TOPIC: ANAESTHESIA MACHINE AND MEDICAL GA

- First Boyle`s machine was made by Edmund gaskin Boyle in 1917.' machine is a continuous flow type of machine used for administration of anaesthesia

MECHANISM OF GAS FLOW:

Gases in cylinders are at high pressure[2,000 pounds per square inch(PSI) for oxygen and 760 Psi for nitrous oxide] which are reduced to **45 to 60** Psi by 1st pressure reducing valve and then further reduced to **15-20** Psi by 2nd pressure reducing valve.

Gases from pressure reducing valve reach flow-meters where flow is regulated by flow

Control knobs.

- These gases mix in a common manifold at the top of the flow meter
- From where they pass through the vaporizer containing inhalational agent, the vapours get mix with gaseous mixture and finally reaches to the machine outlet at a pressure of 5 to 8 psi

Anaesthesia machine is divided into 3 parts:-

- HIGH FLOW SYSTEM
- INTERMEDIATE FLOW SYSTEM
- LOW FLOW SYSTEM

High flow system includes:-

- Cylinders
- Pressure regulator(1st pressure reducing valve)
- Yoke assembly
- Oxygen flush

CYLINDERS:

- Made of molybdenum steel because molybdenum steel can withstand with high pressures
- Aluminium cylinders are also used for MRI suites
- Smallest size available is AA type

- Biggest is H
- Commonly used of Anaesthesia machines are of E type
- Cylinders should be tested every 5 years

OXYGEN CYLINDER

- Black body White shoulders
- Pressure is 2,000 psi
- As oxygen is consumed cylinder pressure falls in proportion to its contents i,e if the pressure gauge is showing 1000 Psi that means oxygen cylinder is half full.

LIQUID OXYGEN:

Special supply reservoirs are used. Oxygen is stored at 119 degree census (because critical temperature of oxygen is 119°C)

1 ml of liquid oxygen gives 840 ml of gas

The advantage of liquid oxygen is that it can be stored in large volumes in small containers

NITROUS OXIDE:

- Blue colour
- Filled as a liquid
- Pressure is 760 psi
- Nitrous oxide is filled as liquid. Vaporization of this liquid produces gas leading to heat loss(which sometimes may produce frost in cylinders) small amount of liquid present in cylinder may still vaporize to produce gas leading the pressure gauge to show the pressure of full cylinder therefore, contents of cylinder are measured by weight and not by pressure gauge.

CYCLOPROPANE:

- Orange colour

- Pressure 75 psi
- Filled in the form of liquid

CARBON DIOXIDE:

- Grey in colour
- Pressure 750 psi
- Stores as liquid

CYLINDER VALVES:

Fitted at the top of the cylinder.

Different types of cylinder valves are available like flush type (most commonly used), bull nosed etc.To start and close gas these valves are rotated anticlockwise and clockwise respectively.

PRESSURE GAUGE:

It is used to measure the cylinder pressure. Most commonly used type is Bourdon type

PRESSURE REGULATOR:

- It converts high variable pressure in cylinders to constant working pressure 45-60 psi
- In most of the machines it is set at 60 psi

OXYGEN FLUSH

- Bypass system
- It bypasses the intermediate and low flow system and oxygen reaches directly to the machine outlet
- It delivers 36 litres of oxygen
- Pressure is 60 psi

YOKE ASSEMBLY

- It is the portion of machine where cylinders get fitted

It Consists of

1. Pin index
2. Bodok seal or washer or gas seal

PIN INDEX SAFETY SYSTEM(PISS):

- Safety mechanism so that one cylinder cannot be fitted at others position
- Consists of 2 pins 4mm and 6 mm long on the yoke of the anaesthesia machine
- These pins are so positioned that the cylinder with corresponding holes can only be fitted

Gas	Index pins
Oxygen	2,5
Nitrous oxide	3,5
Cyclopropane	3,6
O2-CO2(CO2<7.5%)	2,6
O2-CO2(CO2>7.5%)	1,6
O2-He(He>80.5%)	4,6
O2-He(He<80.5%)	2,4
Air	1,5
Nitrogen	1,4
N2O-O	7

BODOK SEAL:

It is used to prevent leak between cylinders and yoke and a filter.

GAS PIPING SYSTEM / RECOMMENDATIONS OF PIPING SYSTEM;

In large hospitals where consumption of gases is more, Oxygen, Nitrous oxide and Air are supplied through central supply pipelines. In central supply rooms oxygen are stored in a set of 4-8 large(type-H) cylinders connected to a common manifold(Many hospitals use liquid oxygen tanks instead of cylinders).In India oxygen and nitrous oxide are supplied at a pressure of 60Psi through central supply

There is **colour coding** for central supply pipelines,

White for oxygen

Blue for nitrous oxide.

Black for Air and Yellow for vacuum.

Like pin index system which prevents wrong fitting of cylinders to machines **Diameter index safety system (DISS)** is to prevent wrong fitting of central supply pipes to machines.

INTERMEDIATE PRESSURE SYSTEM

- It Includes

I. 2nd pressure reducing valve

II. oxygen failure alarm

III. Fail safe valve

2nd PRESSURE REDUCING VALVE:

- Reduces pressure further 15 – 20 psi

OXYGEN FAILURE ALARM:

- Alarm will set up of when o2 pressure falls below 30 psi
- It is pressure dependent not flow dependent

FAIL SAFE VALVE:

- It prevents the delivery of hypoxic mixtures
- If oxygen falls nitrous falls proportionally
- If oxygen falls ,Nitrous will shut off
- Usually shuts off if oxygen pressure falls become less than 25 **psi**

LOW PRESSURE SYSTEM

- **Consists of**

a) Rotameter

b) Vaporizers

c) One way check valve

ROTAMETER:

- Most important component of low flow system
- It contains
- **Flow meters** : glass tubes which are transparent and tapered(narrow at base and wider at apex)
- **Thrope tube:** indicates flow
- **Bobbin**: in each tube there is a float called bobbin which keeps on rotating by the gas stream passing all around the bobbin and upper end of bobbin determines the flow.

- **Flow control knob:** the flow to each tube is controlled by control knob. Knobs are also colour coded blue for nitrous-oxide, white for oxygen, black for air and grey for carbon-dioxide
- **Florescent back panel**

VAPORIZERS:

- Device used to deliver inhalational agents
- Inhalational agents are liquid form in vaporizer
- Made of copper

ONE WAY CHECK VALVE:

- It is placed just before the machine outlet
- Prevents back flow

SAFETY FEATURES OF ANAESTHESIA MACHINE:

- Inter locking mechanism of vaporizers
- Antistatic rubber tyres
- Pin index system
- One way valve
- Oxygen flush
- Oxygen failure alarm
- Different physical appearance of oxygen knob
- Pressure reducing valve
- Colour coding of flow control knobs
- fail safe valve
- Oxygen –nitrous proportional device
- Fluorescent back panel of rotameter
- Oxygen flow meter tube placed mostly down streams
- Pressure relief valve
- DISS