Ventilators

Amechanical ventilator is a machine designed to move breathable air into and out of the lungs to provide breathing for a patient who is physically unable to breathe or is breathing insufficiently, or it is a device designed to provide or augment patient ventilation.

Characteristics of the ideal ventilator

1. simple, portable, robust and economical to use.

2. It should be versatile and supply tidal volumes up to ***1500*** mL with a respiratory rate of up to 60/min and variable I:E ratio. It can be used with different breathing systems. It can deliver any gas or vapour mixture. The addition of positive end expiratory pressure (***PEEP***) should be possible.

3. It should monitor the airway pressure, inspired and exhaled minute and tidal volume, respiratory rate and inspired oxygen concentration.

4. There should be facilities to provide humidification. Drugs can be nebulized through it.

5. Disconnection, high airway pressure and power failure ***alarms*** should be present.

6. There should be the facility to provide other ventilator modes, e.g. SIMV, CPAP and pressure support.

7. It should be easy to clean and sterilize.

Different type of ventilator

Bag in bottle ventilator

Modern anaesthetic machines often incorporate a bag in bottle ventilator.

Components:

1.A ***driving unit*** consisting of:

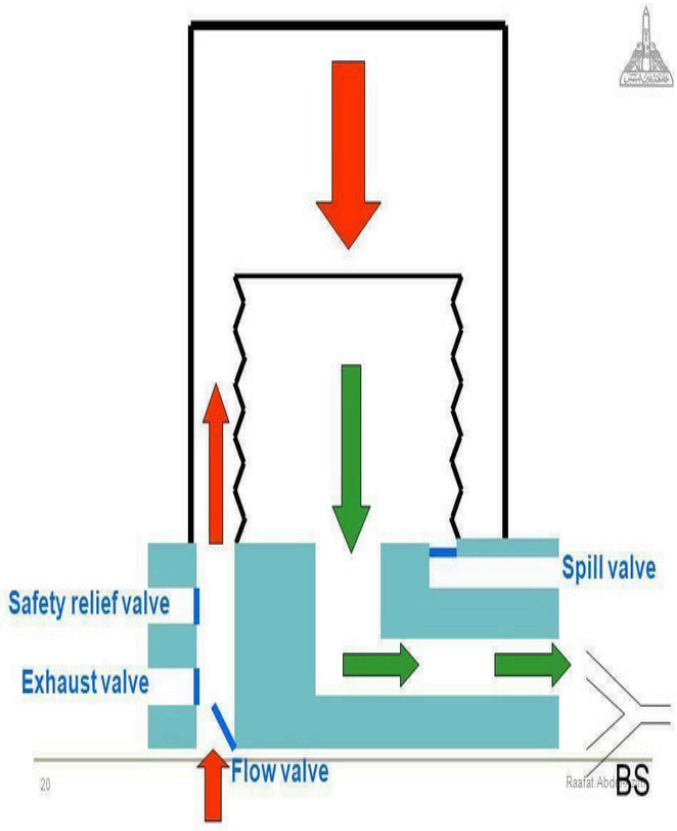
a. a chamber with a tidal volume range of 0–1500 mL (a paediatric version with a
range of 0–400 mL exists)

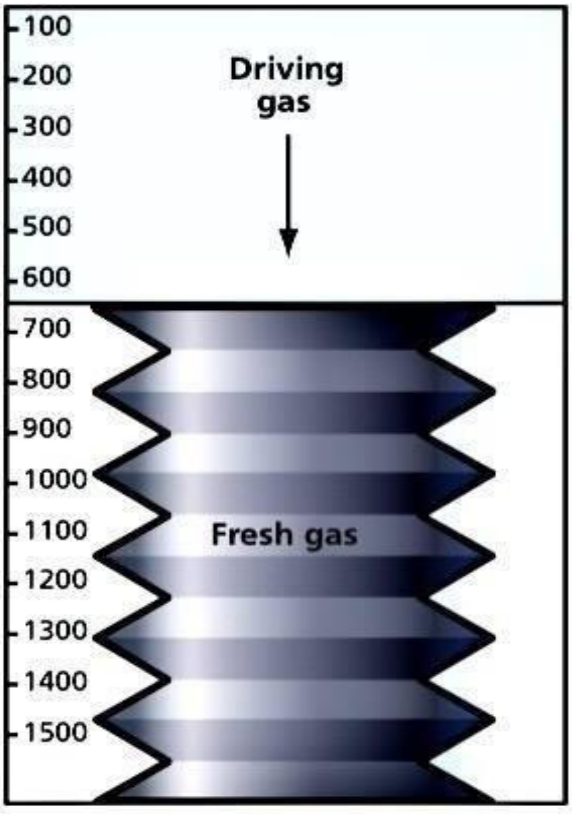
b. an ascending bellows accommodating the FGF.

2. A ***control unit*** with a variety of controls, displays and alarms: the tidal volume, respiratory rate (6–40 breaths/min), I : E ratio, airway pressure and power supply .

Mechanism of action

1. It is a time-cycled ventilator that is pneumatically powered and electronically controlled.
2. The fresh gas is accommodated in the bellows.
3. Compressed air is used as the driving gas ,On entering the chamber, the compressed air forces the bellows down, delivering the fresh gas to the patient.
4. The driving gas and the fresh gas remain separate.
5. The volume of the driving gas reaching the chamber is equal to the tidal volume.
6. Some designs feature a descending bellows instead.





