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(54) **A mobile robot having a humidifier therein**

(57) A mobile robot, in an embodiment, comprises a humidifying device (90) and is capable of humidifying an entire room. The mobile robot comprises a driving part (40) for movably supporting a body (10) and providing a driving force to move the body, a humidifier disposed on the body; and a controller (80) for controlling the driving part.

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Description

[0001] This application claims the benefit 35 U. S. C. § 119(a) of Korean Patent Application No. 2005-15461, filed on February 24, 2005, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

CROSS-REFERENCE TO RELATED APPLICATIONS

[0002] This application may contain subject matter related to one or more of the following pending U.S. Patent Applications: "Air Cleaning Robot and System Thereof," Serial No. 10/822,653 filed April 13, 2004; "Robot Cleaner having Air Cleaning Function and System Thereof," Serial No. 10/804,078 filed March 19, 2004; and "Robot Cleaner Equipped with Negative Ion Generator,," Serial No. 10/887,918 filed July 12, 2004.

BACKGROUND OF THE INVENTION

Field of the Invention

[0003] The present invention relates generally to the field of mobile robots, and in some embodiments, to robots having a humidifier therein.

Description of the Related Art

[0004] In general, humidifiers can be classified into centrifugal spray humidifiers, ultrasonic humidifiers, heat humidifiers, and filter evaporative humidifiers according to how water is evaporated.

[0005] The centrifugal spray humidifiers spray drawn-in water using a centrifugal force and have the water collide with an inner wall, thereby evaporating the water. The ultrasonic humidifiers transmit an electric signal of a predetermined frequency to a vibrator immersed in water and vibrate the vibrator, thereby evaporating the water. A heat humidifier heats water using a heater or an electrode rod, thereby generating vapor. The filter evaporative humidifiers pass air through a wet filter, thereby evaporating the water.

[0006] Such humidifiers maintain indoor humidity at an appropriate level for a fresh room environment, and mostly are stationary at a predetermined place. The stationary humidifier, however, has a disadvantage that its humidifying effect is limited to an area in proximity to a place where the humidifier is installed, particularly if there is no convection current caused by the humidifier. Therefore, it is difficult to achieve a desired level of humidity in the entire room, and humidifying efficiency deteriorates.

SUMMARY OF THE INVENTION

[0007] It is to be understood that both the following summary and the detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed. Neither the summary nor the description that follows is intended to define or limit the scope of the invention to the particular features mentioned in the summary or in the description.

[0008] In certain embodiments, the disclosed embodiments may solve one or more of the above problems and/or disadvantages and may provide one or more of the advantages described herein.

[0009] In some exemplary embodiments, a mobile robot is provided with a humidifier to more uniformly humidify an entire room.

[0010] In a further exemplary embodiment, a mobile robot simultaneously performs cleaning and humidifying operations.

[0011] In more specific examples provided in the specification, a mobile robot comprises a driving part for movably supporting a body and providing a driving force to move the body, a humidifier disposed on the body, and a controller for controlling the driving part.

[0012] In an embodiment, the mobile robot may further comprise a humidity sensor detecting an indoor humidity level; and a cover for covering the body. The controller controls an ON/OFF switching of the humidifier according to the humidity level detected by the humidity sensor.

[0013] The humidifier comprises a reservoir for containing a fluid, an evaporating module for converting the fluid supplied from the reservoir into vapor and distributing the vapor to the outside; and a connection pipe for connecting the reservoir to the evaporating module to supply the fluid contained in the reservoir to the evaporating module.

[0014] In exemplary embodiments, the evaporating module comprises an evaporator for converting the fluid into vapor, and a discharge pipe for discharging the vapor to the outside. The reservoir is provided with an injection port for injecting

the fluid therethrough, and the injection port and the discharge pipe are exposed to the outside through an injection port hole and a discharge pipe hole formed on a cover for covering the body.

