Underwater Autonomous Unrolling Mat

Problem Statement

NAVWAR has developed a new microbial fuel cell (MFC) that generated electricity from bacteria on the ocean floor. These MFCs can be placed on a mat to cover a large surface area on the ocean floor for electrical generation. NAVWAR is looking for a way to autonomously unroll a 100m^2 area mat on the floor of the ocean at a depth of up to 100m underwater in order to deploy these MFCs.

Project Description

Our team has developed a system that can unroll 2 mats with the combined dimensions of 6 ft x 200 ft autonomously underwater through the usage of pressurized air.

Electrical and Piping System Design

The electrical system consists of solenoids that are controlled by timer relay boards. When the start button is pushed the timer relay boards begin counting down. Once the timer relay board ends its countdown, an electrical signal is sent to the fill valve solenoid causing it to open and release air from the gas cylinder into the mat. The timer relay then starts another countdown for how long the fill valve will remain open. Once this countdown is completed the fill valve solenoid will close.

The piping system uses a kink-proof reinforced rubber hose to connect the air cylinder to the waterproof housing, and the waterproof housing to the mat. The mat hosing is made of a cloth material similar like a firehose. Air flow is split between the 2 mats by brass pipe fittings.

Acknowledgements

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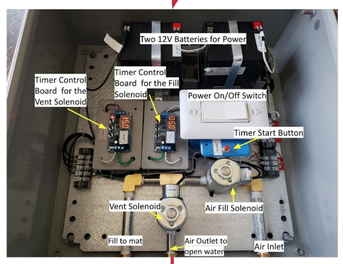
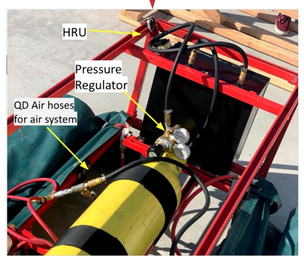
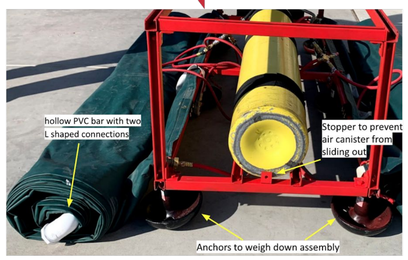
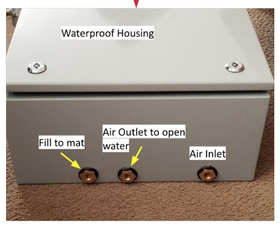
Design Overview

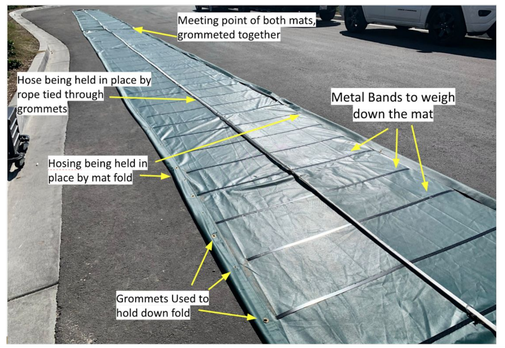
Before the system is deployed into the ocean, compressed air in a heavy duty steel cylinder is set to the required PSI by adjusting the regulator. The system is deployed into the ocean and begins falling. At 4 meters depth, a hydrostatic release unit is activated, and cuts a rope which holds the mat close to the system's frame. When system reaches the bottom of the ocean a time actuated solenoid opens releasing pressurized air from the cylinder. The air reaches a t-joint that divides the airflow between the two mats. The air then flows into three quick disconnects (QD's) on each side, which are attached to the bases of the rolled up mats. The mats have a combined surface area of over 100 m^2. The QD's are connected to three high pressure hose lines that are attached to the sides and middle of the mat. At the end of the mat the hoses connect to a hollow PVC pipe with L-shaped connectors on both ends. These connectors have drilled out pressure release holes to control the release of air from the system. The system will continue to release air until the mats completely unfurl to their combined total length of 200 ft. The second time release solenoid then opens releasing the remaining air from the cylinder. The mat slowly settles to the bottom of the ocean weighed down by steel straps that are attached to the mat and placed perpendicular to the tubing.



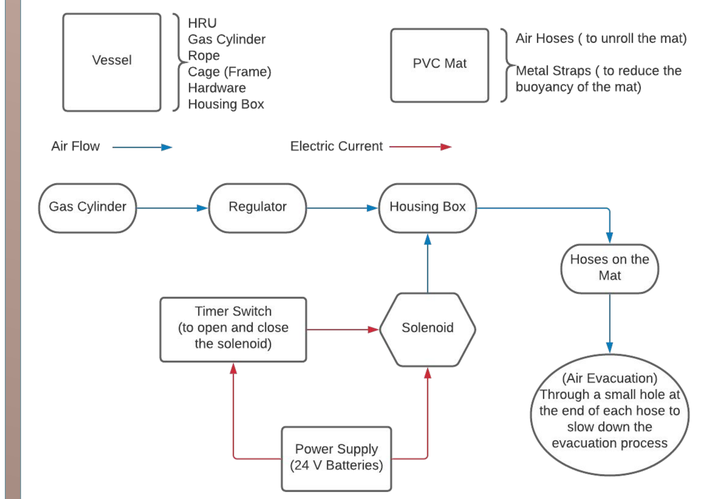








Systems Level Diagram



The Team

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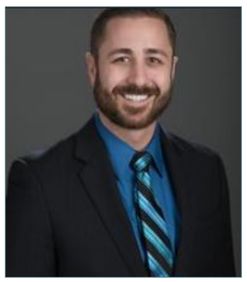

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