

AN INTEGRATED UNDERWATER CLEANING TOOL

Technical Field

[0001] The present invention relates to the technical field of underwater cleaning structure, and more specifically relates to an integrated underwater cleaning tool.

Background

[0002] The underwater operating environment is complex and changeable, which often involves the fields of ocean engineering, ship maintenance, underwater archaeology and so on. In these fields, underwater cleaning work is an essential part.

[0003] Traditional underwater cleaning tools mostly use split type design, which requires divers to carry multiple parts for assembly and operation, which not only increases the diver's work burden, but also reduces the efficiency and safety of operation.

[0004] In addition, there are some problems in the actual use of split underwater cleaning tools. For example, due to the instability of the underwater environment, the connection parts of split tools are easy to loosen in the operation process, leading to the deterioration of tool performance or operation interruption; At the same time, the split tool is not convenient to carry and store, requiring additional space and maintenance work.

[0005] Therefore, providing an integrated underwater cleaning tool with high integration, simple operation and stable performance is an urgent problem for technicians in this field.

Summary of the Invention

[0006] In view of this, the invention provides an integrated underwater cleaning tool with high integration, simple operation and strong safety.

[0007] In order to realize the above purpose, the invention adopts the following technical scheme:

An integrated underwater cleaning tool comprises a support frame, a buoyancy material, a driving device and a cleaning brush disk. The buoyancy material and the driving device are installed on the support frame; The cleaning brush disk is mounted on the driving device and located below the support frame.

[0008] By adopting the above technical scheme, the beneficial effects of the invention are as follows:

The compact, one-piece design integrates all parts together for efficient and stable underwater cleaning operations.

Further, the support frame further comprises a first steel frame located above the support frame and a second steel frame located below the support frame; wherein an elastic buffer device is installed between the first steel frame and the second steel frame; wherein the buoyancy material is installed at the bottom of the first steel frame and is located on both sides of the second steel frame, wherein the driving device is installed on the first steel frame and the second steel frame; and wherein the cleaning brush disk is located under the second steel frame.

[0009] Further, the driving device comprises a hydraulic chamber installed on the top of the first steel frame, a hydraulic pump installed at one end of the hydraulic chamber, an oil pressure compensator installed on the second steel frame and connected with the hydraulic chamber, two hydraulic motors respectively installed on both ends of the second steel frame through a fixed plate, a tee connected with the two

hydraulic motors, two cleaning brush disks located below each end of the second steel frame, wherein the direction of rotation of the cleaning brush disks is opposite to each other; wherein each cleaning brush disk is fixedly connected with an output shaft of each of the two hydraulic motors through a connecting shaft, and wherein the hydraulic pump is connected with the oil pressure compensator and the tee and the two hydraulic motors are connected with the oil pressure compensator through a hydraulic pipeline.

[0010] Further, the hydraulic pipeline comprises two first pipes, two second pipes and two third pipes, and the hydraulic pump is connected with the tee and the oil pressure compensator respectively through the two first pipes, wherein the two interfaces of the tee are respectively connected with an oil inlet of the two hydraulic motors through the two second pipes; and wherein the oil pressure compensator is connected with an oil outlet of the two hydraulic motors respectively through the two third pipes.

[0011] Further, the oil inlet and the oil outlet of the hydraulic motor are straight pipe joints, and each of the straight pipe joints is installed with a cone-sealed steel wire braided hose, wherein the second pipe is connected with the oil inlet of the hydraulic motor, wherein the third pipe and the oil outlet of the hydraulic motor are connected through the cone-sealing steel wire braided rubber hose; wherein the first pipes are bent at 90° angle.

[0012] Further, the oil pressure compensator includes a pressure sensor installed therein.

[0013] Further, a shock-absorbing rubber plate is installed between the cleaning brush disk and the connecting shaft.

[0014] Further, a fixed angle block is fixed on both sides of the first steel frame, and the buoyancy material is connected with the fixed angle block through a screw.

