



Subject: Medical Instrumentations
Lecturer: MSc. Mohammed Tareq Fakhri
Class: Second Class
Academic year: 2023-2024
Lecture: Sixth lecture



INFANT INCUBATOR

A neonatal incubator is a rigid box in which an infant can be kept in a controlled environment for observation and care. The device may include a heater, a fan, a container for water to add humidity, a control valve through which oxygen may be added, and access ports for nursing care.



Principles of Operation:-

- The neonate lies on a mattress in the infant compartment, which is enclosed by a clear plastic hood. Most incubators have hand access ports with doors that permit the infant to be handled while limiting the introduction of cool room air.
- The clinician can raise or remove the plastic hood or open a panel to gain greater access to the infant. Some units feature an air curtain that causes warm air to sweep past the opening.



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- Most incubators warm the infant by a forced or natural flow of heated air. At least one unit supplements air convection by actively warming the incubator walls to reduce radiant heat loss.
- Another unit uses a mattress of warm water, rather than a convective airflow, to warm the infant.
- Heating and humidification systems are located below the infant compartment.
- A fan or natural flow circulates air past the heater and the temperature measuring device, over a water reservoir used to humidify the air (if desired), and up into the infant compartment.
- Most incubators are equipped with proportional heating controls that provide electrical power to the heating coil in response to the difference between the actual temperature and the desired temperature.

Modes of operation

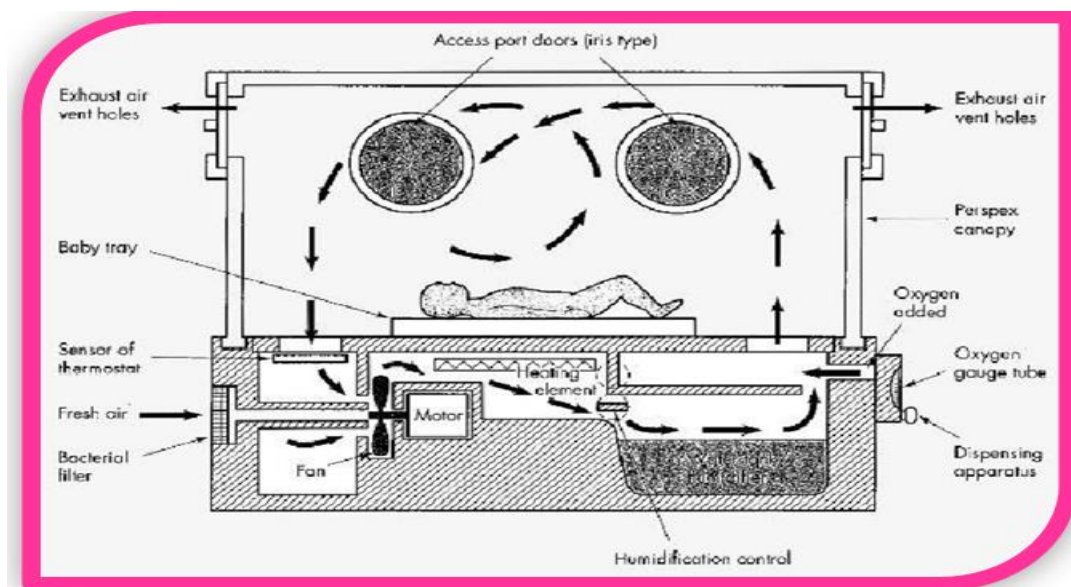
Most units have two modes of operation:

- a) Air-temperature control:** With the air-temperature (**manual**) control, the operator sets the temperature of the air in the incubator; changes in infant body temperature are usually measured periodically with a thermometer, and adjustments in air temperature are made accordingly.
- b) Skin-temperature control:** In the skin temperature control mode, also called the servo (**automatic**) mode, a sensor is taped to the infant's skin, and the heater responds to changes in the sensor to keep the skin temperature at the present level.

Many incubators have one or two **oxygen inlet** ports and can be equipped with optional



oxygen controllers. These incubators can also provide support and protection for oxygen cylinders when oxygen must be delivered to the infant in the incubator. Because the room temperature of the nursery is nearly always, lower than the temperature inside the incubator, radiant heat loss through the incubator walls accounts for as much as half the infant's total heat loss.



In some nurseries, a **plastic heat shield** is placed over the infant inside the incubator to minimize radiant heat loss. In addition, some incubators have double walls separated by an air space to prevent excessive heat loss. However, in a study comparing heat loss from servo-regulated single- and double walled.



