Testing of a Power Take Off (PTO) under simulated sea wave conditions

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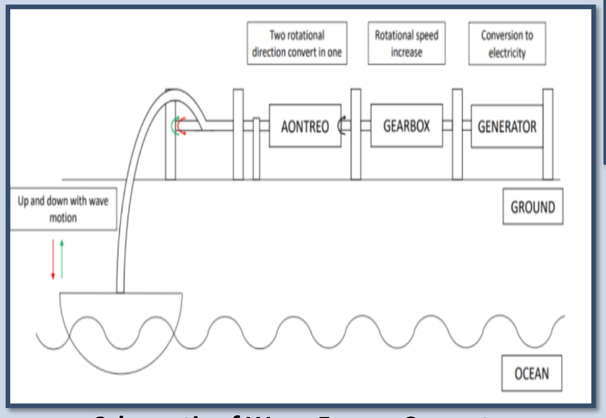
Aim of the Project

The Aim of the project is to design and build a power take off system that will convert wave energy into electrical energy by rotating a generator

Objectives

- Research the operation and application of a Wave Energy Converter Power Take Off system
- Design a mechanical system to test the PTO and produce a full set of drawings for manufacture
- Manufacture the test rig and carry out various tests under different wave conditions

Background

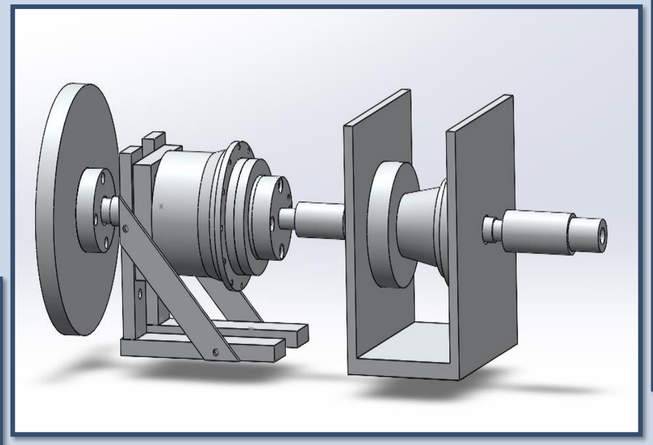


Schematic of Wave Energy Converter

A PTO is made up of a shaft that transfers power from a power source such as an electric motor or engine to a gearbox or through a flywheel depending on the application. Our PTO is going to be designed to transmit power generated from the waves of the ocean by a wave energy converter. The slow moving, high torque motion of the waves will get converted to a high speed, low torque output via a shaft. It consists of a manual motion rectifier (MMR) which converts bidirectional to one direction and a planetary gearbox which increases the velocity at a lower torque output. This enables the PTO to drive a generator at an adequate speed to produce electrical power

Design

The design process was carried out with the knowledge that we were able to externally source a lot of the major items in the assembly. These parts were the motor, MMR, gearbox and flywheel. The design process then became a question of how we were going to transmit the power from the motor through to every component within the rig. The use of shafts was the clear choice for this



Design Assembly in SolidWorks

We knew that it would not be practical to line up each components shaft perfectly with one another so to solve this issue we incorporated the use of universal joints to be placed in between the shafts that run from the motor , MMR and gearbox. The universal joints would enable power to be transmitted through the shafts even if their alignment was slightly off

Another key area of the design process was creating a supportive stand in which the gearbox could be bolted to. The purpose of this was to keep the gearbox rigid and steady during operation but also to raise it up to a sufficient height so that its input and output shafts were at the same level of the other components shafts

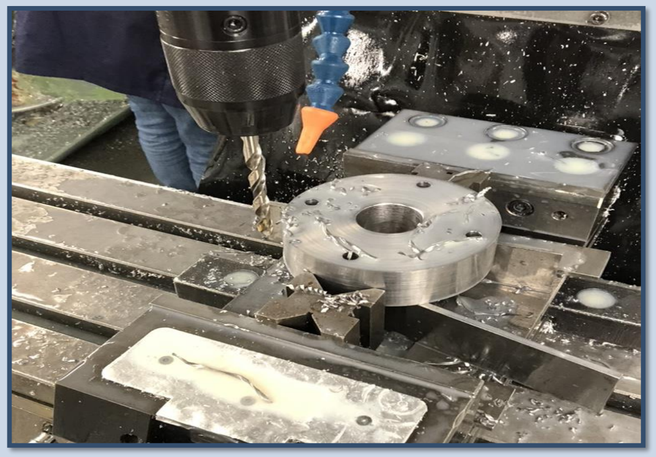
Some changes had to be made to our externally sourced parts to enable our assembly to work so we made sure to include these modifications in our SolidWorks design. This included making the input shaft of the MMR smaller in diameter so that it would fit in the universal joint. Also, the bore at the centre of the flywheel had to be a bigger size to enable our spigot shaft coming from the gearbox to work with it

Manufacturing

The machining and manufacturing process consisted of creating parts that could be used to transfer rotary power from the motor to every component in the assembly. Some of the existing shafts on the externally sourced parts also had to be modified

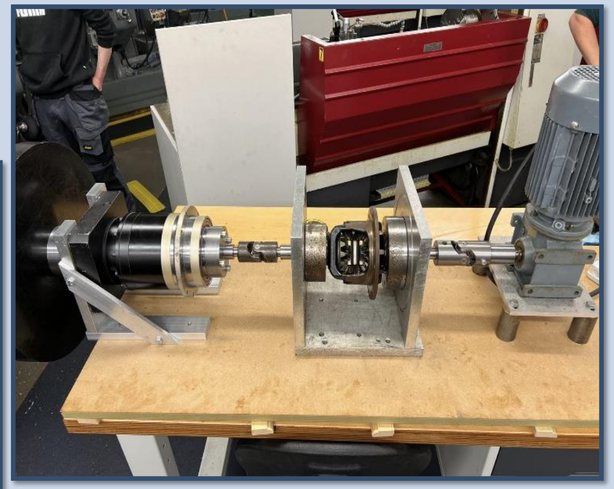
Gearbox Output Shaft

The manufacturing process was completed in the workshop using machine tools such as lathes and milling machines. The photo above shows the gearbox output shaft being turned down to size on the lathe. Shown below is the flywheel bracket. This bracket was turned down to size and bored on the lathe before being transferred to the mill where four holes were drilled and then tapped



Flywheel Bracket

Manufacturing



Full Assembly

The image above shows the fully completed assembly of the rig which was bolted together using wrenches and Allen keys. The universal joints were connected to the shafts using a bolt and nut. A milling machine was used to create the holes for this connecting bolt. The assembly was bolted to a 500x1500mm sheet of MDF to ensure that all components stay securely in place during operation

Conclusion

- After carrying out research and brainstorming ideas, a design was created and then modelled using SolidWorks
- The assembly was manually machined and manufactured using the machine tools in the workshop
- Having a full set of working drawings and planning the machining process before going to the workshop enabled parts to be manufactured efficiently

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