[0015] According to the above technical scheme, the invention discloses an integrated underwater cleaning tool. Compared with the prior art, the invention has the following beneficial effects:

1) High integration: the integrated design reduces the complexity of installation and mounting, and can be easily mounted on the cable underwater robot, improving the working efficiency;

2) Easy operation: After the integrated underwater cleaning tool is mounted on the cable underwater robot, it can work through simple control, simplifying the operation process and reducing the difficulty of the operator;

3) Strong security: fault self-diagnosis function and real-time monitoring system greatly improve the safety of the operation.

Brief Description of the Drawings

[0016] 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.

[0017] Figure 1 is a schematic three-dimensional structural diagram of an integrated underwater cleaning tool provided by the present invention;

[0018] Figure 2 is a front view of an integrated underwater cleaning tool provided by the present invention;

[0019] Figure 3 is a top view of an integrated underwater cleaning tool provided by the present invention; and

[0020] Figure 4 is a bottom view of an integrated underwater cleaning tool 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 1-4, the embodiment of the invention discloses an integrated underwater cleaning tool, which comprises a support frame 1, a buoyancy material 2, a driving device 3 and a cleaning brush disk 4, and the buoyancy material 2 and a driving device 3 are installed on the support frame 1. The cleaning brush disk 4 is installed on the driving device 3 and is located under the support frame 1. The cleaning brush disk 4 is designed to be replaceable and can be quickly replaced with different types of cleaning heads according to different cleaning needs, such as scrapers, grinding blades, etc., with strong adaptability and easy operation. The invention has a compact structure, adopts an integral design, integrates all parts together, and can realize an efficient and stable underwater cleaning operation.

[0024] Specifically, the support frame 1 includes a first steel frame 11 and a second steel frame 12, which are distributed parallel up and down. The first steel frame 11 is welded with 316L or 304 stainless steel rectangular tubes or square tubes. In the case of meeting

the functional requirements, the structure is simplified as far as possible, the overall weight is light, and the strength is high. The second steel frame 12 is welded with 316L or 304 stainless steel rectangular tube or square tube, which simplifies the structure as far as possible to meet the functional requirements, with light weight and high strength. An elastic buffer device 5 is installed between the first steel frame 11 and the second steel frame 12. The elastic buffer device 5 can absorb the impact force. In underwater operation, the cleaning tool may have an impact force due to the collision with a hard object or the operation on an uneven surface. Long time underwater cleaning operation will produce vibration and the elastic buffer device 5 can reduce the impact of these vibrations on the cable underwater robot and tools, improve the comfort and accuracy of the operation, by reducing the impact force and vibration, so that the cleaning disk 4 can more smoothly contact and clean the target surface, improve the efficiency and quality of the operation. It helps to protect the structural integrity of underwater cleaning tools and prevent the loosening or damage of parts caused by long-term operation, that is, it is used to absorb and reduce the impact force and vibration that may be encountered during the operation of tools, so as to protect the structural integrity of tools and improve the stability of operations, which is of great significance for ensuring the safety of underwater operations and extending the service life of tools. The buoyancy material 2 is installed at the bottom of the first steel frame 11 and is located on both sides of the second steel frame 12. The driving device 3 is installed on the first steel frame 11 and the second steel frame 12. The cleaning disk 4 is located under the second steel frame 12.

[0025] Of course, the elastic buffer device 5 can monitor the impact force and vibration of the tool through the built-in sensor in real time. When the impact force or vibration exceeds the preset threshold value is monitored, the elastic buffer device 5 will automatically activate its internal buffer mechanism, such as compressed gas, spring, hydraulic buffer, etc., which can effectively absorb and disperse the impact force. The elastic buffer device 5 distributes the absorbed energy to the support frame 1 of the entire tool through the internal structure, thus reducing the impact on specific components. Under the action of

the elastic buffer device 5, the underwater cleaning tool can maintain a stable operating state and maintain efficient cleaning performance even in complex underwater environments. The elastic buffer device 5 is designed as a self-restoring structure. That is, after absorbing the impact force, it can automatically return to the original state in order to continue the next impact absorption.

