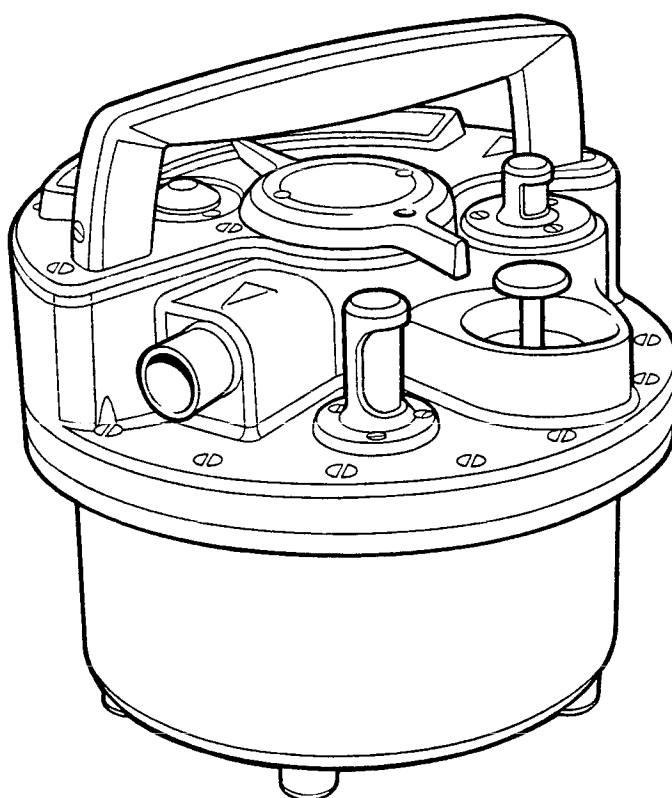


User Manual for EMO Outfit and EMO Ether Inhaler



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IMPORTANT

Servicing and Repairs

In order to ensure the full operational life of the EMO Outfit, servicing by a Penlon trained engineer should be undertaken periodically.

This may be done on site by:

- (a) A trained user.
- (b) An authorized Penlon agent.
- (c) A Penlon service engineer.

For any enquiry regarding the service or repair of this EMO Outfit, contact the nearest accredited Penlon agent * or contact Penlon Service Department.

*Agent's name and address:

Service and Repair Department
Penlon Ltd.
Abingdon, Oxford
OX14 3PH
UK

E-mail: service@penlon.co.uk

Always give as much of the following information as possible:

1. Type of equipment
2. Product name
3. Serial number
4. Approximate date of purchase
5. Apparent fault

FOREWORD

This manual has been produced to provide authorized personnel with information on the function, routine performance and maintenance checks/servicing and repair, applicable to the Penlon EMO Outfit.

Information contained in the manual is correct at the date of publication. The policy of Penlon Ltd. is one of continued improvement to its products. Because of this policy Penlon Ltd. reserves the right to make any changes, which may affect instructions in this manual, without giving prior notice.

Personnel must make themselves familiar with the contents of this manual before using the EMO Outfit.

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E.M.O. OUTFITS and the E.M.O. ETHER INHALER

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USER RESPONSIBILITY

This E.M.O. Outfit has been built to conform with the specification and operating procedures stated in this manual and/or accompanying labels and notices when checked, assembled, operated, maintained and serviced in accordance with these instructions provided. To ensure the safety of this E.M.O. Outfit it must be checked and serviced to at least the minimum standards laid out in this manual. A defective or suspected defective, product must not, under any circumstances be used.

Worn, broken, distorted, contaminated or missing components must be replaced immediately. Should such a repair become necessary it is recommended that a request for service advice is made to the nearest Penlon service centre.

This E.M.O. Outfit and any of its constituent parts must be repaired only in accordance with written instructions issued by Penlon Ltd. and must not be altered or modified in any way without the written approval of Penlon Ltd. The user of this equipment shall have the responsibility for any malfunction which results from improper use, maintenance, repair, damage or alteration by anyone other than Penlon Ltd. or its appointed agents.

The reader must take particular notice of the warnings, cautions, and notes printed throughout the manual.

ASSEMBLY OF OUTFITS

Unpack your E.M.O. Outfit carefully and check the items against the relevant components list which will be found below.

All outfits employ sequential cone and socket (male/female) plastic connections. These are of 22mm taper size. Inlet is **always** the socket: outlet (patient side) the cone. Corrugated hose is **never** fitted direct to a major component.

First, therefore, fit a female breathing tube connector to one end of the long corrugated hose and a male breathing tube connector to the other end of the same hose. The grooved part of the connector goes inside the rubber. These connectors may be left in place within the hose until the hose itself wears out.

If you have an E.M.O. Portable Outfit or an E.M.O. Hospital Model, fit one male and one female connector to the ends of the short corrugated hose.

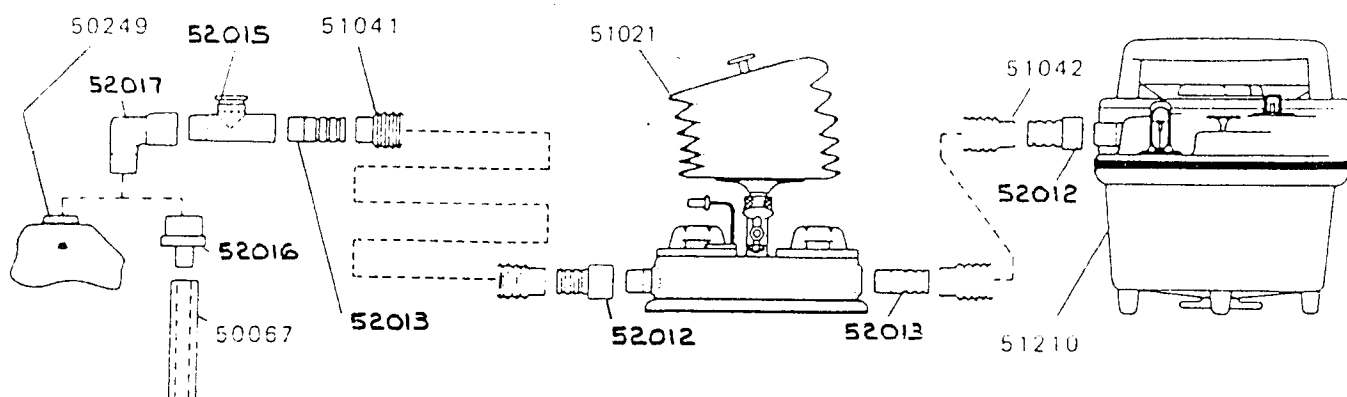
Now proceed to assemble the outfit in accordance with whichever diagram applies.

E.M.O. PORTABLE OUTFIT

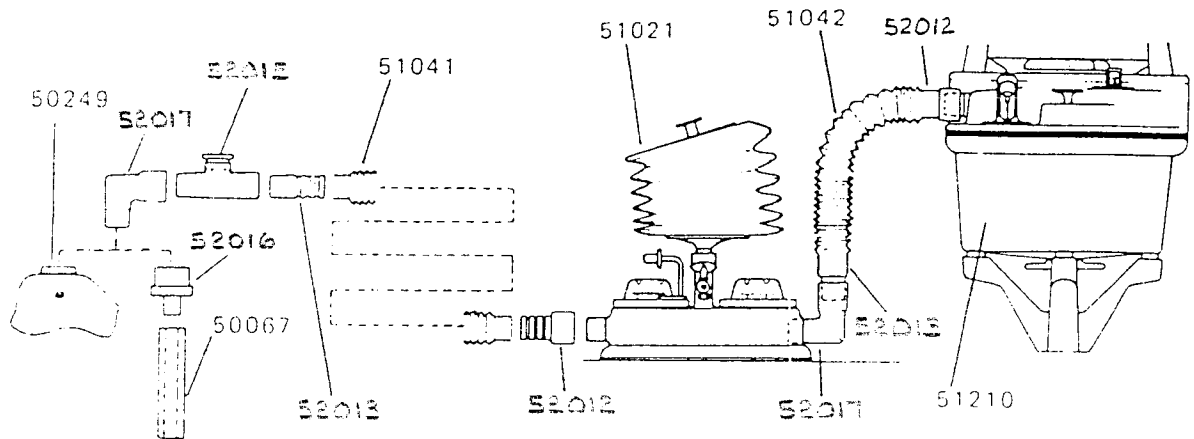
Item 51022

comprising:

