OPERATION AND MAINTENANCE SYSTEM FOR RAIL-TRANSPORTATION LOCOMOTIVE VEHICLE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority of China Patent Application No. 201822159405.6, filed on December 21, 2018, entitled "OPERATION AND MAINTENANCE SYSTEM FOR RAIL-TRANSPORTATION LOCOMOTIVE VEHICLE" and China Patent Application No. 201922307013.4, filed on December 20, 2019, entitled "OPERATION AND MAINTENANCE SYSTEM FOR RAIL-TRANSPORTATION LOCOMOTIVE VEHICLE", the contents of which are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

[0002] The present application relates to the field of rail-transportation, and more particularly, to an operation and maintenance system for a rail-transportation locomotive vehicle.

BACKGROUND

[0003] With the development of the transportation industry, taking urban rail-transportation to travel is becoming a primary travel way. The urban rail-transportation is a general term for the high-speed large-volume public transportation that uses electric energy as power and adopts wheel rails as transportation means, such as the high-speed rail-transportation. In contrast to the overhaul for automobiles, the overhaul for rail locomotive vehicles typically need to use a column-type inspection pit for manual maintenance.

[0004] The characteristic of the column-type inspection pit is that rails are fixed at the top of columns. When a locomotive vehicle is parked on the rails, a space with an enough height from the bottom and the side of the locomotive vehicle to the ground exists for an operator or an apparatus to pass therethrough and to operate on the locomotive vehicle, facilitating the overhaul operation. In an actual overhaul operation, the operator or the apparatus typically has to overhaul from one inspection pit to another inspection pit according to the inspection process requirements. Due to the height difference between the ground outside the inspection pit and the bottom of the pit, this direct transverse manner is very inconvenient and has a great safety issue.

[0005] At present, in order to facilitate the access of the operator, typically, there is a step ladder or a slope between two columns. The bottom of the step ladder or the slope is flush with the bottom of the inspection pit, and the top of the step ladder or the slope is flush with the ground

outside the inspection pit. However, the step ladder or the slope may occupy the ground space outside the inspection pit, so that the outside inspection apparatus cannot access in a straight line adjacent to the columns, and it is not suitable for the apparatus whose movement is restricted by road condition to access. Therefore, the traditional overhaul for rail locomotive vehicles has the problems of low efficiency, high difficulty, and low safety.

SUMMARY

[0006] Based on this, with respect to the problems of low efficiency, high difficulty, and low safety of the traditional overhaul for rail-transportation locomotive vehicles, it is necessary to provide an operation and maintenance system for the rail-transportation locomotive vehicle.

[0007] An operation and maintenance system for a rail-transportation locomotive vehicle includes:

an inspection platform;

a set of rails disposed on the inspection platform;

an inspection pit disposed in the inspection platform and corresponding to the set of rails; and

a lifting apparatus mounted in the inspection pit, wherein in a lifting-to-top state, a top of the lifting apparatus is flush with a surface of the inspection platform.

[0008] The operation and maintenance system for the rail-transportation locomotive vehicle provided in the present application includes the inspection platform, the set of rails, the inspection pit, and the lifting apparatus. The set of rails is arranged corresponding to the inspection pit. The bottom of the lifting apparatus is mounted in the inspection pit, and in the lifting-to-top state, the top of each lifting apparatus is flush with the surface of the inspection platform. The inspection apparatus or the inspector can be descended to the inspection pit from the inspection platform via the lifting apparatus, to overhaul the bottom of the rail-transportation locomotive vehicle, or can be lifted up via the lifting apparatus from the inspection pit to the inspection platform. The operation and maintenance system for the rail-transportation locomotive vehicle provided in the present application can solve the problems of low efficiency, high difficulty, and low safety of the traditional overhaul for rail locomotive vehicles.

[0009] In an embodiment, the lifting apparatus is disposed between two adjacent set of rails and is in contact with inner walls of both sides of the inspection pit.

[0010] In an embodiment, the lifting apparatus includes:

a hoist-type lifting plate;

a bottom mounting frame opposite to the hoist-type lifting plate;

a lifting guide track, wherein one end of the lifting guide track is mounted to the bottom mounting frame, and another end of the lifting guide track is configured to support the hoist-type lifting plate, the lifting guide track along a length direction thereof is in contact with the inspection pit; and

a driving device mounted on the lifting guide track, and configured to move the hoist-type lifting plate upward and downward along the lifting guide track, so that in the lifting-to-top, the hoist-type lifting plate is flush with the surface of the inspection platform.

[0011] In an embodiment, the driving device includes:

a driving box;

a driving motor disposed inside the driving box and mounted on the driving box;

a transmission chain disposed inside the driving box, wherein one end of the transmission chain is connected to the driving motor, and another end of the transmission chain is transmissively connected to the hoist-type lifting plate; and

a hoisting wheel disposed inside the driving box, and mounted on the driving box, wherein the transmission chain is wrapped around the hoisting wheel.

[0012] In an embodiment, at least one lifting apparatus is respectively disposed at an inner side or an outer side of the set of rails, the lifting apparatus is in contact with an inner wall of the inspection pit, the inner side is the side of the set of rails corresponding to the inspection pit, and the outer side is the side of the set of rails corresponding to the inspection platform;

the set of rails includes two adjacent rails corresponding to one inspection pit.

[0013] In an embodiment, the operation and maintenance system includes at least two sets of rails, at least two inspection pits, and at least two sets of lifting apparatuses, wherein each set of lifting apparatuses includes two lifting apparatuses respectively disposed at both sides of each set of rails.

[0014] In an embodiment, at least two sets of lifting apparatus are arranged in a direction perpendicular to an extending direction of the set of rails, and form at least one access route.

[0015] In an embodiment, the lifting apparatus includes:

a lifting plate disposed at a side of each set of rails;

a driving device mounted to the lifting plate and configured to drive the lifting plate to ascend and descend vertically;

a distance sensor mounted to the lifting plate and configured to detect a dwelling state of an apparatus on the surface of the lifting plate; and

a control device electrically connected to the drive device and configured to control the

driving device to turn on or turn off according to the dwelling state of the apparatus on the surface of the lifting plate.

[0016] In an embodiment, the control device includes:

a lifting apparatus control module electrically connected to the driving device and configured to control the driving device; and

a system control scheduler respectively electrically connected to the distance sensor and the lifting apparatus control module, configured to detect an on-site working condition and the dwelling state of the apparatus on the surface of the lifting plate, and control the lifting apparatus control module.

