

HIGH-POLE LAMP POST ROBOT

Field of the Invention:

[0001] The present invention relates to robots, particularly to an inspection and maintenance robots for high mast lamp posts.

Background of the Invention:

[0002] High mast lamp posts are normally located near places that require high illumination for larger areas, such as stadiums or highways. Each includes high power lighting apparatus lifted tens of meters away from the ground by a pole. For the regular inspection and maintenance, an existing method is to inspect the conditions of the high mast lamp post visually using binoculars from a ground location. Obviously at such a distance, the inspector who stands on near ground level can hardly get a close inspection of the pole surface of the high mast lamp post, particularly to the unobvious flaws, thin cracks, and corrosions of the pole surface.

[0003] Another method for inspection is to use a bucket truck that carries a person to a higher level for closer inspection. The bucket truck method, however, is not only expensive, but also imposes significant risks for the person working at such height.

Summary:

[0004] It is an objective of the present invention to provide a robot for high mast lamp posts, which can perform close inspection of the high mast lamp post pole surface, so to not only lowers the maintenance costs and risks of inspections, but also increases the inspection accuracy.

[0005] According to one aspect of the present invention, the robot for inspecting high mast lamp post comprises a circular body, a multiple roller legs assembly, a plurality of wireless monitoring modules and a control system. The roller legs assembly is secured at the bottom side of the circular body and extends downwards from the circular body. One end of each roller leg is

equidistantly connected to the outer rim of the circular body, and the other end of the roller leg has a roller wheel engaged to the pole surface of the high mast lamp post. The wireless monitoring modules are equidistantly spaced and mounted on the circular body. The control system is configured for controlling the roller legs assembly to drive the monitor modules that inspects the pole surface of the high mast lamp post.

[0006] In one embodiment, each roller leg comprises a first leg and a second leg. The first leg has an end connected to an outer rim of the circular body, and another end of the first leg is coupled with a single-wheel roller. The second leg has an end connected to the outer rim of the circular body, and another end of the second leg is coupled with a double-wheel roller.

[0007] Accordingly, based on the aforesaid structure, the high mast lamp post robot is able to be driven by the roller legs, which moves up and down and inspect the high mast lamp post with its monitoring modules. This not only lowers the maintenance costs and risks of manual inspections, but also more accurately perform close inspection of every detail on the high mast lamp post pole surface.

[0008] Another objective of the present invention is to provide a high mast lamp post robot, which is able to perform on-site operations and can be remotely or autonomously controlled, avoiding the risk of having human workers working at high elevations.

[0009] According to another aspect of the present invention, provided is a high mast lamp post robot comprising a multiple roller legs assembly and at least one robotic arm. The roller legs assembly is secured at the circular body and extends downwards from the circular body to the pole surface of the high mast lamp post. One end of the robotic arm is connected to a circular track located on the inner rim of the circular body, while the other end is linked to a working module to perform specific tasks.

[0010] The working module is interchangeable to extend the functionalities of the arm and satisfies various needs. The functionalities include, but are not limited to, surface testing, grinding, polishing, painting, cleaning, ultrasonic for internal sensing and lamp inspections.

[0011] Accordingly, the robotic arm allows the high mast lamp post robot of the present invention perform a close on-site operation directly, avoiding the risk of having human workers working at high elevations.

5 **Brief Description of the Drawings:**

[0012] FIG. 1 is an illustrative diagram of a high mast lamp post robot in accordance with one embodiment of the present invention.

[0013] FIG. 2 is another perspective illustration of the high mast lamp post robot of FIG. 1.

[0014] FIG. 3 is a block diagram of the control system in accordance with one embodiment
10 of the present invention.

[0015] FIG. 4 is an illustrative diagram of a high mast lamp post robot in accordance with one embodiment of the present invention.

[0016] FIG. 5 is another perspective illustration of the high mast lamp post robot.

[0017] FIG. 6 is a block diagram of the control system in accordance with one embodiment
15 of the present invention.