[0015] In an embodiment, the driving part comprises at least one driving motor controlled by the controller, a pair of driving wheels connected to the driving motor and disposed at opposite sides of the body; a pair of driven wheels connected to the pair of driving wheel to transmit a driving force; and a pair of idle wheels for supporting the body. The reservoir is disposed on the body in such a way that the driving wheels, the driven wheels and the idle wheels are subjected to the same load of the reservoir. A pair of the reservoirs are disposed on opposite sides of the body to be located above the driving wheel, the driven wheels, and the idle wheels.

[0016] In some exemplary embodiments the mobile robot may further comprise an optional dust suction part disposed on the body to perform a cleaning operation with respect to a surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The accompanying drawings, which are incorporated herein and form a part of the specification, illustrate exemplary embodiments and, together with the description, further serve to enable a person skilled in the pertinent art to make and use these embodiments and others that will be apparent to those skilled in the art.

[0018] FIG. 1 is an exploded perspective view showing an exemplary embodiment of a mobile robot;

[0019] FIG. 2 is a bottom view showing the mobile robot of FIG. 1;

[0020] FIG. 3 is a block diagram showing an exemplary embodiment of one control system that can be used with the mobile robot of FIG. 1; and

[0021] FIG. 4 is a perspective view showing the mobile robot of FIG. 1 in an assembled state.

DETAILED DESCRIPTION OF AN EXEMPLARY EMBODIMENT

[0022] A mobile robot having various inventive features will now be disclosed in terms of several exemplary embodiments. This specification discloses one or more embodiments that incorporate the features of this invention. The embodiment(s) described, and references in the specification to "one embodiment", "an embodiment", "an example embodiment", etc., indicate that the embodiment(s) described may include a particular feature, structure, or characteristic, but every embodiment may not necessarily include the particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, persons skilled in the art may effect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0023] In the following description, similar drawing reference numerals may be used for the same elements even in different drawings. The embodiments described, and their detailed construction and elements, are merely provided to assist in a comprehensive understanding of the invention. Thus, it is apparent that the present invention can be carried out in a variety of ways, and does not require any of the specific features described herein. Also, well-known functions or constructions are not described in detail since they would obscure the invention with unnecessary detail.

[0024] Referring to FIGS. 1 to 4, a mobile robot according to one exemplary embodiment of the present invention comprises a body 10, a cover 20 covering the body 10, a dust suction part 30, a driving part 40, an upper camera 50, a front camera 52, an obstacle sensor 54, a memory device 60, a transmitting/receiving part 70, a controller 80, and a humidifier 90. An arrow direction I indicates a forwarding direction of the mobile robot cleaner.

[0025] In the exemplary embodiment shown, the dust suction part 30 is disposed on the body 10 to draw in dust-laden air from a cleaning surface and collect the dust. The dust suction part 30 is used in order for the mobile robot to perform a cleaning operation, and it may employ a well-known dust suction part of a general robot cleaner. For example, the dust suction part 30 comprises a suction motor (not shown), a suction port 31 formed on the body 10, for drawing in dust from a cleaning surface by using a suction force generated by the suction motor, a brush 31 exposed to the outside through the suction port 31 to scrub the dust, and a dust collecting chamber (not shown) for collecting dust drawn in through the suction port.

[0026] As shown in FIG. 2, in an exemplary embodiment, the driving part 40 comprises a pair of driven wheels 41 disposed at front opposite sides of the body 10, a pair of driving wheels 42 disposed at rear opposite sides of the body 10, a pair of driving motors 43 for rotating the pair of driving wheels 42, respectively, a power transmitting member 44 for transmitting a driving force from the driving wheels 42 to the driven wheels 41, and a pair of idle wheels 45 disposed at rear sides of the body 10 for movably supporting the body 10. In this embodiment, the power transmitting member 44 uses a timing belt, but the useful power transmission mechanisms are not limited to the timing belt, which is merely shown as an example. The power transmitting member 44 may adopt a gear pulley assembly or any other known method of transmitting power. In this example, a pair driving motors 43 are provided, but any number of motors may be used, for example, a single driving motor. Also, the idle wheels 45 can be omitted if the driving wheels 42 and the driven wheels 41 are arranged appropriately to balance the mobile robot. Various well-known driving mechanisms may be applied, if

they activate the mobile robot and maintain the balance of the mobile robot.

