PRACTICE LECTURE OF ANESTHETIC EQUIPEMENTS

FLOWMETERS

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FLOWMETER

Flowmeters measure the flow rate of a gas passing through them. They are individually calibrated for each gas. Calibration occurs at room temperature and atmospheric pressure (sea level). They have an accuracy of about ±2.5%. For flows above 1 L/min, the units are L/min, and for flows below that, the units are 100 mL/min.

Fig. 2.20 An empty Selectatec back bar of an anaesthetic machine.

Components:

A flow control (needle) valve.

2. A tapered (wider at the top), transparent plastic or glass tube.

3. A lightweight rotating bobbin or ball. Bobbin-stops at either end of the tube ensure that it is always visible to the operator at extremes of flow.

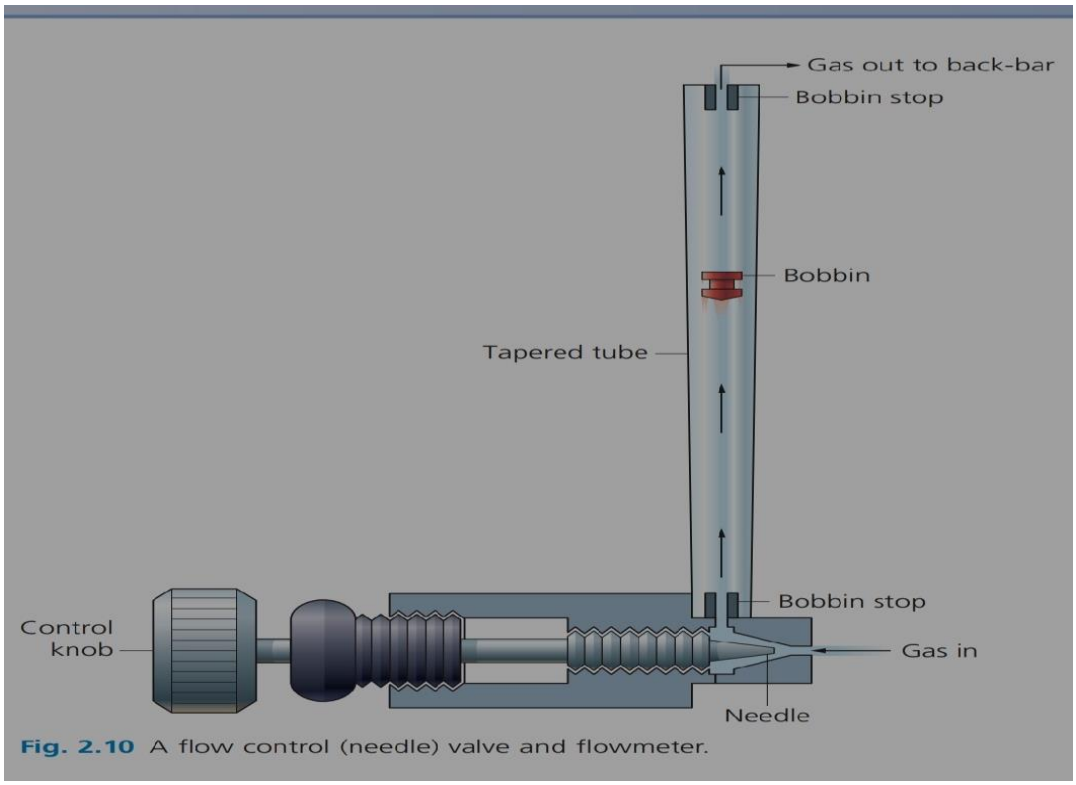


Fig. 2.10 A flow control (needle) valve and flowmeter.

Mechanism of action:

1-When the needle valve is opened, gas is free to enter the tapered tube.

2-The bobbin is held floating within the tube by the gas flow passing around it. The higher the flow rate, the higher the bobbin rises within the tube.

