



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
07.07.2021 Bulletin 2021/27

(51) Int Cl.:
A47L 15/42 ^(2006.01) **A47L 15/46** ^(2006.01)
A47L 15/00 ^(2006.01)

(21) Application number: **19889032.9**

(86) International application number:
PCT/CN2019/099429

(22) Date of filing: **06.08.2019**

(87) International publication number:
WO 2020/107938 (04.06.2020 Gazette 2020/23)

(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 KH MA MD TN

- **FENG, Zongyu**
Zhuhai, Guangdong 519070 (CN)
- **CHENG, Chen**
Zhuhai, Guangdong 519070 (CN)
- **XIAO, Deling**
Zhuhai, Guangdong 519070 (CN)
- **XIAO, Lirong**
Zhuhai, Guangdong 519070 (CN)
- **WANG, Kun**
Zhuhai, Guangdong 519070 (CN)
- **WANG, Xianbo**
Zhuhai, Guangdong 519070 (CN)

(30) Priority: **26.11.2018 CN 201811419584**
26.11.2018 CN 201811420522

(71) Applicant: **Gree Electric Appliances, Inc. of Zhuhai**
Zhuhai, Guangdong 519070 (CN)

(74) Representative: **Berggren Oy**
P.O. Box 16
Eteläinen Rautatiekatu 10A
00101 Helsinki (FI)

(72) Inventors:
• **WANG, Chunjie**
Zhuhai, Guangdong 519070 (CN)

(54) **DISHWASHER AND CONTROL METHOD THEREFOR**

(57) The present disclosure relates to a dishwasher and a method for controlling the dishwasher. The dishwasher includes a housing and further includes a plasma sterilization and disinfection apparatus arranged inside the housing, the plasma sterilization and disinfection apparatus includes a discharge electrode plate, a ground electrode plate, a radio-frequency power supply and an earthing power supply, a tableware storage space is formed between the discharge electrode plate and the ground electrode plate, the radio-frequency power supply is connected to the discharge electrode plate, and the earthing power supply is connected to the ground electrode plate. Large-area glow plasma covering tableware is generated by selecting the appropriate power supply and designing a reasonable discharge electrode structure, thus realizing efficient sterilization and disinfection by the dishwasher through the plasma, solving the problems of low efficiency and long treatment time faced by a sterilization method of an existing dishwasher.

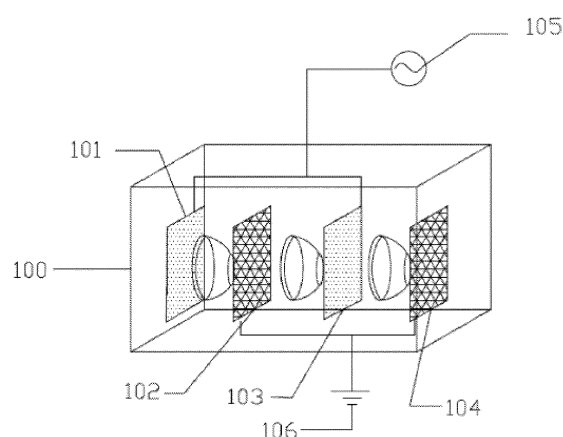


Fig. 1

Description

Cross-Reference to Related Disclosure

[0001] The present disclosure claims the priority of Chinese Patent Disclosure No. 201811419584.0, filed on November 26, 2018 and entitled "Dishwasher and Method for Controlling Dishwasher", and the priority of Chinese Patent Disclosure No. 201811420522.1, filed on the same day and entitled "Novel Dishwasher and Method for Controlling Novel Dishwasher", the disclosures of which are hereby incorporated by reference in its entirety.

Technical Field

[0002] The present disclosure belongs to the technical field of dishwashers, and particularly relates to a dishwasher and a method for controlling the dishwasher.

Background

[0003] With improvement of an oil removal capacity, a dishwasher has been increasingly recognized by consumers, a related market has also been growing, and there has been a trend towards replacing household disinfection cabinets, which requires the dishwasher to have the characteristics of efficiency, fastness and broad-spectrum sterilization. At present, hot water sterilization (70-80°C), high temperature and high pressure sterilization, ultraviolet sterilization, ozone sterilization and other methods are often used by the dishwasher, which are inefficient and cannot effectively kill bacteria. Therefore, it is necessary to introduce efficient, rapid and environmentally-friendly sterilization means into the dishwasher.

