

Research on Ship Weld Inspection Device

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Abstract

Welding is an important processing method in the shipbuilding industry. Weld inspection quality inspection is a heavy pressure inspection process before the ship launches. Because welding seam inspection has many safety hazards in high-altitude operations, the fatigue of high-altitude operations affects the detection accuracy of personnel. In order to solve the safety problems of high-altitude welding seam inspection in the construction of the engine room of the ocean-going LNG dual-fuel tanker chemical tanker, this paper studies and proposes a variety of safety inspection schemes to replace the traditional welding seam inspection.

Keywords

Robots; weld inspection; Chebyshev connecting rod; image recognition.

1. INTRODUCTION

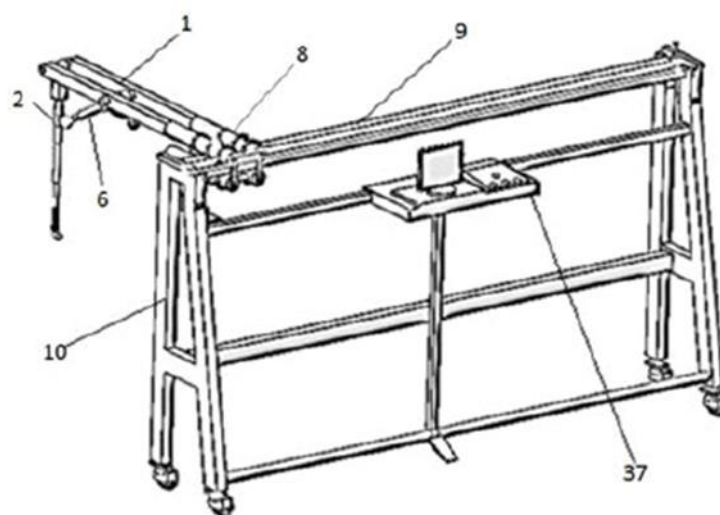
The construction of large ships is mainly constructed in sections. The structure parts of the hull sections need to be strictly inspected. The quality of welding between the hull steel plates. The weld is an important connection part between the ship construction structure. For problems such as edges, slag inclusions, pores, and collapse, the welds between the plate links are prone to gaps. Ships sailing in the water are subjected to extreme water pressure, and small welds pose a great threat to the safety of ships' navigation.

At present, the methods of weld inspection are mainly magnetic particle, penetration and conventional ultrasonic inspection. These methods are time-consuming and labor-intensive, which are not conducive to rapid automatic inspection [1]. At the same time, the ship's welding seam inspection equipment is large in size and the quality of the inspection equipment is heavier. There is a risk of people falling from high altitude when climbing the section of the hull during high-altitude inspections, and the angle between the head of the instrument and the welding seam is detected by manual backpacks and handheld devices. There is a detection error. Therefore, traditional inspection personnel adopt the welding seam detection method of high-altitude operation, which is very inconvenient for personnel to operate, and high-altitude operation is also easy to cause injury accidents, and the safety hazard is very harmful to the sustainable development of the shipbuilding industry. A new type of ship weld inspection device is an important development direction for weld inspection.

2. SOLUTION

Professor Hu of Shanghai Maritime University published a patent for a suspended hull welding seam ultrasonic inspection device, as shown in Figure 1. The automatic telescopic rod controlled by a stepping motor is used to flexibly adjust the length of the telescopic rod mechanism as needed to control the ultrasonic probe and the hull. Angle and distance to adapt

to the changes of the hull surface at different parts. The horizontal rod and track fixing device are adopted, and the horizontal rod is pulled by the stepping motor to move horizontally, which increases the detection range of the horizontal weld seam of the hull. The upside-down wide-angle camera displays the relative position of the ultrasonic probe and the hull surface on the display screen, which is convenient for inspectors to intuitively understand the inspection situation on the spot. By operating the corresponding stepping motor of the operating platform control panel on the ship's deck, the inspector can conveniently control the position of the ultrasonic probe, and record and save the inspection data of the hull welds, which is safe and convenient to operate.

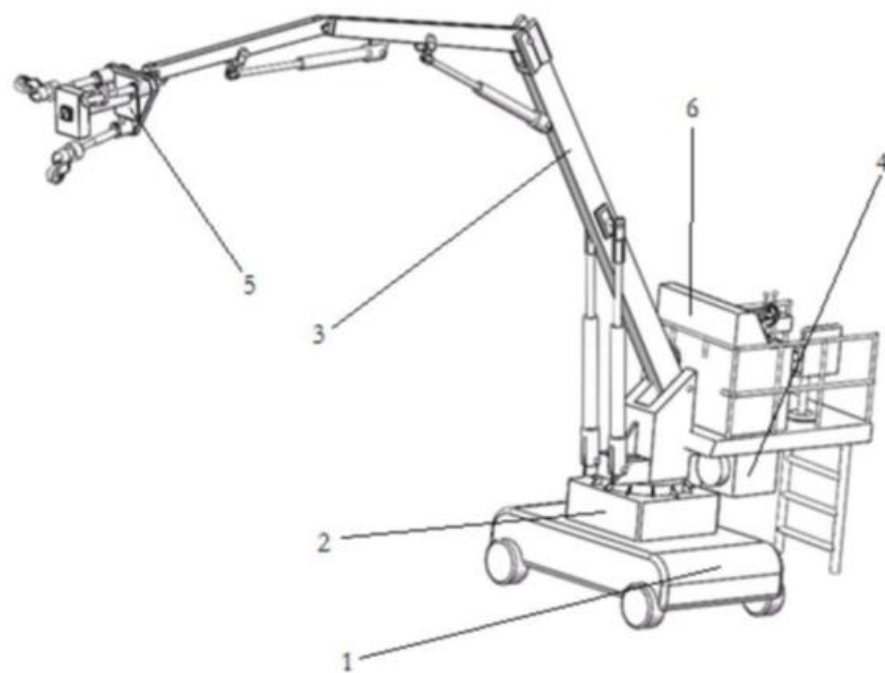


1. Horizontal hydraulic device 2. Welding seam inspection head 6. Detection angle adjustment hydraulic device 8. Vertical hydraulic adjustment device 9. Sliding guide rail
10. Inspection bracket 37. personnel control and display platform

