

AN UNDERWATER THRUSTER TILTING DEVICE

Technical Field

[0001] The present invention relates to the technical field of underwater intelligent equipment, and more specifically to an underwater thruster tilting device.

Background

[0002] With the increasing demand for marine resources development, marine scientific research and military defense, the application of underwater intelligent equipment in these fields has become more and more extensive. The maneuverability and controllability of underwater intelligent equipment is one of the key factors to realize its function. In this context, as the main equipment to provide power and control, the performance and control mode of underwater thrusters have a decisive impact on the operating efficiency and operational capability of the entire underwater intelligent equipment.

[0003] However, traditional underwater thrusters usually adopt fixed Angle thrust output, which limits their mobility and flexibility in complex underwater environments, which is not conducive to the control of underwater intelligent equipment and has poor adaptability.

[0004] Therefore, providing an underwater thruster tilting device with improved controllability and adaptability is an urgent problem for technicians in this field.

Summary of the Invention

[0005] In view of this, the invention provides an underwater thruster tilting device to improve the maneuverability and operational efficiency of underwater intelligent equipment.

[0006] In order to realize the above purpose, the present invention provides an underwater thruster tilting device comprising: a fixed base plate, four rotatable support seats uniformly fixed on the fixed base plate, two first rotatable connectors rotatably connected to two rotatable support seats located at the rear of the fixed base plate, two second rotatable connectors rotatably connected to the other two rotatable support seats located at the front of the fixed base plate, a first rotatable connector shaft wherein both ends of the first rotatable connector shaft are rotatably connected with the two first rotatable connectors, a second rotatable connector shaft wherein both ends of the second rotatable connector shaft are rotatably connected with the two second rotatable connectors, a deceleration motor fixed on the fixed base plate, a first chain drive assembly and a second chain drive assembly. The underwater thruster tilting device has extended ends of each of the first rotatable connectors and each of the second rotatable connectors fixed with underwater thrusters, wherein an output shaft of the deceleration motor is connected with the first rotatable connector shaft through the first chain drive assembly, and the first rotatable connector shaft is connected with the second rotatable connector shaft through the second chain drive assembly.

[0007] By adopting the above technical scheme, the beneficial effects of the invention are as follows:

[0008] With the motor as the power source and the chain drive as the transmission mode, the tilt angle of the underwater thruster can be adjusted to change the thrust direction, achieve more accurate and flexible control, improve adaptability, and can synchronously control the four underwater thrusters to make them rotate in the same direction, and further improve the maneuverability and operational efficiency of the underwater intelligent equipment.

[0009] According to an embodiment of the invention, each underwater thruster is equipped with a first filter cover on its upper end and a second filter cover on its lower end.

[0010] According to an embodiment of the invention, both ends of the first rotatable connector shaft are rotatably connected to the two first rotatable connectors through a key connection, and wherein both ends of the second rotatable connector shaft are rotatably connected with the two second rotatable connectors through a key connection.

[0011] According to an embodiment of the invention, each underwater thruster includes a base threaded with each extended end of the first rotatable connector and each extended end of the second rotatable connector.

[0012] According to an embodiment of the invention, the deceleration motor is fixed on the fixed base plate through a motor fixed plate.

[0013] According to an embodiment of the invention, the first chain drive assembly comprises a first drive sprocket installed on an output shaft of the deceleration motor, a first driven sprocket installed on the first rotatable connector shaft, and an active chain, wherein the first drive sprocket is connected with the first driven sprocket through the active chain.

[0014] According to an embodiment of the invention, the second chain drive assembly comprises a second drive sprocket installed on the first rotatable connector shaft, a second driven sprocket installed on the second rotatable connector shaft, and a drive chain, wherein the second drive sprocket is connected with the second driven sprocket through the drive chain.

[0015] According to an embodiment of the invention, the active chain and the drive chain each includes two chains and two tensioners, and the two chains are connected by two tensioners respectively.