[0027] The driving part 40 rotates the driving motors 43 independently in a forward direction or a backward direction according to a control signal of the controller 80. A traveling direction is determined by changing rotational speed (measured in RPM) of the respective driving motors 43.

[0028] In an embodiment, the upper camera 50 is disposed on the body 10 to photograph an upper image and outputs the photographed image to the controller 80. Preferably, the upper camera 50 employs a fisheye lens (not shown). The structure of the fish eye lens is disclosed in Korean Patent Publication Nos. 1996-7005245, 1997-48669 and 1994-22112, and the fisheye lenses are readily available from various manufacturers, so it is not necessary to include a detailed description of the construction of the lens in this specification.

[0029] In the embodiment shown, the front camera 52 is disposed on the body to photograph a front image and outputs the photographed image to the controller 80.

[0030] In an embodiment, the obstacle sensor 54 is arranged around an edge of the body 10 to transmit signals to the outside and receive reflected signals. The obstacle sensor 54 may use an optic sensor or an ultrasonic sensor. The obstacle sensor 54 may be used to measure a distance to an obstacle or a wall.

[0031] In one method of operation that will be described herein as an example, the memory device 60 stores the upper image photographed by the upper camera 50, and the controller 80 calculates location information or travel information based on image information stored in the memory device 60.

[0032] In this embodiment, the transmitting/receiving part 70 sends out data to an external device 72 and transmits signals received from the external device 72 to the controller 80. The external device 72 is generally a wireless relay device (not shown) or a remote controller (not shown) which are enabled to input and output data.

[0033] According to this embodiment, the controller 80 processes the signal received from the transmitting/receiving part 70 and controls the respective parts based on the signals. The mobile robot may further comprise a key input device (not shown) having a plurality of keys for setting functions of the mobile robot. In this case, the controller 80 processes key signal input from the key input device.

[0034] In an embodiment, the controller 80 extracts an image of a location recognition mark, which is installed on a ceiling of a working area, from the upper image photographed by the upper camera 50, and recognizes a location of the mobile robot based on the image of the location recognition mark. The controller 80 controls the respective parts to perform a target work based on location information. Also, the controller 80 controls an ON/OFF switching of the humidifier 90 according to a value inputted from a humidity sensor 97 (see FIG. 3).

[0035] In the exemplary embodiment shown, the humidifier 90 comprises a pair of reservoirs 91, an evaporating module 93 and a connection pipe 96 for supplying fluid contained in the reservoirs 91 to the evaporating module 93.

[0036] In this embodiment, the pair of reservoirs 91 contain the fluid to be evaporated and are disposed at opposite sides of the body 10 and above the pairs of wheels 41, 42, and 45 so that the pairs of wheels 41, 42, 45 are subjected to equal load of the reservoirs 91. That is, the reservoirs 91 are disposed on the body 10 in such a way that a center of gravity of the reservoirs 91 is the same as that of the mobile robot. The reservoirs 91 may be arranged on the body 10 in various manners. Preferably, their layout satisfies the condition that the center of gravity of reservoirs 91 is identical to that of the mobile robot. In the example shown, each reservoir 91 has an injection port 92 through which fluid is injected into the reservoir 19. The injection port 92 is exposed to the outside through an injection port hole 22 formed on the cover 20 so that a user can directly inject the fluid without opening the cover 20. An openable and closable cover 23 is provided at the injection port hole 22.

[0037] In an embodiment, the evaporating module 93 comprises an evaporator 94 for evaporating the fluid supplied from the reservoirs 91 and a discharge pipe 95 for guiding vapor generated by the evaporator 94 to the outside of the mobile robot. The evaporator 94 is disposed on the body 10 and at a lower position than the reservoir 91 so that the fluid contained in the reservoirs 91 is easily supplied to the evaporator 94. The evaporator 94 may use any of a variety of known humidifying methods. For example, and without limitation, a centrifugal spray method, an ultrasonic method, a heat method or a filter evaporative method may be used. Since the structure and principle of various useful forms of evaporator 94 are well-known to those skilled art in the art, a detailed description of evaporator operation is omitted. The discharge pipe 95 is exposed to the outside through a discharge pipe hole 21 formed on the cover 20.