Detailed Description:

[0018] With reference to FIGs. 1 to 3, FIG. 1 is an an illustrative diagram of a high mast lamp post robot in accordance with one embodiment of the present invention; FIG. 2 is another
20 perspective illustration of the high mast lamp post robot of FIG. 1; and FIG. 3 is a block diagram of the control system in accordance with one embodiment of the present invention. The monitoring module and the control system of FIG. 1 are omitted from FIG. 2 for clarity.

[0019] As shown in FIGs .1 and 2, in one embodiment, the high mast lamp post robot comprises a circular body 10, multiple roller legs assembly 20, a plurality of monitoring modules
25 30 and a control system 40. The circular body 10 is a ring having an inner hole 11 which may be composed of two assembled semi-circle shaped rings. The inner hole 11 is configured for

receiving a pole having a diameter of a range of 230 to 800 millimeters. The roller legs 20 are equidistantly spaced apart and mounted on to the outer rim of circular body 10 and each roller leg 20 has two ends. One end of the roller leg 20 is connected to the outer rim of the circular body 10, and the other end of the roller leg 20 is connected to roller wheels 210, 220 engaged to the pole surface of the high mast lamp post. The monitoring modules 30 are equidistantly spaced apart and mounted on the circular body 10. The control system 40 is electrically connected to the roller legs assembly 20 and the monitoring modules 30. The roller wheel 210/220 is engaged to the pole surface and configures to drive the high mast lamp post robot with the monitoring modules 30 moving up and down along the high mast lamp post to perform inspection on the pole surface.

[0020] Each of the roller legs 20 comprises a first leg 21 and a second leg 22. In this embodiment, the first leg 21 is composed of two pivotally connected leg portions and has a hydraulic cylinder rod 211 connected between two distal ends of the leg portions. One end of the first leg 21 is connected to the circular body 10, and the other end of the first leg 21 is connected to a single-wheel roller 210. The control system 40 controls the hydraulic cylinder rod 211 to move the first leg 21 and drives the single-wheel roller 210.

[0021] The second leg 22 is also composed of two pivotally connected leg portions and has a hydraulic cylinder rod 221 connected between two distal ends of the leg portions. One end of the second leg 22 is connected to the circular body 10, and the other end of the second leg 22 is connected to a double-wheel roller 220. Simultaneously, the control system 40 controls the hydraulic cylinder rod 221 to move the first leg 22 and drives the double-wheel roller 220.

[0022] As shown in FIG. 3, the control system 40 comprises a control unit 41, a power supplying module 42, a GPS module 43, an electronic compass 44 and a wireless transmitting module 45. The power supplying module 42 is configured to supply power to all electronic components. The GPS module 43 is used for positioning. The electronic compass 44 is configured to assist the GPS module 43 for positioning, direction, tilts, and moving speeds of the robot.

However, a person skilled in the art will realize that the electronic compass 44 can easily incorporate the functions of an accelerometer and gyroscope sensor, hence be able to determine the speed and calculate its positions, thus it is not further described herein.

[0023] When the circular body 10 is secured around the high mast lamp post, the control system 40 controls the hydraulic cylinder rod 211. By the extension and retraction of hydraulic cylinder rod 221, it moves the first leg 21 and the second leg 22 respectively to make the single-wheel roller 210 and the double-wheel roller 220 engage to the surface of the pole. The rollers rotate to allow the robot to move up and down along the high mast lamp post.

[0024] A person at ground level is able to transmit a command to the control unit 41 via the wireless transmitting module 45. The control unit 41 instructs the robot to a specific position by using the GPS module 43 and the electronic compass 44 based on the received command. In addition, the control unit 41 determines the location of the robot using the GPS module 43 and the electronic compass 44, and transmit the robot's location information via the wireless transmitting module 45 to the ground crew's terminal equipment for positioning the robot.

[0025] In one embodiment, the number of roller legs 20 is 3, and each roller leg has a first leg 21 and a second leg 22. In other words, the high mast lamp post robot in accordance with this embodiment has 6 legs that are distributed 30 degrees evenly around the circular body 10 and extend downwards. The number of the monitoring modules 30 is 6. The mounting positions of monitoring modules 30 may correspond to the legs.