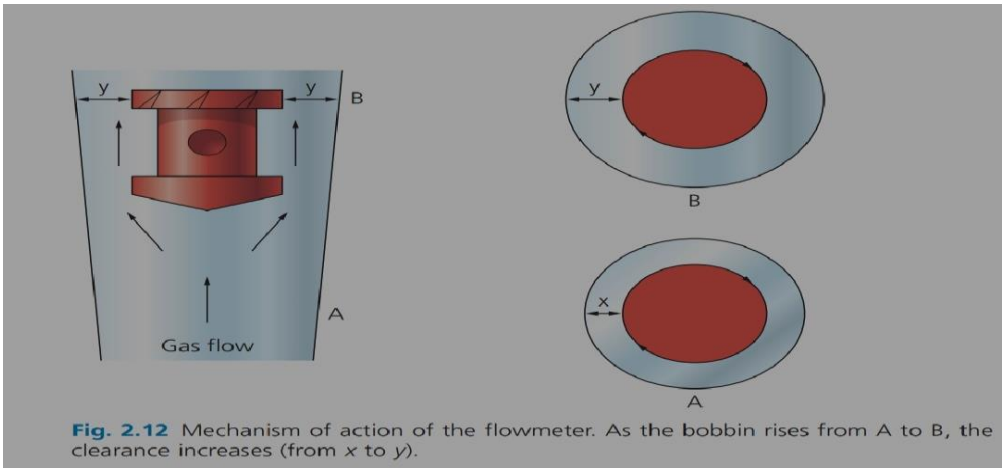


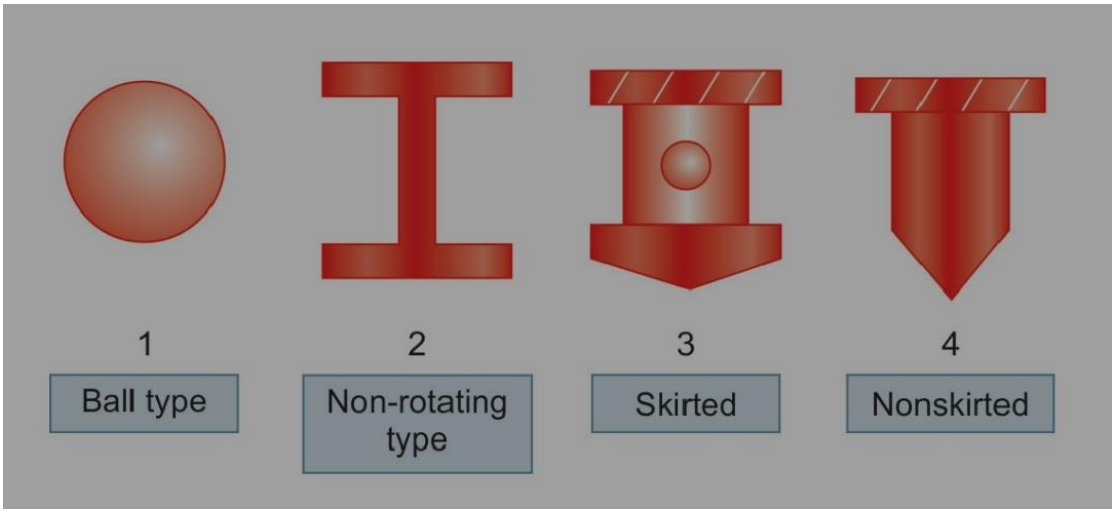
Fig. 2.12 Mechanism of action of the flowmeter. As the bobbin rises from A to B, the clearance increases (from *x* to *y*).

3. The effect of gravity on the bobbin is counteracted by the gas flow. A constant pressure difference across the bobbin exists as it floats.

4. The clearance between the bobbin and the tube wall widens as the gas flow increases.

5-The top of the bobbin has slits (flutes) cut into its side. As gas flows past it, the slits cause the bobbin to rotate. A dot on the bobbin indicates to the operator that the bobbin is rotating and not stuck.

6. The reading of the flowmeter is taken from the top of the bobbin. When a ball is used, the reading is generally taken from the midpoint of the ball.