E.M.O. Ether Inhaler	51210
2 Breathing Tube Connectors, male	52013
2 Breathing Tube Connectors, female	52012
Breathing Hose 30cm.	51042
Head Harness	51043
Connector Mount	52016
Connecting Tube plain, anti-static, 9cm	50067
Oxford Inflating Bellows	51021
Breathing Hose 105cm	52041
Expiratory Valve	52015
Angle Connector	52017
Facemask, size 3	50249
Carrying Case with fitted tray	51160

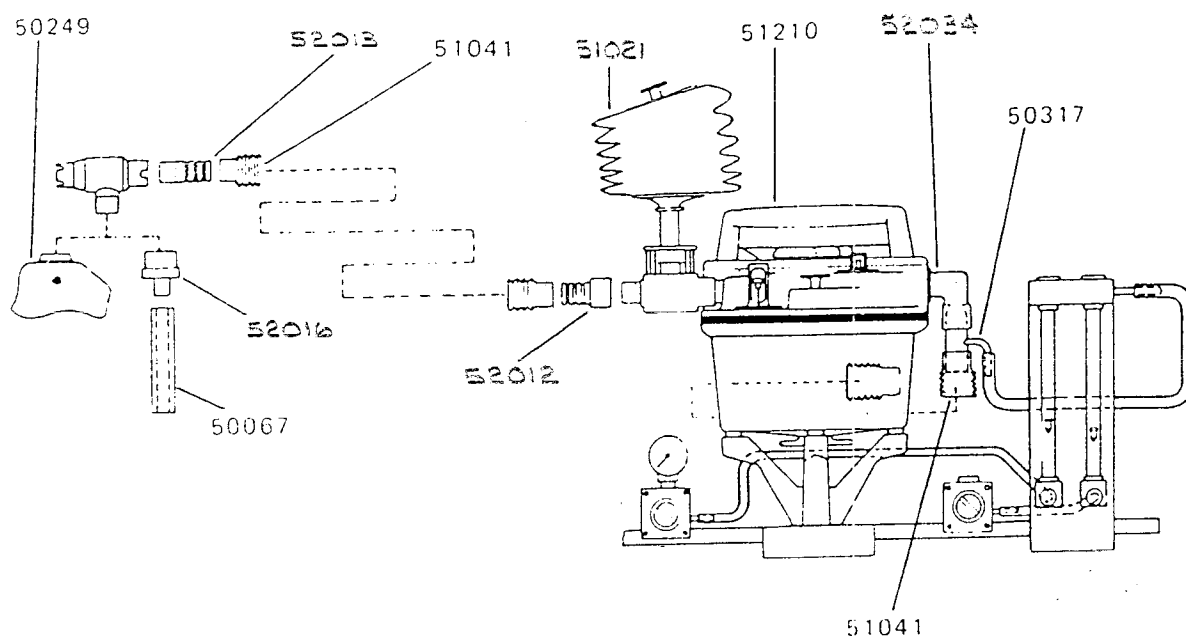


E.M.O. HOSPITAL MODEL Item 51024



E.M.O. Ether Inhaler	51210
2 Breathing Tube Connectors, male	52013
2 Breathing Tube Connectors, female	52012
Breathing Hose 30cm.	51042
Head Harness	51043
Connector Mount	52016
Connecting Tube plain, anti-static, 9cm	50067
Oxford Inflating Bellows	51021
Breathing Hose 105cm	52041
Expiratory Valve	52015
2 Angle Connectors	52017
Facemask, size 3	50249
Hospital Stand	

PENLON QUANTATIVE APPARATUS MARK III Item 51071

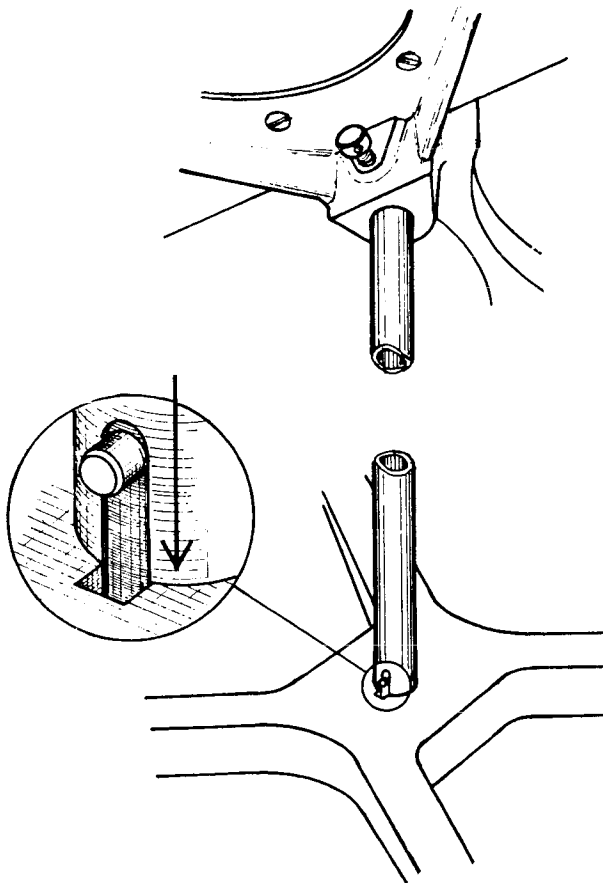


E.M.O. Ether Inhaler	Item 51210
Hospital Stand	Item 51130
Oxford Inflating Bellows Unit	Item 51021
Non-rebreathing Valve	Item 50226
Angle Connector	Item 52017
Medical Gas Inlet	Item 50317
Reservoir Tube	Item 51041
Breathing Tube Connector, female	Item 52013
Breathing Tube Connector, male	Item 52012
2-Gas Flowmeter Unit, Mk II	Item
Facemask, size 3	Item 50249
Connector Mount	Item 52016
Connecting Tube plain, anti-static 9cm	Item 50067
Breathing Hose 105cm	Item 51041
Head Harness	Item 51043

BASIC HOSPITAL STAND Item 51130

Note that the upright has a hole in the side at one end and a cross pin near the other end. Erect the upright so that the cross pin near one end engages in the slots provided in the central hole of the cast base. Then screw in the screw, with washer fitted, which will be found taped to the underside of the base. Tighten the screw with the hexagon key provided.

Place the tray and cradle assembly on the upper end of the upright. Rotate it until the hole under the tray in the tray support is in line with the hole in the top of the upright tube. A large screw is taped to the tray; this should be inserted in the hole in front of the boss on the tray support casting (under the tray) and tightened by using the hexagon key as a lever through the hole in its head.

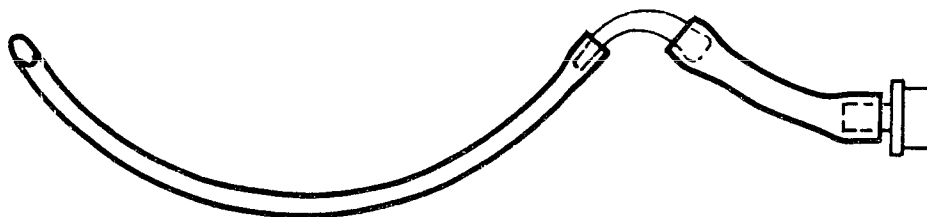


**COMPONENTS OF E.M.O. OUTFITS - EXPLANATORY NOTES: ALTERNATIVES:
ADDITIONAL ITEMS**

Facemask: The standard item supplied with outfits is an Everseal size 3 fitted with studs to take the Connell Head Harness. Any other size or type may be substituted.