[0017] In an embodiment, the lifting apparatus control module is connected to an alarm unit, the alarm unit is electrically connected to the system control scheduler, and configured to output an alarm to remind an inspection apparatus, an inspector, or the operation and maintenance system to stop operations.

[0018] In an embodiment, the operation and maintenance system further includes a plurality of support columns, wherein the bottom of each support column is disposed in the inspection pit, and the top of each support column is connected to the bottom of the rail to support the rail, the lifting apparatus is disposed between two adjacent support columns.

[0019] In an embodiment, at least two lifting apparatuses are arranged at the sides of two adjacent set of rails and in contact with each other, and form an access route in a direction perpendicular to the extending direction of the set of rails, and the at least two lifting apparatuses are located between the two adjacent set of rails;

the access route is configured to communicate the two adjacent inspection pits with each other.

[0020] In an embodiment, the operation and maintenance system further includes:

at least one vehicle undercarriage inspection apparatus electrically connected to and communicated with the system control scheduler,

wherein the at least one vehicle undercarriage inspection device is capable of ascending or descending via the lifting apparatus, so as to perform an overhaul for the rail-transportation locomotive vehicle.

[0021] The operation and maintenance system for the rail-transportation locomotive vehicle provided in the present application can detect whether the on-site working condition meets the overhaul condition by using the system control scheduler, and detect the dwelling state of the apparatus on the surface of the lifting plate by using the system control scheduler and the distance

sensor. The control device can control and activate the driving device to completely lift or lower the lifting plate. The inspection apparatus and the inspector can move across the plurality of inspection pits through the plurality of lifting plates that are completely descended, so as to achieve the obstacle-free cross-rail overhaul for the rail-transportation locomotive vehicle. Through the operation and maintenance system for the rail-transportation locomotive vehicle provided in the present application, the inspection apparatus or the inspector can safely reach the inspection pits through the lifting apparatus, and therefore, the problem of low safety of the traditional overhaul for rail-transportation locomotive vehicles can be solved. In addition, the inspection apparatus or the inspector can move through the lifting apparatuses which are in contact with each other, and perform the cross-rail overhaul, therefore, and the problems of high difficulty and low efficiency of the traditional overhaul for rail-transportation locomotive vehicles can be solved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. 1 is a schematic structural view of an operation and maintenance system for a rail-transportation locomotive vehicle, in which a lifting apparatus is in a descending state, provided in an embodiment.

[0023] FIG. 2 is a schematic structural view of the operation and maintenance system for the rail-transportation locomotive vehicle, in which the lifting apparatus is in an operating state, provided in an embodiment.

[0024] FIG. 3 is a schematic structural partial view of the operation and maintenance system for the rail-transportation locomotive vehicle, in which the lifting apparatus is in the operating state, provided in an embodiment.

[0025] FIG. 4 is a schematic structural view of a lifting apparatus provided in an embodiment.

[0026] FIG. 5 is a schematic structural view of a driving device provided in an embodiment.

[0027] FIG. 6 is a schematic structural view of a lifting apparatus provided in an embodiment.

[0028] FIG. 7 is a schematic structural view of a lifting apparatus provided in an embodiment.

[0029] Description of reference signs

10 operation and maintenance system for a rail-transportation locomotive vehicle
11 support column
100 inspection platform
200 rail
300 inspection pit
400 lifting apparatus

410 lifting plate
420 driving device
430 distance sensor
440 control device
450 lifting apparatus frame structure
460 lifting apparatus driving device
470 lifting apparatus intercross structure
480 foldable support post
490 tie rod
491 tie rod controller
492 lifting apparatus low-position support post
510 hoist-type lifting plate
511 fixing member
520 bottom mounting frame
530 lifting guide track
540 driving device
541 driving box
542 driving motor
543 transmission chain
544 hoisting wheel
610 driving device
620 frame structure
630 intercross lifting structure
640 jack-type lifting plate
650 low-position support post
20 lifting apparatus control module
21 system control scheduler
22 alarm unit
23 action execution unit
30 at least one vehicle undercarriage inspection apparatus

DETAILED DESCRIPTION

[0030] The traditional overhaul for a rail locomotive vehicle has the problems of low

efficiency, high difficulty, and low safety. In view of the above problems, the present application provides an operation and maintenance system for a rail-transportation locomotive vehicle.

[0031] In order to make the objectives, technical solutions, and advantages of the present application more apparent, the operation and maintenance system for the rail-transportation locomotive vehicle of the present application is described in detail hereinafter according to various embodiments in conjunction with accompanying drawings. It should be understood that the specific embodiments described herein are only used to explain the present application, and are not intended to limit the present application.

[0032] The ordinal terms assigned to various members herein, such as “first”, “second”, etc., are only used to distinguish the modified objects, and do not involve any sequence or technical meanings. The terms “connect” or “couple”, unless otherwise specified, can cover the meanings of directly and indirectly connect (or couple). In the specification of the present application, it should be understood that the orientation or position relationships indicated by the terms “upper”, “lower”, “front”, “back”, “left”, “right”, “vertical”, “horizontal”, “top”, “bottom”, “inside”, “outside”, “clockwise”, “counterclockwise”, etc., are on the basis of orientation or position relationships shown in the accompanying drawings, which are only for the convenience of describing the present application to simplify the description, rather than for indicating or implying that the devices or elements described herein must have a specific orientation or position, or be constructed and operated in the specific orientation or position, and therefore, which should not be understood as a limitation of the present application.

[0033] In the present application, unless explicitly specified or defined otherwise, the expression that a first feature is “above” or “below” a second feature may be that the first feature is in direct contact with the second feature, or that the first feature is in indirect contact with the second feature via an intermediary medium. Moreover, the expression that the first feature is “above”, “over” or “on” the second feature may be that the first feature is directly above or obliquely above the second feature, or simply means that a horizontal height of the first feature is greater than the horizontal height of the second feature. The expression that first feature is “under”, “beneath” or “below” the second feature may be that the first feature is directly below or obliquely below the second feature, or simply means that the horizontal height of the first feature is less than the horizontal height of the second feature.

