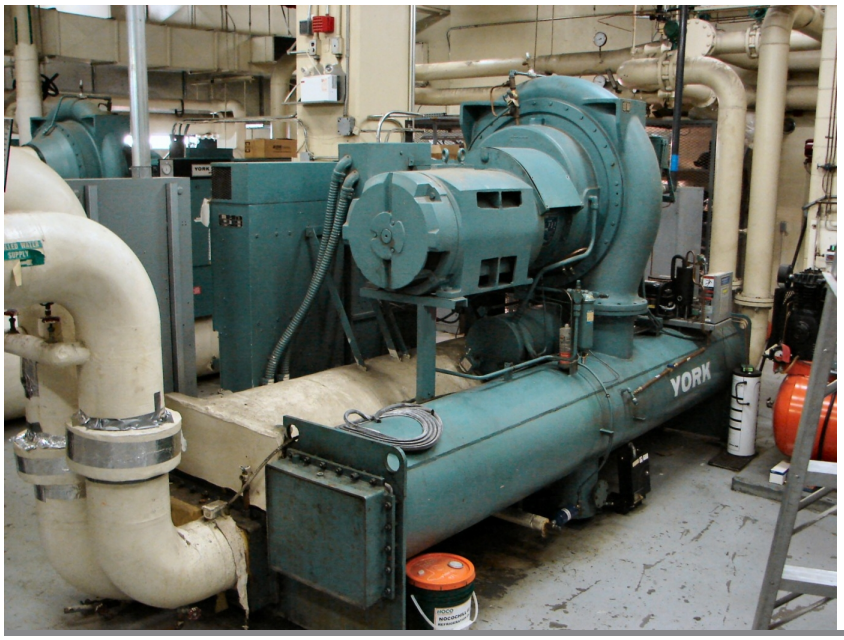


National Aeronautics and Space Administration

NASA

TECHNOLOGY SOLUTION

Mechanical and Fluid Systems

Variable-Aperture Reciprocating Reed (VARR) Valve

Proportional flow control back and forth between two chambers

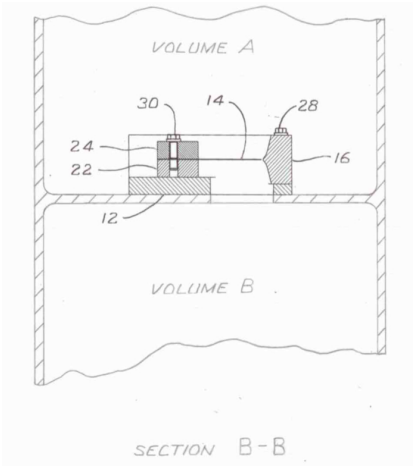
Engineers at NASA's Marshall Space Flight Center have developed a new reed valve for controlling fluid flow back and forth between two chambers. The VARR valve provides two-way flow that is proportional to flow demand. As the pressure gradient builds on one side, the reed valve responds by opening an amount that is proportionate to the gradient, or demand, allowing bidirectional flow. Some mechanical and fluid systems that rely on the controlled flow of fluids between chambers will benefit from the new design. Compared to current fixed orifice devices, VARR may expand the performance envelope by offering a more continuous flow response in applications in which the pressure environment is constantly changing. Proportional two-way flow can enable a fine-tuned system response to pressure building on one side of the valve. In these changing gradient conditions, the reed valve is better than fixed-sized orifices, which are optimized for one flow condition and are likely to over- or under-restrict flow for all other flow gradients.

BENEFITS

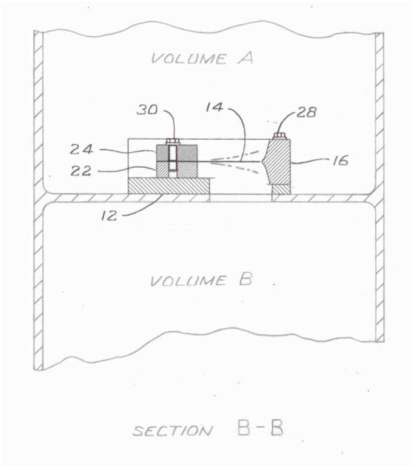
- Reversible: The design allows for reversible flow, while most existing variable-aperture devices or mechanisms are designed to flow in only one direction.
- Adjustable: The shape of the reed tip and the valve housing provide small, large, or highly nonlinear flow vs. pressure differential performance.
- Widely applicable: This device can be tuned to operate as a flow meter over extremely large flow ranges as compared to fixed-orifice meters.
- Fixed at low pressure: The tunable nature of the petal allows the VARR to function as a fixed orifice at the low pressure differential that occurs prior to deflection.

THE TECHNOLOGY

The VARR valve has been designed to provide a variable-size aperture that proportionately changes in relation to gas flow demand. When the pressure delta between two chambers is low, the effective aperture cross-sectional area is small, while at high delta pressure the effective aperture cross-sectional area is large. This variable aperture prevents overly restricted gas flow. As shown in the drawing below, gas flow through the VARR valve is not one way. Gas flow can traverse through the device in a back-and-forth reversing flow manner or be used in a single flow direction manner. The contour shapes and spacing can be set to create a linear delta pressure vs. flow rate or other pressure functions not enabled by current standard orifices. Also, the device can be tuned to operate as a flow meter over an extremely large flow range as compared to fixed-orifice meters. As a meter, the device is capable of matching or exceeding the turbine meter ratio of 150:1 without possessing the many mechanical failure modes associated with turbine bearings, blades, and friction, etc.



The reed valve has a flap (14) covering an orifice between two fluid-filled chambers. The flap in the image above is at rest.



As the pressure gradient builds on one side, the flap responds by opening by an amount that is proportional to the gradient, as indicated by the dashed line above.

APPLICATIONS

The technology has several potential applications:

- Air conditioning systems
- Flow control and exhaust management for two-cycle engines used in lawn equipment, jet skis, motorbikes, and snowmobiles, etc.
- Flow-limiting devices such as variable flow/variable delta pressure response flow meters
- Linearized delta pressure flow meters; expanded operationally range flow meters
- Vibration control enhancement for fluid, tuned mass, and hydropneumatic systems
- Shock absorbers and transient shock attenuators
- Burst diaphragms
- Pressure relief valves

PUBLICATIONS

Patent No: 8,939,178

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