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(54) OBSTACLE SURMOUNTING AUXILIARY DEVICE

(57) An obstacle surmounting auxiliary device (200), comprising a basic obstacle-surmounting auxiliary member (210) and a height-increasing obstacle-surmounting auxiliary member (220) detachably connected to the basic obstacle-surmounting auxiliary member (210). The basic obstacle-surmounting auxiliary member (210) comprises a first top surface (211) and a first bottom surface (212) which are oppositely arranged, and a first inclined surface (213) extending from the first top surface (211) to the first bottom surface (212). The height-increasing obstacle-surmounting auxiliary member (220) comprises a second top surface (221) and a second bottom surface (222) which are oppositely arranged, and a second inclined surface (223) extending from the second top surface (221) to the second bottom surface (222). When the height-increasing obstacle-surmounting auxiliary member (220) is connected to the basic obstacle-surmounting auxiliary member (210), the basic obstacle-surmounting auxiliary member (210) is stacked on the height-increasing obstacle-surmounting auxiliary member (220), at least part of the first bottom surface (212) is attached to at least part of the second top surface (221), and the first inclined surface (213) and the second inclined surface (223) are spliced into an inclined surface of the obstacle surmounting auxiliary device (200).

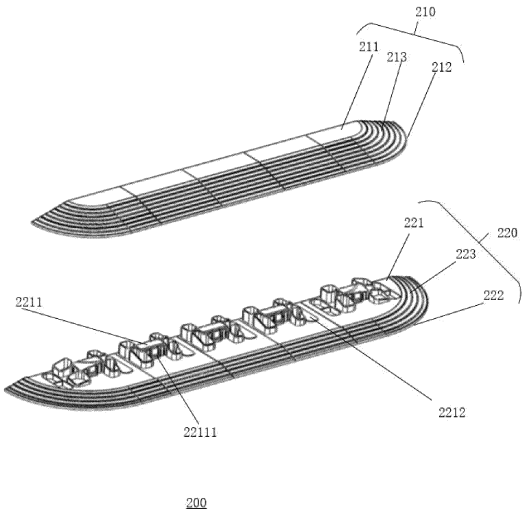

FIG. 4

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present disclosure claims priority of Chinese Patent Applications No. 202221522081.8 and No. 202221520162.4 both filed on June 17, 2022, which are incorporated herein by reference in their entireties as a part of the present disclosure.

TECHNICAL FIELD

[0002] The present disclosure relates to the field of cleaning apparatus technologies, in particular to an obstacle-crossing assisting device, especially an obstacle-crossing assisting device for an automatic cleaning apparatus.

BACKGROUND ART

[0003] With the continuous development of science and technology, cleaning apparatuses, such as floor washing machines, have been widely adopted by families. The floor washing machines are more time-saving and labor-saving than traditional manual cleaning.

[0004] The floor washing machine usually includes an apparatus body and a cleaning seat body. The apparatus body is provided with a recycling water tank, such as a sewage tank, a cleaning liquid tank, such as a clean water tank, and a main fan for suction therein. The cleaning seat body includes cleaning rollers for mopping. In order to ensure cleaning efficiency, two cleaning rollers are generally disposed. Clean cleaning liquid, such as water, is sprayed onto the cleaning rollers with fluff through a built-in water pipe, and the cleaning rollers rotate at high speed to mop the floor. With extensive application of the floor washing machine, it has become a common demand to rationally arrange various component structures in the floor washing machine to make the overall structure more compact.

SUMMARY OF THE INVENTION

[0005] Some embodiments of the present disclosure provide an obstacle-crossing assisting device, including:

a basic obstacle-crossing assisting part, including:

a first top surface and a first bottom surface which are oppositely disposed; and
a first inclined surface extending from the first top surface to the first bottom surface, and

a height-increasing obstacle-crossing assisting part, detachably connected with the basic obstacle-crossing assisting part and including:

a second top surface and a second bottom surface which are oppositely disposed; and
a second inclined surface extending from the second top surface to the second bottom surface,

wherein when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the basic obstacle-crossing assisting part is superposed on the height-increasing obstacle-crossing assisting part, at least part of the first bottom surface is attached to at least part of the second top surface, and the first inclined surface and the second inclined surface are spliced into an inclined surface of the obstacle-crossing assisting device.

[0006] Some embodiments of the present disclosure provide an obstacle-crossing assisting device, configured to assist an automatic cleaning apparatus to perform an obstacle-crossing operation, and the obstacle-crossing assisting device includes:

a top surface and a bottom surface which are oppositely disposed; and
an inclined surface extending from the top surface to the bottom surface,
wherein the inclined surface is provided with a plurality of ridges at intervals in an extending direction from the top surface to the bottom surface, the ridges protrude away from the inclined surface in a direction substantially perpendicular to the inclined surface of the obstacle-crossing assisting device, and the ridges are configured to be matched with wheel patterns of driving wheels of the automatic cleaning apparatus.

BRIEF DESCRIPTION OF DRAWINGS

[0007] The accompanying drawings herein, which are incorporated in and constitute a part of the description, illustrate embodiments consistent with the present disclosure and, together with the description, serve to explain the principles of the present disclosure. Apparently, the accompanying drawings in the following descriptions show merely some embodiments of the present disclosure, and a person of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts. In the accompanying drawings:

FIG. 1 is a schematic structural diagram of an automatic cleaning apparatus according to some embodiments of the present disclosure;
FIG. 2 is a schematic bottom view of an automatic cleaning apparatus according to some embodiments of the present disclosure;
FIG. 3 is a schematic structural diagram of an obstacle-crossing assisting device according to some

embodiments of the present disclosure;

FIG. 4 is an explosive schematic structural diagram of an obstacle-crossing assisting device according to some embodiments of the present disclosure;

FIG. 5 is an explosive schematic structural diagram of an obstacle-crossing assisting device according to some embodiments of the present disclosure;

FIG. 6 is a schematic diagram of an obstacle-crossing assisting device with a cross-sectional structure according to some embodiments of the present disclosure;

FIG. 7 is a schematic structural diagram of an obstacle-crossing assisting device according to some embodiments of the present disclosure;

FIG. 8 is an explosive schematic structural diagram of a basic obstacle-crossing assisting part according to some embodiments of the present disclosure;

FIG. 9 is an explosive schematic structural diagram of a basic obstacle-crossing assisting part according to some embodiments of the present disclosure; and

FIG. 10 is an explosive schematic structural diagram of a height-increasing obstacle-crossing assisting part according to some embodiments of the present disclosure.

DETAILED DESCRIPTION

[0008] For clearer descriptions of the objects, technical solutions, and advantages of the present invention, the present invention will be further described in detail with reference to the accompanying drawings. Apparently, the described embodiments are merely a part of the embodiments of the present invention, rather than all of the embodiments. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without any creative efforts shall fall within the protection scope of the present invention.

[0009] It should also be noted that the terms "comprise", "include" or any other variants are intended to cover the nonexclusive containing, such that the commodities or devices including a series of elements not only include those elements, but also include other unclearly listed elements, or also include the inherent elements of such commodities or devices. In the absence of more limitations, the element defined by the phrase "comprising a ..." does not exclude the existence of other identical elements in the commodity or device that includes such an element.

[0010] In the related art, the obstacle-crossing height of an automatic cleaning apparatus, such as a sweeping robot, is generally below 20mm due to design limitations thereof. When there are higher steps or thresholds in the area cleaned by the automatic cleaning apparatus, the automatic cleaning apparatus cannot perform an obstacle-crossing operation normally, thus affecting a cleaning operation in some areas.

[0011] The present disclosure provides an obstacle-crossing assisting device, including: a basic obstacle-crossing assisting part, including: a first top surface and a first bottom surface which are oppositely disposed, and a first inclined surface extending from the first top surface to the first bottom surface; and a height-increasing obstacle-crossing assisting part, detachably connected with the basic obstacle-crossing assisting part and including: a second top surface and a second bottom surface which are oppositely disposed, and a second inclined surface connecting the second top surface and the second bottom surface, wherein when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the basic obstacle-crossing assisting part is superposed on the height-increasing obstacle-crossing assisting part, at least part of the first bottom surface is attached to at least part of the second top surface, and the first inclined surface and the second inclined surface are spliced into an inclined surface of the obstacle-crossing assisting device. The detachable obstacle-crossing assisting device is adopted to help the automatic cleaning apparatus to achieve the obstacle crossing of different heights, and the automatic cleaning apparatus can walk along the first inclined surface of the basic obstacle-crossing assisting part or the inclined surface of the obstacle-crossing assisting device to perform the obstacle-crossing operation.

[0012] The present disclosure also provides an obstacle-crossing assisting device, configured to assist an automatic cleaning apparatus to perform an obstacle-crossing operation, and the obstacle-crossing assisting device includes: a top surface and a bottom surface which are oppositely disposed; and an inclined surface extending from the top surface to the bottom surface, wherein the inclined surface is provided with a plurality of ridges at intervals in an extending direction from the top surface to the bottom surface, the ridges protrude away from the inclined surface in a direction substantially perpendicular to the inclined surface of the obstacle-crossing assisting device, and the ridges are configured to be matched with wheel patterns of driving wheels of the automatic cleaning apparatus. The inclined surface of the obstacle-crossing assisting device is provided with the ridges matched with the wheel patterns of the driving wheels of the automatic cleaning apparatus, which prevents the automatic cleaning apparatus from slipping when climbing on the inclined surface.

