3. Turn on the incubator, and leave it to heat with the fan circulating the air, for at least 1.5 hours.
4. Remove the bowl of formaldehyde solution, and replace it with a bowl of 200 g/l ammonia solution. Leave for 1.5 hours with the fan and heating switched on. The ammonia removes the smell of the formalin.
5. Remove the ammonia solution, strip the machine down and clean with soap and water. If after cleaning there is still some residual smell of formalin, leave the incubator running until all the smell has disappeared.

Notes on formaldehyde

A stock solution of formaldehyde in water (370 g/l), generally called formalin, should be available. Prior to disinfection, the equipment should be cleaned of all gross contamination and then arranged to permit a free flow of formaldehyde vapour over all potentially infected surfaces. The properties of formaldehyde make it unsuitable for the disinfection of porous substances such as filters and fabrics, including all bedding material. Any such material should be removed and cleaned by other means. The disinfecting process should take place at a temperature above 20 °C.

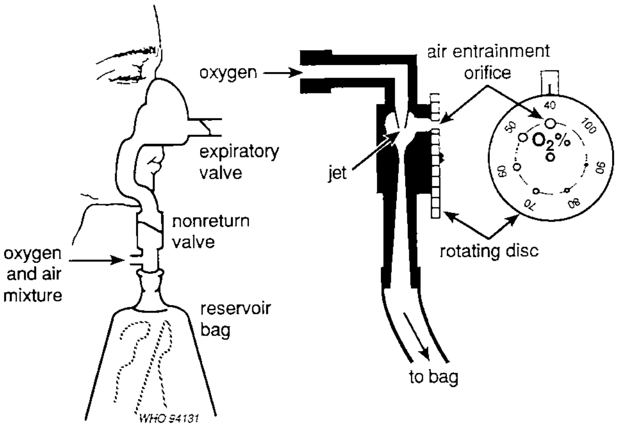
Methanol is often added to formalin as a stabilizer if it is to be stored for long periods. Methanol prevents polymerization. When buying formalin for disinfection, do not select an industrial grade as this may well have up to 10% methanol added. Such a high concentration of methanol can damage some plastics, including Perspex. Buy formalin containing not more than 1% methanol. Always store formalin in a dark-coloured bottle, out of the sunlight.

Oxygen entrainment systems

An entrainer is used to administer an air/oxygen mixture to patients. Fig. 4.3 shows how an entrainer works.

Oxygen from a flowmeter enters the entrainer and draws in air via the air entrainment duct. The duct is covered by a regulator disc, which can be rotated and has holes in it of different sizes. As the disc is turned, different size holes can be lined up with the entrainment duct. In the diagram, the disc has been turned so that the largest hole, marked 40, is against the orifice. At this setting, the flow of oxygen pulls in 3 times its own volume of air, so the mixture administered to the patient is 40% oxygen (because the air also contains some oxygen). The disc can

Fig. 4.3. How an entrainer works.



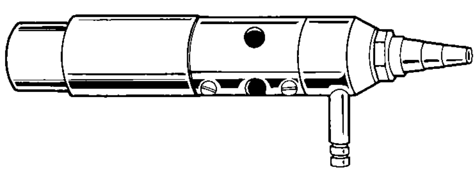
be rotated to a smaller hole, resulting in a higher oxygen concentration being delivered to the patient because less air is taken in. If the disc is turned to 100, the patient will receive 100% oxygen, as there is no inlet for air. Once the disc has been set, the patient will receive a gas mixture with the same proportion of oxygen, whatever the flow rate.

The maintenance of such a basic entrainer is simple, and consists of making sure that the holes in the disc and the jet are not blocked, and that the disc is free to be rotated, though not so free that it can be turned by accident. When checking or unblocking the holes or jet, do not use a drill or wire, as this may alter the size of the hole and thus the amount and composition of gas that is delivered to the patient.

Farman entrainer

This is an entrainer designed for paediatric use (Fig. 4.4). It can be used with an Epstein-Macintosh-Oxford (EMO) machine to vaporize ether, or with an Oxford Miniature Vaporizer (OMV) to vaporize other anaesthetic agents. The entrainer consists of a fine jet through which oxygen passes into a venturi-shaped tube, drawing in air.

Fig. 4.4. Farman entrainer.



The entrainer is plugged into the inlet of an EMO machine and a blood pressure gauge attached to the side-arm. Oxygen from a cylinder is passed through the entrainer, the flow being adjusted until the blood pressure gauge reads 100 mmHg. At this setting, the entrainer will deliver a flow of 10 litres of oxygen-enriched air per minute; the gas mixture will contain about 35% oxygen.

Remember, ether and oxygen mixed in air form an explosive mixture. When testing an entrainer, it is safer to fix it to an empty EMO or carry out the test in a well-ventilated area.

If the outflow of the entrainer is blocked, the high-pressure gas will escape from the air-inlet ports and the maximum pressure in the system will be about 11 mmHg (15 cm H_2O or equivalent on the gauge in use). Thus, if for any reason the gases are prevented from escaping from the breathing circuit, the maximum pressure of gas the patient will receive is about 11 mmHg. A fine filter is provided at the air-inlet port to prevent dust from entering the high-pressure chamber and damaging the jet. Do not clean the jet by probing it with a piece of wire, as this may alter the size of the jet. There is also a wire gauze to protect the air entry port. Make sure the filters are clear and check the jet, which may be removed for cleaning. This entrainer is cheap to buy, economical, safe, and simple in construction; it is easy to maintain (as outlined above) and, if treated with care, will last a long time.

Systems for continuous-flow anaesthesia

Continuous-flow anaesthetic machines (commonly known as Boyle's machines or simply gas machines) are in widespread use. They rely on a supply of compressed