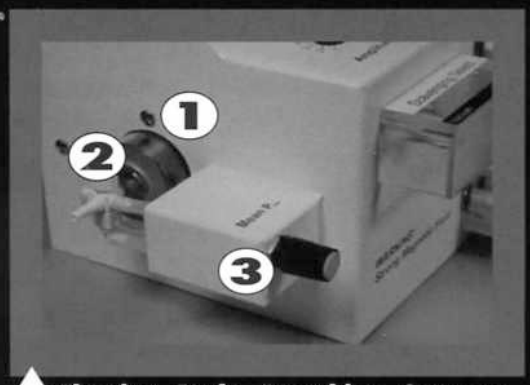
# how it WORKS

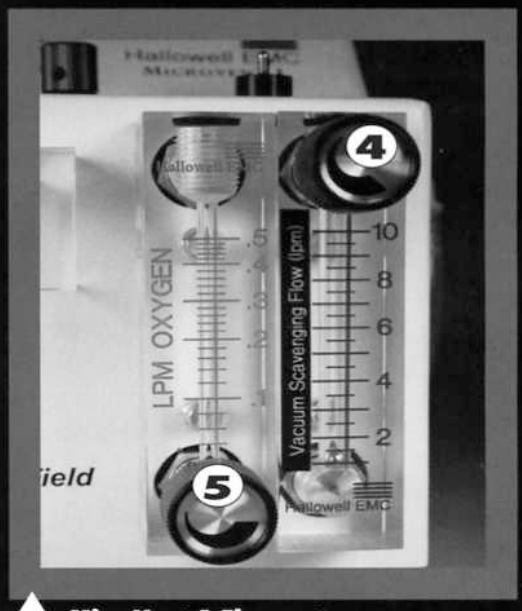
## SMALL ANIMAL VENTILATION

**Problem: Minimizing respiratory movement during thoracic microsurgery in mice**

**Solution: A high frequency oscillatory ventilator for the smallest animals you are capable of intubating**




**Floating Puck, Breathing Systems, and Needle Valve**




**MicroVent 1 Flowmeters**

The MicroVent 1 from Hallowell EMC is a dual mode ventilator. It delivers standard intermittent positive pressure ventilation (IPPV) at 75 to 240 bpm or high frequency oscillatory ventilation (HFOV) at 750 to 2400 "bpm." The entire breathing system has a volume of 0.6 cc. There are four parameters to control, Oxygen flow, Frequency (breaths per minute), Amplitude (tidal volume), and Mean Airway Pressure (Mean $P_{aw}$). No anesthesia machine is required, only a vaporizer for procedures involving gas anesthetics.

A small flow of fresh gas, in the range of 50-100ml/min, is set. This gas can be oxygen as provided by the built-in flow meter ⑤ or any mixture of gases provided from an external source. When using gas anesthetics, this fresh gas flows through an anesthetic vaporizer and on to the breathing system ② where it passes the patient connection, flows through an open needle valve, ③ and on to a scavenging system if required. The animal may breathe spontaneously from this stream of gas as it passes the patient connection at all times. The needle valve is used to restrict the flow of this gas stream and thereby adjust the Mean $P_{aw}$. This pressure will hold the lungs expanded permitting continuous gas exchange with a minimum of atelactatic alveoli. Also connected to the breathing system at the patient connection is a glass cylinder containing a floating puck ①. With "all" the alveoli held open in a steady state the puck is set in motion as per the settings for amplitude and frequency. During HFOV, minuscule tidal volumes are superimposed on the mean pressure to promote gas exchange by molecular diffusion and a number of other mechanisms. No longer do you have the gross movement of the respiratory cycle so distracting to the microsurgeon.

Gas exchange during HFO ventilation is accomplished via several mechanisms. Traditional convective or bulk flow occurs in the proximal airways very close to the endotracheal tube. Molecular diffusion motivated by the partial pressure gradients of the gases of interest in the system, $O_2$, $CO_2$ and anesthetic primarily. Turbulences produced by bulk flow, Taylor dispersions, pendelluft flows, asymmetric velocity profiles between the center and the edges of the airway lumens, and cardiogenic mixing from the contracting heart are some of the known mechanisms involved.

Incorporated into the MicroVent 1 is a waste gas scavenging interface that allows you to connect directly to any scavenging system, direct vacuum, an active or a passive scavenging system. When connected directly to a vacuum source the scavenging flow is set with a flow meter ④ on the front panel.

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