[0013] In the embodiments of the present disclosure, substantially perpendicular means that two directions are approximately perpendicular, for example, an included angle between the two directions is greater than or equal to 75 degrees and less than or equal to 105 degrees, for example, 90 degrees. Substantially parallel means that two directions are approximately parallel, for example, an included angle between the two directions is less than or equal to 15 degrees, for example, 0 degree.

[0014] Optional embodiments of the present application will be described in detail below with reference to the accompanying drawings.

[0015] FIG. 1 is a schematic structural diagram of an

automatic cleaning apparatus according to some embodiments of the present disclosure, and FIG. 2 is a schematic bottom view of an automatic cleaning apparatus according to some embodiments of the present disclosure. As shown in FIG. 1 to FIG. 2, the automatic cleaning apparatus may be a vacuum cleaning robot, a mopping/-brushing robot, a window cleaning robot, or the like. The automatic cleaning apparatus may include a mobile platform 100, a sensing system 120, a control system 130, a driving system 140, a cleaning module 150, an energy system 160, and a human-machine interaction system 170.

[0016] The mobile platform 100 may be configured to automatically move on an operation surface in a target direction. The operation surface may be a surface to be cleaned by the automatic cleaning apparatus. In some embodiments, the automatic cleaning apparatus may be a mopping robot, in which case the automatic cleaning apparatus works on a floor, and the floor is the operation surface; the automatic cleaning apparatus may also be a window cleaning robot, in which case the automatic cleaning apparatus works on the exterior glass surface of a building, and the glass surface is the operation surface; and the automatic cleaning apparatus may also be a pipeline cleaning robot, in which case the automatic cleaning apparatus works on the interior surface of a pipeline, and the interior surface of the pipeline is the operation surface. Merely for the purpose of illustration, the following descriptions of the present application are given by taking a mopping robot as an example.

[0017] In some embodiments, the mobile platform 100 may be an autonomous mobile platform or a non-autonomous mobile platform. The autonomous mobile platform means that the mobile platform 100 itself can automatically and adaptively make operation decisions according to unexpected environmental inputs, while the non-autonomous mobile platform itself, instead of adaptively making operation decisions according to unexpected environmental inputs, can execute given programs or run according to a certain logic. Correspondingly, in the case that the mobile platform 100 is the autonomous mobile platform, the target direction may be autonomously determined by the automatic cleaning apparatus; and in the case that the mobile platform 100 is the non-autonomous mobile platform, the target direction may be set by a system or be set manually. The mobile platform 100 includes a forward portion 111 and a backward portion 110 when the mobile platform 100 is the autonomous mobile platform.

[0018] The sensing system 120 includes a position determining device 121 located above the mobile platform 100, a buffer 122 located on the forward portion 111 of the mobile platform 100, and sensing devices such as a cliff sensor 123, an ultrasonic sensor (not shown in the figures), an infrared sensor (not shown in the figures), a magnetometer (not shown in the figures), an accelerometer (not shown in the figures), a gyroscope (not shown in the figures) and an odometer (not shown in the figures), which are located at the bottom of the mobile platform for providing various position information and motion state information of the machine to the control system 130.

[0019] For clearer descriptions of the actions of the automatic cleaning apparatus, the following directions are defined: the automatic cleaning apparatus may travel on the floor by various combinations of movement relative to the following three mutually perpendicular axes defined by the mobile platform 100: a transverse axis Y, a front-back axis X, and a central vertical axis Z. A forward driving direction along the front-back axis X is marked as "forward", and a backward driving direction along the front-back axis X is marked as "backward". The transversal axis Y extends substantially between a right wheel and a left wheel of the automatic cleaning apparatus along an axis defined by the center point of a driving wheel assembly 141. The automatic cleaning apparatus may rotate about the axis Y. It is called "pitch up" when the forward portion of the automatic cleaning apparatus is tilted up and the backward portion thereof is tilted down, and it is called "pitch down" when the forward portion of the automatic cleaning apparatus is tilted down and the backward portion thereof is tilted up. In addition, the automatic cleaning apparatus may rotate around the axis Z. In the forward direction of the automatic cleaning apparatus, it is called "turn right" when the automatic cleaning apparatus is tilted to the right of the axis X, and it is called "turn left" when the automatic cleaning apparatus is tilted to the left of the axis X.

[0020] As shown in FIG. 2, the cliff sensors 123 are disposed at the bottom of the mobile platform 100 and in front and rear of the driving wheel assembly 141 and configured to prevent the automatic cleaning apparatus from falling off when the automatic cleaning apparatus moves back, so as to protect the automatic cleaning apparatus against damage. The aforementioned "front" refers to the side of the automatic cleaning apparatus orientated in its travelling direction, and the aforementioned "rear" refers to the side of the automatic cleaning apparatus opposite to its travelling direction.

[0021] Specific types of the position determining device 121 include, but are not limited to, a camera and a laser distance sensor (LDS).

[0022] The various components in the sensing system 120 may work independently or jointly to achieve intended functions more accurately. The surface to be cleaned is identified by the cliff sensor 123 and the ultrasonic sensor to determine the physical properties including surface materials, the degree of cleanliness, etc. of the surface to be cleaned, and may be more accurately determined in combination with the camera, and the laser distance sensor, etc.

[0023] For example, whether the surface to be cleaned is a carpet may be determined by the ultrasonic sensor, and if the ultrasonic sensor determines that the surface to be cleaned is made of a carpet material, the control system 130 controls the automatic cleaning apparatus

to conduct carpet-mode cleaning.

[0024] The buffer 122 is disposed on the forward portion 111 of the mobile platform 100. The buffer 122 detects one or more events (or objects) in a travel path of the automatic cleaning apparatus via the sensing system (for example, the infrared sensor) when the driving wheel assembly 141 propels the automatic cleaning apparatus to walk on the floor in the process of cleaning. The automatic cleaning apparatus may control, according to the events (or objects), such as an obstacle and a wall, detected by the buffer 122, the driving wheel assembly 141 to make the automatic cleaning apparatus respond to the events (or objects), for example, moving away from the obstacle.

[0025] The control system 130 is disposed on a main circuit board in the mobile platform 100, and includes a computing processor, such as a central processing unit or an application processor, which communicates with non-temporary memories, such as a hard disk, a flash memory and a random-access memory. The application processor is configured to receive environmental information sensed by the plurality of sensors and transmitted from the sensing system 120, to draw, by using a positioning algorithm (for example, SLAM) according to obstacle information, ect. fed back by the laser distance sensor, a simultaneous map of an environment where the automatic cleaning apparatus is located, autonomously determine the travel path according to the environmental information and the environmental map, and then control the driving system 140 to move forward, backward and/or turn according to the autonomously determined travel path. Further, the control system 130 may also determine, according to the environmental information and the environmental map, whether to activate the cleaning module 150 to perform a cleaning operation.

[0026] Specifically, the control system 130 may comprehensively determine a current working state (such as crossing a threshold, getting on a carpet, being at a cliff, being stuck above or below, having a full dust box or being picked up) of the sweeping robot according to distance information and speed information fed back by the buffer 122 and the sensing devices such as the cliff sensor 123, the ultrasonic sensor, the infrared sensor, the magnetometer, the accelerometer, the gyroscope and the odometer, and may also give specific strategies for next actions according to different situations, making the work of the automatic cleaning apparatus more in line with the requirements of an owner, and achieving a better user experience. Furthermore, the control system may plan the most efficient and reasonable cleaning path and cleaning mode based on the information of the simultaneous map drawn by SLAM, which greatly improves the cleaning efficiency of the automatic cleaning apparatus.

[0027] The driving system 140 may execute a driving command based on specific distance and angle information, such as x, y and θ components and thus control the automatic cleaning apparatus to travel across the floor. As shown in FIG. 2, the driving system 140 includes a driving wheel assembly 141 and may control a left wheel and a right wheel simultaneously. In order to control the movement of the automatic cleaning apparatus more accurately, the driving system 140 preferably includes a left driving wheel assembly and a right driving wheel assembly that are symmetrically arranged along a transverse axis defined by the mobile platform 100.

[0028] For more stable movement on the floor or higher movement ability of the automatic cleaning apparatus, the automatic cleaning apparatus may include one or more steering components 142, which may be driven wheels or driving wheels and may structurally include but is not limited to universal wheels. The steering component 142 may be located in front of the driving wheel assembly 141.

[0029] The energy system 160 includes a rechargeable battery, such as a nickel-hydrogen battery and a lithium battery. The rechargeable battery may be connected to a charging control circuit, a battery pack charging temperature detecting circuit, and a battery undervoltage monitoring circuit which are in turn connected to a single-chip microcomputer control circuit. A host of the automatic cleaning apparatus is connected to a charging pile by charging electrodes disposed on a side of or below the body of the automatic cleaning apparatus for charging. If the exposed charging electrodes are covered with dust, due to the accumulative effect of charges in the process of charging, a plastic body around the electrodes will be melted and deformed, and even the electrodes themself will be deformed and thus is unable to continue to normally charge the automatic cleaning apparatus.

