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Lab: Medical Instrument II

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X-ray machines

X-ray machines

x-ray machines, discovered nearly a century ago, are still in use in hospitals. From the basic and simple X-ray imager for bone structures and lung observation, there are many advanced applications of X-rays in which angiography and cine color imaging and Fluoroscopy are some recent ones. The use of X-rays for destruction of tumors has now been replaced by Radio isotope therapy.

Similar to other discoveries, X-rays were discovered by Roentgen in (1895) when he was investigating the cathode rays of a vacuum tube. What Roentgen did not discover, however and what it took scientists about 50 years to fully appreciate is that X-rays can be dangerous when they are not properly used and may cause cancer. **Major engineering objectives for improving X-ray equipment are :**

1-Minimize the dose of X-rays used on the patient .
2- Heighten the contrast between different tissues
3-Improve size resolution .
4. Improve the quality of the image

The X-ray tube

X-ray tube is simply a glass enclosed vacuum tube consisting of:

The A cathode that thermally emits electrons.

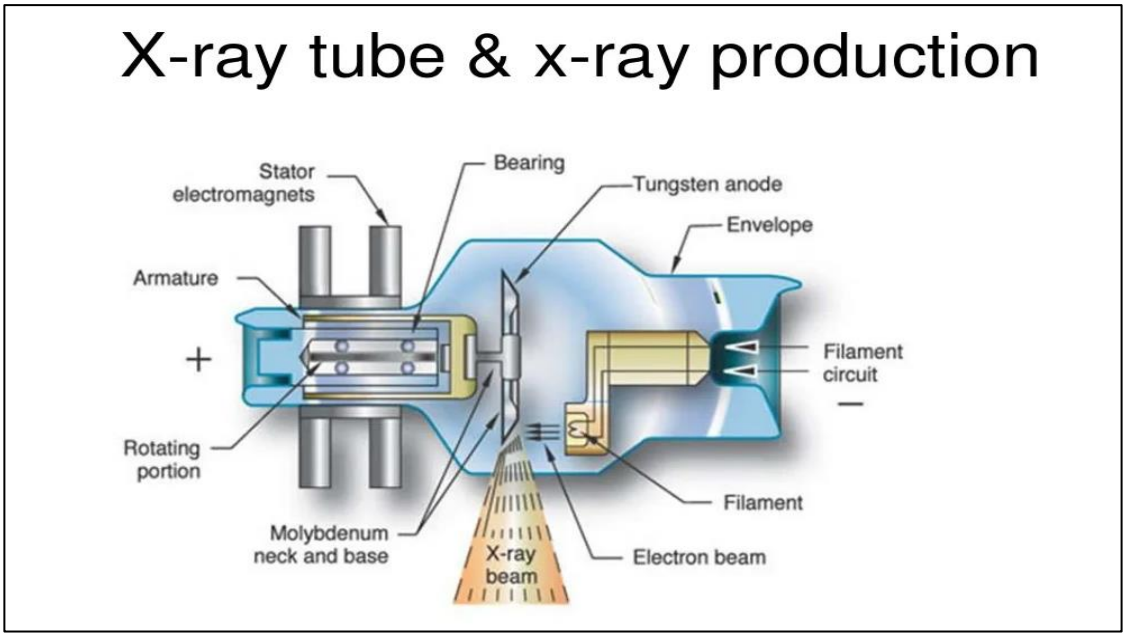
Anode that attracts these electrons.

A functional diagram of an X-ray tube is given in Fig. 1 which shows a filament heated cathode, an anode, and a glass vacuum enclosure.

- The filament source voltage VF caused a current IF to flow through the filament coil.
- The electrons in the cathode are boiled off the metal into the vacuum
- Heating the cathode metal.
- The anode voltage V, is the high enough that these electrons are swept across the anode. 100/kv/
- VA is of the order of This high voltage impels the electrons to a very high velocity.
- Approximately 1% of the electron upon entering the anode collide with atoms and produce X-rays which then pass through the tube into space.
- Electrons are boiled off the heated cathode because thermal agitation

gives them enough energy to escape from the bonding forces into tube vacuum

- The value of that energy, called the work function Ew differs among Metals



Principle of work:

Work of x-ray device depends on:

X-ray absorbed or deflected such as pass through the body.

- Project x-ray arrive at the film, in the human body air has lowest radiodence.fat, liver blood muscle and bone are increasicly radiodence,the result an image in which radiodence tissues are in shade of gray to black.

- If the organ that examiner not containing bone then x-rays technique done by giving the patient barium solution that is causes the contours of organ such as gastric and intestinal lining to appear white.

Components of x-ray machines

1- High tungsten transformer (1 mf): using for raise voltage-250 kV. It's connected directly with tube by cable transmitted in it a large amount of power.

• Property of transformer: .

a- High voltage, b- High frequency, c- Low current

2- X-ray tube:

X-ray produced whenever high-speed electrons are suddenly brought to rest. This is done by accelerating electrons in an electric field between two electrodes. The kinetic energy of the accelerated electrons is converted to three principle ways:

a- Less than 1% into x-ray., b- 98% into heat., c- Some electrons producing heat, x-radiation.

The requirements of the x-ray tube:

1. Source of electrons (cathode), consisting of:

A-focusing cap of nickel to focus the electron to the target.

B-filament of fine tungsten wire coiled to form spiral, mounted within the focusing cup.

- Big filament (24v) (for giving electron).

- Small filament (12v) (for spiral).

2- Energy to accelerate the electrons (potential different across the tube by high-tension transformer).

3- Free electron path (vacuum).
4- Device to stop the electron beam (anode) &there are two types of anode:

-Fixed type: made of cylindrical block copper. Its face inclined at angle (20°). when power target in it with high voltage in one face cause to corrode.

-Rotating type: it solve the corrode problem, it's a disc of tungsten with beveled edge.

5- Envelope glass: made of heat resisting glass.

6- shield: is made of steel sheet or aluminum, lined with a thin sheet of lead.

7-oil: put in the space between the tube and the shield, the function of oil:

a- Has good insulating

b- Cooling properties c- Cool off the spiral.