[0004] Common sterilization methods mainly include thermal sterilization, ionizing radiation, plasma sterilization, chemical sterilization, etc. A temperature of hot water in the dishwasher is less than 100°C, which does not reach a temperature required by the thermal sterilization. Accordingly, hot water sterilization does not effectively remove bacteria in the dishwasher. The high temperature and high pressure sterilization has poor stability and is difficult to control. Space of the dishwasher is narrow, a distance between bowls is relatively small, and the bowls block each other, such that ultraviolet rays can not effectively act on each bowl. If an ozone concentration in the dishwasher is too high, a hypochlorous acid and so on in tap water may be oxidized and therefore substances harmful to human health are produced.

[0005] In contrast, the plasma sterilization has the following characteristics: (1) has the broad-spectrum antibacterial property, it generally takes several minutes to reach a sterility assurance level; (2) a temperature of a plasma gas is close to a room temperature, so the plasma gas can be used to sterilize heat sensitive materials, and therefore dramatical reduction of a usage amount of disposable medical materials and medical costs are expectable; and (3) biological substances with strong resistance

can be efficiently eliminated, which include super bacteria with strong drug resistance, prions with strong temperature resistance, bacterial biofilm with a group protection function, etc., and odorous gases can be effectively removed. This sterilization method is expected to solve the sterilization problem faced by an existing dishwasher, but the difficulty in generating plasma in the dishwasher is how to generate large-area plasma to cover a surface of tableware under an atmospheric pressure.

[0006] Theoretically, generation of the plasma is related to an electric field between electrodes, an electrode spacing and an initial electron number density, and therefore, large-area plasma may be generated by designing a reasonable electrode structure.

Summary

[0007] In order to solve the problem of how to generate large-area plasma under an atmospheric pressure by a dishwasher, the present disclosure provides a dishwasher and a method for controlling the dishwasher.

[0008] In order to achieve the above purpose, the technical solution used in the present disclosure is as follows: the dishwasher includes a housing and further includes a plasma sterilization and disinfection apparatus arranged inside the housing, the plasma sterilization and disinfection apparatus includes a discharge electrode plate, a ground electrode plate, a radio-frequency power supply and an earthing power supply, a tableware storage space is formed between the discharge electrode plate and the ground electrode plate, the radio-frequency power supply is connected to the discharge electrode plate, and the earthing power supply is connected to the ground electrode plate.

[0009] In some embodiments, the plasma sterilization and disinfection apparatus includes a plurality of discharge electrode plates and a plurality of ground electrode plates, and the discharge electrode plates and the ground electrode plates are alternatively arranged.

[0010] In some embodiments, the discharge electrode plate and the ground electrode plate are arranged parallel to each other and respectively perpendicular to a horizontal plane of the housing.

[0011] In some embodiments, a distance between the discharge electrode plate and an adjacent ground electrode plate is 30-60 mm.

[0012] In some embodiments, a distance between any two adjacent discharge electrode plates is equal to a distance between any two adjacent ground electrode plates.

[0013] In some embodiments, a distance between the discharge electrode plate and an adjacent ground electrode plate is 50 mm.

[0014] In some embodiments, the discharge electrode plate is arranged at a top inside the housing, and the ground electrode plate is arranged at a bottom inside the housing.

[0015] In some embodiments, the discharge electrode plate and the ground electrode plate are arranged parallel

to each other and respectively parallel to a horizontal plane of the housing.

[0016] In some embodiments, a distance between the discharge electrode plate and the ground electrode plate is 150-250 mm.

[0017] In some embodiments, an area of the discharge electrode plate is greater than an area of the ground electrode plate.

[0018] In some embodiments, a separating apparatus is arranged in the tableware storage space and configured to separate tableware.

[0019] In some embodiments, a value of a discharge voltage of the radio-frequency power supply is 1-5 kV.

[0020] In some embodiments, the discharge electrode plate and the ground electrode plate are made of conductive materials.

[0021] The method for controlling a dishwasher is configured to control the above dishwasher and includes the following steps:

placing a tableware in a tableware storage space formed between a discharge electrode plate and a ground electrode plate, wherein the tableware serves as an insulation medium;

performing electrification for sterilization: applying a voltage to the discharge electrode plate connected to a radio-frequency power supply, to form an electric field between the discharge electrode plate and the ground electrode plate; and

ionizing air on a surface of the insulation medium, to form plasma to cover a surface of the tableware for sterilization.

