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(54) Title: VACUUM CHAMBER APPARATUS WITH SINGLE ROLLER FOR ROTATING CONTAINER

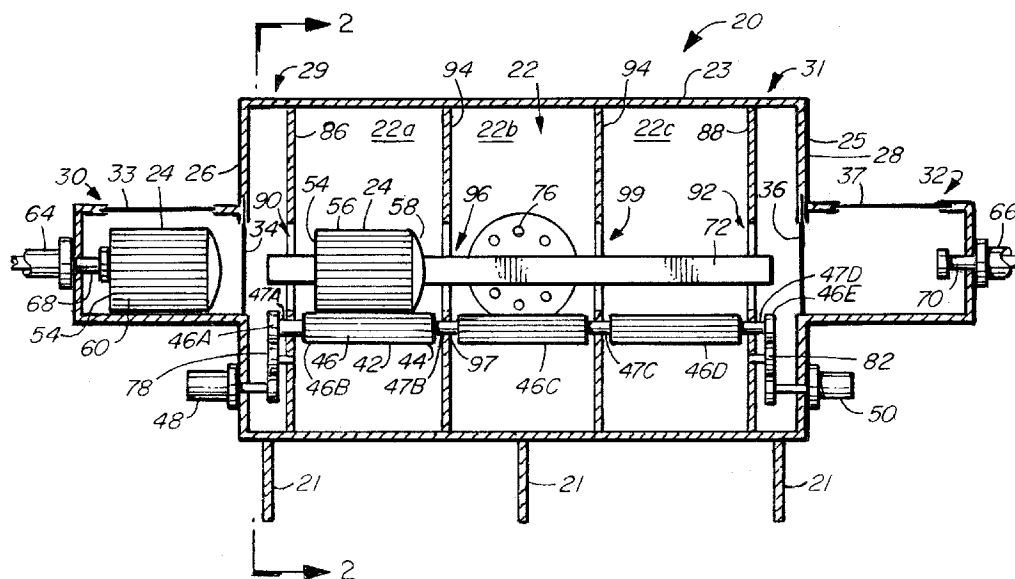


FIG. 1

(57) Abstract: An apparatus and method for providing a simpler and more robust mechanism for transporting materials to be dried through a vacuum microwave chamber in rotating containers. The apparatus (20) has a vacuum chamber (22), an input end (26) to introduce a container (24) into the chamber, and a discharge end (28) to remove the container. The container has spur gear teeth (60) extending along its outer circumferential surface. The apparatus has a single roller (42) having spur gear teeth (46) extending along its outer circumferential surface. The spur gear teeth of the roller mesh with the spur gear teeth of the container such that rotation of the roller about its longitudinal axis rotates the container. The apparatus also includes means for holding the container on the roller, means for moving the container through the chamber, a microwave generator 76 arranged for transmission of microwave radiation from the generator into the chamber, and means for reducing pressure inside the chamber.



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VACUUM CHAMBER APPARATUS WITH SINGLE ROLLER FOR ROTATING CONTAINER

5 Field of the Invention

[0001] The invention pertains to apparatuses and methods for dehydrating organic materials such as food products in a vacuum chamber of the type in which the organic materials are transported through the vacuum chamber in a rotating container.

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Background

[0002] Dehydration of organic materials such as foods and plant materials by vacuum microwave dehydration is known in the art. In one type of these dehydration apparatuses, disclosed, for example, in WO 2009/049409 published April 23, 2009 and WO 2014/085897 published June 12, 2014, organic materials are dehydrated by transporting the materials through a vacuum microwave chamber in a rotating container. In the apparatus disclosed in WO 2014/085897, a pair of rotatable rollers is arranged to support and rotate the container of materials about its horizontal axis and a chain drive is provided to transport the container along the rollers through the length of the chamber. This type of prior art machine is mechanically complicated: the double rollers must maintain synchronization, the transmission mechanism for operating the rollers is highly complex, and the relative alignment of the rollers (e.g., the distance and angle between them) must precisely correspond with the diameter of the rotatable containers to permit proper engagement of the rollers with the containers. The required level of precision for proper operation of this type of machine can be difficult to achieve in a microwave dehydration process since the containers will expand and eventually become distorted over time with the high operating temperatures.