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Systems of operation

The main system of infant incubator:-

1- Air circulation system: - contain:

- **Fans** used to distribute the air inside the glass and also distribute the temperature that the heater made it through the operation.
- **Micro filter:** - it is made of special fibers composed of three layers to pure the air. The micro filter must be replaced each three month.
- **Filter cap**
- **Air convection tube:-** it convect air from behind filter directly to air chamber

2- Humidification system:- contain

- **Water tank:** - it is contain distilled water down infant chamber, water must bereplaced every 24 hours at least.
- **Saw tooth plate:** - is used to hot air passage distance increase on water tank to obtainon proper humidification.
- **mechanical switch** to control on dry and moist air

3- Heating system

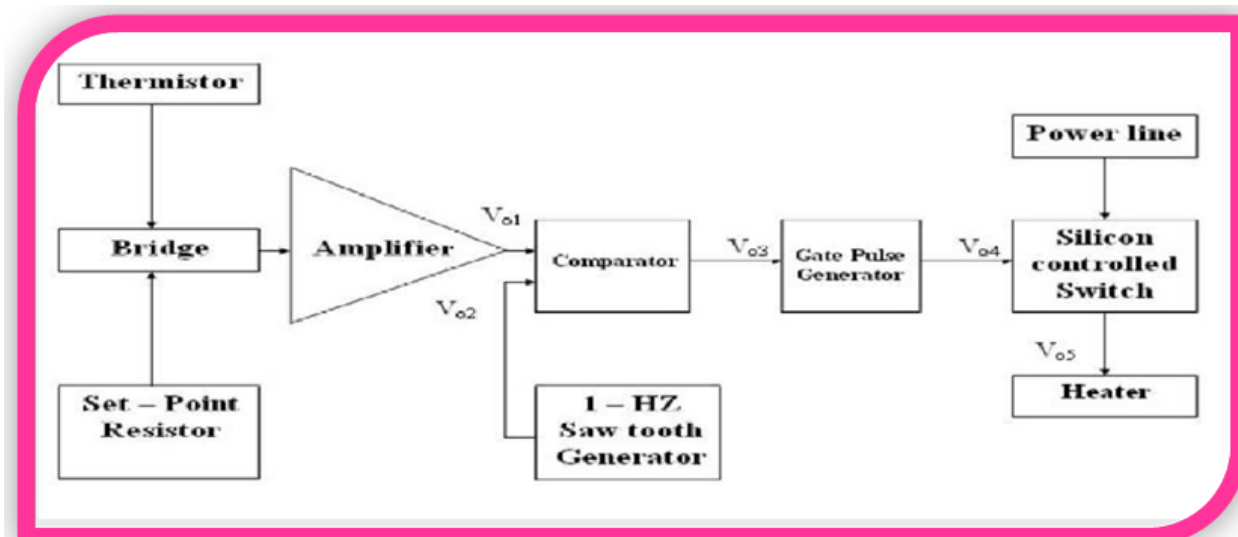
- **Heater thermostat** used to control the temperature inside the incubator so it will disconnected when the temperature reached the wanted level, when temperature decrease or increase from 37 °c or according to the situation of the baby



- **Safety thermostat** used to prevent temperature from increasing above 38 °c that connect with electronic circuit shots a sound or light alarm in case increasing of temperature.

4- Control system:-

- The control system uses thermistor in bridge circuit, with the set point resistance; the bridge output is amplified, giving the voltage V_1 , which is proportional to the difference in temperature between the thermistor and the set point resistor. A 1 HZ-low frequency saw tooth generator produces voltage V_2 , having an amplitude equal to the maximum value of V_1 , then V_1 and V_2 are compared in a comparator circuit that produces on output voltage V_3 when V_1 is greater than V_2
- V_3 voltage controls a gate pulse generator that produces pulses for the silicon-controlled switch. While V_3 is high, the silicon controlled switch allows the power line voltage to be applied to the heater of the incubator. Figure (1) shows the block diagram of control system.





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- 5- **Infant chamber:** - it is made of resist glass or plastic. It is contained group of holes to control and regulate infant position and temperature

- 6- **Alarm system:** - incubator has simple alarm system to alert the clinical staff if there is any dangerous of the device. The system contain a temp controller switch that carrierspower to alarm when the temperature exceeds the safe limit, there is a buzzer connectedin series with that is activated by a bimetallic strip.



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Faults and maintenance

- **The temperature high** inside the glass, in order to solve this problem we should check the motor of fan, where the fan not work because of burning of motor or problem in switch of working. And then check the thermostat that control the temperature inside the glass, in this case the heater work with all its nature because there will be no control on thermostat, so it is should be change, in order to prevent burning of the child.
- **If there is no reading** to the temperature it's either fault in the thermostat or fault in the sensor which is responsible for reading.
- **There is a leak inside the glass** of incubator, so make sure that all the holes or opening found in the hot glass closed and there is no leak.
- The incubator has no problem and **do not work** so check the power supply.
- Fault in the increasing temperature **alarm lamp**.