[0022] In some embodiments, before performing the electrification for sterilization, further comprises: cleaning by the dishwasher, the tableware.

[0023] In some embodiments, after cleaning by the dishwasher, the tableware, the method further comprises: heating for evaporating water on the surface of the tableware.

[0024] The present disclosure provides the dishwasher. The dishwasher includes the housing and further includes the plasma sterilization and disinfection apparatus arranged inside the housing, the plasma sterilization and disinfection apparatus includes the discharge electrode plate, the ground electrode plate, the radio-frequency power supply and the earthing power supply, the tableware storage space is formed between the discharge electrode plate and the ground electrode plate, the radio-frequency power supply is connected to the discharge electrode plate, and the earthing power supply is connected to the ground electrode plate. Large-area glow plasma covering tableware is generated by designing a reasonable discharge electrode structure, efficient sterilization and disinfection on the tableware through the plasma is realized, the problems of low efficiency and long treatment time faced by a sterilization method of an existing dishwasher are solved, and accordingly sterili-

zation time of the dishwasher is shortened and a sterilization effect of the dishwasher is improved.

Brief Description of the Drawings

[0025]

Fig. 1 is a structural schematic diagram of a dishwasher of some embodiments;

Fig. 2 is a structural schematic diagram of a dishwasher of another embodiment;

and

Fig. 3 is a flow chart of a method for controlling the dishwasher.

Detailed Description of the Embodiments

[0026] The technical solutions of the present disclosure will be described below clearly and comprehensively in conjunction with accompanying drawings of the embodiments of the present disclosure. Apparently, the embodiments described are merely some rather than all of the embodiments of the present disclosure.

[0027] As shown in Fig. 1, some embodiments of the present disclosure provides a dishwasher. The dishwasher includes a housing 100, and a plasma sterilization and disinfection apparatus arranged inside the housing 100, the plasma sterilization and disinfection apparatus includes a plurality of discharge electrode plates 101 and 103, a plurality of ground electrode plates 102 and 104, a radio-frequency power supply 105 and an earthing power supply 106. The discharge electrode plates 101 and 103 and the ground electrode plates 102 and 104 are made of conductive materials. The discharge electrode plate and the ground electrode plate are alternatively arranged, that is, one ground electrode plate 102 is arranged between two discharge electrode plates 101 and 103, one discharge electrode plate 103 is arranged between two ground electrode plates 102 and 104, in addition, the discharge electrode plates 101 and 103 and the ground electrode plates 102 and 104 are arranged parallel to each other and respectively perpendicular to a horizontal plane of the housing 100, and a distance between any two adjacent discharge electrode plates is equal to a distance between any two adjacent ground electrode plates. A distance between either of the discharge electrode plates 101 and 103 and an adjacent ground electrode plate of the ground electrode plates 102 and 104 is 50 mm, which is conducive to sterilization and disinfection after placement of tableware. A tableware storage space is formed between the discharge electrode plates 101 and 103 and the ground electrode plates 102 and 104, such that it is guaranteed that the tableware is not overlapped, and generated glow plasma may cover a surface of the tableware, to sterilize and disinfect the tableware more effectively.

[0028] The radio-frequency power supply 105 is connected to the discharge electrode plates 101 and 103,

and the earthing power supply 106 is connected to the ground electrode plates 102 and 104. A value of a discharge voltage of the radio-frequency power supply 105 is 1-5 kV. By selecting an appropriate voltage and designing reasonable discharge structure, the sterilization effect of the dishwasher is more efficient.

[0029] In these embodiments, metal electrodes which are alternatively arranged are designed, that is, the plurality of discharge electrode plates 101 and 103 and the plurality of ground electrode plates 102 and 104 are used to replace an original rack divider in the dishwasher, such that the tableware is placed between two metal electrodes. During operation, two adjacent electrodes are connected to a radio-frequency high voltage and earthed separately, and tableware to be treated is used as an insulation medium, and large-area glow plasma is successfully generated under an atmospheric pressure. The module is installed inside the dishwasher, such that large-area glow discharge plasma is generated on a surface of the tableware inside the dishwasher, to disinfect and sterilize the tableware. Plasma sterilization is fast in speed, strong in effect and wide in range, and no secondary pollution is generated after treatment. Because of air ionization, there will be no consumable consumption, and long-term operation and low power consumption can be achieved.