[0038] In this embodiment, two (2) connection pipes 96 are provided to connect the evaporating module 93 to the respective reservoirs 91.

[0039] Hereinafter, one example of the method of operation of the mobile robot having the above construction will be described.

[0040] The controller 80 controls the driving part 40 in order for the mobile robot to travel a working area according to a travel pattern, creates an image map with respect to an upper area based on an image photographed by the upper camera 50, and stores the image map in the memory device 60. Alternatively, when the mobile robot receives a working command from a key input device or an external device 72 in a wireless manner, the mobile robot can be set to create the image map before performing its actual operation.

[0041] The controller 80 determines a location of the mobile robot based on the image map created in advance. More

specifically, when the controller 80 receives as an input a work request signal from the key input device or the external device 72 in a wireless manner, the controller 80 compares a current image inputted by the upper camera 50 or the upper camera 50 and the front camera 52 with a memorized image map, and thereby determines a current location of the mobile robot. The controller 80 controls the driving part 40 to correspond to a traveling path from the determined current location to a target location. In here, the work request signal includes a signal for cleaning operation, a signal for monitoring operation to be performed by the cameras 50 and 52 and a signal for humidifying operation.

[0042] When the mobile robot travels along the traveling path to the target, it calculates a traveling error by use of a traveling distance measured by an encoder and a current location determined by the comparison of a currently-photographed image with a memorized image map, and controls the driving part 40 to compensate for the traveling error and follow the traveling path to the target location.

[0043] While the mobile robot travels, the controller 80 selectively activates the dust suction part 30 and the humidifier 90, or both of them, according to the work request signal.

[0044] That is, when power is supplied from a power source (not shown) provided in the body 10, a dust suction motor (not shown) is driven. As a result of suction force generated by the driven suction motor, the mobile robot draws in dust from a surface to be cleaned through the suction port 31.

[0045] In an embodiment, the controller 80 determines whether to humidify based on a value received from the humidity sensor 97 and a reference value pre-set in the memory device 60, and the humidifier performs a humidifying operation when a measured humidity level is determined to be below a desired humidity target. Under the control of the controller 80, the mobile robot humidifies at the area where a humidity is low, and does not humidify at the area where a humidity is high. Accordingly, the mobile robot can maintain the indoor humidity in a constant level within an entire working area and improve the humidification efficiency. Meanwhile, the humidifying and the cleaning operations are performed simultaneously and separately.

[0046] If a user inputs a signal to stop the operation of the driving part 40 through the external device 72, the mobile robot stays at a certain place but may continue cleaning or humidifying operation.

[0047] If the user inputs a work stopping command through the external device 72 when the cleaning or the humidifying operation is completed, the controller 80 stops the cleaning or the humidifying operation and returns the mobile robot to an initial location.

[0048] As described above, since the humidifier 90 is movable within a room, it can humidify the entire room.

[0049] Since the humidifier 90 is mounted in the mobile robot having a cleaning function, an additional humidifier is not required and thus a cost-saving effect is achieved. Also, since the cleaning and the humidifying operations are performed simultaneously, a much fresher living space can be obtained.

[0050] The foregoing embodiments and advantages are merely exemplary and are not to be construed as limiting the present invention. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures.

Claims

1. A mobile robot comprising:

a driving part for movably supporting a body and providing a driving force to move the body;
a humidifier disposed on the body; and
a controller for controlling the driving part.

2. The mobile robot as claimed in claim 1, further comprising a humidity sensor detecting an indoor humidity level, wherein the controller controls an ON/OFF switching of the humidifier according to the humidity level detected by the humidity sensor.

3. The mobile robot as claimed in any of claims 1 and 2, wherein the humidifier comprises:

a reservoir for containing a fluid; and
an evaporating module for converting the fluid supplied from the reservoir into vapor and distributing the vapor to the outside.

