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

(11) **EP 4 390 282 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.06.2024 Bulletin 2024/26

(21) Application number: **22383253.6**

(22) Date of filing: **21.12.2022**

(51) International Patent Classification (IPC):
F26B 3/347 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F26B 3/347; F26B 11/04

(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 ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **Universidad Politecnica de Cartagena**
30202 Cartagena (Murcia) (ES)

(72) Inventors:
- **ALBERO ORTIZ, Antonio**
  30202 CARTAGENA (Murcia) (ES)
- **DÍAZ MORCILLO, Alejandro Benedicto**
  30202 CARTAGENA (Murcia) (ES)
- **MONZÓ CABRERA, Juan**
  30202 CARTAGENA (Murcia) (ES)
- **PEDREÑO MOLINA, Juan Luis**
  30202 CARTAGENA (Murcia) (ES)

(74) Representative: **Herrero & Asociados, S.L.**
Edificio Aqua - Agustín de Foxá, 4-10
28036 Madrid (ES)

(54) **DEVICE FOR GENERATION AND DISTRIBUTION OF MICROWAVES IN ROTARY HEAT APPLICATION SYSTEMS**

(57) Device for the generation and distribution of microwaves in rotary heat application systems. It comprises a rotating drum (1) with a side wall (5) with through slots (8) and annular extensions (9), a microwave emitter (2), and a cylindrical fixed microwave filter (3) made of metallic material, for covering the slots (8) on the side wall (5). A non-standard slotted mobile waveguide is formed in the device, delimited by:
- the external face of the side wall (5) of the rotating drum (1), with the slots (8);
- the internal face of the microwave filter (3), with a band-eliminating filter (11); and
- two opposing faces of two consecutive annular extensions (9).

With this guide, the propagated electromagnetic wave is introduced through the slot (8) and gradually loses intensity, distributing the energy evenly inside the rotating drum (1).

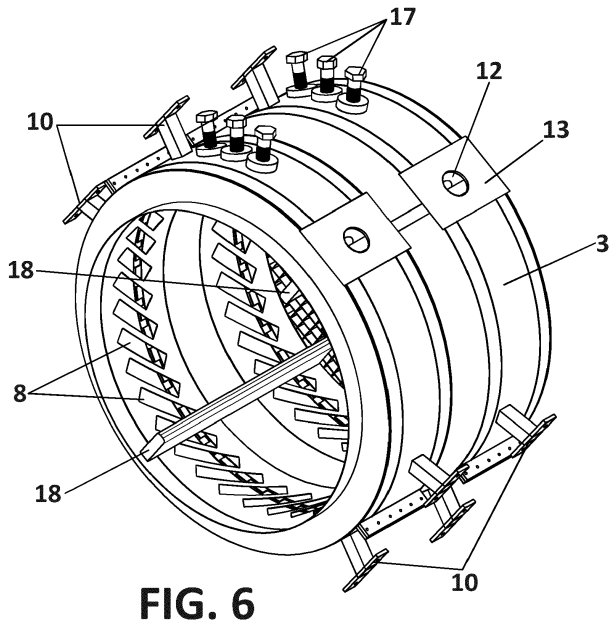

FIG. 6

EP 4 390 282 A1

Description

OBJECT OF THE INVENTION

[0001] The present invention falls within the technical field of drying procedures and devices of materials involving the use of heat, more specifically in that of those using electrical effects for the development of heat, and refers in particular to a device for generation and distribution of microwaves in rotary heat application systems.

[0002] The device has special application in the field of drying washed clothes, therefore it also falls within the specific technical field of heating systems for clothes dryers. However, its use is not limited to this, since it is also useful in seed drying procedures, rubber devulcanization, disinfection, and in general in any application that requires significant heating uniformity.

BACKGROUND OF THE INVENTION

[0003] Drying is one of the processes that consumes most energy, since it implies the contribution of energy to the internal water of a material, as well as to its own solid structure or dry mass. When these materials are poor thermal conductors (thermal insulators), as is the case of clothing or textile materials, the transmission of energy by heat exchange with hot air is an inefficient system because the low thermal conductivity prevents a rapid absorption of airborne heat.

[0004] Due to the high latent heat of evaporation of the water, in addition, the amount of energy to provide to the internal humidity of the materials that are being dried is very important. For this reason, drying processes based on hot air are usually slow and inefficient.

[0005] On the other hand, microwaves heat materials based on their electric permittivity, which is usually optimal when these materials contain water, since water is a polar material that converts microwaves into heat and finally allows the water to evaporate.

[0006] Despite these well-known advantages, commercial devices that use microwave energy to speed up the drying process of textiles are not common, and this is due to several reasons:

- it is technologically complex to use rotating metal drums in which microwaves can be introduced at significant levels to facilitate rapid drying;
- it is difficult to use mobile filters at the microwave frequency that allow this rotation while preventing microwave radiation to the outside;
- the air inlet and outlet in the drum must be adequately compatible with the elimination or significant reduction of microwave radiation through those air inlet and outlet points;
- when several microwave sources are used, they can couple mutually during the drying process and end up being damaged;
- textile materials change their dielectric properties a lot when they lose water, so the load detected by microwave sources varies a lot and, therefore, achieving an efficient and uniform system throughout the process is extremely complex;
- the exact stopping point of the process must be known so as not to overheat or burn the garments; and
- as uniform heating as possible must be provided to all the clothes located inside the dryer.

[0007] In the current state of the art there are patent documents that try to solve some of these disadvantages and provide microwave drying devices. It should be mentioned at this point that rotating drum microwave dryers can be classified into two main types.

[0008] In the first type, the microwave or magnetron source is fixed and heats a cavity where a rotating drum is located and where the clothes or items to be dried are inserted. This drum can be made of plastic so that the microwaves penetrate through it or can be metallic and equipped with a series of holes so that the microwaves can enter the drum and carry out their function of heating and drying.