[0030] As shown in Fig. 2, some other embodiments of the present disclosure provides a dishwasher. The dishwasher includes a housing 100, and a plasma sterilization and disinfection apparatus arranged inside the housing 100, the plasma sterilization and disinfection apparatus includes a discharge electrode plate 101, a ground electrode plate 104, a radio-frequency power supply 105 and an earthing power supply 106. The discharge electrode plate 101 is arranged at a top inside the housing 100, and the ground electrode plate 104 is arranged at a bottom inside the housing 101. The discharge electrode plate 101 and the ground electrode plate 104 are made of conductive materials. The discharge electrode plate 101 and the ground electrode plate 104 are arranged parallel to each other and respectively parallel to a horizontal plane of the housing 100. A distance between the discharge electrode plate 101 and the ground electrode plate 104 is 200 mm, and an area of the discharge electrode plate 101 is greater than an area of the ground electrode plate 104, such that large-area glow plasma can be generated in the dishwasher, to sterilize tableware more effectively.

[0031] A tableware storage space is formed between the discharge electrode plate 101 and the ground electrode plate 104, and a separating apparatus 107 is arranged in the tableware storage space for separate tableware, such that the tableware is sterilized more thoroughly. The radio-frequency power supply 105 is connected to the discharge electrode plate 101, and a value of a discharge voltage of the radio-frequency power supply is 1-5 kV, and the earthing power supply 106 is connected to the ground electrode plate 104. By selecting

an appropriate voltage and designing a reasonable discharge structure, a sterilization effect of the dishwasher is more efficient.

[0032] In these above embodiments, by designing two plate-shaped electrodes which are opposite up and down, namely, the discharge electrode plate 101 and the ground electrode plate 104, tableware to be treated is taken as an insulation medium, and large-area glow plasma is successfully generated under an atmospheric pressure. The module is installed inside the dishwasher, such that large-area glow discharge plasma is generated on a surface of the tableware inside the dishwasher, to disinfect and sterilize the tableware. Plasma sterilization is fast in speed, strong in effect and wide in range, and no secondary pollution is generated after treatment. Because of air ionization, there will be no consumable consumption, and long-term operation and low power consumption can be achieved.

[0033] As shown in Fig. 3, an embodiment of the present disclosure further provides a method for controlling a dishwasher. The method is configured to control the dishwasher of any embodiment described above and includes the following steps:

- S1: a tableware is placed in a tableware storage space formed between a discharge electrode plate and a ground electrode plate, and the tableware serves as an insulation medium;
- S2: electrification for sterilization is performed: and a voltage to the discharge electrode plate connected to a radio-frequency power supply is applied, to form an electric field between the discharge pole plate and the ground electrode plate; and
- S3: air on a surface of the insulation medium is ionized, to form plasma to cover a surface of the tableware for sterilization.

[0034] In some embodiments, the dishwasher firstly cleans the tableware before electrification for sterilization. In some other embodiments, after cleaning is completed, water on the surface of the tableware is heated for evaporating at a high temperature by the dishwasher. In steps S2 and S3, the voltage is applied to the discharge electrode plate through the radio-frequency power supply, to form a large-area high-voltage area between the discharge electrode plate and the ground electrode plate, the tableware located between the discharge electrode plate and the ground electrode plate is used as the insulation medium, and the electric field formed between the discharge electrode plate and the ground electrode plate ionizes the air on the surface of the tableware to form glow plasma, which covers the surface of the tableware serving as the insulation medium, thereby killing bacteria and viruses on the tableware and achieving the purpose of sterilization and disinfection on the tableware.

[0035] The foregoing is only the preferred embodiments of the present disclosure, but a design concept of the present disclosure is not limited thereto. Any act using

this concept to immaterially modify the present disclosure should be an act infringing the scope of protection of the present disclosure.

