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# Modifications of Sanders' technique of ventilation during bronchoscopy

JANE L. BRADLEY, E. N. MOYES, and F. W. PARKE

*Worcester Royal Infirmary, Worcester*

Improvements in Sanders' method of pulmonary ventilation for bronchoscopy under general anaesthesia are described.

The introduction of Sanders' (1967) technique of pulmonary ventilation has simplified general anaesthesia for bronchoscopy. With this technique anaesthesia is obtained by the administration of thiopentone and relaxation by the intermittent administration of suxamethonium, following preoperative medication. After induction, the bronchoscope is passed into the trachea in the usual way and ventilation is achieved by the intermittent injection of oxygen under pressure through a small needle down the bronchoscope. Air is entrained by a Venturi effect through the open proximal end, and there is sufficient pressure and flow at the distal end of the bronchoscope to inflate the lungs. The bronchoscopist can observe the normal dilatation and contraction of the bronchi with respiration and can work unimpeded for as long as necessary.

Sanders' equipment is simple and cheap and consists of: (1) a removable clip with a needle of appropriate size, which can be fixed on to the proximal end of an unaltered bronchoscope. The needle forms the injector; (2) a pressure line connecting the $O_2$ source and the bronchoscope; (3) a tap in the pressure line worked manually to interrupt the oxygen flow; and (4) an $O_2$ supply, either piped or from a cylinder, with a pressure regulating valve at the outlet.

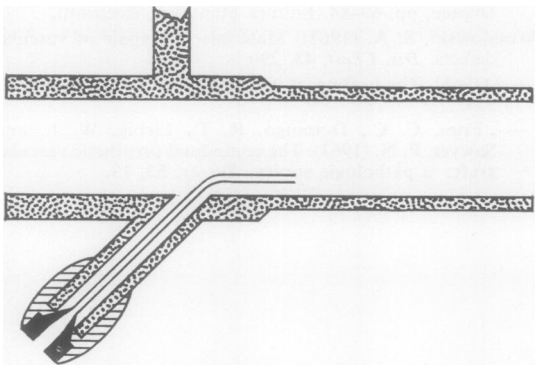

FIG. 1. *Cross-section of a modified bronchoscope.*

Spoerel (1969) changed the injection needle mount and used a Bird Mark II ventilator to supply intermittent oxygen. Hart (1970) used Spoerel's injector needle mount but provided intermittent oxygen by using soft, light plastic tubing, which can be manually occluded by a simple disposable plastic drip clamp. The present article describes further modifications which have been made in an attempt to improve and simplify the use of the apparatus.

## THE APPARATUS

The modified apparatus consists of the following: (1) A permanent alteration is made to an adult Negus bronchoscope to avoid the encumbrance of a detachable clip holding the needle (Fig. 1). A 16 s.w.g. 2-in (5·08 cm) Luer needle of internal diameter 0·043 in (0·109 cm) is inserted into the oxygen inlet of the bronchoscope. It is bent to point distally and lies close to the internal wall of the bronchoscope, leaving a completely clear field of vision. The needle is welded in position and thus becomes an integral part of the bronchoscope.

(2) The oxygen supply line consists of normal high-pressure tubing to a valve, and light plastic tubing from the valve to the inlet needle. The plastic tubing used is cut from an Avon A14 intravenous infusion set, and can withstand pressures up to 90 lb/sq in (621·0 kN/m²). The tubing is plugged into the modified oxygen inlet by a male Luer fitting.

(3) Manual interruption of the oxygen flow is replaced by an electronically operated solenoid valve. This frees the hands of the anaesthetist and allows him to inject anaesthetic and relaxant

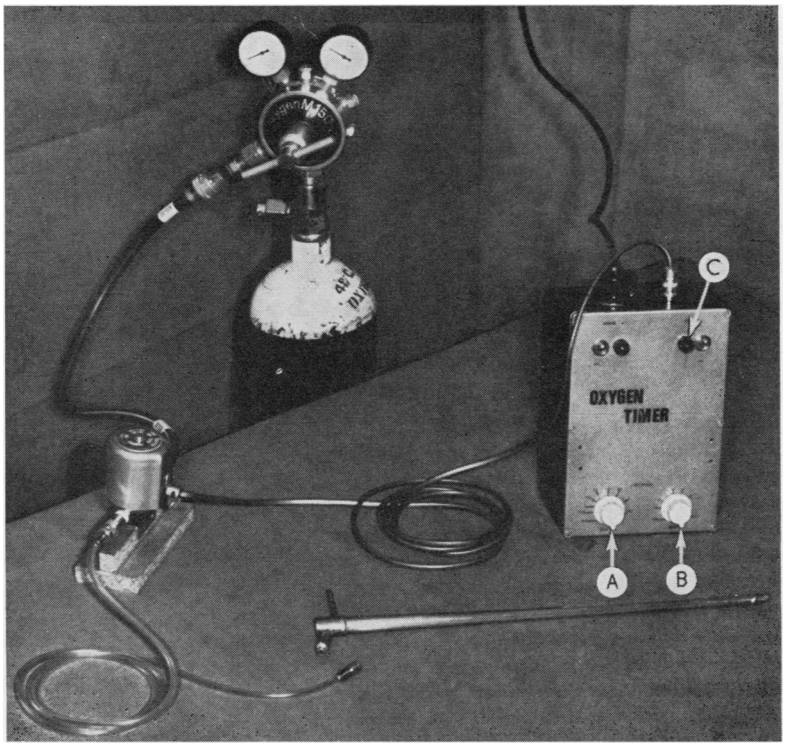


FIG. 2. *See text.*

agents without the help of an assistant. This valve must be mounted upright, with the gas flow horizontal and the coil directly above the valve, and is conveniently clamped to the oxygen cylinder carrier.

The solenoid valve is activated by a timing mechanism, which has two variable controls (Fig 2). Control A gives a continuously variable inspiratory time from 0·5 to 3 seconds. Control B gives a continuously variable expiratory time from 2 to 9 seconds. These controls are calibrated with an accuracy of ±10%. A lamp (C) on the control box lights up during the inspiratory cycle to give a visual indication of its timing. The control box is powered by 230 to 250 volts, AC mains, and the case is earthed. The output to the valve is 24 volts DC, which opens it. The valve is shut when no power is applied, so no oxygen will pass should the power fail.

(4) The oxygen supply is a cylinder of 120 $ft^3$ (3·4 $m^3$) with a variable control-reducing valve BOC M.150.OG. The pressure line is connected by a Schrader pop-off safety valve.

The whole apparatus is cheap and easy to assemble. Its simplicity and efficiency in use are impressive. Test bag measurements give distal end bronchoscope pressures of 25 mmHg and 35 mm Hg at oxygen pressures of 40 lb/sq in and 50 lb/sq in (276·0 and 345·0 $kN/m^2$) respectively. Our blood gas analysis results confirm the findings of Pender, Winchester, Jamplis, Lillington, and McClenahan (1968), who showed that $PO_2$ levels are well maintained and $PCO_2$ levels fall during this type of ventilation. The timing mechanism measures $8 \times 6 \times 4$ in ($20 \times 15 \times 10$ cm) in its box. It and the valve cost £30 and conform to the Ministry of Safety Standards for use with inflammable anaesthetic agents.

We are indebted to J. M. Bryant, Esq., 29 Arle Gardens, Cheltenham, Glos, who made and supplied the electronic timer and valve.

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