[0034] Referring to FIG. 1, the present application provides an operation and maintenance system 10 for a rail-transportation locomotive vehicle. The system includes an inspection platform 100, a set of rails 200, an inspection pit 300, and a lifting apparatus 400.

[0035] The inspection platform 100 can be an inspection surface flush with and connected to the ground or an inspection surface higher than the ground. An inspection apparatus or an inspector can walk on the inspection platform 100 to overhaul the rail-transportation locomotive vehicle. The size of the inspection platform 100 can be selected according to practical requirements and is not limited in the present application.

[0036] The set of rails 200 is located on the inspection platform 100. Specifically, the set of rails 200 can be mounted to the inspection platform 100, or can be mounted above the inspection platform 100 via support columns or other devices, which can be specifically selected according to practical requirements and are not limited in the present application. The set of rails 200 is the tracks for travelling the rail-transportation locomotive vehicle, and includes two rails arranged in parallel. The pitch between the two rails arranged in parallel is set according to the type of the rail-transportation locomotive vehicle. When the rail-transportation locomotive vehicle needs to be overhauled, it can travel to an overhaul position along the set of rails 200. The specific shape and specific material of the rails 200 can be selected according to practical requirements, and are not limited in the present application.

[0037] The inspection pit 300 is located in the inspection platform 100 and corresponds to the set of rails 200. The inspection pit 300 is a pit with a height difference between the pit bottom and the inspection platform 100 in a direction perpendicular to the inspection platform 100; that is, the bottom of each inspection pit 300 is parallel to the inspection platform 100. The inspection pit 300 is a walking platform for the inspection apparatus or the inspector to inspect the bottom of the rail-transportation locomotive vehicle. The inspection pit 300 is located below the set of rails 200. For example, the three-dimensional space can be divided and represented by an X-axis, a Y-axis, and a Z-axis that are commonly used in mathematics. If the plane in which the inspection platform 100 is located is a first plane composed by the X-axis and the Y-axis, and the Z-axis value of the first plane is 0, then the plane in which the bottom of the inspection pit 300 is located can be a second plane composed by the X-axis and the Y-axis, and the Z-axis value of the second plane is a negative number. The absolute value of the negative number is the height difference between the plane in which the inspection platform 100 is located and the plane in which the bottom of the inspection pit 300 is located. Each inspection pit 300 is arranged corresponding to each set of rails 200. Specifically, one inspection pit 300 is provided below each set of rails 200. In an actual inspection process, the inspection apparatus or the inspector can walk in the inspection pit 300 to overhaul the bottom of the rail-transportation locomotive vehicle.

[0038] The lifting apparatus 400 is mounted in the inspection pit 300. In a lifting-to-top state,

a top of the lifting apparatus 400 is flush with the surface of the inspection platform 100. The lifting-to-top state is the state that a lifting plate of the lifting apparatus 400 reaches the top of the lifting apparatus 400. In an embodiment, the lifting apparatus 400 can be disposed in the inspection pit 300 under the set of rails 200. Alternatively, the lifting apparatus 400 can be disposed at a side of the set of rails 200, and the bottom of the lifting apparatus 400 is still located in the inspection pit 300. The set of rails 200 includes two rails 200 above one inspection pit 300. The side can be a side of the set of rails 200, and the side is adjacent to the inspection platform 100. During the inspection process, the inspection apparatus can reach the inspection pit 300 from the inspection platform 100 via the lifting apparatus 400. If the inspection apparatus needs to return to the inspection platform 100, it can be lifted up via the lifting apparatus 400 from the inspection pit 300 to the inspection platform 100.

[0039] It should be noted that the number of the lifting apparatus 400 can be one or at least two. If the number of the lifting apparatus 400 is one, the lifting apparatus 400 can either be provided at the side of the set of rails 200 or under the set of rails 200 according to practical requirements. If the number of the lifting apparatuses 400 is at least two, the bottoms of the lifting apparatuses 400 can be respectively located in two adjacent inspection pits 300, and the lifting apparatuses 400, which are mounted respectively in two adjacent inspection pits 300, are in contact with each other. Therefore, the inspection apparatus or the inspector can directly reach one inspection pit 300 from another inspection pit 300 via the lifting apparatuses 400 in contact with each other if the inspection apparatus or the inspector needs to move between the inspection pits 300. The term “in contact with” means that the lifting plates are in contact with each other. It should be understood that each lifting apparatus 400 has a lifting plate which is configured to provide a platform for standing the inspection apparatus or the inspector. When the lifting apparatus is in the lifting-to-top state, the lifting plate is flush with the surface of the inspection platform, so that the inspection apparatus or the inspector can travel across the rails.

[0040] The present application provides the operation and maintenance system 10 for the rail-transportation locomotive vehicle. The system includes the inspection platform 100, the set of rails 200, the inspection pit 300, and the lifting apparatus 400. The set of rails 200 is arranged corresponding to the inspection pit 300. The bottom of the lifting apparatus 400 is mounted in the inspection pit 300, and the top of each lifting apparatus 400 is flush with the surface of the inspection platform 100. The inspection apparatus or the inspector can be descended to the inspection pit 300 from the inspection platform 100 via the lifting apparatus 400, to overhaul the bottom of the rail-transportation locomotive vehicle, or can be lifted up via the lifting apparatus 400 from the

inspection pit 300 to the inspection platform 100. Therefore, the operation and maintenance system 10 for the rail-transportation locomotive vehicle provided in the present application can solve the problems of low efficiency, high difficulty, and low safety of the traditional overhaul for rail locomotive vehicles.

[0041] Referring to FIGs. 1 to 3, in an embodiment of the present application, the operation and maintenance system 10 for the rail-transportation locomotive vehicle includes at least two lifting apparatuses 400. The at least two lifting apparatuses 400 are respectively located at both sides of the set of rails 200. The bottoms of the lifting apparatuses 400 are respectively mounted in the inspection pits 300, and the tops of the lifting apparatuses 400 are flush with the surface of the inspection platform 100. Specifically, at least one lifting apparatus 400 is located at one side of each set of rails 200. The bottom of each lifting apparatus 400 is mounted in each inspection pit 300, and the lifting apparatus 400 can be lifted or descended between the inspection pit 300 and the inspection platform 100. Therefore, the inspection apparatus or the inspector can be descended via the lifting apparatuses 400 from the inspection platform 100 to the inspection pit 300 to overhaul the bottom of the rail-transportation locomotive vehicle. In addition, the inspection apparatus or the inspector can reach one side of the set of rails 200 from another side of the set of rails 200 via at least two lifting apparatuses 400 provided respectively at both sides of the set of rails 200.

