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WHEELED ROLLING ROBOT

Technical field of the invention - prior art

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The invention relates to the field of rolling robots equipped with a rigid frame and wheels articulated on two separate axes, and more particularly to such robots for military use or civil protection applications.

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Such robots are provided with different equipments, such as a camera or an arm, mounted on the frame which occupies part of the space between the wheels. They move remotely from the human operator thereof, often in uneven environments, and are driven by radio.

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Locomotion by wheels is advantageous with respect to locomotion by track because the wheels allow the robot to move quickly with a good energy efficiency. The lightness of the robot allows it to move quickly. The number of wheels is generally of four: two at the front and
20 two at the rear, but a different number is possible.

Such robots can be intended for mine clearance traditionally, but also more generally for inspecting outside or inside areas, such as premises or a street in a combat area.

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For example, the Dragon Runner robot of the Qinetiq company is known. It moves at a limited speed and it is not compatible with a close combat situation. If the field is uneven, it must be equipped with tracks and thus has a high weight.

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The Cobra MkII robot of the ECA company is also known, and is dedicated to inside or outside inspecting and intervening missions. This robot is not designed for climbing a curbstone or a staircase step for example.

Disclosure of invention - advantages provided by it

In order to improve the security of the staff engaged in risk areas, it is desirable to develop robots
5 capable to move quickly, on any field, without needing any complex maneuvering. Thus, it is desired that a robot be able to climb a curbstone or a staircase step, and doing so without wasting time, and without needing any particular momentum to accomplish it.

10 It is also important that the robot be lightweight such that it can be thrown by the operator's hand, and that it then moves quickly, immediately after its projection.

Thus, the present invention relates to a rolling
15 robot comprising wheels articulated around two parallel rotation axes, as well as a frame comprising a surface which is essentially flat between the two rotation axes, characterized in that the frame surface comprises, between the two rotation axes, a groove extending in parallel to
20 the rotation axes to allow the robot to advance on an obstacle having an angle, without the angle hitting the frame between the rotation axes.

Thus, the robot can move very quickly in any circumstances and act quickly in delicate situations in
25 which the operator thereof wants to engage it, even if obstacles must be climbed. Such a robot is capable of participating in close combat, for example for intercepting an enemy, in particular in urban area or inside. However, it can also have civil protection applications, such as
30 monitoring a jail or assisting in maintaining order in riot-type situations.

In addition, the device is characterized, in some embodiments, as follows.

The groove can have a profile which, given the diameter of the wheels, allows the robot to advance on an obstacle having a right angle, reached at the front, without the right angle hitting the frame. The groove can
5 be midway from the two rotation axes. If the robot has a front side and a rear side, then one of the rotation axes is a front axis and the other is a rear axis and, in this case, the center of gravity is preferred to be closer to the front axis than the rear axis. In this case, in
10 particular, the batteries of the robot could be located in the front half thereof. Furthermore, the robot can have at least one front drive wheel or rear drive wheel, and generally, two front wheels and two rear wheels, even if other arrangements are possible.

15 According to a particularly advantageous embodiment, the rolling robot can move on its wheels on one face or, once turned over, on a second face, the frame comprising surfaces which are essentially flat between the two rotation axes on each of the two faces, each of these
20 surfaces having, between the rotation axes, a groove extending in parallel to the rotation axes to allow the robot to advance on an obstacle having an angle, without the angle hitting the frame between the axes of the wheels. This robot is disposable and can be turned over, because it
25 can move on one face or, once turned over, on its second face. Thus, it is particularly adapted to combat situations.

Advantageously, the robot can be provided with flat brushless motors for its propulsion. These motors
30 allow the robot to move at a very high speed.

The rolling robot is, in a specific version, intended for outside military operations. Thus, it is characterized, for example, by a watertight structure, the

use of materials resistant to mould, such as polyurethane for its shell, as well as resistant to solar radiation and fire. Thus, the robot can be used on a field of outside military operation, and can sustainably resist to difficult
5 conditions that it can experience on such a field.