30 [0003] There is a need in the dehydration industry for a vacuum microwave dehydration apparatus with a simpler and more robust mechanism for transporting rotatable containers. The present invention is directed to an improved vacuum microwave drying apparatus.

Summary

[0004] The invention provides an apparatus for dehydrating organic material. A vacuum chamber has an input end for the introduction of a container of the material to be dehydrated and a discharge end for removal of the container of dehydrated material. The container has spur gear teeth extending along part or all of its outer circumferential surface, and is supported on a single roller, extending longitudinally along a length of the vacuum chamber, with spur gear teeth extending along part or all of its outer circumferential surface. The spur gear teeth of the roller mesh with the spur gear teeth of the container such that driving the rotation of the roller about its longitudinal axis rotates the container about its longitudinal axis. The apparatus includes means for reducing the pressure in the vacuum chamber, means for rotating the roller about its longitudinal axis, means for holding the rotating container on the roller, and means for moving the rotating container through the vacuum chamber along the roller from an input zone to a discharge zone. The apparatus also includes a microwave generator arranged for transmission of microwave radiation from the generator into the vacuum chamber.

[0005] Another aspect of the invention provides a method for dehydrating an organic material. An organic material to be dehydrated is loaded into a container. The container is introduced into a vacuum chamber, the chamber being at a pressure less than atmospheric. The container is supported on a single roller within the vacuum chamber, with the spur gear teeth on the roller meshing with the spur gear teeth on the container. The container is rotated inside the vacuum chamber by the rotation of the roller through the engagement of the pairs of spur gear teeth. The rotating container is moved through the vacuum chamber while applying microwave radiation to dehydrate the organic materials. The container of dehydrated organic material is then removed from the vacuum chamber.

[0006] Further aspects of the invention and features of specific embodiments of the invention are described below.

Brief Description of the Drawings

[0007] Exemplary embodiments are illustrated in referenced figures of the drawings. It is intended that the embodiments and figures disclosed herein are to be considered

illustrative rather than restrictive.

[0008] Figure 1 is a cutaway side elevational view of the vacuum microwave drying apparatus according to one embodiment of the invention.

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[0009] Figure 2 is a sectional view on the line 2-2 of Figure 1, showing the input end of the vacuum chamber of the apparatus of Figure 1, the discharge end being substantially identical thereto.

10 **[0010]** Figure 3 is an isometric sectional view, partly cutaway, of the vacuum chamber of the apparatus of Figure 1.

[0011] Figure 4 is a schematic view of the apparatus of Figure 1.

15 **Detailed Description**

[0012] Referring to Figures 1 to 3, in one embodiment the apparatus of the invention is a vacuum microwave dehydration apparatus **20**. The apparatus **20** has a vacuum chamber **22**, through which a container **24** of organic materials is transported for vacuum microwave dehydration, and a microwave generator **76**. The vacuum chamber **22** has a cylindrical wall **25** supported by a stand **21**, an input end **26** for introducing the container **24** into the vacuum chamber **22**, and a discharge end **28** for removing the container **24** from the vacuum chamber **22**. A loading module **30** is provided at the input end **26** for loading the container **24** containing organic materials to be dehydrated into the vacuum chamber **22**. A discharge module **32** is provided at the discharge end **28** for holding the container **24** containing the dehydrated organic materials after being removed from the vacuum chamber **22**. The loading module **30** and the discharge module **32** each have a pair of airlock doors, respectively **33**, **34** and **36**, **37**. These permit the containers **24** to be loaded into and unloaded from the vacuum chamber **22**, while maintaining the chamber **22** at the reduced pressure required for the dehydration process. The airlock doors are self-sealing doors that form an airtight seal in their closed positions. Airlock doors **34**, **36** separate the respective loading module **30** and discharge module **32** from the vacuum chamber **22**.

