 08 December 2011(08.12.2011)

Date of mailing of the international search report: 22 Dec. 2011 (22.12.2011)

Name and mailing address of the ISA/CN
The State Intellectual Property Office, the P.R.China
6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088
Facsimile No. 86-10-62019451

Authorized officer XU, Ying
Telephone No. (86-10)62412106

Form PCT/ISA /210 (second sheet) (July 2009)
<table>
<thead>
<tr>
<th>Patent Documents referred in the Report</th>
<th>Publication Date</th>
<th>Patent Family</th>
<th>Publication Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN1645972A</td>
<td>27.07.2005</td>
<td>CN100399863C</td>
<td>02.07.2008</td>
</tr>
<tr>
<td>CN1295041A</td>
<td>16.05.2001</td>
<td>CN1237020C</td>
<td>18.01.2006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US6303183B 1</td>
<td>16.10.2001</td>
</tr>
<tr>
<td>CN1685830A</td>
<td>26.10.2005</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>CN1 179702A</td>
<td>22.04.1998</td>
<td>W09623412A1</td>
<td>08.08.1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP8523423T2</td>
<td>27.01.1998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP2961892B2</td>
<td>12.10.1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP2000044416A</td>
<td>15.02.2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP3692825B2</td>
<td>07.09.2005</td>
</tr>
</tbody>
</table>
Continuation of classification of subject matter:
H05B 3/78(2006.01);i
H05B 3/10(2006.01);i
A01N 59/20(2006.01);i
A01N 59/16(2006.01);i
A01P 1/00(2006.01);i
C03C 8/14(2006.01);i
C04B 41/86(2006.01);i