

HIGH FREQUENCY CURRENT

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HIGH FREQUENCY CURRENT:

High frequency current is a current which alternates so rapidly that it doesn't stimulate motor or sensory nerves.

To achieve this it must have the frequency of approximately more than 500,000 cycles/sec and it is often termed as **oscillating current**.

An oscillation may be defined as a swinging to and fro.

A high frequency alternating current is described as an oscillating current, because the electrons swing to and fro in the circuit and behavior of an oscillating current in many ways resembles that of other oscillating systems.

Benefits of High Frequency:

- 1. Stimulates circulation of the blood.
- 2. Increases Glandular activity.
- 3. Aids in elimination and absorption.
- 4. Increases Metabolism.
- 5. Germicidal action occurs during use (direct method only).
- 6. Generates heat inside the tissues.
- 7. Aids in the deeper penetration of product into the skin.

PRODUCTION OF HIGH FREQUENCY CURRENT:

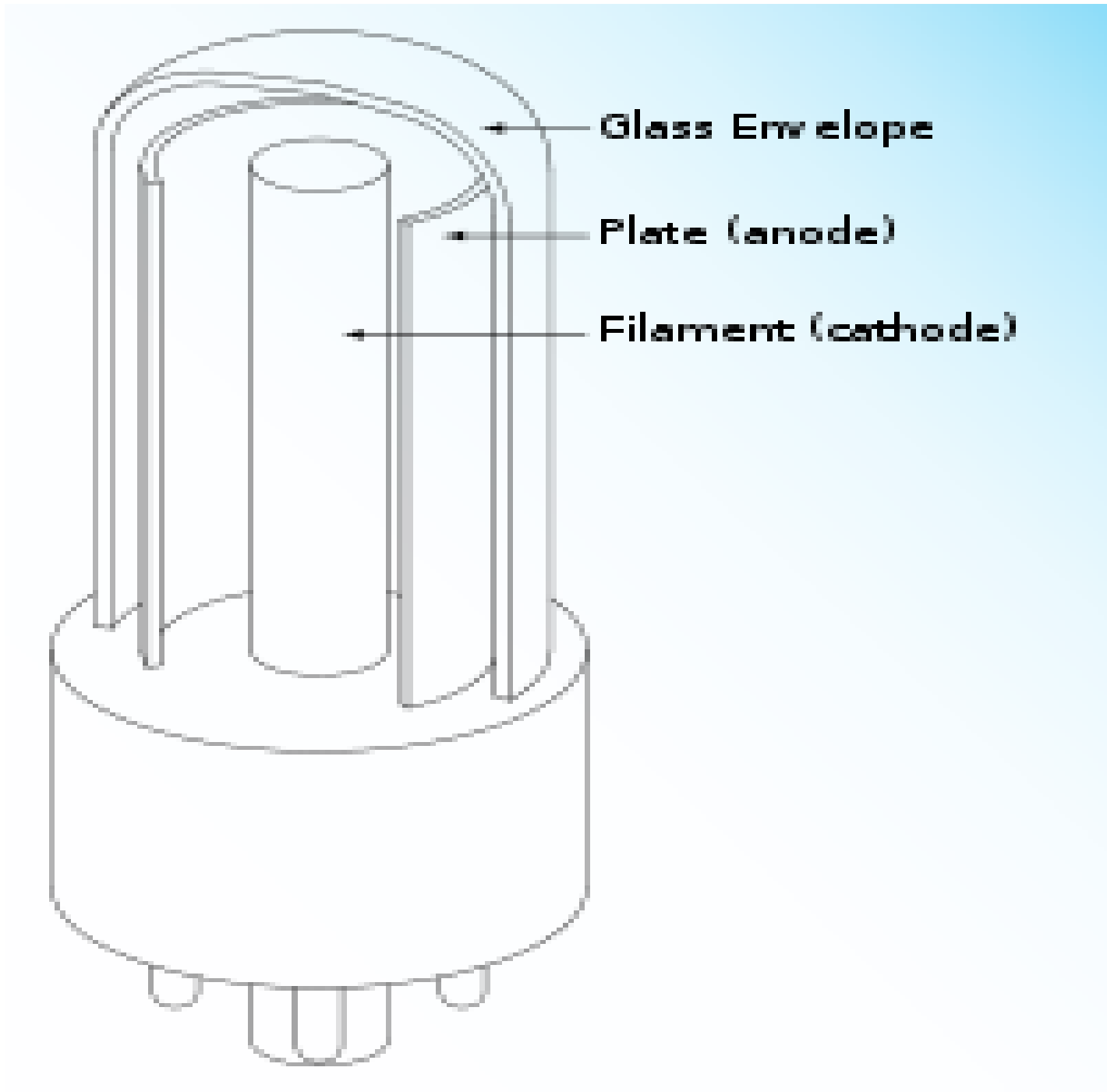
The valve is a device which transmits material in one direction only, common example being the valve of heart, veins and that of bicycle tyre.