[0013] Means are provided within the vacuum chamber **22** for rotating the container **24** and for moving it from the input end **26** to the discharge end **28**. A roller **42** is a longitudinal

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rod extending along a length of the vacuum chamber **22** with one end mounted at an input zone **29** of the vacuum chamber **22** and the other end mounted at a discharge zone **31** for rotation about its longitudinal, horizontal axis, an axis parallel to the longitudinal axis of the vacuum chamber **22**, within the vacuum chamber **22**. Mounting plates (not shown) may be provided at the input **29** and discharge **31** zones for supporting the respective ends of the roller **42**. The input zone **29** is a portion of the vacuum chamber **22** proximate to the input end **26**; the discharge zone **31** is a portion of the vacuum chamber **22** proximate to the discharge end **28**. The roller **42** has a circumferential surface **44** having spur gear teeth **46** extending along its length, parallel to the longitudinal axis of the roller **42**. The spur gear teeth **46** may extend along the entire length of the roller **42**, or extend intermittently along the length thereof such that the roller **42** has alternating sections of spur gear teeth containing circumferential surfaces **46A-46E** and sections with smooth circumferential surfaces **47A-47D**. A gear **78** is mounted on the input zone mounting plate, below the roller **42**, to engage the spur gear teeth **46** of the roller **42** at one end, and a gear **82** is mounted on the discharge zone mounting plate, below the roller **42**, to engage the spur gear teeth **46** of the roller **42** at the other end. Gears **78**, **82** are driven by a respective drive motor **48**, **50**, synchronized together, to rotate the roller **42** about its longitudinal axis, within the vacuum chamber **22**. The mounting plates may be secured to a respective end support frame **86**, **88**, which is mounted on the inner side of the cylindrical wall **25** at the respective input **29** and discharge zones **31** of the vacuum chamber **22**.

[0014] The container **24** is a basket made of a microwave-transparent material, such as high density polyethylene, with a closed bottom wall **54**, a cylindrical surface **56** and a removable lid **58**. The cylindrical surface **56** has spur gear teeth **60** extending along part or all of its outer circumferential surface, parallel to the longitudinal axis of the container **24**. The spur gear teeth **46** of the roller **42** are aligned to mesh with the spur gear teeth **60** of the container **24** to rotate the container **24** about its longitudinal axis as the roller **42** is driven to rotation about its longitudinal axis. The end support frames **86**, **88** define an opening **90**, **92** through which the container **24** is introduced into and removed from the vacuum chamber **22**, aligning the spur gear teeth **46** of the roller **42** with the spur gear teeth **60** of the container **24** within the vacuum chamber **22**.

[0015] Means are provided within the vacuum chamber **22** for holding the container **24** on the rotating roller **42**. As best seen in Figure 2, a pair of guide members **72**, **74** is secured to opposite sides of the opening **90** defined by the end support frame **86**,

circumferentially spaced from the roller **42**, at the input zone **29**, and to opposite sides of the opening **92** defined by the end support frame **88**, circumferentially spaced from the roller **42**, at the discharge zone **31**. Guide members **72**, **74** extend longitudinally through a length of the vacuum chamber **22** from the input zone **29** to the discharge zone **31**, parallel to the longitudinal axis of the vacuum chamber **22**. The guide members **72**, **74** are flat rectangular plates, arranged adjacent to opposing sides of the cylindrical surface **56** of the container **24**, for guiding the container **24** as it moves along the rotating roller **42**. Multiple pairs of longitudinally-spaced or adjoining guide members (not shown) may be provided to extend the length of the vacuum chamber **22**. This is useful where, for example, the vacuum chamber is of a substantial length.

[0016] A plurality of chamber dividers **94**, each extending across the internal, lateral cross-sectional area of the vacuum chamber **22**, separate the vacuum chamber **22** into a plurality of vacuum chamber modules (shown as modules **22a**, **22b**, **22c** in Figure 1). For convenience of illustration, the vacuum chamber **22** is shown with only three modules, but it will be understood that it can have any practical number of modules, as may be required for a particular application. Each of the chamber dividers **94** has openings **96**, **97**, through which the guide members **72**, **74** and the roller **42** extend respectively, for supporting the guide members and rollers through the intermediate portions of the vacuum chamber **22** between the end support frames **86**, **88** at the input **29** and discharge **31** zones. Each of the chamber dividers **94** also has an opening **99** for providing a passageway between adjacent vacuum chamber modules for movement of the containers **24** from one module to an adjacent module. The chamber dividers **94** act as microwave chokes to minimize cross interference between chamber modules.