Brief description of the figures

The invention will now be described in reference
10 with the following appended drawings.

Figure 1 shows a general view of a robot according to an embodiment of the invention.

Figure 2 shows an exploded view of an embodiment of a robot according to the invention, the robot being
15 shown with the cover in the opened position.

Figure 3 shows a top view of the robot.

Figure 4 shows a side view of the robot climbing a step, and then going down a step.

Figure 5 shows another sectional view of the
20 frame of the robot of Figure 3.

Figure 6 shows a three-quarter view of the frame.

Detailed description

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In **figure 1**, an embodiment of the robot 1000 is shown. The robot 1000 comprises two coaxial front wheels 1010 and two coaxial rear wheels 1020, with a rotation axis
30 parallel to the axis of the front wheels 1010. The rear wheels 1020 are of the same diameter as the front wheels 1010.

The robot 1000 also comprises a frame 1030 having a thickness lower than the diameter of the wheels, and

extending in the rectangle defined by them. The wheels are attached to this frame 1030 and the robot 1000 has generally a plane of symmetry passing through the axes of the wheels. The wheels define two planes on which the robot
5 can be placed and move, and which here are parallel, the front and rear wheels having the same diameter. Thus, the robot has two faces having identical functions in terms of locomotion, defining two planes of motion.

The robot 1000 is provided with an arm 1040, for
10 example rotatably articulated around an axis parallel and coplanar to the axes of the wheels. The arm 1040 can adopt at least three configurations. A first configuration is a storage configuration (shown in figures 2 to 6), in which the arm is confined in the volume of the frame. Thus, the
15 robot 1000 can roll on either face, indifferently, when the arm 1040 is in the storage position, the latter being confined between the two planes of motion. The other two configurations of the arm are deployment configurations, in which the arm is erected. Here, the deployment
20 configurations are obtained by rotation of 90° from the storage configuration.

The arm 1040 can carry a payload 3000, visible in figure 1 and which can be rotatably articulated. Here, a range finder 3000 is summarily shown, which is mounted with
25 a multi-turn free rotation at the top of the arm 1040 in the deployment position.

In **figure 2**, the robot 1000 is shown with its frame 1030 in the opened position, so as to reveal the inner components. The arm 1040 is in the storage position.
30 The robot 1000 is shown with the two halves 1031 and 1032 of the frame separated from each other. The frame is, for example, made of polyurethane, but other materials like ABS can also be used, depending on the design choices.

The frame supports the four wheels 1010 and 1020, which are each operated by a flat brushless motor 1011 and 1021. These motors are independent from each other and powered by batteries 1060, and controlled by a controller
5 (not shown) receiving commands by radio.

The wheels are not steerable, but a different speed control on the left and right wheels allows to turn the robot on one side or on the other one. The motors can allow the robot to move at high speeds, for example up to
10 20 km/h.

The robot is equipped with a camera 1050 disposed between the front wheels on the frame 1030. The camera 1050 is multi-directional. The robot can be equipped with four cameras, certain of which being capable of a high-
15 resolution night vision.

At the opposite of the camera, the robot is provided with a handle 1070 for allowing its manipulation and transport by an operator.

In **figure 3**, a top view of the robot 1000 is
20 shown. The robot 1000 has, in an absolutely remarkable way, a frame which is characterized by an indented profile between the axis of the front wheels and the rear wheels. The bottom surface, which is essentially flat, of the frame is crossed by a groove 2010 parallel to the axes of the
25 wheels, from a side of the robot to the opposite side. The groove has a generally V-profile.

