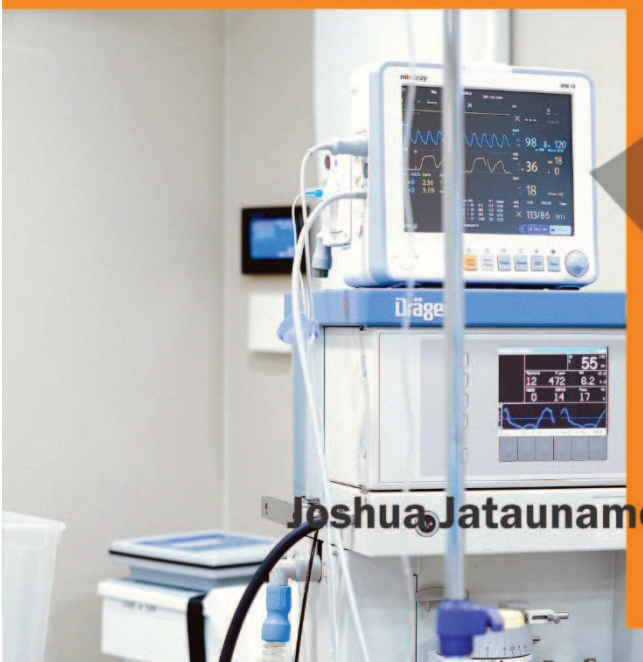
Noogul Digital services

CONTEMPORARY ANAESTHETIC EQUIPMENT'S

(An aid for healthcare professionals).



Book Cover

Joshua Jataunamo Oscar

CONTEMPORARY

ANAESTHETIC EQUIPMENTS.

AN AID FOR HEALTHCARE PROFESSIONALS.

First Published, 2023

ISBN: 978-1-304-99639-8

Noogul Digital Publishing

Table of Contents

List of Figures

SECTION ONE:
EQUIPMENT'S USED IN ANAESTHESIOLOGY

Introduction

The anaesthetic machine enables to deliver gas and vapour mixtures to the patient accurately and continuously. The Boyle anaesthetic machine is designed by **HEG**. Boyle in 1915. Modern machine differs greatly in detail and modified time-to-time, but the basic principles remain the same. It consists of:

i. Oxygen and anaesthetic gas supply
ii. Pressure gauges
iii. Reducing valves
iv. Flow meters
v. Vapourizers
vi. Common gas outlet
vii. Certain other features:

High flow oxygen flush, pressure relief valve, oxygen supply failure alarm, suction apparatus! Monitoring devices.

Medical Gas Supply

Cylinders

- Made of molybdenum steel to withstand high pressures
- Made of different sizes (A to J). Size E cylinders are used in the anaesthetic machine
- Oxygen is stored as gas at about 2000 lb/inch^2 and nitrous oxide is stored in a liquid phase with vapour on the top at a pressure of 760 lb/inch^2. It is 75% filled with liquid nitrous oxide **Note:**

Filling ratio is the weight of fluid in the cylinder divided by the weight of water need to fill the cylinder.

- Cylinders are colour coded.
  - Oxygen: Black with white shoulders, green in some countries.
  - Nitrous oxide: Blue
  - Carbon dioxide: Grey
  - Entonox: Blue with white /bluequarters shoulder
  - Air: Grey with white/black quarters shoulder.
- Some markings engraved on the cylinders: Test pressure, chemical formula, Tare weight, dates of test performed, etc.
- Checking and testing by manufacturers at regular intervals:
  - Flattening test
  - Bending test
  - Impact test
  - Pressure test
  - Tensile test.
- Gases and vapour must be free from water vapour as it may freeze and block the exit port at a decreased temperature particularly when opening
- Cylinder valve provides *pin index- system* as a safety feature to make it almost impossible to connect a cylinder to a wrong yoke
- Should be stored in a dry, well-ventilated and fire proof room. Avoid dampness, corrosives and fumes nearby. No oil or grease or any other flammable materials or any source of heat ; should be allowed
- Full cylinders should be kept separately and should not be mixed with empty ones
- Avoid over pressurized full cylinders..

Pin index system

A specific pin configuration for each medical gas on the yoke of the anaesthetic machine. The pin will match the holes on the valve block. It permits only the correct gas cylinder to be fitted in the yoke.

- Oxygen: 2 and 5
- Nitrous oxide: 3 and 5
- Cyclopropane: 3 and 6
- Entonox: 7
- Air: 1 and 5
- Carbon dioxide: 1 and 6

Pressure in the cylinders

- Oxygen: About 2000 lb/inch^2
- Nitrous oxide: About 750 lb/inch^2
- Cyclopropane: 751b/inch^2 [stored in light alloy cylinders as a liquid]
- Carbon dioxide: 720 lb/inch^2.

Cylinder valve

- Mounted on the neck of the cylinder, screwed with threaded connection
- The valve can be opened or closed by an off/on spindle for gas pathway
- Non inter changeable safety device (pin index system) prevents wrong cylinder assembly
- Bodok seal is placed between the valve outlet and yoke of the machine to make the gas tight joint.