A thermionic valve is a device which transmits an electric current in one direction only, and the term thermionic implies that heat plays some part in the working.

There are various types of thermionic valve which are named according to the number of electrodes that they contain.

THE DIODE VALVES:

This is the simplest form of thermionic valve, and contains two electrodes. The **filament** and the **plate** which are enclosed in evacuated glass bulb. For a current to pass across the valve the filament must be heated and a P.D (potential difference) is applied, so that the plate is positive in relation to the filament. When the filament is heated thermionic emission to the filament, the free electrons are attracted through the vacuum to the plate and current passes across the valve.



if P.d is reversed so that the plate is negative relative to the filament, as there are no free electrons in the region of plate.

Thus electron can pass from the filament to the plate, but not in reverse direction, and the valve transmits current in one direction only.

The pressure in the valve must be low so that there is minimal impedance to the electron movement increase the **flow of electron**.

The **intensity** of the current that flows across the valve depends on **heating of filament and on p.d the filament and the plate**.

Increasing the former increases the number of electrons that are liberated and increase in p.d makes available the greater force to attract them across the valve.

The filament is heated by an electric current and circuit which carries this current is known as the filament circuit.

This circuit which attract the current which passes across the valve is termed the plate or anode circuit.

The filament may be heated directly by passing the electric current through it or may be of the indirectly heated type.

Indirectly heated type filament takes rather longer to reach the necessary temperature and there is some delay after switching on, before the valve begins to transmit current.

THE TRIODE VALVE:

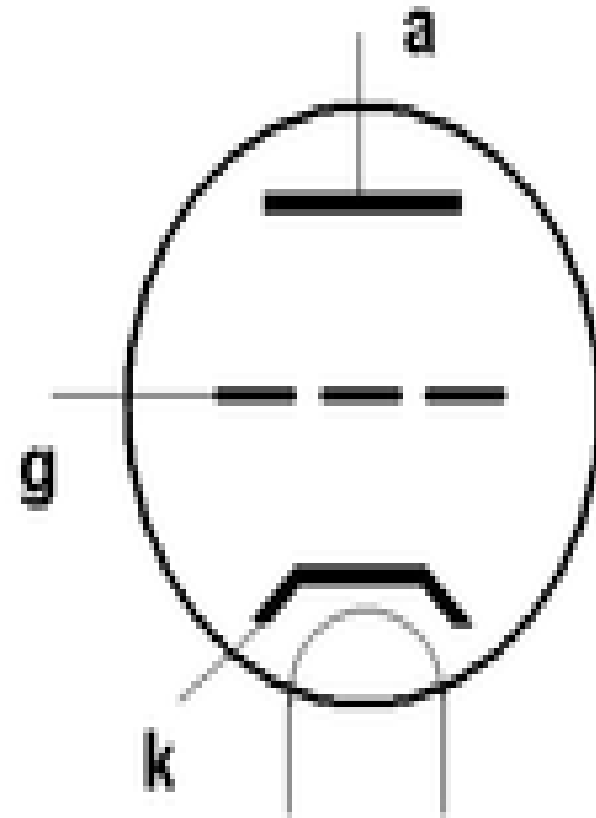
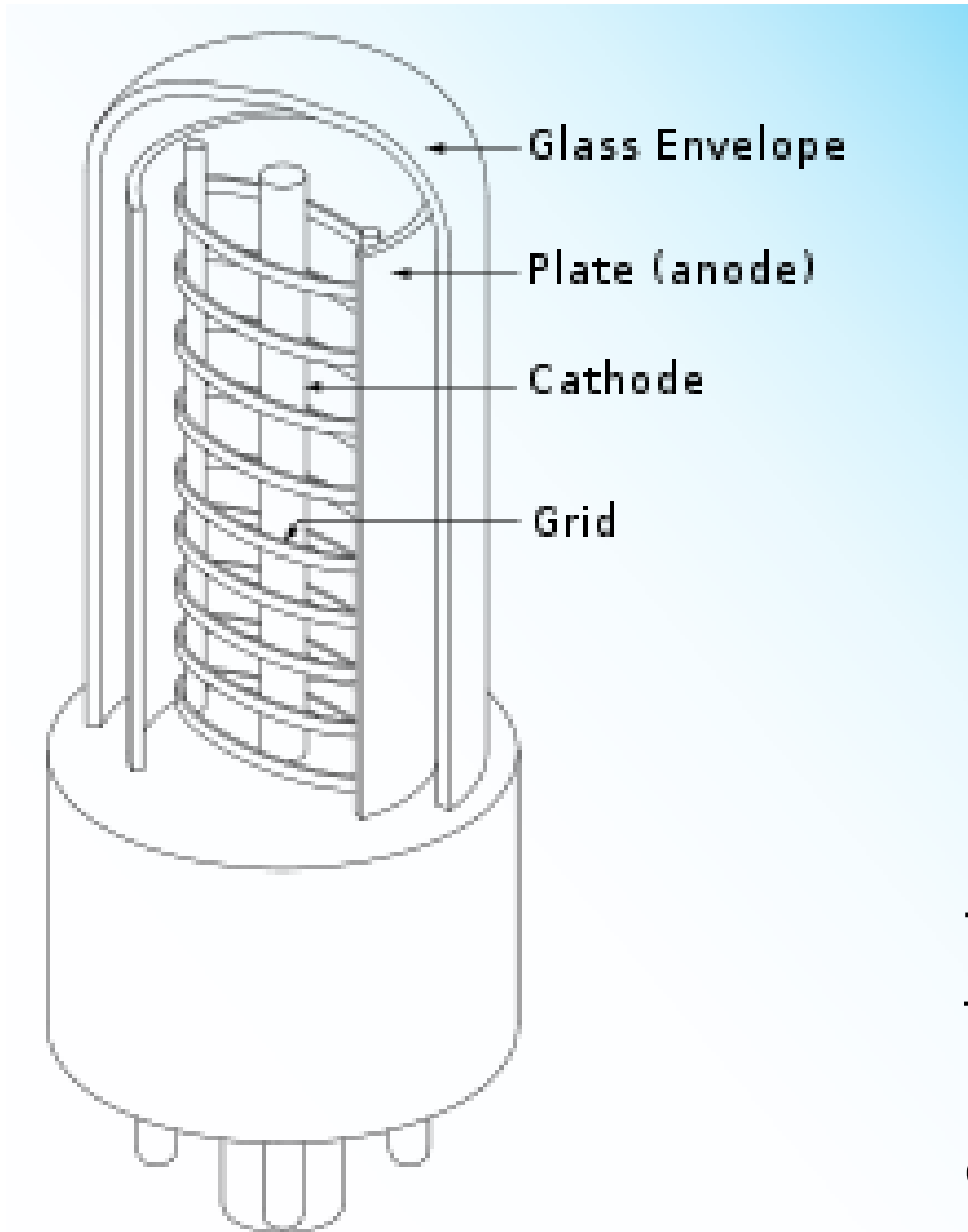
This is constructed in a similar manner to the diode,, but in addition contains a third electrode, **the grid**, which is placed b/w the filament and the plate.

The grid may consists of Metall plate perforated to allow the electrons to pass through, or, more usually, may be a coil of wire. When the filament is heated a current can be passed through the valve.

As in the diode, in one direction only i.e. from the filament to the plate.

If the grid is **uncharged** it has no effect on the current, that the electron pass through the opening in it and on to the anode, if the grid is **charges negatively** from some outside source, it repels electrons, so that the current is reduced on intensity, with the stronger charge stopped completely.

If, however, the grid is **charged positively** the electrons can pass and current flows. The intensity of the current is then greater than when the grid is uncharged, as positive electrons away from the filament.



Triode symbol. From top to bottom: plate (anode), control grid, cathode, heater (filament)

The charge is applied to the grid from an external source are known as **grid biased** and, as the grid lies closer to the filament than does the plate, the grid charged has a greater influence on the flow of current than has a similar charge on the anode.