4. The mobile robot as claimed in claim 3, wherein the evaporating module comprises:

an evaporator for converting the fluid into vapor; and
a discharge pipe for discharging the vapor to the outside.

5 5. The mobile robot as claimed in claim 4, wherein the reservoir is provided with an injection port for injecting the fluid therethrough, and the injection port and the discharge pipe are exposed to the outside through an injection port hole and a discharge pipe hole formed on a cover for covering the body.

6. The mobile robot as claimed in any of claims 3 to 5, wherein the driving part comprises:

10 at least one driving motor controlled by the controller;
a pair of driving wheels connected to the driving motor and disposed at opposite sides of the body;
a pair of driven wheels connected to the pair of driving wheel to transmit a driving force; and
a pair of idle wheels for supporting the body,

15 wherein the reservoir is disposed on the body in such a way that the driving wheels, the driven wheels and the idle wheels are subjected to the same load of the reservoir.

20 7. The mobile robot as claimed in claim 6, wherein a pair of the reservoirs are disposed on opposite sides of the body to be located above the driving wheel, the driven wheels, and the idle wheels.

8. The mobile robot as claimed in any of claims 4 to 7, wherein the humidifier further comprise a connection pipe for connecting the reservoir and the evaporator to supply the fluid from the reservoir to the evaporator.

25 9. A mobile robot comprising:

a driving part for movably supporting a body and providing a driving force to move the body;
a humidifier disposed on the body;
a humidity sensor for detecting an indoor humidity level;
a dust suction part disposed in the body to perform a cleaning operation with respect to a surface; and
30 a controller for controlling the driving of the driving part and an ON/OFF switching of the humidifier according to the indoor humidity level detected by the humidity sensor.

