A PRESSURE-OPERATED COLLECT VALVE FOR RESPIRATORY STUDIES DURING INTERMITTENT POSITIVE PRESSURE VENTILATION

BY

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During the inflation phase of intermittent positive pressure ventilation gas is compressed in the tubes and connections between the valves of the ventilator and the patient. In machines where the valves are an integral part of the mechanism of the ventilator, and are therefore situated at some distance from the patient, the volume of gas compressed in the collecting tubes may be appreciable. The compressible volume is increased if a humidifier is included in the circuit. During expiration the compressed gas mixes with the gas expired from the patient. The true volume of gas delivered to the patient is therefore less than the expired volume measured by a gas meter on the expiratory side of the ventilator. Furthermore, that part of the compressed gas which has a composition similar to inspired gas will also alter the gas tensions present in expired gas. Although such a dilution effect does not affect the accuracy of measurements of oxygen consumption it tends to cause an increase in measured deadspace. If the volume of compressed gas is known, a correction can be applied (Pauca and Sykes, 1966). However, it is simpler to separate the compressed gas from the volume of gas which has actually entered the airways by means of a collect valve. Many designs have been tried but the following appears to be most satisfactory.

The valve consists of two concentric perspex cylinders, the outer forming the casing of the valve and the inner holding the valve flaps (fig. 1). The inspiratory valve consists of a stiff rubber flap valve, mounted on a central pin, or a rubber-backed spring-loaded disc valve. The valve spring is long to ensure constant thrust despite a 2–3 mm lift of the valve flap. The resistance of this valve is deliberately kept fairly high to ensure that adequate pressure is maintained on the expiratory diaphragm during inspiration. This diaphragm is cut from a child’s rubber balloon, is 4 cm in diameter and is loosely mounted so that it clears the expiratory valve seating by 4–5 mm during expiration (fig. 2).

During inspiration gas from the ventilator enters chamber A. Pressure is exerted on the expiratory diaphragm which seals the expiratory

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As pressure builds up in this chamber the inspiratory valve opens and gas passes to the patient. The expiratory valve port remains closed during inspiration because (a) the total force exerted on the outside of this diaphragm is less than the force exerted on the inside, due to the difference in area exposed to the pressure, and (b) the pressure inside the chamber is greater than the pressure outside due to the resistance of the inspiratory valve.

When the flow into chamber A falls towards the end of inspiration, the inspiratory valve closes. The pressure in the chamber falls when the expiratory valve of the driving ventilator opens and the gas compressed in the tubes between ventilator and collect valve is dumped through the ventilator. The expiratory valve flap on the collect valve opens when the pressure in chamber A falls below the pressure in the patient’s airways and the lungs deflate.

The valve has been tested with a number of ventilators and no leak-back or slip past the expiratory valve has occurred. A continual check on the function of the valve is obtained during use by inserting a Wright respirometer in the expiratory line and by monitoring the inflation pressure between the valve and patient.

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REFERENCE


BOOK REVIEW

*Diagnostic Bronchoscopy*, By Peter Stradling. Published by E. & S. Livingstone. Pp. 103; 132 plates; 12 figs. Price 60s. net.

It is a rare pleasure in a book review to feel the necessity of limiting one’s superlatives to ensure credence, but *Diagnostic Bronchoscopy* is an exceptional book.

The first section is a thoroughly competent description of the technique of manipulating the bronchoscope, and the second describes and illustrates the normal bronchial tree. The third, fourth, fifth, sixth and seventh sections respectively describe and illustrate bronchial pathology under the headings inflammation, bronchial distortion and displacement, tumours, taking specimens, and miscellaneous conditions. This layout means that the information more useful to the novice comes early in the book and that more interesting to the expert comes later.

Throughout all the sections the superb colour photographs give a quite remarkable sense of presence and, unlike many illustrations, are helpful to the novice and not only to those with experience. The excellence of the illustrations should not detract from the accompanying diagrams and text. The diagrams ensure full understanding of the illustrations, and the text, while short enough not to overwhelm the illustrations, is full enough to be useful.

One does not wish to criticize a book of such excellence, but as an anaesthetist I should have welcomed more information about the anaesthetic technique which allowed time and operating conditions to take photographs of such high standard. I was also surprised by the omission of an index.

All anaesthetists who undertake bronchoscopy will gain from reading this book. Dr. Stradling has fully justified the confidence of those firms, listed in the acknowledgments, whose generosity made it possible to produce this book at such a reasonable cost.

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