

Flow is calculated from the simple relation:

$$\dot{V} = \frac{V \times 60}{t}$$

where \dot{V} is flow in liters per minute, V the volume of the burette in liters, t time in seconds, and 60 the seconds-to-minutes conversion factor.

THE APPARATUS

Simple burettes, without stopcocks, of volumes from 10 ml to one liter are available from laboratory supply houses. Those of smaller sizes may be stocked with side arms. Most firms will insert a side arm at slightly extra cost; it should have a $\frac{1}{4}$ -inch diameter. Alternately, a glass T and rubber tubing suffice, as shown in figure 1. A soap reservoir is provided by a medicine dropper bulb, bulb syringe, or a clamped length of rubber tubing. An ordinary stop watch timing to $\frac{1}{10}$ second completes the list of necessary parts. A burette stand and apparatus clamp are useful accessories.

USE

Connect the gas delivery tube of the anesthesia machine to the burette. Choice of burette depends on the flow to be measured, assuring that the bubble does not rise either too fast or too slow for convenient timing. About 20 seconds is a convenient interval. The burette is selected according to the graph in figure 2, choosing that with a line closest to the intersection of the nominal flow and the 20-second ordinate. Thus, a one-liter burette is appropriate for a 5 l/min flow and a 25-ml burette for a 100 ml/min flow.

The reservoir is filled just to the side arm with a mixture of water and high-sudsing detergent; the mix is not critical, and almost any dishwashing detergent will do. Slight compression of the reservoir causes the inflowing gas to blow bubbles. At first they rapidly break as they rise in the dry glass, but they soon wet the walls and rise higher. Tilting the burette or rinsing the walls with solution initially speeds the process.

The measurement begins with a deft but not too violent pinch of the reservoir, so that only one or two bubbles start upward. The interval between passing the lower and upper calibration lines is timed. Repeated measurements should agree within one-tenth of a second.

The defoaming metal sponge of a disposable oxygenator can be used atop the burette to help break up excessive bubbles. With just a little practice, the four to six flowmeters of an ordinary gas machine can be calibrated at two gas flows each, in ten to 15 minutes, and the anesthesia machine cleaned with the fluid bubbled out of the burettes. The major limitation results from the surface properties of volatile agents, which cause poor bubbling with soap mixtures. I empty the vaporizers before testing their flowmeters, but a suitable bubble mixture probably could be found in the new bubble technology.¹

REFERENCE

1. Strong CL: How to blow soap bubbles that last for months or even years (The Amateur Scientist). *Sci Amer* 221:123, 1969

A Safety Modification of the Emerson Postoperative Ventilator

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The Emerson Postoperative Ventilator is valuable for many patients requiring long-term, controlled, constant-volume ventilation.

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Recently, during use of this device in our Intensive Care Units, we experienced difficulty consisting of intermittent, erratic, rapid inspiratory cycling. During these periods, the cycling rate of the ventilator would increase abruptly from 16 to approximately 45 to 50

per minute. This rate change did not allow adequate expiratory time and resulted in excessive pressure within the system. Fortunately, in every instance the patient was disconnected before any adverse effects occurred.

After extensive investigation, it was determined that the erratic performance occurred every hour, lasting approximately 5 to 7 seconds each time. Interestingly, this time period coincided with the audiofrequency signals generated by the Simplex clock-setting system which recently had been installed in our institution. This system uses audiofrequency tone bursts, superimposed on the ac current, to reset the clocks in the hospital automatically.

After consultation with the Emerson and Simplex Companies, it was concluded that the most effective and inexpensive solution, in view of the wide distribution of the clock-reset signal, would be to filter the electrical power within the ventilator. Therefore, a harmonic-neutralized constant-voltage trans-

former of about 400 watts maximum capacity* was added to each of the Emerson units. This transformer can be safely installed by an electrician, using the instructions provided. The total cost, including installation, was approximately \$160.00.

Since this modification, the potentially lethal erratic characteristics of the Emerson Postoperative Ventilator have been eliminated. In our opinion, this experience further stresses the need for all manufacturers of patient care equipment to be cognizant of the potential for electrical interactions which can produce erratic function in solid-state control circuits.

ADDENDUM

Since submission of this information for publication, the authors have been advised by the Emerson Company that the control circuitry in all new Postoperative Ventilator units has been modified to filter out high-frequency interference signals.

* Sola Electric, Elk Grove Village, Illinois 60007. Catalogue number CVS-23-22-150.

CASE REPORTS

Administration of Gallamine in the Presence of Renal Failure—Reversal of Neuromuscular Blockade by Peritoneal Dialysis

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The administration of gallamine, a nondepolarizing muscle relaxant excreted entirely by the kidney,¹ is generally contraindicated in the presence of compromised renal function. However, occasionally it becomes mandatory to administer gallamine when other muscle relaxants are contraindicated because of their pharmacologic side-effects. We present a case report of a man who had acute renal tubular necrosis, hyperkalemia, and severe hypovolemic shock, who received gallamine for the above reason. Neuromuscular blockade was reversed promptly by peritoneal dialysis. Several cases in which blockade induced by gal-

lamine was reversed by hemodialysis have been reported.²⁻⁴ This is the first instance in which peritoneal dialysis has been shown to be effective.

REPORT OF A CASE

A 56-year-old man, was admitted to the hospital with a diagnosis of aortic valvular stenosis. Seven years previously he had undergone debridement of the aortic valve for aortic stenosis. About one and a half years prior to the present admission, he had developed atrial fibrillation and congestive heart failure. From that time he had been retracted to a bed-chair existence.

On February 14, 1969 the patient underwent replacement of the aortic valve, with two hours and two minutes of cardiopulmonary bypass. The pharmacologic responses to both succinylcholine and *d*-tubocurarine were clinically normal during the procedure. Postoperatively, the patient was oliguric and hypotensive, and required epineph-

Received from the Anesthesia Laboratory of the Harvard Medical School at the Massachusetts General Hospital and the Department of Pharmacology, Harvard Medical School, Boston, Mass. Supported in part by USPHS Grant GM 15904-3.