[0009] An example of this first type can be found in patent publication number US6393725B1, which describes a compact microwave clothes dryer that is small enough to be placed on a counter. Air circulates through the microwave generator and power supply components into the drying chamber to transfer heat from the components to the clothes in the chamber. The feeding occurs directly with the antenna of the magnetron directed towards the rectangular microwave cavity, in which a rotating cylinder is located where the clothes are inserted.

[0010] In the second type, the microwave or magnetron source is located on the axis of the drum, either at the back or at the door, and emits directly into the rotating drum where the clothes or items to be dried are located.

[0011] An example of this second type can be found in the document with publication number CN110318230A. This relates to a clothes dryer comprising a box assembly, a door assembly, a cylinder assembly, a condensing assembly and a microwave assembly. The box assembly comprises a front sealing door with an opening for placing objects, the door assembly covers the front sealing door, and the cylinder and the door assembly are correspondingly arranged within the box assembly. The cylinder assembly comprises an inner cylinder that contains the clothes to be dried and an outer cylinder that covers the outer cylinder, wherein the condensing assembly is disposed within the case assembly and the condensing assembly is disposed below the cylinder assembly to condense gas exiting the cylinder assembly. The microwave assembly is arranged on the outer surface of the outer cylinder, and the microwave assembly transmits microwaves through the inner space of the outer cylinder through the outer cylinder.

[0012] This same applicant has a previous utility model, ES1246295U, related to a dryer that allows the waves

to be redirected towards the drum where the clothes are located. The dryer comprises a microwave-impermeable casing, with a door, equally impermeable, for introducing the clothes into a prismatic cavity configured to dry the clothes, which has one or more magnetrons with waveguides oriented towards the cavity, and one or more spaces isolated from microwaves for electronic or electrical equipment and other devices sensitive to microwaves, characterized in that the cavity has one or more microwave reflectors oblique to the walls of the cavity at its edges.

[0013] In both types of rotating drum microwave dryers, the problem is that as the clothes dry, they absorb less microwaves. Unused and uncontrolled, these microwaves end up damaging the magnetron and making the device very inefficient. In the case of magnetrons that directly feed the drum, there is also a greater risk of fire due to the high temperature that the clothes closest to the source can reach.

[0014] To avoid damage to the magnetron, current devices finish the drying process before the object in question, usually clothing, is completely dry. Therefore, to avoid damage to the device, the final objective is not achieved, which is to completely dry the inserted object.

[0015] Therefore, there continues to be a need for a device for generating and distributing microwaves in rotary heat application systems that, in a simple and efficient manner, allows overcoming the mentioned objections of the current state of the art.

DESCRIPTION OF THE INVENTION

[0016] The object of the invention consists of a device for the generation and distribution of microwaves in rotary heat application systems, which basically comprises the following elements:

- a rotating drum, preferably cylindrical, into which the material to be heated or dried is introduced, which includes through slots distributed on the side wall of the drum;
- at least one microwave emitting source, comprising magnetrons or solid-state generators, for generating and emitting a microwave electromagnetic field;
- fixed microwave filters, located on the slots of the drum without impeding its rotation, while they form a non-standard waveguide that distributes the microwave electromagnetic field selectively and uniformly throughout the material to be heated or dried; and
- an external structure that supports the previous elements.

[0017] Microwave filters are preferably materialized in the form of metallic cylinders that encase at least partially an outer surface of the rotating drum to prevent microwave radiation from escaping from the waveguide surrounding the rotating drum, confining it without leaving it more than one outlet through a set of slots described later, and therefore forcing said radiation to move inside the metal drum, where the materials are heated and/or dried. The microwave filters are attached to the external structure of the rotating system, allowing the microwave emitting sources to be installed on them.

[0018] The cylindrical filters can also comprise metal screws that are inserted into the non-standard waveguide to adapt the initial impedance of the process and improve its efficiency, with a fixed or adaptable configuration in the event of possible changes in the electromagnetic response of the load. Likewise, the cylindrical filters can be divided into several parts to allow their installation in the device in a simple way or to increase the number of microwave emitting sources.

[0019] Since the processed materials can change their internal moisture appreciably during the process, and with it their dielectric properties, a gradual or abrupt mismatch can occur between the microwave sources and their load, that is, the rotating drum with the material inside. To avoid this, a launcher is additionally added inside the non-standard waveguide, which makes it possible to make the impedance detected by the microwave emitting source independent with respect to the heating and/or drying conditions of the material and provide, consequently, an adaptation with reflection coefficient values less than -10 dB during the entire heating and/or drying process. Thus, high efficiency and homogeneity in the process are achieved.

[0020] In its preferred embodiment, the launcher is made up of two metal plates: one vertical and parallel to the antenna of the magnetron or solid-state generator, and another that is located below said antenna. The magnetrons or the antennas of the solid-state generators are therefore arranged on the cylindrical filters and the slots of the drum. The antenna of the microwave emitting source is located between the wall of the corresponding filter and the metallic launcher, to direct the microwave beam towards a determined direction of the drum and its slots. Likewise, these launchers allow one or more microwave sources to be mounted on the same filter, since the slots act as distributed antennas and there is little power available at the end of its journey through the non-standard waveguide under which they are located.

[0021] Regarding the distribution of the rotating drum slots, these can be configured in different radiant groups in such a way that, when there are several microwave sources, they are uncoupled from each other, allowing the use of several microwave sources simultaneously without occurring any breakage due to power transfers between these sources, nor loss of efficiency in the heating and/or drying process.

[0022] The decoupling between the groupings of slots is achieved by distributing them along the surface of the cylindrical side wall of the drum and making said groupings of slots cause an electric field perpendicular to that emitted by the other group of slots. Likewise, the lower and upper slots of the same radiating group also generate

perpendicular electric fields, there being no coupling between slots of the same group. This also favors the use of several microwave sources simultaneously without the risk of breakage due to source coupling and, therefore, the energy is directed exclusively to the material that must be dried and/or heated.

[0023] In this way, one of the advantages of the device is achieved, since by being able to install and use several microwave sources simultaneously, faster and more effective heating and extraction of humidity is achieved than in the previously reviewed inventions.

