AUTOMATIC LIFT CARRIER

Field of the Invention

The present invention relates to handling equipment, in particular to a simple, aboveground carrier.

Background of the Invention

As to traditional aboveground handling equipment, forklift is generally used for small-sized and light-weighed goods. For large structural members such as concrete precast members and its templates, they are generally hoisted by a crane. However, this hoisting procedure involves high-altitude operation, which is relatively dangerous and thus has a high risk coefficient. In addition, manual assistance is necessary before and after each hoisting operation, so that this procedure is time-consuming and labor-consuming.

For this purpose, CN108358084A discloses a lift carrier, which includes a supporting frame with trolleys mounted at a bottom thereof. The trolleys are driven by a motor, so as to move the lift carrier back and forth. The supporting frame is provided with four motors, which can drive a lifting rack to move upward or downward through four cables respectively. The lifting rack is provided thereon with a plurality of bearing arms that can be extendable or retractable. The article to be handled can be moved to its desirable destination through controlling the lifting rack and the bearing arms.

However, the accuracy of the lift carrier is low, and the four motors that drive the lifting rack to move upward or downward may be out of synchronization in operation. In addition, jitter would be often incurred when the motors start up and stop, so that

the article to be carried will be tilted or even dropped from the carrier, thus causing a security risk. Moreover, for this type of lift carrier, manual intervention is necessary at each step of the overall handling procedure, so that automation operation of this type of lift carrier is far from satisfactory. It is also impossible to find obstacles or operators that may appear in different positions or tracks around the lift carrier in time. Thus there also exists a certain security risk.

Summary of the Invention

The technical problem to be solved by the present invention is to provide an automatic lift carrier with higher accuracy, security and automation.

In order to solve the above technical problem, the present invention proposes an automatic lift carrier, including a supporting frame provided with a moving mechanism, a lifting rack mounted on the supporting frame, a driving mechanism for driving the lifting rack to move up or down, at least one bearing mechanism arranged on the lifting rack, and a control system. The driving mechanism comprises two first motors each having a frequency inverter, driving wheels that are arranged at a right side and a left side of the supporting frame respectively, and at least one cable assembly connecting the driving wheels with the lifting rack. The driving wheels are each connected for power transmission with an output end of a corresponding first motor through a coupling, and the output end of each of the first motors has a first encoder. For driving the lifting rack to move up or down, the control system sends out two sets of identical pulse signals to input ends of two frequency inverters, which each have an output end connected with a corresponding first motor, and output signals of the first encoders are fed to respective frequency inverters as return signals, whereby the return signals are compared with input pulse signals by means of controllers in the frequency inverters, so that input to the frequency inverters and output from the frequency inverters to the first motors can be consistent with each other through adjustment.

Two driving wheels are arranged in tandem on an upper portion of the supporting frame at each of a right side and a left side thereof, and said two first motors are respectively arranged at a front portion and a rear portion of the supporting frame, wherein each of the first motors has a right and a left output ends, which are respectively connected for power transmission with a driving wheel arranged at the right side of the supporting frame and a driving wheel arranged at the left side thereof.

The lifting rack has two level meters respectively arranged at both sides thereof, and during a process of the lifting rack moving up and down, the control system continuously reads horizontal parameters generated by said two level meters, wherein when the horizontal parameters exceed a set value, the control system adjusts speeds of the frequency inverters, so that the horizontal parameters generated by said two level meters are less than the set value, in order to control the horizontal level at both sides of the lifting rack.

The driving wheels at both sides are each provided with a second encoder directly connected to a respective coupling, and during the process of the lifting rack moving up and down, the control system continuously compares parameters generated by two second encoders, wherein when a difference between the parameters exceed a set value, the control system, according to its logic setting, sends out an alarm signal to stop the lift carrier, or adjust the speeds of the frequency converters until the difference is less than the set value.