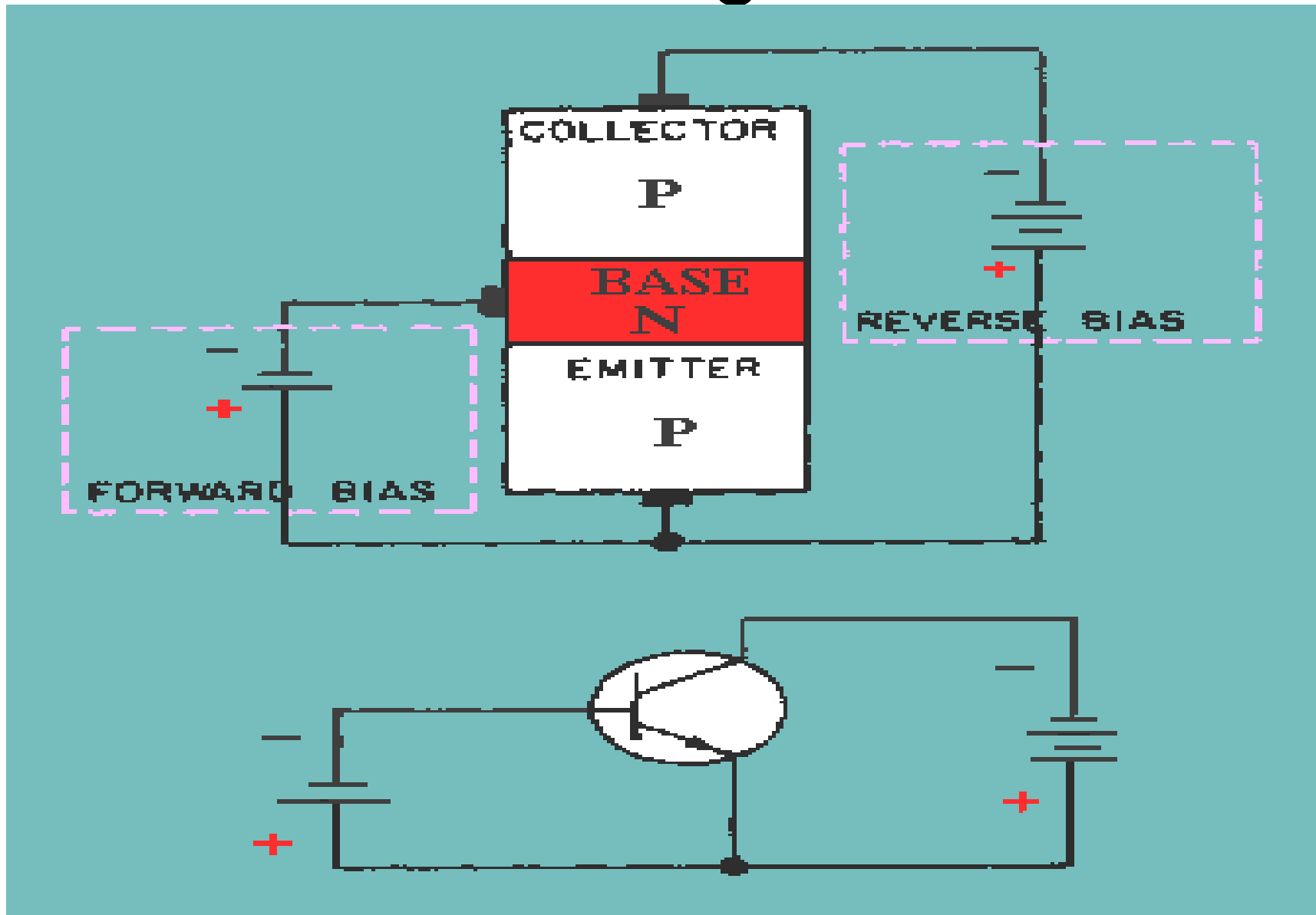
The strength of the current going across the valve can be regulated, as in the diode, by altering the temperature of the filament or by altering the positive charge applied to the anode. In addition, **the flow of current** across the triode valve can be regulated by adjusting the biased of the grid.

The triode valve has various functions in electrometrical apparatus, the principle ones being its used for the production of the interrupted direct and other muscle stimulation currents and, in conjunction with a condenser and an inductance, for the production of high frequency currents.
It is not used specifically as a rectifier, but will always rectify the current that passes through it.