[0024] The interior of the rotating drum can contain metal blades, or preferably dielectric blades, which allow the material heated inside to be moved so that there is a greater uniformity of heating and/or drying, and so that the steam can escape from the dried material in a simpler way. Generally, these blades are made of a material that is transparent to microwaves, although it is also possible to use metal with rounded edges or other types of materials.

[0025] To close the faces of the drum, a front wall and a rear wall are arranged, perpendicular to the axis of rotation of said drum. Each one of them comprises a plurality of grid-type metal holes acting as cut-off waveguides, which totally or partially cover said walls in order to allow the evacuation of water vapor or other gases from the interior of the rotating drum. These walls can be integral with the body of the drum, and therefore rotate at the same time as it, or they can be independent and remain stationary while the drum rotates. In this second case, it is necessary to insert an additional cylindrical filter that, as a joint, prevents the microwave radiation from escaping.

[0026] Each metal wall is linked to the drum maintaining electrical continuity so that the passage of microwaves through these cut-off waveguides is prevented, but the passage of air, water vapor or any other gas is allowed. In the case of the front wall, it is necessary that there is at least one folding sector as a door to allow the introduction and extraction of materials from inside the drum.

[0027] A flow of air or another type of inert gas, such as nitrogen or helium, is generated before the rear perpendicular wall. Said gas flow crosses the cylindrical drum, evacuating the water vapor or any other gas generated inside. The length and internal dimensions of each cut-off guide are designed to provide enough attenuation to the electric field so that it comes out minimally through these holes and, in any case, complying with the electromagnetic compatibility regulations applicable to equipment that uses microwave radiation.

[0028] The metal grill on the front wall can be fixed or mobile to introduce and extract the materials to be heated or dried inside the drum. In this second case, the most common, it incorporates a filter in its contour that prevents contact with the rotating drum and prevents microwaves from radiating out of it, acting as a door for the rotating system.

[0029] With the device thus described, multiple advantages are achieved over the current state of the art. The most notable is derived from the fact that more efficient, uniform and rapid heating and drying is achieved, which has a positive effect on total energy consumption, due to the optimal use of the microwave flow. Reflections and interactions between the various microwave flows are minimized, which also prolongs the life of the magnetron by avoiding the couplings that occur with known devices.

DESCRIPTION OF THE DRAWINGS

[0030] To complement the description that is being made and in order to help a better understanding of the characteristics of the invention, according to a preferred example of its practical embodiment, a set of drawings is attached as an integral part of said description, where, with an illustrative and non-limiting nature, the following has been represented:

Figure 1.- Shows a front perspective view of the assembly made up of the rotating drum and the cylindrical filters for microwaves.

Figure 2.- Shows a rear perspective view of the assembly made up of the rotating drum and the cylindrical filters.

Figure 3.- Shows a partial exploded view of Figure 2 in which the interior of the rotating drum can be seen.

Figure 4.- Shows a schematic front view of the device.

Figure 5.- Shows a schematic rear view of the device.

Figure 6.- Shows a partial exploded view of the device.

Figure 7.- Shows a perspective view of a cylindrical filter.

PREFERRED EMBODIMENT OF THE INVENTION

[0031] A detailed explanation of a preferred embodiment of the object of the present invention is provided below, with the help of the aforementioned figures.

[0032] The device for generating and distributing microwaves in rotating heat application systems that is described is made up of a rotating drum (1), at least one microwave emitter (2), at least one fixed microwave filter (3), and an external structure (4) that supports the previous elements.

[0033] The rotating drum (1), essentially cylindrical and made of a metallic material, comprises a continuous side wall (5), a front closure (6) and a rear closure (7), which delimit an internal housing intended to house an element

to which to apply heat, either for drying or heating. The side wall (5) comprises a plurality of through slots (8) distributed along its surface that allow a beam of microwave energy from the microwave emitters (2) to pass towards the interior housing of the drum (1).

[0034] As can be seen in the attached figures, especially in figures 3 and 6, in this preferred embodiment the slots (8) have an oblique orientation with respect to an axis of rotation passing through the center of the rotating drum (1). Likewise, in this embodiment the slots (8) are distributed in an annular alignment along the side wall (5) and in such a way that two slots (8) diametrically opposing each other do not exactly face each other.

[0035] In a preferred embodiment of the device, shown in the attached figures, the side wall (5) of the rotating drum (1) comprises two alignments, parallel and separated from each other, of slots (8), separated from each other by an intermediate annular extension (9). The rotating drum (1) also includes two further annular extensions (9), one front and one rear. In this way, each of the alignments of slots (8) is delimited between two annular extensions (9).

[0036] Each one of the microwave filters (3) is made up of a cylindrical body of metallic material, intended to encase the exterior of a sector of the side wall (5) of the rotating drum (1) in which a grouping of slots (8) is located, so that it is covered by the microwave filter (3). In the preferred embodiment shown in the figures, the device comprises two microwave filters (3), each one covering a respective alignment of slots (8). The cylinder that makes up each microwave filter (3) has an internal diameter greater than the diameter of the rotating drum (1).

[0037] The microwave filters (3) are fixed to the external structure (4) by means of fastening elements (10), which in this case are columns. In this way the rotation of the rotating drum (1) is not hindered while ensuring that the alignment of slots (8) is always covered, as illustrated in Figures 4 and 5. The fastening elements (10) must ensure the correct mechanical stability of the assembly.

[0038] As can be seen in Figure 7, each microwave filter (3) has an external face and an internal face intended to face the external face of the side wall (5), and cover an alignment of slots (8). The internal face additionally comprises a band-eliminating filter (11), which in this case is made up of metallic corrugations intended to interact with the annular extensions (9) of the rotating drum (1).

[0039] Each microwave filter (3) also has at least one through hole (12), and in correspondence with said through hole (12) a support (13) is arranged to house the microwave emitter (2) on the external face of the microwave filter (3). The microwave emitter (2), which in this preferred embodiment consists of a magnetron, comprises an antenna insertable through the through hole (12), to direct the microwave beam towards the side wall (5) of the rotating drum (1).

