(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
03 June 2021 (03.06.2021)

WIPO | PCT

(10) International Publication Number
WO 2021/107321 A1

(51) International Patent Classification:
*A47L 9/00* (2006.01) *B25J 19/02* (2006.01)
*B25J 11/00* (2006.01) *B60B 33/04* (2006.01)
*B25J 9/16* (2006.01) *B60B 33/06* (2006.01)

(21) International Application Number:
PCT/KR2020/009580

(22) International Filing Date:
21 July 2020 (21.07.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10-2019-0156711 29 November 2019 (29.11.2019) KR

(71) Applicant: **LG ELECTRONICS INC.** [KR/KR]; 128, Yeoui-daero, Yeongdeungpo-gu, Seoul 07336 (KR).

(72) Inventor: **KIM, Hwang**; IP Center, LG Electronics Inc., 51, Gasan digital 1-ro, Geumcheon-gu, Seoul 08592 (KR).

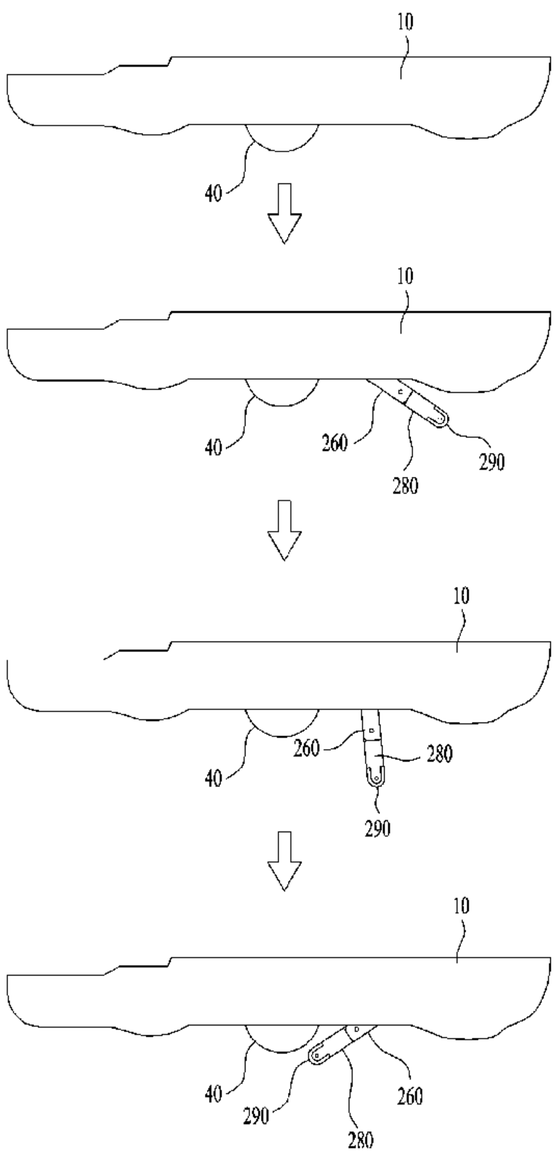
(74) Agent: **KBK & ASSOCIATES**; (Jamsil Hyundae Building 7th Floor), 82, Olympic-ro, Songpa-gu, Seoul 05556 (KR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Published:**
— *with international search report (Art. 21(3))*

(54) Title: ROBOT CLEANER




(57) Abstract: Provided is a robot cleaner including a main body including a suction portion disposed therein, a main wheel for moving the main body, wherein a vertical level of the main wheel varies in a vertical direction with respect to the main body, an auxiliary wheel disposed at a front portion or a rear portion of the main body, wherein a vertical level of the auxiliary wheel is fixed with respect to the main body, and a driving member assembly disposed in the main body, wherein the driving member assembly varies a vertical level of the main body from a floor face while rotating in forward and rearward directions of the main body, wherein the driving member assembly has different hitting radii when rotating forward and rearward.

WO 2021/107321 A1

# Description

# Title of Invention: ROBOT CLEANER

## Technical Field

[1] The present disclosure relates to a robot cleaner, and more particularly, to a robot cleaner capable of easily passing over an obstacle.

## Background Art

[2] Generally, a vacuum cleaner is an appliance that sucks air containing a foreign substance from outside by driving an air suction apparatus, which is disposed inside a cleaner main body to generate an air suction force, and separates and collects the foreign substance.

[3] The vacuum cleaner performing the above function is classified into a manual vacuum cleaner that is directly manipulated by a user and a robot cleaner that performs cleaning by itself without the user manipulation. A robot cleaner sucks various foreign substances lying on a face to be cleaned while autonomously travelling on the face-to-be cleaned.

[4] According to US Patent Application Publication No. US20140166375A, a technology in which a member that hits a floor face while a wheel rotates is included to pass over an obstacle is disclosed. However, according to the prior art, because the member only provides a certain trajectory when hitting the floor face, passable obstacles may be limited. Specifically, a robot cleaner according to the prior art may pass over a certain obstacle, but may often fail to pass over another obstacle.

## Disclosure of Invention

## Technical Problem

[5] The present disclosure is to solve the problem as described above. The present disclosure is to provide a robot cleaner capable of stably passing over an obstacle.

[6] In addition, the present disclosure is to provide a robot cleaner that may prevent travel thereof from being interrupted resulted from being caught by obstacles of various shapes.

## Solution to Problem

[7] A spring applied for a suspension function of main wheels in a general robot cleaner has a linearity for a displacement and a load. In a state in which the main wheels are withdrawn on a floor, a spring restoring force becomes significantly reduced by an extended stroke and does not exert a sufficient ground reaction force (a normal force). Thus, a sufficient frictional force is not able to be provided to the main wheels, which causes the main wheels to idle. In order to solve such problem, the present disclosure provides a technology in which a link assembly having a length larger than a reachable

range of the main wheels is disposed to allow the robot cleaner to escape from an obstacle.

[8] The present disclosure includes a rotating motor and a link assembly operated by the motor. In this connection, a sensor may be included to determine a time point for driving the motor. The sensor may transmit information about a rotation of the main wheels to a controller, and the controller may determine a rotation time point of the link assembly.

[9] The present disclosure includes a main body including a suction portion disposed therein, a main wheel for moving the main body, wherein a vertical level of the main wheel varies in a vertical direction with respect to the main body, an auxiliary wheel disposed at a front portion or a rear portion of the main body, wherein a vertical level of the auxiliary wheel is fixed with respect to the main body, and a driving member assembly disposed in the main body, wherein the driving member assembly varies a vertical level of the main body from a floor face while rotating in forward and rearward directions of the main body.

[10] The driving member assembly may include a motor for providing a rotational force and a link assembly rotated by the motor. While the link assembly is not in operation, the link assembly is accommodated in a recess defined in a bottom face of the main body, so that the link assembly is not exposed downward of the bottom face of the main body. Thus, when the main body is moved, the link assembly does not interfere with the movement of the main body.