[0017] Means are provided for moving the container **24** through the vacuum chamber **22** at the input module **30** and for removing the container **24** from the vacuum chamber **22** at the discharge module **32**. Figure 1 illustrates an example mechanism. A pushing cylinder **64** is affixed to the input module **30** for pushing the container **24** through the input end **26** of the vacuum chamber **22**, and a pulling cylinder **66** is affixed to the discharge module **32** for pulling the container **24** out of the vacuum chamber **22** at the discharge end **28**. The pushing cylinder **64** and the pulling cylinder **66** are air cylinders, with a piston **68**, **70** respectively, that is moveable between a position extending into the vacuum chamber **22** through the respective loading **30** and discharge modules **32** and a retracted position. Connection means may be provided at the bottom wall **54** and the lid **58** of the container **24**

to secure the container **24** to the respective piston **68**, **70**.

[0018] A plurality of containers **24**, each loaded with organic materials, can be concurrently supported on the roller **42**. As best seen in Figure 1, containers **24** are sequentially introduced into the vacuum chamber **22** and arranged to be moved, one after another, along the length of the roller **42**. The containers abut one another on the roller **42**, such that each downstream container is pushed by the adjacent upstream container.

[0019] The dehydrating apparatus **20** includes the components conventionally required for the operation of vacuum microwave driers. As illustrated schematically in Figure 4, a vacuum pump **98** is operatively connected through a condenser **100** and via a vacuum distributor **102** to vacuum ports in the vacuum chamber **22**. The condenser condenses water vapor produced during dehydration of the organic material. A refrigeration unit **104**, comprising a compressor, cooling fan and refrigerant pump, conveys refrigerant to the condenser **100** to maintain the condenser at a desired temperature. A water load system **106** may be provided in the vacuum chamber **22** to absorb excess microwave energy, by means of a water pump and conventional piping within the vacuum chamber. The dehydration apparatus **20** includes a programmable logic controller (PLC) **110**, programmed and connected to control the operation of the system, including controlling the drive motors **48**, **50** to rotate the roller **42**, the microwave generators **76**, the vacuum pump **98**, the refrigerant pump, the airlock doors **33**, **34**, **36**, **37**, and the pushing and pulling cylinders **64**, **66**.

[0020] The dehydrating apparatus **20** operates according to the following method. The vacuum pump **98**, refrigerant pump, water pump, microwave generators **76** and the motors **48**, **50** to rotate the roller are actuated, all under the control of the PLC. The vacuum chamber **22** is brought to reduced pressure. Operating pressures may be in the range, for example, of about 30 to 300 Torr (3.9 to 39.9 kPa), or 0.1 to 30 Torr (0.13 to 4.0 kPa). A container **24** of organic material to be dehydrated is loaded into the loading module **30**, whose pressure is then equalized with the vacuum chamber **22**. The airlock door **34** lifted, and the container **24** is pushed by the piston **68** through the opening **90** of the end support frame **86** at the input end **26** into the vacuum chamber **22**, supported by and moving along the rotating roller **42**. The container **24** rotates about its longitudinal axis within the vacuum chamber **22** by engagement of the spur gear teeth **60** on its outer circumferential surface with the spur gear teeth **46** on the outer circumferential surface of the rotating roller **42**,

tumbling the material in the container **24** as the material is being dehydrated. Longitudinally-extending guide members **72**, **74** hold the container **24** in position on the roller **42** as it moves along the length thereof. The spur gear teeth **46**, **60** mesh during the movement of the container **24** along the roller **42**.

5 **[0021]** In the illustrated example embodiment, the container **24** is loaded into the loading module **30** through airlock door **33**. The loading module **30** is sealed and its pressure equalized with the vacuum chamber **22**. Airlock door **34** is then opened, and actuation of the pushing cylinder **64** moves the piston **68** into the loading module **30**, pushing the container **24** from the loading module **30** into the vacuum chamber **22**. The
10 airlock door **34** is then closed and the piston **68** is retracted. The second container is loaded in the same manner as the first container. Once the second container is in the loading module **30**, the airlock door **34** is opened, and the piston **68** pushes it onto the rotating roller **42**. This pushes the second container against the first container, displacing the first container farther down the vacuum chamber **22** towards the discharge end **28** by the length
15 of one container. The process is repeated by loading additional containers in the same manner, each container displacing the previously-loaded ones in the vacuum chamber **22**. Once the first container is at or near the discharge end **28**, the airlock door **36** is opened, and the pulling cylinder **66** is actuated to move the piston **70** into the vacuum chamber **22** through the discharge end **28**, and pull the first container into the discharge module **32**. The
20 airlock door **36** is then closed, and the piston **70** is retracted. The discharge module **32** is brought to atmospheric pressure and the first container is removed through airlock door **37**. The discharge module **32** is then sealed and its pressure equalized with the vacuum chamber **22**. The process is again repeated by removing additional containers from the vacuum chamber **22** in the same manner. The apparatus is operated on a continuous-
25 throughput basis.