[0030] The human-machine interaction system 170 includes buttons on a panel of the host for a user to select functions, and may further include a display screen and/or an indicator light and/or a speaker, as well as a mobile phone client program. The display, the indicator light and the speaker show the user the current status or function options of the automatic cleaning apparatus. For a route-navigation type cleaning apparatus, a mobile phone client may show the user a map of the environment where the apparatus is located, as well as the location of the apparatus, thereby providing the user with richer and more user-friendly function items.

[0031] FIG. 3 is a schematic structural diagram of an obstacle-crossing assisting device according to some embodiments of the present disclosure, FIG. 4 is an explosive schematic structural diagram of an obstacle-crossing assisting device according to some embodiments of the present disclosure, and FIG. 5 is an explosive schematic structural diagram of an obstacle-crossing assisting device according to some embodiments of the present disclosure. As shown in FIG. 3 to FIG. 5, some embodiments of the present disclosure provide an obstacle-crossing assisting device 200 for assisting an automatic cleaning apparatus to perform an obstacle-crossing operation, so that the automatic cleaning apparatus can cross a higher step or threshold by means of the assisting.

[0032] The obstacle-crossing assisting device 200 includes a basic obstacle-crossing assisting part 210 and a height-increasing obstacle-crossing assisting part 220.

[0033] The basic obstacle-crossing assisting part 210 includes a first top surface 211, a first bottom surface 212 and a first inclined surface 213 disposed between the first top surface 211 and the first bottom surface 212. The first inclined surface 213 connects the first top surface 211 and the first bottom surface 212, that is, the first inclined surface 213 extends from the first top surface 211 to the first bottom surface 212. The height-increasing obstacle-crossing assisting part 220 is detachably connected with the basic obstacle-crossing assisting part 210. The height-increasing obstacle-crossing assisting part 220 includes a second top surface 221 and a second bottom surface 222 which are oppositely disposed, and a second inclined surface 223 disposed between the second top surface 221 and the second bottom surface 222. The second inclined surface 223 connects the second top surface 221 and the second bottom surface 222, that is, the second inclined surface 223 extends from the second top surface 221 to the second bottom surface 222.

[0034] When the height-increasing obstacle-crossing assisting part 220 is assembled and connected with the basic obstacle-crossing assisting part 221, the basic obstacle-crossing assisting part 210 is superposed on the height-increasing obstacle-crossing assisting part 220, at least part of the first bottom surface 212 is attached to at least part of the second top surface 221, and the first inclined surface 213 and the second inclined surface 223 are spliced into an inclined surface 230 of the obstacle-crossing assisting apparatus 200. At least part of the inclined surface 230 may be used as a slope surface when the automatic cleaning apparatus crosses obstacles, and the automatic cleaning apparatus may perform a climbing operation on the inclined surface 230.

[0035] In some embodiments, the obstacle-crossing assisting device 200 may assist the automatic cleaning apparatus to perform the obstacle crossing by using the basic obstacle-crossing assisting part 221 only, or may assist the automatic cleaning apparatus to perform the obstacle crossing by using the basic obstacle-crossing assisting part 221 and the height-increasing obstacle-crossing assisting part 220 simultaneously. For example, when a height of the step or threshold that the automatic cleaning apparatus needs to cross is 20 mm to 28 mm, only the basic obstacle-crossing assisting part 221 may be adopted to assist the automatic cleaning apparatus to perform the obstacle crossing, specifically, the basic obstacle-crossing assisting part 221 is attached to the step or threshold, and the first inclined surface 213 is away from the step or threshold relative to the attachment surface to serve as a climbing surface of the automatic cleaning apparatus. When a height of the step or threshold that the automatic cleaning apparatus needs to cross is 28 mm to 35 mm, the basic obstacle-crossing assisting part 221 and the height-increasing obstacle-crossing assisting part 220 may be assembled together to assist the automatic cleaning apparatus to perform the obstacle crossing, specifically, the spliced obstacle-crossing assisting device 200 may be attached to the step or threshold, and the inclined surface 230 is away from the step or threshold relative to the attachment surface to serve as a climbing surface of the automatic cleaning apparatus.

[0036] FIG. 6 is a schematic diagram of an obstacle-crossing assisting device with a cross-sectional structure according to some embodiments of the present disclosure. In combination with FIG. 3 to FIG. 6, the inclined surface 230 is provided with a plurality of ridges 231 at equal intervals in the direction from the first top surface 211 to the second bottom surface 222, and the ridges 231 protrude away from the inclined surface in the direction substantially perpendicular to the inclined surface 230. With such an arrangement, slipping can be avoided when the automatic cleaning apparatus climbs along the inclined surface 230, so that the automatic cleaning apparatus can climb smoothly. In some embodiments, as shown in FIG. 2, the surface of the driving wheel assembly 141 of the automatic cleaning apparatus is provided with a plurality of recesses, that is, wheel patterns of driving wheels of the automatic cleaning apparatus. The recesses are, for example, disposed at equal intervals in a circumferential direction of the driving wheel assembly 141, and the ridges 231 may be, for example, matched with the recesses of the driving wheel assembly 141 of the automatic cleaning apparatus. When the automatic cleaning apparatus performs the climbing operation, the ridges 231 may be clamped in the recesses of the driving wheel assembly 141 to prevent the automatic cleaning apparatus from slipping.

[0037] As a whole, the obstacle-crossing assisting device 200 may include a top surface and a bottom surface which are oppositely disposed, and the inclined surface 230 which connects the top surface and the bottom surface, that is, the inclined surface 230 extends from the top surface to the bottom surface. When the height-increasing obstacle-crossing assisting part 220 is connected with the basic obstacle-crossing assisting part 210, the basic obstacle-crossing assisting part 210 is superposed on the height-increasing obstacle-crossing assisting part 220, the first top surface 211 serves as the top surface of the obstacle-crossing assisting device 200, the second bottom surface 222 serves as the bottom surface of the obstacle-crossing assisting device 200, and the first inclined surface 213 and the second inclined surface 213 are spliced into the inclined surface of the obstacle-crossing assisting device 200. The obstacle-crossing assisting device 200 is configured to assist the automatic cleaning apparatus 100 to perform the obstacle-crossing operation, the inclined surface 230 is provided with the plurality of ridges 231 at equal intervals in the direction from the top surface to the bottom surface, the ridges 231 protrude away from the inclined surface in the direction substantially perpendicular to the inclined surface 230 of the obstacle-crossing assisting device 200, and the ridges 231 are matched with the wheel patterns of the driving

wheels of the automatic cleaning apparatus, so that the automatic cleaning apparatus 100 can be prevented from slipping in the process of climbing on the inclined surface 230 when the automatic cleaning apparatus performs the obstacle-crossing operation by virtue of the obstacle-crossing assisting device 200, and it is ensured that the automatic cleaning apparatus smoothly performs the climbing operation.

[0038] The bottom surface, the first bottom surface and the second bottom surface according to the present disclosure may be continuous surfaces or hollow grid surfaces. As shown in FIG. 5, the bottom surface, the first bottom surface and the second bottom surface are hollow grid surfaces assembled by reinforcing ribs.

[0039] In some embodiments, as shown in FIG. 3, the obstacle-crossing assisting device 200 further includes a guide component, and when the obstacle-crossing assisting device 200 assists the automatic cleaning apparatus 100 to perform the obstacle-crossing operation, the guide component is configured to guide the automatic cleaning apparatus 100 to climb from the bottom surface to the top surface along a middle area of the inclined surface 230, for example, climb from the bottom surface to the top surface along a middle line M of the inclined surface 230.

[0040] In some embodiments, the plurality of ridges 341 are disposed substantially parallel to each other, and the interval between adjacent ridges 341 is 7 mm to 8 mm, for example, 7.6 mm. The interval of the ridges 341 is matched with the interval of the recesses of the driving wheel assembly 141, which is convenient for the automatic cleaning apparatus to climb.

[0041] In some embodiments, as shown in FIG. 3 to FIG. 6, the first bottom surface 212 of the basic obstacle-crossing assisting part 210 is provided with accommodating grooves 2121, and the second top surface 221 of the height-increasing obstacle-crossing assisting part 220 is provided with bumps 2211 matched with the accommodating grooves 2121. The accommodating grooves 2121 accommodate the bumps 2211 in a matching manner when the height-increasing obstacle-crossing assisting part 220 is assembled and connected with the basic obstacle-crossing assisting part 210, so that the height-increasing obstacle-crossing assisting part 220 and the basic obstacle-crossing assisting part 210 are fixed relative to each other and spliced into the stable obstacle-crossing assisting device 200. In some embodiments, the number of each of the accommodating grooves 2121 and the bumps 2211 is one or more, and they are in one-to-one correspondence.

[0042] In some embodiments, as shown in FIG. 3 to FIG. 6, sidewalls of the accommodating groove 2121 are provided with clamping grooves 21211, and sidewalls of the bump 2211 are provided with buckles 22111 matched with the clamping grooves 21211. Due to matching between the buckles 22111 and the clamping grooves 21211, the basic obstacle-crossing assisting part 210 and the height-increasing obstacle-crossing assisting part 220 can be more stably spliced together. For example, as shown in FIG. 3 to FIG. 6, two opposite sidewalls of the accommodating groove 2121 are provided with the clamping grooves 21211, and two opposite sidewalls of the corresponding bump 2211 are provided with the buckles 22111.