[0040] Likewise, on the internal face of the microwave filter (3) and in correspondence with the through hole (12) there is a launcher (14) for directing and adapting the microwave beam towards a certain direction of the side wall (5) and the slots (8) of the rotating drum (1).

[0041] In this preferred embodiment, the launcher (14) comprises a vertical wall (15), which projects perpendicularly from the internal face of the microwave filter (3) and parallel to the antenna of the microwave emitter (2), and a horizontal wall (16), which heads perpendicularly towards a free end of the vertical wall (15), giving the launcher (14) an L-shaped profile. All the elements of the launcher (14) are metallic.

[0042] Therefore, a non-standard slotted mobile waveguide is formed in the device, which in this preferred embodiment is delimited by the following elements:

- the external face of the side wall (5) of the rotating drum (1), with the slots (8);
- the internal face of the microwave filter (3), including the band-eliminating filter (11) and the launcher (14); and
- two opposing faces of two annular extensions (9) of the rotating drum (1).

[0043] The non-standard slotted mobile waveguide has a mobile part, the one made up of the elements of the rotating drum (1), and another fixed part, the one corresponding to the microwave filter (3) and the elements linked to it. Said guide confines within it the microwave beam coming from the microwave emitter (2) introduced into the guide through the through hole (12), and forces said microwave beam to radiate, which penetrates into the interior of the rotating drum (1) through the slots (8).

[0044] The launcher (14) also allows microwave energy to be radiated in a direction predetermined within this waveguide, as well as one or more microwave emitters (2) to be mounted on the same microwave filter (3), since the slots (8) act as distributed antennas and there is little power available at the end of their run through the non-standard slotted mobile waveguide under which they are located.

[0045] With the guide thus described, the propagated electromagnetic wave is introduced through each of the slots (8) and gradually loses intensity, distributing the energy evenly inside the rotating drum (1). If said rotating drum (1) has a sufficiently large diameter, at the end of the cylindrical path the wave has practically no residual power, which allows good load adaptation and high energy efficiency.

[0046] The front closure (6), which in this case is attached to the front open face of the side wall (5), allows the passage of water vapor or other types of gases for its evacuation and condensation, and is at least partially foldable with respect to the side wall (5) to allow the introduction and extraction of materials in the device, as well as the confinement of the microwave energy inside the rotating drum (1). The air flow allows the extraction

of water vapor and other gases and suspended particles generated during the heat application process and comes from a generating system external to the device.

[0047] Said front closure (6) has a central grid and a perimeter frame, which is connected with electrical continuity to the corresponding microwave filter (3). The grid allows the passage of an air flow into the rotating drum (1).

[0048] In an alternative embodiment of the device, the front closure (6) does not have electrical contact with the rotating drum (1) and interacts with it through a metallic plate perpendicular to the drum, which is connected to it with electrical continuity. Thus, the front closure (6) with the metal grid and the microwave filters (3) remains stationary and is located a few millimeters from this metal wall, but without any contact, filtering microwaves and allowing rotation of the rotating drum (1), as well as the air flow through the metal grid.

[0049] In this preferred embodiment, the rear closure (7) is integral with the side wall (5) of the rotating drum (1), and includes, like the front closure (6), a central grid and a perimeter frame, which connects with electrical continuity to the corresponding microwave filter (3) and to the side wall (5) of the drum (1). In the rear closure (7) a rotating axis and some mechanical reinforcements are installed that allow the joint rotation of these elements together with the rotating drum (1). Said metallic axis is mechanically supported on the external structure (4) of the device to have a point around which to rotate.

[0050] The option of adding a thin sheet of dielectric material transparent to microwaves is contemplated on the inside of the microwave filter (3) and on the slots (8). Said sheet prevents airflow leaks through the annular extensions (9) of the rotating drum (1) and prevents the water vapor from the materials that are dried inside from penetrating the interior of the non-standard slotted mobile waveguide, thus forcing them to come out through the front closure (6). This supposes an additional protection for the microwave emitters (2).

[0051] Tuning elements (17) are provided on the external face of the microwave filters (3), made of metal screws, which allow the adaptation of the microwave emitter (2), either for the initial adjustment of the application process of heat, or for a continuous adaptation of the same by means of its intelligent introduction when changing the conditions of heating or drying. These tuning elements (17) can be fixed or movable. In the second case, the introduction and extraction of the tuning elements (17) occurs automatically by artificial intelligence and an electronic board and according to data obtained through sensors in the microwave emitters (2).

[0052] In an alternative embodiment of the device, the fixed filter (3) rests on the side wall (5) of the rotating drum (1) with interposition of metallic bearings, to provide greater electromagnetic isolation and to provide greater mechanical stability against device vibrations.

[0053] Finally, on the inside face of the side wall (5) of the rotating drum (1) there are some transversal blades (18) made of dielectrics transparent to microwaves, to move the clothes or the heated material, favoring a more uniform heating and drying and that water vapor or other gases pass from the material into the drum (1). These blades (18) also provide a smoothing and conditioning mechanism for the garments thus dried.

Claims

1. Device for generating and distributing microwaves in rotary heat application systems, comprising:

- an essentially cylindrical rotating drum (1) which in turn comprises:
  - a side wall (5) with at least one group of through slots (8);
  - annular extensions (9) projecting from an external face of the side wall (5);
  - a front closure (6); and
  - a rear closure (7);

which delimit an internal housing intended to house an element to be heated, and where each group of slots (8) is located between two consecutive annular extensions (9);
- at least one microwave emitter (2);
- at least one fixed microwave filter (3), without direct contact with the rotating drum (1), made up of a cylindrical body of metallic material, for outer covering of a sector of the side wall (5) of the rotating drum (1) in which a group of slots (8) is located; and
- a fixed external structure (4) that supports the above elements;

the device being **characterized in that** the microwave filter (3) comprises:

- at least one through hole (12) for insertion of the microwave emitter (2);
- an external face, for fixing the microwave emitter (2); and
- an internal face, opposable to the external face of the side wall (5) for covering the group of slots (8), comprising at least one band-eliminating filter (11);

so that in the device a non-standard slotted mobile waveguide is formed, delimited by:

- the external face of the side wall (5) of the rotating drum (1), with the slots (8);
- the internal face of the microwave filter (3), with the band-eliminating filter (11); and
- two opposing faces of two consecutive annular extensions (9).