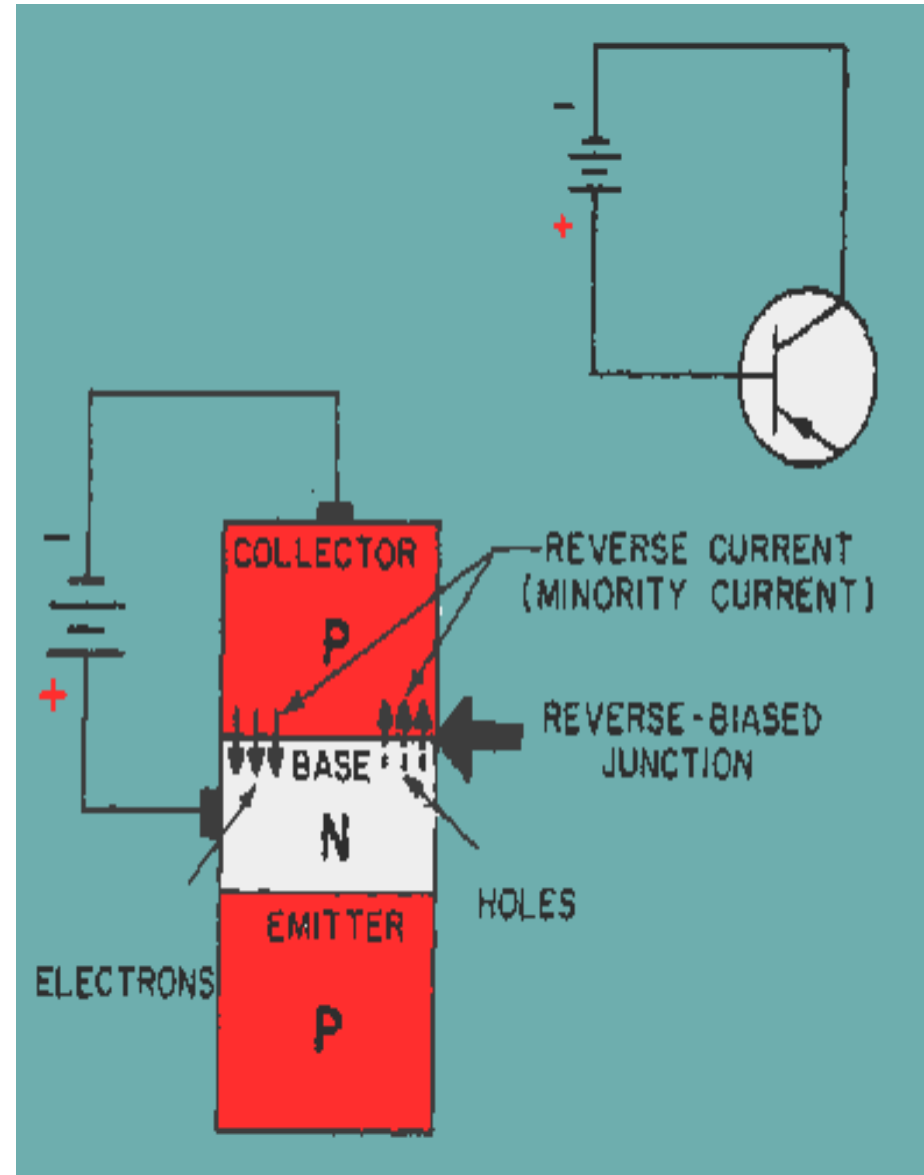