[0042] The at least two lifting apparatuses 400 provided in the present embodiment facilitate the inspection apparatus or the inspector to reach one inspection pit 300 from another inspection pit 300, and also facilitate the inspection apparatus or the inspector to reach one side from another side of the set of rails 200, without having to be lifted to the inspection platform 100 again. Therefore, the at least two lifting apparatuses 400 provided in the present embodiment simplifies the inspection procedures of the inspection apparatus or the inspector, reduces the overhaul difficulty for the rail-transportation locomotive vehicle, and improves the overhaul efficiency and safety.

[0043] Referring to FIGs. 1 to 3, in an embodiment of the present application, the lifting apparatus 400 is disposed between two adjacent set of rails 200. The lifting apparatus 400 is in contact with inner walls of two sides of the inspection pit 300. It should be understood that when the lifting apparatus 400 is in the lifting-to-top state, the opposite ends of the lifting plate of the lifting apparatus 400 are respectively in contact with the inspection platform 100, and the lifting plate is communicated with the inspection platform 100, so that the inspection apparatus or the inspector can reach the inspection platform 100 from the inspection pit 300 via the lifting apparatus 400.

[0044] Referring to FIG. 4, in an embodiment of the present application, the lifting apparatus 400 includes a hoist-type lifting plate 510, a bottom mounting frame 520, lifting guide tracks 530,

and driving devices 540.

[0045] The shape and thickness of the hoist-type lifting plate 510 can be selected according to practical requirements and are not limited in the present application. However, the size and shape of the hoist-type lifting plate 510 need to be adapted to the width of the inspection pit 300. It can be understood that fixing members 511 can be provided on the hoist-type lifting plate 510. Specifically, the fixing members 511 are mounted on a surface of the hoist-type lifting plate 510. For example, the shape of the hoist-type lifting plate 510 is rectangular, and the fixing members 511 are mounted at four corners of the rectangle. The driving devices 540 can be connected to the fixing members 511, thereby being connected to the lifting plate 510.

[0046] The bottom mounting frame 520 is arranged opposite to the hoist-type lifting plate 510. The shape and size of the bottom mounting frame 520 need to be adapted to the width of the inspection pit 300. In an embodiment, the shape of the bottom mounting frame 520 can be rectangular.

[0047] One end of the lifting guide track 530 is mounted to the bottom mounting frame 520, and another end thereof is configured to support the hoist-type lifting plate 510. The lifting guide track 530 along a length direction thereof is in contact with the inspection pit 300. It can be understood that the length of the lifting guide track 530 is selected according to the depth of the inspection pit 300. In an embodiment, the number of the lifting guide tracks 530 can be four. The shape of each lifting guide track 530 can be adapted to the shape of the bottom mounting frame 520.

[0048] The driving devices 540 are mounted on the lifting guide tracks 530. The driving devices 540 are drivingly connected to the hoist-type lifting plate 510 to drive the hoist-type lifting plate 510 to move along the lifting guide tracks 530, in order to make the hoist-type lifting plate 510 flush with the surface of the inspection platform 100. The driving devices 540 are configured to drive the edges of the hoist-type lifting plate 510 such that the edges of the hoist-type lifting plate 510 move along the lifting guide tracks 530. When the inspection apparatus needs to reach the inspection platform 100 from the inspection pit 300, the inspection apparatus can be moved to the hoist-type lifting plate 510, and the driving devices 540 control the hoist-type lifting plate 510 to ascend along the lifting guide tracks 530. The driving devices 540 can be manually controlled, or can be controlled by a control device 440.

[0049] Referring to FIG. 5, the driving device 540 includes a driving box 541, a driving motor 542, a transmission chain 543, and a hoisting wheel 544.

[0050] The size of the driving box 541 can be selected according to practical requirements and

is not limited in the present application. It can be understood that the driving box 541 includes a driving box housing and a receiving cavity surrounded by the driving box housing. The driving motor 542 is disposed inside the driving box 541, and is mounted on the housing of the driving box 541. That is, the driving motor 542 is disposed in the receiving cavity of the driving box 541, and mounted on the driving box housing. The type and model of the driving motor 542 can be selected according to practical requirements, and are not limited in the present application. The transmission chain 543 is disposed in the driving box 541. One end of the transmission chain 543 is connected to the driving motor 542, and another end thereof is transmissively connected to the hoist-type lifting plate 510 via the fixing member 511. The hoisting wheel 544 is disposed inside the driving box 541, and mounted on the housing of the driving box 541. The hoisting wheel 544 is configured to fix the transmission chain 543.

[0051] When the inspection apparatus is about to enter the inspection pit 300 from the inspection platform 100, through the transmission chain 543, the driving motor 542 drives the hoisting wheel 544 to rotate and pulls the hoist-type lifting plate 510 to ascent to the high position. The inspection apparatus directly passes through the space between the multiple support columns 11, and travels onto the hoist-type lifting plate 510. Then, the lifting plate 510 descends to the low position. The inspection apparatus can directly work on the hoist-type lifting plate 510, or travel to other positions of the operation surface of the pit for overhaul operation, so as to achieve the switch between the operation surfaces.

[0052] Referring to FIG. 6, in another embodiment, the lifting apparatus 400 includes a driving device 610, a frame structure 620, an intercross lifting structure 630, a jack-type lifting plate 640, and low-position support posts 650.

[0053] The low-position support posts 650 and the intercross lifting structure 630 are both mounted on the frame structure 620. In an embodiment, the frame structure 620 can include four frame members at the bottom thereof, and the four frame members are connected in sequence to form a rectangular frame structure. The low-position support posts 650 are respectively mounted at the four corners of the rectangular frame structure.

[0054] The jack-type lifting plate 640 is mounted to the intercross lifting structure 630. The driving device 610 is drivingly connected to the intercross lifting structure 630, to make the jack-type lifting plate 640 flush with the surface of inspection platform 100. It can be understood that when the intercross lifting structure 630 is folded or unfolded, the jack-type lifting plate 640 moves downward or upward. The size and shape of the jack-type lifting plate 640 can be selected according to practical requirements, which are not limited in the present application.