Figure 1. Suspended hull weld ultrasonic inspection device [2]

Although the weld inspection rack can solve the safety problem of personnel high-altitude inspection, the working environment of the inspection site is limited. The welded hull sections need to be transported to the weld inspection rack for inspection operations. The size determines the maximum size of the detected hull section. Therefore, further research on the welding seam detection device needs to have good flexibility in maintaining the original safety angle of the welding seam detection, and it is suitable for different inspection environments.

The research team proposed a boom-type hull section weld inspection vehicle, which includes an electric trolley, a fixed chassis, a hydraulic drive mechanism, an adaptive detection unit, a sliding counterweight, and an operation console; the fixed chassis is set on the electric trolley. The hydraulic drive machine includes several sections of mechanical arms and corresponding hydraulic rods, which can adjust the pitch angle and/or the length of the extended arm, so that the adaptive detection unit connected to the last section of the mechanical arm through a universal joint can achieve predetermined detection. Position so that the head of the testing equipment is centered on the weld to be tested at the hull. The angle and height of the inspection equipment can be adjusted conveniently, avoiding the hazard of high-altitude operation of the hull section weld inspection, and improving the efficiency of ship inspection.

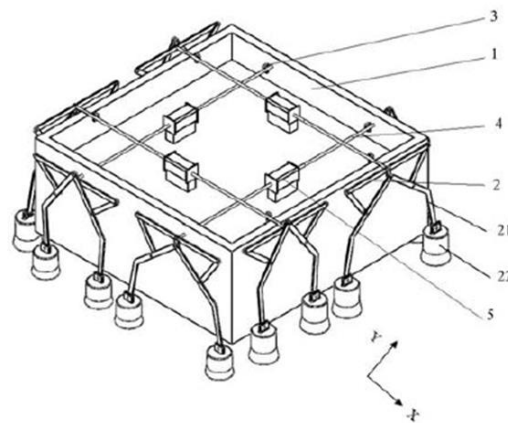


1 Electric detection trolley 2. Hydraulic rotating device 3. Hydraulic telescopic arm
4. Sliding counterweight device 5. Adaptive detection head 6. Operation table

Figure 2. Boom type hull section weld inspection vehicle [3]

The design of the inspection trolley is in line with the traditional inspection safety problems. The trolley is moved to inspect the welds of large hulls, avoiding wasting the transportation time of the hull sections, and the arm length of the inspection small fleet is still limited to the inspection of super large ships. In addition, the cost of the ship welding seam inspection car is relatively high. At the beginning of the design, the cost of the actual application and the replacement of the electric car were considered. However, the actual problem is still not solved. Therefore, a safe and efficient inspection is required while also considering To the cost of practical application.

The research proposes a wall-climbing ship welding seam detection robot by combining the welding seam detection device with the robot structure, which mainly includes: the robot shell; the detector for detecting the welding seam; several sets of Chebyshev linkage walking mechanisms, including the Chebyshev The Schiff link and the two electromagnetic walking feet that move alternately. When the walking feet are energized, they are attracted to the surface of the hull by electromagnetic force, and move when the power is off; several phase cams control the walking feet to be powered on or off; several steps into the motor, as the power source; several transmission shafts, the stepper motor drives the Chebyshev connecting rod to rotate through the transmission shafts to drive the walking foot to move, the robot moves, after the robot moves in place, press the "fix" button on the remote control, After the robot is attached to the surface of the hull and the "inspection" button is pressed, the detector detects the weld. The invention greatly reduces the danger caused by high-altitude operations and greatly improves the inspection efficiency of ships. The detection device can be moved according to needs to detect welds at different positions, with simple structure and convenient operation.



1. Robot shell 2. Chebyshev connecting rod 3. Control walking foot device 5. Robot power source 21 Electromagnetic walking foot 22 rounds of current and power-off device

Figure 3. Wall-climbing ship welding seam inspection robot [4]

This wall-climbing ship weld inspection robot uses magnetolectric adsorption technology and Chebyshev linkage to form a hull weld inspection robot. The ground operator controls the inspection robot on the ship surface or hull section through a handheld remote control. The surface is moved to complete the experience of the welding seam of the hull; the present invention greatly reduces the danger caused by high-altitude operations and greatly improves the inspection efficiency of the ship. The detection device can be moved as needed to detect the welding seam at different positions. The structure is simple and the operation is convenient. . Different from the magnetic crawler robot, the Chebyshev connecting rod robot can climb the complex welding environment, better fit the weld inspection, and provide a new prototype for the future weld inspection robot.

3. PROSPECT

With the rapid development of robots and artificial intelligence applications in the future [5], future weld detection technology solutions tend to be unmanned and high-precision. The development of image recognition technology can replace the human eye's recognition of weld quality, The high efficiency and high precision of seam detection is the basic guarantee for future LNG ship construction. Later, the image recognition of the weld inspection robot and the independent completion of the inspection work are the future research directions.

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