The cable assembly includes first driven wheels that are arranged on the upper portion of the supporting frame at the right side and the left side thereof respectively, second driven wheels that are arranged at the right side and the left side of the lifting rack, a steering wheel arranged beside the first driven wheels, and a cable, wherein the cable is connected at one end thereof to a side of the lifting rack, and then sequentially passes the first driven wheel, the second driven wheel, and the driving wheel that are

all arranged at the same side of the lifting rack, and finally extends outward after passing the steering wheel.

The cable assembly further includes a counter weight, a plurality of third driven wheels mounted on the upper portion of the supporting frame at the right and left sides thereof, and a plurality of fourth driven wheels mounted on the counter weight below, wherein the cable extending from the steering wheel is connected to the supporting frame after passing through the third driven wheels and the fourth driven wheels.

The cable is a double-row metal chain, and the first driven wheels, the second driven wheels, the driving wheels, the steering wheel, the third driven wheels and the fourth driven wheels each have a structure of double-row sprocket.

The supporting frame is provided with a vertical rail, which is in slide engagement with a sliding groove arranged on the lifting rack.

A protective net is fixedly provided at a position of the lifting rack where the vertical rail and the sliding groove are in engagement with each other, and also at a position where the cable is connected with the lifting rack.

The supporting frame is formed as a rectangular frame.

The moving mechanism includes rollers arranged at a bottom of the supporting frame, and second motors for controlling rotation of the rollers, wherein each roller has a rotating shaft connected with a third encoder.

A pair of area sensors is vertically arranged at respectively inner right and left sides of the supporting frame, for detecting a height of article to be carried and a height of the article to be removed.

Ultrasonic sensors are arranged at both sides of a bottom of a front end and a rear end of the lift carrier.

A two-dimensional laser scanner is arranged on the upper portion of the supporting frame at a position below an upper limit position of the lifting rack.

Four pairs of thru-beam sensors, each pair including an upper thru-beam sensor and a lower, opposite thru-beam sensor, are mounted on a top portion and a bottom portion of four inner corners of the lift carrier.

The lifting rack includes two horizontal beams, a right one and a left one, and two or more longitudinal connecting bars for connecting said two horizontal beams, wherein the bearing mechanism is disposed on said two horizontal beams.

Four bearing mechanisms are arranged on a front portion and a rear portion of said two horizontal beams respectively, wherein each bearing mechanism includes a bearing arm, and a third motor for controlling the bearing arm to extend forward or retract backward.

A monitoring probe is arranged at each of a front end and a rear end of the upper portion of the supporting frame, and at each of the right side and the left side of the lifting rack.

The lift carrier further comprises a console connecting with the control system, the console being provided with a display and an operation button.

Compared with the prior arts, the automatic lift carrier according to the present invention has improved performances in terms of safety and controllability. The driving mechanism adopts two motors to drive the cable assemblies so as to move the

lifting rack up and down. The output end of each motor has an encoder, so that asynchronization between motors can be effectively reduced. In addition, frequency inverters have been used to control the motors, so that acceleration can be provided in the startup stage to improve the working efficiency of the lift carrier. The frequency converter can further effectively prevent the occurrence of jitter during the startup and stop stages of the motors, so that the movement of the lift carrier is more stable and smooth.

Moreover, a level meter is arranged at each side of the lifting rack, and an encoder is arranged on each driving wheel. With the level meter and the encoder, the horizontal level of the lifting rack can be automatically adjusted through the control system when there is asynchronization between two motors or the lifting rack is tilted. Therefore, the article to be conveyed can be prevented from being titled, which is very important to the operation and safety of the lift carrier.

Further, the automatic lift carrier according to the present invention is also provided with area sensors, ultrasonic sensors, two-dimensional laser scanners, thru-beam sensors, monitoring probes, or the like, by means of which obstacles in the working area of the lift carrier can be detected. In this manner, safety is greatly improved, and accidents can be reduced. In addition, the control of the lift carrier is easy, whereby automatic operation of the lift carrier can be essentially achieved, thus improving the working efficiency. With safety ensured, the accuracy of the lift carrier is also greatly enhanced. For example, the error for back and forth movement is less than 50 mm, while the error for up and down movement is less than 20 mm.

