the physician's airway from contamination by the victim's exhalation, the nonrebreathing valve should insure a prompt release of the increased airway pressure which occurs at the termination of the patient's forced inspiration. This increase can be equalized mechanically by a pressure-deflecting valve, preferably of the mushroom type (fig. 1), or by a separate pop-off valve, as in the commercially-available derivative of the Chemical Warfare Laboratory resuscitator (fig. 2). The addition of the breathing tubing will cause an increase of respiratory resistance, while the addition of the pop-off valve will limit the available inflation pressure. If the breathing tubing is incorporated into the rescuer's deadspace its content should be kept at 300 ml to assure an optimal balance between the retention of CO₂ and the amount of fresh air which flushes the tubing with each respiratory cycle.

In the use of this ventilator, the resicer follows the usual procedures for instituting respiratory measures, ensuring the patient's airway and determining the adequacy of ventilation. In our experience we have been able to observe adequate chest expansion in all patients, including several robust men. We were impressed also by the greater ease of operation and decreased effort required on the part of the resicer, compared with the usual method of cardiac resuscitation. These advantages constitute coronary artery protective factors of some value, to the older physician in particular.

REFERENCES


A Cardiotope Recording System

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The moment-to-moment contact provided by the oscillographic display of an ECG has proven to be a valuable adjunct in patient management. Unfortunately, the problems associated with making simultaneous permanent records of important ECG changes and the time sequence of antiarrhythmic drug therapy, variations in ventilation or anesthetic depth, etc., have limited the applicability of this monitoring approach. In particular, the teaching value of dynamic sequential ECG changes often is lost in trying to recapitulate life-threatening situations from static records. The Cardiotope Recording System, developed at the University of Kentucky Medical Center, represents one approach to high-quality permanent ECG recording with minimal technical and logistic difficulties. This system, assembled from commercially-available electronic equipment, utilizes one channel of a standard stereophonic tape recording for the
ECG and the second channel for voice commentary. This arrangement was selected to facilitate correlation of dynamic ECG recordings with accurate time-sequence events, a feature of great significance when using the recorded material for teaching purposes. This report describes the circuitry, physical arrangement of the components and the specially designed d.c. operational amplifier utilized in the system.

Figure 1 illustrates the components employed. These include: a Model 2, FM Recording Adapter (A. R. Vetter Co., Lemont, Pa.); a Model TC-330C, Sony Taperecorder (Superscope, Inc., Los Angeles, California); a Model 502A, Tektronix Dual-Beam Oscilloscope (Tektronix, Inc., Portland, Oregon); and a Model 510C, Shure Controlled Magnetic Microphone (Shure Brothers, Inc., Evanston, Illinois).

The d.c. amplifier module, including a Nexus ESL-1 (Nexus Research Labs., Inc., Canton, Mass.) operational amplifier connected as a differential input, single-ended output conditioning amplifier was developed specially for use in the system (fig. 2). This module was employed to raise the signal amplitude to meet the input requirements of the FM adapter and

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**Fig. 1. Schematic representation of components used in Cardiotape System. Refer to text for details.**

**Fig. 2. D.C. amplifier module developed for use in the Cardiotape System.**
to eliminate the 2–3 volt common mode voltage present at the O.R.M. (Electronics for Medicine, White Plains, New York) "recorder" output jack. The gain of approximately 30 of this module is determined by the 680K resisters in the amplifier circuit in conjunction with the 22K output resistances of the O.R.M. The ten-turn potentiometer provides for balancing differential d.c. signals appearing in the O.R.M. circuit. The O.R.M. "recorder" jack ECG signal source was selected to provide maximum flexibility and to provide maximal patient isolation from electrical hazard.

An additional design consideration was the direct coupling of the ECG signal from the d.c. amplifier to the oscilloscope. (fig. 1). This arrangement facilitates continuous remote visual monitoring of the "live time" ECG tracing during recording intervals and permits the comparison of recorded tracings with the "live time" ECC. This feature has been particularly useful when comparing pre- and post-therapy ECC configurations.

The total cost of the caster-equipped, rack-mounted system (fig. 3), including engineering and technical costs, was approximately $1,000, a figure which could be reduced appreciably by utilizing a less sophisticated tape deck and oscilloscope.

In practice the Cardiotape System has proven to be a versatile, reliable, relatively inexpensive unit for the dynamic recording and replay of ECC abnormalities. The voice channel has proven acceptable and quite useful for patient identification, event-sequences, therapeutic techniques and other commentary relative to changes in the ECG patterns. When a sufficient spectrum of both normal and abnormal ECG tracings has been obtained and appropriately edited, it will be made available as a comprehensive library for ECG training.

Surgery

THROMBOPHLEBITIS Postinfusion thrombophlebitis is often due to the 3- to 5-pH range of the most commonly-used glucose solutions. Neutralization is believed to be the most important factor in reducing the incidence of phlebitis. Because of the instability of glucose solutions maintained in a neutral or basic environment for prolonged periods, it is recommended that bicarbonate be added to the infusion solution immediately prior to use. (Fonkalsrud, E. W., and others: Reduction of Infusion Thrombophlebitis with Buffered Glucose Solutions, Surgery 63: 280 (Feb.) 1968.)