

محاضرة رقم 6

Lecture No6

نظري

Theoretic
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أسس أجهزة التخدير الكورس الاول

FLOWMETER

Sawa University

جامعة ساوة

College of health and medical
techniques

الاهلية

Department of Anesthesia

كلية التقنيات الصحية
والطبية

.....second..... Stage

قسم تقنيات التخدير

المرحلة

.....الثانية

استاذ المادة د. حسن جساب
البركي

Definition: A flowmeter is a device in the anesthesia machine that measures and controls the flow rate of gases (such as oxygen, nitrous oxide, and air) before they enter the vaporizer and then the breathing system

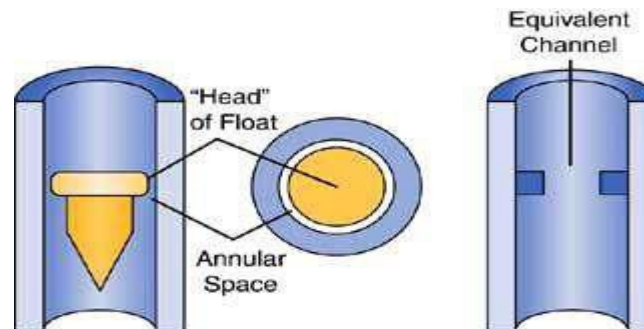
Main parts

1. Flow control valve
2. Flow tube (rotameter)
3. Float (bobbin or ball)
- 2 4. Scale . Marked in liters per minute (L .. Min)



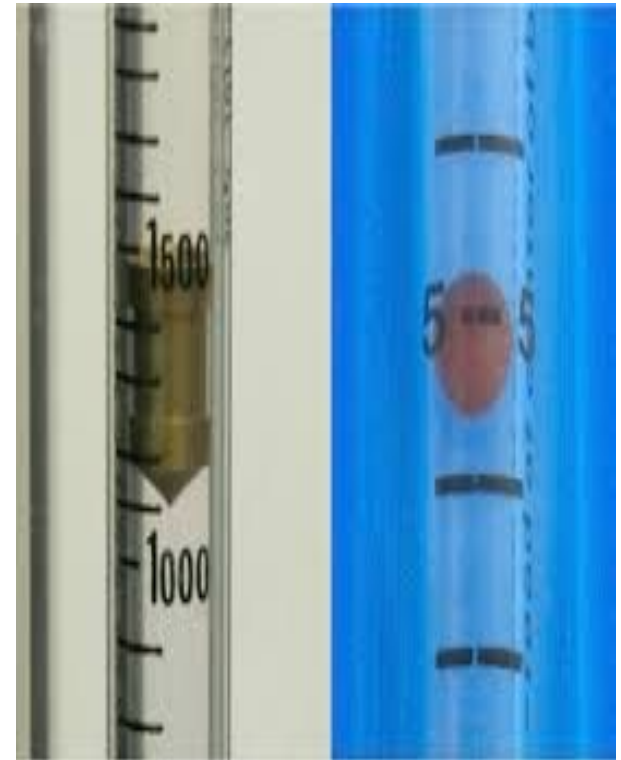
Flowmeter

Separate flow meters are provided for each gas and a flow control valve controls the flow of gas. As the valve is opened, a bobbin or ball moves up the flow meter. The flow of gas is read from the position of the top of the bobbin or the middle of the ball. The flow control valves are delicate, and should only be opened and closed by hand. Some basic anesthetic machines use turret-type flow meters in which the gas leaves the flow meter from the bottom of the unit. These can also be purchased combined with a pressure reducing valve and regulator and used on a compressed gas cylinder as a simple and inexpensive means of supplying oxygen.



Bobbins and balls

Bobbin flowmeters are more accurate, but more expensive, and should be read from the top of the bobbin (the shape of the bobbin is designed to optimise gas flow, and has nothing to do with being a 'pointer'). Ball float types should be read from the middle of the ball.