[0055] The driving device 610 can be an electric-driven cylinder, a hydraulic cylinder, a pneumatic cylinder, an airbag, etc., as long as it can drive the intercross lifting structure 630 to be folded or unfolded.

[0056] It can be understood that in a normal state, the lifting apparatus 400 is in the low position. That is, the jack-type lifting plate 640 is in contact with the low-position support posts 650, which forms a stable structure by rigid support and is capable of supporting a relatively large weight and facilitating other apparatuses or persons to pass therethrough safely. When the inspection apparatus is needed to enter or exit the inspection pit 300, the lifting apparatus 400 performs a corresponding lifting operation.

[0057] For example, when an inspection apparatus needs to enter the inspection pit 300 from the inspection platform 100, the jack-type lifting plate 640 is lifted to the high position, and the inspection apparatus directly passes through the space between the adjacent support columns 11 and travels to the jack-type lifting plate 640. When the jack-type lifting plate 640 is descended to the low position, the inspection apparatus can directly work on the jack-type lifting plate 640, or travel to other positions of the inspection pit 300 for the overhaul operation, so as to achieve the switch between the operation surfaces.

[0058] In an embodiment of the present application, at least one lifting apparatus 400 is respectively disposed at an inner side or an outer side of the set of rails 200. The lifting apparatus 400 is in contact with an inner wall of the inspection pit 300. The inner side is the side of the set of rails 200 corresponding to the inspection pit 300, and the outer side is the side of the set of rails 200 corresponding to the inspection platform 100. The set of rails 200 includes two adjacent rails 200 corresponding to one inspection pit 300. It should be noted that there is no need for the lifting apparatus 400 to be in contact with the two inner walls of the inspection pit 300. The inspection apparatus can access both sides of the set of rails 200 by the lifting apparatuses 400 respectively disposed at the inner side and the outer side of the set of rails 200. During a practical overhaul, the inspection apparatus or the inspector can directly move across the set of rails 200 from the inner side to the outer side, which is safe and convenient.

[0059] In an embodiment of the present application, the operation and maintenance system 10 for the rail-transportation locomotive vehicle includes at least two sets of rails 200, at least two inspection pits 300, and at least two sets of lifting apparatuses 400. Each set of rails 200 includes two rails 200, and the two rails 200 correspond to one inspection pit 300. Each set of lifting apparatuses 400 includes two lifting apparatuses 400. Each set of lifting apparatuses 400 are respectively disposed

at both sides of each set of rails 200. The bottom of each lifting apparatus 400 is mounted in each inspection pit 300. The top of each lifting apparatuses 400 is flush with the surface of the inspection platform 100. Specifically, the bottom of each of the at least two lifting apparatuses 400 is fixedly mounted at a side of the inspection pit 300.

[0060] In addition, at least two sets of lifting apparatuses 400 are arranged in a direction perpendicular to the extending direction of the rails, and form at least one access route. Specifically, when it needs to cross the rails to overhaul the bottom of the rail-transportation locomotive vehicle, as the lifting apparatuses 400 are arranged in the direction perpendicular to the extending direction of the rails and form the at least one access route, the inspection apparatus or the inspector can travel between the at least two inspection pits 300 through completely descended lifting apparatuses 400. Therefore, there is no need to lift the inspection apparatus or the inspector to reach the inspection platform 100 once again; that is, there is no need to descend once again to enter another inspection pit 300. The lifting apparatus 400 can be a lifting apparatus with guide tracks, a crank-type lifting apparatus, an intercross lifting apparatus, a chain-type lifting apparatus, etc., which can be selected according to practical requirements, and is not limited in the present application. According to the above description, the inspection apparatus or the inspector can pass through the plurality of inspection pits 300 via the plurality of the lifting apparatuses 400 which are completely descended, so as to achieve the purpose of a cross-rail overhaul. Therefore, the problems of low efficiency, high difficulty, and low safety of the traditional overhaul for rail-transportation locomotive vehicles can be solved.

[0061] In an embodiment of the present application, the lifting apparatus 400 includes a lifting plate 410, a driving device 420, a distance sensor 430, and a control device 440.

[0062] The lifting plate 410 is mounted in the lifting apparatus 400, and is located at the side of the set of rails 200. When the lifting plate 410 is in the completely ascending state, the lifting plate 410 should be in the plane in which the inspection platform 100 is located. When the lifting plate 410 is in the completely descending state, the lifting plate 410 should be in the plane in which the bottom of the inspection pit is located. It should be noted that the lifting plate 410 only has the completely ascending state and the completely descending state without staying at any middle positions. The lifting plate 410 is an insulation plate. The material of the insulation plate can be an inorganic insulating material, an organic insulating material, or a mixed insulating material, which can be selected according to practical requirements, and is not limited in the present application. The shape of the lifting plate 410 can be rectangular, trapezoidal, polygonal, etc., which can be selected according to practical requirements,

and is not limited in the present application. In addition, one lifting plate 410 for one set of rails 200 is in contact with another lifting plate 410 for another set of rails 200. Specifically, if the lifting plates 410 are completely descended, the inspection pits 300 can be communicated with each other; that is, an access route is formed in the inspection platform 100. The inspection apparatus or the inspector can travel in the access route, so as to achieve the cross-rail overhaul.

[0063] The driving device 420 is mounted to the lifting plate 410, and is configured to drive the lifting plate 410 to ascend and descend vertically. The specific mounting position of the driving device 420 on the lifting plate 410 can be selected according to practical requirements and is not limited in the present application. The number of the driving device 420 can be selected according to practical requirements and is not limited in the present application. The driving device 420 can be a hydraulic driving device, a pneumatic driving device, an electrical driving device, a chain-type driving device, etc., as long as it can drive the lifting plate 410 to ascend and descend vertically. It can be selected according to practical requirements, and is not limited in the present application. In the present embodiment, the driving device 420 is a hydraulic driving device, which is combined with the lifting plate 410 to form a hydraulic intercross lifting platform. The hydraulic intercross lifting platform is a fixed hydraulic intercross lifting platform. The rollers, balls, turntables and other parts of the fixed hydraulic intercross lifting platform can be arbitrarily configured to meet practical requirements. Therefore, during a practical usage, a maintenance person or a user can easily adjust the driving device 420 according to practical requirements, which facilitates the usage of the lifting apparatus 400.