2. Device according to claim 1 further comprising a metallic launcher (14) located on the internal face of the filter (3) in correspondence with the through hole (12), for directing and adapting a microwave beam coming from the microwave emitter (2) towards a determined direction. of the side wall (5) and the slots (8) of the rotating drum (1).

3. Device according to claim 2, wherein the launcher (14) has an L-shaped profile and comprises:

- a vertical wall (15), which projects perpendicularly from the inner face of the microwave filter (3) and parallel to the antenna of the microwave emitter (2); and
- a horizontal wall (16), which heads perpendicularly towards a free end of the vertical wall (15).

4. Device according to any of the preceding claims wherein:

- each grouping of slots (8) is located between two sectors of the rotating drum (1), and where the annular extensions (9) have a height close to 0; and
- the microwave filters (3) have side walls forming an inverted U, at the lower end of which the band-eliminating filters (11) are located, which completely cover each grouping of slots (8) and interact with the side wall (5) of the drum.

5. Device according to any of the preceding claims, wherein the slots (8) have an oblique orientation with respect to an axis of rotation passing through the center of the rotating drum (1).

6. Device according to any of the preceding claims, wherein the slots (8) are distributed aligned along the side wall (5) in such a way that two slots (8) diametrically opposed to one another do not face each other.

7. Device according to any of claims 1-6, wherein the front closure (6) and/or the rear closure (7) are integral with the side wall (5).

8. Device according to any of the claims 1-6, wherein the front closure (6) and/or the rear closure (7) are independent of the side wall (5).

9. Device according to claim 8 further comprising two additional microwave filters (3) insertable between the front (6) and rear (7) closures and the side wall (5).

10. Device according to any of the preceding claims, wherein the microwave filters (3) additionally comprise fastening elements (10) for fixing to internal walls of the external structure (4).

11. Device according to any of the preceding claims further comprising a sheet of dielectric material transparent to microwaves, located on the internal face and/or on the external face of the side wall (5) of the drum (1) and on the slots (8).

12. Device according to any of the preceding claims, wherein the microwave filters (3) additionally comprise tuning elements (17) located in the microwave filters (3) for adapting the microwave emitter (2) to the material to be heated.

13. Device according to claim 12, wherein the tuning elements (17) are automatically movable and insertable by means of artificial intelligence and an electronic board and according to data obtained through sensors associated with the microwave emitters (2).

14. Device according to any of the preceding claims, wherein the rotating drum (1) comprises transversal blades (18) made of dielectrics transparent to microwaves or metallic materials and attached to the internal face of the side wall (5).

15. Device according to any of the preceding claims, wherein the fixed filter (3) rests on the side wall of the rotating drum to provide greater electromagnetic isolation and/or to give greater mechanical stability against vibrations from the dryer.