[11] The link assembly is composed of a first link and a second link. The second link is able to rotate in one direction with respect to the first link, but is not able to rotate in the other direction. For example, the second link is able to rotate clockwise with respect to a rotation shaft disposed on the first link, but is not able to rotate counter-clockwise. Thus, when the link assembly is rotated with respect to the main body, radii at which the link assembly is able to hit the floor upon in contact with the floor are different when rotating clockwise and counterclockwise. Thus, different forms of operation are possible. Thus, the robot cleaner is able to escape from various obstacles, thereby improving a travel performance of the main body.

## Advantageous Effects of Invention

[12] According to the present disclosure, the robot cleaner may stably pass over the obstacle. According to the present disclosure, cleaning may be performed while the travel of the robot cleaner is not interrupted by the obstacle.

[13] In particular, the member that hits the floor in various manners is included in addition to the wheel that moves the robot cleaner, so that the robot cleaner may easily pass over the obstacle while the obstacles of various shapes are placed below the main

body.

## Brief Description of Drawings

[14] FIG. 1 is a view illustrating a bottom face of a robot cleaner according to an embodiment of the present disclosure.

[15] FIG. 2 is a view specifically illustrating a portion of FIG. 1.

[16] FIG. 3 is a control block diagram of an embodiment.

[17] FIG. 4 is a view for illustrating main components in an embodiment.

[18] FIG. 5 is an exploded perspective view of FIG. 4.

[19] FIG. 6 is a view illustrating a state in which a driving member assembly is rotating in a forward direction.

[20] FIG. 7 is a view illustrating a state in which a driving member assembly is rotating in a rearward direction.

## Mode for the Invention

[21] Hereinafter, a preferred embodiment of the present disclosure that may specifically realize the above objects will be described with reference to the accompanying drawings.

[22] In this process, a size, a shape, or the like of a component shown in the drawings may be exaggerated for clarity and convenience of the description. In addition, terms specifically defined in consideration of a configuration and an operation of the present disclosure may vary depending on a user or an operator's intention or practice. Definitions of such terms should be made based on the contents throughout this specification.

[23] FIG. 1 is a view illustrating a bottom face of a robot cleaner according to an embodiment of the present disclosure. Further, FIG. 2 is a view specifically illustrating a portion of FIG. 1. Hereinafter, a description will be achieved with reference to FIGS. 1 and 2.

[24] An embodiment of the present disclosure includes a main body 10 for forming an exterior of the robot cleaner, a dust suction portion and dust storage installed in the main body 10, and main wheels 40 for moving the main body 10.

[25] The dust suction portion may be installed inside the main body 10 to provide a suction force for sucking dust and the like from outside. The dust storage may be installed inside the main body 10 to provide therein a space in which a foreign substance such as the dust and the like sucked through the dust suction portion may be stored. When the foreign substance such as the dust and the like is accumulated in the dust storage, the user may remove the dust storage from the main body 10 to remove the foreign substance in the dust storage.

[26] Main wheels 40 may be arranged beneath the main body 10 to move the main body

10 back and forth or to turn the main body 10. In this connection, as the main wheels 40 are rotated, the main body 10 may change a direction or move forward or rearward. In this connection, the main wheels 40 are arranged on left and right sides of the main body 10 independently of each other. The main wheels 40 on the left and right sides may be driven independently of each other.

[27] In one example, the robot cleaner includes a front auxiliary wheel 20 for supporting one side of the main body 10 and assisting the movement of the main body 10 by the main wheels 40.

[28] A suction portion 14 may include an agitator disposed on the main body 10 and being brought into contact with a floor face on which cleaning is performed while rotating, a suction hole defined in the main body 10 and capable of sucking the external foreign substance by the suction force generated inside the main body 10, and the like.

[29] In one example, a rear auxiliary wheel 30 may be disposed rearward of the main wheels 40 to support the other side of the main body 10. The front auxiliary wheel 20 and the rear auxiliary wheel 30 are arranged to be freely rotatable in a horizontal direction with respect to the main body 10. In one example, the front auxiliary wheel 20 and the rear auxiliary wheel 30 are arranged to have fixed vertical levels with respect to the main body 10.

[30] In one example, although the main wheels 40 are not rotatable in the horizontal direction with respect to the main body 10, the main wheels 40 are composed of two wheels on both sides and the wheels on the both sides rotate at different rotational speeds or in different directions, so that the main body 10 may turn left or right. In addition, the main wheels 40 may move in a vertical direction with respect to the main body 10 such that a vertical level of the main body 10 from the floor face varies. When the main wheels 40 descends toward the floor face, the vertical level of the main body 10 from the floor face may be increased. Further, when the main wheels 40 ascends from the floor face, the vertical level of the main body 10 from the floor face may be reduced.

[31] In addition, the main wheels 40 are arranged on the both sides of the main body 10, and vertical levels of the main wheels 40 may become different from each other. When the main body 10 travels on floor faces of a left floor face and a right floor face having different vertical levels or passes over an obstacle, a main wheel on a floor face with a lower vertical level may descend with respect to the main body, but a main wheel on a floor face with a higher vertical level may ascend with respect to the main body. As a result, a horizontal level of the main body 10 may be maintained when the robot cleaner passes the corresponding location.

[32] A side brush assembly 100 is disposed on one side of the main body 10. In the side

brush assembly 100, as a brush rotates, the brush moves an obstacle located away from a bottom of the main body 10 or an obstacle in contact with a wall to be sucked into the suction portion 14. The side brush assembly 100 may be driven together with the suction portion 14 when the robot cleaner is driven.

[33] A recess 60 in which a driving member assembly 200 is accommodated is defined in a bottom face of the main body 10. The driving member assembly 200 may be exposed downward of the bottom face of the main body 10 while rotating forward or rearward of the main body 10. In a state in which the driving member assembly 200 is not driven, the driving member assembly 200 is completely accommodated in the recess 60, so that the driving member assembly 200 is not disposed lower than the bottom face of the main body 10. Thus, a user is not able to view the driving member assembly 200 when viewing the main body 10 from the side.

[34] The recess 60 may extend to have a length greater than that of the driving member assembly 200 such that the driving member assembly 200 may be accommodated in the recess 60 in both of situations where the rotation is stopped in a state in which the driving member assembly 200 is rotated forward and where the rotation is stopped in a state in which the driving member assembly 200 is rotated rearward.

[35] FIG. 3 is a control block diagram of an embodiment.

[36] Referring to FIG. 3, in an embodiment, a sensor 310 for sensing rotation information of the main wheels 40 and a controller 300 for driving the driving member assembly 200 in response to a signal transmitted from the sensor 310 are included.

[37] When it is determined that the driving member assembly 200 needs to be driven based on the signal transmitted from the sensor 310, the controller 300 may drive a motor 210 of the driving member assembly 200. When the controller 300 operates the motor 210, the motor 210 may be repeatedly rotated clockwise or counterclockwise. In addition, the motor 210 may be rotated such that each rotation has a rotation angle of 180 degrees. The motor 210 has the rotation angle of 180 degrees when rotated clockwise and also has the rotation angle of 180 degrees when rotated counter-clockwise.

[38] When it is determined that the driving member assembly 200 does not need to be driven based on the signal transmitted from the sensor 310, the controller 300 does not drive the motor 210 of the driving member assembly 200.