[0026] Each monitoring module 30 comprises a camera for capturing images of the pole surface of the high mast lamp post. The images captured by the monitoring module 30 is transmitted via wired or wireless transmission to the ground crew for further inspection. The monitoring modules 30 captures images at 360-degree angles to present images in a seamlessly integrated manner. The wireless transmitting module 45 streams the images directly to a terminal device (e.g., mobile phone, tablet or notebook computer of the ground crew). Alternatively, the

images may be stored in non-transient memory for later downloading and further processing by a remote device.

[0027] Moreover, there may be a downward monitoring module (not shown) mounted underneath the circular body 10. The downward monitoring module and the monitoring module 30 have similar functionalities. The differences are that the downward monitoring module is disposed at a different location and provides another shooting angle. In this manner, the ground crew is provided with upward, downward, left, and right 720-degrees view without blind spots.

[0028] Accordingly, through the use of the roller legs, the high mast lamp post robot is able to navigate up and down along the high mast lamp post to perform the inspection with the monitoring modules. This not only lowers the costs and risks, but also increases the inspection coverage and detail resolution on the pole surface of the high mast lamp post.

[0029] With references to FIGs. 4 to 6, FIG. 4 is an exemplary diagram illustrating an high mast lamp post robot in accordance with one embodiment of the present invention; FIG. 5 is another perspective illustration of the high mast lamp post robot of FIG. 4; and FIG. 6 is a block diagram of the control system in accordance with one embodiment of the present invention. The present embodiment is similar to the above described embodiment. The major difference is that the present embodiment further comprises at least one robotic arm to perform specific tasks, avoiding the risk of having human worker to work at such height. As shown in FIG. 4, the monitoring module 30 is disposed between the first leg 21 and the second leg 22. Similarly, the positions of the monitoring modules 30 are corresponded to the roller legs, and are equidistantly spaced apart and mounted on the circular body 10.

[0030] In this embodiment, as shown in FIGs. 4 and 5, one or more arm 50 is connected to the circular body 10. The circular body 10 has a circular track 12 formed at the inner rim of the circular body 10. The arm 50 is extended upwards and has an end connected to a slider 51 that is installed inside the circular track 12 of the circular body 10. The other end of the arm is connected

to a working module 52 corresponding to a target task. The slider 51 is able to drive the arm 50 horizontally 360-degrees to perform the task.

[0031] Moreover, in order to satisfy the needs of different tasks, the working module 52 is replaceable and interchangeable. As shown in FIG. 4, the working module 52 is illustrated as a painting module for painting tasks. The working module 52 of FIG. 5 is illustrated as a grading module for grading and/or polishing tasks. Further, the working module 52 may be an ultrasonic sensing module to sense unobvious flaws, thin cracks, and corruptions that are unidentified by the human eyes. For example, the ultrasonic sensing module is able to sense inside the pole or inspect the conditions of the bolts and nuts of the high mast lamp post, such as loose or damaged.

[0032] With further reference to FIG. 6, the control system 40 further comprises an extension control module 46 that corresponds and is electrically connected to the arm 50. In another embodiment, the extension control module 46 may integrate within the control unit 41.

[0033] In the above embodiment, the roller legs 20 are mounted on the outer rim of the circular body 10 and the arm 50 is mounted on the inner rim of the circular body 10. However, a person skilled in the art can realize that the circular track 11 may form at the outer rim of the circular body 10 and the roller legs 20 may be mounted on the inner rim of the circular body 10.

[0034] Accordingly, the arm is able to allow the high mast lamp post robot to perform a close on-site operation directly at the high mast lamp post, which avoids the risk of having human worker to work at such height. Furthermore, the working module extends to the functionalities of the arm and satisfies various needs. The functions include, but are not limited to surface testing, grinding, polishing, painting, cleaning, ultrasonic for internal sensing and lamp inspections.