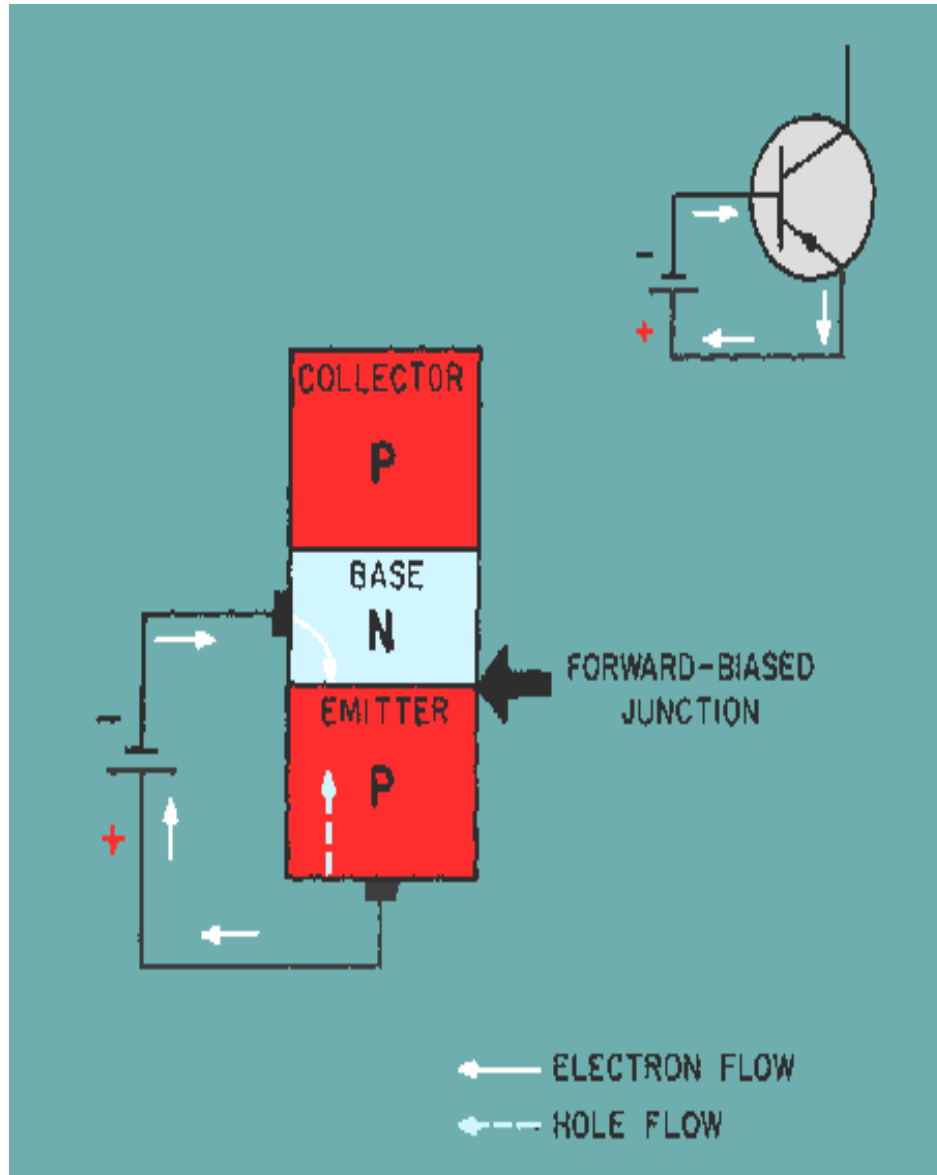
TRANSISTORS