FIG. 1

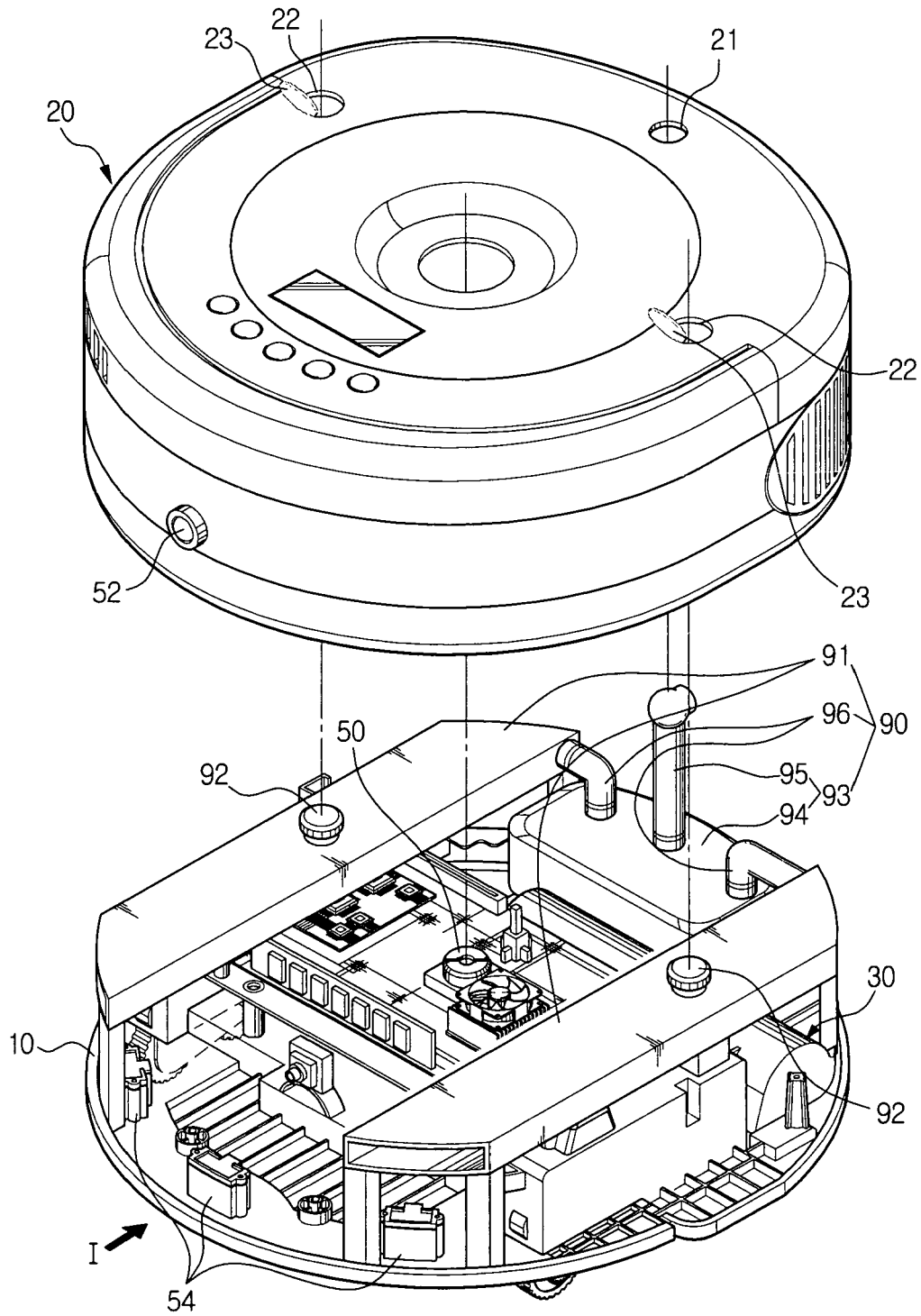


FIG. 2

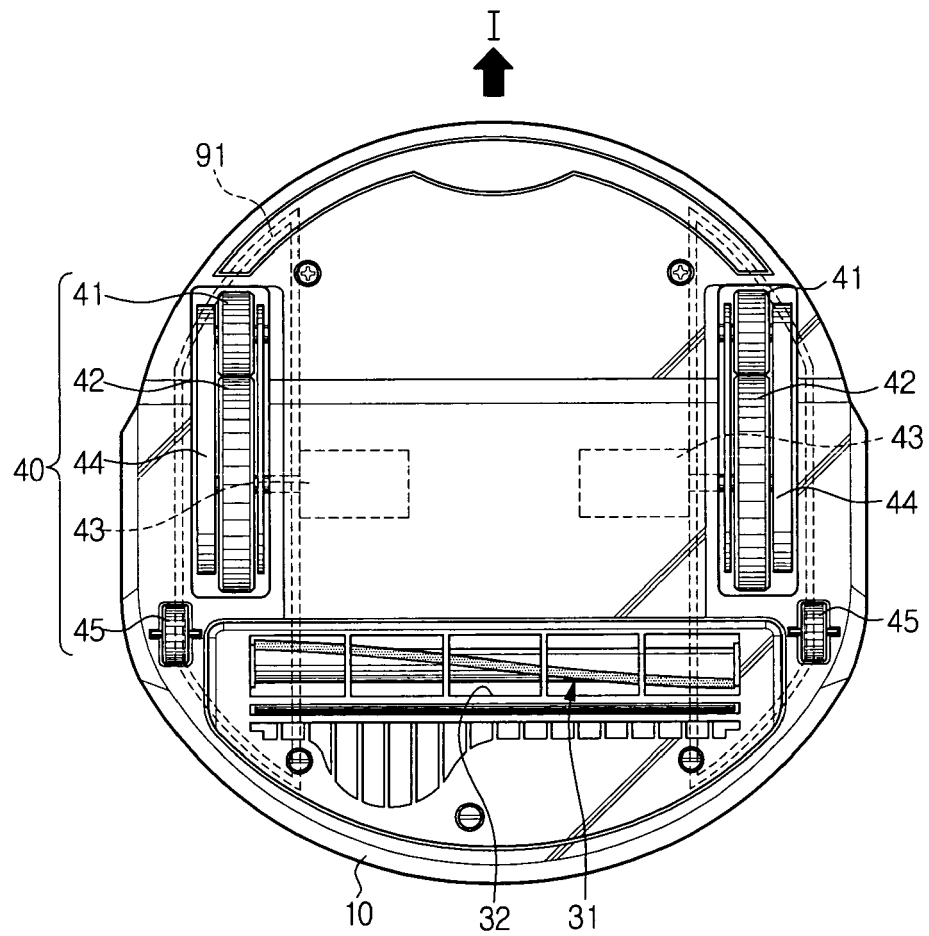