[39] The controller 300 may drive the driving member assembly 200 when the numbers of rotations of the main wheels 40 arranged on the both sides of the main body 10 received from the sensor 310 are different. For example, when the main body 10 encounters the obstacle and is unable to move to a desired path and unable to escape from a certain location, the numbers of rotations of the two main wheels 40 arranged on the left and right sides may be different. In this connection, the controller 300 may operate

the driving member assembly 200 to induce the robot cleaner to escape the obstacle.

[40] The controller 300 may drive the driving member assembly 200 when the sensor 310 senses that a slip has occurred on one of the main wheels 40 arranged on the both sides of the main body 10. Each main wheel 40 receives a rotational force from an individual motor. When a difference between a travel distance of the main body 10 and the number of rotations transmitted from the motor is equal to or greater than a predetermined value, it may be seen that the slip has occurred on the corresponding main wheel. That is, it may be a situation where the wheel does not travel as much as desired on a desired path due to the slip. Such situation may be a situation where the main body 10 has encountered the obstacle and the wheel is caught by the obstacle. In this connection, the controller 300 may operate the driving member assembly 200 to induce the robot cleaner to escape the obstacle.

[41] FIG. 4 is a view for illustrating main components in an embodiment. Further, FIG. 5 is an exploded perspective view of FIG. 4.

[42] Referring to FIGS. 4 and 5, the driving member assembly 200 includes a motor 210 that provides a rotational force for forward and reverse rotation, and a link assembly rotated by the motor 210.

[43] In the motor 210, the forward and reverse rotations are sequentially performed. Rotation angles of the forward and reverse rotations may be equally approximately 180 degrees. When the motor 210 is terminated after performing the forward rotation immediately before being driven, the motor 210 starts to be driven while performing the reverse rotation. On the other hand, when the motor 210 is terminated after performing the reverse rotation immediately before being driven, the motor 210 starts to be driven while performing the forward rotation. Then, when the motor 210 is driven, after performing the forward rotation by 180 degrees, the reverse rotation is started. In addition, after performing the reverse rotation by 180 degrees, the forward rotation is started. In such a manner, the rotations are alternately performed.

[44] A gear 220 is formed on a rotation shaft 212 of the motor 210. Teeth are formed on the gear 220. The gear 220 transmits a rotation provided from the rotation shaft 212 of the motor 210 to the link assembly as it is.

[45] The link assembly includes a first link 260 and a second link 280 that are engaged with the gear 220 and rotated. The link assembly may be composed of two links rotatable to each other.

[46] The first link 260 is equipped with a gear having teeth that are engaged with the teeth of the gear 220 at one end thereof. Thus, when the gear 220 is rotated, the first link 260 is rotated together. In this connection, a radius, a thickness of a tooth, and a spacing between two teeth of the gear 220 are the same as those of the gear of the first link 260 such that a rotation angle of the gear 220 may be transmitted to the first link 260 as it

is. That is, when the gear 220 rotates 180 degrees in the forward direction, the first link 260 rotates 180 degrees in the reverse direction. On the other hand, when the gear 220 rotates 180 degrees in the reverse direction, the first link 260 rotates 180 degrees in the forward direction.

[47] A through-hole 268 through which a rotation shaft 262 passes is defined in the first link 260 at an opposite side of a portion where the gear is formed. In addition, a through-hole 282 through which the rotation shaft 262 passes is also defined in the second link 280. One rotation shaft 262 penetrates both the through-hole of the first link 260 and the through-hole of the second link 280, so that the first link 260 and the second link 280 are rotatable with respect to each other.

[48] One end of the first link 260 has an empty space defined at a central portion thereof and includes flanges respectively extending at both sides. The through-hole 268 is defined in the flanges. The second link 280 is inserted between the two flanges, and a portion where the first link 260 and the second link 280 overlap is present. In the corresponding portion, the rotation shaft 262 penetrates the two links.

[49] Guide grooves 284 are defined at one end of the second link 280. The guide grooves 284 are defined to have a size less than a size of a central portion of the second link 280. The guide grooves 284 are respectively defined in a front face and a rear face of the second link 280. In this connection, the front face is a face directed in a front direction when the link assembly starts to rotate forward from a state of being folded in the recess 60. The rear face is a face directed in a rear direction when the link assembly starts to rotate rearward from the state of being folded in the recess 60.

[50] A cover 290 made of a rubber material is disposed on the guide grooves 284. The cover 290 may be formed in a substantially 'U' shape and may be coupled to the guide grooves 284 while being in contact with total three faces of the guide grooves 284. The cover 290 is disposed to surround the front face and a rear face of one end of the second link 280, so that the second link 280 may always be in contact with the floor while being rotated forward and rearward. The cover 290 is made of the rubber material, so that the cover 290 may have high friction with respect to the floor face. That is, the cover 290 is made of a material that is easily deformed compared to the first link 260 and the second link 280, so that damage to the floor face occurring when the driving member assembly hits the floor may be prevented.

[51] A stopper 274 and a guide 270 are formed on both sides of the first link 260 around the through-hole 268 into which the rotation shaft 262 is coupled.

[52] The stopper 274 limits a direction in which the second link 280 is rotated. The stopper 274 may be of a square shape having a right angle around the rotation shaft 262.

[53] The second link 280 includes a body extending from a portion where the through-

hole 282 is defined. The body is a portion with a thickness greater than that of the portion where the through-hole 282 is defined, and extends from a portion where a step 281 is formed. That is, the portion where the through-hole 282 is defined is inserted between the flanges of the first link 260 and coupled to the flanges of the first link 260. On the other hand, the body includes the step 281, and thus, is not able to be inserted between the flanges. Thus, the second link 280 may no longer rotate while the step 281 is in contact with the stopper 274. The stopper 274 may prevent the second link 280 from being folded toward the first link 260 when the second link 280 is rotated forward of the main body.

[54] The step 281 is formed perpendicular to a direction in which the first link 260 and the second link 280 are unfolded and coupled to each other.

[55] The guide 270 is formed to be curved around the rotation shaft 262 such that the second link 280 is rotated along an outer circumferential face of the guide 270. When the second link 280 is rotated around the rotation shaft 262, the first link 260 may be folded toward the second link 280. The guide 270 may form an arc shape having the same radius around the rotation shaft 262. Thus, even when the second link 280 is rotated around the rotation shaft 262, the step 281 is not brought into contact with the guide 270. Thus, the second link 280 may be folded toward the first link 260. The guide 270 may induce the second link 280 to be folded toward the first link 260 when the second link 280 is rotated rearward of the main body.

[56] A spring 278 for providing a restoring force to return to the second link 280 to a location where the first link 260 and the second link 280 are arranged in parallel when the second link 280 is rotated around the rotation shaft 262 is included. The spring 278 has one end fixed to the first link 260 and the other end fixed to the second link 280.

[57] In a situation in which the second link 280 is folded with respect to the first link 260 when the link assembly is rotated rearward of the main body 10, the spring 278 guides the second link 280 to be unfolded with respect to the first link 260 when an external force is removed. When the first link 260 and the second link 280 are folded, the spring 278 is compressed. When the second link 280 is not in contact with the floor, the external force applied to the second link 280 is removed. Thus, the first link 260 and the second link 280 may be unfolded by the restoring force of the spring 278.