Flowmeter working

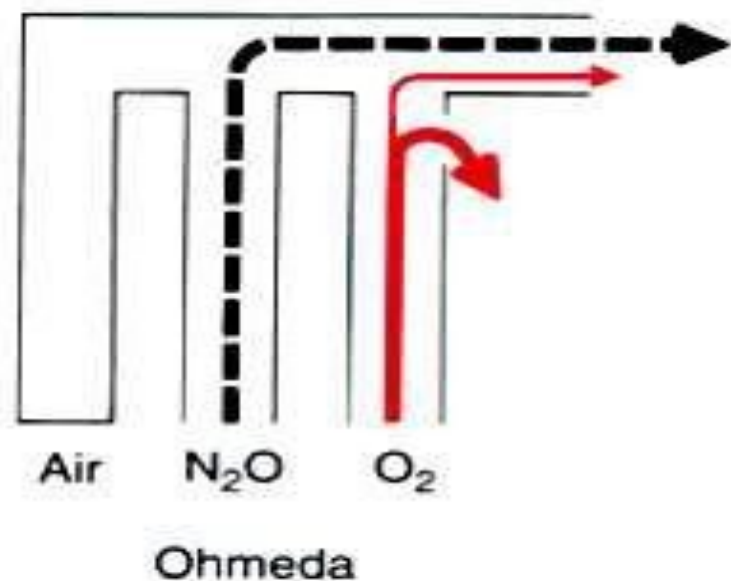
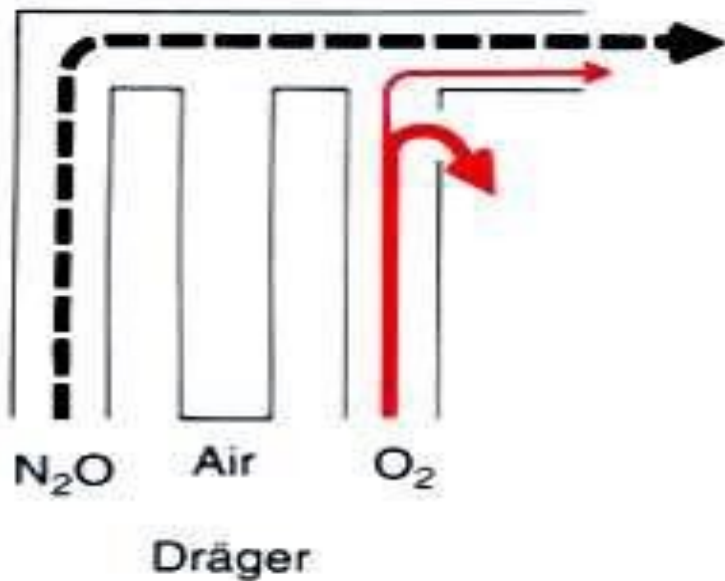
- ❖ *Flowmeters adjust the proportions of medical gases controlled by the anesthesia machine as well as the total gas flows delivered to the patient circuit .*
- ❖ *Flowmeters measure **the drop in pressure** that occurs when a gas passes through a resistance and correlates this **pressure drop to flow** .*



- ❖ *The indicator floats freely at a point where the downward force on it (gravity) equals the upward force caused by gas molecules hitting the bottom of the float.*
- ❖ *As the bobbin rises with increased flow, the size of the annulus between it and the glass tube increases. In other words, there is a variable orifice around the bobbin which depends on the gas flow.*



However a leak in the oxygen flowmeter tube can cause a hypoxic mixture, even when oxygen is located in the downstream position.



Flowmeter problems

- ❑ *At high flow rates flow becomes turbulent, and flow becomes a function of density, a property that is influenced by altitude.*
- ❑ *The resulting decreases in density will increase the actual flow rate so the flowmeter will read lower than the actual flow rate.*
- ❑ *At increased pressure, as in a hyperbaric chamber, the reverse is seen; the delivered flow rate is slightly less than the actual flow rate*



Flowmeters physics

- ❑ *Turbulent flow is often present where there is an **orifice**, a sharp bend or some other irregularity which may cause local increase in velocity.*
- ❑ *Turbulence is also affected by other factors such as **viscosity** and **density** of the fluid and **diameter** of the tube.*
- ❑ *The effect of density on onset of turbulent flow can be illustrated by use of helium in respiratory disorders*
- ❑ *Helium reduces the density of the gas inhaled and so reduces the incidence of turbulent flow, therefore lower resistance to breathing*

Back Pressure

- ❖ *In machines without an outlet check valve, if pressure at the common gas outlet increases, this is transmitted back to the flowmeters, compressing the gas above the float*
- ❖ *Pressure above the indicator rises forcing the float down, causing the flowmeter to be read lower than the actual gas flow rate*



Static Electricity:

Static electricity causes the float to stick to the side of the tube causing reading inaccuracy. These electrostatic charges are negligible as long as the float rotates freely

Hidden Floats:

- ☐ *The float may adhere to the stop at the top of the tube even if no gas is flowing*
- ☐ *The float may disappear from view if the stop is present e.g. broken float stop*



Oxygen ratio and proportioning systems

- ❑ Protection against hypoxic mixture at the flowmeter level.
- ❑ Prevention of delivery of a hypoxic gas mixture is a major consideration in the design of contemporary anesthesia machines.
- ❑ **Mandatory minimum oxygen flow:** Some machines require a minimum flow (50-250ml/min) of oxygen before other gas will flow.
- ❑ Some machine activate an alarm if O₂ flow falls below a certain limit.
- ❑ **Minimum oxygen ratio:**
- ❑ In modern anesthesia machines, N₂O and O₂ flow controls are physically interlinked so that a fresh gas mixture containing at least 25% O₂ is delivered at the flowmeters when only N₂O and O₂ are used .



Any questions?

*Thank
You*