Brief Description of the Drawings

Fig. 1 schematically shows the structure of an automatic lift carrier according to the present invention;

Fig. 2 is an exploded view of a supporting frame;

Fig. 3 is an exploded view of a top frame member of the supporting frame;

Fig. 4 schematically shows the structure at a right or left top frame beam of the supporting frame;

Fig. 5 schematically shows the structure of a lifting rack;

Fig. 6 is an exploded view of a horizontal beam arranged at a right side or a left side of the lifting rack;

Fig. 7 schematically shows the structure of a cable assembly;

Fig. 8 schematically shows the structure of the supporting frame with a two-dimensional laser scanner mounted thereon;

Fig. 9 schematically shows the structure of the supporting frame with thru-beam sensors mounted thereon;

Fig. 10 schematically shows the structure of a bearing mechanism; and

Fig. 11 schematically shows the structure of a console.

Detailed Description of the Embodiments

The present invention will be described in further detail with reference to the embodiments as shown in the accompanying drawings.

As shown in Fig. 1, the automatic lift carrier according to the present invention

mainly comprises: a supporting frame 2 provided with a moving mechanism 1, a lifting rack 3 mounted on the supporting frame 2, a driving mechanism for driving the lifting rack 3 to move upward or downward, a bearing mechanism 5 arranged on the lifting rack 3, and a control system.

The supporting frame 2 is designed, in terms of shape and size, depending on the shape and size of the article to be handled. In the present embodiment, the automatic lift carrier according to the present invention is used for carrying building templates. Therefore, as shown in Figs. 1 and 2, the supporting frame 2 is designed as a square frame structure, which is mainly formed by a top frame member 21 horizontally disposed at the top of the supporting frame 2, and two side frame members 22 vertically disposed at the right and left sides thereof respectively and both connected to the top frame member 21. Each of the side frame members 22 includes a front column 221 and a rear column 221, and horizontal bars and diagonal bars for connecting said two columns 221. As shown in Fig. 3, a top frame beam 211 is disposed at each of the right and left sides of the top frame member 21, and longitudinal and transverse horizontal bars and diagonal bars are arranged to connect the top frame beams 211 at the right and left sides.

The moving mechanism 1 is arranged at the bottom of each of four corners of the supporting frame 2, and includes a roller 11, and a second motor 12 for controlling the rotation of the roller 11. Further, the roller 11 has a rotating shaft connected with a third encoder, so that the distance traveled by the lift carrier can be measured accurately. By means of the data fed back by the third encoder, it can be determined whether the lift carrier has reached its designated position.

As shown in Fig. 5, the lifting rack 3 includes a right horizontal beam 33, a left horizontal beam 33, and two or more longitudinal connecting rods 34 for connecting said two horizontal beams 33. In this embodiment, three longitudinal connecting rods 34 are provided, and each of the longitudinal connecting rods 34 presents a C-shape

that is arched over the two horizontal beams 33. The end faces of each horizontal beam 33 are each provided with a vertical sliding groove 32. As shown in Fig. 2, the four vertical columns 221 arranged at the corners of the supporting frame 2 are each provided with a respective vertical rail 24. Therefore, four vertical rails 24 are slidably engaged with sliding grooves 32 provided at four corners of the lifting rack 3, respectively. In this manner, the lifting rack 3 can slide up and down along the vertical rails 24.

There may be provided with four bearing mechanisms 5, which are respectively arranged on the front and the rear portions of the two horizontal beams 33 disposed at the right and left sides of the lifting rack 3. The four bearing mechanisms 5 can synchronously move along with the up-and-down movement of the lifting rack 3. As shown in Fig. 10, each bearing mechanism 5 includes a bearing arm 51, a third motor 52, a belt 55, a synchronizing wheel 56, a bearing arm pivot shaft 57, and a mounting bracket 58. The bearing arm 51 is horizontally disposed, and has a middle portion fixedly coupled to the bearing arm pivot shaft 57. The synchronizing wheel 56 is synchronously coupled to the upper end of the bearing arm pivot shaft 57. The third motor 52 drives the synchronizing wheel 56 and the bearing arm pivot shaft 57 through the belt 55 to turn clockwise or counterclockwise, thereby correspondingly driving the bearing arm 51 to turn clockwise or counterclockwise so that the bearing arm 51 will extend forward or retract backward. The mounting bracket 58 is used to mount the bearing mechanism 5 on the horizontal beams 33.