Connector Mount and Connecting Tube (Catheter Mount)

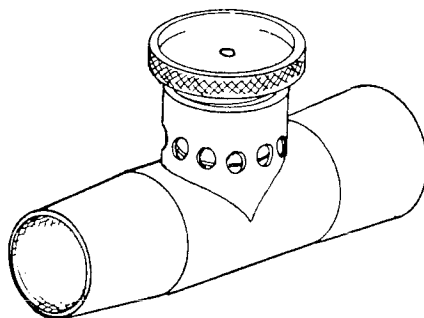
These are used in place of the facemask to connect the equipment to an endotracheal tube via an endotracheal tube connector viz:



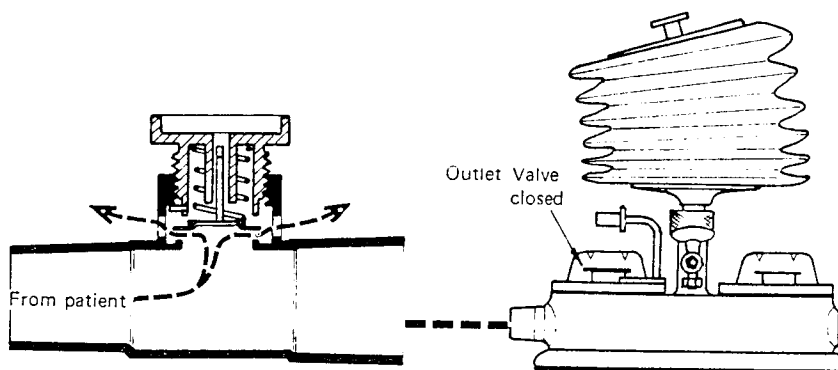
A corrugated connecting tube may be used instead of the plain type for greater flexibility. (See catalogue for details).

Expiratory Valve: The simple expiratory valve included with the E.M.O. Portable Outfit is little more than a one-way valve to atmosphere.

With the cap screwed open, the valve disc will lift and let out any pressure within the system. It works here in association with the outlet valve of the O.I.B. for spontaneous respiration viz:

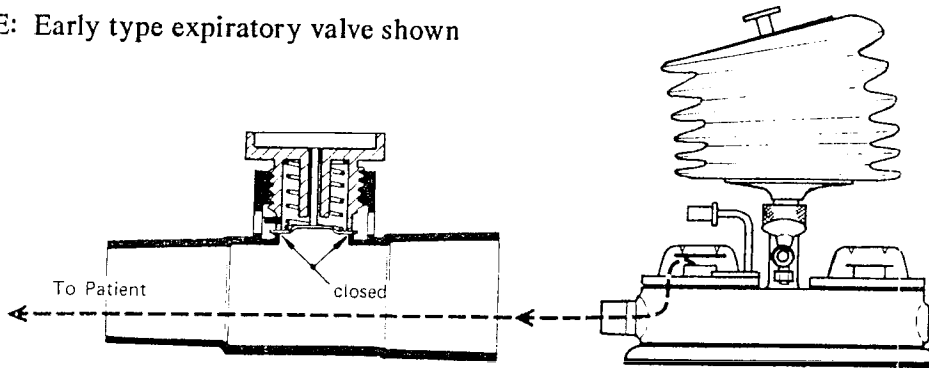


NOTE: Early type expiratory valve shown



For manual ventilation it is essential that the screw cap be closed, the bellows being compressed for inflation.

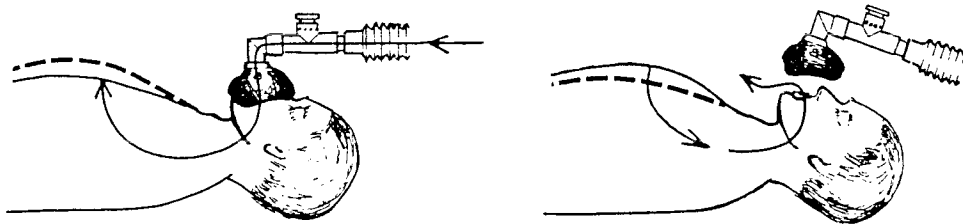
NOTE: Early type expiratory valve shown



Exhalation is permitted by lifting the facemask slightly whilst simultaneously expanding the bellows preparatory to the next inflation stroke.

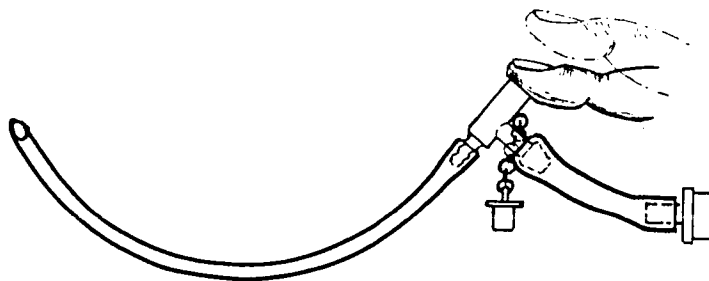
The mask is then firmly applied again as the bellows are once more compressed.

N.B. It is vital to ensure that the patient's airway is maintained by extending the head and neck and raising the mandible throughout ventilation.



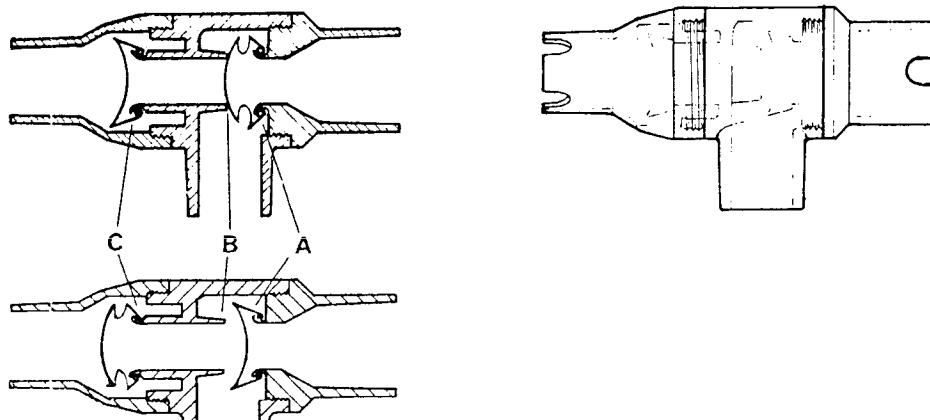
When an endotracheal tube is used, the same effect can be obtained with a Cobb or Magill T-Suction endotracheal tube connector. The cap of the suction limb is removed and the hole is closed during inflation by placing a finger over it. The finger is then raised at the end of the inflation phase and the patient exhales through the suction hole.

Although these procedures sound difficult, they are quite rapidly mastered since a similar action is required by each hand at the same time, i.e. press down on the bellows and press down the facemask, then raise the bellows and lift the facemask.



Nevertheless the change from spontaneous to assisted breathing is clumsy and far from instantaneous as it means screwing down the expiratory valve cap. This has led to the development of the so-called "non-rebreathing" valves (Ruben, Ambu E, Ada etc.) in which the change is completely automatic.

The **Ambu E valve** functions in the following way:



Inspiration - Inflation

The gas-flow opens the labial side valves of the elastic shutter. The shutter then swells outwards and blocks the outlet passage at seat B, leaving the channel to the patient open.

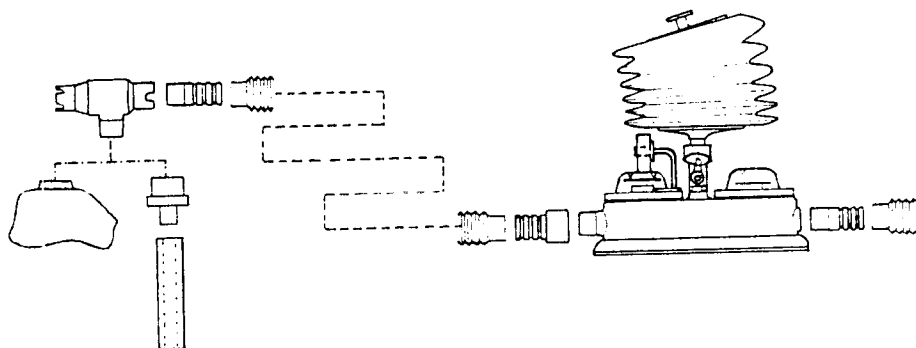
Exhalation

As soon as the inspiration or insufflation is completed the labial openings immediately close the way to A. The shutter returns to its original position permitting the patient to exhale through Valve C.