[58] FIG. 6 is a view illustrating a state in which a driving member assembly is rotating in a forward direction. Further, FIG. 7 is a view illustrating a state in which a driving member assembly is rotating in a rearward direction.

[59] In FIGS. 6 and 7, a left direction means a front of the main body 10 and a right direction means a rear of the main body 10. That is, when the main body 10 is moved forward, the main wheels 40 move the main body in the left direction in FIGS. 6 and 7. On the other hand, when the main body 10 is moved rearward, the main wheels 40

move the main body in the right direction in FIGS. 6 and 7.

[60] There may be a case in which the main body 10 should climb an obstacle at a vertical level higher than that of a floor face previously traveled or pass over an obstacle at a vertical level lower than that of the floor face previously traveled while traveling. In addition, a situation in which the vertical level of the floor face increases and then decreases or decreases and then increases may occur despite a short travel distance when the robot cleaner encounters the obstacle. In a process in which the robot cleaner passes over the obstacle, a situation in which it is difficult for the robot cleaner to sufficiently escape from the obstacle using the rotational force provided from the main wheels 40 may occur. For example, a situation where the main wheel falls into a narrow gap or is stuck in a deep groove and is not sufficiently in contact with the floor may be considered.

[61] When the sensor 310 obtains information about such situation using the rotation information of the main wheels 40, the controller 300 may allow the driving member assembly 200 to be driven.

[62] When the motor 210 of the driving member assembly 200 is driven by the controller 300, the link assembly 260 and 280 may rotate forward or rearward of the main body 10. When the link assembly is rotated forward as in FIG. 6, the link assembly hits the floor in the state in which the first link 260 and the second link 280 are folded because the second link 280 is caught by the stopper 274 and is not able to be rotated. Thus, a radius at which the link assembly hits the floor may be kept constant at a length of the unfolded first link 260 and second link 280. Even when the cover 290 is brought into contact with the floor face before the link assembly is rotated by 90 degrees with respect to the bottom face of the main body 10, the second link 280 is rotated in an unfolded state.

[63] Even when the rotation of the link assembly is made as shown in FIG. 6, when it is determined that the main body has not escaped the obstacle by the information obtained by the sensor 310 from the main wheels 40, the controller 300 may rotate the link assembly again in an opposite direction.

[64] The link assembly is rotated rearward of the main body 10 as shown in FIG. 7. In this connection, the link assembly may hit the floor face before the second link 280 is rotated by 90 degrees perpendicular to the bottom face of the main body 10. In one example, the cover 290 first comes into contact with the floor face. Because there is a load of the main body 10, the first link 260 and the second link 280 may be folded as the second link 280 is rotated relative to the rotation shaft 262. In this connection, an angle at which the second link 280 is folded to the first link 260 may be changed based on characteristics of the floor face on which the main body 10 is located or the vertical level of the floor face.

[65] That is, in the present embodiment, the driving member assembly 200 has different hitting radii when rotating forward and when rotating rearward. When the link assembly is rotated forward of the main body, the hitting radius is constant in the state in which the first link 260 and the second link 280 are unfolded. On the other hand, when the link assembly is rotated rearward of the main body, the hitting radius may vary because the second link 280 is folded variously with respect to the first link 260. When the link assembly is rotated forward, the hitting radius may be larger than that when rotated rearward.

[66] In the present embodiment, because one driving member assembly may vary the hitting radius when hitting the floor, various types of motions may be generated when the movement of the main body to the obstacle is restricted. While the driving member assembly is rotated alternately forward and rearward, the main body may escape from the obstacle and the main body may move to a desired location.

[67] Referring to FIG. 3, the recess 60 provides therein the space in which the first link 260 and the second link 280 are able to be accommodated while being unfolded. The recess 60 is extended in the front and rear directions of the main body 10 such that the first link 260 and the second link 280 may be accommodated therein in both of a case in which the driving of the motor 210 is terminated in the state in which the first link 260 and the second link 280 are rotated forward and a case in which the driving of the motor 210 is terminated in the state in which the first link 260 and the second link 280 are rotated rearward. That is, the recess 60 may be extended to have a length about twice the length of the unfolded first link 260 and second link 280. In addition, a width of the recess 60 is greater than widths of the first link 260 and the second link 280, so that the first link 260 and the second link 280 may be inserted into the recess 60 without friction.

[68] The present disclosure is not limited to the above-described embodiments. As may be seen from the appended claims, the present disclosure is able to be modified by those of ordinary skill in the field to which the present disclosure belongs, and such modifications are within the scope of the present disclosure.

# Claims

[Claim 1] A robot cleaner comprising:
a main body including a suction portion disposed therein;
a main wheel for moving the main body, wherein a vertical level of the main wheel varies in a vertical direction with respect to the main body;
an auxiliary wheel disposed at a front portion or a rear portion of the main body, wherein a vertical level of the auxiliary wheel is fixed with respect to the main body; and
a driving member assembly disposed in the main body, wherein the driving member assembly varies a vertical level of the main body from a floor face while rotating in forward and rearward directions of the main body,
wherein the driving member assembly has different hitting radii when rotating forward and rearward.

[Claim 2] The robot cleaner of claim 1, wherein the driving member assembly includes:
a motor for providing a rotational force for forward and reverse rotations; and
a link assembly rotated by the motor.

[Claim 3] The robot cleaner of claim 2, wherein a recess for accommodating the link assembly therein is defined in a bottom of the main body.

[Claim 4] The robot cleaner of claim 2, wherein the link assembly includes:
a first link rotated by the rotational force of the motor; and
a second link rotatably coupled to the first link.

[Claim 5] The robot cleaner of claim 4, wherein the first link includes:
a rotation shaft disposed to rotate the second link therearound; and
a stopper disposed at one end of the first link,
wherein the stopper limits a rotation direction of the second link.

[Claim 6] The robot cleaner of claim 5, wherein the stopper prevents the second link from being folded toward the first link when the second link is rotated forward of the main body.

[Claim 7] The robot cleaner of claim 4, wherein the first link includes:
a rotation shaft disposed to rotate the second link therearound; and
a guide,
wherein the guide is formed to be curved around the rotation shaft such that the second link is rotated along an outer circumferential face of the guide.

[Claim 8] The robot cleaner of claim 7, wherein the guide portion forms an arc shape having the same radius around the rotation shaft.

[Claim 9] The robot cleaner of claim 7, wherein the driving member assembly includes a spring for providing a restoring force to return to the second link to a location where the first link and the second link are arranged in parallel when the second link is rotated around the rotation shaft.

[Claim 10] The robot cleaner of claim 9, wherein one end of the spring is fixed to the first link and the other end of the spring is fixed to the second link.

