

NASA TECH BRIEF

Manned Spacecraft Center



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An Efficient Prebreathing Apparatus for Humans During Decompression

The problem:

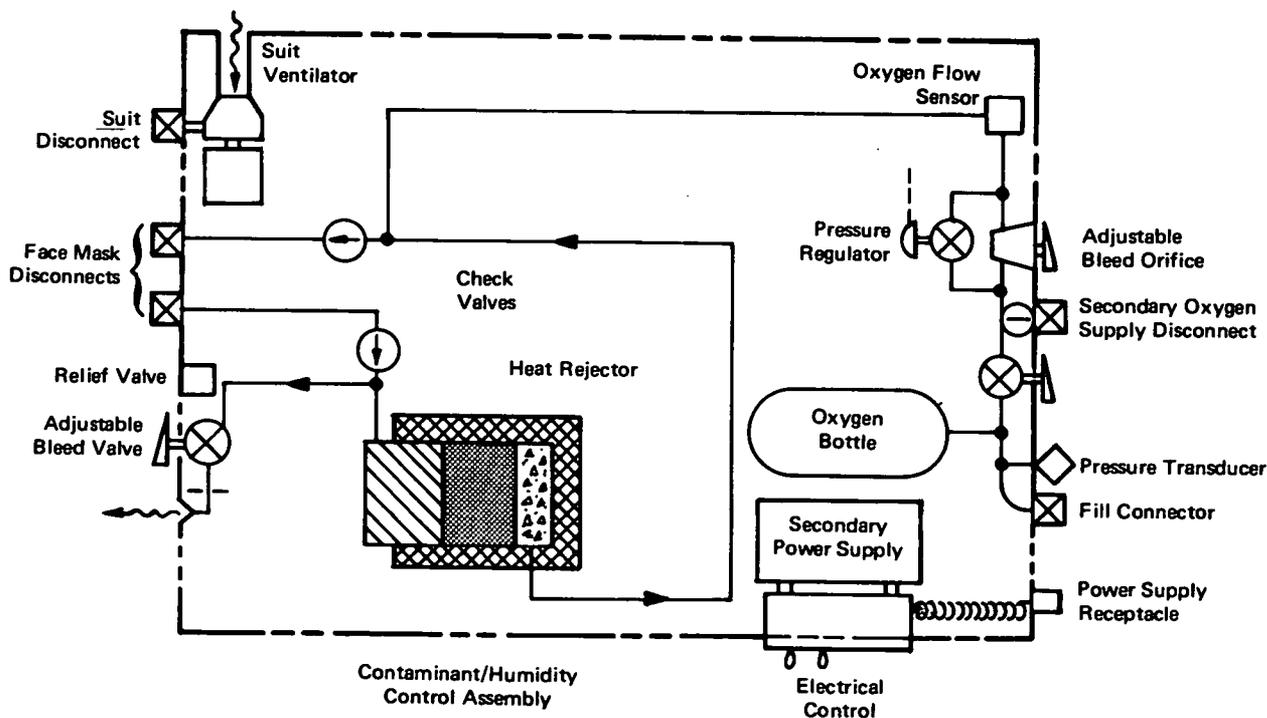
Humans subjected to decompression require prebreathing of oxygen. Oxygen, in this case, reduces dissolved inert gases in the human body to a level that exists under normal atmospheric pressure and thus eliminates the risk of decompression sickness (dysbarism). In enclosed environments, the existing systems used for such prebreathing release all of the oxygen that is not metabolically consumed into the enclosure and thus increase fire hazards. Also, they increase the total atmospheric pressure within the enclosure which requires undesirable cycling of enclosure pressure relief valves to the outside.

The solution:

A portable prebreathing system was developed which recirculates and reconditions the respiratorily exhaled oxygen. It reduces fire hazards, simplifies prebreathing procedures, and does not require any extensive usage of enclosure venting systems.

How it's done:

In application of the prebreathing apparatus, shown in the figure, the user connects the two hoses of the mask/hose assembly to the prebreathing assembly and dons the face mask. The prebreathing assembly is activated by opening the adjustable bleed valve in conjunction



(continued overleaf)

with the adjustable bleed orifice and opening the primary oxygen supply shutoff valve. Initially, the assembly is set at the high purge rate, approximately 2.73 kg/hr (6.0 lb/hr), for a predetermined time (approximately two minutes) then the adjustable valves are reset to the nominal oxygen bleed rate of 0.0455 to 0.091 kg/hr (0.1 to 0.2 lb/hr). The makeup oxygen being supplied from the high pressure storage bottle is mixed with the reconditioned respiratory gas prior to going to the mask.

The gas expired by the user re-enters the prebreathing assembly where carbon dioxide, water vapor, odors, and trace contaminants are removed by a replaceable chemical bed containing lithium hydroxide, silica gel, and charcoal, respectively. The reconditioned oxygen is then recirculated back to the user. The bleed/purge capability is provided to reduce the nitrogen content of the recirculated gas. In addition to the nitrogen, a small amount of the oxygen, water vapor, carbon dioxide, and trace contaminants are vented to the surrounding environment. The heat of reaction from the chemical bed is rejected to the surrounding environment by either radiation or forced convection. A pressure regulator in the prebreathing apparatus maintains the oxygen face mask at a pressure slightly above ambient pressure. A pressure relief valve is provided in case pressure exceeds expected values.

Notes:

1. In addition to the described function, the system can ventilate space suits. Approximately 17 m³/hr (10 cfm) are provided by the fan.
2. This system can be used as a compact oxygen respirator, which provides extended capability.
3. Requests for further information may be directed to:
Technology Utilization Officer
Manned Spacecraft Center
Code JM7
Houston, Texas 77058
Reference: TSP72-10690

Patent status:

NASA has decided not to apply for a patent.

Source: J. R. Jaax
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