Immediately upon completion of expiration the labial Valve C in the outlet port closes and the re-entry of air into the valve through the outlet is precluded. N.B. If the Ambu E Valve has been dismantled, it is most important to ensure on re-assembly that both shutters face the same way and are fitted to points A and C in the diagram above. A shutter **MUST NEVER** be fitted at point B as it would completely block exhalation.

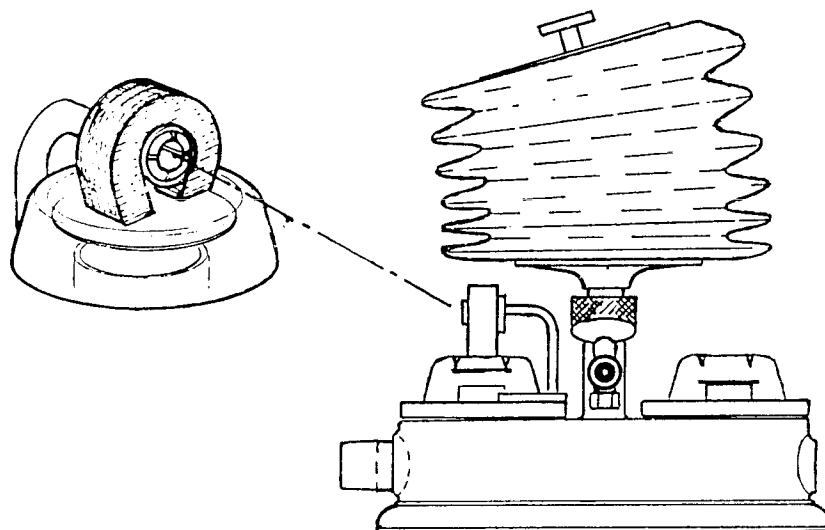
The basic principle is the same in other types. In the "Ada Valve" plain magnetic flaps of silicone rubber form the valve elements, whilst in the "Ruben Valve" plastic discs connected to make a shuttle are used.

AN IMPORTANT POINT to notice is that with all these valves the "inflation" condition is held until pressure has fallen to zero - sometimes even a slight negative pressure is necessary for a moment to release the element which is closing the expiratory port.



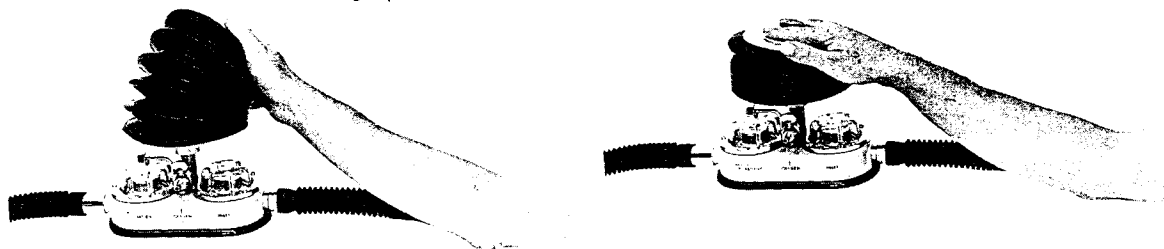
IF A "NON-REBREATHING" VALVE IS USED WITH THE O.I.B., THE RED MAGNET MUST BE PLACED OVER THE OUTLET VALVE OF THE O.I.B.

If this is not done the O.I.B. outlet valve may close before pressure has fallen enough to open the outlet valve of the "non-rebreathing" valve. The corrugated breathing tube is too rigid to relieve the pressure by distending, so that a pressure lock develops preventing exhalation:



The O.I.B. and its Red Magnet: The practical way of avoiding the disaster which could arise from the pressure lock described above is to hold open the O.I.B. outlet valve. If this is done the concertina bellows will take up the excess gas and relieve the pressure - in normal ventilatory assistance the anaesthetist will be lifting the hand working the bellows. In the instant before the O.I.B. inlet valve opens, this will produce a slight and brief negative pressure along the breathing tube and the outlet occlusion of the non-rebreathing valve will be released.

Using the bellows: It is strongly recommended that the anaesthetist rests his elbow on a surface roughly level with the base of the O.I.B. and then operates the bellows by alternately pronating and supinating his forearm.



This action can be kept up almost indefinitely without strain or fatigue. If the hand is placed right over the top of the bellows with the knob lying between the fingers, or between thumb and forefinger, it will improve the anaesthetists "feel" and again be less tiring than gripping the knob itself. The knob is primarily used to engage or disengage the internal bellows transit catch.

Paediatric Bellows: The capacity of the standard bellows fitted to an O.I.B. is such that about 1.3 litres will be delivered at a full stroke. This ensures good ventilation and so good oxygenation of an adult patient. It is almost twice the volume which most anaesthetists can deliver by normal "bag squeezing" on a Boyle type anaesthetic machine. When very young children are being anaesthetised, however, this greater capacity may be an inconvenience. To make it easier to deliver small volumes at a higher rate Penlon can supply a Paediatric Bellows Unit having a full stroke capacity of approximately 400ml. (Item 51214). Other parts of the system remain quite unchanged - the length and size of the corrugated breathing tube, for example, has no effect upon the dead space so there is no point in seeking a smaller one.

To fit the Paediatric Bellows - or replace a standard bellows assembly - screw up by a turn or two the red plastic lock-nut which will be found on the central stem of the O.I.B. below the bellows. Unscrew the knurled metal ring just below it and lift off the bellows assembly. Put the other assembly in place, **checking first that there is a washer inside the central stem.** Screw up the knurled metal ring. Screw down the red plastic lock-nut.

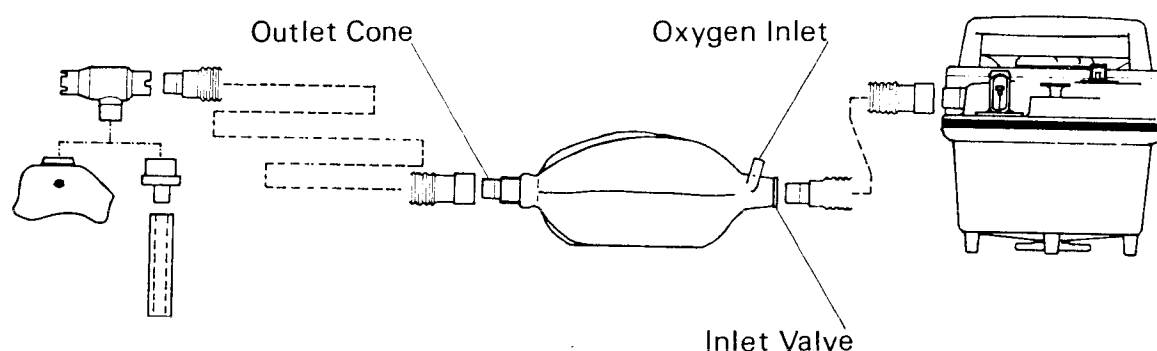
Indications of spontaneous breathing: The concertina bellows of the O.I.B. will normally move slightly in response to the inspiratory effort of a patient breathing spontaneously. Whilst this movement is a useful visual indication of the rate of respiration, it is **not a measure of volume.** The concertina bellows are relatively stiff and the inlet valve of O.I.B. very light - thus the patient breathing spontaneously tends to draw fresh ether/air mixture straight through the inlet valve rather than from the bellows itself. To check volume it is necessary to use a volume meter such as the Wright Respirometer or the Parkinson-Cowan gas meter.

Oxygen Inlet on the O.I.B. A small metal tube protrudes from the side of the central stem of the O.I.B. This is for oxygen feed when the bellows are being used for resuscitation. It is not recommended that oxygen be fed in at this point during routine anaesthesia as it will dilute the mixture being drawn from the E.M.O. If this is done, there is little point in using a carefully calibrated vaporizer.

The oxygen inlet tube on the O.I.B. is fitted with a simple tap. **It is most important that this tap is closed at all times except when oxygen is actually being fed in through this inlet.**

Ambu Bag: When used in an E.M.O. outfit, the Ambu Bag is the exact functional equivalent of the Oxford Inflating Bellows Unit.