- (Bipolar) transistor = combination of two diodes that share middle portion, called “base” of transistor; other two sections: “emitter” and “collector”;
- usually, base is very thin and lightly doped.
- two kinds of bipolar transistors: **pnp** and **npn** transistors
- Pnp is commonly used in electrotherapy apparatuses used in physiotherapy departments.
- “pnp” means emitter is p-type, base is n-type, and collector is p-type material;
- in “normal operation of pnp transistor, apply positive voltage to emitter, negative voltage to collector;

Fig



operation of pnp transistor:



operation of pnp transistor:

Forward biased transistors:

- if emitter-base junction is forward biased, “holes flow” from battery into emitter, move into base;
- some holes annihilate with electrons in n-type base, but base thin and lightly doped \Rightarrow most holes make it through base into collector,
- holes move through collector into negative terminal of battery; i.e. “collector current” flows whose size depends on how many holes have been captured by electrons in the base;

operation of pnp transistor:

- this depends on the number of n-type carriers in the base which can be controlled by the size of the current (the “base current”) that is allowed to flow from the base to the emitter;
- the base current is usually very small;
- small changes in the base current can cause a big difference in the collector current

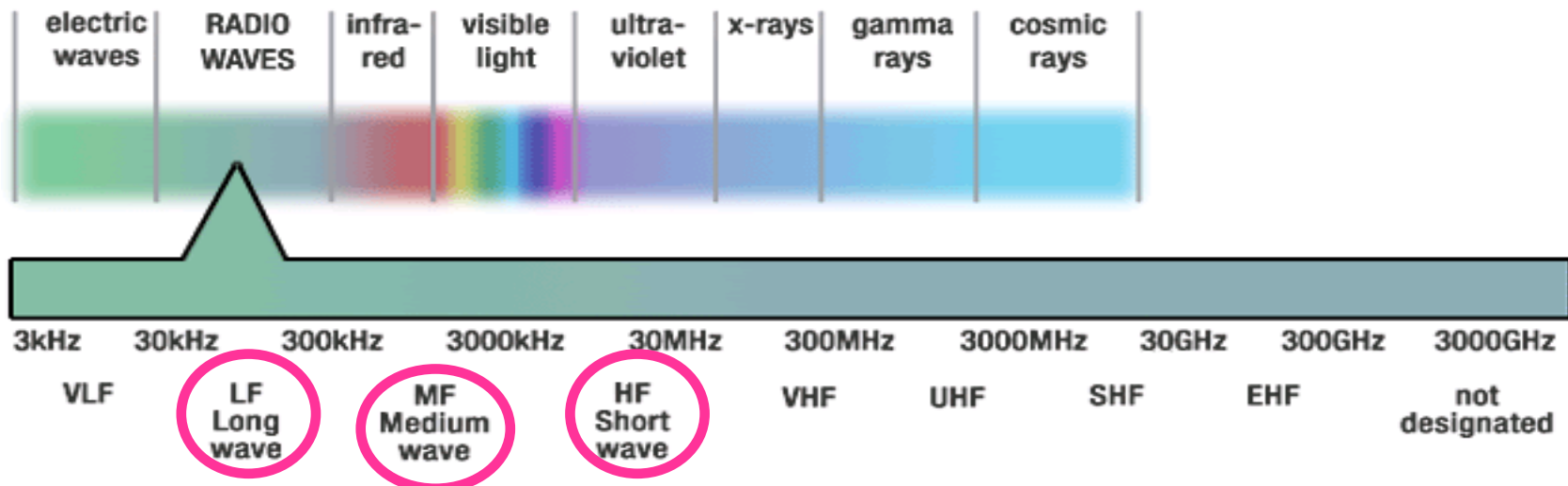
Transistor operation

- **transistor acts as amplifier of base current**, since *small changes in base current cause big changes in collector current*.
- **transistor as switch**: if voltage applied to base is such that emitter-base junction is reverse-biased, no current flows through transistor -- transistor is “off”
- therefore, a *transistor can be used as a voltage-controlled switch*; computers use transistors in this way.

What is DIATHERMY?

- The use of non-ionizing electromagnetic energy from the radio-frequency spectrum as therapeutic

Electromagnetic Spectrum
Showing the Radio Frequency Spectrum



VLF: Very Low Frequency, LF: Low Frequency, MF: Medium Frequency,
HF: High Frequency, VHF: Very High Frequency, UHF: Ultra High Frequency,
SHF: Super High Frequency, EHF: Extremely High Frequency

Types of Diathermy

☒ Long wave

- longest wavelength 300 – 30 m
- most penetrating
- no longer utilized due to high potential of causing burns and interference with radio transmissions

☒ Shortwave

☒ Microwave

PRODUCTION OF HIGH FREQUENCY SHORT WAVES:

High frequency electromagnetic waves of frequency b/w 10^7 or 10^8 and a wavelength b/w 30-3 m to generate heat in body tissues. therapeutically used and available $f=27.12\text{MHz}$ and $\lambda=11\text{m}$ commonly.

It is not possible to construct any mechanical device which causes sufficient rapid movement to produce high frequency current so this type of current is obtained by discharging a condenser through an inductance of low ohmic resistance. The basic oscillator circuit consists of a condenser and an inductance and current of different frequencies are obtained by selecting suitable condensers and inductances.

If a current of high frequency is required the capacity and inductance are small, while to produce a current of lower frequency a larger condenser and/or inductance are used. Basic oscillator circuit is now a days frequently replaced by a more modern oscillator such as co-axial line or pot oscillator but the principle remain same.

In order to produce high frequency current the condenser must be made to charge and discharge repeatedly and to achieve this the oscillator is incorporated in either a spark gap or a valve circuit, the latter being commonly used in apparatus encountered in physiotherapy department. In future transistor may replace the triode valve.

The high frequency current is produced in the basic oscillator which is incorporated in anode circuit of triode valve.

This current produces a similar high frequency current in a second circuit, the resonator circuit by electromagnetic induction and by action of wireless waves.

It is the current from this second circuit, which is used for the treatment of patients and for the production of oscillator and a resonator circuits must be in a resonance with each other.

For this to occur the product of inductance and capacity must be same for both circuits.

MICRO WAVE PRODUCTION:

Microwave diathermy can be defined as Use of microwave for various therapeutic purposes. Microwave has much higher frequency and a shorter wavelength than short wave diathermy. The frequency and wavelength ranges from 300 MHz TO 300 GHz and 1cm to 1m.

The commonly used frequency are 2456 MHz, 915 MHz and 433 MHz with a wavelength 12.24 cm ,32.79cm and 69cm respectively.

PRODUCTION OF MICROWAVES:

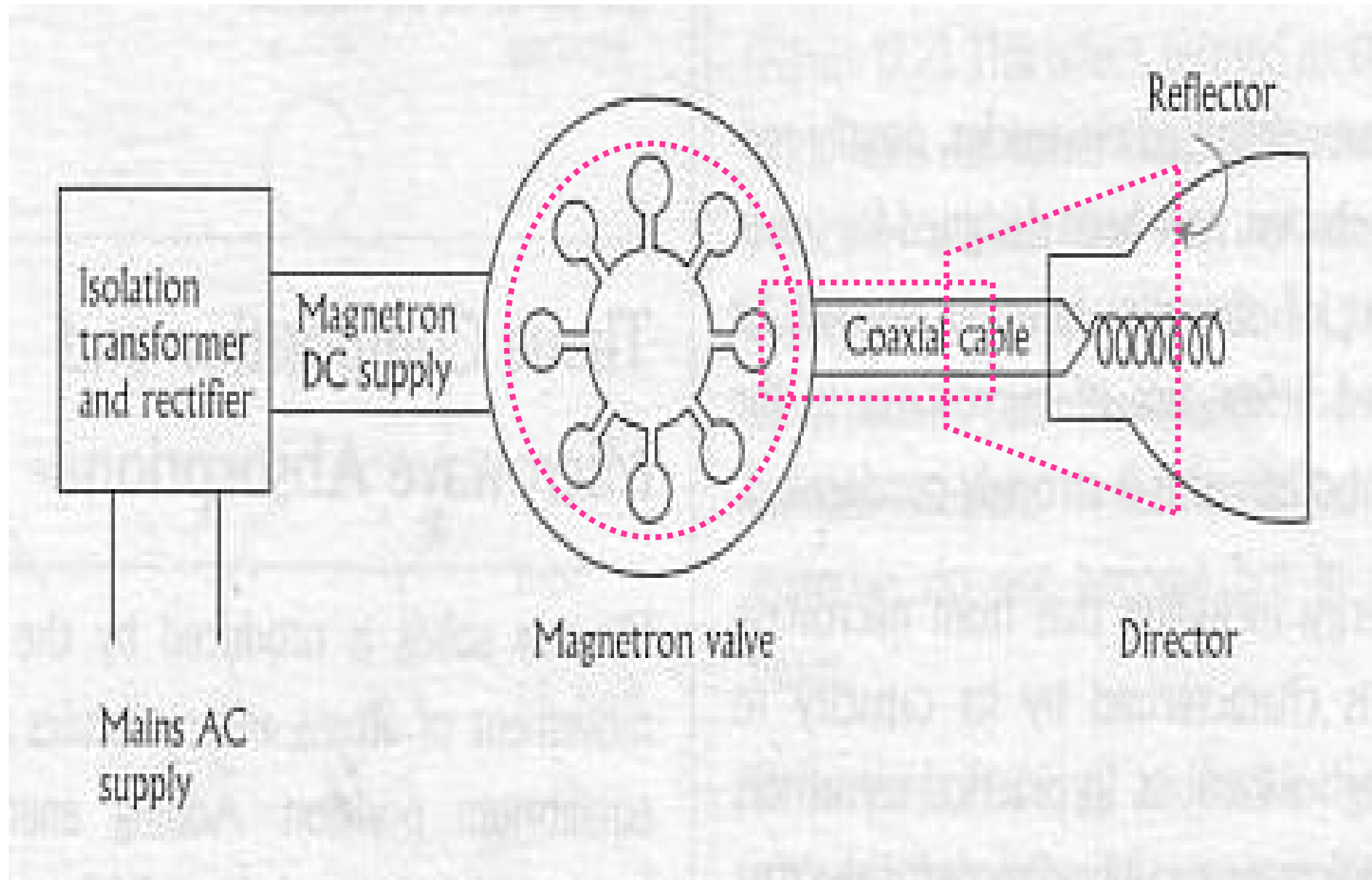
The microwave circuit is connected to the main AC which provides it a current of 50 Hz and a voltage of 220volts.

It is not possible to produce microwaves by mechanical means and hence a special type of thermionic valve is used called magnetron.

The primary function of magnetron is to produce high frequency current required for he production of microwaves.

Magnetron is special type of thermionic valve characterized by centrally placed cathode and a surrounding circular metal anode.

MICROWAVE DIATHERMY APPARATUS



Coaxial cables carries this high frequency currents from the magnetron and passes it to the antenna of emitter.

Emitter is also known as director or applicator consists of antenna and a reflector.

Antenna is mounted in front of a metal reflector. Reflector is a metal plate which directs the microwaves in on direction only.

The distance b/w the emitter and skin should be about 10-20 cms from the body.

However vary according to size of emitter , the part to be treated and condition of patient.

THERAPEUTIC EFFECTS

- Increased blood flow or circulation to the area
- Increased tissue temperature
- Increased metabolism
- Facilitate relaxation
- Increased pain threshold
- Decreased blood viscosity

INDICATIONS

- Soft tissue injury
 - Mobilization
 - Pain relief

CONTRAINDICATIONS

- Pacemakers
- Metal implants
- Impaired sensation
- Pregnancy
- Hemorrhage
- Ischemic Tissue
- Testicles and eyes
- Malignant CA
- Active TB
- Fever
- Thrombosis
- X-ray exposure
- Uncooperative patient
- Areas of poor circulation

THANKS