FIG. 3

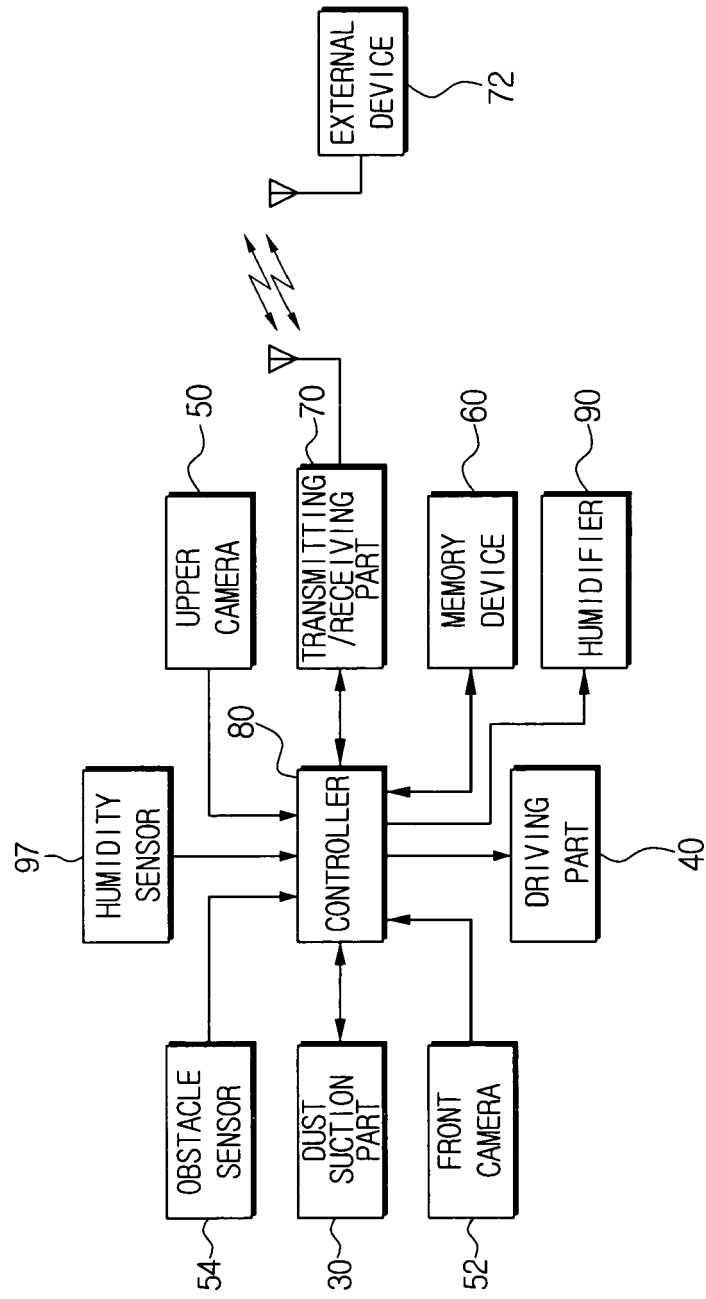
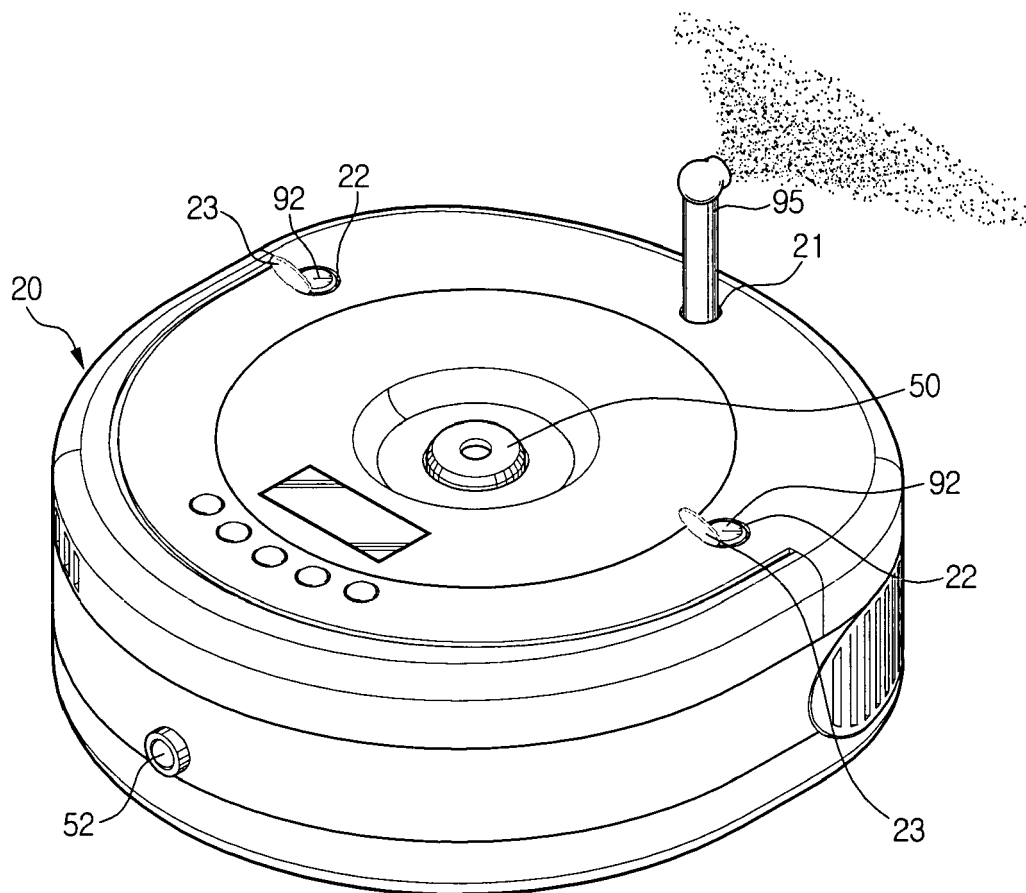