[0043] In some embodiments, in combination with FIG. 3 to FIG. 6, the first bottom surface 212 of the basic obstacle-crossing assisting part 210 is provided with first back adhesives 2122. When only the basic obstacle-crossing assisting part 210 is adopted to assist the automatic cleaning apparatus to perform the climbing operation, the first back adhesives 2122 may bond and fix the basic obstacle-crossing assisting part 210 on the ground adjacent to the step or threshold, so that the basic obstacle-crossing assisting part 210 is fixed relative to the step or threshold, to facilitate obstacle crossing of the automatic cleaning apparatus. The second top surface 221 of the height-increasing obstacle-crossing assisting part 220 is provided with receiving grooves 2212, which are matched with the first back adhesives. When the height-increasing obstacle-crossing assisting part 220 and the basic obstacle-crossing assisting part 210 are assembled and connected, the first back adhesives 2122 are received in the receiving grooves 2212, and the first back adhesives 2122 are spaced apart from bottom walls of the receiving grooves 2212, so that the basic obstacle-crossing assisting part 210 and the height-increasing obstacle-crossing assisting part 220 are prevented from being bonded together by the first back adhesives, to avoid the difficulty in disassembling of the two.

[0044] FIG. 7 is a schematic structural diagram of an obstacle-crossing assisting device according to some embodiments of the present disclosure. As shown in FIG. 3 to FIG. 7, the basic obstacle-crossing assisting part 210 further includes a first sidewall 214, such as a vertical plane, and the first sidewall 214 extends from the first top surface 211 to the first bottom surface 212. In some embodiments, the first sidewall 214 connects the first top surface 211 and the first bottom surface 212. At least one of the first bottom surface 212 and the first sidewall 214 is provided with first connectors 250, such as back adhesives and suckers, for fixing the basic obstacle-crossing assisting part 210 relative to the step or threshold. The first connectors disposed on the first sidewall 214 can, for example, connect and fix the first sidewall with the step or threshold, and the first connectors disposed on the first bottom surface 212, such as the first back adhesives 2122, can connect and fix the first bottom surface 212 with the bottom surface adjacent to the step or threshold.

[0045] The height-increasing obstacle-crossing assisting part 220 further includes a second sidewall 224, such as a vertical plane, the second sidewall 224 connects the second top surface 221 and the second bottom surface 222, and at least one of the second bottom surface 222 and the second sidewall 224 is provided with second connectors 260. The second connectors are, for

example, back adhesives, suckers and the like. When the basic obstacle-crossing assisting part 210 and the height-increasing obstacle-crossing assisting part 220 are spliced and connected, the first sidewall 214 and the second sidewall 224 are spliced to form a sidewall 240 of the obstacle-crossing assisting device 200. The second connectors 260 and the first connectors 250 can fix the spliced obstacle-crossing assisting device 200 relative to the step or threshold, the first connectors and the second connectors which are disposed on the sidewall 240 can, for example, connect and fix the sidewall with the step or threshold, and the second connectors disposed on the second bottom surface 222 can connect and fix the second bottom surface 222 with the bottom surface adjacent to the step or threshold.

[0046] FIG. 8 is an explosive schematic structural diagram of a basic obstacle-crossing assisting part according to some embodiments of the present disclosure, and FIG. 9 is an explosive schematic structural diagram of a basic obstacle-crossing assisting part according to some embodiments of the present disclosure. As shown in FIG. 8 and FIG. 9, the basic obstacle-crossing assisting part 210 includes a plurality of first splicing parts 2101 detachably spliced end to end to form the basic obstacle-crossing assisting part 210. Specifically, the plurality of first splicing parts 2101 include, for example, one first left splicing part 21011, one first right splicing part 21012, and one or more first intermediate splicing parts 21013. FIG. 8 shows three first intermediate splicing parts 21013, and FIG. 9 shows four first intermediate splicing parts 21013. A length of the basic obstacle-crossing assisting part 210 can be adjusted by adjusting the number of the first intermediate splicing parts 21013.

[0047] In some embodiments, as shown in FIG. 9, the plurality of first splicing parts 2101, such as one first left splicing part 21011, four first intermediate splicing parts 21013 and one first right splicing part 21012, may be spliced end to end in sequence, and one of two adjacent first splicing parts 2101 has a slot 2123 and the other thereof has an insertion bone 2124, so that the two adjacent first splicing parts can be spliced with each other in a matching manner.

[0048] FIG. 10 is an explosive schematic structural diagram of a height-increasing obstacle-crossing assisting part according to some embodiments of the present disclosure. In some embodiments, as shown in FIG. 10, the height-increasing obstacle-crossing assisting part 220 includes a plurality of second splicing parts 2201 detachably spliced end to end to form the height-increasing obstacle-crossing assisting part 220. Specifically, the plurality of second splicing parts 2201 include, for example, one second left splicing part 22011, one second right splicing part 22012, and one or more second intermediate splicing parts 22013. FIG. 10 shows three second intermediate splicing parts 22013, and the length of the basic obstacle-crossing assisting part 220 can be adjusted by adjusting the number of the second intermediate splicing parts 22013.

[0049] In some embodiments, the plurality of second splicing parts 2201 may also be spliced to form the height-increasing obstacle-crossing assisting part 220 by means of matching between the insertion bones and the slots.

[0050] In some embodiments, the plurality of second splicing parts 2201 and the plurality of first splicing parts 2101 are in one-to-one correspondence, for example, the second left splicing part 22011 corresponds to the first left splicing part 21011, the second right splicing part 22012 corresponds to the first right splicing part 21012, and the one or more second intermediate splicing parts 22013 correspond to the one or more first intermediate splicing parts 21013 respectively.

[0051] For any pair of first splicing part 2101 and second splicing part 2201 which correspond to each other, one in the pair has an accommodating groove, and the other in the pair has a bump matched with the accommodating groove, so that the first splicing part and the second splicing part which correspond to each other can be detachably spliced. As shown in FIG. 3 to FIG. 10, for example, the first splicing parts 2101 have the accommodating grooves 2121, which are disposed on the first bottom surface 212, and the second splicing parts 2201 have the bumps 2211 matched with the accommodating grooves 2121. The accommodating grooves 2121 and the matched bumps 2211 can be engaged with each other in a matching manner, so that the corresponding first splicing parts 2101 and second splicing parts 2201 can be detachably spliced together.

[0052] In this case, the plurality of first splicing parts 2101 may be spliced end to end to form the basic obstacle-crossing assisting part 210, and the plurality of second splicing parts 2201 may be correspondingly spliced to the plurality of first splicing parts, so as to realize splicing to form the obstacle-crossing assisting device 200.

[0053] In some embodiments, as shown in FIG. 3 to FIG. 10, a plurality of groove portions are arranged on at least one of the first bottom surface 212 of the basic obstacle-crossing assisting part 210 and the second bottom surface 222 of the height-increasing obstacle-crossing assisting part 220. The sidewalls shared by adjacent groove portions form reinforcing ribs, which reduces weights of the basic obstacle-crossing assisting part 210 and the height-increasing obstacle-crossing assisting part 220 while ensuring their structural strength.

[0054] In some embodiments, a slope angle of the inclined surface is 14° to 17°, for example, 15.5°, which is convenient for climbing of the automatic cleaning apparatus.

[0055] In some embodiments, as shown in FIG. 3 to FIG. 10, the obstacle-crossing assisting device 200 further includes a guide component configured to guide the automatic cleaning apparatus 100 to climb from the bottom surface to the top surface of the obstacle-crossing assisting device 200 along the center line M of the inclined surface 230 when the obstacle-crossing assisting

device 200 assists the automatic cleaning apparatus 100 to perform the obstacle-crossing operation. That is, the automatic cleaning apparatus 100 can be guided to climb and cross obstacles via the middle part of the obstacle-crossing assisting device 200 to avoid a climbing failure caused by the fact that the automatic cleaning apparatus 100 is too close to any end portion of the obstacle-crossing assisting device 200 during climbing. Specifically, as shown in FIG. 3 to FIG. 10, the inclined surface 230 is arc-shaped at the two end portions of the obstacle-crossing assisting device 200, which is not conducive for the automatic cleaning apparatus to climb.

[0056] Some embodiments of the present disclosure provide an obstacle-crossing assisting device, including:

a basic obstacle-crossing assisting part, including:

a first top surface and a first bottom surface which are oppositely disposed; and

a first inclined surface extending from the first top surface to the first bottom surface, and

a height-increasing obstacle-crossing assisting part, detachably connected with the basic obstacle-crossing assisting part and including:

a second top surface and a second bottom surface which are oppositely disposed; and

a second inclined surface extending from the second top surface to the second bottom surface,

wherein when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the basic obstacle-crossing assisting part is superposed on the height-increasing obstacle-crossing assisting part, at least part of the first bottom surface is attached to at least part of the second top surface, and the first inclined surface and the second inclined surface are spliced into an inclined surface of the obstacle-crossing assisting device.

[0057] In some embodiments, the inclined surface is provided with a plurality of ridges at intervals in an extending direction from the first top surface to the second bottom surface, and the ridges protrude away from the inclined surface in a direction substantially perpendicular to the inclined surface of the obstacle-crossing assisting device.

[0058] In some embodiments, the plurality of ridges are disposed substantially parallel to each other.

[0059] In some embodiments, the first bottom surface is provided with accommodating grooves, the second top surface is provided with bumps matched with the accommodating grooves, and when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the accommodating grooves accommodate the bumps in a matching manner, so that the height-increasing obstacle-crossing assisting part and the basic obstacle-crossing assisting part are fixed relative to each other.