[0064] The distance sensor 430 is mounted to the lifting plate 410, and is configured to detect a dwelling state of an apparatus on the surface of the lifting plate 410. When the distance sensor 430 is mounted to the lifting plate 410, the upper surface of the distance sensor 430 is flush with the upper surface of the lifting plate 410. When an apparatus stays on the surface of the lifting plate 410, the apparatus can be detected by the distance sensor 430, and then detection information about whether there is an apparatus located on the surface of the lifting plate 410 can be generated. The distance sensor can be a capacitive sensor to sense proximity, a laser sensor to sense distance, or an ultrasonic sensor, which can be selected according to practical requirements, and is not limited in the present application. The number of the distance sensor 430 can be one or more, which can be selected according to practice requirements, and is not limited in the present application.

[0065] The control device 440 is electrically connected to the driving device 420, and is

configured to control the driving device 420 to turn on or turn off. The control device 440 includes a lifting apparatus control module 20 and a system control scheduler 21.

[0066] The lifting apparatus control module 20 is electrically connected to the driving device 420, and is configured to control the driving device 420. The system control scheduler 21 is respectively electrically connected to the distance sensor 430 and the lifting apparatus control module 20, and is configured to determine an on-site working condition and the dwelling state of the apparatus on the surface of the lifting plate 410 and to control the lifting apparatus control module 20. The lifting apparatus control module 20 is connected to an action execution unit 23 and an alarm unit 22. The action execution unit 23 is respectively electrically connected to the system control scheduler ~~30~~ 21 and the driving device 420, and is configured to control the driving device 420. The alarm unit 22 is electrically connected to the system control scheduler ~~30~~21, and is configured to output an alarm to remind the inspection apparatus, the inspector or the operation and maintenance system 10 for the rail-transportation locomotive vehicle to stop operations.

[0067] Specifically, the system control scheduler 21 receives feedback information about the detection result of the on-site working condition. If the on-site working condition meets an operating condition, the system controls scheduler 21 outputs an activating signal or an energizing signal for operations. The lifting apparatus control module 20 receives the activating signal or the energizing signal from the system control scheduler 21. The lifting apparatus control module 20 activates the action execution unit 23 to control the driving device 420 to activate. If the on-site working condition does not meet the operating condition, the system control scheduler 21 outputs a stop signal or an alarm signal to stop operations. The lifting apparatus control module 20 receives the stop signal or the alarm signal from the system control scheduler 21. The lifting apparatus control module 20 activates the alarm unit 22. The alarm unit 22 outputs the alarm signal to remind an on-site operator that the current working condition does not meet the operating condition, and the lifting apparatus 10 may not perform corresponding lifting and descending actions. If there is an apparatus staying on the surface of the lifting plate 410, the distance sensor 430 detects an apparatus dwelling signal, and feeds the detection result to the system control scheduler 21. The system control scheduler 21 receives the apparatus dwelling signal, and outputs a corresponding instruction according to the apparatus dwelling signal in combination with the detection result of the on-site working condition. If the on-site working condition meets the operating condition and there is an apparatus staying on the surface of the lifting plate 410, the action execution unit 23 controls and activates the driving device 420, and the driving device 420 controls the lifting plate 410 to ascend or descend. If the on-site working

condition does not meet the operating condition and there is an apparatus staying on the surface of the lifting plate 410, the alarm unit 22 also outputs the alarm signal to stop operations.

[0068] The operation and maintenance system 10 for the rail-transportation locomotive vehicle provided in the present application can detect whether the on-site working condition meets an overhaul condition by using the system control scheduler 21, and detect the dwelling state of the apparatus on the surface of the lifting plate 410 by using the system control scheduler 21 and the distance sensor 430. The control device 440 can control and activate the driving device 420, to completely lower the plurality of lifting plates 410. The inspection apparatus and the inspector can pass through the plurality of inspection pits 300 through the completely descended lifting plates 410, so as to achieve the obstacle-free cross-rail overhaul for the rail-transportation locomotive vehicle. The operation and maintenance system 10 for the rail-transportation locomotive vehicle provided in the present application enables the inspection apparatus or the inspector to safely reach the inspection pits 300 through a plurality of lifting apparatuses 400, and therefore, the problem of low safety of the traditional overhaul for rail-transportation locomotive vehicles can be solved. In addition, the inspection apparatus or the inspector can pass through the plurality of lifting apparatuses 400 which are in contact with each other, and perform the cross-rail overhaul, and therefore, the problems of high difficulty and low efficiency of the traditional overhaul for rail-transportation locomotive vehicles can be solved.

[0069] In an embodiment of the present application, the operation and maintenance system 10 for the rail-transportation locomotive vehicle further includes a plurality of support columns 11. The bottom of each support column 11 is disposed in the inspection pit 300, and the top thereof is connected to the bottom of the rail 200 to support the rail 200. The lifting apparatus 400 is located between adjacent support columns 11. Each of the plurality of support columns 11 can be a rectangle, a cube, a cylinder, etc., which can be selected according to practical requirements and is not limited in the present application. The size of each of the plurality of support columns 11 can be selected according to practical requirements, and is not limited in the present application. Each of the plurality of support columns 11 can be made of a solid material. Specifically, each of the plurality of support columns 11 can be made of a metallic material, an inorganic non-metallic material, or an organic polymer material, which can be selected according to practical requirements, and is not limited in the present application. The plurality of support columns 11 are arranged such that the rails 200 are higher than the inspection platform 100, so that during the overhaul for a vehicle undercarriage, the inspection apparatus or the inspector can also inspect the vehicle undercarriage, thereby providing multiple guarantees for the overhaul of the rail-

transportation locomotive vehicle. The design of the plurality of support columns can improve the reliability and practicability of the operation and maintenance system for the rail-transportation locomotive vehicle.

[0070] In an embodiment of the present application, the at least two lifting apparatuses 400 are arranged opposite to each other on both sides of the set of rails 200. Specifically, the at least two lifting apparatuses 400 can be separated by the inspection pit 300 and arranged in parallel, or can be separated by the inspection pit 300 and arranged in non-parallel, which can be selected according to practical requirements, and is not limited in the present application. In addition, the at least two lifting apparatuses 400 arranged on the sides of two adjacent set of rails 200 are in contact with each other, and form the access route in the direction perpendicular to the extending direction of the rails 200. The at least two lifting apparatuses 400 are located between the two adjacent set of rails 200. The access route is configured to communicate the two adjacent inspection pits 300 with each other. Therefore, the inspection apparatus or the inspector can reach one inspection pit 300 from another inspection pit 300 through the access route to perform the cross-rail overhaul for the vehicle.