In **figure 4**, the robot 1000 is shown climbing an obstacle having a right angle, such as a staircase step or a curbstone (left part of the figure). First, the robot
30 climbs the obstacle with its front wheels, and then, given the distance between the front wheels and the rear wheels, ends up with the front wheels leaning against the horizontal face of the step, and the rear wheels leaning

against the other face of the step, which is vertical. To avoid that the angle of the step hits the frame in this situation, the groove 2010 has been designed such that its depth and its width allow, given the diameter of the wheels and the spacing thereof, to receive the angle of the step climbed by the robot. The angle of the step occupies the empty space of the groove and therefore does not hit the surface of the frame. The robot continues its progression thanks to the action of its wheels and entirely rises the step. The same principle is used for going down an obstacle (right part in the figure).

In **figure 5**, the frame 1030 is shown in a sectional view, in the median plane perpendicular to the axes of the wheels. One can identify in particular the groove 2010, but also a groove 2020 arranged on the other face of the frame 1030, and symmetrical to the groove 2010. Thus, the robot can roll on either face and, in both cases, it is provided in a remarkable way that the profile of the frame is adapted for facilitating the clearing of obstacles.

It can also be noted the presence of batteries 1060 in the front part of the robot, which results, together with the other weight distributions in the structure, in locating the center of gravity of the robot closer to the axis of the front wheels than the axis of the rear wheels, and helping to climb obstacles such as steps.

In **figure 6**, the frame 1030 of the robot is shown in the closed position, without its wheels. The arm 1040 is visible, as well as the load 3000 placed at its end. The arm is in the folded configuration. The groove 2020 is visible, as well as the groove 2010. The base 1042 of the arm 1040, when in the folded position, fits closely to the

profile of the grooves 2010 and 2020, on either side of the frame.

The wheel tires are preferentially made of polyurethane, like the frame. The structure is watertight
5 and fireproof.

The invention is described with reference to the drawings showing particular embodiments, but extends to all alternatives in the scope of the claims.

CLAIMS

1. A rolling robot (1000) comprising wheels (1010, 1020)
5 articulated around two parallel rotation axes, as well as a
frame (1030) comprising a surface which is essentially flat
between the two rotation axes, characterized in that the
frame surface comprises, between the two rotation axes, a
groove (2010, 2020) extending in parallel to the rotation
10 axes to allow the robot (1000) to advance on an obstacle
having an angle, without the angle hitting the frame (1030)
between the rotation axes.
2. The rolling robot according to claim 1, the groove
(2010, 2020) of which has a profile which, given the
15 diameter of the wheels (1010, 1020), allows the robot
(1000) to advance on an obstacle having a right angle,
reached at the front, without the right angle hitting the
frame (1030).
3. The rolling robot according to claim 1 or 2, which can
20 move on its wheels (1010, 1020) on one face or, once turned
over, on a second face, the frame (1030) comprising
surfaces which are essentially flat between the two
rotation axes on each of the two faces, each of these
surfaces having, between the rotation axes, a groove (2010,
25 2020) extending in parallel to the axes to allow the robot
(1000) to advance on an obstacle having an angle, without
the angle hitting the frame (1030) between the rotation
axes.
4. The rolling robot according to one of claims 1 to 3,
30 wherein the groove (2010, 2020) is midway from the two
rotation axes.
5. The rolling robot according to one of claims 1 to 4,
one of the axes of which is a front axis and the other is a

rear axis and, and the center of gravity of which is closer to the front axis than the rear axis.

6. The rolling robot according to one of claims 1 to 5, comprising batteries (1060) located in the front half of
5 the robot (1000).

7. The rolling robot according to one of claims 1 to 6, a front wheel (1010) of which has the same diameter as a rear wheel (1020).

8. The rolling robot according to one of claims 1 to 7,
10 comprising at least one front drive wheel (1010) or rear drive wheel (1020).

9. The rolling robot according to one of claims 1 to 8, comprising two front wheels (1010) and two rear wheels (1020).

15 10. The rolling robot according to one of claims 1 to 9, equipped with flat brushless motors for its propulsion.

11. The rolling robot according to one of claims 1 to 10, adapted for outside military operations.