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Design of Water Flow Power Generation Device for Ships

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Abstract

There is a relative speed between the ship and the sea when the ship is at anchor. This article proposes a new energy utilization method that uses the water kinetic energy to generate electricity when the ship is docked or anchored. Power generation, reducing energy consumption and environmental pollution.

Keywords

Ship; suspension of navigation; water flow power generation; new energy.

1. INTRODUCTION

There are two main waterways in China, the Yangtze River and the Yellow River. There are many inland ships and the waterway transportation is developed. In recent years, with the increase in cargo volume, the number and deadweight of inland watercrafts have also increased. At present, inland watercrafts in China are mainly driven by diesel, which increases energy consumption and environmental pollution. There are many ports and anchorages on both sides of the inland river, and the number of ships calling frequently, and the diesel generator set is still required to operate when the ship is stopped to provide electricity for the equipment and personnel on board. The water in the two main channels continuously flows from west to east, and contains abundant water kinetic energy. When the ship is stopped, the water flows through the ship, making the water kinetic energy wasted. At present, the new energy utilization methods used on ships mainly include wind power generation, photovoltaic power generation, etc., but the use of water flow power generation devices when the ship is out of service has not been reported. As new energy power generation technologies, hydroelectric generators and tidal generators have not only stayed at the stage of theoretical and experimental research, related products have been applied in small batches, and good economic and environmental benefits have been achieved [1]. Compared with ocean-going ships, the wind resources and solar resources in inland waters are relatively small, but the water flow speed is higher when the voyage is suspended, and the energy density of the water flow is much higher than that of wind and solar energy. Therefore, it is necessary to design a set of hydrodynamic power generation devices for ships at a halt, which can make full use of the water flow of the inland waterway to generate electricity, which will not affect the normal navigation of the ship, and can provide clean electricity to the ship when the ship is at a halt, and even replace the diesel engine to generate electricity [2].

2. SELECTION OF WATER FLOW GENERATOR

Since the ship travels in two directions, and the direction of water flow has always been from west to east, in order to increase the power generation efficiency, combined with fluid mechanics, this device adopts a twin-propeller generator and a structure with a reduced diameter of the shroud. As shown in Figure 1, the water flow impacts After the first set of blades impact the second set of blades, the utilization rate of hydrokinetic energy is improved.

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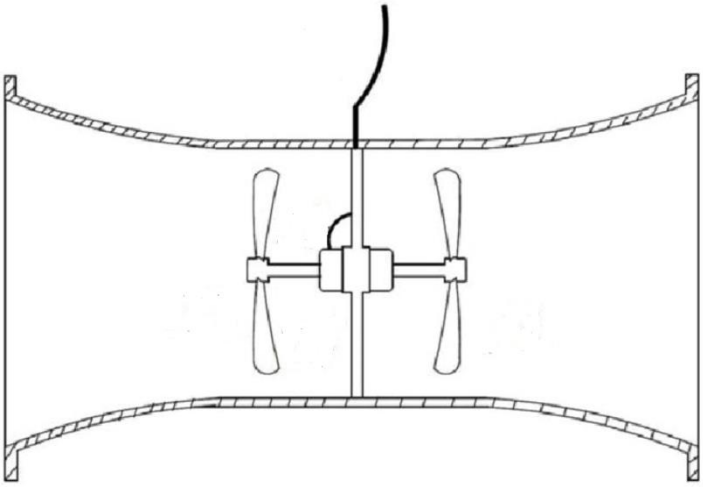

Figure 1. Sectional view of water flow generator

3. SHRINKAGE DESIGN OF POWER GENERATION DEVICE

3.1. Design Requirements

When the ship is sailing normally, although the power generation device in the water can provide electricity to the ship, it still outweighs the loss of the fuel consumed by the ship. Therefore, it is necessary to take measures to realize that the power generation device is in the ship when the ship is sailing normally. The power generation device extends out of the ship into the water, thereby generating electricity to provide electricity to the ship.

When the ship is at a stop, the generator extends out of the cabin, and the kinetic energy generated by the impact of the water flow on the ship when the ship is at stop drives the rotation of the blades on the generator to convert the energy of the water flow into electrical energy; when the ship is sailing normally, the The generator shrank into the cabin.

In order to achieve the above requirements, the required devices mainly include two generators, which are located on both sides of the ship; the ship side door opening and closing device is used to open/close the ship side door; the generator telescopic mechanism, which makes the generator extend out of the cabin And retract into the cabin; the control circuit is used to control the forward or reverse rotation of each motor of the main circuit to realize the opening and closing of the door and the expansion and contraction of the generator; when the ship is stopped, the generator extends out of the cabin, and when the ship is sailing normally, it generates electricity The machine retracted into the cabin.

3.2. Design Requirements to Achieve

In order to utilize the water flow energy as much as possible, power generation devices should be installed on both sides of the ship. Because the power generation devices on both sides are symmetrical, this article only provides a schematic diagram of one side power generation device, as shown in Figure 2. In the figure, the motor 15 is the switch of the ship's side door 10, which controls the opening and closing of the ship's side door, and 7 is the limit switch of the door opening position. When the ship's side door 10 is fully opened, the limit switch 7 will act and the motor 15 will automatically stop; After the side door is opened, the motor 28 controls the three-phase water flow generator 11 to extend out of the hull, and 5 is the limit switch at the end position of the generator extension. When the generator reaches the specified position, the limit switch 5 will act, and the motor 28 will automatically close and generate The machine starts to run under the impact of water flow to generate electricity, which is processed by modern grid-connected technology and placed on the ship's power grid. The sequence is: the door opens → the generator extends out of the hull → starts to generate

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electricity and connect to the grid. When the ship is about to set sail and the power generation device needs to be retrieved, the sequence is: retract the generator into the hull → close the door.