[0026] Specifically, the driving device 3 comprises a hydraulic chamber 31, a hydraulic pump 32, an oil pressure compensator 33, a tee 34 and two hydraulic motors 35, the number of cleaning brush disk 4 is two, the two cleaning brush disk 4 is located at the second steel frame 12 under the two ends, the rotation direction of the two cleaning brush disk 4 is opposite. The hydraulic chamber 31 is installed on the top of the first steel frame 11, and the hydraulic chamber 31 is equipped with a high-power motor, which acts as the power source of the hydraulic pump 32. The hydraulic motor rotates to drive the hydraulic pump 32 to work, and the hydraulic chamber 31 acts as an oil cylinder, which is filled with oil. When the hydraulic pump 32 works, the low-pressure hydraulic oil is extracted from the inside and delivered to the hydraulic motor 35 through the pressurized pump of hydraulic pump 32. Drive cleaning disk 4 work; The two hydraulic motors 35 are respectively installed at both ends of the second steel frame 12 through a fixed plate 36. In this embodiment, the fixed plate 36 is made of stainless steel plate with a thickness of 3-6mm. The stainless steel can be 316L stainless steel or 304 stainless steel and is fixed on the second steel frame 12 by welding or threaded connection to fix the hydraulic motor 35. The hydraulic motor 35 acts an integrated underwater cleaning tool drive device or actuator and plays an indispensable role in the entire system. The hydraulic motor 35 overall material is made of corrosion resistant material, through threaded connection fixed on the fixed plate 36. The various types of hydraulic motor 35 can be used: Gear hydraulic motor, screw hydraulic motor, blade hydraulic motor, axial piston hydraulic motor and other different types, the specific use of which depends on different working conditions. The cleaning brush disk 4 is fixed to the output shaft of the hydraulic motor 35 through the connecting shaft 37, and the power is transferred to the cleaning brush disk 4 through the

connecting shaft 37, which drives the rotation of the cleaning brush disk 4. The steel wire brush is fixed on the cleaning brush disk 4, and the number can be 6-12, evenly distributed on the cleaning brush disk 4. The steel wire material is 316L stainless steel or 304 stainless steel. Good corrosion resistance, good wear resistance, can adapt to different water quality and underwater environment; The hydraulic pump 32 is installed at one end of the hydraulic chamber 31. The hydraulic pump 32 is used to convert hydraulic energy into mechanical energy, generating enough pressure to drive the cleaning brush disk 4 for effective cleaning operations. The hydraulic pump 32 can provide stable pressure output to ensure that the cleaning head can work with constant force in various underwater environments, thus improving the cleaning efficiency and effect. By adjusting the output flow rate and pressure of the hydraulic pump 32, the precise control of the cleaning disk 4 can be achieved, including the cleaning force and speed, to adapt to different cleaning requirements; The oil pressure compensator 33 is installed on the second steel frame 12 and connected with the hydraulic chamber 31 to ensure that the underwater cleaning tool can work stably under different underwater depths and provide a constant power output. The oil pressure compensator 33 adapts to the change of external water pressure by adjusting the internal oil pressure, so as to ensure that the performance of the cleaning tool is not affected. The hydraulic pump 32 and the oil pressure compensator 33, hydraulic pump 32 and tee 34, tee 34 and two hydraulic motors 35, and two hydraulic motors 35 and oil pressure compensator 33 are connected by hydraulic lines. The tee 34 is used to distribute or collect fluid in the hydraulic system. The hydraulic oil output of hydraulic pump 32 can be distributed to two different hydraulic motor 35 on the left and right sides, so that these components can receive hydraulic oil at the same time or on demand, so as to achieve collaborative work, and the use of the tee 34 can reduce the number of pipeline connection points, simplify the pipeline layout of the entire hydraulic system, reduce the risk of leakage, improve the reliability of the system. The design of the tee 34 makes it more convenient to disassemble and replace the relevant parts when the hydraulic system is needed for maintenance or overhaul, reducing the maintenance workload and time. During the whole working process, the pressure and flow rate in the hydraulic system will be monitored in real time. If

necessary, the flow direction and flow rate of hydraulic oil can be controlled by adjusting the valve on tee 34 to ensure the stable operation of the system.