Claims

1. A dishwasher, comprising a housing, wherein the dishwasher further comprises a plasma sterilization and disinfection apparatus arranged inside the housing, wherein the plasma sterilization and disinfection apparatus comprises a discharge electrode plate, a ground electrode plate, a radio-frequency power supply and an earthing power supply, a tableware storage space is formed between the discharge electrode plate and the ground electrode plate, the radio-frequency power supply is connected to the discharge electrode plate, and the earthing power supply is connected to the ground electrode plate. 5
2. The dishwasher according to claim 1, wherein the plasma sterilization and disinfection apparatus comprises a plurality of discharge electrode plates and a plurality of ground electrode plates, the discharge electrode plates and the ground electrode plates are alternatively arranged. 10
3. The dishwasher according to claim 2, wherein the discharge electrode plate and the ground electrode plate are arranged parallel to each other and respectively perpendicular to a horizontal plane of the housing. 15
4. The dishwasher according to claim 2, wherein a distance between the discharge electrode plate and an adjacent ground electrode plate is 30-60 mm. 20
5. The dishwasher according to any one of claims 2 to 4, wherein a distance between any two adjacent discharge electrode plates is equal to a distance between any two adjacent ground electrode plates. 25
6. The dishwasher according to claim 5, wherein a distance between the discharge electrode plate and an adjacent ground electrode plate is 50 mm. 30
7. The novel dishwasher according to claim 1, wherein the discharge electrode plate is arranged at a top inside the housing, and the ground electrode plate is arranged at a bottom inside the housing. 35
8. The novel dishwasher according to claim 7, wherein the discharge electrode plate and the ground electrode plate are arranged parallel to each other and respectively parallel to a horizontal plane of the housing. 40
9. The novel dishwasher according to claim 7 or 8, 45
10. The novel dishwasher according to claim 7, wherein an area of the discharge electrode plate is greater than an area of the ground electrode plate. 50
11. The novel dishwasher according to claim 7, wherein a separating apparatus is arranged in the tableware storage space and configured to separate tableware. 55
12. The dishwasher according to claim 1, wherein a value of a discharge voltage of the radio-frequency power supply is 1-5 kV.
13. The dishwasher according to claim 1, wherein the discharge electrode plate and the ground electrode plate are respectively made of conductive materials.
14. A method for controlling a dishwasher, wherein the method controls the dishwasher according to any one of claims 1 to 13, and comprises the following steps:
 - placing a tableware in a tableware storage space formed between a discharge electrode plate and a ground electrode plate, wherein the tableware serves as an insulation medium;
 - performing electrification for sterilization: applying a voltage to the discharge electrode plate connected to a radio-frequency power supply, to form an electric field between the discharge electrode plate and the ground electrode plate;
 - and
 - ionizing air on a surface of the insulation medium, to form plasma to cover a surface of the tableware for sterilization.
15. The method for controlling the dishwasher according to claim 14, wherein before performing the electrification for sterilization, further comprises: cleaning by the dishwasher, the tableware.
16. The method for controlling the dishwasher according to claim 15, wherein after cleaning by the dishwasher, the tableware, the method further comprises: heating for evaporating water on the surface of the tableware.