[0060] In some embodiments, a sidewall of the accommodating groove is provided with a clamping groove, and a sidewall of the bump is provided with a buckle matched with the clamping groove.

[0061] In some embodiments, the first bottom surface is provided with a first back adhesive, the second top surface is provided with a receiving groove, and when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the first back adhesive is received in the receiving groove, and the first back adhesive is spaced apart from a bottom wall of the receiving groove.

[0062] In some embodiments, the basic obstacle-crossing assisting part further includes a first sidewall extending from the first top surface to the first bottom surface, and at least one of the first bottom surface and the first sidewall is provided with a first connector, and/or, the height-increasing obstacle-crossing assisting part further includes a second sidewall connecting the second top surface and the second bottom surface, and at least one of the second bottom surface and the second sidewall is provided with a second connector.

[0063] In some embodiments, the basic obstacle-crossing assisting part includes a plurality of first splicing parts detachably spliced end to end to form the basic obstacle-crossing assisting part.

[0064] In some embodiments, the height-increasing obstacle-crossing assisting part includes a plurality of second splicing parts detachably spliced end to end to form the height-increasing obstacle-crossing assisting part.

[0065] In some embodiments, a plurality of groove portions are arranged on at least one of the first bottom surface and the second bottom surface.

[0066] In some embodiments, a slope angle of the inclined surface is 14° to 17°.

[0067] Some embodiments of the present disclosure provide an obstacle-crossing assisting device, configured to assist an automatic cleaning apparatus to perform an obstacle-crossing operation, and the obstacle-crossing assisting device includes:

a top surface and a bottom surface which are oppositely disposed; and

an inclined surface extending from the top surface to the bottom surface,

wherein the inclined surface is provided with a plurality of ridges at intervals in an extending direction from the top surface to the bottom surface, the ridges protrude away from the inclined surface in a direction

substantially perpendicular to the inclined surface of the obstacle-crossing assisting device, and the ridges are configured to be matched with wheel patterns of driving wheels of the automatic cleaning apparatus.

[0068] In some embodiments, the plurality of ridges are disposed substantially parallel to each other.

[0069] In some embodiments, the obstacle-crossing assisting device further includes a guide component configured to guide the automatic cleaning apparatus to climb from the bottom surface to the top surface along a middle area of the inclined surface when the obstacle-crossing assisting device assists the automatic cleaning apparatus to perform the obstacle-crossing operation.

[0070] In some embodiments, the obstacle-crossing assisting device includes a basic obstacle-crossing assisting part and a height-increasing obstacle-crossing assisting part which are detachably assembled, wherein

the basic obstacle-crossing assisting part includes:

a first top surface and a first bottom surface which are oppositely disposed; and

a first inclined surface extending from the first top surface to the first bottom surface, and

the height-increasing obstacle-crossing assisting part is detachably connected with the basic obstacle-crossing assisting part, and includes:

a second top surface and a second bottom surface which are oppositely disposed; and

a second inclined surface extending from the second top surface to the second bottom surface,

when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the basic obstacle-crossing assisting part is superposed on the height-increasing obstacle-crossing assisting part, the first top surface is used as the top surface, the second bottom surface is used as the bottom surface, and the first inclined surface and the second inclined surface are spliced into the inclined surface.

[0071] In some embodiments, the basic obstacle-crossing assisting part includes a plurality of first splicing parts detachably spliced end to end to form the basic obstacle-crossing assisting part.

[0072] In some embodiments, one of any two adjacent spliced first splicing parts has a slot and the other thereof has an insertion bone, and the slot is engaged with the insertion bone in a matching manner.

[0073] In some embodiments, the height-increasing obstacle-crossing assisting part includes a plurality of second splicing parts, the plurality of second splicing parts and the plurality of first splicing parts are in one-to-one correspondence, and for any pair of first splicing part and second splicing part which correspond to each other, one in the pair has an accommodating groove and the other in the pair has a bump matched with the accommodating groove, so that the first splicing part and the second splicing part which correspond to each other are detachably spliced.

[0074] In some embodiments, the first bottom surface is provided with a first back adhesive, the second top surface is provided with a receiving groove, and when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the first back adhesive is received in the receiving groove, and the first back adhesive is spaced apart from a bottom wall of the receiving groove.

[0075] In some embodiments, a plurality of groove portions are arranged on at least one of the first bottom surface and the second bottom surface.

[0076] In some embodiments, a slope angle of the inclined surface is 14° to 17°.

[0077] Compared with the related art, the above solution according to the embodiments of the present disclosure at least has the following beneficial effects:

The detachable obstacle-crossing assisting device is adopted to help the automatic cleaning apparatus to achieve the obstacle crossing of different heights, and the automatic cleaning apparatus can walk along the first inclined surface of the basic obstacle-crossing assisting part or the inclined surface of the obstacle-crossing assisting device to perform the obstacle-crossing operation.

[0078] The ridges are disposed on the inclined surface to avoid slipping when the automatic cleaning apparatus climbs on the inclined surface.

[0079] At least one of the basic obstacle-crossing assisting part and the height-increasing obstacle-crossing assisting part is spliced by the splicing parts, so that a packaging cost can be reduced, and the length of the basic obstacle-crossing assisting part and/or the height-increasing obstacle-crossing assisting part can be adjusted by adjusting the number of the splicing parts according to realization needs.

[0080] It should be noted that various embodiments in the description are described in a progressive way, each embodiment focuses on the differences from other embodiments, and the same and similar parts between various embodiments may be referred to for each other. As for the system or device disclosed in the embodiments, since it corresponds to the method disclosed in the embodiments, the descriptions are relatively simple, and for related points, reference may be made to the descriptions of the method section.

[0081] The foregoing is merely exemplary embodiments of the present disclosure, and unable to limit the scope of the present disclosure. That is, all equivalent

changes and modifications made in accordance with the teaching of the present disclosure are still within the scope of the present disclosure. Other embodiments of the present disclosure will be readily conceivable by those skilled in the art from consideration of the description and practice of the present disclosure. The present disclosure is intended to cover any variations, uses, or adaptations of the present disclosure following the general principles thereof and including common general knowledge or conventional technical means in the technical field which are not recorded in the present disclosure. The description and embodiments are to be considered as exemplary only, and the scope and spirit of the present disclosure are defined by the claims.

Claims

1. An obstacle-crossing assisting device, comprising:

a basic obstacle-crossing assisting part, comprising:

a first top surface and a first bottom surface, disposed opposite to each other; and
a first inclined surface, extending from the first top surface to the first bottom surface, and

a height-increasing obstacle-crossing assisting part, detachably connected with the basic obstacle-crossing assisting part, and comprising:

a second top surface and a second bottom surface, disposed opposite to each other; and
a second inclined surface, extending from the second top surface to the second bottom surface,

wherein when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the basic obstacle-crossing assisting part is superposed on the height-increasing obstacle-crossing assisting part, at least part of the first bottom surface is attached to at least part of the second top surface, and the first inclined surface and the second inclined surface are spliced into an inclined surface of the obstacle-crossing assisting device.

2. The obstacle-crossing assisting device according to claim 1, wherein the inclined surface is provided with a plurality of ridges arranged at intervals in an extending direction from the first top surface to the second bottom surface, and the ridges protrude away from the inclined surface in a direction substantially perpendicular to the inclined surface of the obstacle-crossing assisting device.

3. The obstacle-crossing assisting device according to claim 2, wherein the plurality of ridges are disposed substantially parallel to each other.

4. The obstacle-crossing assisting device according to any one of claims 1 to 3, wherein
the first bottom surface is provided with an accommodating groove, the second top surface is provided with a bump matched with the accommodating groove, and when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the accommodating groove accommodates the bump in a matching manner, enabling the height-increasing obstacle-crossing assisting part and the basic obstacle-crossing assisting part to be fixed relative to each other.

5. The obstacle-crossing assisting device according to claim 4, wherein a sidewall of the accommodating groove is provided with a clamping groove, and a sidewall of the bump is provided with a buckle matched with the clamping groove.

6. The obstacle-crossing assisting device according to any one of claims 1 to 3, wherein the first bottom surface is provided with a first back adhesive, the second top surface is provided with a receiving groove, and when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the first back adhesive is received in the receiving groove, and the first back adhesive is spaced apart from a bottom wall of the receiving groove.

7. The obstacle-crossing assisting device according to any one of claims 1 to 3, wherein the basic obstacle-crossing assisting part further comprises a first sidewall extending from the first top surface to the first bottom surface, and at least one of the first bottom surface and the first sidewall is provided with a first connector, and/or
the height-increasing obstacle-crossing assisting part further comprises a second sidewall connecting the second top surface and the second bottom surface, and at least one of the second bottom surface and the second sidewall is provided with a second connector.

8. The obstacle-crossing assisting device according to any one of claims 1 to 3, wherein the basic obstacle-crossing assisting part comprises a plurality of first splicing parts detachably spliced end to end to form the basic obstacle-crossing assisting part.

9. The obstacle-crossing assisting device according to

any one of claims 1 to 3, wherein the height-increasing obstacle-crossing assisting part comprises a plurality of second splicing parts detachably spliced end to end to form the height-increasing obstacle-crossing assisting part.

10. The obstacle-crossing assisting device according to any one of claims 1 to 3, wherein a plurality of groove portions are arranged on at least one of the first bottom surface and the second bottom surface.