[0022] Throughout the foregoing description and the drawings, in which corresponding and like parts are identified by the same reference characters, specific details have been set forth in order to provide a more thorough understanding to persons skilled in the art. However, well known elements may not have been shown or described in detail or at all to
30 avoid unnecessarily obscuring the disclosure.

[0023] As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the scope thereof. Accordingly, the description and drawings are to

be regarded in an illustrative, rather than a restrictive, sense.

Claims

1. An apparatus (20) for dehydrating organic material, comprising:
 - (a) container (24) for holding the organic material, the container being rotatable about a longitudinal axis thereof, the container having spur gear teeth (60) extending along an outer circumferential surface thereof;
 - (b) a vacuum chamber (22) having an input end (26) for introduction of the container and a discharge end (28) for removal of the container;
 - (c) a roller (42) extending within the vacuum chamber between an input zone (29) proximate to the input end and a discharge zone (31) proximate to the discharge end, the roller having spur gear teeth (46) extending along an outer circumferential surface thereof, the roller being positioned within the vacuum chamber to support the container, with the spur gear teeth of the roller meshing with the spur gear teeth of the container;
 - (d) means (48, 50, 78, 80) for rotating the roller about a longitudinal axis thereof and thereby rotating the container;
 - (e) means (72, 74) for holding the rotating container on the roller;
 - (f) means (64, 66, 68, 70) for moving the rotating container through the vacuum chamber along the roller from the input end to the discharge end;
 - (g) a microwave generator (76) arranged for transmission of microwave radiation into the vacuum chamber; and
 - (h) means (98) for reducing pressure inside the vacuum chamber.
2. An apparatus according to claim 1, wherein the spur gear teeth on the container are parallel to the longitudinal axis of the container and the spur gear teeth on the roller are parallel to the longitudinal axis of the roller.
3. An apparatus according to any one of the preceding claims, wherein the longitudinal axis of the roller is horizontal.

4. An apparatus according to any one of the preceding claims, wherein the means for holding the rotating container on the roller comprises a pair of guide members (72, 74).
5. An apparatus according to any one of claims 1 to 3, wherein the means for holding the rotating container on the roller comprises multiple pairs of longitudinally-spaced or adjoining guide members.
6. An apparatus according to any one of the preceding claims, wherein the means for moving the rotating container through the vacuum chamber along the roller comprises a piston (68) arranged to push the container into the vacuum chamber.
7. An apparatus according to any one of the preceding claims, further comprising means (64, 68) for introducing the container into the input end of the vacuum chamber.
8. An apparatus according to claim 7, wherein the means for introducing the container into the input end of the vacuum chamber comprises:
 - a loading module (30) having a first end for receiving the container and a second end adjacent to the input end of the vacuum chamber;
 - a loading, airlock door (34) separating the loading module from the input end of the vacuum chamber; and
 - a piston (68) arranged to push the container from the loading module into the vacuum chamber.
9. An apparatus according to any one of the preceding claims, further comprising means (66, 70) for removing the container from the vacuum chamber at the discharge end.
10. An apparatus according to claim 9, wherein the means for removing the container from the vacuum chamber at the discharge end thereof comprises:
 - a discharge module (32) having a first end adjacent to the discharge end of the vacuum chamber and a second end;
 - an unloading, airlock door (36) separating the discharge module from the discharge end of the vacuum chamber; and

a piston (70) arranged to pull the container from the vacuum chamber into the discharge module.