As shown in Fig. 3, the driving mechanism includes at least one first motor 41, at least one driving wheel 42 mounted on the supporting frame 2, and at least one cable assembly connecting the driving wheel 42 with the lifting rack 3. There may be provided with two of first motors 41, each of which is provided with a frequency converter to control the respective motor. Therefore, acceleration can be provided at the startup stage, thus improving the working efficiency of the lift carrier. Moreover, the frequency converter can effectively prevent the occurrence of jitter during the

startup and stop stages of the motor, so that the movement of the lift carrier is more stable and smooth. Said two first motors 41 are respectively installed at positions between the front end portion and the rear end portion of the top frame member 21, and each of the first motors 41 is provided with two output ends, which are each provided with a first coder. There may be provided with four driving wheels 42, which are respectively installed at the front and the rear portions of each of two top frame beams 211. The four driving wheels 42 are respectively connected via four couplings 44 to four output ends of the two first motors 41 for power transmission. The two first motors 41 drive the four driving wheels 42 into rotation through the couplings 44, and the four driving wheels 42 pull the lifting rack 3 through the cable assembly to slide it up or down.

There may be provided with four cable assemblies, which are respectively arranged at four corners adjacent to the four columns 221. As shown in Fig. 7, each cable assembly mainly includes: a first driven wheel 431, a second driven wheel 432, a steering wheel 433, and a cable 434. Among others, the first driven wheel 431 is mounted on the top frame beam 211 at a position adjacent to the driving wheel 42, and the second driven wheel 432 is mounted on the horizontal beam 33 of the lifting rack 3 at a position under the first driven wheel 431 and the driving wheel 42. The cable 434 is connected to the horizontal beam 33 of the lifting rack 3 at one end thereof, and then sequentially passes the first driven wheel 431, the second driven wheel 432, and the driving wheel 42 that are all arranged at the same side, and finally extends outward after passing the steering wheel 433. When the driving wheel 42 rotates in the forward or reverse direction, the cable 43 will be moved in the forward or reverse direction, thus pulling the lifting rack 3 to move up or down. Here, the first driven wheel 431 and the second driven wheel 432 are provided to increase the load capacity of each cable assembly. Accordingly, each cable assembly can provide three times of load capacity through pulling the lifting rack 3 with three cables. However, the first motor 41 should also reach a three-time speed to meet the lifting speed requirement.

In order to prevent the phenomenon that the cable 434 extending from the steering wheel 433 is knotted due to accumulation, each cable assembly further includes: a counter weight 435, two third driven wheels 436 mounted on the upper portion of the supporting frame 2, and two fourth driven wheels 437 mounted on the counter weight 435 below. The cable 434 extending from the steering wheel 433 is connected to the supporting frame 2 after passing through the third and fourth driven wheels 436 and 437. Under the self-weight of the counter weight 435, the cable 434 extending from the steering wheel 433 will be straightened tautly, thereby avoiding the knotting thereof. Another function of the counter weight 435 is to reduce the energy consumption of the motor during the accelerating stage, in particular when the load is just lifted or the motor is under a slow speed with a load.

In order to prevent the counter weight 435 from being disturbed by foreign objects, such as a worker's body or the like, during lifting, and thus avoid accident, a vertical protective shell 23 having a square shape is provided at a position where the counter weight 435 is located, as shown in Figs. 1 and 7. Therefore, the counter weight 435, the third driven wheels 436, the fourth driven wheels 437, and the cable 434 extending around the driven wheels are all enclosed in an inner cavity of the protective shell 23.