Since the valves are quite easily removed, it is important that the user should check their presence and function before commencing work. A rubber side tube moulded in to one end of the bag is the oxygen inlet. This must always be fitted with a spring loaded plastic check valve incorporating the gas hose connection. The large rubber bush at the same end of the bag must be fitted with a tapered metal inlet socket incorporating a one-way inlet valve (Penlon Part No. 18005). The other end of the bag should be fitted with a standard breathing tube outlet cone. Correct functioning of these valves may be checked by compressing the bag, then blocking the end of the outlet cone with the palm of the hand. Keeping the outlet blocked, release the body of the bag, which should then immediately expand and fill with air drawn in through the inlet valve. Still keeping the outlet blocked, squeeze the bag. There should now be strong resistance and no air should escape from either the main inlet of the oxygen inlet.

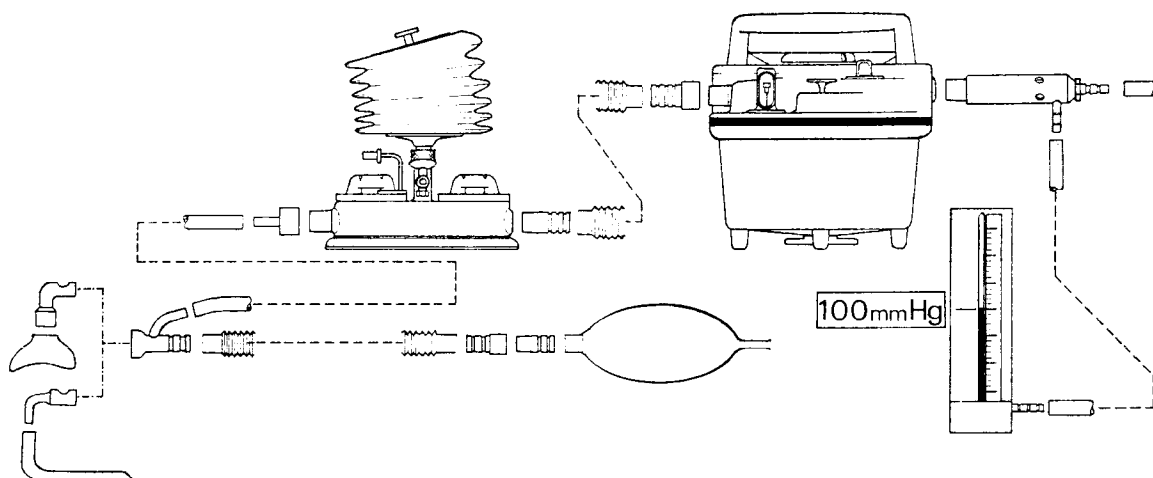


Additional Items:

Oxygen Attachment Kit (Item 51200): When it is desired to give additional oxygen, this should be done at the E.M.O. inlet so that the oxygen/air mixture all passes through the E.M.O. Only then will the ether concentrations indicated by the E.M.O. setting remain accurate. For general purposes it is sufficient to use the simple oxygen attachment kit which consists of Tee piece connector (cone fitting one end, breathing tube fitting the other and side limb to take $\frac{1}{4}$ " gas hose). The long breathing tube acts as a reservoir (capacity approximately 500ml) which, being open ended, permits free outflow of excess oxygen and free inflow of air to make up the volume of gas demanded by the patient.

WARNING: Ether/Oxygen and Ether/Nitrous Oxide mixtures are potentially EXPLOSIVE.

Paediatric Outfit (Item 51029): Many anaesthetists prefer to use insufflation (low positive pressure) techniques on babies and small children. This may be done most conveniently with the E.M.O. Paediatric Outfit. A venturi entrainer (Item 50332) is plugged in to the inlet of the E.M.O. This entrainer is designed so that an ordinary sphygmomanometer (not included) when attached to the side tube acts as a calibration monitor. Oxygen is fed from any type of fine control valve to the end connection of the entrainer and the flow adjusted until the sphygmomanometer reads 100mm Hg. The total flow will now be 10 l.p.m and the mixture $8\frac{1}{2}/1\frac{1}{2}$ air/oxygen (i.e. total of 32% oxygen).



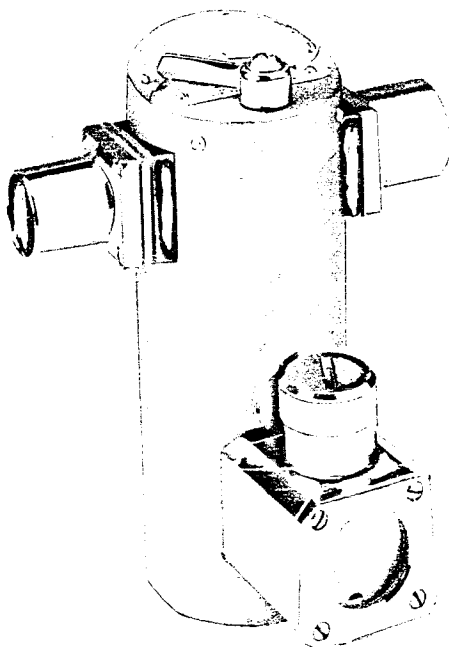
The O.I.B. is left connected to the outlet of the E.M.O. This is important since a non-return valve must be interposed between the E.M.O. and patient: the inlet valve of either of these bellows units conveniently serves the purpose. To the outlet of the bellows unit is attached an assembly consisting of a length of small bore anaesthetic hose and the Ozorio pattern Ayres T-piece assembly. Included with the outfit are two sizes of Rendell-Baker Paediatric facemask, four Ozorio Oral pattern endotracheal tube connectors and six Oxford non-kinking tubes.

When this continuous flow system is used, the ether concentrations will be slightly below those indicated by the E.M.O. pointer. The relationship is not constant throughout the scale but ranges from an actual concentration of about 1.65% at the 2% setting to 13.75% at the 15% setting.

Oxford Miniature Vaporizer: (Item 51180)

This is a sophisticated and versatile induction unit. It is thermo-stabilised and calibrated to deliver known concentrations of halothane up to 3.5%. It has a total capacity of 50ml of halothane and in addition to induction permits the anaesthetist to add low concentrations of halothane during surgery to deepen the ether anaesthesia.

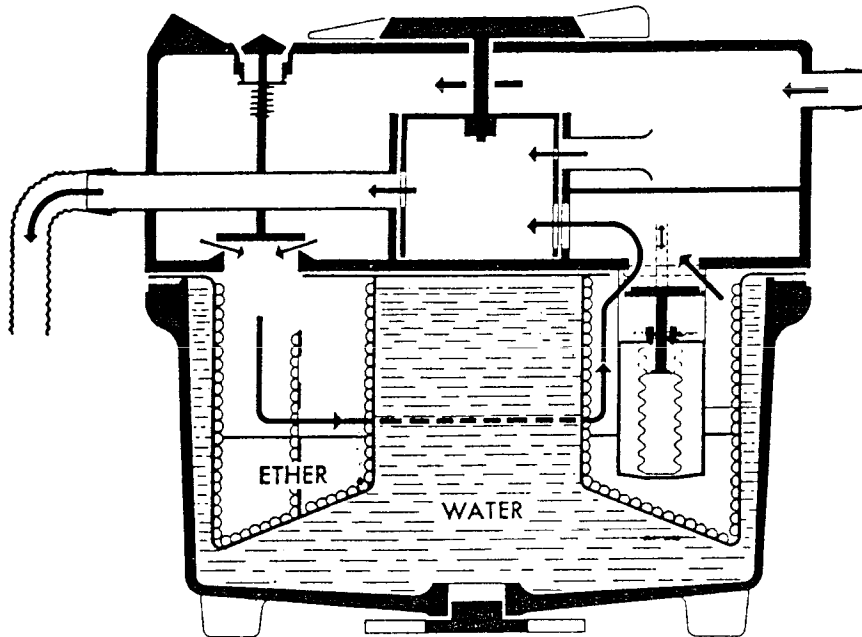
Trichloroethylene or chloroform may also be used and interchangeable calibration scales are available.



Separate literature supplied with each O.M.V. describes its use and maintenance in detail. In addition to its use as an E.M.O. accessory, the O.M.V. may be employed with a conventional gas anaesthesia machine, and, in emergency situations, on its own with an Oxford Inflating Bellows.

The E.M.O.