11. An apparatus according to claim 8 or claim 10, wherein the container has a closed end (54), a removable lid (58) at the opposite end, and means for connecting the respective pistons to the closed end and the removable lid.
12. An apparatus according to any one of the preceding claims, wherein spur gear teeth of the roller extend along the entire length of the outer circumferential surface thereof.
13. An apparatus according to any one of claims 1 to 11, wherein the spur gear teeth of the roller extend intermittently along the length of the outer circumferential surface thereof, the roller having alternating sections of circumferential surfaces with spur gear teeth and sections with smooth circumferential surfaces.
14. A method for dehydrating an organic material, comprising the steps of:
 - (a) reducing pressure within a vacuum chamber (22) to a pressure less than atmospheric;
 - (b) introducing a container (24) of the organic material into the vacuum chamber;
 - (c) supporting the container on a single roller (42) within the vacuum chamber, with spur gear teeth (46) on the roller meshing with spur gear teeth (60) on the container;
 - (d) rotating the roller, causing the spur gear teeth on the roller to engage with the spur gear teeth on the container and thereby rotate the container;
 - (e) moving the rotating container through the vacuum chamber supported on the roller, while applying microwave radiation to dehydrate the organic material; and
 - (f) removing the container of dehydrated organic material from the vacuum chamber.
15. A method according to claim 14, wherein the container inside the vacuum chamber is rotated about a horizontal axis.