[0016] According to the above technical scheme, the invention discloses an underwater thruster tilting device. Compared with the prior art, the invention has the following beneficial effects:

- 1) Strong maneuverability enables the underwater vehicle to achieve steering and maneuverability by adjusting the thrust direction of the underwater thruster without changing its own direction, which greatly improves the flexibility and maneuverability of the underwater vehicle.
- 2) The inclination angle of the thruster can be precisely controlled, so as to achieve accurate adjustment of the attitude of the underwater vehicle. This is especially important for missions that require delicate operations in complex underwater environments.
- 3) By adjusting the inclination angle of the underwater thruster, the thrust can be used more effectively and the energy loss can be reduced, which helps to improve the energy efficiency ratio of the underwater vehicle and extend its working time underwater.
- 4) Can adapt to different underwater environments and operating requirements, whether in calm waters or in complex seabed terrain, can provide stable propulsion.
- 5) It can reduce the number of independent control equipment required for underwater vehicles and simplify the overall design of the system.
- 6) The direction of the thruster can be quickly adjusted in the event of obstacles or other emergencies, thereby avoiding collisions or reducing damage, and improving the safety of underwater vehicles.
- 7) Expanded the application range of underwater vehicles, enabling them to perform more types of tasks, such as underwater archaeology, submarine pipeline maintenance, and Marine resource exploration.

Brief Description of the Drawings

[0017] In order to more clearly state the technical scheme in the embodiment of the invention or the prior art, the following is a brief introduction of the drawings required to be used in the description of the embodiment or the prior art. Obviously, the drawings in the description below are only embodiments of the invention. For ordinary technicians in the field, without creative labor, Additional drawings may also be obtained based on the drawings provided.

[0018] Figure 1 is a schematic three-dimensional structural diagram of an underwater thruster tilting device provided by the present invention;

[0019] Figure 2 is a front view of an underwater thruster tilting device provided by the present invention; and

[0020] Figure 3 is a top view of an underwater thruster tilting device provided by the present invention.

Detailed Description

[0021] The following will be combined with the drawings in the embodiment of the invention, the technology in the embodiment of the invention.

[0022] The scheme is clearly and completely described, and it is obvious that the embodiments described are only a part of the embodiments of the invention and not all embodiments. Based on the embodiments of the invention, all other embodiments obtained by ordinary technicians in the field without making creative labor fall within the scope of protection of the invention.

[0023] As shown in Figure 1-3, the embodiment of the invention discloses an underwater thruster tilting device, which comprises a fixed base plate 1, four rotatable support seats 2, two first rotatable connectors 3, two second rotatable connectors 4, a first rotatable connector shaft 5, a second rotatable connector shaft 6, a deceleration motor 7, a first chain drive assembly 8 and a second chain drive assembly 9. The four rotatable support seats 2 are uniformly fixed on the fixed base plate 1, and the four rotatable support seats 2 are installed on the same plane. Two first rotatable connectors 3 are respectively mounted on two rotatable support seats 2 located at the rear side and rotationally connected. Two second rotatable connectors 4 are respectively mounted on two rotatable support seats 2 located on the front side and rotationally connected. An underwater thruster 10 is fixed at the extended end of each first rotatable connector 3 and each second rotatable connector 4. The two ends of the first rotatable connector shaft 5 are respectively fixed and mounted on two first rotatable connectors 3. The two ends of the second rotatable connector shaft 6 are respectively fixed and mounted on two second rotatable connectors 4. The deceleration motor 7 is fixed on the fixed base plate 1. The output shaft of the deceleration motor 7 is connected with the first rotatable connector shaft through the first chain drive assembly 8. The first rotatable connector shaft 5 and the second rotatable connector shaft 6 are connected through the second chain drive assembly 9. The chain drive has a certain elasticity, which can absorb and alleviate the impact force and vibration caused by changes in the underwater environment or the thruster load to a certain extent. The present invention takes the motor as a power source and chain drive as a mode of transmission, and can adjust the tilt angle of underwater thruster 10 to change the thrust direction to realize more accurate and flexible control, improve adaptability, and synchronously control four underwater thrusters 10 to make them rotate in the same direction, and further improve the maneuverability and working efficiency of underwater intelligent equipment.