The general design of the inhaler is represented by the diagram below:



As it has been developed specifically for intermittent draw-over anaesthesia, its internal passageways are all relatively large. Flow is created by intermittent "suction" at the outlet rather than by continuous positive pressure at the inlet. The inlet is normally at atmospheric pressure. The outlet communicates with a small chamber in the centre of the control rotor which lies below the concentration pointer. This passageway is always fully open irrespective of the position of the pointer. The chamber has two inlet ports both of which vary in size of opening, depending upon the position of the pointer.

One of these points leads from the large chamber of the main top casting of the inhaler which is full of fresh air drawn in through the E.M.O. inlet itself. This port is fully open when the control pointer is at "Close for Transit" so that in this condition there is an unobstructed air passage from the E.M.O. inlet to E.M.O. outlet.

The other port leads via the thermo compensator valve from the vaporizing chamber. In the "Close for Transit" condition, this port is completely closed.

As the control pointer is moved round the scale towards 20% the first (fresh air) port steadily closes whilst the second (ether vapour) port opens.

The thermo compensator valve, which is situated between the vaporizing chamber and the rotor, is completely automatic in operation. It opens as the temperature in the ether vaporizing chamber falls so as to maintain a constant concentration at a given pointer setting, irrespective of changes of ambient temperature and the steady cooling of the ether which takes place as it is vaporized.

The active element of the T/C Unit is a sealed capsule filled with liquid ether. Ether was chosen as the expansion medium since it not only had a suitable coefficient of expansion, but in the very rare and unlikely event of leakage, no unexpected toxic substance would become mixed with the anaesthetic.

These capsule are made and rigorously tested at our own factory. They are guaranteed for five years and should give perfect service for about ten years. Ultimately, however, the continuous flexing of the bellows will lead to failure through metal fatigue.

The chief remaining part of E.M.O. is the closing mechanism. This seals the inflow passage between the large chamber of the top casting and the vaporizing chamber when the pointer is at "Close for Transit". The outlet, it will be recalled, is at the same time sealed by the rotor.

When the pointer is moved off "Close for Transit", this passage is open and fresh air is drawn in to the vapour chamber as ether vapour is drawn out.

Also incorporated in the closing mechanism is an inlet relief valve. Normally this is closed by light spring pressure but should the main inlet of the E.M.O. be blocked, the relief valve will open.

PREPARING THE E.M.O. INHALER FOR USE (See illustration on next page.)

Filling the Water Jacket

The lower part of the Inhaler is provided with a double walled water jacket. This provides a heat reservoir to prevent rapid chilling of the ether chamber by evaporation during use, and also, by internal convection currents, serves to prevent cold spots developing on the vaporizing surfaces.

To reduce transit weight the E.M.O. is despatched from the factory with an empty water jacket, but before using the E.M.O. the jacket must be filled with water at room temperature (10-30°C) by inverting the Inhaler and unscrewing the plug which is central on the base.

This plug is normally of the wing nut type, but older Inhalers have a coin slot.

The Inhaler requires 1100-1200ml of water to fill the jacket.

In cold climates, or cases where the apparatus is likely to be transported in unheated cargo compartments of aircraft, it is recommended that a 25% (1 part to 3 parts) mixture of glycol based anti-freeze and distilled water should be employed to fill the jacket, as freezing of ordinary water can cause damage to the Inhaler.

E.M.O. Inhalers after Serial No. 2950 have a stainless steel water jacket and need no further attention. Early E.M.O. Inhalers with an aluminium water jacket should be emptied when not in use, and in any event every three months, and the water replaced with a fresh supply. If this is not done chemical action is likely to occur, building up gas pressure in the water chamber and causing damage to the internal parts of the Inhaler.

Filling with Ether

Having filled the water jacket, the Inhaler is returned to the upright position and may be filled with ether.

To do this the filler knob (marked "Ether") is depressed and ether is poured into the funnel-shaped opening round the knob.

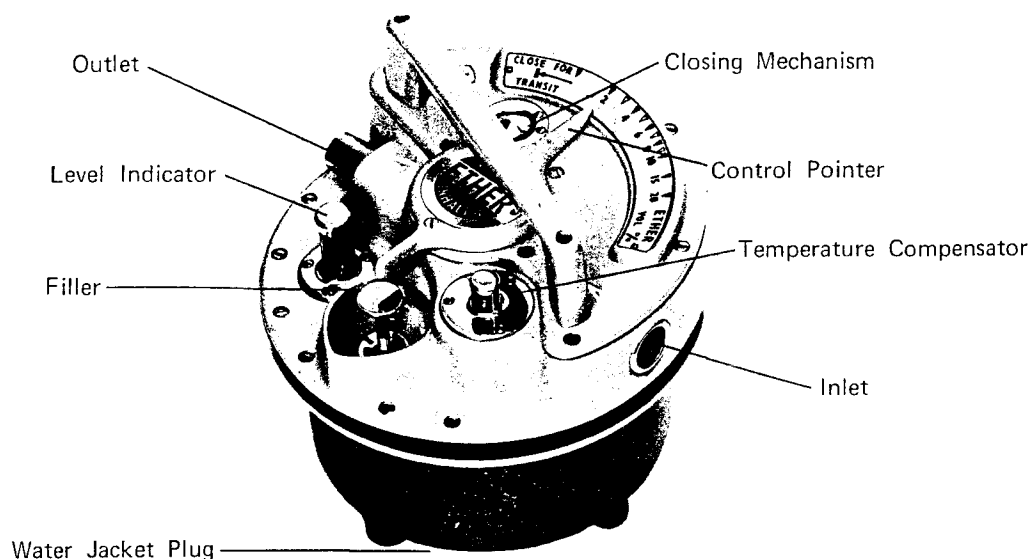
When the wicks in the Inhaler are dry, it will be found that 150-200ml of ether can be poured in before the level indicator will lift from the "Empty" position. A further 300ml will be required to raise the level indicator to the "F" (full) position. DO NOT OVER FILL.

It is not necessary always to fill to the "F" position but the level indicator should not be allowed to reach the Empty point when the Inhaler is in use.

NOTE: If it is necessary to refill the ether chamber while an anaesthetic is given, the control knob should be turned to the "Closed" position while the filler is open, as the Inhaler will otherwise deliver a high concentration during this time.

PROCEDURE IN TROPICAL CLIMATES

In ambient temperatures exceeding 32°C (90°F), the action of the temperature compensating unit may prevent accurate use of the Inhaler unless steps are taken to cool the Inhaler before use. This may be accomplished by refilling with cold water (below 25°C) or by forced evaporation of ether. The latter method is carried out by setting the control pointer to '20', opening the filler and pumping air through the Inhaler with the bellows unit. The cooling effect is rapid and the process need be continued for only a few minutes.



E.M.O. OUTFITS - ROUTINE INSPECTION

The E.M.O. Inhaler is very simple to use and very robust. Only a minimum of servicing is required, but in order to obtain completely satisfactory results a few points require regular attention.

Rubber Items: Check that breathing tubes and bellows are not cracked or perished.

Servicing Instruction:

The E.M.O. Inhaler has only two moving components, the concentration rotor and the temperature compensator. Before leaving the factory these components are accurately adjusted and the adjustment must not be altered under any circumstances, nor must any attempt be made to lubricate any part.

To ensure that the apparatus is always in perfect working order the following simple tests should be carried out periodically. It is particularly important to carry out these tests if the Inhaler has been stored for any length of time out of use.

(a) Level Indicator

With the ether compartment or container empty, slowly invert the Inhaler and check that the indicator falls freely to the 'Full' position and likewise returns to the 'Empty' position when the Inhaler is returned to the upright position. When refilling, check that the quantity of ether agrees approximately with the figures given on page 22.

(b) Closing Mechanism

Turn the Control Knob to the transit position and connect the outlet of the Oxford Inflating Bellows or other ventilating equipment to the inlet of the Inhaler. Block the outlet of the E.M.O., apply gentle pressure to the Bellows Unit, and open the ether filler. There should be no escape of air through the filler, or through the top of the closing mechanism.

(c) Filler

With the Bellows still connected to the inlet of the Inhaler and the outlet blocked, open the Control Knob to '10'. Close the filler, apply gentle pressure to the Bellows and note that there should be no leakage through the filler.

