

the gauze with little increase in air-flow resistance, and pneumotachometer sensitivity remains unchanged. The resistance of the trap itself is 0.3 cm H<sub>2</sub>O/l/sec. It is difficult to estimate the functional deadspace accurately because of the almost directly opposed inlet and outlet. The inlet and outlet tubes alone

have a deadspace volume of 15 ml. The volume of the chamber by itself is 15 ml. The maximum deadspace possible is 30 ml. The units are sufficiently inexpensive that several sterile complete units with gauze already in place can be kept on hand for easy replacement.

## A Safety Signal for Detection of Excessive Anesthetic Gas Flows

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In many institutions it is common practice to drain the gas lines of the anesthesia machines at the end of the working day by turning the pin valve to the full-open position. At times these valves are inadvertently left open. At the start of a new day, when the gas cylinders are opened or gas supply hoses connected to central outlets, the bobbins are projected to the top of the glass column with such speed that it goes unnoticed. This has led to serious overdosages of anesthetic gases. Fortunately, there have been no fatalities or permanent sequelae in this institution. The most common alerting sign has been "dark blood" in the operating field especially when the offending agent was nitrous oxide.

Using a closed system, it becomes immediately obvious when excessive gases are flowing, as evidenced by an overdistended reservoir bag. However, with a semiclosed system, the fault is more difficult to detect since the gas escapes from the pop-off valve and distention of the rebreathing bag may not occur.

We have developed a mechanical device which provides a visual warning of excessive gas flows. A lightweight aluminum pin is contained in an airtight lucite chamber attached to the top of the flow column. The pin has a

bright red top for easy visualization. Should the bobbin come into contact with the pin (as it would during excessive flow rates), the bob-

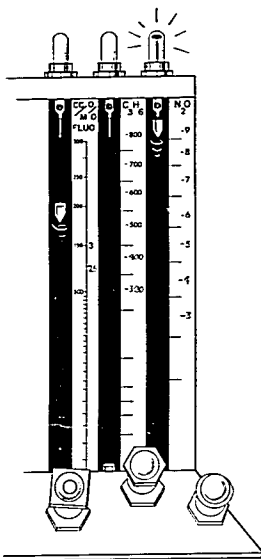


Fig. 1. Signal device in the raised position (right) during excessive gas flow.

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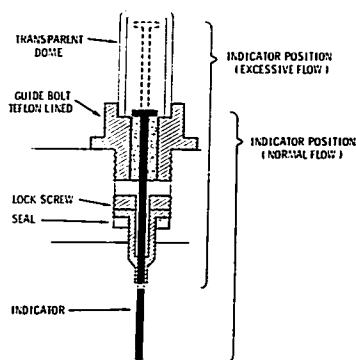


FIG. 2. Signal device in raised and lowered positions.

bin would push the pin upward and the red top would be visible through the lucite chamber (fig. 1).

We chose the Foregger anesthesia machine as subject for our first prototype, but we believe that the device can be applied equally well to other anesthesia machines. A mechanical drawing of the device is shown in figure 2.

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### Pneumatic Exsanguination for Intravenous Regional Anesthesia

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Intravenous regional anesthesia is a simple procedure readily performed even by one inexperienced with the technique. It may be the anesthesia of choice for elective surgery in patients with severe impairment of cardiac reserve, since the blood levels of local anesthetic resulting from this type of anesthesia, when properly conducted, are considerably lower than those resulting from brachial plexus anesthesia.<sup>1</sup>

One of the problems originally associated with the intravenous regional anesthesia technique was that of tourniquet pain. This was largely solved by application of a double-cuffed tourniquet or a second tourniquet distal to the first in the area of anesthesia, with subsequent removal of the proximal cuff.<sup>2,3</sup> However, another problem which has remained unsolved is that presented by the patient with trauma to the hand or arm so that application of an Esmarch bandage is too painful, and even simple elevation of the extremity as a compromise to produce some degree of exsanguination is unbearable. In this situation inadequate exsanguination all too often results in spotty or absent anesthesia. In addition,

back-bleeding becomes a significant problem during the course of surgery.

For such situations we have developed a painless technique of pneumatic exsanguination (fig. 1). When the patient is positioned on the surgical table, the painful extremity is placed in an inflatable arm splint<sup>4</sup> designed for the stabilization of fractures. After venipuncture has been accomplished with a rubber-stoppered butterfly needle, the zipper is closed. The splint is then inflated to a pressure that exceeds arterial pressure, either by using a hand pump (fig. 1B) or, more simply, by attaching the delivery tube of an anesthesia machine and filling the splint with nitrous oxide.

Usually, as the pressure in the splint increases the pain in the extremity decreases, particularly if the injury is an unstable fracture. After the appropriate pressure has been reached in the splint, the proximal cuff of the double-cuffed tourniquet is inflated, the pneumatic splint is deflated and unzipped, and the intravenous injection of local anesthetic is made via the butterfly needle (fig. 1C). When

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\* Available as Redi Splint (Half-Arm Splint #30-966-1), Parke, Davis and Company, Detroit, Michigan 48232.