In this embodiment, as shown in Fig. 6, the cable 434 may be a double-row metal chain. Correspondingly, the first driven wheel 431, the second driven wheel 432, the driving wheel 42, the steering wheel 433, the third driven wheel 436 and the fourth driven wheel 437 can all have a structure of double-row sprocket. The double-row chain can increase safety, since one chain can still provide protection in the event that the other chain is broken.

In order to prevent the conveyed template from being tilted and thus improve safety, the automatic lift carrier according to the present invention adopts an active

mode and a passive mode to ensure that the lifting rack 3 is kept horizontal when it is moving up or down.

In the active mode, the synchronous operation of two first motors 41 is controlled through the cooperation of the control system and the frequency converters. According to the present invention, the control system is capable of outputting two-axis synchronization signals to two first motors 41, and the frequency converters are each capable of controlling the respective motor through a return signal. When the control system receives a command, it outputs two sets of identical pulse signals to the input ends of two frequency converters respectively, which have their output ends connected to respective first motors 41. The output signal of each of the first encoders is sent out to a corresponding frequency inverter as a return signal. Therefore, by means of the controller in the frequency inverter, the return signal is compared with the input pulse signal, so that input to the frequency inverters and output from the frequency inverters to the first motors can be consistent with each other through adjustment. Since the control system outputs two sets of signals that are totally identical to each other, the operations of the two first motors 41 are almost the same.

Because the horizontal level of the lifting rack 3 and the bearing arm 51 mounted thereon is very important to the operation and safety of the lift carrier, the above-mentioned active mode can, in theory, meet the requirements on the operation of the lift carrier. However, in order to provide safer and more stable operation, the invention further employs a passive mode of detecting the horizontal level of the lifting rack 3 through a level meter and an encoder. As shown in Figs. 6 and 8, a level meter 31 is arranged in the middle portion of each of the horizontal beams 33 disposed at the right and left sides of the lifting rack 3. During the up-and-down movement of the lifting rack 3, the control system continuously reads the horizontal level parameters generated by two level meters 31. When the horizontal level parameters exceed a set value, the control system would adjust the speed of the frequency converters so that the parameters of the level meters 31 are less than the set

value, thus controlling the horizontal level at both sides of the lifting rack 3. As shown in Fig. 4, the four driving wheels 42 at the right and left sides are each provided with a second encoder 45 directly connected to a corresponding coupling 44. During the process that the lifting rack 3 is moving up and down, the control system continuously compares the parameter of one of the second encoders 45 with the parameter of the other of the second encoders 45. When the difference of the parameters between two sides exceeds a set value, the control system will, according to its logic setting, send out an alarm signal to stop the lift carrier, or adjust the speed of the frequency converters so that said difference is less than the set value. Accordingly, the horizontal level adjustment of the lifting rack 3 can be achieved. In addition, a comparison between the detection by the level meter and that by the encoder can be also performed. If the difference between the two detections exceeds the set value, the lift carrier will be immediately stopped and an alarm signal will be sent out. Furthermore, the second encoders 45 can also accurately detect whether the lifting rack 3 reaches a specified height, thereby improving the accuracy of the lift carrier.

As shown in Fig. 2, a pair of area sensors 7 is vertically arranged at respectively inner sides of the middle portions of the right and left side frame members 22 of the supporting frame 2, for detecting the height of the article to be carried and the height of the article to be removed. Through the pair of area sensors 7, the number of stacked templates can be detected, and thus the height of the stacked templates can be known in time. Therefore, the lift carrier can automatically recognize the height of the templates, and then handle the templates based on the information. In this manner, the working efficiency is greatly improved.

During operation, the moving mechanism 1 drives the supporting frame 2 to the position where the template to be conveyed is located. The driving mechanism drives the lifting rack 3 to move downward, until the bearing arms 51 of the bearing mechanisms 5 are lower than the bottom surface of the template. The third motors 52 drive the bearing arms 51 to extend forward, and then the first motors 41 drive the

lifting rack 3, with templates mounted thereon, through the driving wheels 42 and the cable assemblies, to the upper limit position. Subsequently, the moving mechanism 1 drives the supporting frame 2 to the position where the template is to be removed. The lifting rack 3 descends, and places the conveyed template on the template being stored there already. Then, the lifting rack 3 is further lowered by a certain distance, and the bearing arms 51 are retracted backward. After that, the lift carrier is again moved to the template to be conveyed, so as to perform a next round of carrying operation.