(d) Safety Release Valve (This is combined in the Closing Mechanism Unit.)

With the Control Knob set at '2' and the Oxford Bellows connected in the normal position on the outlet of the E.M.O. Inhaler, block the inlet to the Inhaler and check that operation of the Bellows draws in air through the safety valve.

(e) Temperature Compensating Unit

The position of the temperature compensating indicator will show whether the unit is in satisfactory working order. The indicator consists of a rod with a black and red band and a metal top. At normal room temperature (20-25°C) the metal top and black band should be visible; at temperatures above 30°C, the red band will begin to show. If only the metal can be seen at 20-25°C, the unit is faulty and should be replaced.

(f) **Water Compartment**

If the water used to fill the water compartment is suspected to contain high concentrations of salts or chlorine, it is advisable to empty and refill this compartment from time to time.

In the event of difficulties in use, or shown by these tests, follow the instructions given on the following pages.

It must be stressed that only pure ether should be used in the ether E.M.O. Inhaler; any other drug may cause serious corrosion difficulties. Extra care should be taken in using ether from lacquer covered cans as any lacquer that gets into the vaporizing chamber can "gum up" working parts and reduce efficiency of wicks.

Cleaning and Sterilising

No antiseptic solutions must be used to clean the Inhaler. The exterior may be cleaned (when necessary) by wiping over with a cloth damped in ether.

Sterilising is not normally necessary as the Inhaler is used on open circuit, protected from contamination by non-return valves. If special circumstances make it necessary to sterilise, the only suitable method is the use of Ethylene Dioxide gas. Excessive heat, due to boiling or autoclaving would render the Inhaler useless.

FAULT FINDING - RECTIFICATION

The following notes are for the guidance of users and agents carrying out servicing. The user is recommended to replace defective units in all cases. These are readily available from the manufacturer or from principal agents on a 'service exchange' basis.

When ordering spare units the serial no. of the Inhaler should always be quoted, and the defective part returned with the order if possible.

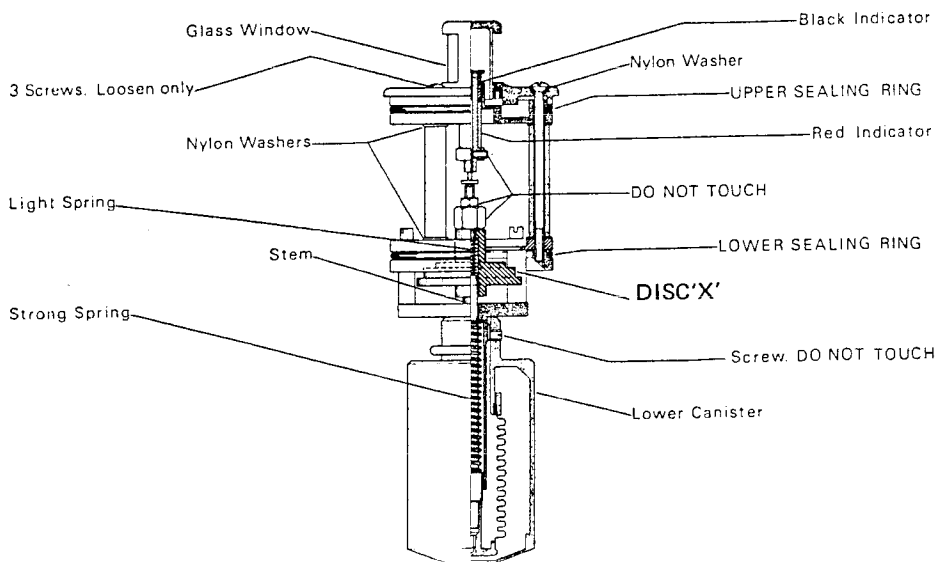
FAULT	CAUSE	RECTIFICATION BY USER
Concentration Control seized	Rotor seized	Return E.M.O. to Service Engineer
Ether Escaping although control is in "closed for transit" position	(a) Broken level indicator glass	(a) Replace level indicator unit. (See page 24)
	(b) Broken indicator glass on temperature compensator	(b) Replace Temperature Compensator unit (See page 24)
	(c) Closing mechanism not shutting	(c) Adjust or replace closing mechanism unit (See page 24)
Concentrations appear to be higher than normal initially but drop rapidly during use	(a) Temperature compensator not operating	(a) Carry out check (e) (See page 21) and if unit appears defective proceed to para, 3 page 23
	(b) Filler left open	(b) Close Filler
Concentrations appear to be lower than normal	(a) Leak in circuit	(a) Find and rectify
	(b) Relief valve on closing mechanism stuck open	(b) Carry out test (d) page 21 Replace closing mechanism unit if necessary (See page 24)
Concentrations appear to be lower than normal	(c) Overfilled with ether so that vaporizing surface area is too small	(c) Pour out excess ether and check level indicator
	(d) Temperature compensator not operating	(d) Carry out check (e) (see page 21). If suspect proceed to para. 3 page 23.
Level Indicator fails to rise when ether is added, but moves freely when Inhaler is inverted	Broken float	Replace level indicator unit. (See page 24)
Level Indicator sticks at any point and will not move when Inhaler is inverted	(a) Float caught by frayed wick	Remove unit, cut away frayed ends of wicks with scissors
	(b) Caught by collapsed ether compartment due to gas build-up in water jacket owing to use of impure water	Return to makers or agents for servicing

Temperature Compensator

As stated on p.19, this is the working "heart" of the E.M.O. which should respond constantly to changes of temperature.

If the routine check described on p.21, or consideration of an observed fault with the help of the fault finding chart, leads the user to suspect malfunction of the temperature compensator, the following procedure may be carried out:-

Remove the temperature compensator following the instructions on p.24.



If room temperature is above 70°F (21°C), put the canister part of the unit into iced water for about a minute: remove it from the water and with finger and thumb round the lower sealing ring press first up and then down on stepped valve disc X. This should move against springs in each direction, but if the E.M.O. has been left out of use for some time in an extreme temperature it may have become stuck on its spindle. Firm pressure will generally release it. If it cannot be released, the whole unit must be replaced.

Now immerse the canister part of the unit in iced water and observe that the whole stem and disc X move down and the visual indicator falls. Transfer the unit to moderately hot water - about 110°F (40°C), and check that the stem, disc and indicator rise. The disc should completely block the hole in the lower sealing ring and the indicator rise until the red part is visible through the glass. Transfer back to cold water once more and check again that the movement is now correct. Take the can out of the water and dry it.

Replace the unit in the E.M.O. in accordance with the instructions on p.24.

IMPORTANT: ON NO ACCOUNT TOUCH EITHER THE TWO NUTS AT THE TOP OF THE STEM OR THE GRUB SCREW AT THE TOP OF THE CAN. These control basic adjustments which have been correctly set under carefully controlled conditions at the factory using micrometer measurements.

If the temperature compensator does not respond in the manner described, or if there is any reason to suspect its further malfunction, it must be replaced with a complete new unit obtained from the factory.

REPLACEMENT OF COMPONENTS

Level Indicator (Part No. 60600)

This is retained by three screws round the base. Remove each screw completely, when it will be possible to lift out the Level Indicator assembly. The new unit is inserted and the three screws replaced.

Temperature Compensator: (Part No. 61601 and quote serial no. of E.M.O.)

NOTE: The Temperature Compensator responds to all changes of ambient temperature from the moment it is first made at the factory. Although it has a guaranteed life of five years and may normally be expected to last for ten years or more, these periods are absolute from date of manufacture. It makes no difference whether the temperature compensator is fitted to an E.M.O. nor whether the E.M.O. is being used. It is therefore not desirable to keep spares of this item. When a new one is needed, it can be sent from the factory by air and will reach most parts of the world within a few days.

The Temperature Compensator is retained in the Inhaler by 3 screws which expand rubber sealing sleeves when tightened. To remove assembly from Inhaler slacken all three screws by 3-4 turns. Tap heads of screws down flush with plastic or wood block. Grip top of unit and twist or wriggle slightly to break grip of rubber seals. The unit should then lift out.

It may be necessary to repeat the slackening of the screws and tapping process if the Inhaler has been in use for some time. **Do not remove screws completely** as parts may be lost inside the Inhaler.