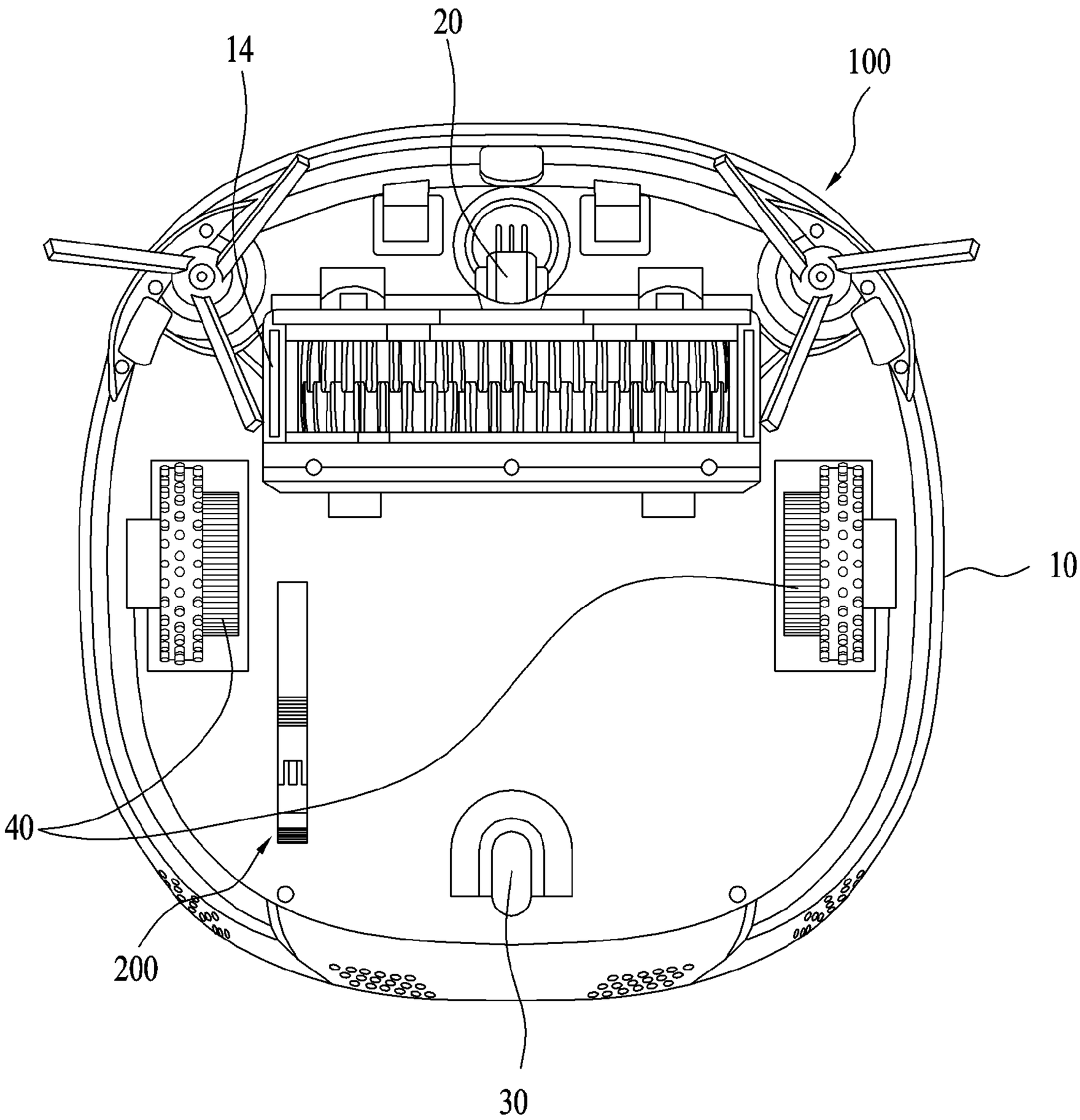
[Claim 11] The robot cleaner of claim 1, wherein the driving member assembly includes a cover made of a rubber material.

[Claim 12] The robot cleaner of claim 1, further comprising:
a sensor for sensing rotation information of the main wheel; and
a controller configured to drive the driving member assembly in response to a signal transmitted from the sensor.

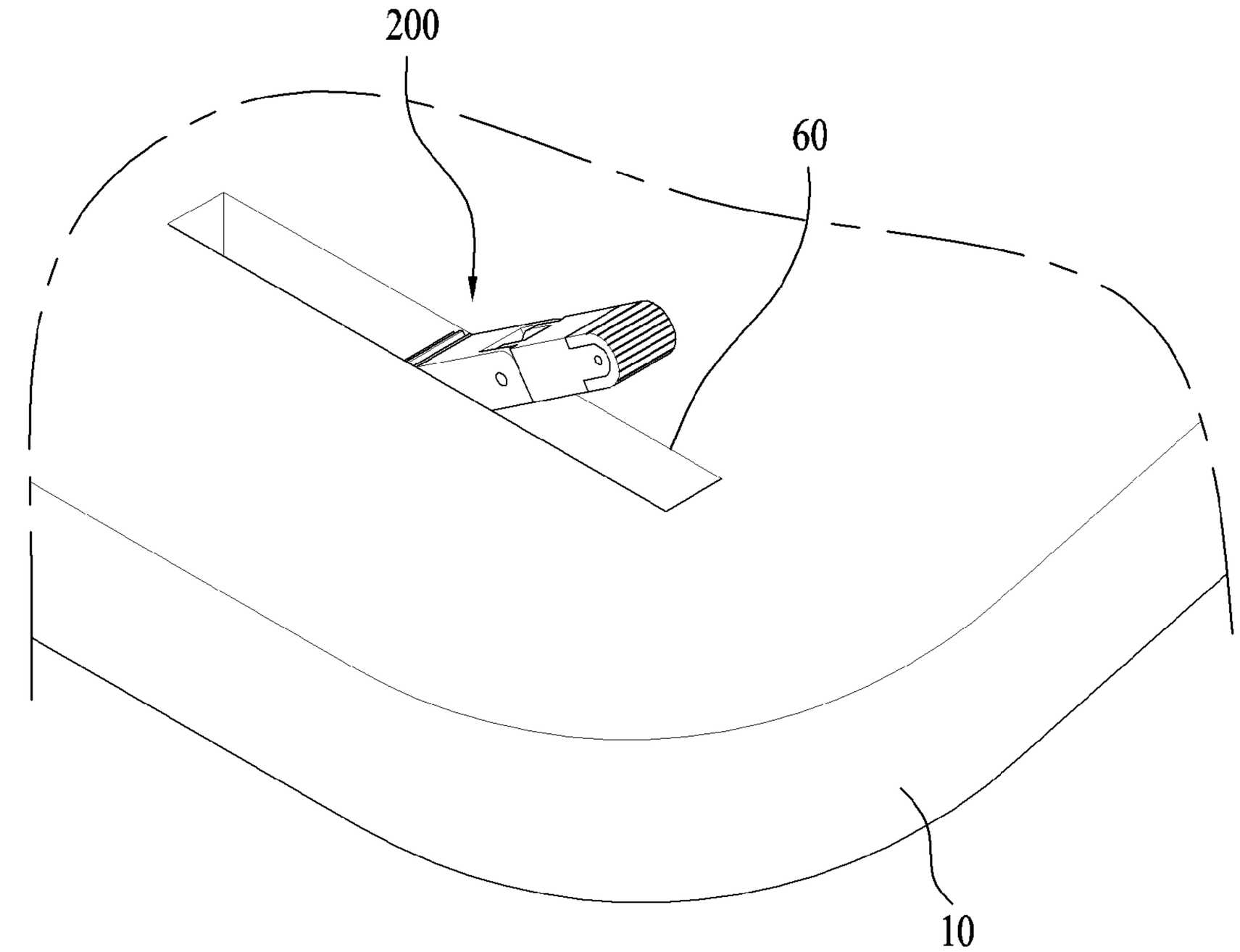
[Claim 13] The robot cleaner of claim 12, wherein the controller is configured to drive the driving member assembly when the numbers of rotations of main wheels arranged on both sides of the main body sensed by the sensor are different from each other.