FIG. 4





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EUROPEAN SEARCH REPORT

Application Number
EP 05 29 2156

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 459 955 B1 (BARTSCH ERIC RICHARD ET AL) 1 October 2002 (2002-10-01) * column 24, line 35 - line 64; figures *	1-9	INV. F24F6/00 A47L7/04
A	US 6 267 274 B1 (SMRT THOMAS J) 31 July 2001 (2001-07-31) * abstract; figures *	1-9	
A	US 3 979 485 A (HOAG ET AL) 7 September 1976 (1976-09-07) * the whole document *	1-9	
A	US 2003/221821 A1 (PATEL CHANDRAKANT D ET AL) 4 December 2003 (2003-12-04) * the whole document *	1-9	
A,D	US 2005/022485 A1 (PARK JEE-SU ET AL) 3 February 2005 (2005-02-03) * the whole document *	1,9	
			TECHNICAL FIELDS SEARCHED (IPC)
			F24F A47L
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 23 May 2006	Examiner González-Granda, C
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	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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23-05-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6459955	B1	01-10-2002	NONE
US 6267274	B1	31-07-2001	US 6276574 B1 21-08-2001
US 3979485	A	07-09-1976	NONE
US 2003221821	A1	04-12-2003	NONE
US 2005022485	A1	03-02-2005	AU 2004201755 A1 17-02-2005 CN 1575736 A 09-02-2005 DE 102004021116 A1 24-02-2005 FR 2858204 A1 04-02-2005 GB 2404438 A 02-02-2005 JP 2005046591 A 24-02-2005 NL 1026024 C2 01-02-2005 RU 2264155 C1 20-11-2005 SE 526977 C2 29-11-2005 SE 0401646 A 30-01-2005

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