[0024] In order to further optimize the technical scheme of the invention, a first filter cover 11 is installed on the upper part of each underwater thruster 10, and the corrosion-resistant materials such as 316L or 304 stainless steel are selected to prevent impurities and suspended substances in the water from entering the underwater thruster 10 and reduce the

pollution and wear inside the underwater thruster 10. It helps to maintain the working efficiency and performance of underwater thruster 10 and improves the safety and reliability of the entire underwater thruster tilting device. The lower part of each underwater thruster 10 is installed with a second filter cover 12, and the material is made of 316L or 304 stainless steel and other corrosion-resistant materials to prevent impurities and suspended objects in the water from entering the underwater thruster, reducing the pollution and wear inside the underwater thruster 10, and helping to maintain the working efficiency and performance of the underwater thruster 10. The safety and reliability of the whole underwater thruster tilting device are improved.

[0025] Specifically, both ends of the first rotatable connector shaft 5 are rotatably connected with two first rotatable connectors 3 through a key connection, and the first rotatable connectors 3 is concentrically distributed with the rotatable support seats 2. The two ends of the second rotatable connector shaft 6 are rotatably connected with two second rotatable connectors 4 through a key connection, and the second rotatable connector 4 is concentrically distributed with the rotatable support seats 2.

[0026] Specifically, the bases of the four underwater thrusters 10 are threaded with the extended ends of the two first rotatable connectors 3 and the extended ends of the two second rotatable connectors 4.

[0027] Specifically, the deceleration motor 7 is fixed on the fixed base plate 1 through the motor fixed plate 13, and the motor fixed plate 13 is connected with the deceleration motor 7 through a threaded connection, and then through a threaded connection or welding, and the frame of the underwater robot to be carried is fixed together.

[0028] Specifically, the deceleration motor 7 includes a motor and a motor reducer, the motor reducer is connected with the output shaft of the motor, the connection method can be connected by a key connection or a coupling connection, the motor reducer can convert the high-speed rotation of the motor into a lower speed and higher torque output to the first

drive sprocket, of course, the motor can be a DC motor, AC motor or a brushless motor. Providing the required power for the entire tilting unit, the use of motors can simplify the mechanical design and make the mechanical system more compact and efficient by direct drive or by using a reducer.

[0029] In particular, the first chain drive assembly 8 comprises a first drive sprocket 81, a first driven sprocket 82 and an active chain 83. The first drive sprocket 81 is mounted on the output shaft of the reduction motor 7. In the present embodiment, the first drive sprocket 81 is connected to the output shaft of the reduction motor 7 by a key connection or thread connection. The first driven sprocket 82 is installed on the first rotatable connector shaft 5, the shoulder position on the first rotatable connector shaft 5 defines the axial movement of the first driven sprocket 82, the first drive sprocket 81 and the first driven sprocket 82 are connected by the active chain 83. The active chain 83 transfers the power of the first drive sprocket 81 to the first driven sprocket 82. In this embodiment, the active chain is made of high-strength corrosion-resistant materials, and the chain drive structure is simple and easy to maintain, helps to reduce the complexity and cost of the entire structure. The chain drive has a certain degree of elasticity, can absorb and alleviate the impact force and vibration caused by changes in the underwater environment or changes in the thruster load to a certain extent.

[0030] In particular, the second chain drive assembly 9 comprises a second drive sprocket 91, a second driven sprocket 92 and a drive chain 93, the second drive sprocket 91 is mounted on the first rotatable connector shaft 5, in the present embodiment, the second drive sprocket 91 is fixed on the first rotatable connector shaft 5 by a key connection, and the second driven sprocket 92 is mounted on the second rotatable connector shaft 6. The axial movement of the second driven sprocket 92 is defined by the shoulder position on the second rotatable connector shaft 6. In the present embodiment, the second driven sprocket 92 is fixed on the second rotatable connector shaft 6 by a key connection, and the second drive sprocket 91 is connected with the second driven sprocket 92 by the drive chain 93. The drive chain 93 transfers the power of the second drive sprocket 91 to the second driven

sprocket 92. In this embodiment, the drive chain 93 is made of high-strength corrosion-resistant material, and the chain drive structure is simple and easy to maintain, which helps to reduce the structural complexity and cost.