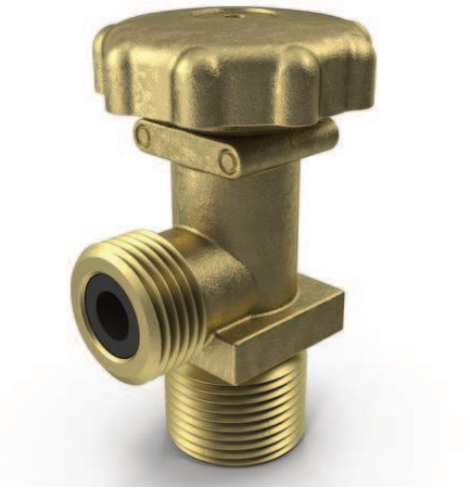


Figure 1: Cylinder Valve Flush Type

- The cylinder valve should be fully open during use. Check the Bodok seal before use to detect any damage.

Piped gas supply

- Gas delivered from a central supply to different locations at a pressure of about 400 kPa;
- Oxygen, nitrous oxide, entonox, compressed air and medical vacuum can be used through the pipe line system
- *Components:*
  - Central supply (cylinder bank/liquid oxygen storage bank or oxygen concentrator)
  - Pipe work (made of copper), flexible and colour coded
  - Outlets (identified by gas colour coding, gas name and by shape) accept matching quid connect or disconnect probes with an indexing colour specific for each gas.

- The cylinders of each group are connected through non return valve to a common pipe. Then in turn *is* connected to the pipe line through pressure regulators
- The cylinders should be well-housed in a well-ventilated room (fire proof) in a suitable place in hospital.

Liquid oxygen

- Oxygen can be stored and supplied in a vacuum thermally insulated evaporator at a temperature of - 150°C to - 170°C and at a pressure of 5 to 10 atmospheres.
- A pressure regulator permits gas to enter the pipelines and maintains it at about 400 kpa
- It also provides a safety valve to release the buildup high pressure, if occurs
- A control valve is also there to meet the extra demands on the system
- Cold oxygen gas is warmed outside the vessel in copper tubing coil. The increase in temperature increases the pressure.

Oxygen Concentrator

- Extracts oxygen from air when exposed a zeolite molecular sieve column at certain pressure.
- The zeolite sieve selectively retains nitrogen and other unwanted constituents of air and releases them to atmosphere
- Maximum oxygen concentration can be-achieved is nearly 95% by volume. Argon may be main of the other constituents.

Compressed Air

- Can be used either clinically at a pressure of 400 kPa or to drive power tools at a pressure of about 700 kPa
- Can be supplied from cylinders or from a compressor
- For clinical use air should be cleaned by filters and separators and then dried.

Pressure Gauge

- Measures the pressure in the cylinder mounted in the front facing panel on the anaesthetic machine
- High pressure gas acts to straighten a coiled tube (Bourdon gauge). Movement of the tube causes the needle pointer to move on a calibrated dial to indicate the pressure

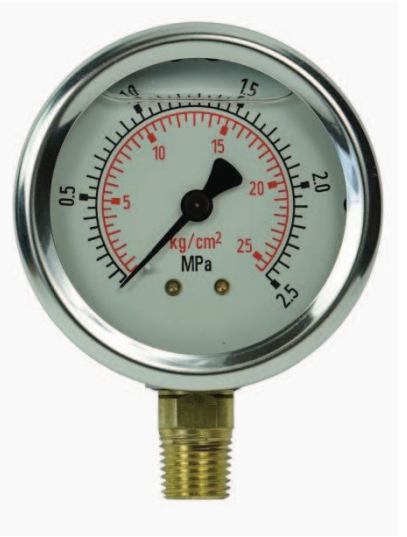


Figure 2: Pressure Gauge

- Colour coded and calibrated for a particular gas or vapour
- Indicates the contents of gas available in the cylinder
- Nitrous oxide cylinder does not provide pressure gauge as it is stored as a *liquid* and vapour
- Pressure gauge meant for pipeline is not for cylinder and *vice versa.* May lead to inaccuracies and/or damage
- Misassemble is possible.

Pressure regulator (Reducing valve)

- Reduces the variable gas pressure from cylinders to about 400 kpa
- Positioned between the cylinders and the rest of anaesthesia machine
- Provides fine control of gas flow and protects the parts of machine against high pressure
- Prevents the pressure from increasing above a predetermined limit
- Contents of the cylinder should be free from water, otherwise ice can form inside the valve
- Earlier models are with 'fins' to augment acquisition of heat from the environment
- Mechanism of action: The gas from the cylinder enters into the chamber of reducing valve where it distorts a diaphragm to which a toggle mechanism is connected and a balance between two opposing forces maintains a constant predetermined operating pressure (60 psi)
- Diaphragm can rupture
- Relief valve is fitted downstream of the regulator. It helps to escape the gas, if regulator fails.

Flow restrictor

- Pipeline pressure increase can be controlled by using a pressure regulator on a flow restrictor
- Flow restrictor provides a constriction between the pipeline supply and the remaining part of the anaesthetic machine. The constriction causes a significant pressure drop in presence of a high gas flow rate.

Flowmeters

- Measures flow rate of a gas per minute
- Each gas is individually calibrated