

Module : 4

Cardiac Pacemaker :

- The parameter is physiological assist device helps in extending the life of cardiac patients having total bundle block.
- Pacemaker is an electrical pulse generator for starting and for maintaining the normal heart beat.

Need for a Cardiac Pacemaker :

- The Rhythmic beating of the heart is due to the triggering pulses that originates in an area of specialized tissue in the right atrium of heart. The area is known as the sino-atrial node.
- In abnormal situations, if this natural pacemaker ceases to function or becomes unreliable. The natural and normal synchronization of the heart action gets disturbed.
- The changes can be monitored through an electrocardiogram (ECG) waveform.
- ~~Contains~~ Certain abnormal situations are:-
 - * Bradycardia - a situation in which heart beats too slowly less than 60 beats/min.
 - * Tachycardia - a situation in which the heart beats too fast more than 80 beats/min.
 - * Atrial fibrillation:- The upper chamber of the heart beat rapidly.

- By giving external electrical stimulation impulses to the heart muscle, it is possible to regulate the heart rate. These impulses are given by an electronic instrument called a pacemaker.

Components of Pacemaker:-

Pacemaker basically consists of :-

- Power source - for supplying energy to the pacemaker.
- An electronic unit which generates simultaneously impulses of controlled rate and amplitude known as pulse maker.
- The lead which carries the electrical pulses from the pulse generator to the heart.

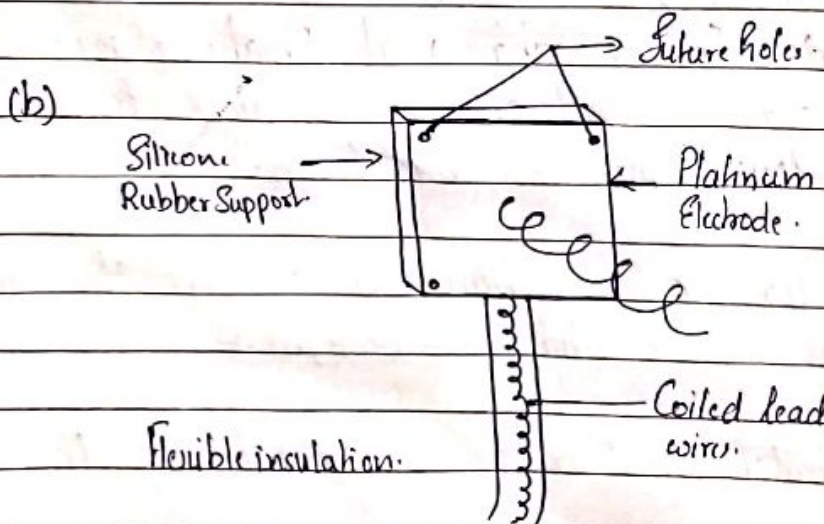
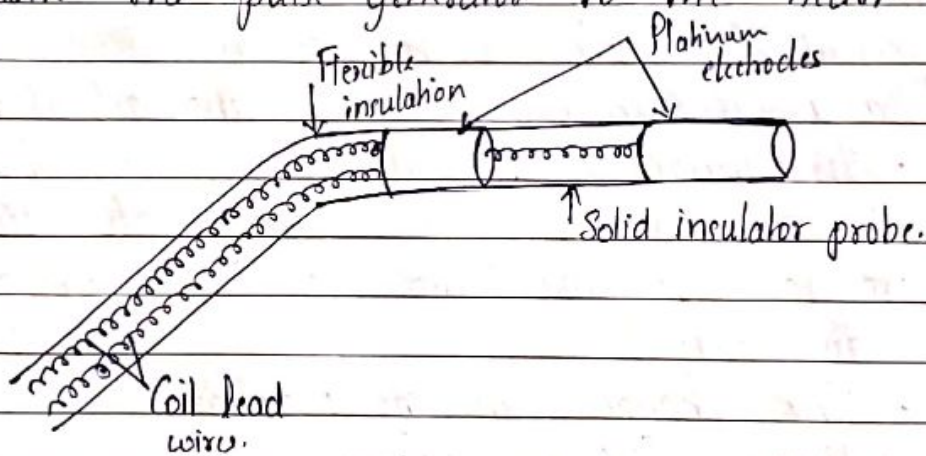


Fig: 1 Two of the more commonly applied cardiac pacemaker electrodes.

(a) Bipolar instrument (b) Intra-myocardial electrode.

Types of Pacemaker:

The classification of pacemakers into different types is based on the placement of the pacemaker.

1) External pacemaker:

External pacemakers are used when the heart block presents as an emergency and when it is expected to be present for a short time or a short term pacing is considered adequate.

2) Internal pacemaker / Implanted Pacemaker.

Internal pacemakers are used in cases requiring long term pacing because of permanent damage that prevents normal cardiac operation.

External Pacemaker

- The electrodes are called endocardial electrodes and applied to heart by means of an electrode catheter with electrodes situated at the apex of the right ventricle. These are in contact with the inner surface of the heart chamber.

Internal Pacemaker.

- These electrodes are called myocardial electrodes and are in contact with the outer wall of myocardium (heart muscle). Endocardium electrodes are also used.