11. The obstacle-crossing assisting device according to any one of claims 1 to 3, wherein a slope angle of the inclined surface is 14° to 17°.

12. An obstacle-crossing assisting device, configured to assist an automatic cleaning apparatus to perform an obstacle-crossing operation, the obstacle-crossing assisting device comprising:

a top surface and a bottom surface, disposed opposite to each other; and
an inclined surface, extending from the top surface to the bottom surface,
wherein the inclined surface is provided with a plurality of ridges arranged at intervals in an extending direction from the top surface to the bottom surface, the ridges protrude away from the inclined surface in a direction substantially perpendicular to the inclined surface of the obstacle-crossing assisting device, and the ridges are configured to be matched with wheel patterns of driving wheels of the automatic cleaning apparatus.

13. The obstacle-crossing assisting device according to claim 12, wherein the plurality of ridges are disposed substantially parallel to each other.

14. The obstacle-crossing assisting device according to claim 12 or 13, wherein the obstacle-crossing assisting device further comprises a guide component, and the guide component is configured to guide, when the obstacle-crossing assisting device assists the automatic cleaning apparatus to perform the obstacle-crossing operation, the automatic cleaning apparatus to climb from the bottom surface to the top surface along a middle area of the inclined surface.

15. The obstacle-crossing assisting device according to claim 12 or 13, wherein the obstacle-crossing assisting device comprises a basic obstacle-crossing assisting part and a height-increasing obstacle-crossing assisting part detachably assembled to each other,

the basic obstacle-crossing assisting part comprises:
a first top surface and a first bottom surface, disposed opposite to each other; and
a first inclined surface, extending from the first top surface to the first bottom surface,

the height-increasing obstacle-crossing assisting part is detachably connected with the basic obstacle-crossing assisting part, and comprises:

a second top surface and a second bottom surface, disposed opposite to each other; and
a second inclined surface, extending from the second top surface to the second bottom surface, and

when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the basic obstacle-crossing assisting part is superposed on the height-increasing obstacle-crossing assisting part, the first top surface is used as the top surface, the second bottom surface is used as the bottom surface, and the first inclined surface and the second inclined surface are spliced into the inclined surface.

16. The obstacle-crossing assisting device according to claim 15, wherein the basic obstacle-crossing assisting part comprises a plurality of first splicing parts detachably spliced end to end to form the basic obstacle-crossing assisting part.

17. The obstacle-crossing assisting device according to claim 15, wherein one of any two adjacent spliced first splicing parts is provided with a slot, another one of the two adjacent spliced first splicing parts is provided with an insertion bone, and the slot is engaged with the insertion bone in a matching manner.

18. The obstacle-crossing assisting device according to claim 15, wherein the height-increasing obstacle-crossing assisting part comprises a plurality of second splicing parts, the plurality of second splicing parts and the plurality of first splicing parts are in one-to-one correspondence, and for any pair of first splicing part and second splicing part corresponding to each other, one in the pair is provided with an accommodating groove, and another one in the pair is provided with a bump matched with the accommodating groove, enabling the first splicing part and the second splicing part corresponding to each other to be detachably spliced with each other.

19. The obstacle-crossing assisting device according to claim 15, wherein the first bottom surface is provided with a first back adhesive, the second top surface is

provided with a receiving groove, and when the height-increasing obstacle-crossing assisting part is connected with the basic obstacle-crossing assisting part, the first back adhesive is received in the receiving groove, and the first back adhesive is spaced apart from a bottom wall of the receiving groove.

20. The obstacle-crossing assisting device according to claim 15, wherein a plurality of groove portions are arranged on at least one of the first bottom surface and the second bottom surface.

21. The obstacle-crossing assisting device according to claim 12 or 13, wherein a slope angle of the inclined surface is 14° to 17°.

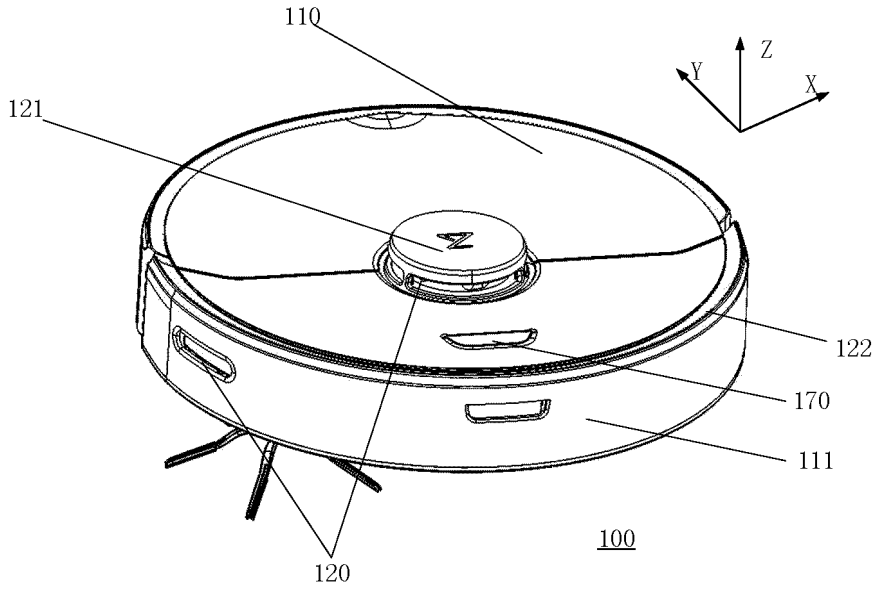
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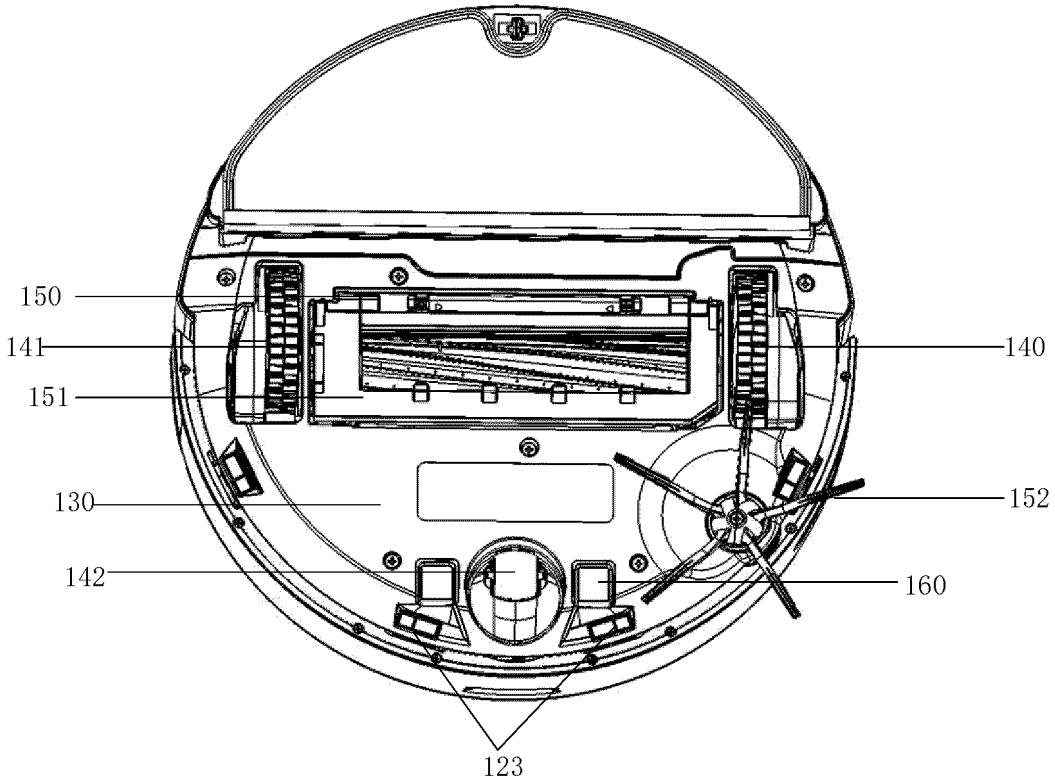
FIG. 1