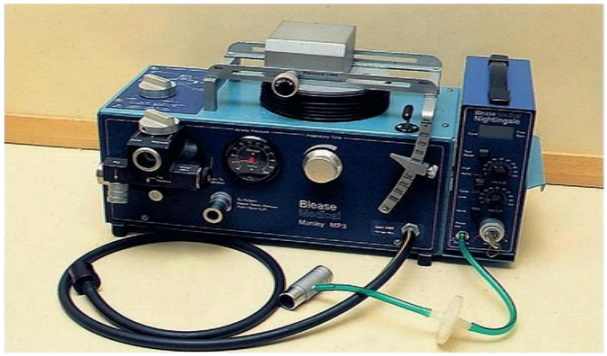
Mechanism of action of the bag in bottle ventilator.

Problems in practice and safety features.

1. Positive pressure in the standing bellows causes a PEEP of 2–4 cm H2O.
2. The ascending bellows collapses to an empty position and remains stationary in cases of disconnection or leak.
3. The descending bellows hangs down to a fully expanded position in a case of disconnection and may continue to move almost normally in a case of leakage.

Manley MP3 ventilator:

This is a minute volume divider (time cycled, pressure generator). All the FGF (the minute volume) is delivered to the patient divided into readily set tidal volume



Advantages

- No electrical power required.
- Simple to use and reliable.
- Does not waste pressurized gas, because all of the FGF is divided and supplied to the patient; no additional gas flow is required to drive the ventilator.
- The ventilator may be used in conjunction with a circle system.

Disadvantages

- Only a single mode of mechanical ventilation is possible.
- Generates back pressure within the breathing circuit, which can affect the accuracy of vaporizers within the circuit

Penlon Nuffield 200 ventilator:

The Penlon Nuffield 200 is an intermittent blower ventilator. It is small, compact, versatile, and easy to use with patients of different sizes, ages, and lung compliances. It can be used with different breathing systems. It is a volume-preset, time-cycled flow generator in adult use. In pediatric use, it is a pressure-preset, time-cycled, flow generator

Components

1. The control module, consisting of an airway pressure gauge (cmH2O), inspiratory and expiratory time dials (seconds), inspiratory flow rate dial (L/s), and an on/off switch. Underneath the control module, there are connections for the driving gas supply and the valve block. Tubing connects the valve block to the airway pressure gauge.
2. The valve block has three ports:

a) A port for tubing to connect to the breathing system reservoir bag mount.

b) An exhaust port which can be connected to the scavenging system

c) A pressure relief valve that opens at 60 cmH2O.

4. The valve block can be changed to a pediatric (Newton) valve

Problems in practice and safety features

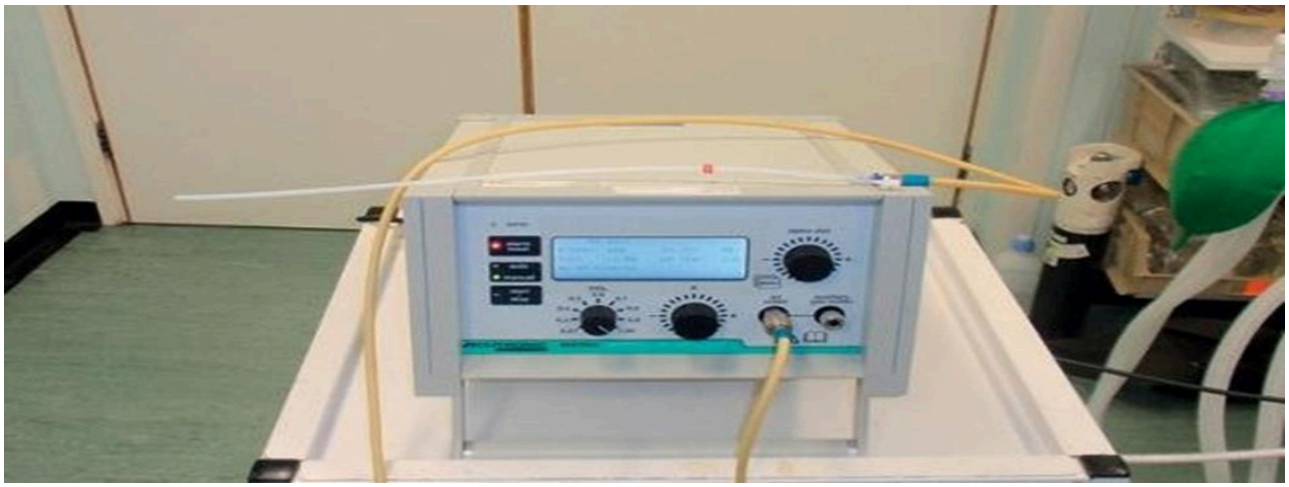
1. The ventilator continues to cycle despite breathing system disconnection.
2. Requires high flows of driving gas.

Uses

It is used for short periods of ventilation, most commonly in the anesthetic room, but also sometimes in remote locations such as the radiology department. An MRI- compatible unit is available.

High-frequency jet ventilator

This ventilator reduces the extent of the side effects of conventional intermittent positive pressure ventilation (IPPV). It generates low tidal volumes at a high frequency, leading to lower peak airway pressures. High-frequency jet ventilation is better tolerated by alert patients than conventional IPPV. It is frequently used in anesthesia for ear, nose, and throat (ENT) surgery



Problems in practice and safety features

1. Barotrauma can still occur as expiration is dependent on passive lung and chest wall recoil driving the gas out through the tracheal tube.
2. High-pressure (35–40 cmH2O) and system malfunction alarms are featured