slope of the record of the gas concentration. The present apparatus was designed to ensure rapid mixing and continuous sampling for individual gas concentrations without losing any volume, as the gas going to the analyzer is fed back to the system so that total expired volume remains unaltered.

The apparatus (fig. 1) consists of a 12-inch diameter plexiglass cylinder with an inner partition. The proximal chamber, towards the left side of the figure, is approximately 3 liters in volume. The fan at the bottom of the chamber is driven electromagnetically and the motor is located outside the chamber, thus preventing any alteration in temperature of the mixing and sampling chambers. Outgoing gas passes through four circular holes (thick arrows), each with half the diameter of the intake-tube, so that total incoming and outgoing circumferences are the same. Mixed gas is sampled by a glass tube through a hole at the center of the partition. The distal part of the apparatus acts as a buffering chamber and the returning gas from the analyzer is fed back into this chamber at the center of the outlet. This helps in rapid evacuation of this chamber by setting up a venturi effect.

This apparatus is airtight and has negligible resistance. Variation in temperature is so minimal that temperature correction is not necessary. The initial response time for adults is 18–20 seconds, since only three breaths provide adequate air to fill the bottom half of the mixing chamber.

The author wishes to thank Mr. Robert Maclean for building the apparatus and Mr. G. Wagener for making necessary modifications.

References

1. Krogh, A., and Lindhard, J.: On the average composition of alveolar air and its variation during respiratory cycle, J. Physiol. 47: 431, 1913–1914.
2. Comroe, J. H., Jr., Forster, R. E., Dubois, A. B., Briscoe, W. A., and Carlsen, E.: The Lung. Second Edition. Chicago, Year Book Publishers, 1962, pp. 338–339.
3. Briscoe, W. A., and Courand, A.: Uneven ventilation of normal and diseased lungs studied by open-circuit method, J. Appl. Physiol. 14: 289, 1959.
4. Bates, D. V., Boucot, N., and Dormer, A. E.: The pulmonary diffusing capacity in normal subjects. J. Physiol. 129: 237, 1955.
5. Sackner, M. A.: Personal communication.

A Simple Device for Continuous Measurement of Inspired Oxygen Concentration

Kenneth M. Janis, Capt., USAF, MC,* and J. D. Schulz, SSgt, USAF †

There is increasing recognition of the need for continuous monitoring of inspired oxygen concentrations delivered by ventilators to critically-ill patients. Despite advances in the development of calibrated air–oxygen mixing devices, it is nonetheless still important to have the capability for continuous recording of moment-to-moment changes in the delivered concentration of oxygen.

* Anesthesiology Service, Wilford Hall USAF Medical Center, Lackland Air Force Base, Texas.
† Inhalation Therapy, Wilford Hall USAF Medical Center, Lackland Air Force Base, Texas.
The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Air Force or the Department of Defense.

At Wilford Hall USAF Medical Center the device described here (fig. 1) enables the physician and nurse to be continuously cognizant of changes in the inspired oxygen concentration. The figure shows a standard plastic three-way stopcock,‡ attached to *B*, the input line of a Beckman oxygen analyzer.§ The male arm of the plastic stopcock is inserted into the superior opening of a standard Bird ¶ Y piece connector, *C*, which is in turn attached to the patient (*D*). The entire assembly is then connected to the ventilator. When the control lever of the stopcock is

‡ Tomac, American Hospital Supply, Evanston, Ill.
§ Beckman Instruments, Fullerton, Calif.
¶ Bird Corp., Palm Springs, Calif.

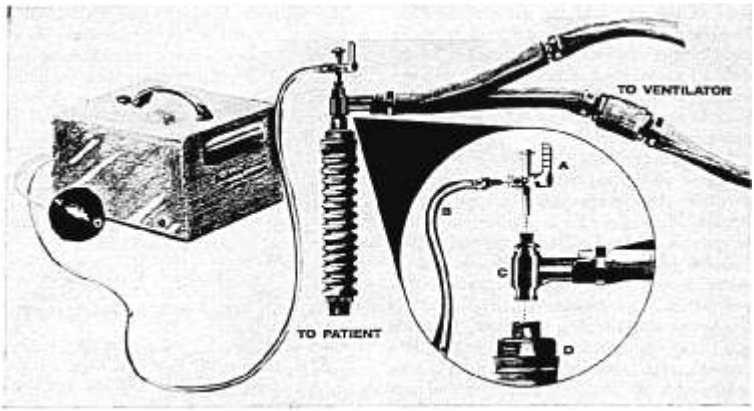

FIG. 1. Device for continuous oxygen measurement.

placed as shown in the figure the inspired partial pressure of oxygen can be monitored continuously as the gas drive of the ventilator will continuously fill the input line of the oxygen analyzer.

Adjustment of the control lever of the stopcock will also permit sampling of gas for measurement in electrode systems, continuous sampling for other measurements (*e.g.*, pneumotachygraph, CO_2 analyzer, etc.), cessation of flow through the O_2 analyzer, or cessation of flow through any portal of the stopcock. This device is inexpensive, simple to install or replace, and allows expansion of monitoring capabilities in patients who require constant ventilatory support.

Bupivacaine Hydrochloride: Laboratory and Clinical Studies

DANIEL C. MOORE, M.D., L. DONALD BRIDENBAUGH, M.D., PHILLIP O. BRIDENBAUGH, M.D., GEOFFREY T. TUCKER, PH.D.

A long-acting anilide local anesthetic agent, bupivacaine (1-n-butyl-DL-piperidine-2-carboxylic acid-2,6-dimethylanilide hydrochloride) (LAC 43, Marcaine), was synthesized in 1957 by Af Ekenstam *et al.*[1] Its chemical and pharmacologic properties have been studied in the laboratory, and at least 24 reports of its clinical use in Europe, Japan, and South America have appeared.[2-26]

The present study of bupivacaine was designed to: 1) measure bupivacaine in whole blood over a four-hour period following a single dose, as an index of elimination from the blood; 2) discern toxicity, *i.e.*, changes in blood morphology, blood chemistry; and urine; 3) correlate dosage with blood levels and de-

Received from the Mason Clinic and the Virginia Mason Research Center, Seattle, Washington 98101. Supported in part by U. S. Public Health Service grant IR01 GM 14416-01 from the National Institutes of Health.