[0071] In an embodiment of the present application, the operation and maintenance system 10 for the rail-transportation locomotive vehicle further includes at least one vehicle undercarriage inspection apparatus 30. The at least one vehicle undercarriage inspection apparatus 30 is electrically connected to and communicated with the system control scheduler 21. The system control scheduler 21 controls the actions of the vehicle undercarriage inspection apparatus 30. The at least one vehicle undercarriage inspection device 30 can be lifted up or lowered via the lifting apparatus 400, so as to perform an overhaul and/or an cross-rail overhaul for the rail-transportation locomotive vehicle. The at least one vehicle undercarriage inspection apparatus 30 is a movable inspection apparatus. Specifically, the system control scheduler 21 receives feedback information about the detection result of the on-site working condition. If the on-site working condition meets an operating condition, the system control scheduler 21 controls the at least one vehicle undercarriage inspection apparatus 30 to move to the lifting plate 410, and move across the plurality of inspection pits 300 via the ascending or descending of the plurality of lifting apparatuses 400 to overhaul the undercarriages of a plurality of rail-transportation locomotive vehicles. It should be noted that the system control scheduler 21 can simultaneously control a plurality of vehicle undercarriage inspection apparatuses 30 to perform the overhaul, which can be operated according to practical requirements, and is not limited in the present application. The at least one vehicle undercarriage inspection device 30 provided in the present embodiment can

improve the overhaul convenience and safety for the rail-transportation locomotive vehicle.

[0072] According to the above description, the operation and maintenance system 10 for the rail-transportation locomotive vehicle provided in the present application can detect whether the on-site working condition meets the overhaul condition by using the system control scheduler 21, and detect the dwelling state of the apparatus on the surface of the lifting plate 410 by using the system control scheduler 21 and the distance sensor 430. The control device 440 can control and activate the driving device 420 to completely lift or lower the lifting plate 410. The inspection apparatus and the inspector can move across the plurality of inspection pits 300 through the plurality of lifting plates 410 that are completely descended, so as to achieve the obstacle-free cross-rail overhaul for the rail-transportation locomotive vehicle. Through the operation and maintenance system 10 for the rail-transportation locomotive vehicle provided in the present application, the inspection apparatus or the inspector can safely reach the inspection pits through the lifting apparatus 400, and therefore, the problem of low safety of the traditional overhaul for rail-transportation locomotive vehicles can be solved. In addition, the inspection apparatus or the inspector can move through the lifting apparatuses 400 which are in contact with each other, and perform the cross-rail overhaul, therefore, and the problems of high difficulty and low efficiency of the traditional overhaul for rail-transportation locomotive vehicles can be solved.

[0073] Referring further to FIG. 7, in an embodiment of the present application, the lifting apparatus 400 includes a lifting apparatus frame structure 450, a lifting apparatus driving device 460, a lifting apparatus intercross structure 470, a lifting apparatus lifting plate 471, a foldable support post 480, a tie rod 490, and a tie rod controller 491. The lifting apparatus intercross structure 470 is mounted on the lifting apparatus frame structure 450. The lifting apparatus driving device 460 is drivingly connected to the lifting apparatus intercross structure 470. The lifting apparatus lifting plate 471 is mounted on the lifting apparatus intercross structure 470. The foldable support post 480 is mounted between the lifting apparatus frame structure 450 and the lifting apparatus lifting plate 471, and includes a folding-unfolding structure. The tie rod 490 is connected to the foldable support post 480, and is configured to fold or unfold the folding-unfolding structure. The tie rod controller 491 is connected to the tie rod 490, and is configured to control the movement of the tie rod 490 to fold or unfold the folding-unfolding structure. It should be noted that the folding-unfolding structure can be a hinge provided on the foldable support post 480, and the foldable support post 480 can be folded in half via the folding-unfolding structure.

[0074] The lifting apparatus intercross structure 470 is mounted on the lifting apparatus frame

structure 450. Similar to the lifting apparatus 400 as shown in FIG. 6, in an embodiment, the frame structure 450 can include four frame members at the bottom thereof. The frame members are connected in sequence to form a rectangular frame structure. One end of the lifting apparatus intercross structure 470 is mounted to the lifting apparatus frame structure 450, and another end thereof is configured to mount the lifting apparatus lifting plate 471. The size and shape of the lifting apparatus lifting plate 471 can be selected according to practical requirements, and are not limited in the present application.

[0075] The lifting apparatus driving device 460 can be an electric-driven cylinder, a hydraulic cylinder, a pneumatic cylinder, an airbag, etc.

[0076] The lifting apparatus lifting plate 471 is kept at the high position in a normal state; that is, the lifting apparatus lifting plate 471 is flush with the inspection platform 100. In this state, the foldable support post 480 is pushed by the tie rod 490 to form a straight line, and the tie rod 490 is locked by the tie rod controller 491, so that the foldable support post 480 forms a stable structure with a rigid support, which can support a relatively large weight and facilitate other apparatuses or persons to pass through safely. When the inspection apparatus needs to enter and exit the pit, the lifting apparatus 400 performs a corresponding lifting operation.

[0077] For example, when the inspection apparatus needs to enter the inspection pit 300 from the inspection platform 100, the inspection apparatus travels to the lifting apparatus lifting plate 471, and then the lifting apparatus lifting plate 471 is descended. When reaching the low position, that is, the position at which the lifting apparatus lifting plate 471 is in contact with the lifting apparatus low-position support posts 492, the inspection apparatus directly passes through the space between the adjacent support columns 11 and travels to the inspection pit 300, so as to achieve the switch between the operation surfaces. In the process of traveling from the inspection pit 300 to the inspection platform 100, the inspection apparatus travels to the lifting apparatus lifting plate 471, and then the lifting apparatus lifting plate 471 is lifted up.

[0078] The technical features of the above-mentioned embodiments can be combined arbitrarily. In order to make the description concise, not all possible combinations of the technical features are described in the embodiments. However, as long as there is no contradiction in the combination of these technical features, the combinations should be considered as in the scope of the present application.