[Claim 14] The robot cleaner of claim 12, wherein the controller is configured to drive the driving member assembly when it is sensed by the sensor that a slip has occurred on one of main wheels arranged on both sides of the main body.

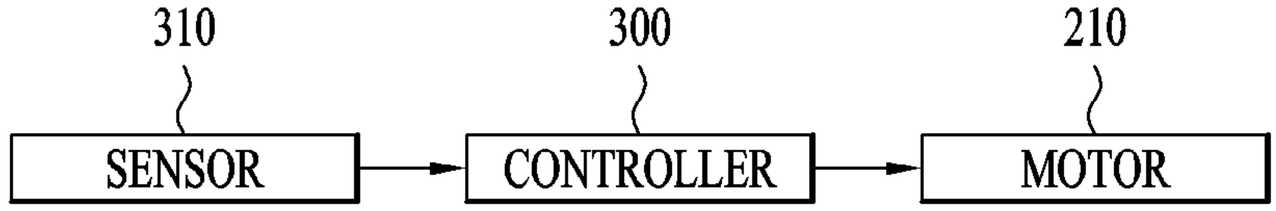
[Fig. 1]



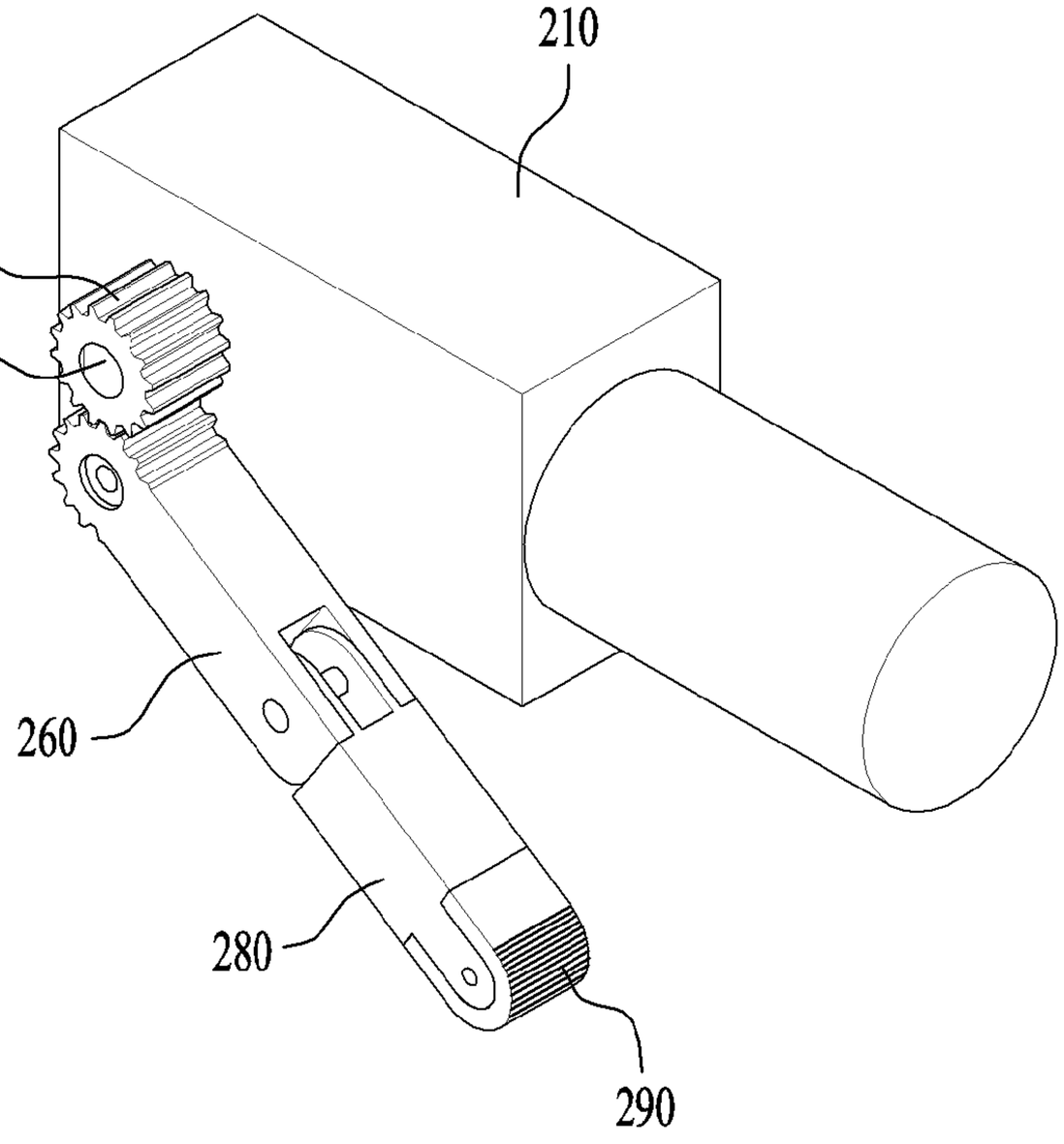
[Fig. 2]