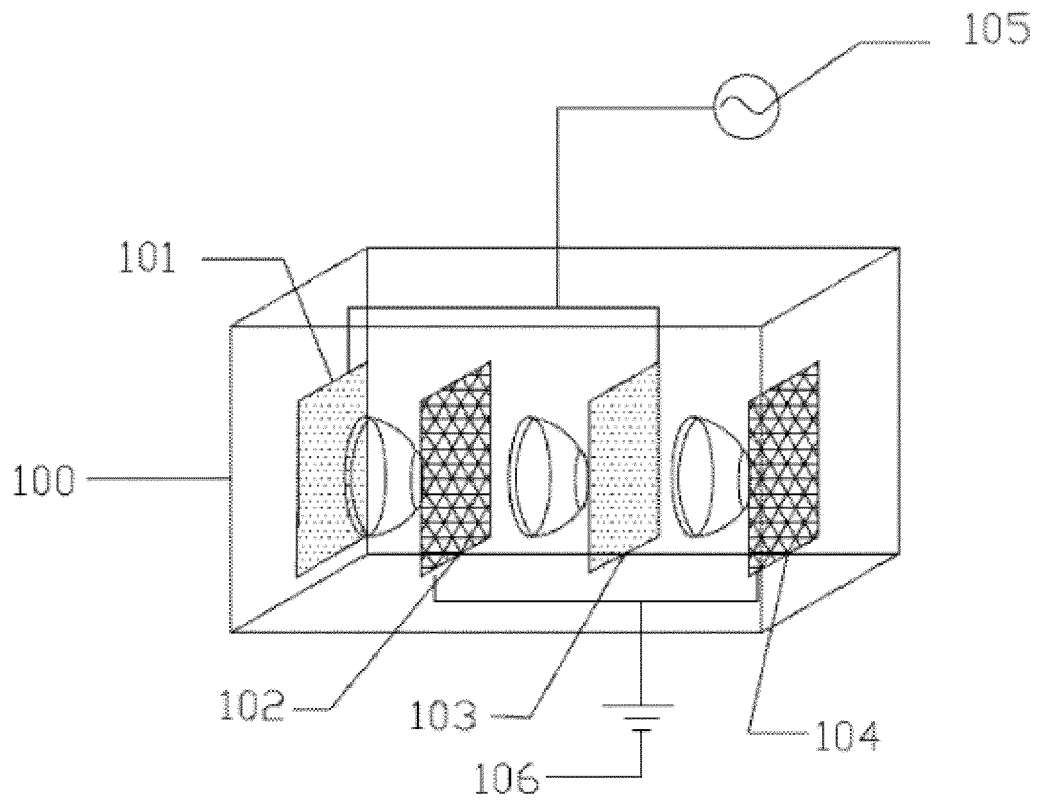


Fig. 1

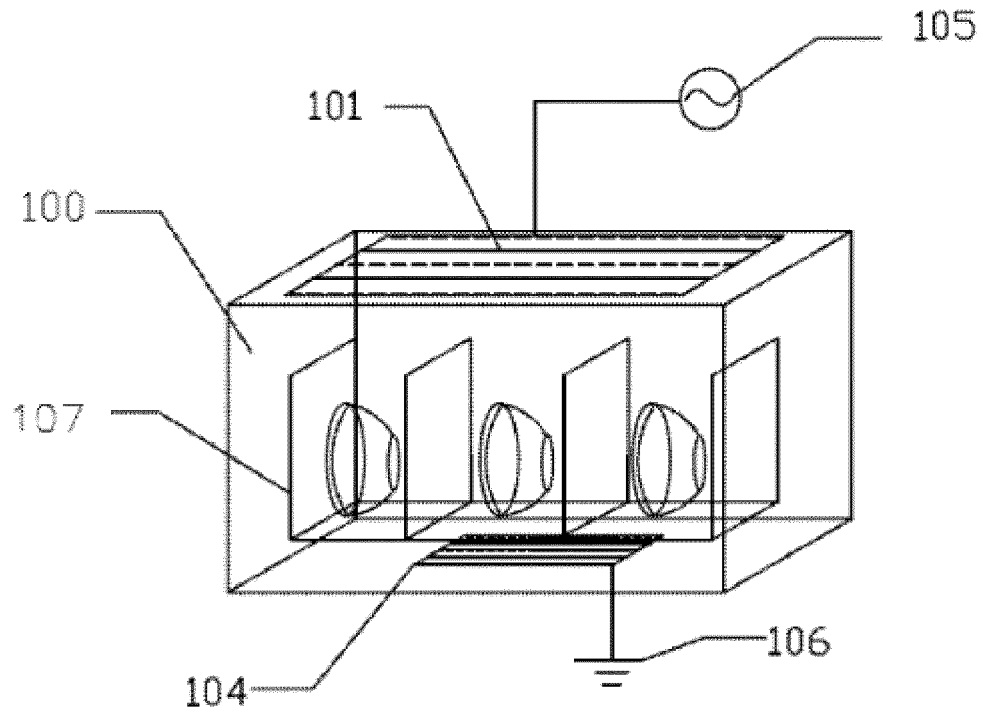


Fig. 2

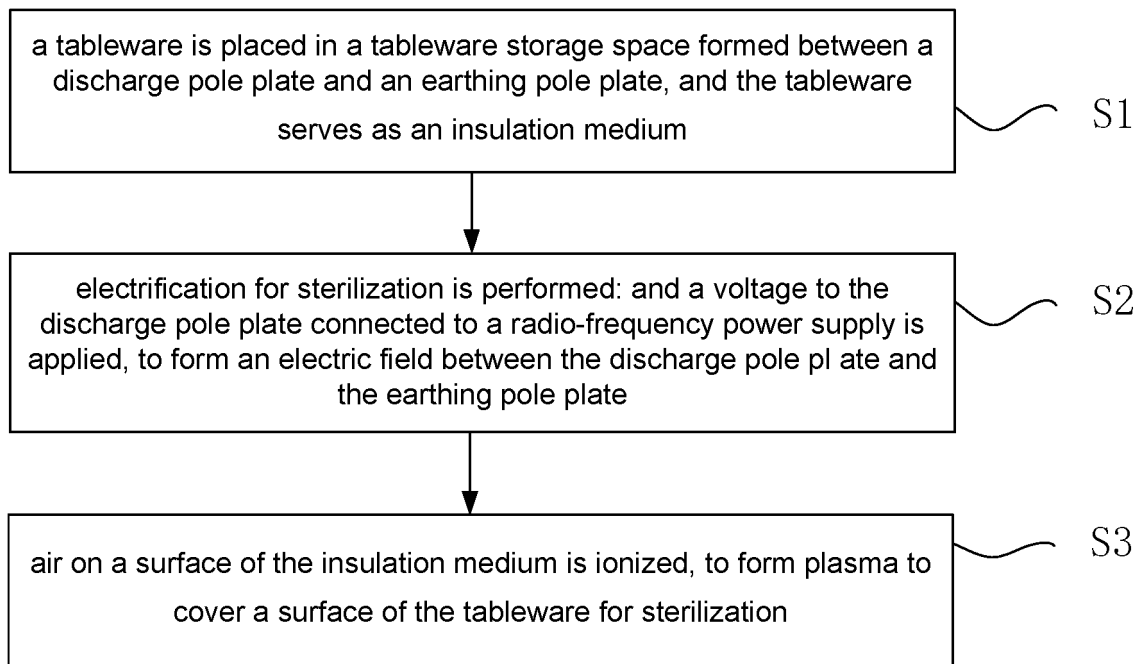


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2019/099429

A. CLASSIFICATION OF SUBJECT MATTER

A47L 15/42(2006.01)i; A47L 15/46(2006.01)i; A47L 15/00(2006.01)i

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)

A47L

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)

CNABS; CNTXT; CNKI; VEN; USTXT; WOTXT; EPTXT: 洗碗机, 餐具, 碗, 消毒, 杀菌, 灭菌, 等离子, 电极, 极板, 接地, 地线, 地电极, 平行, dishwasher, bowl, antiseptic, disinfect, sterilize, plasma, electrode, plate, ground+, parallel

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 109222817 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 18 January 2019 (2019-01-18) description, paragraphs [0005]-[0031], and figures 1 and 2	1-6, 12-16
PX	CN 109303537 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 05 February 2019 (2019-02-05) description, paragraphs [0006]-[0032], and figures 1 and 2	1, 7-16
X	CN 104748229 A (LIANYUNGANG YOUYUAN MEDICAL EQUIPMENT MANUFACTURING CO., LTD.) 01 July 2015 (2015-07-01) description, paragraphs [0006]-[0028], and figures 1-3	1-16
X	CN 103028127 A (XI'AN JIAOTONG UNIVERSITY) 10 April 2013 (2013-04-10) description, paragraphs [0006]-[0054], and figures 1-8	1-16
X	CN 104623704 A (HUBEI NEW DIRECTIONS PHARMACEUTICAL CO., LTD. et al.) 20 May 2015 (2015-05-20) description, paragraphs [0006]-[0072], and figures 1-4	1-16
A	CN 102343106 A (DALIAN NATIONALITIES UNIVERSITY) 08 February 2012 (2012-02-08) entire document	1-16

☒ 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

20 September 2019

Date of mailing of the international search report

06 November 2019

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)
No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing
100088
China

Authorized officer

Facsimile No. (86-10)62019451

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2019/099429

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 207083267 U (YUNNAN AEROSPACE IND CO., LTD.) 09 March 2018 (2018-03-09) entire document	1-16

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2019/099429

5

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report			Publication date (day/month/year)		Patent family member(s)		Publication date (day/month/year)	
CN	109222817	A	18 January 2019		None			
CN	109303537	A	05 February 2019		None			
CN	104748229	A	01 July 2015		None			
CN	103028127	A	10 April 2013		None			
CN	104623704	A	20 May 2015		None			
CN	102343106	A	08 February 2012		CN	102343106	B	23 July 2014
CN	207083267	U	09 March 2018		CN	107241849	A	10 October 2017

Form PCT/ISA/210 (patent family annex) (January 2015)

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

- CN 201811419584 [0001]
- CN 201811420522 [0001]