- It does not necessitate the open heart surgery.
- The battery can be easily replaced and any defect or adjustment in the ckt can be easily attended without getting any help from a medical doctor.
- During placement swelling and pain, etc not arise due to minimum foreign body reaction.
- Here there is no safety for the pacemaker particularly in the case of children getting pacemaker.
- Mostly these are used for temporary heart irregularities.
- It requires an open heart surgery to place the circuit.
- The battery can be replaced only by minor surgery, further any defect or adjustment in the circuit cannot be easily attended a doctor's help is necessary to rectify the defect in the circuit.
- During placement swelling and pain arise due to foreign body reaction.
- Here there is a cent percent safety for the circuit from external disturbance.
- Mostly these are used for permanent heart damages.

Different modes of Operation:-

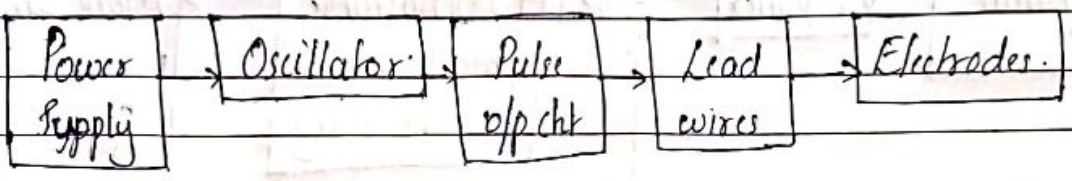
- Several pacing modes are available with both internal and external pacemakers.

• They are:-

- 1) Asynchronous pacemaker
- 2) Synchronous pacemaker

★ Asynchronous pacemaker:-

• It is the first type of pacemaker that was developed. A cardiac pacemaker that is free running. It gives a fixed heart rate.



Pulse generator.

fig: 4 : Block diagram of an asynchronous cardiac pacemaker.

★ Synchronous Pacemaker:-

It is used when a human's heart can establish a normal cardiac rhythm between periods of block. This means that it is not necessary to stimulate the ventricles continuously.

- There are two general forms of Synchronous pacemakers.
- a) Demand pacemaker
 - b) Atrial-synchronous pacemaker.

Demand Pacemaker:-

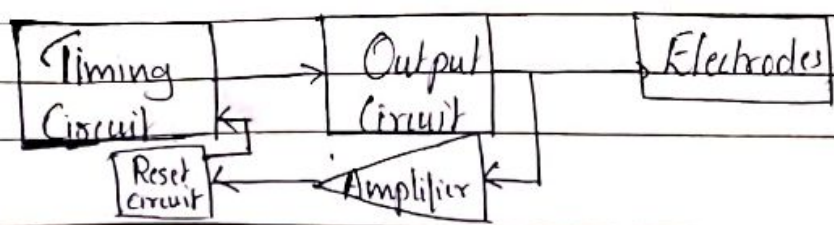


fig:-5. A demand type synchronous Pacemaker. -
 Electrodes serves as a means of both applying the stimulus pulse and detecting the electrical signal from spontaneously occurring ventricular contractions that are used to inhibit the pacemakers timing circuit.

Atrial - Synchronous pacemaker:-

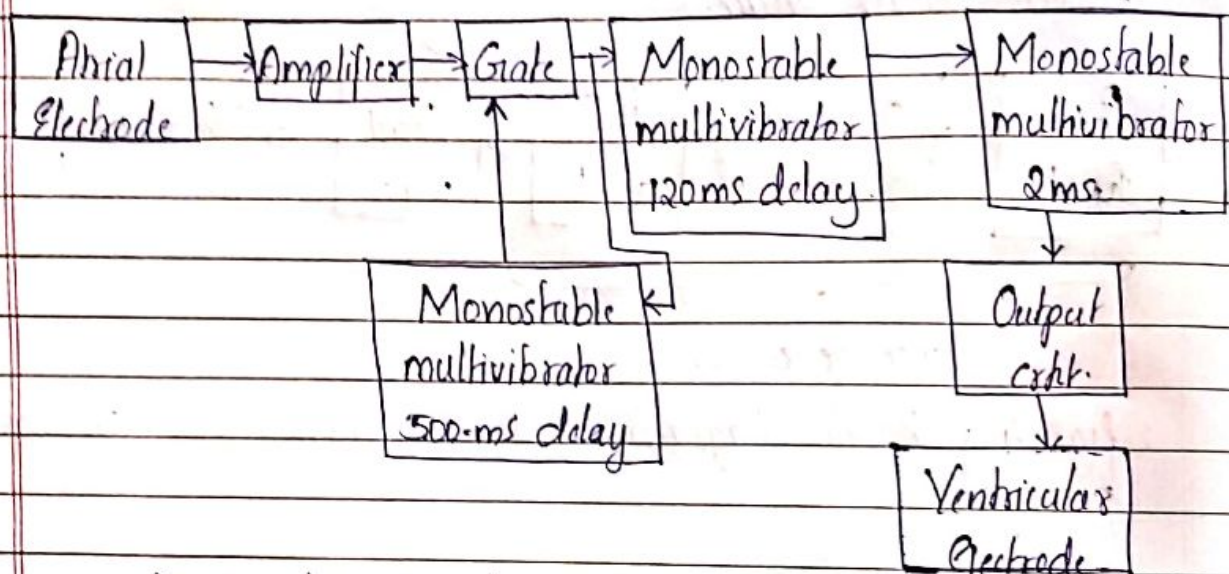


fig:-6 An Atrial synchronous cardiac pacemaker which detects electric signals corresponding to the contraction of the atria and uses appropriate delays to activate a stimulus pulse to the ventricles.