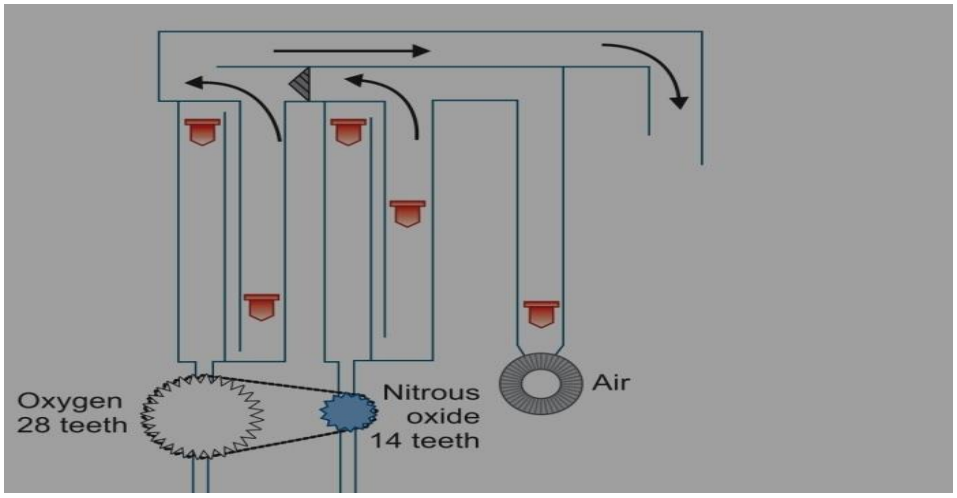
7. When very low flows are required, e.g. in the circle breathing system, an arrangement of two flowmeters in series is used. One flowmeter reads a maximum of 1 L/min.

Problems in practice and safety features:

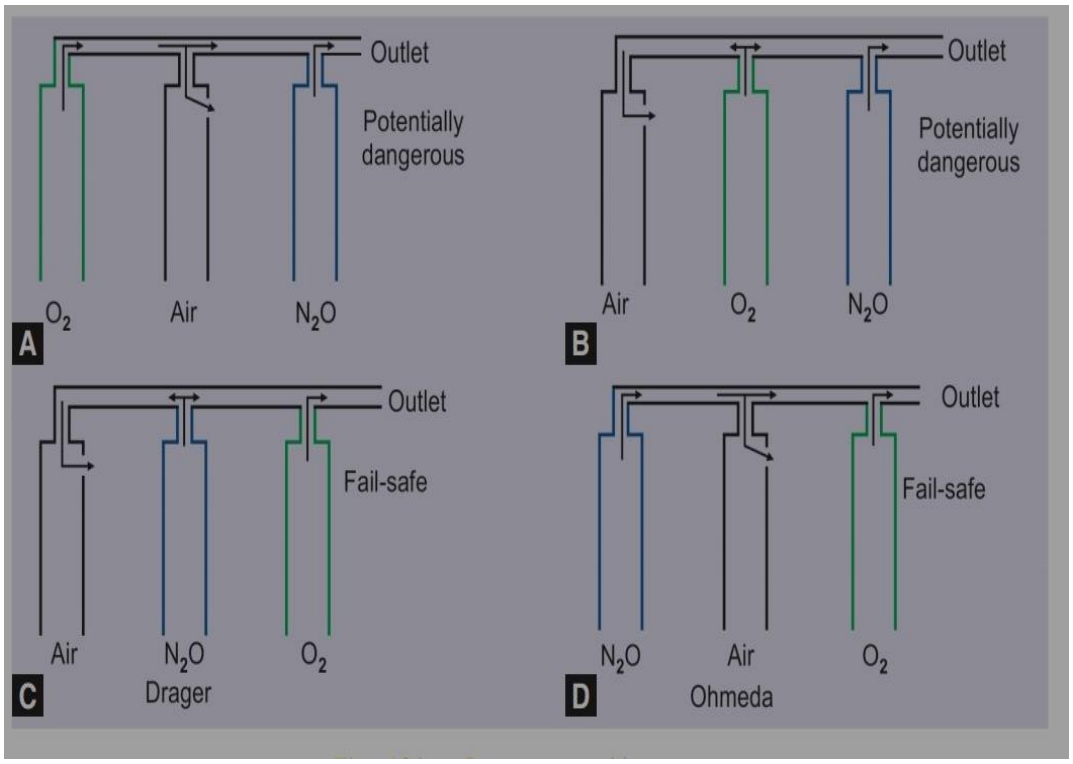
1-The flow control knobs are colour-coded for their respective gases.