[0027] Specifically, the hydraulic pipeline comprises two first pipes, two second pipes and two third pipes, and the hydraulic pump 32 is connected with the tee 34 and the oil pressure compensator 33 respectively through the two first pipes. The two interfaces of the tee 34 are connected with the oil inlet of the two hydraulic motors 35 respectively through the two second pipes. The oil pressure compensator 33 is connected to the oil outlet of the two hydraulic motors 35 respectively through the two third pipes. When the integrated underwater cleaning tool starts working, the hydraulic motor in the hydraulic chamber 31 rotates, drives the hydraulic pump 32 to rotate, and the hydraulic pump 32 starts and starts pumping the hydraulic oil, drawing the hydraulic oil from the low pressure area (oil pressure compensator 33). Through the internal structure of the hydraulic pump 32 (such as gear pump, plunger pump, etc.), the hydraulic oil flows through the first pipe to tee 34. The tee 34 can distribute the hydraulic oil output of the hydraulic pump 32 to two different hydraulic motors 35 on the left and right sides, the hydraulic motor 35 rotates and then drives the cleaning brush disk 4 to rotate, according to the actual cleaning needs. The hydraulic pump 32 can adjust the output pressure and flow through the variable pump or servo valve and other control components to achieve the precise control of the cleaning action, after the actuator completes the work, the hydraulic oil will be recovered and returned to the oil pressure compensator 33 internal, recycling, forming a closed hydraulic system. The entire hydraulic system is usually equipped with monitoring equipment such as pressure sensors and temperature sensors to monitor the working status of the system in real time to ensure that the hydraulic pump 32 operates within a safe and effective range.

[0028] Specifically, the oil inlet and outlet of the hydraulic motor 35 are straight pipe joints, easy to connect with the pipeline, strong pressure bearing capacity, not easy to leak. The pipe joints are made of corrosion resistant materials and each straight pipe joint is installed with cone-sealed steel wire braided hose 38, the second pipe and the oil inlet of

the hydraulic motor 35, The oil outlet of the third pipe and the hydraulic motor 35 are connected through the cone-seal steel wire braided hose 38, the cone-seal steel wire braided hose 38 is used to connect the pipeline, and can be connected with different pipe joints through threaded connection, high temperature resistance, corrosion resistance and pressure resistance is strong and not easy to leak performance. Both the first pipes are 90° bent.

[0029] In order to further optimize the technical scheme of the invention, the oil pressure compensator 33 is equipped with a pressure sensor inside, and the oil pressure compensator 33 has a pressure balancing function, which can sense the change of external water pressure through the pressure sensor, and automatically adjust the internal oil pressure to balance the influence of external water pressure on the underwater cleaning tool. This can ensure that the underwater cleaning tool can maintain stable performance when working in different depths of the underwater environment, by maintaining a constant oil pressure, the oil pressure compensator 33 ensures that the power transmission system can continue to transfer power to the cleaning disk 4, so that the cleaning operation can be uniform and efficient. The oil pressure compensator 33 also helps to protect other components of the underwater cleaning tool against damage to the equipment or degradation of performance due to changes in water pressure.

[0030] Work flow of oil pressure compensator: When the underwater cleaning tool starts to go down, the pressure sensor inside the oil pressure compensator 33 will monitor the change of external water pressure in real time. According to the sensed water pressure, the oil pressure compensator 33 will automatically adjust the internal oil pressure. If the external water pressure increases, the oil pressure compensator 33 will increase the internal oil pressure to maintain balance; Conversely, if the external water pressure decreases, the internal oil pressure will also decrease accordingly.

[0031] In addition, during the entire working process, the oil pressure compensator 33 will also monitor its own working status, if it detects an abnormal situation, such as the internal oil pressure is too high or too low, it will start the protection mechanism, suspend the work of the tool, and send an alarm to the surface console through the signal transmission system, so that the diver or the operator can deal with it in time, not only improving the efficiency and safety of the operation, but also improving the safety of the operation. It also greatly extends the service life of the tool.