As shown in Fig. 6, a proximity switch sensor 35 is mounted near each of the bearing arms 51 on each horizontal beam 33, for detecting whether the corresponding bearing arm 51 is extended forward or retracted backward. The bottom surface of each horizontal beam 33 is further provided with a photoelectric sensor 36. The sensing range of the photoelectric sensor 36 is in the same plane as the top surface of a corresponding bearing arm 51, for detecting and judging whether the top surface of said bearing arm 51 is already under the bottom surface of the template to be conveyed so that it can extend forward. Further, as shown in Fig. 10, a small proximity switch sensor 53 is disposed in a recess formed in the surface of each bearing arm 51, for sensing whether the bearing arm 51 is successfully loaded with the template. The bottom surface of each bearing arm 51 is further provided with a photoelectric sensor 54, for detecting whether the bearing arm 51 is close to the top surface of the stored template when the bearing arm 51 is descending after the removal of the conveyed template. In this manner, the lifting rack 3 and the bearing arms 51 can be prevented from being excessively lowered to collide with the stored templates.

In addition, the lift carrier according to the present invention is further provided with a variety of safety detecting devices. Thus the lift carrier is greatly improved in terms of safety.

As shown in Fig. 1 and Fig. 5, a protective net 6 is fixedly provided at a position,

where the vertical rail 24 and the sliding groove 32 are engaged with each other, on each of the horizontal beams 33 at the left and right sides of the lifting rack 3, and also at a position where the cable 434 is connected with each of the horizontal beams 33. The protective nets can prevent the worker's hands from injury due to touch with moving members.

As shown in Fig. 1, an ultrasonic sensor 81 is arranged on each side of the bottom of each of the front and rear ends of the lift carrier. In this embodiment, the ultrasonic sensors 81 are respectively installed at four corners of the outermost periphery of the lift carrier, that is, at the corner positions where the moving mechanisms 1 are respectively located, for detecting whether there is an obstacle on the moving track. When there is an obstacle or a worker that approaches the lift carrier in the forward direction thereof, the ultrasonic sensors will send out a starting signal. Upon receipt of the signal, the control system will control the frequency inverters to stop the second motors 12, so that the lift carrier will stop moving forward, thus improving the safety of the lift carrier. The lift carrier can continue the unfinished operation when the obstacle leaves away.

As shown in Fig. 8, a two-dimensional laser scanner 82 is arranged on the upper portion of the supporting frame 2 at a position below the upper limit position of the lifting rack 3, and the main function thereof is to detect whether there is an obstacle at a higher level before or after the lift carrier when it moves forward or backward. When an obstacle is detected, the two-dimensional laser scanner 82 will send out a signal to the control system, which controls the lift carrier to stop moving, issues an alarm to notify the operator, or controls the lift carrier to move after the obstacle leaves away.

As shown in Fig. 9, four pairs of thru-beam sensors 83, each pair including an upper one and a lower, opposite one, are mounted on the top and bottom of four inner corners of the lift carrier, and are mainly used to detect whether the object on the

template to be conveyed extends beyond the outer periphery of the template to influence on the operation of the lifting rack 3. When an obstacle blocks the infrared rays emitted from the thru-beam sensors 83, this indicates that there is an object on the template to be conveyed extends beyond the template, so that the thru-beam sensors 83 cannot receives response signal any more. Therefore, the control system will control the lift carrier to stop moving forward and send out an alarm signal. Since the thru-beam sensors 83 are installed at the foremost and rearmost positions and thus are still at a distance from the lifting rack 3, the object extending beyond the range of the template will not damage the lifting rack 3 after the lift carrier is stopped.

