



technology opportunity

Hypoxia Detection and Warning System

Method and apparatus for monitoring oxygen partial pressure in air masks



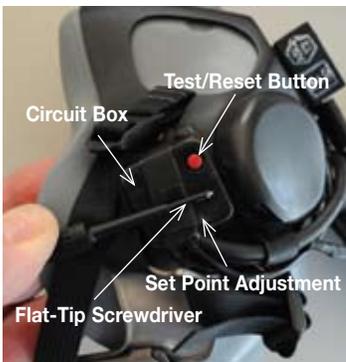
Researchers at NASA's Johnson Space Center have developed an innovative oxygen warning system capable of detecting and preventing oxygen deprivation, or hypoxia, in the user. If oxygen partial pressure dips below a safe, predefined level, the sensor's alarm and aggressive vibration are capable of arousing an individual who may have become impaired by symptoms of hypoxia such as drowsiness, slowed reaction times, and blackouts. The partial pressure warning system can be incorporated into virtually any commercially available oxygen mask.

Benefits

- **Effective:** The “nose beater” vibration and high-pitched alarm alerts an individual who may otherwise be too groggy to respond to hypoxia.
- **Targeted for hypoxia:** The sensor measures the partial pressure of oxygen, which correlates more highly with hypoxia than the measurements of other oxygen sensor systems that typically only measure oxygen concentration.
- **Precise:** The sensor monitors oxygen partial pressure within the air mask, rather than within the supply air, allowing for more accurate analysis of the air the user is actually breathing.
- **Fail-safe:** The sensor functions independently of the oxygen or air system, so it can provide accurate detection and warnings in the event of an oxygen system failure.
- **Easy to implement:** The system relies on communication wiring already present in oxygen masks and therefore requires minimal modifications and production costs.

Applications

- Military aviation
- Firefighting
- Respiratory and life support systems
- Scuba diving
- Underwater welding
- Mountain climbing
- Industrial sites with hazardous-breathing environments



Circuit box showing red test/reset button and alarm set point adjustment

Technology Details

NASA's oxygen sensor was originally developed to reduce the incidence of hypoxia in aircraft pilots. The innovation has several applications beyond aerospace, including oxygen systems for the military, firefighting, scuba diving, mountain climbing, as well as medical oxygen systems.

How it Works

The oxygen partial pressure sensor and vibrating alarm is composed of an electrochemical oxygen sensor, a voltage comparator, and a vibrator motor. All of these components are installed directly within the breathing mask. When the partial pressure of oxygen in the system falls below a predefined set point, as measured by the electrochemical oxygen sensor, the voltage comparator triggers the vibrator motor to deliver vibration within the mask. In the event of an oxygen system malfunction, this sensor's vibration provides immediate warning that hypoxia conditions exist. The sensor's vigorous tactile and aural stimulation allows the user to take corrective action before succumbing to the dangerous, and potentially fatal, effects of hypoxia.

Why it is Better

Currently available oxygen sensors are limited in three important ways:

1. Oxygen concentration sensors are not capable of monitoring oxygen partial pressure.
2. Sensors are typically placed upstream of the oxygen breathing system, which makes it hard to detect problems in connections, hoses, mask fit, etc.
3. Other sensors do not provide tactile stimulation when hypoxia is detected.

This sensor measures the product of oxygen concentration and total ambient pressure (oxygen partial pressure). Thus the sensor will trigger

the alarm circuitry for low oxygen concentration at constant total pressure, constant oxygen concentration at low total pressure, and any combination of low oxygen concentration and low total pressure that drops the product below a user-defined set point. The high-pitched alarm provides a warning system that alerts the user, along with others in the vicinity, of life-threatening hypoxia conditions, and the "nose beater" vibration is vigorous enough to stimulate the user to take corrective action.



Patents

Johnson Space Center has received patent protection (U.S. Patent No. 7,040,319) for this technology.

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing this Method and Apparatus for Monitoring Oxygen Partial Pressure in Air Masks (MSC-23309-1) for commercial applications.

For More Information

If you would like more information or want to pursue transfer of this technology, please contact:

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For more information about other technology licensing and partnering opportunities, please visit:

Advanced Planning Office

NASA's Johnson Space Center

Web: <http://technology.jsc.nasa.gov>