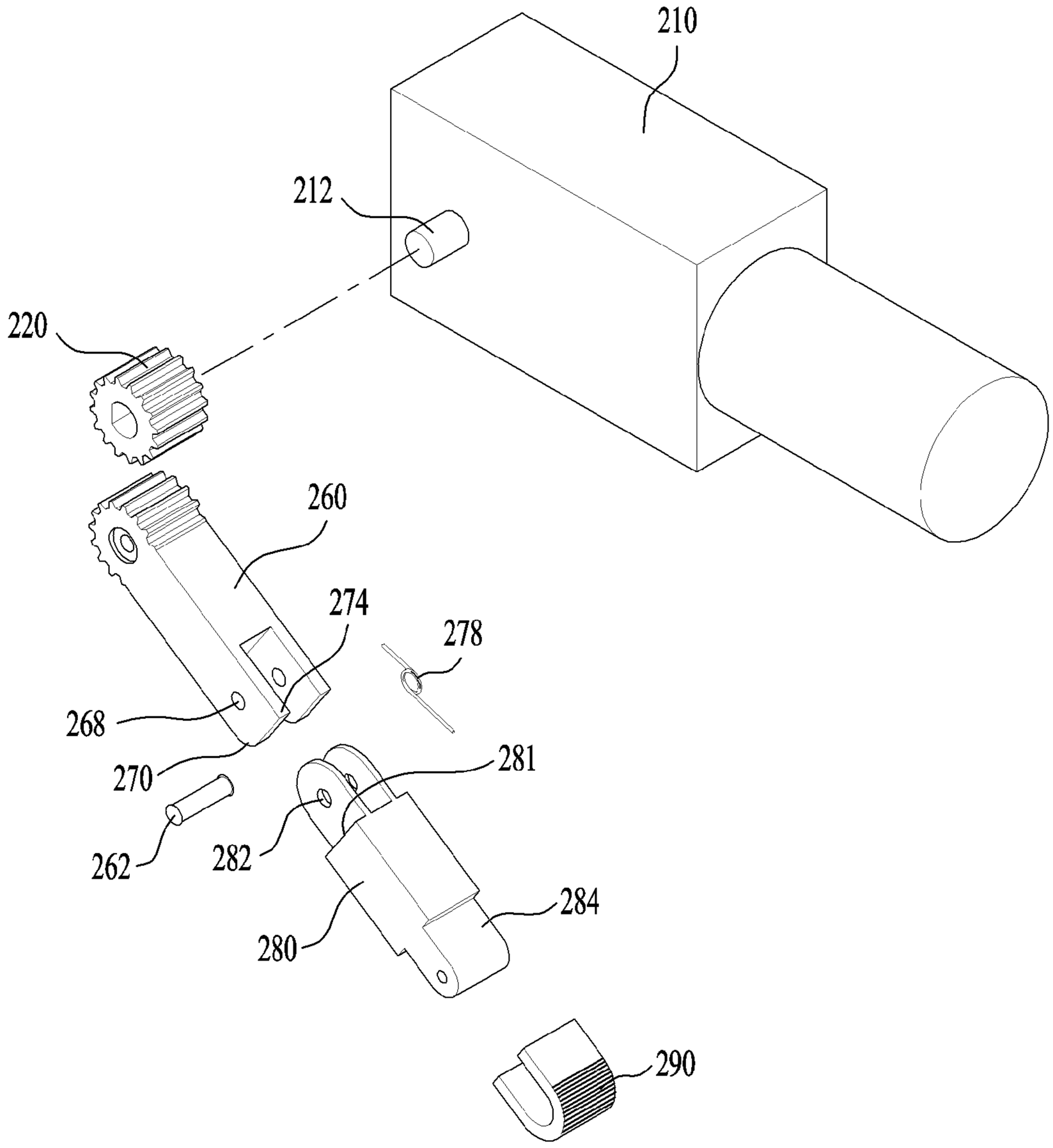

[Fig. 3]



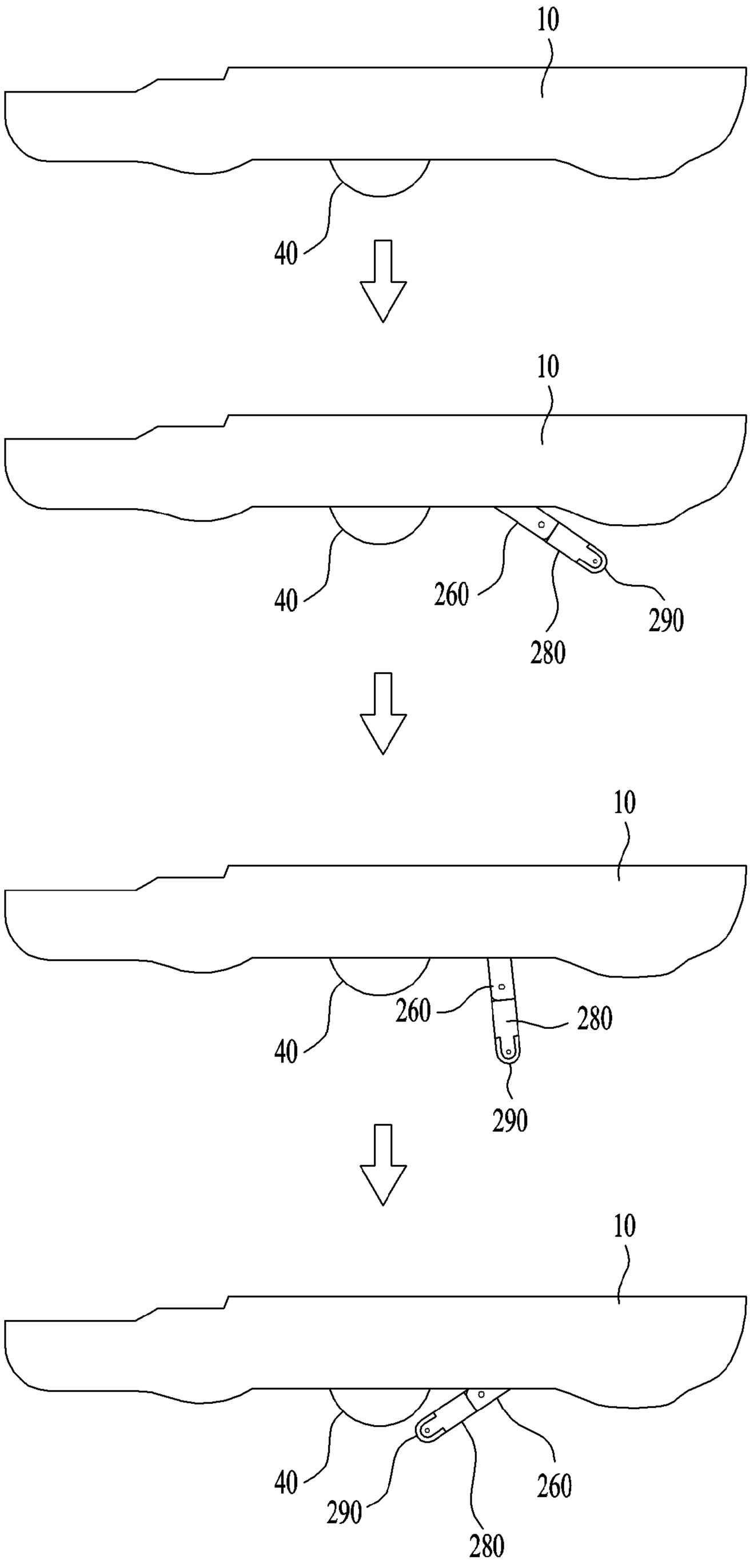

[Fig. 4]