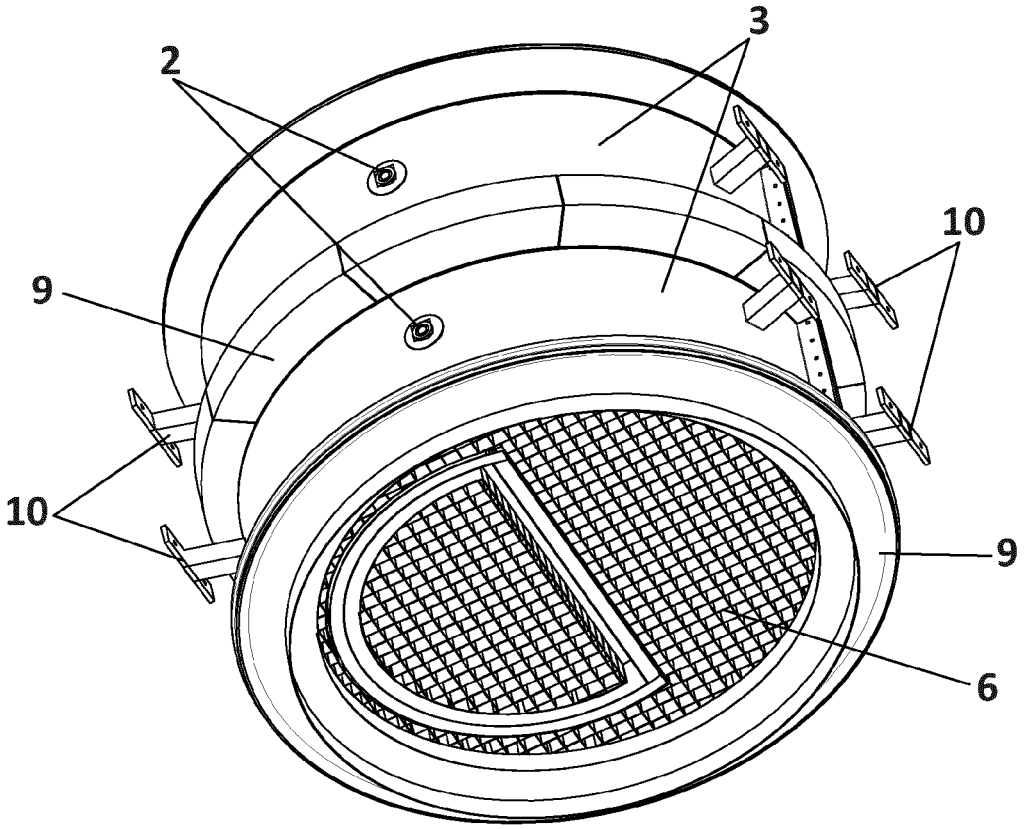

FIG. 1

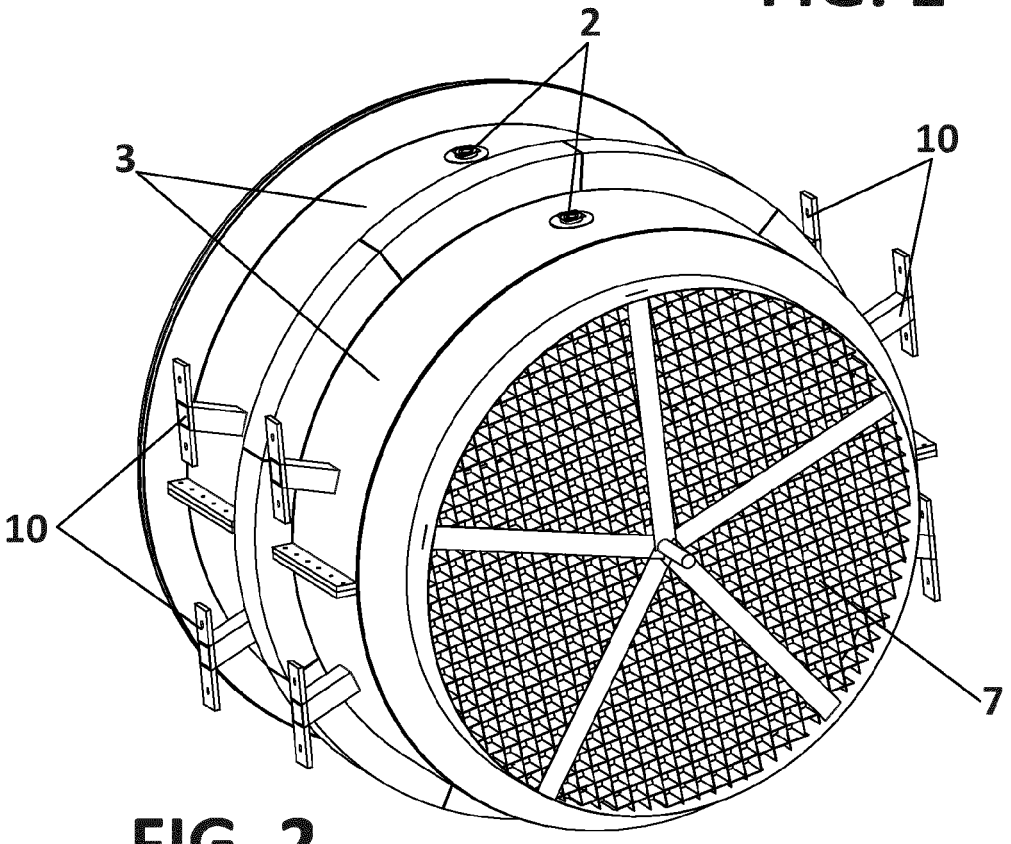

FIG. 2

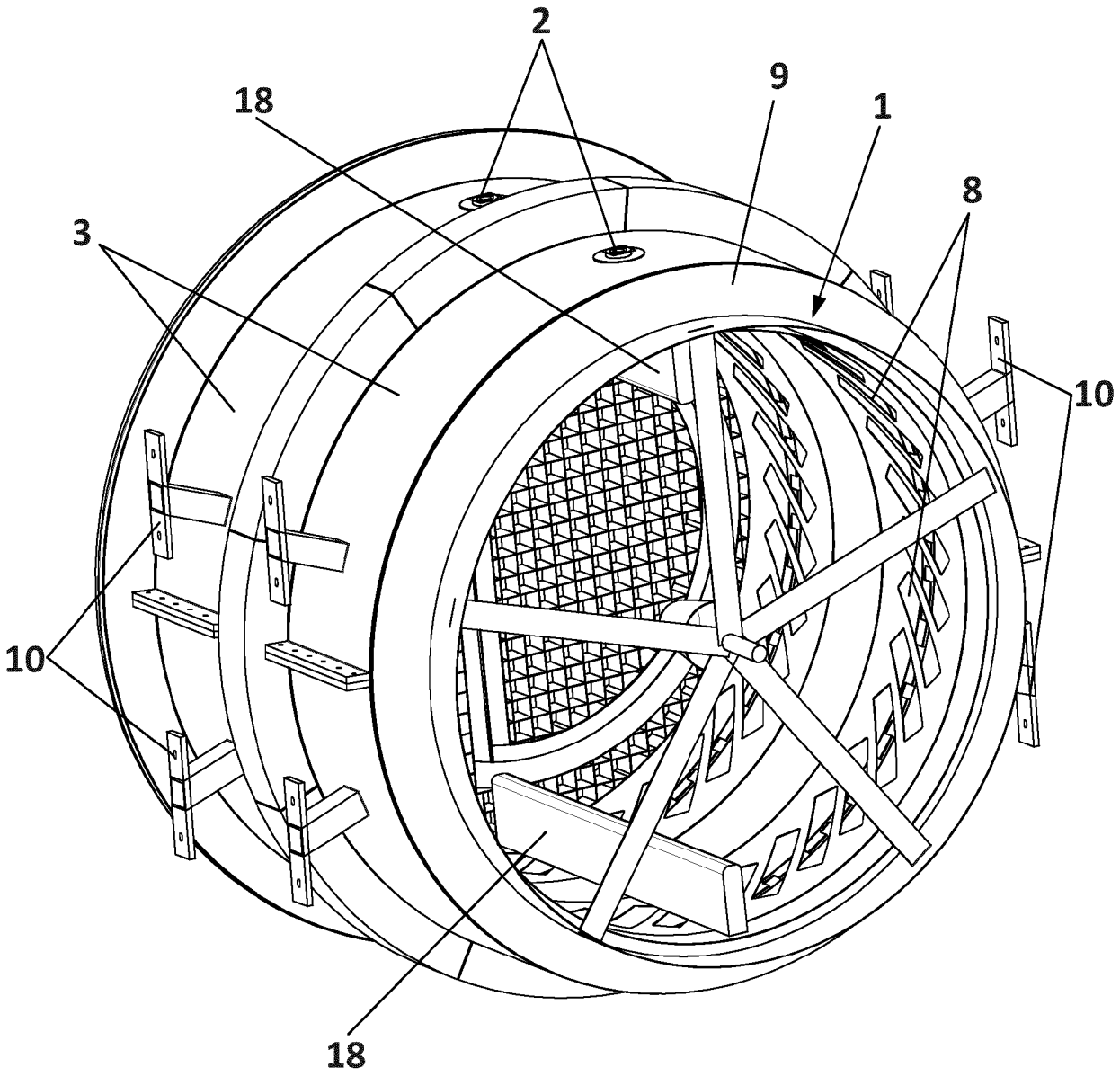

FIG. 3

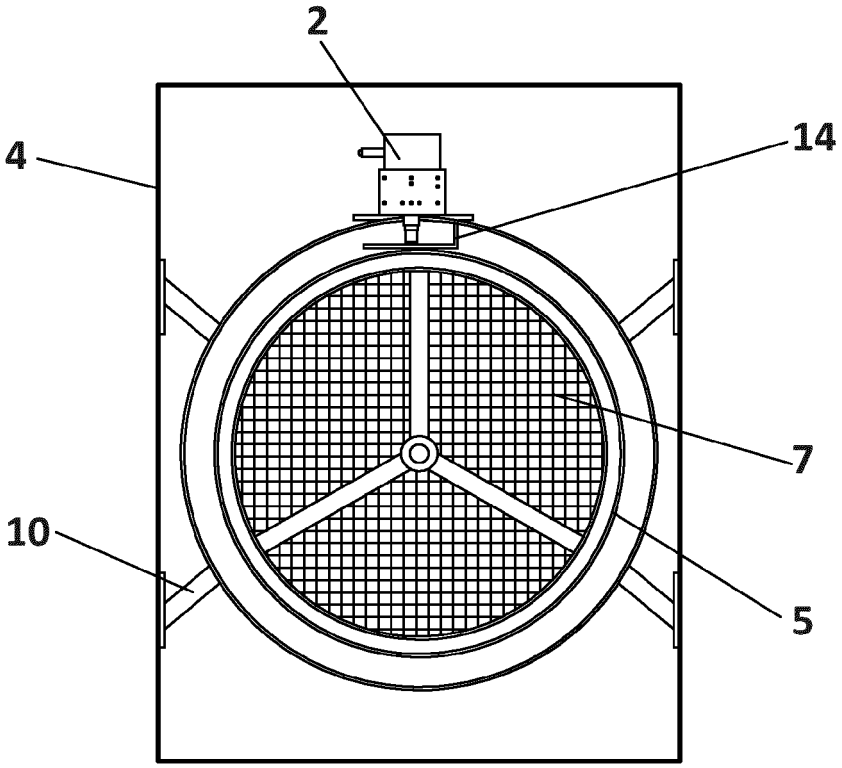

FIG. 4

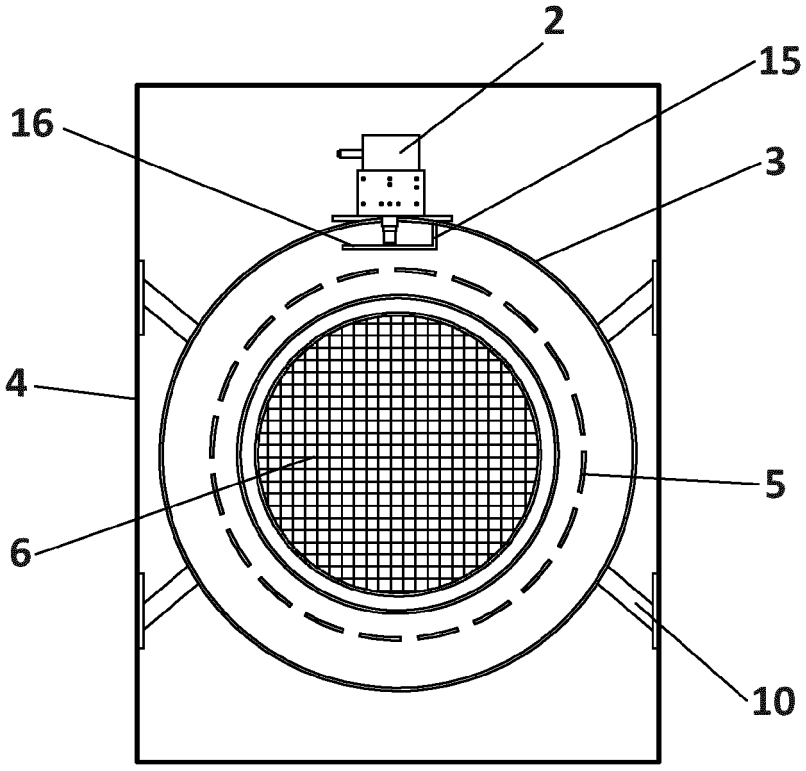

FIG. 5

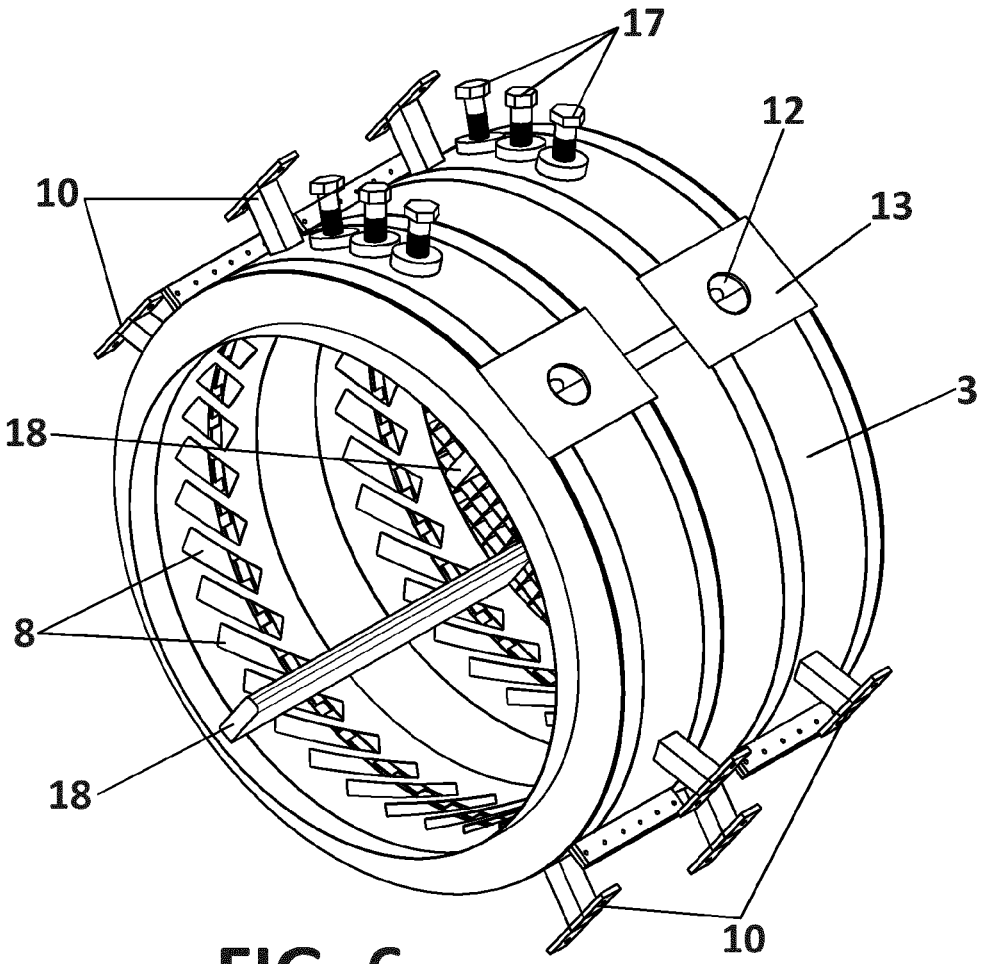

FIG. 6

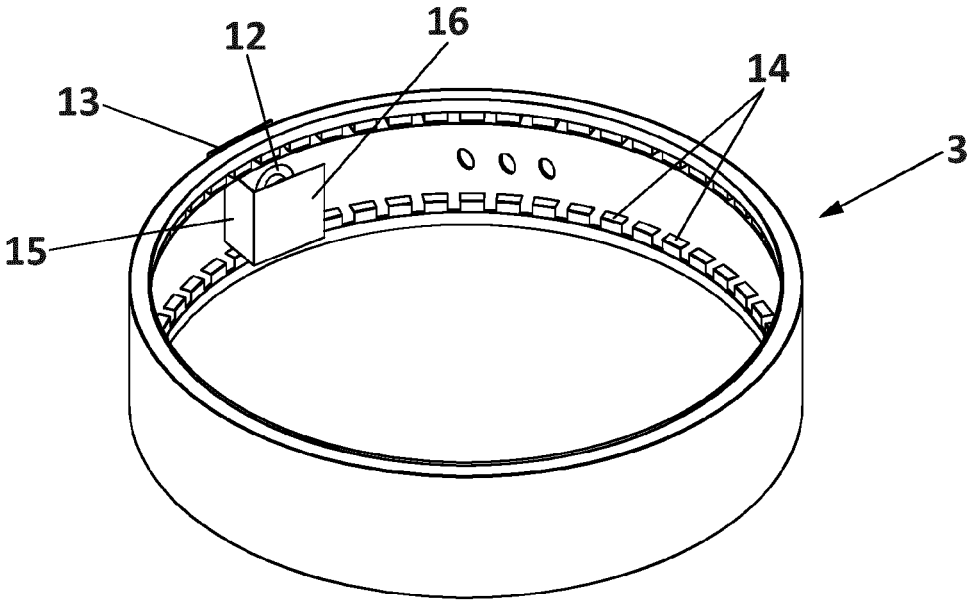

FIG. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 38 3253

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	CN 206 752 162 U (GUANGDONG MIDEA KITCHEN APPLIANCES MFG CO LTD; MIDEA GROUP CO LTD) 15 December 2017 (2017-12-15)	1-12,14, 15	INV. F26B3/347
A	* the whole document *	13	