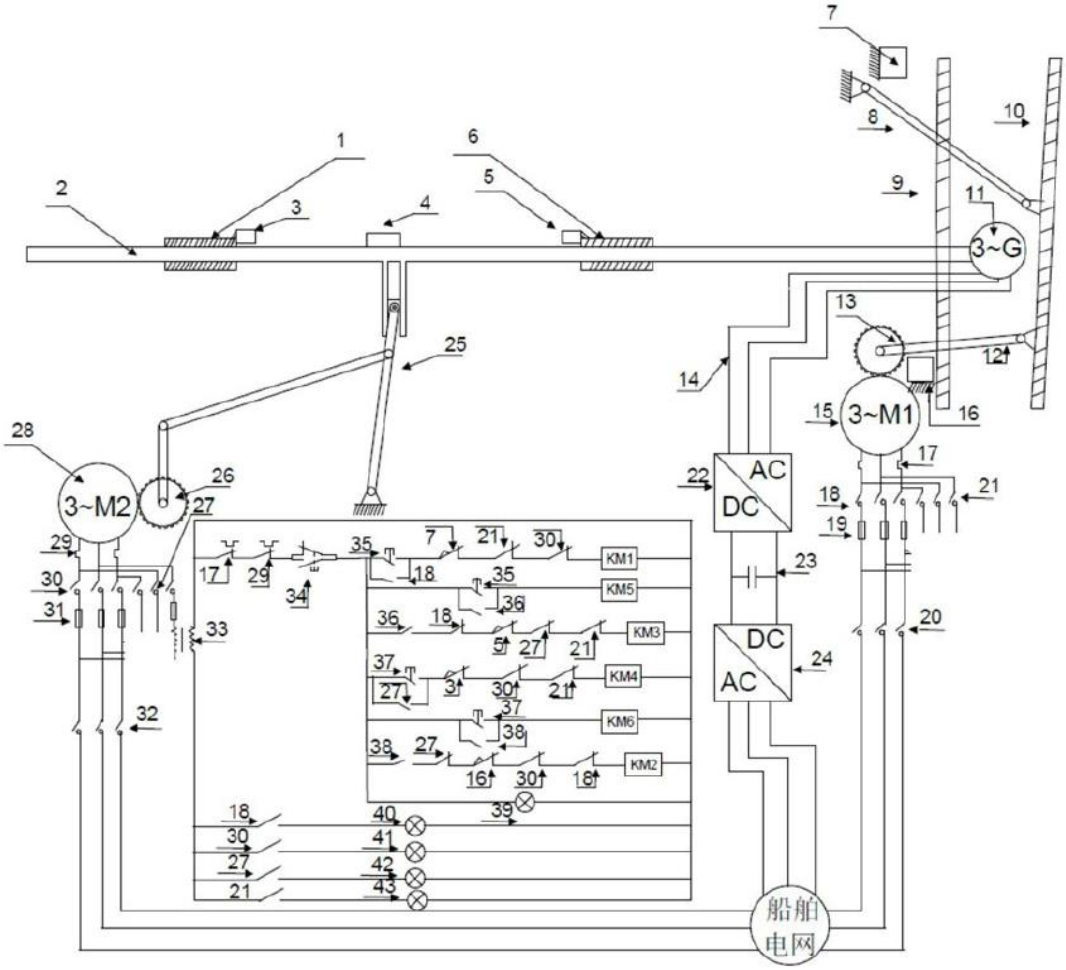

Figure 2. Schematic diagram of water flow generator expansion.

4. CONCLUSION

The propulsion motor is a heavy load in the ship's power grid, and the power quality of the grid is very important to the reliability of the propulsion system. SVPWM space vector control can achieve the control performance of DC motor by decoupling the stator current of the motor in the direct axis and the cross axis. The electric power propulsion ship grading start is better than the direct start. Establish a mathematical model of diesel generator set and permanent magnet synchronous motor, and build the model and simulate using SIMULINK function in MATLAB. Observe the grid voltage frequency change of the diesel generator set by adding 100% rated load; simulate the motor with load start and sudden rated load, analyze the dynamic performance of the motor; simulate and analyze the characteristics of the electric propulsion ship under two starting modes. The simulation of the ship's electric propulsion system, the simulation results reached the expected, the simulation is reasonable.

The oscilloscope module can vividly and intuitively display the process and trend of variable changes, and can analyze the performance of the system in a targeted manner. Through the simulation of the limited capacity of the limited ship power grid, it provides valuable data for large-capacity load start; simulates the load start and sudden rated torque simulation of the propulsion motor, and analyzes the dynamic change process to provide valuable data and ideas for optimal control. The simulation of the main parameters of ship direct start and grading start

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changes, providing valuable data for the selection of modern electric propulsion ship starting methods.

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