[0079] The above-described embodiments are only several implementations of the present application, and the descriptions are relatively specific and detailed, but they should not be construed as limiting the scope of the present application. It should be understood by those of

ordinary skill in the art that various modifications and improvements can be made without departing from the concept of the present application, and all fall within the protection scope of the present application. Therefore, the patent protection of the present application shall be defined by the appended claims.

CLAIMS

What is claimed is:

1. An operation and maintenance system for a rail-transportation locomotive vehicle, characterized by comprising:

an inspection platform;

a set of rails disposed on the inspection platform;

an inspection pit disposed in the inspection platform and corresponding to the set of rails; and

a lifting apparatus mounted in the inspection pit, wherein in a lifting-to-top state, a top of the lifting apparatus is flush with a surface of the inspection platform.

2. The operation and maintenance system of claim 1, wherein the lifting apparatus is disposed between two adjacent set of rails and is in contact with inner walls of both sides of the inspection pit.

3. The operation and maintenance system of claim 2, wherein the lifting apparatus comprises:

a hoist-type lifting plate;

a bottom mounting frame opposite to the hoist-type lifting plate;

a lifting guide track, wherein one end of the lifting guide track is mounted to the bottom mounting frame, and another end of the lifting guide track is configured to support the hoist-type lifting plate, the lifting guide track along a length direction thereof is in contact with the inspection pit; and

a driving device mounted on the lifting guide track, and configured to move the hoist-type lifting plate upward and downward along the lifting guide track, so that in the lifting-to-top, the hoist-type lifting plate is flush with the surface of the inspection platform.

4. The operation and maintenance system of claim 3, wherein the driving device comprises:

a driving box;

a driving motor disposed inside the driving box and mounted on the driving box;

a transmission chain disposed inside the driving box, wherein one end of the transmission chain is connected to the driving motor, and another end of the transmission chain is transmissively connected to the hoist-type lifting plate; and

a hoisting wheel disposed inside the driving box, and mounted on the driving box, wherein the transmission chain is wrapped around the hoisting wheel.

5. The operation and maintenance system of claim 1, wherein at least one lifting apparatus is

respectively disposed at an inner side or an outer side of the set of rails, the lifting apparatus is in contact with an inner wall of the inspection pit, the inner side is the side of the set of rails corresponding to the inspection pit, and the outer side is the side of the set of rails corresponding to the inspection platform;

the set of rails comprises two adjacent rails corresponding to one inspection pit.

6. The operation and maintenance system of claim 5, comprising at least two sets of rails, at least two inspection pits, and at least two sets of lifting apparatuses, wherein each set of lifting apparatuses comprises two lifting apparatuses respectively disposed at both sides of each set of rails.

7. The operation and maintenance system of claim 5, wherein at least two sets of lifting apparatus are arranged in a direction perpendicular to an extending direction of the set of rails, and form at least one access route.

8. The operation and maintenance system of claim 5, wherein the lifting apparatus comprises:

a lifting plate disposed at a side of each set of rails;

a driving device mounted to the lifting plate and configured to drive the lifting plate to ascend and descend vertically;

a distance sensor mounted to the lifting plate and configured to detect a dwelling state of an apparatus on the surface of the lifting plate; and

a control device electrically connected to the drive device and configured to control the driving device to turn on or turn off according to the dwelling state of the apparatus on the surface of the lifting plate.

9. The operation and maintenance system of claim 8, wherein the control device comprises:

a lifting apparatus control module electrically connected to the driving device and configured to control the driving device; and

a system control scheduler respectively electrically connected to the distance sensor and the lifting apparatus control module, configured to detect an on-site working condition and the dwelling state of the apparatus on the surface of the lifting plate, and control the lifting apparatus control module.

10. The operation and maintenance system of claim 9, wherein the lifting apparatus control module is connected to an alarm unit, the alarm unit is electrically connected to the system control scheduler, and configured to output an alarm to remind an inspection apparatus, an

inspector, or the operation and maintenance system to stop operations.

11. The operation and maintenance system of claim 9, further comprising a plurality of support columns, wherein the bottom of each support column is disposed in the inspection pit, and the top of each support column is connected to the bottom of the rail to support the rail, the lifting apparatus is disposed between two adjacent support columns.

12. The operation and maintenance system of claim 9, wherein at least two lifting apparatuses are arranged at the sides of two adjacent set of rails and in contact with each other, and form an access route in a direction perpendicular to the extending direction of the set of rails, and the at least two lifting apparatuses are located between the two adjacent set of rails;

the access route is configured to communicate the two adjacent inspection pits with each other.

13. The operation and maintenance system of claim 9, further comprising:

at least one vehicle undercarriage inspection apparatus electrically connected to and communicated with the system control scheduler,

wherein the at least one vehicle undercarriage inspection device is capable of ascending or descending via the lifting apparatus, so as to perform an overhaul and/or a cross-rail overhaul for the rail-transportation locomotive vehicle.

14. The operation and maintenance system of claim 1, wherein the lifting apparatus comprises:

a driving device;

a frame structure;

an intercross lifting structure;

a jack-type lifting plate; and

low-position support posts,

wherein the low-position support posts and the intercross lifting structure are both mounted on the frame structure; the jack-type lifting plate is mounted to the intercross lifting structure; the driving device is drivingly connected to the intercross lifting structure to control the intercross lifting structure to be folded or unfolded to move the jack-type lifting plate downward or upward; and the jack-type lifting plate is capable of being in contact with the low-position support posts when the lifting apparatus is in a low position.

15. The operation and maintenance system of claim 1, wherein the lifting apparatus comprises:

a lifting apparatus frame structure;

a lifting apparatus driving device;

a lifting apparatus intercross structure;

a lifting apparatus lifting plate;

a foldable support post;

a tie rod; and

a tie rod controller;

wherein the lifting apparatus intercross structure is mounted on the lifting apparatus frame structure; the lifting apparatus driving device is drivingly connected to the lifting apparatus intercross structure; the lifting apparatus lifting plate is mounted on the lifting apparatus intercross structure; the foldable support post is mounted between the lifting apparatus frame structure and the lifting apparatus lifting plate, and comprises a folding-unfolding structure; the tie rod is connected to the foldable support post, and is configured to fold or unfold the folding-unfolding structure; the tie rod controller is connected to the tie rod, and is configured to control the movement of the tie rod to fold or unfold the folding-unfolding structure.