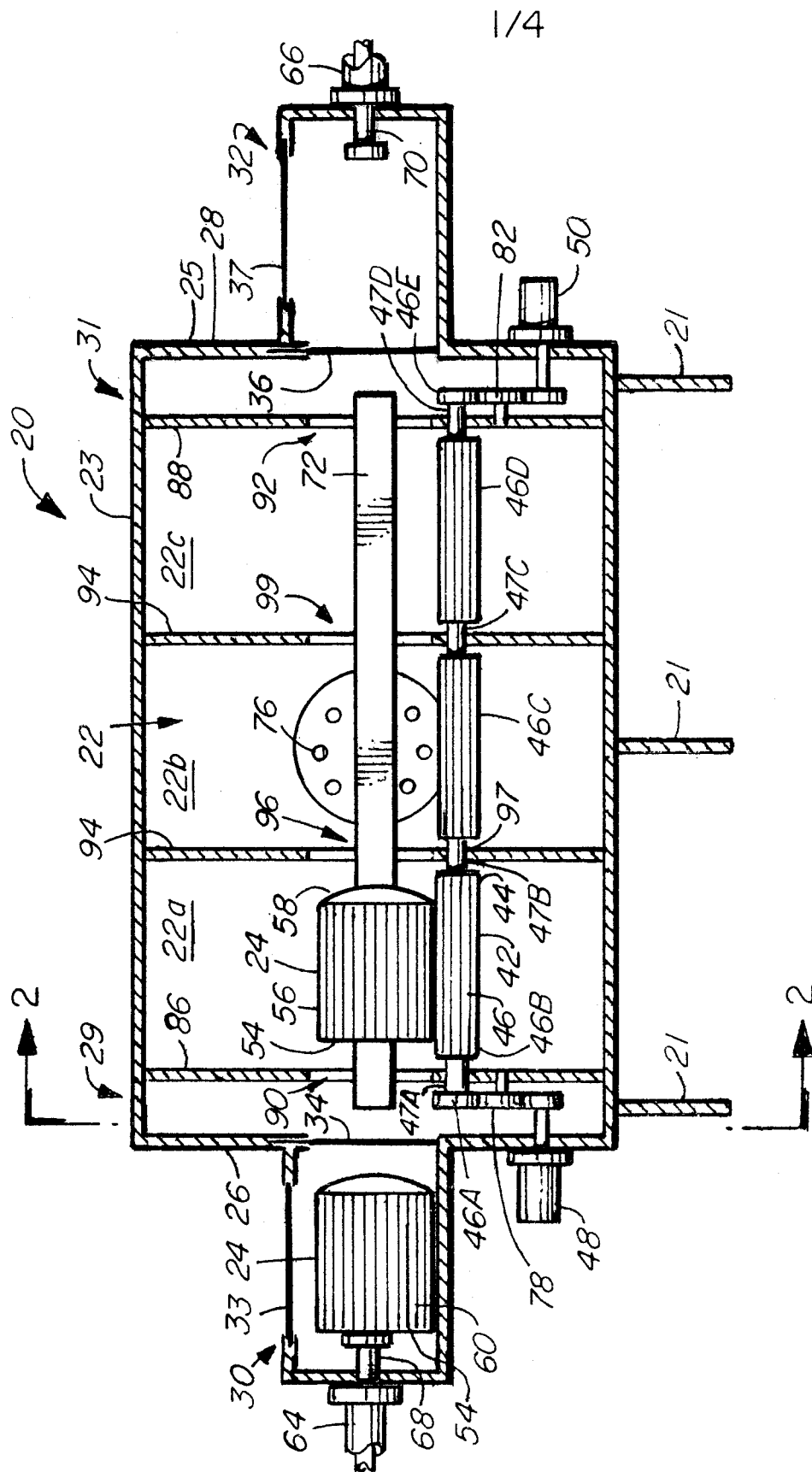


Fig. 1

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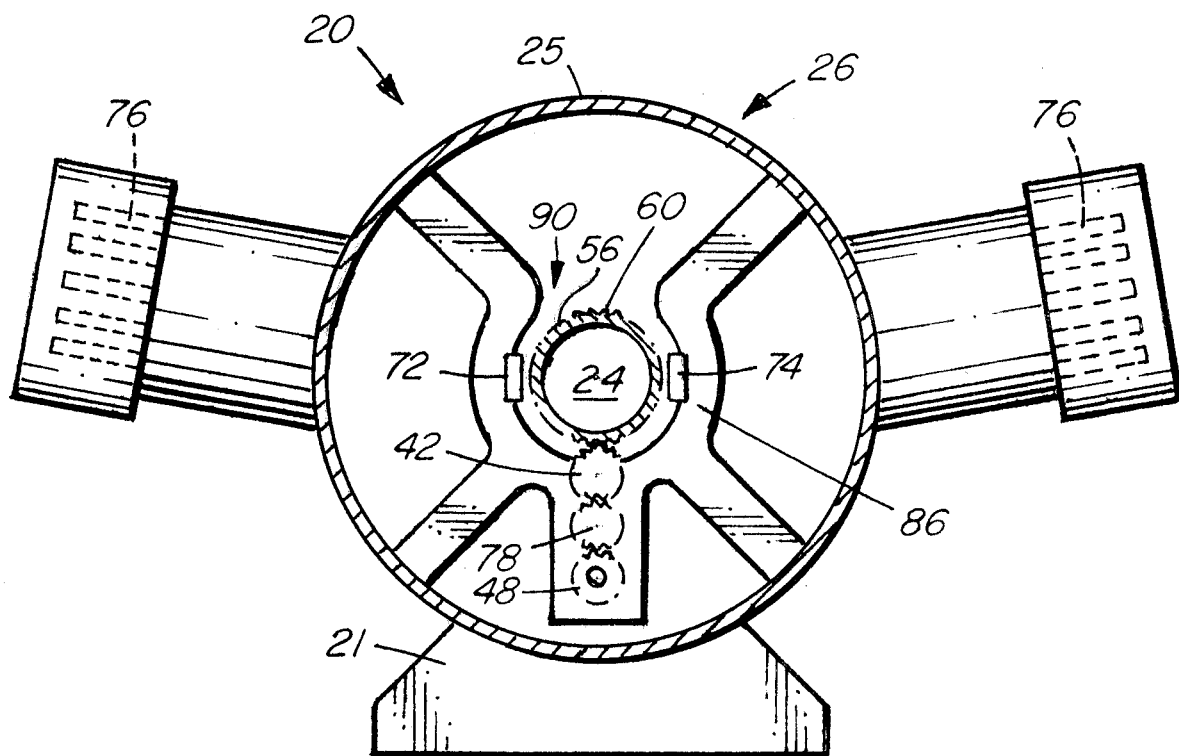