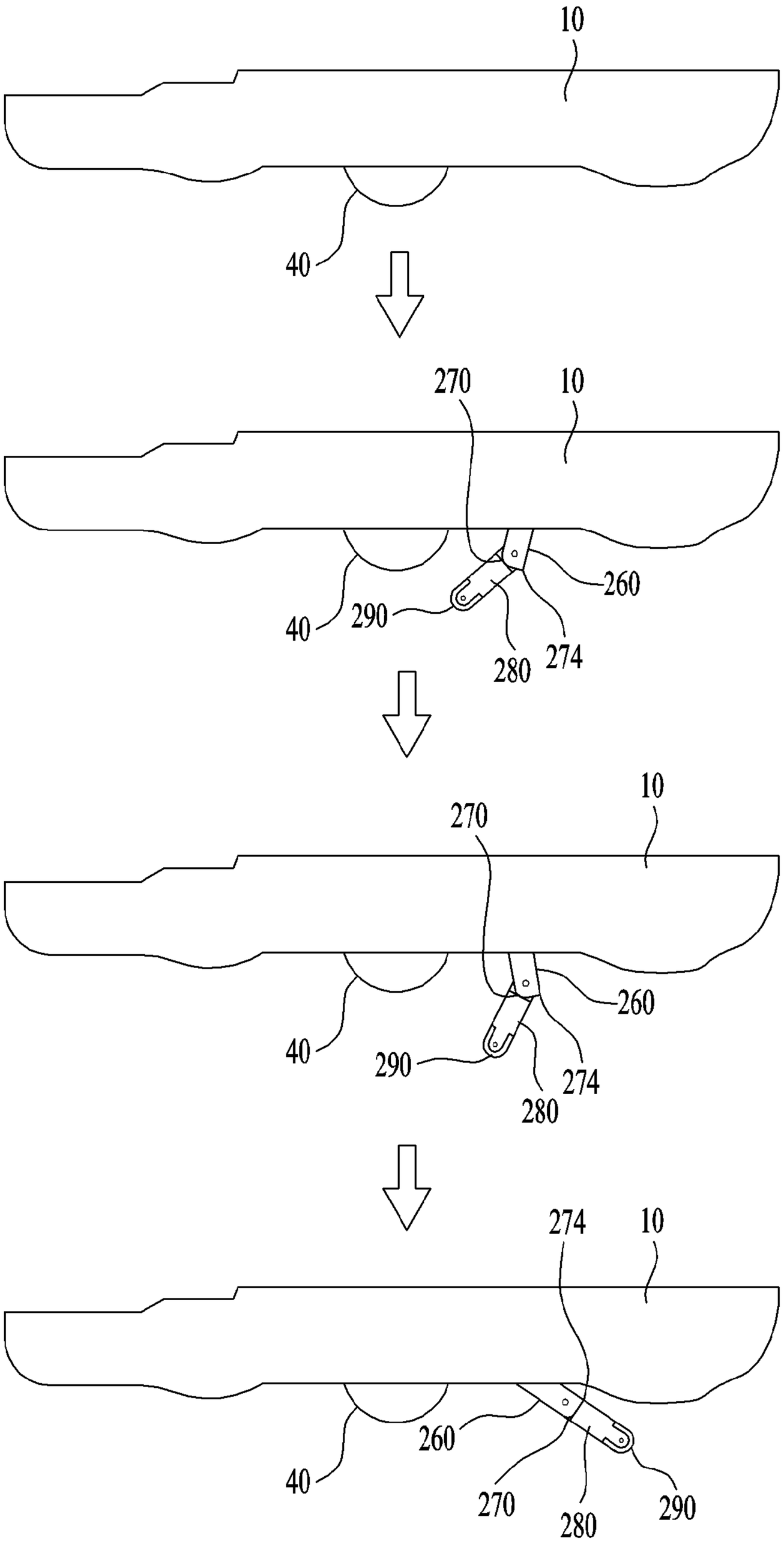
[Fig. 5]



[Fig. 6]



[Fig. 7]


10
40
270
10
260
40
290
280
274
10
270
260
40
290
274
280
274
10
260
40
270
280
290

# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/KR2020/009580**

## A. CLASSIFICATION OF SUBJECT MATTER

**A47L 9/00**(2006.01)i; **B25J 11/00**(2006.01)i; **B25J 9/16**(2006.01)i; **B25J 19/02**(2006.01)i; **B60B 33/04**(2006.01)i; **B60B 33/06**(2006.01)i

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A47L 9/00(2006.01); A47L 9/28(2006.01); B25J 13/08(2006.01); B25J 5/00(2006.01); B25J 9/16(2006.01); B60B 33/04(2006.01); G05D 1/02(2006.01)

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

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: robot cleaner, shaft, guide, stopper, main wheel, auxiliary wheel, link, recess, arc, rubber, cover, spring

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | KR 10-2014-0067705 A (LG ELECTRONICS INC.) 05 June 2014 (2014-06-05)<br>paragraphs [0045]-[0063] and figures 1-5, 7-8 | 1-8,11-14 |
| A | | 9-10 |
| Y | KR 10-2014-0000811 A (LG ELECTRONICS INC.) 06 January 2014 (2014-01-06)<br>paragraphs [0044], [0071], [0080]-[0101] and figures 1-4, 6-10 | 1-8,11-14 |
| Y | KR 10-1386011 B1 (SEOUL NATIONAL UNIVERSITY R&DB FOUNDATION) 16 April 2014 (2014-04-16)<br>paragraphs [0116]-[0122] and figures 11-13 | 5-8 |
| A | KR 10-2015-0065134 A (SAMSUNG ELECTRONICS CO., LTD.) 12 June 2015 (2015-06-12)<br>paragraphs [0155]-[0157] and figures 16-18 | 1-14 |

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| **12 January 2021** | **12 January 2021** |

| Name and mailing address of the ISA/KR | Authorized officer |
|---|---|
| **Korean Intellectual Property Office**<br>**189 Cheongsa-ro, Seo-gu, Daejeon**<br>**35208, Republic of Korea** | **BAHNG, Seung Hoon** |
| Facsimile No. **+82-42-481-8578** | Telephone No. **+82-42-481-5560** |

# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/KR2020/009580**

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | JP 2000-202792 A (SHARP CORP.) 25 July 2000 (2000-07-25)<br>paragraphs [0021]-[0038] and figures 1-7 | 1-14 |

# INTERNATIONAL SEARCH REPORT
**Information on patent family members**

International application No.
**PCT/KR2020/009580**

| Patent document cited in search report | Publication date (day/month/year) | Patent family member(s) | Publication date (day/month/year) |
|---|---|---|---|
| KR 10-2014-0067705 A | 05 June 2014 | KR 10-1411742 B1 | 25 June 2014 |
| KR 10-2014-0000811 A | 06 January 2014 | CN 103505155 A | 15 January 2014 |
| | | CN 103505155 B | 23 November 2016 |
| | | EP 2679130 A1 | 01 January 2014 |
| | | EP 2679130 B1 | 16 November 2016 |
| | | ES 2615526 T3 | 07 June 2017 |
| | | KR 10-1984575 B1 | 03 September 2019 |
| | | PL 2679130 T3 | 31 May 2017 |
| | | US 2013-0340201 A1 | 26 December 2013 |
| | | US 9775476 B2 | 03 October 2017 |
| KR 10-1386011 B1 | 16 April 2014 | US 2014-0158439 A1 | 12 June 2014 |
| | | US 9073587 B2 | 07 July 2015 |
| KR 10-2015-0065134 A | 12 June 2015 | AU 2014-357957 A1 | 23 June 2016 |
| | | AU 2014-357957 B2 | 15 June 2017 |
| | | CN 105792720 A | 20 July 2016 |
| | | CN 105792720 B | 01 February 2019 |
| | | EP 3076845 A1 | 12 October 2016 |
| | | EP 3076845 B1 | 27 February 2019 |
| | | US 10362917 B2 | 30 July 2019 |
| | | US 2015-0150429 A1 | 04 June 2015 |
| | | US 2016-0374527 A1 | 29 December 2016 |
| | | US 9480380 B2 | 01 November 2016 |
| | | WO 2015-084078 A1 | 11 June 2015 |
| JP 2000-202792 A | 25 July 2000 | None | |