MODIFICATION OF THE COXETER-MUSHIN CIRCLE ABSORBER UNIT
FOR USE WITH HALOTHANE IN THE CLOSED CIRCUIT

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In a previous article (Brown and Woods, Brit. J. Anaesth., this issue, p. 333) we have referred to technical difficulties experienced with the machines we used in our closed circuit cases.

As it seems possible that others working with similar apparatus may wish to employ halothane in this way, we thought that some account of the troubles encountered and the modifications required might be of interest.

The Boyle II and Coxeter-Mushin units at our disposal were designed for use with di-ethyl ether or cyclopropane, both of which are relatively inert chemically when mixed with the oxygen, nitrogen, carbon dioxide, and water vapour flowing through the circle absorber with each respiration of the patient.

Moist halothane vapour under the same conditions is chemically active and tends to destroy many of the rubber and synthetic materials used for gaskets and washers in anaesthetic apparatus. Certain metals are also attacked and corroded—notably brass, solder, and certain alloys of aluminium. It was corrosion of the brass control drum of the vaporizer on the Boyle II unit which caused it to become immovable and forced us to abandon this machine for closed circuit work early in the series.

Fortunately the moving metal parts of the Coxeter-Mushin unit proved sufficiently resistant for our purpose, though there was evidence of corrosion in the ether container. The first failure with this machine was the rubber washer forming the joint between the ether vaporizer and the body of the unit, which softened, expanded and soon became useless. Frequent replacements were required. Next in succession was the washer sealing the lower end of the sight gauge glass, which failed and allowed liquid halothane to run out. Next came the gasket between the two halves of the carcase of the unit which softened and became extruded inside the machine. Detached portions of this caused anxiety by threatening to block the ports of the vaporizer. As may be imagined, at this stage in our work we felt a little discouraged. Two of our machines were out of action, and the others had to be carefully watched when in use in case of sudden failure.

We were fortunate enough to seek the advice of Mr. J. Cockton of the Department of Pharmacy, Imperial Chemical Industries Ltd. He provided a toughened glass replacement for the metal ether container of the unit, and took the unserviceable machines for examination by technical experts of Imperial Chemical Industries Ltd. and the British Oxygen Company. As a result of the information obtained further consultations took place and the following modifications were decided upon:

1. The metal ether container was replaced by one of similar size and shape made of toughened laboratory glass. A filler with a ground glass stopper was provided. We do not empty this container between operating sessions—firstly because of the risk of breakage, and secondly because there is a noticeable loss of halothane by evaporation on decanting (fig. 1).

2. The bakelite or metal retaining ring holding the washer which seals the gap between the ether container and the unit has been removed. The rubber washer is retained but is protected from contact with halothane vapour by a thin channel shaped moulding of Fluon (a halothane resistant plastic). Fluon by itself is too hard to provide a gastight joint (fig. 2).

3. The gasket between the two halves of the carcase of the unit has been replaced by a sandwich of Fluon and Gatan leather—the latter,
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which is halothane resistant, and softer than Fluon, to allow bedding together to take place.

These modifications appear to have eliminated the faults which our misuse of the machines had produced. No further faults have developed, and we are satisfied that the Coxeter-Mushin absorber unit properly modified is perfectly suitable for the closed circuit administration of halothane.

The British Oxygen Company informs us that they are willing to undertake the above modifications for those wishing to use the Coxeter-Mushin unit for halothane anaesthesia.

Any anaesthetist wishing to experiment with closed circuit halothane without radically altering his machine may care to adopt the following procedure:

(1) After screwing off the copper vane assembly remove the rubber washer and its retaining ring (secured by three grub screws) between the ether vaporizer and the carcase of the unit. Cut a similar washer from polythene sheet of suitable thickness (to 1 inch) but make it wide enough to cover the three grub screws. The grub-
screws are then used to retain it in position. The washer must fit exactly into the recess in the unit to avoid leakage.

(2) Carefully remove the gauge glass from the ether container. Take out the synthetic rubber washers below and above it and replace them with polythene—the old washers can be used as patterns for cutting the new.

(3) Replace the ether container, put in a few ounces of halothane, and test for leaks by opening the vaporizer control to full on, filling the rebreathing bag with air or oxygen, and squeezing the bag firmly with the opening at the mask connection occluded by the other hand, the hose connections having previously been forced tight. Any leak detected must be eliminated before using the machine.

The gasket between the two halves of the carcase of the unit may be left in situ. If it causes trouble it is easily replaced with a sheet of polythene or polyvinyl chloride. This sheet should be placed in position and the unit assembled, the various openings being cut out afterwards with a fine sharp scalpel. No adhesive or jointing compound is required. Halothane left in the metal ether container soon becomes brown and muddy-looking. This is due to dissolved metallic salts and oxdized thymol, and is of no clinical significance. We have been assured that no volatile impurities occur.

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