[0032] In order to further optimize the technical scheme of the invention, a shock-absorbing rubber disk 6 is installed between the cleaning brush disk 4 and the connecting shaft 37. In the present embodiment, the shock-absorbing rubber disk 6 is fixed through threaded connection and the material is rubber, which can reduce the vibration generated during the operation of the cleaning brush disk 4.

[0033] Specifically, a fixed angle block 111 is fixed on both sides of the first steel frame 11, which is made of corrosion-resistant stainless steel plate cut and processed, and is fixed on the first steel frame 11 by welding or threaded connection, and the buoyancy material 2 is connected with the fixed Angle block 111 by screws. In this embodiment, the buoyancy material 2 is divided into two parts, which are respectively fixed on the first steel frame 11 by threaded connection. The material is low density glass microbeads, light weight, not easy to absorb water, and can provide enough buoyancy for integrated underwater cleaning tools.

[0034] 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.

[0035] 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 integrated underwater cleaning tool comprises: a support frame, a buoyancy material, a driving device and a cleaning brush disk, wherein the buoyancy material and the driving device are installed on the support frame and the cleaning brush disk is mounted on the driving device and located below the support frame.

2. The integrated underwater cleaning tool according to claim 1, wherein the support frame further comprises a first steel frame located above the support frame and a second steel frame located below the support frame; wherein an elastic buffer device is installed between the first steel frame and the second steel frame; wherein the buoyancy material is installed at the bottom of the first steel frame and is located on both sides of the second steel frame, wherein the driving device is installed on the first steel frame and the second steel frame; and wherein the cleaning brush disk is located under the second steel frame.

3. The integrated underwater cleaning tool according to claim 2, wherein the driving device comprises:

- a hydraulic chamber installed on the top of the first steel frame;
- a hydraulic pump installed at one end of the hydraulic chamber;
- an oil pressure compensator installed on the second steel frame and connected with the hydraulic chamber;

- two hydraulic motors respectively installed on both ends of the second steel frame through a fixed plate;

- a tee connected with the two hydraulic motors;

- two cleaning brush disks located below each end of the second steel frame, wherein the direction of rotation of the cleaning brush disks is opposite to each other; wherein each cleaning brush disk is fixedly connected with an output shaft of each of the two hydraulic motors through a connecting shaft; and

wherein the hydraulic pump is connected with the oil pressure compensator and the tee and the two hydraulic motors are connected with the oil pressure compensator through a hydraulic pipeline.

4. The integrated underwater cleaning tool according to claim 3, wherein the hydraulic pipeline comprises two first pipes, two second pipes and two third pipes, and the hydraulic pump is connected with the tee and the oil pressure compensator respectively through the two first pipes;

wherein the two interfaces of the tee are respectively connected with an oil inlet of the two hydraulic motors through the two second pipes; and

wherein the oil pressure compensator is connected with an oil outlet of the two hydraulic motors respectively through the two third pipes.

5. The integrated underwater cleaning tool according to claim 4, wherein the oil inlet and the oil outlet of the hydraulic motor are straight pipe joints, and each of the straight pipe joints is installed with a cone-sealed steel wire braided hose, wherein the second pipe is connected with the oil inlet of the hydraulic motor, wherein the third pipe and the oil outlet of the hydraulic motor are connected through the cone-sealing steel wire braided rubber hose; wherein the first pipes are bent at 90° angle.

6. The integrated underwater cleaning tool according to claim 3, wherein the oil pressure compensator includes a pressure sensor installed therein.

7. The integrated underwater cleaning tool according to claim 3, wherein a shock-absorbing rubber plate is installed between the cleaning brush disk and the connecting shaft.

8. The integrated underwater cleaning tool according to claim 2, wherein a fixed angle block is fixed on both sides of the first steel frame, and the buoyancy material is connected with the fixed angle block through a screw.