150
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123

FIG. 2

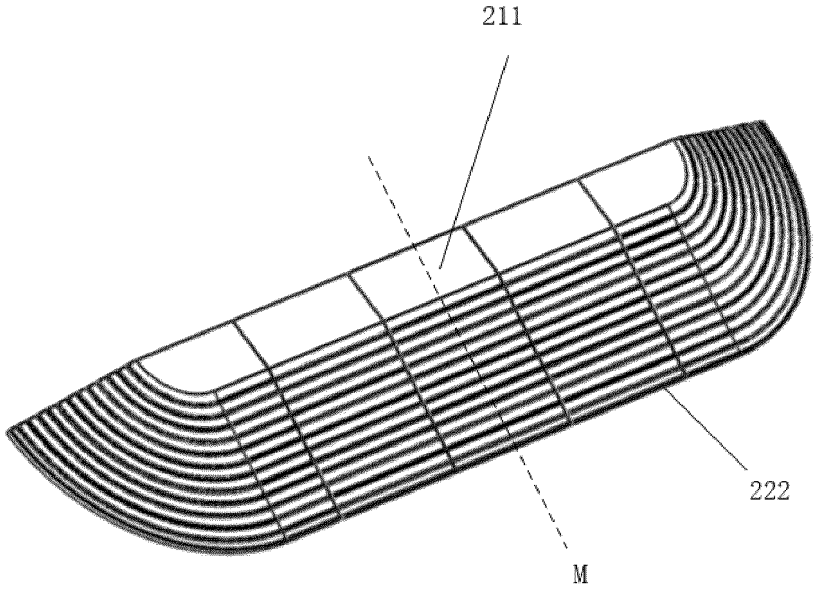


FIG. 3

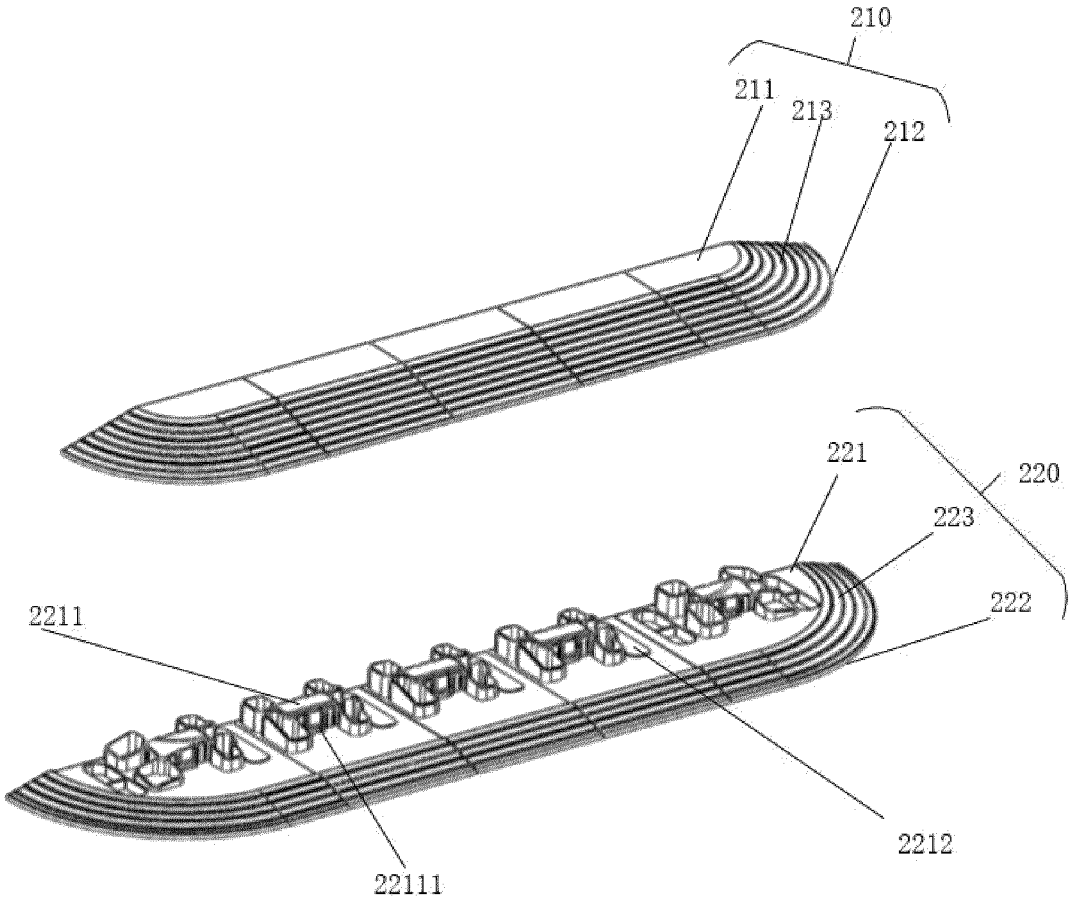


FIG. 4

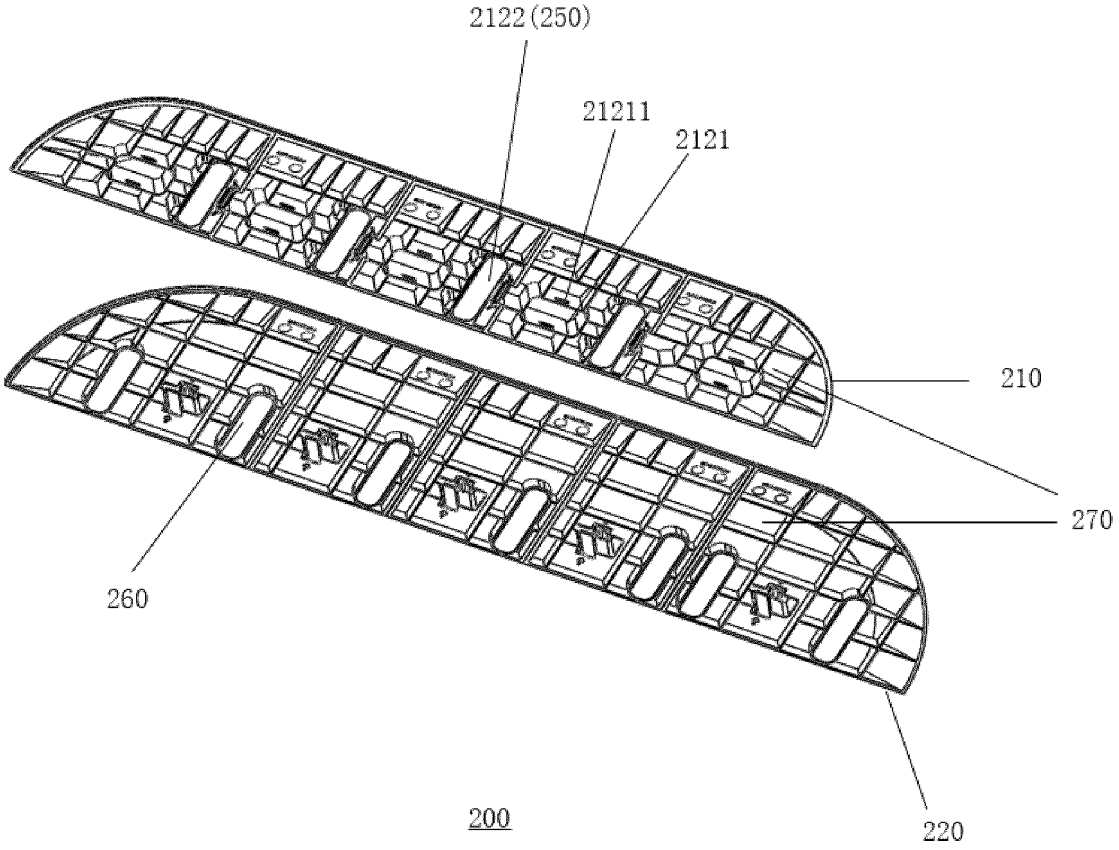

2122(250)
21211
2121
210
270
260
200
220

FIG. 5

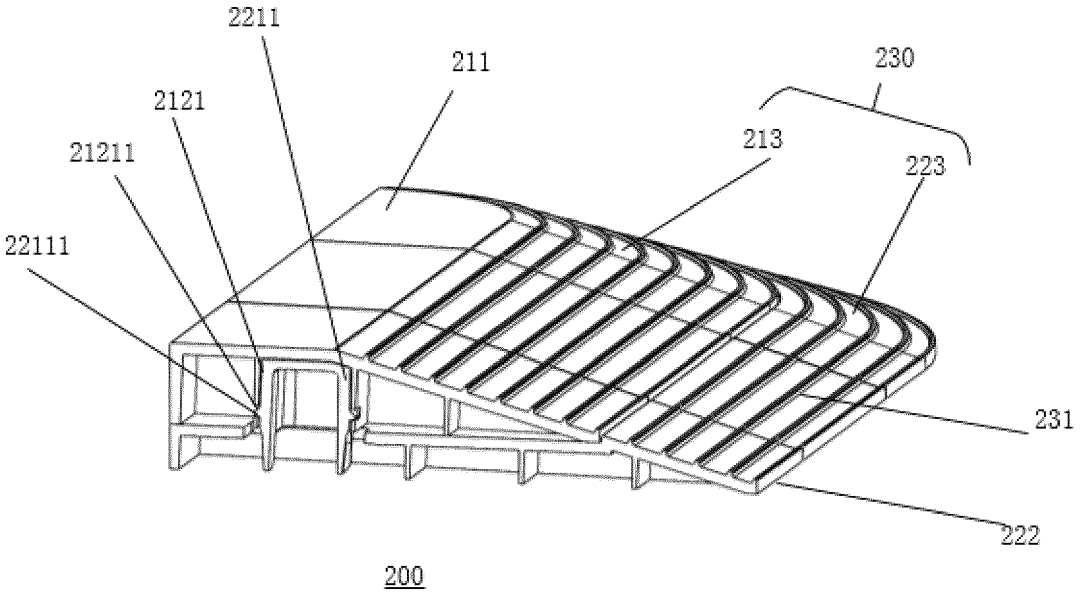
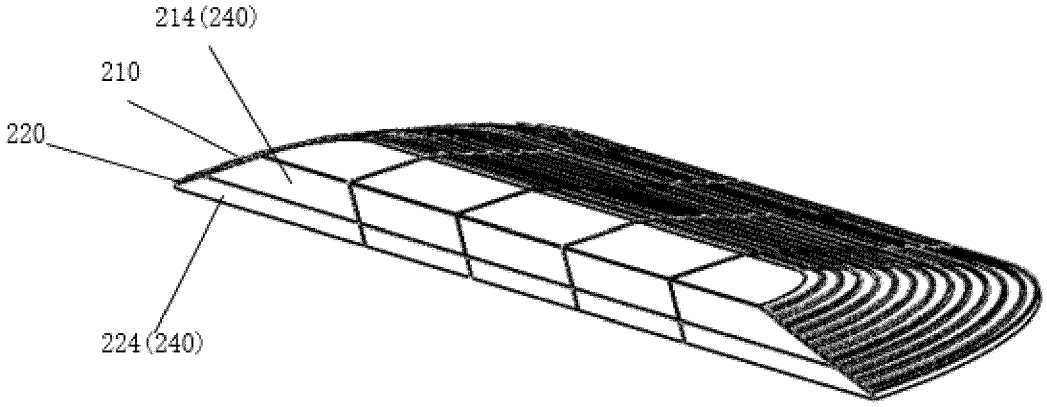