To fit new unit

Make sure that the well in the Inhaler body is clean, slacken 3 screws, and slide unit in the Inhaler body. Check that the top plate is fitting correctly to the Inhaler without gaps and tighten screws.

Note. If this unit is removed for any reason, it is desirable to fit new rubber seals before refitting to the Inhaler.

These are available as:

Lower sealing ring	Part number
Upper sealing ring	Part number
Nylon washers for screw heads	Part number
Nylon washers for spacers	Part number

E.M.O. Inhalers made after January 1968, serial numbers 7100 upwards, have O-ring seals replacing the lower sealing ring and upper sealing ring.

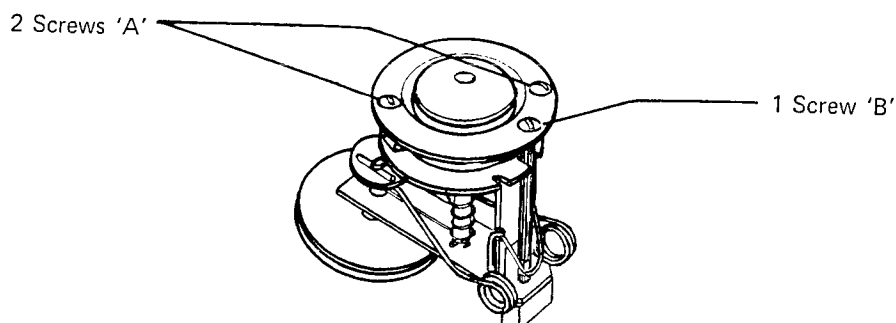
These seals are identical in size but, of different hardness, and can be identified as follows:-

Lower O-ring marked with Red and Blue spots	Part number 0519
Upper O-ring marked with Red and Green spots	Part number 0518

Closing Mechanism: (Part No. 60900)

Adjustment - When the E.M.O. control pointer is turned from the calibrated part of the scale to "Close for Transit" it should ride on to the domed head of the closing mechanism without undue force. At the same time it should depress the domed head sufficiently to ensure that the internal valve between upper and lower parts of the E.M.O. closes completely (Routine Inspection check "b" p. 21).

Screw B in the drawing below adjusts this valve. Turning the screw in a clockwise direction increases the closing pressure.



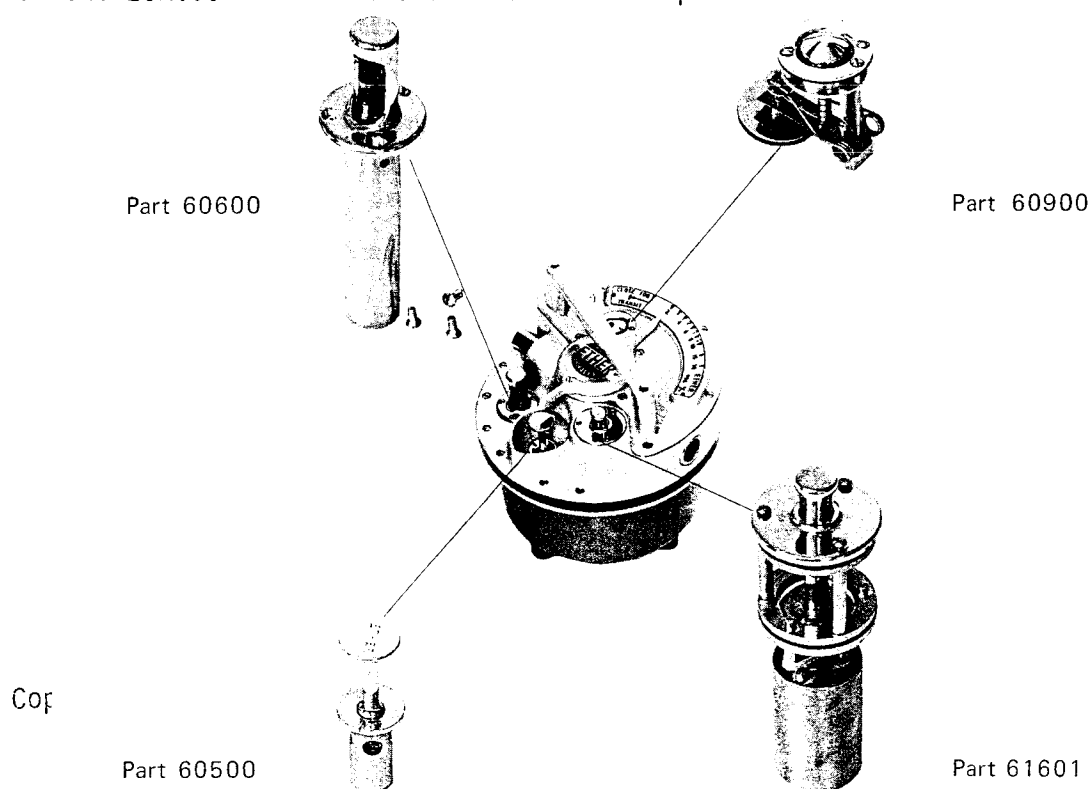
Replacement: The closing mechanism unit is retained in the Inhaler by two dogs operated by screws, marked A on drawing. To release the unit, turn these screws anticlockwise 2 or 3 turns only, tap top of unit lightly with wood or plastic to break grip of sealing washer. A further turn of each screw should then release the dogs and the unit can be lifted out complete.

To fit a new closing mechanism to the Inhaler, make sure that the dogs are turned fully in and insert unit in its seating, checking that the tongue provided on the Inhaler fits into the slot in the closing mechanism body. Tighten the two screws by one turn, lift unit to check that both dogs are engaged and then tighten screws.

After fitting a new unit, adjustment may be required to ensure correct seating of the valve.

Ether Filler: (Part No. 60500)

It is most unlikely that replacement of this unit will ever be necessary. A special key (E.M.O. Tool No. 1) is required to engage the slots on either side of the flange. With this key the complete unit may be unscrewed from the body of the E.M.O. and a new one fitted in its place.



SPARE PARTS

E.M.O.

Part No.

• Level Indicator - complete	60600
*Temperature Compensator - complete	61601
Closing Mechanism - complete	60900
Filler Unit - complete	60500
Water Compartment-Drain Plug-complete	60132
Water Compartment-Drain Plug-Washer only	60104
(All the above complete units include gaskets and seals)	
*Temperature compensator units should not generally be held in stock as spares (see p.25). The following seals may be required between occasions of total temperature compensator replacement and may be held in stock indefinitely.	
Lower sealing ring	0519) See
Upper sealing ring	0518) Page 24
Nylon washers for screw heads (3 required)	60906
Nylon washers for spacers (3 required)	61656

O.I.B.

Item

Bellows Assembly-complete (Adult size)	51212
Bellows Rubber only (Adult)	51213
Bellows Assembly-complete (Paediatric size)	51214
Bellows Rubber only (Paediatric)	51215
Magnet	51015
Glass Dome	51019
Pair of Gaskets for Glass Dome	51018
Inlet Valve disc (plain)	51017
Outlet Valve disc (magnetic- with white spot)	51016

AMBU BAG

Air Inlet Valve and female connector (B.S. Taper)	Part No. 18005
Oxygen Inlet Valve	Item 51061
Outlet connectors (male) (B.S. Taper)	Item 50327
Self Inflating bag only without valves	Item 51060

SERVICE DATASHEET



Item	Part No	Description	Req'd
1	62883	Base	1
2	020015	Wing Nut M5	1
3	22020	Pressure Relief Valve	1
4	62885	Adaptor	1
5	39875	Taper Connector -inspiratory	1
6	053212	Plug	1
7	0117	O-ring	2
8	041105	O-ring (not shown)	1
9	15056	Label (not shown)	1
10	39883	Seal	2
11	39884	Valve Seat	2
12	62889	Valve Disc (magnetic)	2
13	39892	Dome	2
14	62810	Bellows Assembly	1
15	62884	Arm	1
16	62886	Magnet	1
17	01008	Screw M4 (for magnet - not shown)	1
18	011259	Pad (for base - not shown)	4
19	62888	Taper Adaptor	1
20	041216	O-ring (not shown)	1
21	041246	O-seal	1
22	041207	O-seal	1



Cat No. 51010

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