FIG. 2

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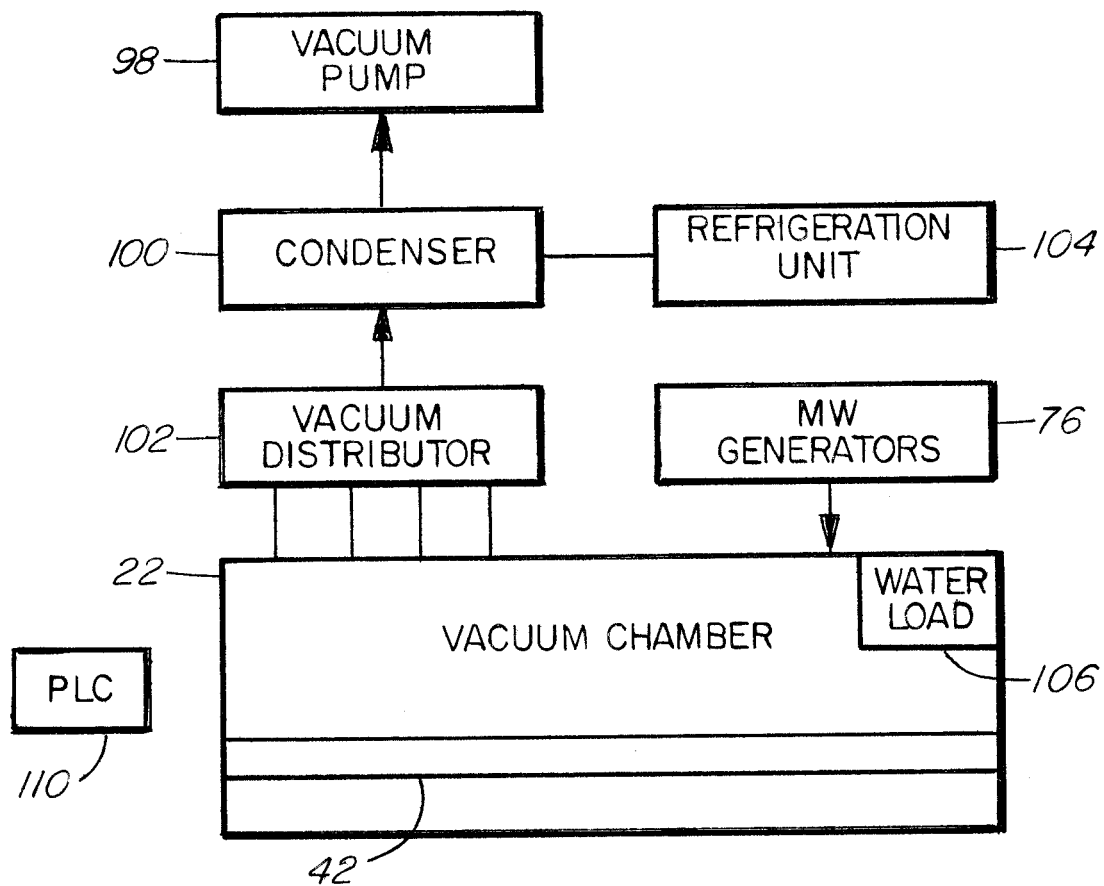


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC: **F26B 11/04** (2006.01), **A23B 7/02** (2006.01), **A23B 7/028** (2006.01), **A23L 3/40** (2006.01),
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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: **F26B**, **A23B**, **A23L**

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

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

Database: Questel Orbit

Keywords: microwave, vacuum, gear, tooth, teeth, rotate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2014/085897 A1 (DURANCE et al.) 12 June 2014 (12-06-2014) *Entire document*	1, 14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
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"P" document published prior to the international filing date but later than the priority date claimed	

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30 March 2020 (30-03-2020)

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
WO2014085897A1	12 June 2014 (12-06-2014)	AU2012396134A1	28 May 2015 (28-05-2015)
		AU2012396134A2	28 May 2015 (28-05-2015)
		AU2012396134B2	04 May 2017 (04-05-2017)
		BR112015013184A2	11 July 2017 (11-07-2017)
		CA2818377A1	07 June 2014 (07-06-2014)
		CA2818377C	20 January 2015 (20-01-2015)
		CN104769377A	08 July 2015 (08-07-2015)
		CN104769377B	08 March 2017 (08-03-2017)
		EP2753888A1	16 July 2014 (16-07-2014)
		EP2753888A4	15 June 2016 (15-06-2016)
		HK1208524A1	04 March 2016 (04-03-2016)
		JP2015536440A	21 December 2015 (21-12-2015)
		JP6042996B2	14 December 2016 (14-12-2016)
		KR20150092155A	12 August 2015 (12-08-2015)
		KR101966209B1	13 August 2019 (13-08-2019)
		MX2015005161A	17 July 2015 (17-07-2015)
		MX365683B	11 June 2019 (11-06-2019)
		NZ706088A	28 April 2017 (28-04-2017)
		US2015128442A1	14 May 2015 (14-05-2015)
		US9267734B2	23 February 2016 (23-02-2016)

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