[0035] While the disclosure has been described in connection with a number of embodiments and implementations, the disclosure is not limited, but covers various obvious modifications and equivalent arrangements, which fall within the appended claims. Although features of the disclosure are expressed in certain combinations among the claims, it is still uncertain that these features can be arranged in any combination and order.

Claims:

1. A high mast lamp post robot for inspecting high mast lamp posts, comprising:

a circular body;

5 a plurality of roller legs mounted on to the circular body and extended downwards from the circular body, an end of the each roller leg being equidistantly spaced apart and connected to an outer rim of the circular body, another end of the each roller leg having a roller wheel that is engaged to pole surface of the high mast lamp post, wherein each roller leg comprises:

10 a first leg having one end connected to and outer rim of the circular body and another end linked to a single-wheel roller;

a second leg having one end connected to and outer rim of the circular body and another end linked to a double-wheel roller;

a plurality of monitoring modules being equidistantly spaced apart and mounted on the circular body; and

15 a control system configured for controlling the roller legs to drive the high mast lamp post with the monitor modules inspecting pole surface of the high mast lamp post.

2. The high mast lamp post robot as claimed in claim 1, wherein the circular body has a circular track formed at an inner rim of the circular body, and at least one arm is installed to the circular track and extends upwardly from the circular body, wherein the arm is able to slide 360 degree
20 along the circular track to perform a specific task.

3. The high mast lamp post robot as claimed in claim 2, wherein the arm has a grinding module.

25 4. The high mast lamp post robot as claimed in claim 2, wherein the arm has a painting module.

5. The high mast lamp post robot as claimed in claim 2, wherein the arm has an ultrasonic sensing module.

6. The high mast lamp post robot as claimed in claim 1, wherein the first leg is composed of two pivotally connected leg portions, an end of the first leg is connected to the outer rim of the circular body, and another end of the first leg is linked to a single-wheel roller, and the first leg has a hydraulic cylinder rod connected between two distal ends of the leg portions; wherein the control system controls the hydraulic cylinder rod and drives the single-wheel roller of the first leg.

7. The high mast lamp post robot as claimed in claim 1, wherein the second leg is composed of two pivotally connected leg portion, an end of the second leg is connected to the outer rim of the circular body, and another end of the second leg is linked to a double-wheel roller, and the second leg has a hydraulic cylinder rod connected between two distal ends of the leg portions; wherein the control system controls the hydraulic cylinder rod and drives the double-wheel roller of the second leg.

8. The high mast lamp post robot as claimed in claim 1, wherein the control system comprises a control unit, a power suppling module, a GPS module, an electronic compass and a wireless transmitting module.

9. The high mast lamp post robot as claimed in claim 8, wherein a person on the ground uses a terminal device to transmit a command to the control unit via the wireless transmitting module, and the control unit instructs the high mast lamp post robot to move to a specific position by using the GPS module and the electronic compass based on the received command.

10. The high mast lamp post robot as claimed in claim 8, wherein the control unit 41 determines a position of the high mast lamp post robot by using the GPS module 43 and the electronic compass 44, and transmits the position of the high mast lamp post robot to a terminal device being used by a person on the ground via the wireless transmitting module 45 for position setting.

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11. The high mast lamp post robot as claimed in claim 1, further comprising a downward monitoring module mounted underneath the circular body.

12. A high mast lamp post robot for inspecting high mast lamp posts, comprising:

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a circular body having a circular track formed at an inner rim of the circular body;

a plurality of roller legs mounted on to the circular body and extended downwards from the circular body, an end of each roller leg being equidistantly spaced apart and connected to an outer rim of the circular body, another end of each roller leg having a roller wheel that is engaged to pole surface of the high mast lamp post;

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at least one arm being installed onto the circular track through a slider, being extended upwardly from circular body, and being configured to perform a specific task;

a plurality of monitoring modules being equidistantly spaced apart and mounted on the circular body; and

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a control system being configured for controlling the roller legs to drive the monitor modules that inspects the pole surface of the high mast lamp post.