Y	NL 8 700 130 A (JAN THEO STREEFKERK) 16 August 1988 (1988-08-16)	1-12,14, 15	
A	* the whole document *	13	
Y	WO 2005/073449 A1 (ARCELIK AS [TR]; DIKMENLI SERAP [TR]; KURAL CEM [TR]; TUNCEL TUNC [TR]) 11 August 2005 (2005-08-11)	1-12,14, 15	
A	* figures 1-8 *	13	
Y	CN 110 409 148 A (WUXI LITTLESWAN ELECTRIC APPLIANCE CO LTD) 5 November 2019 (2019-11-05) * the whole document *	1-12,14, 15	
Y	CN 110 318 230 A (WUXI LITTLESWAN ELECTRICAL APPLIANCE CO LTD) 11 October 2019 (2019-10-11) * the whole document *	1-12,14, 15	TECHNICAL FIELDS SEARCHED (IPC) F26B
Y	CN 102 587 101 A (FUQI LI) 18 July 2012 (2012-07-18) * the whole document *	1-12,14, 15	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 June 2023	Makúch, Milan

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 22 38 3253

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.

07-06-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 206752162 U	15-12-2017	NONE	
NL 8700130 A	16-08-1988	NONE	
WO 2005073449 A1	11-08-2005	TR 200603706 T1 WO 2005073449 A1	22-01-2007 11-08-2005
CN 110409148 A	05-11-2019	NONE	
CN 110318230 A	11-10-2019	NONE	
CN 102587101 A	18-07-2012	NONE	

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

- US 6393725 B1 **[0009]**
- CN 110318230 A **[0011]**
- ES 1246295 U **[0012]**