[0031] Specifically, the underwater thruster 10 includes a motor, reducer, conduit and thruster, the motor can be DC motor, AC motor or brushless motor, reducer can choose planetary gear reducer, cycloidal reducer and other types, the thruster periphery is installed with a annular conduit, can optimize the flow field around the thruster, improve the efficiency of propulsion, While increasing thrust and protecting the thruster, thruster blades are usually two -, three -, four -, or five-bladed and are made of carbon fiber, aluminum alloy, or stainless steel.

[0032] In order to further optimize the technical scheme of the invention, the active chain 83 and the drive chain 93 have the same structure and both include two chains 831 and two tensioners 832, and the two chains 831 are connected by two tensioners 832 respectively.

[0033] Each embodiment in this specification is described in a progressive manner, and each embodiment focuses on its differences from other embodiments. The same and similar parts of each embodiment can be referred to each other. For the device disclosed by the embodiment, because it corresponds to the method disclosed by the embodiment, the description is relatively simple, and the relevant points can be described in the method section.

[0034] The above description of the disclosed embodiments enables persons skilled in the art to realize or use the invention. Various modifications to these embodiments will be apparent to those skilled in the art, and the general principles defined herein may be realized in other embodiments without departing from the spirit or scope of the present invention. Therefore, the invention will not be limited to these embodiments shown herein, but will conform to the widest range consistent with the principles and novel features disclosed herein.

CLAIMS

1. An underwater thruster tilting device comprising:
 - a fixed base plate;
 - four rotatable support seats uniformly fixed on the fixed base plate;
 - two first rotatable connectors rotatably mounted to two rotatable support seats located at the rear of the fixed base plate;
 - two second rotatable connectors rotatably mounted to the other two rotatable support seats located at the front of the fixed base plate;
 - a first rotatable connector shaft wherein both ends of the first rotatable connector shaft are rotatably connected with the two first rotatable connectors;
 - a second rotatable connector shaft wherein both ends of the second rotatable connector shaft are rotatably connected with the two second rotatable connectors;
 - a deceleration motor fixed on the fixed base plate;
 - a first chain drive assembly and a second chain drive assembly;
 - wherein the extended ends of each of the first rotatable connectors and each of the second rotatable connectors are fixed with underwater thrusters;
 - wherein an output shaft of the deceleration motor is connected with the first rotatable connector shaft through the first chain drive assembly, and the first rotatable connector shaft is connected with the second rotatable connector shaft through the second chain drive assembly.
2. The underwater thruster tilting device according to claim 1, wherein each underwater thruster is equipped with a first filter cover on its upper end and a second filter cover on its lower end.
3. The underwater thruster tilting device according to claim 1, wherein both ends of the first rotatable connector shaft are rotatably connected to the two first rotatable connectors through a key connection, and wherein both ends of the second rotatable connector shaft are rotatably connected with the two second rotatable connectors through a key connection.

4. The underwater thruster tilting device according to claim 2, wherein each underwater thruster includes a base threaded with each extended end of the first rotatable connector and each extended end of the second rotatable connector.
5. The underwater thruster tilting device according to claim 1, wherein the deceleration motor is fixed on the fixed base plate through a motor fixed plate.
6. The underwater thruster tilting device according to any one of claims 1-5, wherein the first chain drive assembly comprises a first drive sprocket installed on an output shaft of the deceleration motor, a first driven sprocket installed on the first rotatable connector shaft, and an active chain, wherein the first drive sprocket is connected with the first driven sprocket through the active chain.
7. The underwater thruster tilting device according to claim 6, wherein the second chain drive assembly comprises a second drive sprocket installed on the first rotatable connector shaft, a second driven sprocket installed on the second rotatable connector shaft, and a drive chain, wherein the second drive sprocket is connected with the second driven sprocket through the drive chain.
8. The underwater thruster tilting device according to claims 6 and 7, wherein the active chain and the drive chain each includes two chains and two tensioners, and the two chains are connected by two tensioners respectively.