2211
211
230
2121
213
21211
223
22111
231
222
200

FIG. 6



200

FIG. 7

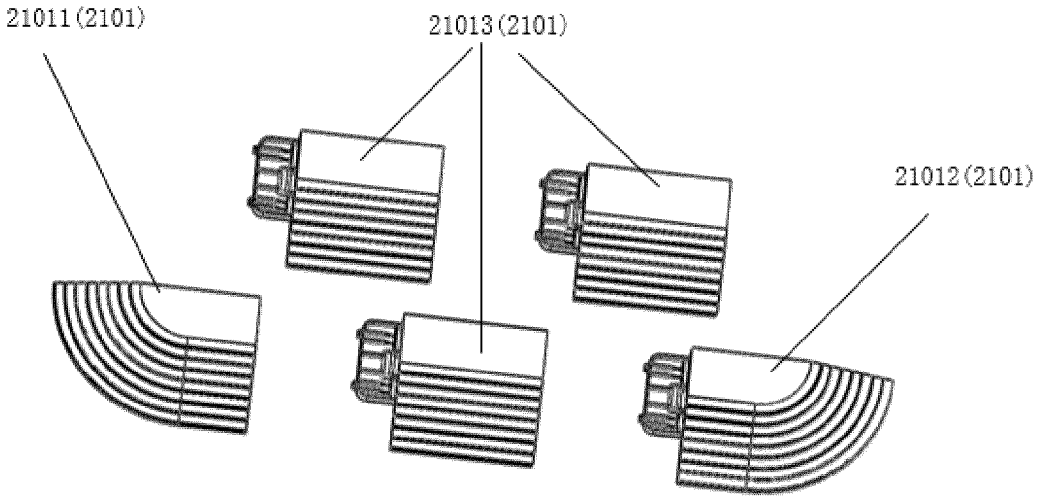


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FIG. 8

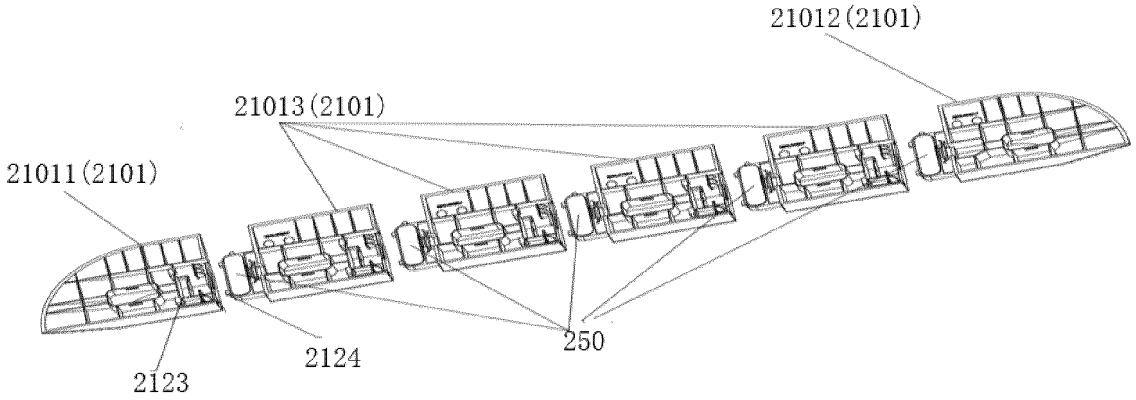

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FIG. 9

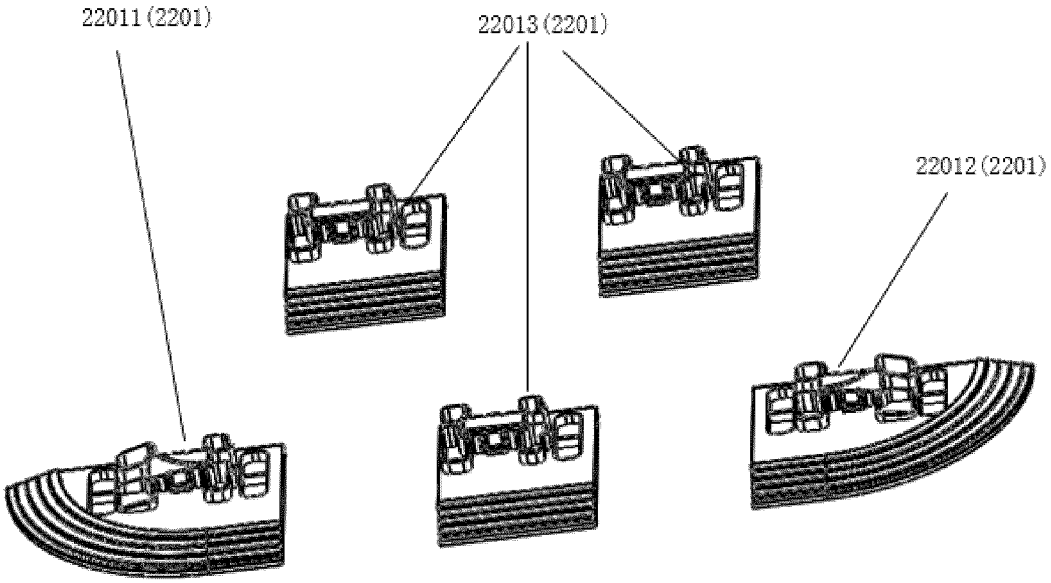

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FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/099973

A. CLASSIFICATION OF SUBJECT MATTER

A47L11/24(2006.01)i; A47L11/40(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)

IPC: A47L11/-; B25J19/-; E01C9/-; A61G5/-

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

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

CNTXT, CNKI, ENTXTC, WPABC, VEN, DWPI: 越障, 过障, 过坎, 跨越, 辅助, 坡, 斜面, 拼接, 插接, 拼合, 层叠, 叠置, obstacle, barrier, detour+, cross+, auxiliary, assist+, incline+, splice+, overlap+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 217592720 U (BEIJING ROBOROCK TECHNOLOGY CO., LTD.) 18 October 2022 (2022-10-18) description, paragraphs [0062]-[0081], and figures 1-10	1-21
PX	CN 217959952 U (BEIJING ROBOROCK TECHNOLOGY CO., LTD.) 06 December 2022 (2022-12-06) description, paragraphs [0059]-[0082], and figures 1-10	1-21
X	CN 113069044 A (ECOVACS ROBOT CO., LTD.) 06 July 2021 (2021-07-06) description, paragraphs [0050]-[0058] and [0074]-[0078], and figures 1-4	1, 4-7
Y	CN 113069044 A (ECOVACS ROBOT CO., LTD.) 06 July 2021 (2021-07-06) description, paragraphs [0050]-[0058] and [0074]-[0078], and figures 1-4	2-3, 8-11, 15-20
X	CN 212331091 U (CLOUD WHALE SMART TECHNOLOGY (DONGGUAN) CO., LTD.) 12 January 2021 (2021-01-12) description, paragraphs [0049]-[0098], and figures 1-12	12-14, 21
Y	CN 212331091 U (CLOUD WHALE SMART TECHNOLOGY (DONGGUAN) CO., LTD.) 12 January 2021 (2021-01-12) description, paragraphs [0049]-[0098], and figures 1-12	2-3, 8-11, 15-20

☑ 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
05 July 2023	**13 July 2023**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/099973

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	CN 103174078 A (ZHEJIANG HAOQING AUTOMOBILE MANUFACTURING CO., LTD. et al.) 26 June 2013 (2013-06-26) entire document	1-21
A	CN 204703022 U (TANG YIDAN) 14 October 2015 (2015-10-14) entire document	1-21
A	WO 2022123173 A1 (MYDL) 16 June 2022 (2022-06-16) entire document	1-21

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/099973

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 217592720 U	18 October 2022	None	
CN 217959952 U	06 December 2022	None	
CN 113069044 A	06 July 2021	None	
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CN 303592123 S	17 February 2016	None	
CN 103174078 A	26 June 2013	CN 103174078 B	04 November 2015
CN 204703022 U	14 October 2015	None	
WO 2022123173 A1	16 June 2022	FR 3117139 A1	10 June 2022
		FR 3117139 B1	16 December 2022

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202221522081 **[0001]**
- CN 202221520162 **[0001]**