Science and Technology

EMERGENCY PREVENTION & RESPONSE

INVERTED CYLINDER HYDROSTATIC VENTILATOR

A LOW-COST, PORTABLE, AND EASILY-ASSEMBLED VENTILATOR TO SAFELY DELIVER HUMIDIFIED AND DECONTAMINATED BREATHING AIR TO PATIENTS.

Ventilation machines provide breathing support for patients by delivering breathable air into and out of patients' lungs. High demand for ventilators during the COVID-19 pandemic stressed healthcare systems and highlighted insufficient ventilator availability during patient surges. Manufacturing and maintaining ventilators can be time-consuming and expensive, especially in low-resource areas. Supply chain constraints and the limited availability of ventilator components can also inhibit maintenance and impact patient access.

To address these challenges, researchers at the US Coast Guard (USCG) invented the Inverted Cylinder Hydrostatic Ventilator (ICHV) – a low-cost, portable, and easy-to-operate ventilator that provides positive air pressure and delivers warm, humidified, and decontaminated breathing air to patients. The design of ICHV is easy to build with inexpensive, available materials and requires minimal electronics, making it ideal for use in remote locations or patient surges. In addition, the ventilator's controller and adjustable delivery methods allow for proper and individualized care for patients' specific needs.

KEY BENEFITS

+ Easy to operate
+ Portable and lightweight
+ Adjustable based on patient needs
+ Easy to assemble and repair with affordable materials

STAGE OF DEVELOPMENT

Prototype

PARTNERSHIP SOUGHT

License

INVENTORS

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DHS COMPONENT

United States Coast Guard

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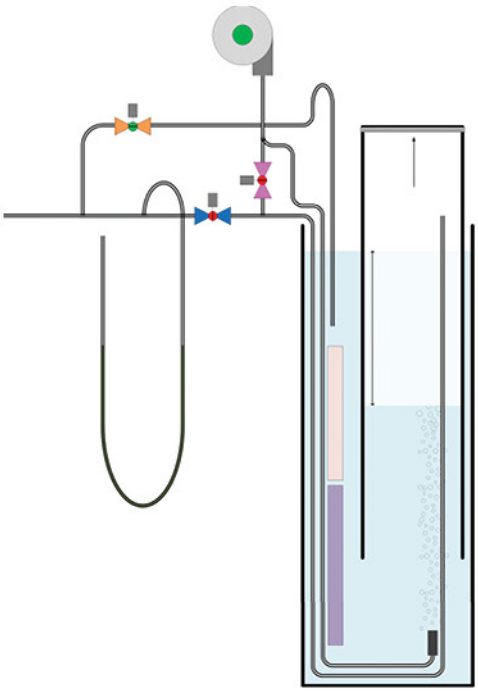
THE TECHNOLOGY

The ICHV involves two nested cylinders. The upright, outer cylinder is larger and has an open top and holds a water bath. An inverted, inner cylinder with an open bottom is submerged in the water bath but contains a pocket of breathing air. When the inner cylinder travels up and down along guide rails that keep it within the upright outer cylinder, the available air volume within it expands or contracts at a pressure prescribed by the total buoyant weight of the inner cylinder.

An air supply line delivers pumped air to the inner cylinder and builds air pressure in its chamber, causing it to rise in the water. During the downward stroke of the inner cylinder, the available air volume decreases and the air within it is delivered to the patient at a steady prescribed pressure via an inhalation tube. To control the air pressure, adjustable cylinder weights can be placed on top of the inner cylinder. The air supply can stop based on signals from a patient's breathing or a preset timer.



ICHV schematic depicting two nested cylinders, with the inverted cylinder holding an air chamber that is filled with an air supply line and drained with a line to a patient's inhalation tube. A third, shorter tube allows exhalations to be sent back to the water bath at a depth appropriate to provide back-pressure to guard against alveolar collapse. The manometer uses salt water or some other electrically conductive liquid to provide breathing signals from the patient to the control hardware.

APPLICATIONS

The technology has several potential end users:

+ **Hospitals and clinics**
+ **Home care providers**
+ **Remote or mobile medical care**

PATENT INFORMATION

US Patent numbers 11,033,706; 11,197,972; 11,364,360; and 11,559,655

CONTACT INFORMATION

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TECHNOLOGY SOLUTION

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