As shown in Fig. 1 and Fig. 6, the front end and the rear end of the top frame member 21 of the supporting frame 2 and the horizontal beams 33 at the right and left sides of the lifting rack 3 are each mounted with a monitoring probe 84, which can monitor whether there is a staff member in the moving direction of the lift carrier, and also monitor the working state of the bearing arms 51. When an obstacle or a moving staff enters the working area of the lift carrier, the monitoring probe will send out an alarm signal, so that the lift carrier will stop working.

A console 91 connected to the control system may also be provided beside the working area of the lift carrier. As shown in Fig. 11, the console 91 is provided with a display 911 and an operation button 912, and thus constitutes a control center of the lift carrier. The monitoring state of the four monitoring probes 84 can be observed through the display 911 of the console 91. With the operation button 912 on the control panel, the lift carrier can be freely switched between the manual mode and the automatic mode. With the touch screen on the control panel, the operation states of the first motors 41 and the second motors 12 can be monitored, and the lift carrier can reach its designated position. The console is simple and easy to use, and it is also convenient to know the production status of the lift carrier in time.

As shown in Figs. 1 and 9, a main electric box 92 is fixed on the outer side of

one side frame member 22 of the supporting frame 2. An ultrasonic sensor is also mounted on the main electric box 92.

The foregoing description is merely illustrative of preferred embodiments of the present invention, and is not intended to limit the present invention. Various changes and modifications may be made by those skilled in the art. Any modifications, equivalent substitutions, improvements, and the like within the spirit and principles of the present invention are intended to be included within the scope of the present invention.

AMENDED CLAIMS

1. An automatic lift carrier, including a supporting frame (2) provided with a moving mechanism (1), a lifting rack (3) mounted on the supporting frame (2), a driving mechanism for driving the lifting rack (3) to move up or down, at least one bearing mechanism (5) arranged on the lifting rack (3), and a control system,

characterized in that the driving mechanism comprises two first motors (41) each having a frequency inverter, driving wheels (42) that are arranged at a right side and a left side of the supporting frame (2) respectively, and at least one cable assembly connecting the driving wheels (42) with the lifting rack (3), the driving wheels (42) each being connected for power transmission with an output end of a corresponding first motor (41) through a coupling (44), and the output end of each of the first motors (41) having a first encoder;

wherein for driving the lifting rack (3) to move up or down, the control system sends out two sets of identical pulse signals to input ends of two frequency inverters, which each have an output end connected with a corresponding first motor (41), and output signals of the first encoders are fed to respective frequency inverters as return signals, whereby the return signals are compared with input pulse signals by means of controllers in the frequency inverters, so that the input and output can be consistent with each other through adjustment; and

wherein the cable assembly includes first driven wheels (431) that are arranged on an upper portion of the supporting frame (2) at a right side and a left side thereof respectively, second driven wheels (432) that are arranged at a right side and a left side of the lifting rack (3), a steering wheel (433) arranged beside the first driven wheels (431), and a cable (434), wherein the cable (434) is connected at one end thereof to a side of the lifting rack (3), and then sequentially passes the first driven wheel (431), the second driven wheel (432), and the driving wheel (42) that are all arranged at the same side of the lifting rack (3), and finally extends outward after passing the steering wheel (433).

2. The automatic lift carrier according to claim 1, characterized in that two driving wheels (42) are arranged in tandem on an upper portion of the supporting frame (2) at each of a right side and a left side thereof, and said two first motors (41) are respectively arranged at a front portion and a rear portion of the supporting frame (2), wherein each of the first motors (41) has a right and a left output ends, which are respectively connected for power transmission with a driving wheel (42) arranged at the right side of the supporting frame (2) and a driving wheel (42) arranged at the left side thereof.

3. The automatic lift carrier according to claim 2, characterized in that the lifting rack (3) has two level meters (31) respectively arranged at both sides thereof, and during a process of the lifting rack (3) moving up and down, the control system continuously reads horizontal parameters generated by said two level meters (31), wherein when the horizontal parameters exceed a set value, the control system adjusts speeds of the frequency inverters, so that the horizontal parameters generated by said two level meters (3) are less than the set value, in order to control the horizontal level at both sides of the lifting rack (3).