2-The European Standard for anaesthetic machines (EN 740) requires them to have the means to prevent the delivery of a gas mixture with an oxygen concentration below 25%. Current designs make it impossible for nitrous oxide to be delivered without the addition of a fixed percentage of oxygen. This is achieved by using interactive oxygen and nitrous oxide controls. This helps to prevent the possibility of delivering a hypoxic mixture to the patient. In the mechanical system, two gears are connected together by a precision stainless steel link

chain. One gear with 14 teeth is fixed on the nitrous oxide flow control valve spindle. The other gear has 29 teeth and can rotate the oxygen flow control valve spindle. This is called (Link 25).



3-A crack in a flowmeter may result in a hypoxic mixture. To avoid this, oxygen is the last gas to be added to the mixture delivered to the back bar.



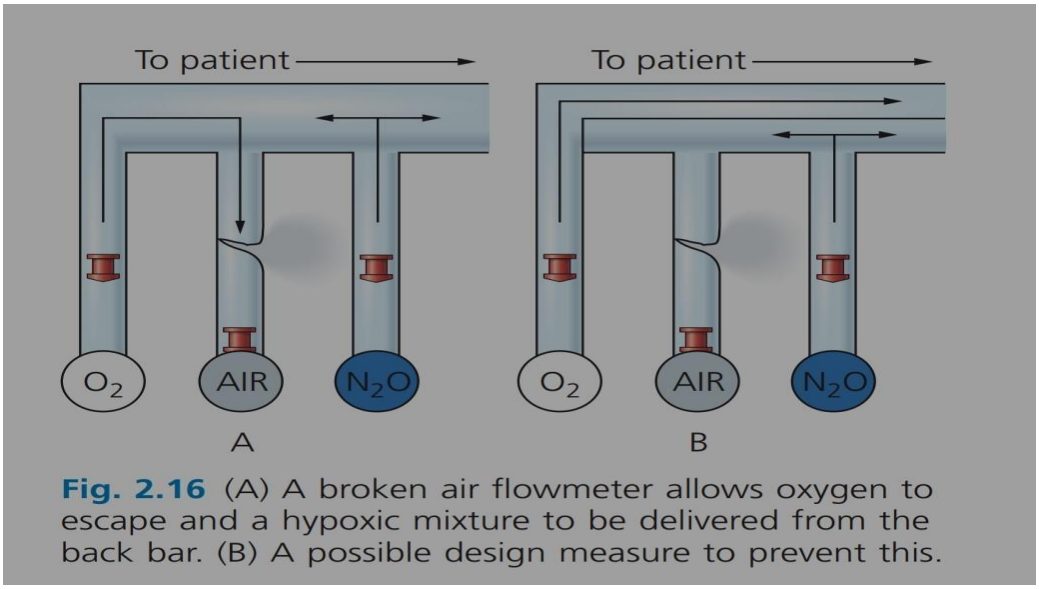


Fig. 2.16 (A) A broken air flowmeter allows oxygen to escape and a hypoxic mixture to be delivered from the back bar. (B) A possible design measure to prevent this.

4. Flow measurements can become inaccurate if the bobbin sticks to the inside wall of the flowmeter. The commonest causes are:

a) dirt: this is a problem at low flow rates when the clearance is narrow. The source of the dirt is usually a contaminated gas supply. Filters, acting before gas enters the flowmeters, will remove the dirt

b) static electricity: the charge usually builds up over a period of time, leading to inaccuracies of up to 35%. Using antistatic materials in flowmeter construction helps to eliminate any build-up of charge.

5-Flowmeters are designed to be read in a vertical position, so any change in the position of the machine can affect the accuracy.

6. Pressure rises at the common gas outlet are transmitted back to the gas above the bobbin. This

results in a drop in the level of the bobbin with an inaccurate reading.

7-Accidents have resulted from failure to see the bobbin clearly at the extreme ends of the tube. This can be prevented by illuminating the flowmeter bank and installing a wire stop at the top to prevent the bobbin reaching the top of the tube.

8-Highly accurate computer controlled gas mixers are available.

THANK YOU