4. The automatic lift carrier according to claim 3, characterized in that the driving wheels (42) at both sides are each provided with a second encoder (45) directly connected to a respective coupling (44), and during the process of the lifting rack (3) moving up and down, the control system continuously compares parameters generated by two second encoders (45), wherein when a difference between the parameters exceed a set value, the control system, according to its logic setting, sends out an alarm signal to stop the lift carrier, or adjust the speeds of the frequency converters until the difference is less than the set value.

5. The automatic lift carrier according to claim 1, characterized in that the cable assembly further includes a counter weight (435), a plurality of third driven wheels (436) mounted on the upper portion of the supporting frame (2) at the right and left

sides thereof, and a plurality of fourth driven wheels (437) mounted on the counter weight (435) below, wherein the cable (434) extending from the steering wheel (433) is connected to the supporting frame (2) after passing through the third driven wheels (436) and the fourth driven wheels (437).

6. The automatic lift carrier according to claim 5, characterized in that the cable (434) is a double-row metal chain, and the first driven wheels (431), the second driven wheels (432), the driving wheels (42), the steering wheel (433), the third driven wheels (436) and the fourth driven wheels (437) each have a structure of double-row sprocket.

7. The automatic lift carrier according to claim 1, characterized in that the supporting frame (2) is provided with a vertical rail (24), which is in slide engagement with a sliding groove (32) arranged on the lifting rack (3).

8. The automatic lift carrier according to claim 7, characterized in that a protective net (6) is fixedly provided at a position of the lifting rack (3) where the vertical rail (24) and the sliding groove (32) are in engagement with each other, and also at a position where the cable (434) is connected with the lifting rack (3).

9. The automatic lift carrier according to any one of claims 1 to 4, characterized in that the supporting frame (2) is formed as a rectangular frame.

10. The automatic lift carrier according to claim 9, characterized in that the moving mechanism (1) includes rollers (11) arranged at a bottom of the supporting frame (2), and second motors (12) for controlling rotation of the rollers (11), wherein each roller (11) has a rotating shaft connected with a third encoder.

11. The automatic lift carrier according to claim 9, characterized in that a pair of area sensors (7) are vertically arranged at respectively inner right and left sides of the

supporting frame (2), for detecting a height of article to be carried and a height of article to be removed.

12. The automatic lift carrier according to claim 9, characterized in that ultrasonic sensors (81) are arranged at both sides of a bottom of a front end and a rear end of the lift carrier.

13. The automatic lift carrier according to claim 9, characterized in that a two-dimensional laser scanner (82) is arranged on the upper portion of the supporting frame (2) at a position below an upper limit position of the lifting rack (3).

14. The automatic lift carrier according to claim 9, characterized in that four pairs of thru-beam sensors (83), each pair including an upper thru-beam sensor and a lower, opposite thru-beam sensor, are mounted on a top portion and a bottom portion of four inner corners of the lift carrier.

15. The automatic lift carrier according to claim 9, characterized in that the lifting rack (3) includes two horizontal beams (33), a right one and a left one, and two or more longitudinal connecting bars (34) for connecting said two horizontal beams (33), wherein the bearing mechanism (5) is disposed on said two horizontal beams (33).

16. The automatic lift carrier according to claim 15, characterized in that four bearing mechanisms (5) are arranged on a front portion and a rear portion of said two horizontal beams (33) respectively, wherein each bearing mechanism (5) includes a bearing arm (51), and a third motor (52) for controlling the bearing arm (51) to extend forward or retract backward.

17. The automatic lift carrier according to any one of claims 1 to 4, characterized in that a monitoring probe (84) is arranged at each of a front end and a rear end of the

upper portion of the supporting frame (2), and at each of the right side and the left side of the lifting rack (3).

18. The automatic lift carrier according to any one of claims 1 to 4, characterized in that the lift carrier further comprises a console (91) connecting with the control system, the console (91) being provided with a display (911) and an operation button (912).